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Long-Term Monitoring Plan
Site 9 (Neptune Drive Disposal Site)
Naval Air Station, Brunswick, Maine

Contract No. N62472-92-D-1296
Contract Task Order No. 0047

Prepared for

Department of the Navy
Northern Division
Naval Facilities Engineering Command
10 Industrial Highway
Mail Stop No. 82
Lester, Pennsylvania 19113-2090

Prepared by

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August 1999
FINAL
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Peter L. Nimmer, P.G. — Date: 8/12/99
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QUALITY REVIEW STATEMENT

Contract No. N62472-92-D-1296 EA Project No.: 29600.47.3110
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Activity: Naval Air Station, Brunswick, Maine

Description of Report/Deliverable:

Long-Term Monitoring Plan, Site 9 (Neptune Drive Disposal Site), Naval Air Station, Brunswick, Maine

EA CTO Manager: Peter L. Nimmer, P.G.

In compliance with EA's Quality Procedures for review of deliverables outlined in the Quality Management Plan, this final deliverable has been reviewed for quality by the undersigned Senior Technical Reviewer(s). The information presented in this report/deliverable has been prepared in accordance with the approved Implementation Plan for the Contract Task Order (CTO) and reflects a proper presentation of the data and/or the conclusions drawn and/or the analyses or design completed during the conduct of the work. This statement is based upon the standards identified in the CTO and/or the standard of care existing at the time of preparation.

Senior Technical Reviewer

James A. Shultz, C.P.G. 16 August 1999
Senior Geologist (Date)

CONTENTS

Page

LIST OF REVISIONS
LIST OF FIGURES
LIST OF TABLES

1. INTRODUCTION 1-1

1.1 Purpose and Scope 1-1
1.2 Site Background 1-2

1.2.1 Former Incinerator and Ash Landfill/Dump Area 1-3
1.2.2 Building 201 1-3
1.2.3 Unnamed Streams 1-3

1.3 Previous Investigations 1-3

1.3.1 Site History 1-3
1.3.2 Site Hydrogeology 1-4
1.3.3 Results of Previous Investigations 1-4
1.3.4 Long-Term Monitoring 1-5

1.4 Summary of Changes to Long-Term Monitoring Plan 1-5

1.4.1 Sampling Locations 1-5
1.4.2 Sampling Frequency 1-6
1.4.3 Sampling Method 1-6
1.4.4 Staff Gauge Monitoring 1-6
1.4.5 Analytical Methods 1-6

1.5 Reports and Data Presentation 1-7

2. REGULATORY FRAMEWORK 2-1

3. MONITORING PLAN 3-1

3.1 Long-Term Monitoring Program 3-1

3.1.1 Ground-Water Sampling Program 3-1
3.1.2 Surface Water and Stream Sediment Sampling Program 3-1
3.1.3 Seep Sampling Program 3-2
3.1.4 Staff Gauge Water Elevations 3-2
3.1.5 Sampling Frequency 3-2

Page

3.2 Sampling Procedures 3-2

3.2.1 Ground-Water Sampling Program 3-2
3.2.2 Surface Water and Stream Sediment Sampling Program.....3-2
3.2.3 Seep Sampling Program 3-2
3.2.4 Visual Inspection.....3-3

3.3 Analytical Parameters and Procedures.....3-3

3.3.1 Program Modifications.....3-3
3.3.2 Data Reduction and Analytical Data Quality Review.....3-3
3.3.3 Laboratory Quality Assurance and Quality Control.....3-4
3.3.4 Corrective Measures 3-4

REFERENCES

APPENDIX A: STANDARD OPERATING PROCEDURES FOR FIELD SAMPLING
APPENDIX B: QUALITY ASSURANCE PROJECT PLAN

LIST OF REVISIONS

Section	Date	Revision	Description

LIST OF FIGURES

Number	Title
1-1	Site location map, Site 9 (Neptune Drive Disposal Site), Naval Air Station, Brunswick, Maine
1-2	Site plan, Site 9 (Neptune Drive Disposal Site), Naval Air Station, Brunswick, Maine.

LIST OF TABLES

Number	Title
1-1	Summary of changes to the Long-Term Monitoring Program at Site 9, Naval Air Station, Brunswick, Maine.
3-1	Summary of the Long-Term Monitoring Program at Site 9.

1. INTRODUCTION

Naval Air Station (NAS) Brunswick is located south of the Androscoggin River between Brunswick and Bath, Maine (Figure 1-1). NAS Brunswick is an active base, owned and operated by the Federal government through the Department of the Navy. This facility is currently participating in the Navy's Installation Restoration Program, which was designed to identify, evaluate, and remediate former disposal and spill sites at defense facilities. In 1987, the U.S. Environmental Protection Agency (EPA) placed NAS Brunswick on the National Priorities List. Thirteen individual sites on base, including the Neptune Drive Disposal Site (Site 9), were identified in the Federal Facility Agreement. Site 9 consists of an area north of Neptune Drive containing a former incinerator and an abandoned ash landfill/dump area, and an area south of Neptune Drive near Building 201. This Long-Term Monitoring Plan (LTMP) was developed to support the Navy's overall strategy for remediation at Site 9 at NAS Brunswick, as specified in the Proposed Plan and Interim Ground-Water Record of Decision for Site 9 (ABB-ES 1994a, 1994b). The site plan is shown on (Figure 1-2).

1.1 PURPOSE AND SCOPE

The purpose of the Long-Term Monitoring Program is to identify monitoring that will be conducted to verify the effectiveness of the selected remedial action, natural attenuation with long-term monitoring, at Site 9. The monitoring activities described in this document include:

- Sampling locations and procedures for ground-water, surface water, sediment, and seep samples
- Required analytical parameters and laboratory methods
- Reporting requirement to be followed to document the effectiveness of the remedial actions
- Maintenance actions and corrective measures to be undertaken should monitoring data indicate they are necessary
- Visual inspection activities

The Comprehensive Environmental Response, Compensation, and Liability Act 5-year review is part of the continuation of the LTMP. At the end of each 5-year period, evaluation of the data collected will be used to determine if changes are desirable or required for the implemented remedial strategy. Long-term monitoring has been conducted since 1995 and, therefore, the first 5-year review is scheduled to be conducted in 1999.

Although sampling is planned for up to a 30-year period, periodic evaluations will provide a basis for continued sampling and refinements/alterations to the monitoring program or remedial activity, as appropriate.

The goals of the Long-Term Monitoring Program are to obtain data necessary to document the long-term trends in environmental media at Site 9. These goals are as follows:

- Monitor changes in the plume boundaries and potential migration pathways
- Monitor effectiveness of the remedial action for the protection of human health and the environment
- Evaluate whether the inactive landfill contents are impacting ground water
- Monitor the volatile organic compound contamination to evaluate the effectiveness of natural attenuation and determine trends with time
- Monitor impact to the environment due to Site 9.

Currently, a Final Record of Decision is being prepared for Site 9. The components of the LTMP have been defined based on the Interim Ground-Water Record of Decision for Site 9. The results of the monitoring program will be used to revise this monitoring program and to assess the success of the proposed remedy that is required as part of the Installation Restoration Program activities at Site 9. The decision to modify or terminate the Long-Term Monitoring Program will be made by the Navy, EPA, and Maine Department of Environmental Protection (MEDEP) with input from the Restoration Advisory Board, and be based on the results of long-term monitoring sampling.

1.2 SITE BACKGROUND

The Neptune Drive Disposal Site (Site 9) is located in the central portion of the NAS Brunswick. Site 9 was identified as a potential hazardous waste site in the Initial Assessment Study and was later included in the Pollution Abatement Confirmation Study (R.F. Weston Inc. 1983; E.C. Jordan Co. 1985). Site 9 has been defined as three areas of potential concern, as shown on Figure 1-2:

- The former location of an incinerator in what is now the northeast corner of Building 220, and an inactive ash landfill/dump area in the current location of Buildings 218 and 219 (military barracks north of Neptune Drive)
- A reported disposal area behind Building 201 (the dining facility south of Neptune Drive)
- Two streams/impoundment ponds bordering the recreational area east of Building 201, which have iron oxide staining characteristic of leachate.

Based on the results of ground-water, surface water, and sediment samples collected during 14 monitoring events completed to date, the Long-Term Monitoring Program at Site 9 has been focused on site ground water north of the unnamed streams. Ground water is impacted by several volatile organic compounds, particularly vinyl chloride, which has been reported in samples from site monitoring wells.

1.2.1 Former Incinerator and Ash Landfill/Dump Area

The Initial Assessment Study identifies this area as the "first dump area used at the Air Station." The incinerator was apparently operated during a period commencing on or after April 1943 when the Naval Air Station was commissioned, until the Fall of 1946 when the Air Station was demobilized. The incinerator could have been used as late as 1953, when the barracks that now occupy the location of the former incinerator were built. The Initial Assessment Study (R.F. Weston, Inc. 1983) states that during the period the incinerator was in operation, solid wastes were burned and the ash was placed in the dump. Wastes disposed of at this location reportedly included solvents that were burned on the ground, paint sludge, and possibly wastes from the Metal Shop. Current land use at the former incinerator and inactive ash landfill/dump area is for military residences.

1.2.2 Building 201

Historical information and aerial photographs indicate an area southeast of Building 201 as a potential source of contamination (Figure 1-2). This area was reportedly used as a dumping area (R.F. Weston, Inc. 1983). Building 201 was formerly the Chief's Club, and in 1993 was converted to the Galley. The main use of this building is as a cafeteria. The area behind Building 201 has been used as a picnic area. A barbecue pit is located southeast of the building.

1.2.3 Unnamed Streams

Two unnamed streams border the area around Building 201; one to the east and one to the south. Two surface water impoundments were constructed in 1997, which resulted in flooding of the southern stream and majority of the eastern stream. The upper and lower surface water impoundment ponds receive runoff from the central portion of the base, including the runways, parking lots, and paved roads. One seep has been observed flowing into the northern unnamed stream.

1.3 PREVIOUS INVESTIGATIONS

1.3.1 Site History

The Navy conducted field activities and environmental sampling in 1988, as part of the remedial investigation for Site 9, to determine the geologic and hydrologic conditions and the distribution of contamination at this site. The focus of these investigations was on the area south of Neptune Drive, including Building 201 and the two unnamed streams. The results of these investigations

are presented in the Draft Final Remedial Investigation Report (E.C. Jordan Co. 1990). The Navy conducted additional investigations in 1990 at Site 9, including test pitting, and soil and ground-water sampling. Data from this program did not uncover evidence of a solvent burning or disposal area(s) near Building 201.

In 1991, plans were discovered by NAS Brunswick identifying the presence of a septic system east of Building 201. This septic system was installed in 1952 when Building 201 was built, and was used until 1972 when Building 201 was connected to the basewide sewer system (E.C. Jordan Co. 1991). The septic system, located upgradient of the most highly contaminated monitoring wells, was then speculated to be the primary source of ground-water contamination at Site 9, prompting further investigation of this area.

In January-March 1993, the Navy conducted additional investigations to evaluate the Building 201 septic system as a potential source of contamination and to address data gaps identified by the EPA and the MEDEP concerning the northern portion of Site 9. The results of these investigations are summarized in the Technical Memorandum (ABB-ES 1994c). Results of sampling and analysis in 1993 indicate that the septic system and subsurface soil around the septic system are not acting as a current source of ground-water contamination. As such, remedial actions developed and presented in the Feasibility Study report for removing, containing, or treating the septic system or subsurface soil were no longer considered necessary (E.C. Jordan Co. 1992).

1.3.2 Site Hydrogeology

Shallow ground water at Site 9 occurs in the overburden soil and varies in depth between 10 and 14 ft below ground surface. Overburden soil at Site 9 is a stratified formation consisting of a sand layer, a transition layer, and a clay layer overlying bedrock. Depth to bedrock has not been determined at this site. The elevation of ground surface at the site is approximately 40-50 ft above mean sea level. The top of clay has been interpreted from boring logs to occur at a depth of approximately 20 ft below ground surface on the southern edge of the site. One monitoring well (MW-NASB-227) was installed on 9 November 1998, to bound the westward extent of volatile organic compounds in ground water.

The shallow ground-water flow at the site is to the south and southeast. Historical ground-water flow patterns indicate that the shallow ground water discharges to the two streams (now flooded). Ground-water levels in these wells and the adjacent stream support the assumption that the stream is a discharge area for shallow ground water.

1.3.3 Results of Previous Investigations

The results of the 1988, 1990, and 1993 field investigations at Site 9 indicate the presence of vinyl chloride and 1,2-dichloroethene in ground water both south and north of Neptune Drive at concentrations in excess of their respective Maximum Contaminant Levels, Maximum Contaminant Level guidelines, and Maximum Exposure Guidelines; 1,1-dichloroethane was

detected in ground water south of Neptune Drive at concentrations in excessof its respective Maximum Exposure Guideline. The septic system, originally thought to be a potential source of volatile organic compound contamination south of Neptune Drive, was sampled to evaluate residual contamination. Sampling results indicate that the septic system is not a current source of ground-water contamination.

The former ash landfill/dump area, north of Neptune Drive, was identified and soil andground-water samples were collected for analysis. Polynuclear aromatic hydrocarbons were detected in the ash material; however, these compounds were not detected in ground water immediately downgradient from this area. Vinyl chloride was detected in one monitoringwell located downgradient from the disposal area, but was not detected in ash or soil samples. Elevated concentrations of inorganics were detected in ground water downgradient of the ash disposal area, and the presence of these analytes may be due to past disposal activities in this area. Inorganics and polynuclear aromatic hydrocarbons were detected in seep and/or sediment samples. The presence of these contaminants have been attributed to the ash or to other non-point source runoff from the roadways or parking lots.

1.3.4 Long-Term Monitoring

The Navy initiated long-term monitoring at Site 9 in 1995, and has completed 14 monitoring events as of April 1999. The LTMP is comprised of two components: (1) the gauging of water elevations in monitoring wells and surface water impoundment ponds, and (2) the collection of ground water, surface water, stream sediment, and seep. The initial LTMP established the requirement for monitoring/sampling to be conducted on a quarterly basis for 5 years (ABB-ES 1994d). Tri-annual sampling was initiated in June 1996 following approval by the MEDEP and EPA Region 1 on 19 April 1996. Bi-annual sampling was initiated in April 1999 following approval by the MEDEP and EPA Region I in May 1998. Long-term monitoring results indicate volatile organic compounds in ground water, particularly vinyl chloride, are the major site concerns.

1.4 SUMMARY OF CHANGES TO LONG-TERM MONITORING PLAN

This revised LTMP contains changes to the original LTMP for Site 9, which was issued in 1995. Changes have been made based on a review of analytical data from Monitoring Events 1 through 13, and discussions held with the MEDEP, EPA, and other Restoration Advisory Board members. This section summarizes the changes included in this LTMP. The long-term monitoring requirements for Site 9 are included in Chapter 3 of this document.

1.4.1 Sampling Locations

Following a review of the ground-water concentrations reported in Monitoring Events 1through 13, sampling points at Site 9 have been revised. Five monitoring wells (MW-NASB-070, MW-NASB-073, MW-NASB-078, MW-NASB-079, and MW-NASB-081) were selected to be dropped from the sampling program based on a lack of detections and/or close locations of other

monitoring wells. Three wells (MW-NASB-069, MW-NASB-070, and MW-NASB-079) will be sampled for Target Analyte List elements and semivolatile organic compounds because these wells are immediately downgradient of the ash landfill. One monitoring well (MW-NASB-227) was installed on 9 November 1998 and added to the gauging and sampling programs. Monitoring well MW-NASB-022 was also added to the sampling program effective November 1998 to assess ground-water conditions to the west of Site 9. Two wells (MW-NASB-022 and MW-NASB-204) were added to the gauging program effective September 1998 to improve gauging data coverage. Although they are not part of Site 9, the 9 site monitoring wells at the Navy Exchange Service Station will be added to bi-annual gauging to further assess ground-water flow north of the site.

The construction of two surface water impoundments has flooded the southern and northern unnamed streams, and previous sampling locations will no longer be sampled (SW/SED-011, SW/SED-012, SW/SED-915, SW/SED-916, SW/SED-918, and SW/SED-919). Surface water sample and sediment samples will continue to be collected from sample location SW/SD-010. An aqueous seep sample will continue to be collected from LT-901. Changes to the Long-Term Monitoring Program at Site 9 are summarized in Table 1-1.

1.4.2 Sampling Frequency

The initial LTMP established the requirement for monitoring/sampling to be conducted on a quarterly basis for 5 years (ABB-ES 1994d). Tri-annual sampling was initiated in June 1996 following approval by the MEDEP and EPA Region 1 on 19 April 1996. Following a review of the reported ground-water concentrations in Monitoring Events 1 through 13, sampling frequency was reduced to bi-annual sampling.

1.4.3 Sampling Method

The sampling methods for surface water, sediment, and seep sampling will remain unchanged from the initial LTMP. The standard operating procedures for ground-water sampling have been revised to reflect the use of dedicated submersible pumps. The standard operating procedures for field sampling of ground-water, surface water, sediment, and seep sampling methods are provided in Appendix A.

1.4.4 Staff Gauge Monitoring

Two retention ponds have been formed due to the installation of two surface water impoundments at Site 9 in 1997. One staff gauge has been established in each pond and the water level recorded during each sampling event.

1.4.5 Analytical Methods

The analytical requirements for Site 9 have been reduced following a review of analytical data collected during Monitoring Events 1 through 13. The sampling parameters will be limited to

Target Compound List volatile organic compounds by EPA Method 8260B inground-water, surface water, sediment, and seep samples. Target Analyte List inorganics will be analyzed for selected ground-water samples. Sampling requirements for Target Compound List semivolatile organic compounds have been eliminated for site monitoring points.

If a monitoring well is being considered for deletion from the sampling program for volatile organic compounds, ground-water samples from that well will be analyzed using Method 8260B modified for SIM for two sampling rounds, in order to achieve the detection limit of 0.15 Fg/L (State MEG for vinyl chloride). This method will not be used at a well where vinyl chloride is known to be above 2 Fg/L, as established using EPA Method 8260B.

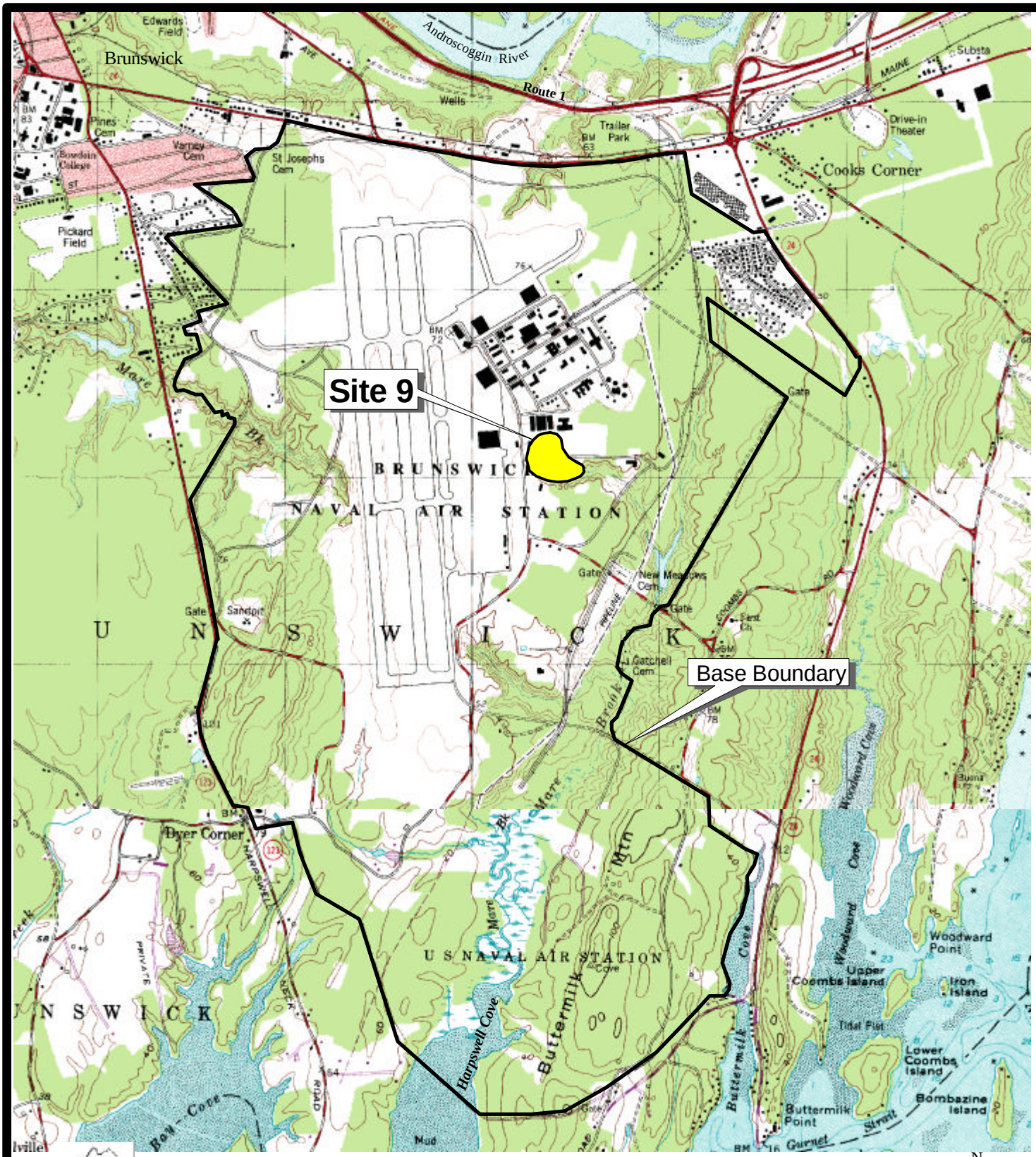
1.5 REPORTS AND DATA PRESENTATION

Monitoring event reports will present the data in tabular format and on figures. Whenever possible, graphs or other visual representations of data may also be provided. These monitoring event reports will not contain data interpretation, but will focus on data summary. Monitoring event reports will be submitted to EPA, MEDEP, and other Restoration Advisory Board members to inform interested parties of the findings of environmental monitoring at Site 9.

The annual report will provide data interpretation in the form of tables, figures, trend graphs, and other graphical tools, if applicable. This report will also contain a detailed presentation of data results and present conclusions and recommendations based on these results. The annual report will provide a basis for discussing the findings of the LTMP sampling, and propose refinements of the monitoring program. The annual report will also provide the response letters to comments received on the previous year's annual report and monitoring event reports contained in the annual report.

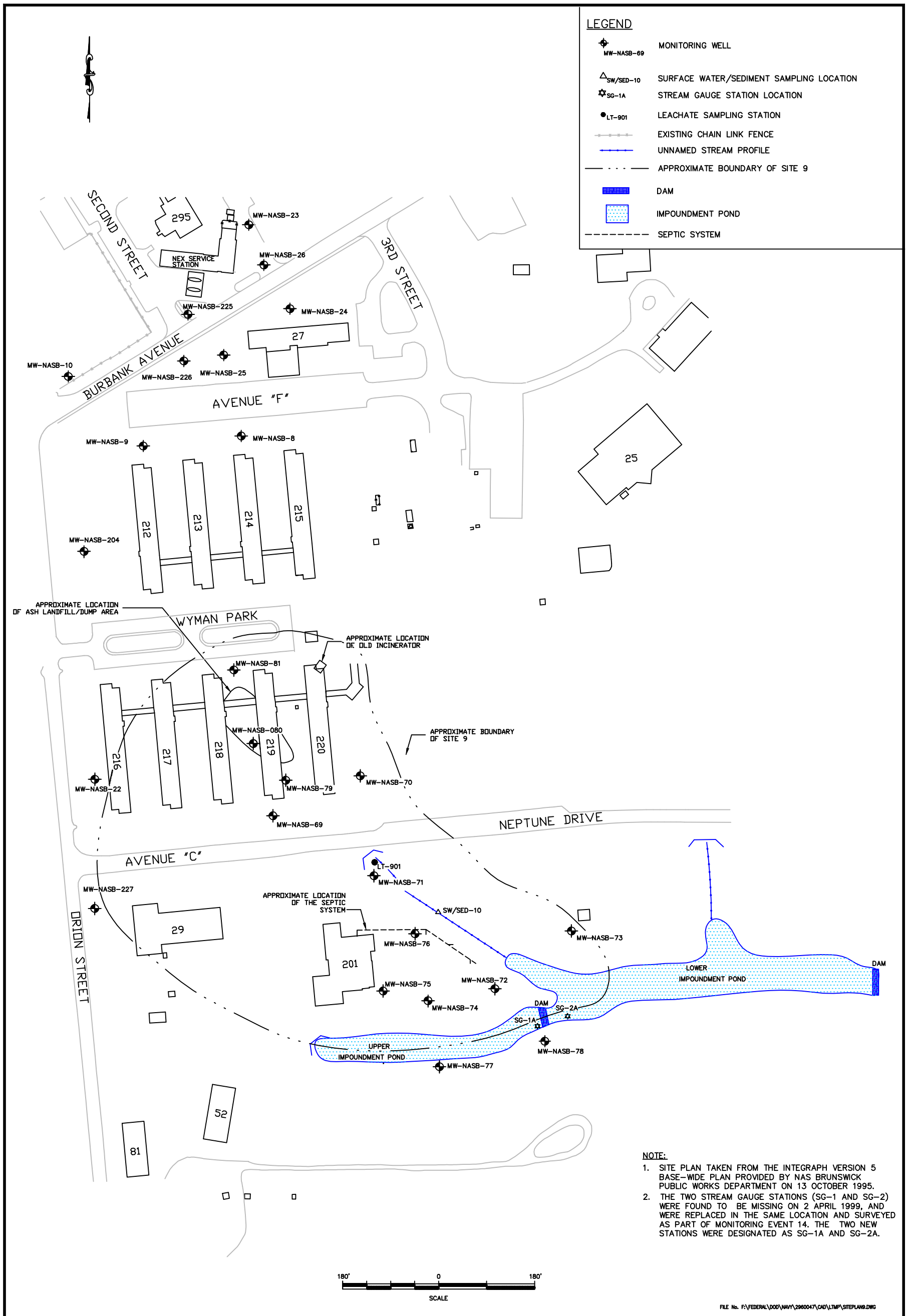
The following table provides a schedule of expected report issue months and regulator review periods:

Task	Report Preparation Duration or Review Period	Scheduled Delivery Date
Monitoring Event Report (April)	2 months	End of June
Comments from Regulators	1 month	End of July
Monitoring Event Report (September)	2 months	End of November
Comments from Regulators	1 month	End of December
Draft Annual Report	1 month after monitoring event report comments received	February
Comments from Regulators	1 month	March
Final Annual Report	1 month	April
NOTE: Response to comments received from monitoring event reports and the previous year's annual will be included in the Final Annual Report.		



SOURCE MAPS: USGS ORRS ISLAND (1978) AND BRUNSWICK (1980) 7.5 MINUTE QUADRANGLES.

EA ENGINEERING, SCIENCE, AND TECHNOLOGY	NAVAL AIR STATION BRUNSWICK, MAINE	FIGURE 1 - 1 SITE LOCATION MAP, SITE 9 (NEPTUNE DRIVE DISPOSAL SITE)					
PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT No	FILE No
PLN	BT	BT	PLN	AS SHOWN	16 August 1999	29600.47	i:\nasb_gis \navy.apr



NOTE:

1. SITE PLAN TAKEN FROM THE INTEGRAPH VERSION 5 BASE-WIDE PLAN PROVIDED BY NAS BRUNSWICK PUBLIC WORKS DEPARTMENT ON 13 OCTOBER 1995.
2. THE TWO STREAM GAUGE STATIONS (SG-1 AND SG-2) WERE FOUND TO BE MISSING ON 2 APRIL 1999, AND WERE REPLACED IN THE SAME LOCATION AND SURVEYED AS PART OF MONITORING EVENT 14. THE TWO NEW STATIONS WERE DESIGNATED AS SG-1A AND SG-2A.

FILE No. F:\FEDERAL\DOD\NAVY\2960047\CAD\LTMP\SITEPLAN9.DWG

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

SITE 9
(NEPTUNE DRIVE DISPOSAL SITE)
NAVAL AIR STATION
BRUNSWICK, MAINE

FIGURE 1-2
SITE PLAN

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FILE No.
PLN	SAP	SAP	PLN	1"=180'	28 JULY 1999	29600.47	SITEPLAN9

TABLE 1-1 SUMMARY OF CHANGES TO THE LONG-TERM MONITORING PROGRAM AT SITE 9, NAVAL AIR STATION, BRUNSWICK, MAINE

Well Designation	Sampling Frequency	Sample Parameters		
		TCL VOC	TAL Elements	Bi-Annual Gauging
Monitoring Wells				
MW-NASB-069	Bi-Annual	X	X[a]	X
MW-NASB-070	Bi-Annual	NR	X[a]	X
MW-NASB-071	Bi-Annual	X	NR	X
MW-NASB-072	Bi-Annual	X	NR	X
MW-NASB-073	---	Removed	NR	X
MW-NASB-074	Bi-Annual	X	NR	X
MW-NASB-075	Bi-Annual	X	NR	X
MW-NASB-076	Bi-Annual	X	NR	X
MW-NASB-077	Bi-Annual	X[b]	NR	X
MW-NASB-078	---	Removed	NR	X
MW-NASB-079	Bi-Annual	NR	X[a]	X
MW-NASB-080	Bi-Annual	X	NR	X
MW-NASB-081	---	Removed	NR	X
MW-NASB-022	Bi-Annual	X	NR	X
MW-NASB-204	---	NR	NR	X
MW-NASB-227	Bi-Annual	X	NR	X
Seep				
LT-901 (SEEP)	Bi-Annual	X	NR	NR
LT-901 (SED)	---	Removed	NR	NR
Surface Water				
SW-010	Bi-Annual	X	NR	NR
SW-011	---	Removed	NR	NR
SW-012	---	Removed	NR	NR
SW-915	---	Removed	NR	NR
SW-916	---	Removed	NR	NR
SW-919	---	Removed	NR	NR
SW-922	---	Removed	NR	NR
Stream Gauges				
SG-1	Bi-Annual	NR	NR	X
SG-2	Bi-Annual	NR	NR	X
Sediment				
SED-010	Bi-Annual	NR	X	NR
SED-011	---	Removed	X	NR
SED-012	---	Removed	X	NR
SED-915	---	Removed	X	NR
SED-916	---	Removed	X	NR
SED-919	---	Removed	X	NR
SED-922	---	Removed	X	NR

(a) These wells will also be sampled and analyzed for semivolatile organic compounds.
(b) Monitoring well MW-NASB-077 will be analyzed using EPA Method 8260B modified for SIM for two rounds (September 1999 and April 2000). This well will be considered for removal from the Long-Term Monitoring Program if both rounds are non-detect. If vinyl chloride is detected above the Maximum Exposure Guideline, the well will be retained in the Long-Term Monitoring Program.

NOTE: TCL = Target Compound List; VOC = Volatile organic compounds; TAL = Target Analyte List; NR = Not required. Dashes (---) indicate matrix not sampled.
Nine NEX Service Station monitoring wells will be added to bi-annual gauging, although they are not part of Site 9.

2. REGULATORY FRAMEWORK

The selected remedy for ground water at Site 9 specified in the Proposed Plan and Interim Ground-Water Record of Decision at Site 9 is natural attenuation with long-term monitoring (ABB-ES 1994a, 1994b). Currently, the Record of Decision for the site is being finalized. The final selected remedy may require changes in the long-term monitoring of ground water, and may include institutional controls to prevent human contact with ground water in this area. Because the selected remedy (natural attenuation with long-term monitoring) leaves contaminants onsite and does not immediately allow for unlimited use and unrestricted access, a 5-year statutory review is required. The results of this monitoring program are intended to evaluate the effectiveness of natural attenuation with long-term monitoring and ensure that this action remains protective of human health and the environment. These data will also be used by the Navy to evaluate the need for changes in the sampling requirements for Site 9. Approval of this LTMP by EPA and MEDEP is required prior to implementation.

This LTMP will allow the Navy to collect data to conduct 5-year reviews. The first 5-year review is scheduled to be conducted in 1999. It is anticipated that the monitoring program will continue until a future review suggests that no further action is appropriate or another remedy is selected.

At the time of this plan development, no remedial actions have been conducted at this site. The Navy has issued a revised Proposed Plan and is currently revising a Final Record of Decision, which will be submitted for regulatory review and comment.

3. MONITORING PLAN

This chapter describes the long-term monitoring requirements being conducted to assess the effectiveness of the selected remedy (i.e., natural attenuation with long-term monitoring) for Site 9. This chapter details the sampling locations, sampling frequency, analytical methods, and visual inspections to be conducted during each monitoring event. The monitoring program conforms with the Resource Conservation and Recovery Act requirements for ground-water detection monitoring (40 CFR Subpart F) and specifies the monitoring locations, sampling frequency, sampling procedures, and analytical parameters. The quality assurance and quality control procedure requirements are described in the Quality Assurance Project Plan in Appendix B. Health and safety procedures to be followed during sampling are described in the Safety, Health, and Emergency Response Plan for NAS Brunswick (EA 1997).

3.1 LONG-TERM MONITORING PROGRAM

A Long-Term Monitoring Program is currently being conducted at Site 9. Long-term monitoring activities will continue to include collection of ground water, surface water, stream sediment, and seep. A summary of the sampling program for Site 9 can be found in Table 3-1. The locations of monitoring points are shown on Figure 1-2.

3.1.1 Ground-Water Sampling Program

A total of 12 site monitoring wells will be sampled to assess ground-water quality at Site 9 (MW-NASB-069, MW-NASB-070, MW-NASB-071, MW-NASB-072, MW-NASB-074, MW-NASB-075, MW-NASB-076, MW-NASB-077, MW-NASB-079, MW-NASB-080, MW-NASB-022, and MW-NASB-227). A summary of the Long-Term Monitoring Program can be found in Table 3-1. Prior to ground-water sampling activities, water level measurements will be collected from all 16 existing site monitoring wells and recorded along with pertinent well details on the Field Record of Well Gauging forms (Appendix A). Although they are not part of Site 9, water level measurements will also be collected at the 9 site monitoring wells at NEX Service Station. The monitoring locations are presented in Figure 1-2.

3.1.2 Surface Water and Stream Sediment Sampling Program

One surface water and stream sediment sample will be collected from the location along the northern unnamed stream (SW/SED-010). The surface water sample will be collected if sufficient liquid is present to permit valid sample recovery during bi-annual sampling events. The stream sediment will be collected regardless of whether liquid is present at the time of sampling.

3.1.3 Seep Sampling Program

One seep sample (LT-901) will be collected from the location of the former drain, along the northern unnamed stream. The sample will be collected if sufficient liquid is present topermit valid sample recovery during bi-annual sampling events. The sediment at this location will not be sampled.

3.1.4 Staff Gauge Water Elevations

Two staff gauge locations have been established in the surface water retention ponds. During gauging events, water elevations at the staff gauges will be noted for usein assessing ground-water flow patterns at the site.

3.1.5 Sampling Frequency

Monitoring points will be sampled bi-annually in April and September to correspond to the periods of high and low water conditions. Depending on the long-term trends of the compound concentrations, monitoring frequency may be changed with approval by EPA and MEDEP. Monitoring well MW-NASB-077 will be sampled for two rounds (September 1999 and April 2000). This well will be considered for removal from the Long-Term Monitoring Program if both rounds are non-detect. If vinyl chloride is detected above the Maximum Exposure Guideline, the well will be retained in the Long-Term Monitoring Program.

3.2 SAMPLING PROCEDURES

3.2.1 Ground-Water Sampling Program

Consistent with previous long-term monitoring sampling, ground-water samples will be collected at Site 9 using dedicated, low-flow submersible pumps. The low-flow sampling method will be used since it minimizes turbidity in ground-water samples. The low-flow sampling standard operating procedure is provided in Appendix A. Note that during sampling, water level in a well will not be allowed to decline below the intake level of the sampling pump to prevent the well from being purged dry.

3.2.2 Surface Water and Stream Sediment Sampling Program

The procedure for collecting the surface water samples has been designed to permit collection of representative samples. Surface water samples will be collected first at each location without disturbing stream bottom sediment to ensure that there will not be cross-contamination from suspended sediment. Stream sediment samples will be collected immediately following completion of the surface water sample collection. The surface water and stream sediment sampling standard operating procedures are provided in Appendix A.

3.2.3 Seep Sampling Program

The procedure for collection of the seep sample is similar to that for surface water and has been designed to permit collection of representative samples. The seep sampling standard operating procedure is provided in Appendix A.

3.2.4 Visual Inspection

Visual inspection of the monitoring well locations at the time of sampling will be performed to ensure proper integrity of the wells. Monitoring well labels will be checked, covers and grating inspected, and the general condition of the well noted. Repairs will be completed, if necessary, prior to the next sampling event.

3.3 ANALYTICAL PARAMETERS AND PROCEDURES

Ground-water samples collected from monitoring wells, surface water, sediment, and seeps may be analyzed for the following compounds:

- Target Compound List VOC by EPA Method SW-846 Method 5030B/8260B.

- If a monitoring well is being considered for deletion from the sampling program for volatile organic compounds, ground-water samples from that well will be analyzed using Method 8260B modified for SIM for two sampling rounds, in order to achieve the detection limit of 0.15 Fg/L (State MEG for vinyl chloride). This method will not be used at a well where vinyl chloride is known to be above 2 Fg/L, as established using EPA Method 8260B.

- Target Analyte List elements, including metals by inductively coupled plasma by EPA Method 6010 and graphite furnace by EPA Method 7000 Series.

- Target Compound List semivolatile organic compounds by EPA SW-846 Method 3520A/8270C.

- Field parameters will be monitored at the time of sampling, including, pH, temperature, turbidity, specific conductance. Optional field parameters, including Eh and dissolved oxygen, will also be recorded.

Table 3-1 summarizes the LTMP analytical requirements for ground-water, surface water, sediment, and seep sampling.

3.3.1 Program Modifications

A modification or reduction in the number of sample parameters could occur if a parameter is not detected in ground water at monitoring locations for a significant period of time. Modifications to the monitoring network included in the LTMP may be appropriate if a trend of contamination concentrations change significantly. Proposed modifications to the monitoring program will be submitted in writing to EPA and MEDEP in accordance with 40 CFR 264.118.

3.3.2 Data Reduction and Analytical Data Quality Review

A review of laboratory data will be conducted, as specified in the companion Quality Assurance Project Plan document (Appendix B). This review will include an assessment of the precision, accuracy, representativeness, completeness, and comparability and analytical data quality objective requirements. The findings of the sample analytical data quality review will be included in the monitoring event and annual reports, and will report significant data discrepancies which may affect analytical data usability. Method detection limits will be included in monitoring event reports, as requested by EPA.

3.3.3 Laboratory Quality Assurance and Quality Control

As specified in the Quality Assurance Project Plan, appropriate laboratory quality assurance and quality control method blanks, trip blanks, rinsate blanks, and source water blanks will be collected and analyzed to provide the required level of quality control for the analytical data. The data will be evaluated and reported to the regulatory agencies in the monitoring event and annual reports. The data evaluation will consider the applicability of the data to the LTMP objectives and recommend how the data should be utilized.

3.3.4 Corrective Measures

If problems or concerns are identified during field activities, visual inspections, and/or laboratory analysis or reporting, corrective measures will be identified and implemented by the Navy prior to the next scheduled sampling event. Should the problem repeat itself in a subsequent monitoring event, the Navy will recommend additional corrective action to the regulatory agencies, and the Navy may implement such action upon agreement with the EPA and MEDEP. Conditions may exist which cannot be corrected (i.e., highly turbid water samples causing analytical equipment interference). In those instances, corrective measures may not be practicable.

TABLE 3-1 SUMMARY OF THE LONG-TERM MONITORING PROGRAM AT SITE 9

Well Designation	Previous Well Designation	Monitoring Frequency	Sample Parameters				Field Parameters [a]
			TCL VOC	TAL Elements	TCL SVOC	Bi-Annual Gauging	
MW-NASB-069	MW-901	Bi-Annual	X	X	X	X	X
MW-NASB-070	MW-902	Bi-Annual	NR	X	X	X	X
MW-NASB-071	MW-903	Bi-Annual	X	NR	NR	X	X
MW-NASB-072	MW-904	Bi-Annual	X	NR	NR	X	X
MW-NASB-073	MW-905	Bi-Annual	NR	NR	NR	X	NR
MW-NASB-074	MW-906	Bi-Annual	X	NR	NR	X	X
MW-NASB-075	MW-907	Bi-Annual	X	NR	NR	X	X
MW-NASB-076	MW-908	Bi-Annual	X	NR	NR	X	X
MW-NASB-077	MW-909	Bi-Annual	NR[b]	NR	NR	X	NR
MW-NASB-078	MW-910	Bi-Annual	NR	NR	NR	X	NR
MW-NASB-079	MW-914	Bi-Annual	NR	X	X	X	X
MW-NASB-080	MW-915	Bi-Annual	X	NR	NR	X	X
MW-NASB-081	MW-916	Bi-Annual	NR	NR	NR	X	NR
MW-NASB-022	---	Bi-Annual	X	NR	NR	X	X
MW-NASB-204	---	Bi-Annual	NR	NR	NR	X	NR
MW-NASB-227	---	Bi-Annual	X	NR	NR	X	X

Sample Type/Location	Monitoring Frequency	Sample Parameters			Field Parameters [a]
		TCL VOC	TAL Elements	Bi-Annual Gauging	
Seep					
LT-901 (SEEP)	Bi-Annual	X	NR	NR	X
Surface Water					
SW-010	Bi-Annual	X	NR	NR	X
Sediment					
SED-010	Bi-Annual	X	NR	NR	NR
Stream Gauge Surface Water					
SG-1	Bi-Annual	NR	NR	X	NR
SG-2	Bi-Annual	NR	NR	X	NR

(a) Determination of field parameters in accordance with EPA/600/4-79020 using the following methods: pH (Method 150.1), temperature (Method 170.1), specific conductance (Method 120.1), and turbidity (Method 180.1); optional field parameters, including dissolved oxygen (Method 360.1) and Eh, may also be recorded. Includes water level measurement.

(b) Monitoring well MW-NASB-077 will be analyzed using EPA Method 8260B modified for SIM for two rounds (September 1999 and April 2000). This well will be considered for removal from the Long-Term Monitoring Program if both rounds are non-detect. If vinyl chloride is detected above the Maximum Exposure Guideline, the well will be retained in the Long-Term Monitoring Program.

NOTE: TCL = Target Compound List; VOC = Volatile organic compounds; TAL = Target Analyte List; SVOC = Semivolatile organic compounds; NR = Not required.
Dashes (---) indicate no previous well designation.
Nine NEX Service Station monitoring wells will be gauged bi-annually, although they are not part of Site 9.
Bi-annual sampling and gauging to be co nducted in April and September.

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Appendix A

Standard Operating Procedures for Field Sampling

APPENDIX A – CONTENTS

Page

A.1 STANDARD OPERATING PROCEDURE NO. 1 – GROUND-WATER SAMPLING BY LOW-FLOW PURGE AND SAMPLING METHOD USING DEDICATED PUMPS A-1

A.1.1 Scope of Application A-1
A.1.2 Equipment/Materials A-1
A.1.3 Preliminary Site Activities A-2
A.1.4 Well Purging and Sampling Procedure A-3
A.1.5 Sample Preservation A-5
A.1.6 Field Quality Control A-6
A.1.7 Decontamination A-6

A.2 STANDARD OPERATING PROCEDURE NO. 2 – SURFACE WATER AND SEEP SAMPLING PROCEDURE A-7

A.2.1 Scope of Application A-7
A.2.2 Equipment/Materials A-7
A.2.3 Preliminary Site Activities A-8
A.2.4 Sampling Procedure A-8
A.2.5 Sample Preservation A-9
A.2.6 Field Quality Control A-10
A.2.7 Decontamination A-10

A.3 STANDARD OPERATING PROCEDURE NO. 3 – SEDIMENT SAMPLING PROCEDURE A-11

A.3.1 Scope of Application A-11
A.3.2 Equipment/Materials A-11
A.3.3 Preliminary Site Activities A-12
A.3.4 Sampling Procedure A-12
A.3.5 Field Quality Control A-14
A.3.6 Decontamination A-14

APPENDIX A

STANDARD OPERATING PROCEDURES FOR FIELD SAMPLING

A.1 STANDARD OPERATING PROCEDURE NO. 1 - GROUND-WATER SAMPLING BY LOW-FLOW PURGE AND SAMPLING METHOD USING DEDICATED PUMPS

A.1.1 Scope of Application

The purpose of this Standard Operating Procedure (SOP) is to establish the protocol for collecting ground-water samples using dedicated pump systems. The procedure is designed to permit the collection of ground-water samples with minimum turbidity, and is intended to be used in conjunction with the analyses for the most common types of ground-water contaminants (volatile organic compounds [VOC], metals, and inorganic compounds). This SOP was prepared based on draft guidance prepared by U.S. Environmental Protection Agency (EPA) Region I and conforms with the procedures described in the Long-Term Monitoring Plan (LTMP) (ABB-ES 1994[1] and EA 1999[2]).

A.1.2 Equipment/Materials

- LTMP
- Well construction data, location map, field data from last sampling event
- Field logbook and Field Record of Well Gauging, Purging, and Sampling forms (FigureA-1) and Field Record of Well Gauging Forms (Figure A-2)
- Electronic water level measuring device, 0.01 ft accuracy for monitoring water level during pumping operations
- Pumps: adjustable rate, submersible pumps constructed of stainless steel and Teflon®
- Tubing: Teflon or Teflon-lined polyethylene must be used to collect samples for organic analysis; for samples collected for inorganics analysis, Teflon or Teflon-lined polyethylene tubing will be used

1. ABB Environmental Services, Inc. (ABB-ES). 1994. Long-Term Monitoring Plan. Building 95, Sites 1 and 3, and Eastern Plume. Naval Air Station, Brunswick, Maine. August.

2. EA Engineering, Science, and Technology. 1999. Long-Term Monitoring Plan, Site 9 (Neptune Drive Disposal Site), Naval Air Station Brunswick, Maine. Draft.

- Flow measurement supplies (e.g., graduated cylinder and stop watch)

- Power source (generator, etc.)

- Water quality indicator parameter monitoring instruments? pH, turbidity, specific conductances, and temperature; optional indicators? Eh and dissolved oxygen; water quality indicator parameters will be measured in the field in accordance with EPA-600/ 4-79-020 (1983) using the following methods: temperature (Method 170.1), pH (Method 150.1), turbidity (Method 180.1), specific conductance (Method 120.1), and dissolved oxygen (Method 360.1)

- Flow through cell for water quality probes

- Decontamination supplies (for monitoring instrumentation)

- Sample bottles and sample preservation supplies (as required by the analytical methods)

- Sample tags or labels

- Coolers with bagged ice for sample bottles.

A.1.3 Preliminary Site Activities

The following site activities are required prior to performing well purging and ground-water sampling. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate: site name, project number, field personnel, well identification, weather conditions, date and time, equipment used, and quality assurance/quality control data for field instrumentation.

- Check well for damage or evidence of tampering, record pertinent observations in field logbook and sampling form.

- Lay out sheet of polyethylene for monitoring and sampling equipment.

- Unlock well and remove well cap (if applicable).

- Measure VOC with a photoionization detector instrument at the rim of the well and in the breathing zone, and record the readings in the field logbook and the sampling form.

- Measure and record the height of protective casing above the concrete pad or ground surface, as appropriate. This reading is compared to that recorded during well installation as an indication of possible well damage or settling that may have occurred.

- Measure and record the depth to water (to 0.01 ft) in the well to be sampled before purging begins. If the well casing does not have a reference point (usually a v-cut or indelible mark in the well casing), make one. Care should be taken to minimize disturbance of any particulate attached to the sides or at the bottom of the well. The depth to well bottom will not be measured following the completion of sampling because of the potential to stir up sediment at the bottom of the well.

- Prepare the pump by checking electrical connections, discharge tubing, and motor (Grundfos Redi-Flo2). Locate the generator (if applicable) downwind of the well; connect the power converter to the generator and to the pump.

A.1.4 Well Purging and Sampling Procedure

The following general procedure should be followed to obtain representative ground-water samples. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted.

Enter the following information in the field logbook and sampling form, as appropriate, prior to purging: purge date and time, purge method, and total well depth.

- Connect the flow through the cell containing the instrumentation header to the pump discharge and begin purging the well at 0.2-0.5 L/min, unless a different purge rate has been previously established for that well. Fill the flow cell completely. Care should be taken not to cause entrapment of air in the system. Record the purge start time and purge rate.

- Establish that the water level has not dropped significantly such that the pump is dry (bubbles in discharge) or water is heard cascading down the inside of the well. Ideally, the pump rate should cause little or no water level drawdown in the well (<0.5 ft and the water level should stabilize). The water level should be monitored every 3-5 minutes (or as appropriate) during pumping. Record pumping rate adjustments and depths to water. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump (e.g., 0.1-0.2 L/min) to avoid pumping the well dry and/or to ensure stabilization of indicator parameters. If the water level continues to drop with the pump on the lowest flow rate, the pump will be shut off and the well will be allowed to recharge to prevent the well from going dry. **The well will not be purged to dryness prior to sampling to prevent erroneous field parameters and ground-water samples.** Sampling will commence as soon as the well has recharged to a sufficient level to collect the appropriate volume of samples with the pump.

- During purging of the well, monitor the water quality indicator parameters (turbidity, temperature, specific conductance, pH, etc.) every 3-5 minutes (or as appropriate). Record purge rate, drawdown, volume purged, depth to water, water quality indicator parameters values, and clock time at 3- to 5-minute intervals in field logbook and sampling record. Purging of the standing well water is considered complete when three consecutive readings of the water quality indicator parameters agree within approximately 10 percent. Turbidity readings consistently below 10 nephelometric turbidity units (NTU) are considered to represent stabilization of discharge water for this parameter. If the parameters have stabilized, but the turbidity is not in the range of the 10 NTU goal, the pump flow rate should be decreased and measurement of the parameters should continue every 3-5 minutes.

- Prior to sampling, disconnect the discharge tubing from the flow through cell. If the water discharged by the pump is silty, wait for the water to clear before sampling. Ensure that bubbles are not observed in the discharge tubing. Record pertinent observations in field logbook and sampling records.

- Begin filling sample containers from the pump discharge, allowing the water to fill the containers by allowing the pump discharge to flow gently down the inside of the container with as little agitation or aeration as possible. Collect the samples in the order below, as applicable:

  ? VOC
  ? Semivolatile organic compounds
  ? Inorganics.

- VOC samples requiring pH adjustment will have their pH checked to assure that the proper pH has been obtained. This will require that a test sample be collected to determine the amount of preservative that needs to be added to the sample containers prior to sampling. Details on sample preservation are discussed in Section A.1.5.

- Label each sample as collected. Those samples (VOC, etc.) requiring cooling will be placed into an ice cooler for delivery to the laboratory. Metal samples, after preservation, do not need to be cooled.

- After collection of the samples, restore the dedicated pumping assembly to the well by hanging the tube, electric line, and support cable inside the well by the specially-designed PVC well cap assembly. Lock well.

- Complete remaining portions of Field Record of Well Gauging, Purging, and Sampling form (Figure A-1) after each well is sampled, including sample date and time, total quantity of water removed, well sampling sequence, types of sample bottles used, sample identification numbers, preservatives used, parameters requested for analysis, and field observations of sampling event.

A.1.5 Sample Preservation

The following preservation procedures are examples of typical preservation protocols specific to the indicated analyses. Minimum sample preservation requirements for each parameter group are summarized below:

- **VOC?** Aqueous VOC samples must be collected as specified below. Each VOC sample is taken in duplicate:

  — Uncap the sample bottle, taking care not to touch the Teflon-faced septum. If the septum is contaminated in any way, it should be replaced.

  — Fill a sample bottle, preserve with HC1, and check the pH. Adjust the volume of HCl to assure pH<2.

  — Add the amount of HC1 determined in the above step, and fill the sample vial slowly from the tubing, minimizing air entrainment, until the vial slightly overflows.

  — Place the Teflon-faced silicon rubber septum on the convex meniscus, Teflon side (shiny side) down and screw cap on.

  — Invert the bottle, tap lightly, and check for air bubbles.

  — If air bubbles are present, open the bottle, add sample to eliminate air bubbles, and reseal. Repeat this procedure until the bottle is filled and no air bubbles are detected.

  — Place samples on ice until shipment.

- **Semivolatile Organic Compounds**—Fill the sample bottle, seal with a Teflon-lined cap, and place on ice for shipment.

- **Metals?** Fill the sample bottle, preserve the sample to pH<2 with nitric acid (HNO_3), seal container, and place sample on ice for shipment.

Disposable pipettes should be used to introduce chemicals into the samples. Chemicals used for preserving should be poured into a 150-ml beaker. They should not be drawn directly from the preservative bottles because the bottle may become contaminated. Measurements for pH and temperature should not be taken from the sample containers. When preserving samples to a required pH, pH paper should be used to check the resultant pH. The sample should be poured across the pH paper. Never place pH paper directly into sample.

NOTE: Shipping regulations limit the amount of preservative that can be added. For a 1-L sample, this is generally 1.5 ml of acid preservative.

A.1.6 Field Quality Control

Quality control samples are required to verify that the sample collection and handling process has not affected the quality of the ground-water samples. All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples will be collected for each sample delivery group (SDG) (an SDG may not exceed 20 samples) at the frequency noted.

- Field Duplicate? Required at a frequency of 10 percent per SDG
- Matrix Spike/Matrix Spike Duplicate? Required at a frequency of 5 percent
- Equipment (Rinsate) Blank? Required once prior to installation of dedicated pump systems
- Source Water Blank? Required at a frequency of once per sampling event when equipment (rinsate) blank is required
- Trip Blank? Required for VOC samples at a frequency of one per sample shipment.

A.1.7 Decontamination

Non-dedicated sampling equipment and field monitoring equipment will be decontaminated prior to use and following sampling of each well. This equipment will be decontaminated by the procedure listed below. Alternative procedures must be approved by the Quality Assurance Officer prior to sampling event.

The following decontamination procedure will be used:

- Flush the equipment with potable water
- Flush with non-phosphate detergent solution
- Flush with tap water to remove all of the detergent solution

- Flush with distilled/deionized water
- Flush with isopropyl alcohol
- Flush with distilled/deionized water.

It is recommended that the detergent and isopropyl alcohol used in the above sequence be used sparingly.

A.2 STANDARD OPERATING PROCEDURE NO. 2 - SURFACE WATER AND SEEP SAMPLING PROCEDURE

A.2.1 Scope of Application

The purpose of this SOP is to establish the protocol for collecting surface water and seep samples. The procedure is designed to permit the collection of representative surface water and seep samples, and has been adapted from the procedure outlined in the LTMP (ABB-ES 1994). This SOP is suitable for collecting surface water and seep samples requiring analyses for the surface water contaminant (VOC).

A.2.2 Equipment and Materials

- LTMP
- Location map, field data from last sampling event
- Field logbook and Field Record of Surface Water and Sediment Sampling forms (Figure A-3)
- Water quality indicator parameter monitoring instruments? pH, turbidity, specific conductances, and temperature; optional indicators? Eh and dissolved oxygen
- Decontamination supplies (for monitoring instrumentation)
- Dedicated, pre-cleaned 1-L wide-mouth or 40-ml volatile organic analyte sample container (for sample collection)
- Sample bottles and sample preservation supplies (as required by the analytical methods)
- Sample tags or labels.

A.2.3 Preliminary Site Activities

The following site activities are required prior to performing surface water or seep sampling. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted.

- Enter the following information in the field logbook and sampling form, as appropriate site name, project number, field personnel, sample station identification, weather conditions, date and time, equipment used, and quality assurance/quality control data for field instrumentation.

- Visually inspect sample station for evidence of changes in physical condition; record pertinent observations in field logbook and sampling form.

- Measure VOC with an ionization detector (photo or flame) instrument in the breathing zone and record the reading in the field logbook and sampling form.

A.2.4 Sampling Procedure

The technique for surface water and seep sampling must be selected after addressing such items as:

- Depth of waterbody
- Depth of sample
- Seasonal variations
- Analytical parameters of interest.

The following general procedure should be used to obtain representative surface water and seep samples. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate, prior to sampling: date and time, sample method, and sample depth.

- Collect the sample from the surface water by immersing a pre-cleaned dedicated 1-L glass or 40-ml volatile organic analyte sample container into the waterbody. If a stream is being sampled, collect the sample upstream of the sampler with the opening of the sampling device oriented upstream but avoiding floating debris.

- Directly fill the appropriate sample containers from the 1-L glass or 40-ml volatile organic analyte sampling device.

- Collect the samples in the order below, as applicable:

  ? VOC only

- Water sample containers are generally filled directly from the source or sampler without special considerations. The exception is the collection of aqueous VOC samples requiring pH adjustment. VOC samples will have their pH checked to assure that the proper pH has been obtained. This will require that a test sample be collected to determine the amount of preservative that needs to be added to the sample containers prior to sampling. Details on sample preservation methods are discussed in Section A.2.5.

- Label each sample as collected. Those samples (VOC, etc.) requiring cooling will be placed into an ice cooler for delivery to the laboratory.

- Measure water quality indicator parameters, if possible, by direct immersion of instrument probes into the waterbody immediately following sample collection in accordance with EPA-600/4-79-020 (1983) using the following methods: temperature (Method 170.1), pH (Method 150.1), turbidity (Method 180.1), specific conductance (Method 120.1), and dissolved oxygen (Method 360.1). If direct measurement is not possible, measure these parameters from water remaining in the sampling device or another sample bottle. Record this information in the field logbook and sample data record.

- Complete remaining portions of the Field Record of Surface Water and Sediment Sampling form (Figure A-3) after each station is sampled, including time of sample collection, types of sample bottles used, sample identification numbers, preservatives used, parameters requested for analysis, and field observations of sampling event.

A.2.5 Sample Preservation

The following preservation procedures are examples of typical preservation protocols specific to the indicated analyses. Minimum sample preservation requirements for each parameter group are summarized below:

- **VOC?** Aqueous VOC samples must be collected as specified below. Each sample is taken in duplicate:

  — Uncap the sample bottle, taking care not to touch the Teflon-faced septum. If the septum is contaminated in any way, it should be replaced.

  — Fill a sample bottle, preserve with HC1, and check the pH. Adjust the volume of HCl to assure pH<2.

— Add the amount of HC1 determined in the above step, and fill the sample vial slowly from the 1-L container, minimizing air entrainment, until the vial slightly overflows.

— Place the Teflon-faced silicon rubber septum on the convex meniscus, Teflon side (shiny side) down and screw cap on.

— Invert the bottle, tap lightly, and check for air bubbles.

— If air bubbles are present, open the bottle, add sample to eliminate air bubbles, and reseal. Repeat this procedure until the bottle is filled and no air bubbles are detected.

— Place samples on ice until shipment.

Disposable pipettes should be used to introduce chemicals into the samples. Chemicals used for preserving should be poured into a 150-ml beaker. They should not be drawn directly from the preservative bottles because the bottle may become contaminated. Measurements for pH and temperature should not be taken from the sample containers. When preserving samples to a required pH, pH paper should be used to check the resultant pH. The sample should be poured across the pH paper. Never place pH paper directly into sample.

NOTE: Shipping regulations limit the amount of preservative which can be added. For a 1-L sample, this is generally 1.5 ml of acid preservative.

A.2.6 Field Quality Control

Quality control samples are required to verify that the sample collection and handling process has not affected the quality of the surface water and seep samples. All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples will be collected for each SDG (an SDG may not exceed 20 samples) at the frequency noted:

- Field Duplicate? Required at a frequency of 10 percent per SDG
- Matrix Spike/Matrix Spike Duplicate? Required at a frequency of 5 percent
- Equipment (Rinsate) Blank—Required at a frequency of once per day per media sampled
- Source Water Blank? Required at a frequency of once per sampling event
- Trip Blank? Required for VOC samples at a frequency of one per sample shipment

A.2.7 Decontamination

Field monitoring equipment will be decontaminated prior to use and following sampling of each station by the procedure listed below. Laboratory pre-cleaned, dedicated 1-L glass sample collection containers are used once and discarded and, therefore, do not undergo any decontamination.

Procedure

The following decontamination procedure will be used:

- Flush the equipment with potable water
- Flush with non-phosphate detergent solution
- Flush with tap water to remove all of the detergent solution
- Flush with distilled/deionized water
- Flush with isopropyl alcohol
- Flush with distilled/deionized water.

It is recommended that the detergent and isopropyl alcohol used in the above sequence be used sparingly.

A.3 STANDARD OPERATING PROCEDURE NO. 3 - SEDIMENT SAMPLING PROCEDURE

A.3.1 Scope of Application

The purpose of this SOP is to establish the protocol for collecting sediment samples. The procedure is designed to permit the collection of representative sediment samples, and has been adapted from the procedure outlined in the LTMP (ABB-ES 1994). This SOP is suitable for collecting sediment samples requiring analyses for the contaminant (VOC).

A.3.2 Equipment and Materials

- LTMP
- Location map, field data from last sampling event
- Field logbook and Field Record of Surface Water and Sediment Sampling forms (Figure A-3)
- Decontamination supplies (for sampling equipment and monitoring instrumentation)
- Stainless steel hand trowel and mixing bowls (for sample collection)
- Sample bottles and sample tags or labels

A.3.3 Preliminary Site Activities

The following site activities are required prior to performing sediment sampling. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted.

- Enter the following information in the field logbook and sampling form, as appropriate: site name, project number, field personnel, sample station identification, weather conditions, date and time, equipment used, and quality assurance/quality control data for field instrumentation.

- Visually inspect sample station for evidence of changes in physical condition; record pertinent observations in field logbook and sampling form.

- Measure VOC with an ionization detector (flame or photo) instrument in the breathing zone and record the reading in the field logbook.

- Clear sample area of detritus (seasonally).

A.3.4 Sampling Procedure

Sediment samples are usually taken in conjunction with surface water and/or seep samples. If both surface water and sediment samples are to be collected at a given sampling location, the water samples will be collected prior to the sediment sample. The sediment samples will be collected in the following manner:

- The sampler will locate the sample station as indicated on the site map and flagged with a stake (unless previously flagged).

- The sampler will photograph the sample location (optional), complete the required records, and initiate chain-of-custody procedures.

The recommended sediment collection devices are Teflon? or stainless steel spatulas, hand trowels, or core tubes for shallow wadeable water. In shallow, wadeable waters, the direct use of a core liner or tube (5 in.) is recommended. The tube is pushed into the substrata until approximately 1 in. (2.5 cm) or less of the tube is above the sediment water interface. When hard or coarse substrates are sampled, a gentle rotation of the tube while it is pushed will facilitate greater penetration and reduce core compaction. The tube is then capped with a Teflon plug or a sheet of Teflon held in place by a rubber stopper or cork. After capping, the tube is slowly extracted, the negative pressure and adherence of the sediment keeping the sample in the tube. Caution should be exercised not to disturb the area to be sampled. The sampler should always stand downstream from the sample location when wading in shallow water.

To help prevent contamination from direct contact between the sampler's gloves and the upper part of the tube, a collar-type device can be constructed of wood and should have a circular recess to accept the top of the tube. The recess should have a hole in it to allow water to pass through when the tube is pushed in, and should be lined with sheet Teflon. Handles should be attached to the side of the collar. After the tube is driven in, one should use a wide circular motion to help loosen the core for easy removal, take off the collar device, and cap the top of the tube (as described above) and pull it up out of the sediment layer.

Sediment samples must contain greater than 30 percent solids to be acceptable. A minimum of 100 g of sediment should be collected at each sample station. Therefore, one tube with a 4-in. long core, outer diameter of 2 in., and wall thickness of 0.125-in. is adequate for one sample (the volume of each core would be approximately 0.75 qt or 750 ml). For other tube sizes and core lengths, the number of tubes necessary can be calculated by using the formula for the volume of a cylinder. Additional material may be required if duplicate analyses are performed on individual samples.

When the sediment material is difficult to penetrate with a Teflon or glass tube, a commercially available hand coring device can be used. These devices are equipped with a metal barrel, a handle, and a core liner. The liner is inserted and then held in place by a screw-on core cutter, usually manufactured of stainless steel. The core cutter, along with the handle attached to the core barrel, increases the efficiency of sediment penetration. After the sample has been obtained, the cutting head is removed and the liner is carefully withdrawn and immediately capped, as previously described. When coarse grain deposits such as sand are sampled, the use of a core retainer will increase the efficiency of sample retention. Only retainers manufactured of stainless steel should be used in order to minimize the risk of trace metals contamination and eliminate corrosion. When several samples are to be obtained, it is advisable to carry extra core liners to the sample site. This eliminates the need for time-consuming extensions and permits the use of the core liners as sample containers for shipment to the laboratory.

- Directly fill the appropriate sample containers from the sampling device. Collect the samples in the order below, as applicable:

  — VOC.

- Label each sample as collected. Those samples (VOC, etc.) requiring cooling will be placed into an ice cooler for delivery to the laboratory.

- Complete remaining portions of the Field Record of Surface Water and Sediment Sampling form (Figure A-3) as each sample is collected, including time sample collected, type of sample collected, sediment type, sample odor and color, equipment used for sample collection, decontamination fluids used, types of sample bottles used, sample identification numbers, parameters requested for analysis, and field observations of sampling event.

A.3.5 Field Quality Control

Quality control samples are required to verify that the sample collection and handling process has not affected the quality of the surface water and seep samples. All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples will be collected for each SDG (an SDG may not exceed 20 samples) at the frequency noted.

- Field Duplicate? Required at a frequency of 10 percent per SDG
- Matrix Spike/Matrix Spike Duplicate? Required at a frequency of 5 percent
- Equipment (Rinsate) Blank? Required once per day per media sampled
- Source Water Blank? Required at a frequency of once per sampling event
- Trip Blank? Required for VOC samples at a frequency of one per sample shipment.

A.3.6 Decontamination

Field monitoring and sampling equipment will be decontaminated prior to use and following sampling of each station by the procedure listed below.
The following decontamination procedure will be used:

- Flush the equipment with potable water
- Flush with non-phosphate detergent solution
- Flush with tap water to remove all of the detergent solution
- Flush with distilled/deionized water
- Flush with isopropyl alcohol
- Flush with distilled/deionized water.

It is recommended that the detergent and isopropyl alcohol used in the above sequence be used sparingly.

EA Engineering, Science, and Technology

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Site Name:		Project Number:	
Well ID:		Well Lock Status:	
Well Condition:		Weather:	

Gauge Date:		Gauge Time:	
Sounding Method:		Measurement Ref:	
Stick Up/Down (ft):		Well Diameter (in.):	

Purge Date:		Purge Time:	
Purge Method:		Field Personnel:	
Ambient Air VOCs (ppm):		Well Mouth VOCs (ppm):	

WELL VOLUME

A. Well Depth (ft):		D. Well Volume/ft (L):	
B. Depth to Water (ft):		E. Well Volume (L) (C*D):	
C. Liquid Depth (ft) (A-B)		F. Three Well Volumes (L) (E*3):	

Parameter	Beginning	1	2	3	4	5
Time (min.)						
Depth to Water (ft)						
Purge Rate (L/min)						
Volume Purged (L)						
PH						
Temperature (°C)						
Conductivity (Fmhos/cm)						
Dissolved Oxygen (mg/L)						
Turbidity (NTU)						
eH (mV)						

Total Quantity of Water Removed (L):

Samplers:		Sampling Time (Start/End):	
Sampling Date:		Decontamination Fluids Used:	
Sample Type:		Sample Preservatives:	
Sample Bottle IDs:			
Sample Parameters:			

Figure A-1. Field Record of Well Gauging, Purging, and Sampling form.

EA Engineering, Science, and Technology

FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING (OVERFLOW PAGE)

Site Name: _____	Project Number: _____	Date: _____
Well ID:	Field Personnel:	

Parameter	6	7	8	9	10	11
Time (min.)						
Depth to Water (ft)						
Purge Rate (L/min)						
Volume Purged (L)						
pH						
Temperature (EC)						
Conductivity (Fmhos/cm)						
Dissolved Oxygen (mg/L)						
Turbidity (NTU)						
eH (mV)						

Parameter	12	13	14	15	16	17
Time (min.)						
Depth to Water (ft)						
Purge Rate (L/min)						
Volume Purged (L)						
pH						
Temperature (EC)						
Conductivity (Fmhos/cm)						
Dissolved Oxygen (mg/L)						
Turbidity (NTU)						
eH (mV)						

Comments and Observations:

Figure A-1 (Continued)

EA Engineering, Science, and Technology

FIELD RECORD OF WELL GAUGING

Project Name:	Project No:	Date:
Weather/Temperature/Barometric Pressure/Humidity:		
EA Personnel:	Equipment:	

Well Number	Well Elevation	Depth to Water	Depth to LNAPL	LNAPL Thickness	Corrected Water Table Elevation[a]

(a) Based on an assumed specific gravity of 0.80 for LNAPL.

NOTE: All measurements in feet. LNAPL = Light, non-aqueous phase liquid.

EA 5120 0794-1

Figure A-2. Field Record of Well Gauging form.

EA Engineering
Science, and
Technology

FIELD RECORD OF SURFACE WATER AND SEDIMENT SAMPLING

Project:			Site:
Project Number:			Date:
Sample Location ID:			Sample Team Members:
Time:	Start:	End:	Signature of Sampler:

SURFACE WATER INFORMATION

Water Depth and Sample Location _____ (ft)

Depth of Sample from Top of Water _____ (ft)

Type of Surface Water:
( ) Stream ( ) River
( ) Pond/Lake ( ) Seep

Equipment Used for Collection:
( ) None, Grab into Bottle
( ) Bomb Sampler
( ) Pump _____

Decontamination Fluids Used:
( ) Isopropyl Alcohol
( ) ASTM Type II Water
( ) Deionized Water
( ) Liquinox Solution
( ) Hexane
( ) HNO_3 Solution
( ) Potable Water
( ) None

Velocity Measurements Obtained? ( ) No ( ) Yes, See Flow Measurement Data Record _____

Temperature _____ Degree C. Specific Conductivity _____ Fmhos/cm pH _____ Units Dissolved Oxygen_____ ppm

Field QC Data: ( ) Field Duplicate Collected
Duplicate ID _____

Sample Location Sketch:
( ) Yes
( ) No

Method Used:
( ) Winkler
( ) Probe

SEDIMENT INFORMATION

Type of Sample Collected:
( ) Discrete
( ) Composite

Sediment Type:
( ) Clay
( ) Sand
( ) Organic
( ) Gravel

Equipment Used for Collection:
( ) Gravity Corer
( ) Stainless Steel Split Spoon
( ) Dredge
( ) Hand Spoon/Trowel
( ) Aluminum Pans
( ) Stainless Steel Bucket
( ) _____

Decontamination Fluids Used:
( ) Isopropyl Alcohol
( ) ASTM Type II Water
( ) Deionized Water
( ) Liquinox Solution
( ) Hexane
( ) HNO_3 Solution
( ) Potable Water
( ) None

Sample Observations:
( ) Odor
_____
( ) Color
_____
( )
_____
_

Field QC Data: ( ) Field Duplicate Collected
Duplicate ID _____

SAMPLES COLLECTED

Check if Required at this Location	Matrix		Check if Preserved with Acid/Base	Volume Required	Check if Sample Collected	Sample Bottle IDs
	Surface Water	Sediment				

NOTES/SKETCH

Figure A-3. Field Record of Surface Water and Sediment Sampling form.

Appendix B

Quality Assurance Project Plan

Quality Assurance Project Plan for the Long-Term Monitoring Plan for Site 9: Neptune Drive Disposal Site Naval Air Station, Brunswick, Maine

Contract No. N62472-92-D-1296
Contract Task Order No. 0047

Prepared for

Department of the Navy
Northern Division
Naval Facilities Engineering Command
10 Industrial Highway
Mail Stop No. 82
Lester, Pennsylvania 19113-2090

Prepared by

EA Engineering, Science, and Technology
The Maple Building
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Newburgh, New York 12550

August 1999
FINAL
296.0047

Quality Assurance Project Plan
for Site 9 (Neptune Drive Disposal Site)
Long-Term Monitoring Plan
Naval Air Station, Brunswick, Maine

Contract No. N62472-92-D-1296
Contract Task Order No. 0047

Prepared for

Department of the Navy
Northern Division
Naval Facilities Engineering Command
10 Industrial Highway
Mail Stop No. 82
Lester, Pennsylvania 19113-2090

8/13/99

Peter L. Nimmer, P.G.
CTO Manager

Date

8/13/99

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Program Manager

Date

August 1999
FINAL
296.0047

CONTENTS

Page

LIST OF TABLES

1. INTRODUCTION 1-1

1.1 Purpose and Scope 1-1
1.2 Revisions 1-1
1.3 Project Management 1-1

2. DATA QUALITY OBJECTIVES 2-1

2.1 Data Types 2-1
2.2 Data Quantity 2-1
2.3 Data Uses 2-1
2.4 Data Quality Characteristics 2-2

2.4.1 Precision 2-2
2.4.2 Accuracy 2-2
2.4.3 Representativeness 2-3
2.4.4 Comparability 2-3
2.4.5 Completeness 2-3

2.5 Applicable, Relevant, and Appropriate Project Requirements 2-4
2.6 Quantitative Objectives for Precision and Accuracy 2-4

3. SAMPLE CUSTODY 3-1

3.1 Sample Kits 3-1
3.2 Field Sampling Operations 3-1

3.2.1 Sample Handling 3-1
3.2.2 Sample Labeling 3-1

3.3 Laboratory Operations 3-2

3.3.1 Duties and Responsibilities of Sample Management Officer 3-2
3.3.2 Sample Receipt and Logging 3-2
3.3.3 Sample Storage and Security 3-3
3.3.4 Sample Disposal 3-4

Page

4. CALIBRATION 4-1

4.1 Field Calibration Procedures 4-1
4.2 Laboratory Calibration 4-1

4.2.1 The Calibration System 4-1

4.2.1.1 Calibration Procedures 4-2
4.2.1.2 Equipment Identification 4-2
4.2.1.3 Calibration Frequency 4-2
4.2.1.4 Calibration Reference Standards 4-2
4.2.1.5 Calibration Failure 4-3
4.2.1.6 Calibration Records 4-3

4.2.2 Operational Calibration 4-4

4.2.2.1 Preparation of Calibration Curve 4-5

5. LABORATORY AND FIELD PROCEDURES 5-1

5.1 Field Procedures and Measurements 5-1
5.2 Target Analytes and Analytical Methods for Laboratory Data 5-1

5.2.1 Volatiles 5-1
5.2.2 Metals 5-2
5.2.3 Semivolatiles 5-2

5.3 Standard Operating Procedures 5-2
5.4 Recordkeeping 5-2
5.5 Project Reporting Limits 5-3
5.6 Field Quality Assurance/Quality Control 5-4

6. DATA COLLECTION, REDUCTION, AND REPORTING 6-1

6.1 Laboratory Data Collection 6-1
6.2 Data Reduction 6-1

6.2.1 Calibration 6-1

6.2.1.1 Chromatographic Methods 6-2
6.2.1.2 Significant Figures and Units 6-2

Page

6.2.2 Sample Calculations 6-2

6.3 Data Reporting 6-3

6.3.1 Laboratory Data Reporting 6-3
6.3.2 Electronic Data Deliverables 6-3
6.3.3 Field Data Reporting 6-3

7. INTERNAL QUALITY CONTROL CHECKS 7-1

7.1 Internal Quality Control Samples 7-1

7.1.1 Method (Reagent) Blank 7-1
7.1.2 Fortified Method Blank Spike (Laboratory Control Sample) 7-1
7.1.3 Fortified Sample (Matrix Spike) 7-1
7.1.4 Surrogates 7-2

7.2 Field Blank Quality Control Samples 7-2
7.3 Application of Controls 7-2

8. PREVENTIVE MAINTENANCE 8-1

9. DATA QUALITY ASSESSMENT 9-1

9.1 Laboratory Data Assessment 9-1

9.1.1 Responsible Personnel 9-1
9.1.2 Criteria 9-1

9.2 Field Data Assessment 9-2
9.3 Final Report Review 9-2

9.3.1 Analytical Data Quality Review 9-3

10. CORRECTIVE ACTIONS 10-1

10.1 Objectives 10-1
10.2 Rationale 10-1

Page

10.3 Corrective Action Methods 10-1

10.3.1 Immediate Corrective Actions..... 10-1
10.3.2 Long-Term Corrective Actions 10-1

10.4 Corrective Action Process 10-2
10.5 Corrective Action Report Review and Filing.....10-2
10.6 Corrective Actions Reports to Management 10-2

11. QUALITY ASSURANCE REPORTS 11-1

ATTACHMENT A-1: SUMMARY OF LABORATORY QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTION PROCEDURES
ATTACHMENT A-2: QUALITY CONTROL CRITERIA FOR PRECISION AND ACCURACY FOR MATRIX SPIKES, SURROGATE SPIKES, AND LABORATORY CONTROL SAMPLES
ATTACHMENT A-3: EXAMPLE TABLE OF CONTENTS FOR LABORATORY DATA REPORT

LIST OF TABLES

Number	Title
2-1	Formulas for the calculation of data quality characteristics for chemical data.
3-1	Required containers, preservation technique, and holding times for ground-water, surface water, and seep samples from Naval Air Station, Brunswick.
4-1	Summary of periodic calibration requirements for laboratory equipment.
5-1	Analytical methods for ground water and sediment.
5-2	Analytes, reporting limits, and applicable or relevant and appropriate requirements for ground-water samples collected at Naval Air Station, Brunswick.
6-1	Calibration models.
6-2	Sample concentration formulas.
6-3	Electronic data deliverable for chemical data.
8-1	Laboratory preventive maintenance procedures.

1. INTRODUCTION

This Quality Assurance Project Plan (QAPP) is written in order to describe the field and laboratory testing programs which will be utilized for the collection of analytical data in support of the Long-Term Monitoring Plan (LTMP) developed for remediation at Site 9 at Naval Air Station (NAS) Brunswick under Contract No. N62472-92-D-1296, Contract Task Order 0047.

1.1 PURPOSE AND SCOPE

The LTMP describes the field and laboratory activities which will be used at NAS Brunswick. The QAPP has been prepared for use by EA Engineering, Science, and Technology and its subcontractors to ensure that data collected are scientifically valid and legally defensible, and to establish the field and analytical protocols and documentation requirements that will ensure the data collected meet the data quality objectives of the long-term monitoring program.

1.2 REVISIONS

This QAPP has been revised to ensure comparability in data quality for all analytical contractors. The QAPP is a dynamic document and should be revised or updated to reflect any changes in organization and procedures needed to meet the data quality objectives identified in the LTMP. Whenever revisions are made or addenda added to the QAPP, a document control system shall be put into place to assure: (1) all parties holding a controlled copy of the QAPP shall receive the revisions/addenda, and (2) outdated material is removed from circulation.

1.3 PROJECT MANAGEMENT

This project will be managed through an organized effort of scientific and engineering personnel and technical resources to perform the required tasks at NAS Brunswick. In order to meet the data collection objectives, each field investigation will employ field procedures, sampling techniques, and analytical methods specified in the LTMP and in this QAPP. Field and project activities will be performed by EA personnel who will also supervise any subcontractors needed for the project. EA will direct the field activities, including subcontractors who may be working on the site. All analytical work will be performed by a Navy-approved laboratory.

2. DATA QUALITY OBJECTIVES

Data quality objectives specify the data type, uses, quantity, and quality needed to make decisions and are the basis for designing data collection activities. Data quality objectives must be consistent with the applicable, relevant, and appropriate project requirements (ARARs) as specified in the Record of Decision and attainable with acceptable field and analytical procedures to support the selected remedial action. The following sections contain an overview of the project data quality objectives.

2.1 DATA TYPES

The two general categories of data used by the U.S. Environmental Protection Agency (EPA) are defined as: (1) screening data, and (2) definitive data. Screening data are not used for environmental decision making, and are generally semi-quantitative. For this project, screening data include water quality parameters: pH, temperature, turbidity, and specific conductance. Optional field parameters, including Eh and dissolved oxygen, may also be recorded. Water elevations will be recorded prior to sampling site monitoring wells.

For this project, definitive data are required, and will be generated using rigorous documented analytical methods. Data are analyte-specific, and both identification and quantitation are confirmed. These methods have standardized QC and documentation requirements. Definitive data are not restricted in their use unless quality problems require data qualification. The following chemical data will be collected for the monitoring wells.

2.2 DATA QUANTITY

The sampling design for this project can be found in Chapter 3 of the LTMP.

2.3 DATA USES

Long-term monitoring data will be used to monitor changes in the plume boundaries and potential migration pathways, monitor the effectiveness of the remedial action for protection of human health and the environment, evaluate whether the inactive landfill contents are impacting ground water, monitor the volatile organic compound contamination to evaluate the effectiveness of natural attenuation and evaluate trends with time, and monitor impact to the environment of Site 9.

2.4 DATA QUALITY CHARACTERISTICS

The purpose of this section is to define data quality goals in terms of precision, accuracy, representativeness, comparability and completeness. Unless otherwise specified in an approved addendum/revision, the acceptance criteria established in this plan are relevant and applicable to the environmental data generated in support of this project.

A review of laboratory data will be conducted. This review will include assessment of the precision, accuracy, representativeness, completeness, and comparability and data quality objective requirements. The findings of the data quality review will be included in the monitoring event report, and will report significant data discrepancies which may affect analytical data usability.

2.4.1 Precision

Precision measures the reproducibility of measurements. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions. *Analytical* precision is the measurement of the variability associated with duplicate (two) or replicate (more than two) analyses. The laboratory control sample is used to determine the precision of the analytical method. If the recoveries of analytes in the laboratory control sample are within established control limits, then precision is within limits. In this case, the comparison is not between a sample and a duplicate sample analyzed in the same batch, rather the comparison is between the sample and samples analyzed in previous batches. *Total* precision is the measurement of the variability associated with the entire sampling and analysis process. It is determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations. Field duplicate samples and matrix duplicate spiked samples shall be analyzed to assess field and analytical precision, and the precision measurement is determined using the relative percent difference between the duplicate sample results.

Precision is to be expressed as relative percent difference and calculated using the equations in Table 2-1.

2.4.2 Accuracy

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systemic error. It, therefore, reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike or standard. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into a laboratory control sample to a control limit. For volatile and semivolatile organic compounds, surrogate compound recoveries

are also used to assess accuracy and method performance for each sample analyzed. Analysis of double blind performance evaluation samples shall also be used to provide additional information for assessing the accuracy of the analytical data being produced.

Both accuracy and precision are calculated for each analytical batch, and the associated sample results are interpreted by considering these specific measurements. Accuracy is to be expressed as percent recovery and calculated using the equation in Table 2-1.

2.4.3 Representativeness

Objectives for representativeness are defined for each sampling and analysis task and are a function of the investigative objectives. Representativeness shall be achieved through use of the standard field, sampling, and analytical procedures. Representativeness is also determined by appropriate program design, with consideration of elements such as proper well locations, drilling and installation procedures, and sampling locations.
The LTMP contains the sampling and field handling protocols (e.g., storage, handling, and shipping) designed to ensure that the collected samples are representative of the media. Proper field documentation is to be used to show that the designated protocols have been followed, and that sample identification and integrity have been maintained during the sampling event.

2.4.4 Comparability

Comparability is the confidence with which one data set can be compared to another data set. The objective for this QA/QC program is to produce data with the greatest possible degree of comparability. The number of matrices that are sampled and the range of field conditions encountered are considered in determining comparability. Comparability is achieved by using standard methods for sampling and analysis, reporting data in standard units, normalizing results to standard conditions, and using standard and comprehensive reporting formats. Complete field documentation using standardized data collection forms shall support the assessment of comparability. Historical comparability shall be achieved through consistent use of methods and documentation procedures throughout the project.

2.4.5 Completeness

Completeness is calculated using the equation in Table 2-1 for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples. Completeness is calculated and reported for each method, matrix and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not qualified as unusable. The goal for completeness is 95 percent. For any instances of samples that could not be analyzed for any reason (holding time violations in which

resampling and analysis were not possible, samples spilled or broken, etc.), the numerator of this calculation becomes the number of valid results minus the number of possible results not reported.

2.5 APPLICABLE, RELEVANT, AND APPROPRIATE PROJECT REQUIREMENTS

Chemical data results for this project will be evaluated against the following criteria:

- Federal Maximum Contaminant Levels
- State of Maine Maximum Exposure Guidelines.

2.6 QUANTITATIVE OBJECTIVES FOR PRECISION AND ACCURACY

Attachment A-1 identifies QC criteria for precision and accuracy for matrix spikes, matrix spike duplicates, surrogates, and laboratory control samples for the various parameter groups. Attachment A-2 summarizes the QC criteria and corrective actions for the methods specified for this project.

TABLE 2-1 FORMULAS FOR THE CALCULATION OF DATA QUALITY CHARACTERISTICS FOR CHEMICAL DATA

Characteristic	Formula	Symbols
Precision (As relative percent difference [%RPD])	$RPD = \frac{\lvert x_1 - x_2 \rvert}{(x_1 + x_2)/2} \times 100 = \frac{\lvert x_1 - x_2 \rvert}{(x_1 + x_2)} \times 200$	x1, x2 = Duplicate values
Precision (As relative standard deviation [%RSD])	$RSD(\%) = \frac{s}{\bar{x}} _ 100$	s = Standard deviation $\bar{x}$ = Mean of the measurements
Accuracy (As percent recovery [%R] for samples without a background level of the analyte, such as reference materials, laboratory control samples, and performance evaluation samples)	$\%R = \frac{X}{T} _ 100$	X = Found concentration T = True or assumed concentration
Accuracy (As percent recovery [%R] for measurements in which a known amount of analyte (a spike) is added to an environmental sample)	$\%R = \frac{X - B}{T} _ 100$	X = Found concentration B = Background concentration T = True or assumed concentration
Completeness	C = (N) S) H 100	C = Completeness (%) N = Number of valid data S = Number of samples collected

3. SAMPLE CUSTODY

3.1 SAMPLE KITS

Sample kits, which are coolers containing chain-of-custody (COC) forms, custody seals, sample containers (with preservatives), and packing material, are prepared by the Sample Management Office.

The COC procedure begins with the preparation of the sample containers and preservatives to be used in sample collection. Unless superseded by specific project requirements, the laboratory purchases and distributes pre-cleaned sample containers. Vendors are required to provide documentation of analysis for each lot of containers, and the documentation is kept on file in the Sample Management Office.

For the analyses specified for this project, Table 3-1 defines the type of sample container required, preservation techniques, and holding times for ground-water, surface water, and seep samples collected. Preservatives will be added to the sample containers in the laboratory prior to shipment.

3.2 FIELD SAMPLING OPERATIONS

3.2.1 Sample Handling

The sample collection program is described in the LTMP. After the samples are collected, they are split as necessary among containers and preservatives appropriate to the parameters to be determined. Each container is provided with a sample label that is filled out at the time of collection. At this time, a COC form is initiated. The collected samples are cooled, if necessary, and returned to the laboratory by the most expedient means to ensure that holding times will be met. The COC form is signed and dated as necessary as the samples pass from the collectors to those persons responsible for their transportation.

3.2.2 Sample Labeling

The importance of sample labeling cannot be overstated. Improperly or inadequately labeled samples are of little value in a monitoring program. Improperly labeled samples lead to questions with regard to location, project, sampling station, date sampled, and sampler. This information is essential for proper sample handling.

The following information, at a minimum, is required on each sample label:

Client	Date collected
Project number	Time collected
Location	Collected by
Station	Preservative(s)

After the label has been completed in the field and has been affixed to the sample container, the label is covered with clear tape. Pre-printed pressure-sensitive labels are supplied by the laboratory.

3.3 LABORATORY OPERATIONS

The laboratory has a designated Sample Management Officer. This individual is responsible for receiving samples in the laboratory, opening the coolers and checking the sample integrity and the custody seal, logging samples into the laboratory system, and controlling the handling and storage of samples while in the laboratory.

3.3.1 Duties and Responsibilities of Sample Management Officer

The duties and responsibilities of the Sample Management Officer includes monitoring custody of samples in the laboratory. Samples are physical evidence and should be handled according to certain procedural safeguards. For the purposes of some types of legal proceedings, the laboratory must be prepared to produce documentation that traces the in-house custody of the samples from the time of receipt to the completion of the analysis. The National Enforcement Investigations Center of EPA defines custody of evidence in the following ways:

- It is in your actual possession
- It is in your view, after being in your physical possession
- It was in your possession and then you locked or sealed it to prevent tampering
- It is in a secure area.

3.3.2 Sample Receipt and Logging

Sample shipments will be received at the laboratory. Sample control personnel will verify the number of shipping containers received against the numbers listed on the shipping manifest/COC record. Any damage to the shipping containers or other discrepancy will be noted on the COC record before signing it.

Upon receipt at the laboratory, the Sample Management Officer or designate inspects the samples for integrity and checks the shipment against the COC/analytical task order form. Cooler temperatures are checked and documented on the COC. The pH of preserved samples (except volatile organics) is measured and documented in the Sample pH Logbook which is maintained in

the Sample Management Office. The pH of sample vials submitted for volatile organics determinations is checked by the analyst during analysis, and recorded in the instrument run logbook.

Discrepancies are addressed at this point and documented on the COC form and must be resolved **before** samples are released to the laboratory for analysis. If discrepancies are found, the Laboratory Project Manager is notified and the problem is documented in a Non-Conformance Record (NCR). The Laboratory Project Manager will subsequently contact the Contract Task Order (CTO) Manager for further instructions. A copy ofthe completed NCR will become a permanent part of the laboratory's report file.

After the incoming samples are inspected, the samples will be logged into a sample logbook and Laboratory Information Management System in order to maintain proper tracking of all samples.

So that the laboratory may satisfy sample COC requirements, standard operating procedures for laboratory/sample security are followed:

- Samples are stored in secured areas at all times
- Refrigerators, freezers, and other sample storage areas are securely maintained or locked
- Only the designated sample custodian and supervisory personnel have keys to locked sample storage area(s)
- All transfers of samples into and out of storage are documented on an internal COC record
- After a sample has been removed from storage by the analyst, the analyst is responsible for the custody of the sample
- Access to the laboratory is through a monitored area. Outside-access doors to the laboratory are kept locked
- Visitors sign a visitor's log and are escorted while in the laboratory.

3.3.3 Sample Storage and Security

Samples for analysis are to be properly stored in the laboratory according to container type, preservative, and type of security required by the project. Samples will be stored immediately upon receipt to prevent sample degradation. All samples and extracts will be stored in a refrigerator separate from standards.

All of the refrigerated storage areas will be maintained at 4°C ("2°C), and the temperature will be monitored and recorded daily. If the temperature falls outside the specified range, corrective actions will be taken and appropriately documented. Samples will be removed from the non-compliant refrigerator to another that is working properly; alternatively, samples may be stored in coolers with sufficient ice to maintain the temperature within the acceptance range. The CTO Manager will be contacted to discuss sample handling and analysis of the affected samples. All corrective action and data qualifications will be included in the analytical report narrative.

3.3.4 Sample Disposal

Samples are retained at the laboratory for 60 days after the final analytical data report has been forwarded to the CTO Manager so that any analytical problems can be addressed. The samples are then discarded.

TABLE 3-1 REQUIRED CONTAINERS, PRESERVATION TECHNIQUE, AND HOLDING TIMES FOR GROUND-WATER, SURFACE WATER, AND SEEP SAMPLES[a] FROM NAVAL AIR STATION, BRUNSWICK

Parameter	Volume Required (mL)	Container[b]	Preservative	Holding Time[c]
ORGANICS				
Target Compound List Volatile Organics	2- 40 mL vials[d]	Glass, teflon-lined septum	Cool, 4°C HCl to pH <2	14 days
Target Compound List Semivolatile Organics[e]	4,000	Glass, teflon-lined cap	Cool, 4°C	7 days until extraction 40 days after extraction
TARGET ANALYTE LIST METALS				
Mercury	500	Polyethylene, Glass	Cool, 4°C HNO_3 to pH <2	28 days
Other Metals	500	Polyethylene, Glass	Cool, 4°C HNO_3 to pH <2	180 days

(a) From time of sample collection (40 CFR Part 136.3).
(b) For metals, polyethylene with a polypropylene cap (no liner) is preferred.
(c) Holding time requirements are from sample collection.
(d) Include 2 additional 40-mL vials for matrix spike/matrix spike duplicate.
(e) Include additional 2,000-mL sample volume for required matrix spike/matrix spike duplicate for each fraction.

4. CALIBRATION

4.1 FIELD CALIBRATION PROCEDURES

It is the CTO Manager's responsibility to confirm that the field team members are trained in the calibration, use, and maintenance of all applicable field instruments and equipment. All field equipment will be calibrated and operated in accordance with the manufacturers' instructions. The calibration results for each field instrument will be recorded in the field logbook or on appropriate field data sheets, and will include the date, standards, personnel, and results of the calibration.

4.2 LABORATORY CALIBRATION

The analytical systems, including instrumentation, equipment, and reference standards, are controlled by a formal calibration program. The program verifies that equipment is of the proper type, range, accuracy, and precision to provide data compatible with specified requirements. All instruments and equipment that measure a quantity, or whose performance is expected at a stated level, are subject to calibration. Calibration is performed by laboratory personnel using reference standards or externally by calibration agencies or equipment manufacturers.

Implementation and documentation of the laboratory calibration program is the responsibility of the laboratory Section Chiefs. The Quality Services Manager monitors the procedures through systems, performance and data audits (Chapter 10). Two types of calibration are discussed in this section:

- Periodic Calibration is performed at prescribed intervals for measurement equipment, such as balances, automatic pipets, and thermometers. In general, equipment which can be calibrated periodically is a distinct, singular purpose unit and is relatively stable in performance. Table 4-1 contains the requirements for equipment subject to periodic calibration.

- Operational Calibration is routinely performed as part of an analytical procedure or test method, such as the development of a standard curve for use with determinations where an analytical system response is related to analyte concentration, e.g., spectrometric and chromatographic systems.

4.2.1 The Calibration System

The following sections contain a discussion of the elements comprising the calibration system.

4.2.1.1 Calibration Procedures

Written procedures are used by the laboratory for all instruments and equipment subject to calibration. Whenever possible, recognized procedures, such as those published by ASTM or the EPA or procedures provided by manufacturers, are adopted. If established procedures are not available, a procedure is developed considering the type of equipment, stability characteristics of the equipment, required accuracy, and the effect of operational error on the quantities measured At a minimum, the procedures include:

- Equipment to be calibrated
- Reference standards used for calibration
- Calibration technique and sequential actions
- Acceptable performance tolerances
- Frequency of calibration
- Calibration documentation format.

4.2.1.2 Equipment Identification

Equipment that is subject to calibration is identified by a unique number assigned by the laboratory, and calibration records reference the specific instrument identification.

4.2.1.3 Calibration Frequency

Instruments and equipment are calibrated at prescribed intervals and/or as part of the operational use of the equipment. Calibration frequency is based on the type of equipment, inherent stability, manufacturer?s recommendations, values provided in recognized standards, intended data use, specified analytical methods, effect of error upon the measurement process, and prior experience.

4.2.1.4 Calibration Reference Standards

Two types of reference standards are used within the laboratory for calibration:

- *Physical standards*, such as weights for calibrating balances and certified thermometers for calibrating working thermometers, refrigerators, and ovens, are generally used for periodic calibration. Whenever possible, physical reference standards have known relationships to nationally recognized standards (e.g., National Institute of Standards and Technology) or accepted values of natural physical constants. If national standards do not exist, the basis for the reference is documented. Physical reference standards are used only for calibration and are stored separately from equipment used in analyses. In general, physical reference standards are at least 4-10 times as accurate as the requirements for the equipment which they are used to calibrate. In general, physical standards are recalibrated annually by a certified external agency, anddocumentation is maintained by the Quality Assurance staff.

- *Chemical standards*, such as Standard Reference Materials provided by the National Institute of Standards and Technology or EPA. Whenever possible, chemical reference standards are directly traceable to National Institute of Standards and Technology Standard Reference Materials. If Standard Reference Materials are not available, compounds of vendor-certified high purity are used to prepare calibration standards. These are primarily used for operational calibration. Documentation, e.g., certificates of analysis, of traceability is required for all chemical standards used for calibration and quality control. Chemical standards are verified prior to use.

4.2.1.5 Calibration Failure

Equipment or analytical systems that cannot be calibrated must be repaired and satisfactorily recalibrated before reuse. Analysis shall not proceed until appropriate corrective action is taken and an acceptable calibration is achieved. This activity is documented in aNCR which is discussed in Chapter 10 of this QAPP.

Scheduled calibration of equipment does not relieve the laboratory staff of the responsibility for using properly functioning equipment. If an equipment malfunction is suspected, the equipment is tagged and removed from service and recalibrated. If it fails recalibration, the above process shall apply. The laboratory Section Chiefs are responsible for the development and implementation of a contingency plan for major equipment failure. The plan includes guidelines on waiting for repairs, use of other instrumentation, subcontracting analyses, and evaluating scheduled priorities.

4.2.1.6 Calibration Records

Records are prepared and maintained for each piece of equipment subject to calibration. Records demonstrating accuracy of preparation, stability, and proof of continuity of reference standards is also maintained. Records for periodically calibrated equipment shall include, as appropriate:

- Unique identification number of equipment and type of equipment
- Calibration frequency and acceptable tolerances
- Identification of calibration procedure used
- Date calibration was performed

- Identity of laboratory personnel and/or external agencies performing calibration
- Reference standards used for calibration
- Calibration data
- Certificates or statements of calibration provided by manufacturers and external agencies and traceability to national standards
- Information regarding calibration acceptance or failure and any repair of failed equipment.

Records for periodically calibrated equipment are maintained in the instrument logbooks, or in the equipment file maintained by the Quality Services Manager. Physical reference standards are kept in a separate folder.

For instruments and equipment that are calibrated on an operational basis, calibration generally consists of determining instrumental response against compounds of known composition and concentration or the preparation of a standard response curve of the same compound at different concentrations. Records of these calibrations are maintained in the instrument logbook, which provides an ongoing record of the calibration undertaken for a specific instrument. Logbook entries shall be signed and dated by the chemist. Copies are placed in data packages as required, and reviewed by the QC Chemist. Logbook entries are reviewed during internal audits by the Quality Services staff.

In addition to the instrument logbook, copies of the raw calibration data are kept with the analytical sample data. In this way, results can be readily processed and verified because the raw data package is complete as a unit. If samples from several projects are processed together, the calibration data are copied and included with each group of data.

4.2.2 Operational Calibration

Operational calibration is generally performed as part of the analytical procedure and refers to those operations in which instrument response (in its broadest interpretation) is related to analyte concentration. Included is the preparation of a standard response (calibration) curve and often the analysis of blanks.

4.2.2.1 Preparation of Calibration Curve

Preparation of a standard calibration curve is accomplished by using calibration standards. The process is summarized as:

- Preparation of a standard calibration curve is accomplished by the analysis of calibration standards that are prepared by adding the analyte(s) of interest to the solvent that is introduced into the instrument.

- The concentrations of the calibration standards are chosen to cover the working range of the instrument or method.

- All sample measurements are made within this working range.

- The calibration curve is prepared by plotting or regressing the instrument responses versus the analyte concentrations, or by calculating a calibration/ response factor for chromatographic methods.

- The concentrations of the analyzed samples are calculated from system response using the calibration curve.

Attachment A-1 contains the operational calibration procedures and criteria used by the various instrument groups to meet requirements for the analysis of ground-water samples for this project.

TABLE 4-1 SUMMARY OF PERIODIC CALIBRATION REQUIREMENTS FOR LABORATORY EQUIPMENT

Instrument	Calibration Frequency		Acceptance Limits	Corrective Actions
Analytical Balances	Daily	Sensitivity (with Class P weights)	"0.001 g	Adjust sensitivity
	Monthly	Checked with Class S weights	Standard deviation <0.1 mg	Service balance
	Annually	Calibrated by outside vendor against certified Class S weights	ASTM tolerance guidance	Service balance
Thermometers	Annually	Calibrated against certified NIST thermometers by outside vendor	"0.5 C	Tag, remove from service
Automatic Pipettors	Quarterly	Gravimetric check	High volume (>100 mL): #1.0% relative error as RSD Low volume (<100 mL): #2.0% relative error as RSD	Service or replace

NOTE: ASTM = American Society of Testing and Materials.
RSD = Relative standard deviation.

5. LABORATORY AND FIELD PROCEDURES

5.1 FIELD PROCEDURES AND MEASUREMENTS

Field methodologies are described in the project LTMP.

5.2 TARGET ANALYTES AND ANALYTICAL METHODS FOR LABORATORY DATA

Ground-water samples collected from monitoring wells associated with Site 9 will be analyzed for the following compounds:

- Target Compound List volatile organic compounds by EPA SW-846 Method 5030B/8260B
- Vinyl chloride by EPA SW-846 Method 5030B/8260B modified for SIM
- Target Compound List semivolatile organic compounds by EPA SW-846 Method 3520A/8270C
- Target Analyte List metals, including metals by trace inductively coupled plasma by EPA Method 6010, and graphite furnace (EPA Method 7000 series).

Method references are listed in Table 5-1.

5.2.1 Volatiles

The laboratory will perform the volatile analysis using a 25-mL purge volume. This will provide lowered reporting limits and method detection limits (MDLs), as listed on Table 5-2, formost analytes in order to achieve the target quantitation levels identified.

As a result of the larger sample volume, it is anticipated that the method required criteria for minimum response factors may not be achievable for some compounds. This is due to the relatively high solubility of these compounds in water, so that the purging efficiency decreases with increased volume. As such, the minimum response factor criteria used will be the Contract Laboratory Program Low Concentration Statement of Work (OLCO2.0), which is a 25-mL purge procedure.

In addition, hexachlorobutadiene, a semivolatile Target Compound List, will be determined in this fraction to meet the Maximum Exposure Guideline.

5.2.2 Metals

For the determination of mercury, a modification to the reference method includes the use of an autoclave digestion in place of a water bath.

5.2.3 Semivolatiles

Benzo(a)pyrene, a Target Compound List semivolatile, will be determined in the HPLC fraction to meet the Federal Maximum Contaminant Level.

5.3 STANDARD OPERATING PROCEDURES

The laboratory maintains a manual of all procedures other than laboratory-specific analytical methods in a document controlled Standard Operating Procedures Manual. Laboratory Method Standard Operating Procedures are maintained as controlled documents in a Methods Manual.

5.4 RECORDKEEPING

All data entries are made in indelible, water-resistant ink. The date of the entry and the observer are clear on each entry. The observer uses his/her full name or initials. An initial and signature log is maintained so that the recorder of every entry can be identified. All information is recorded in a notebook or on other records at the time the observations are made. Recording information on loose pieces of paper is not allowed.

When a mistake is made, the wrong entry is crossed out with **a single line**, initialed and dated by the person making the entry, and the correct information recorded. Obliteration of an incorrect entry or writing over it is not allowed; neither is the use of correction tape or fluid on any laboratory records.

The following are some of the records that are used to document activities in the laboratory:

- **Reagent and Titrant Preparation Records?** The procedure for each analysis includes the procedures for reagent/titrant preparation, including concentration, storage, and discard information. After a reagent/titrant is prepared, the following information is entered on a label affixed to the storage bottle: (1) its identity, (2) intended use, (3) titer/concentration, (4) preparation date, (5) storage requirement, (6) discard date, and (7) preparer. For titrimetric analyses, the procedure includes directions for standardizing the titrant, and the laboratory data sheets include space for titrant standardization data.

- **Standards Preparation Logs?** The preparation of stock, intermediate, and working standard solutions is recorded in standards preparation logbooks, which are specific to the requirements of each operational group. Each standard is assigned

a number that is used to trace the preparation from stock to working standards and to reference the analysis of the standards. The logbooks are completed by the appropriate analysts as they prepare the standards and are reviewed by the supervisor.

- **Sample Preparation Logs:** Sample preparation operations, such as digestions and extractions, are documented in sample preparation logs, which are specific to the operations involved. The information in these logs can include: date, analyst, sample identification, weight or volume of sample used, reagents used, final volume, and volume of spiking, surrogate, or internal standard solution.

- **Bench Data Sheets:** Laboratory bench data sheets are used for those analyses in which instrument responses are manually transcribed from instrument readout or from recorder tracings. The data sheets are preprinted to reflect the requirements of the analysis and are used to ensure that the information is recorded in a complete and organized manner.

- **Instrument Run Logs:** When instrumentation is involved in the data generation, the sequence of the introduction of standards, field samples, and QC samples is recorded in an instrument run log. The following information is recorded when applicable: instrument identification, date, time, analyst, sample identifications, dilutions, and filenames for disk storage.

  In addition, instrument malfunctions, repairs, and maintenance activities are recorded in the run logs.

- **Strip Chart Recordings/Chromatograms/Computer Output:** All strip chart recordings, chromatograms, computer output, and other instrument-generated records are clearly labeled with the following information: instrument identification, date, analyst, sample identifications, and operational conditions, if applicable.

5.5 PROJECT REPORTING LIMITS

For this project both reporting limits and MDLs were compared to the listed ARARs. In order to achieve or approach the ARARs, the MDLs are used for reporting data.

In using this approach, it is recognized that data near the MDL cannot be reported with the precision and accuracy stated for the method. To alert the data user, all organic results between the MDL and the Reporting Limit will be qualified “J,” to indicate that the results have a greater uncertainty than those values reported about the Reporting Limit.

If a monitoring well is being considered for deletion from the sampling program for volatile organic compounds, ground-water samples from that well will be analyzed using Method 8260B modified for SIM for two sampling rounds, in order to achieve the detection limit of 0.15 Fg/L (State MEG for vinyl chloride). This method will not be used at a well where vinyl chloride is known to be above 2 Fg/L, as established using EPA Method 8260B.

5.6 FIELD QUALITY ASSURANCE/QUALITY CONTROL

Appropriate laboratory QA/QC trip blanks, equipment rinsate blanks, source water blanks, and duplicate samples will be collected and analyzed to provide the required level of QC for the analytical data.

Trip blanks will be sent with each shipment of volatile organic compound samples to assess the potential for introduction of contaminants during sample transport. Equipment rinsate blanks will be collected by running de-ionized water across a decontaminated sample apparatus and into appropriate sample containers to determine if cross-contamination is taking place. One equipment rinsate blank will be collected per site per matrix.

Duplicate samples will be collected at a frequency of 2 out of every 20 samples collected to determine precision information on homogeneity.

TABLE 5-1 ANALYTICAL METHODS FOR GROUND WATER AND SEDIMENT

Parameter	Method	Reference Method
SAMPLE PREPARATION		
Water		
Metals Digestion	Acid Digestion -HNO_3/HCl	3010A
Metals Digestion	Acid Digestion - HNO_3/H_2O_2	3020A
Volatile Organics Preparation	Purge and trap	5030B
Semivolatile Organics Extraction	Continuous Extraction	3520A
Sediment		
Volatile Organics Preparation	Purge and trap	5035
ORGANICS		
Volatile Organics	GC/MS - Capillary Column Technique	8260B
Vinyl Chloride	GC/MS - Capillary Column Technique	8260B modified for SIM
Semivolatile Organics Extraction	GC/MS - Capillary Column Technique	8270C
Pentachlorophenol	GC/ECD	8151A
METALS		
Aluminum	Atomic Emission - ICP	6010B
Antimony	Atomic Emission - ICP-Trace	6010B
Arsenic	Atomic Emission - ICP-Trace	6010B
Barium	Atomic Emission - ICP	6010B
Beryllium	Atomic Emission - ICP	6010B
Cadmium	Atomic Emission - ICP	6010B
Calcium	Atomic Emission - ICP	6010B
Chromium	Atomic Emission - ICP	6010B
Cobalt	Atomic Emission - ICP	6010B
Copper	Atomic Emission - ICP	6010B
Iron	Atomic Emission - ICP	6010B
Lead	Atomic Emission - ICP-Trace	6010B
Magnesium	Atomic Emission - ICP	6010B
Manganese	Atomic Emission - ICP	6010B
Mercury	Cold Vapor - AA	7470A
Nickel	Atomic Emission - ICP-Trace	6010B
Potassium	Atomic Emission - ICP	6010B
Selenium	Atomic Emission - ICP-Trace	6010B
Silver	Atomic Emission - ICP	6010B
Sodium	Atomic Emission - ICP	6010B
Thallium	Graphite Furnace - AA	7841
Vanadium	Atomic Emission - ICP	6010B
Zinc	Atomic Emission - ICP	6010B

Reference: U.S. Environmental Protection Agency. 1997. Test Methods for Evaluating Solid Waste. Physical/Chemical Methods. EPA SW-846, 3rd edition including UPDATE III. U.S. EPA, Washington, D.C. June.

TABLE 5-2 ANALYTES, REPORTING LIMITS, AND APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR GROUND-WATER SAMPLES COLLECTED AT NAVAL AIR STATION, BRUNSWICK

Target Compound	CAS Number	Method Detection Limit[a] (Fg/L)	Reporting Limit[b] (Fg/L)	MEG[c] (Fg/L)	Federal MCL (Fg/L)[d]
VOLATILES (SW-846 5030A/8260B) - 25-mL purge					
1,2-Dichloroethene (total)	540-59-0	0.5	1	70	70
1,1-Dichloroethane	75-34-3	0.4	1	70	---
1,1,2-Trichloroethane	79-00-5	0.4	1	3	5
1,1,2,2-Tetrachloroethane	79-34-5	0.2	1	---	---
1,2-Dichloropropane	78-87-5	0.4	1	5	5
1,1,1-Trichloroethane	71-55-6	0.3	1	200	200
1,1-Dichloroethene	75-35-4	0.6	1	7	7
1,2-Dichloroethane	107-06-2	0.2	1	5	5
2-Butanone	78-93-3	0.4	5	170	---
2-Hexanone	591-78-6	1.2	5	---	---
4-Methyl-2-pentanone	108-10-1	1.2	5	---	---
Acetone	67-64-1	3	5	---	---
Benzene	71-43-2	0.3	1	5	5
Bromodichloromethane	75-27-4	0.4	1	---	80[a]
Bromoform	75-25-2	0.2	1	---	80[a]
Bromomethane	74-83-9	0.7	1	10	---
Carbon Tetrachloride	56-23-5	0.4	1	3	5
Carbon Disulfide	75-15-0	0.4	1	---	---
Chlorobenzene	108-90-7	0.2	1	47	100
Chloroethane	75-00-3	0.6	1	---	---
Chloroform	67-66-3	0.2	1	---	80[e]
Chloromethane	74-87-3	0.7	1	3	---
cis-1,3-Dichloropropene	10061-01-5	0.4	1	---	---
Dibromochloromethane	124-48-1	0.2	1	---	---
Ethylbenzene	100-41-4	0.3	1	700	700
Hexachlorobutadiene	87-68-3	0.4	1	1	---
Methylene Chloride	75-09-1	0.5	1	---	5
Styrene	100-42-5	0.3	1	5	100
Tetrachloroethene	127-18-4	0.3	1	5	5
Toluene	108-88-3	0.5	1	1,400	1,000
Trans-1,3-Dichloropropene	10061-02-6	0.3	1	---	---
Trichloroethene	79-01-6	0.4	1	5	5
Vinyl Chloride[f]	75-01-4	0.6	1	0.15	2
Xylenes (total)	1330-20-7	0.6	1	600	10,000

(a) Method Detection Limit determined according to the procedure in 40 CFR 136, Appendix B. These are the minimum concentrations that can be detected.
(b) The laboratory has established *Reporting Limits* as laboratory quantitation limits. These are the minimum concentrations reported with the precision and accuracy stated for the method, and are generally the low standard concentration.
(c) State of Maine Maximum Exposure Guidelines (MEGs). Dashes (---) indicate no MEG applicable.
(d) U.S. Environmental Protection Agency (EPA) Federal Maximum Contaminant Levels (MCLs) for drinking water (40 CFR 141). Dashes (---) indicate no MCL applicable.
(e) Trihalomethane (THM) total cannot exceed 80 Fg/L.
(f) If a monitoring well is being considered for deletion from the sampling program for volatile organic compounds, ground-water samples from that well will be analyzed using Method 8260B modified for SIM for two sampling rounds, in order to achieve the detection limit of 0.15 Fg/L (State MEG for vinyl chloride). This method willnot be used at a well where vinyl chloride is known to be above 2 Fg/L, as established using EPA Method 8260B.

Target Compound	CAS Number	Method Detection Limit[a] (Fg/L)	Reporting Limit[b] (Fg/L)	MEG[c] (Fg/L)	Federal MCL (Fg/L)[d]
SEMIVOLATILES (SW-846 8151)					
Pentachlorophenol	87-86-5	0.1	1	1	1
SEMIVOLATILES (SW-846 3520A/8270C)					
1,2,4-Trichlorobenzene	120-82-1	3	10	70	70
1,2-Dichlorobenzene	95-50-1	2	10	600	600
1,4-Dichlorobenzene	106-46-7	3	10	27	75
1,3-Dichlorobenzene	541-73-1	3	10	600	---
2-Chlorophenol	95-57-8	3	50	---	---
2,4-Dinitrotoluene	121-14-2	4	10	---	---
2-Methylphenol	95-48-7	4	10	---	---
2,2'-oxybis (1-Chloropropane)	108-60-1	4	10	250	---
2-Chloronaphthalene	91-58-7	3	10	---	---
2,4-Dinitrophenol	51-28-5	6	50	---	---
2,4,6-Trichlorophenol	88-06-2	3	10	---	---
2,4,5-Trichlorophenol	95-95-4	3	50	---	---
2,6-Dinitrotoluene	606-20-2	4	10	---	---
2-Nitrophenol	88-75-5	3	10	83	---
2,4-Dimethylphenol	105-67-9	3	10	---	---
2-Nitroaniline	88-74-4	5	50	---	---
2,4-Dichlorophenol	120-83-2	3	10	20	---
2-Methylnaphthalene	91-57-6	3	10	---	---
3,3'-Dichlorobenzidine	91-94-1	4	10	---	---
3-Nitroaniline	99-09-2	4	50	---	---
4-Bromophenyl-phenyl ether	101-55-3	5	10	---	---
4-Chloroaniline	106-47-8	5	10	---	---
4-Methylphenol	106-44-5	4	10	---	---
4-Chlorophenyl-phenyl ether	7005-72-3	4	10	---	---
4-Nitroaniline	100-01-6	4	50	---	---
4-Nitrophenol	100-02-7	5	50	---	---
4,6-Dinitro-2-methylphenol	534-52-1	6	50	---	---
4-Chloro-3-methylphenol	59-50-7	4	10	---	---
Acenaphthene	83-32-9	3	10	---	---
Acenaphthylene	208-96-8	4	10	---	---
Anthracene	120-12-7	4	10	---	---
Benzo(a)anthracene	56-55-3	3	10	---	---
Benzo(b)fluoranthene	205-99-2	4	10	---	---
Benzo(g,h,i)perylene	191-24-2	5	10	---	---
Benzo(k)fluoranthene	207-08-9	3	10	---	---
bis-(2-Chloroethyl)ether	111-44-4	4	10	---	---
bis(2-Chloroethoxy)methane	111-91-1	4	10	---	---
bis(2-Ethylhexyl)phthalate	117-81-7	7	10	25	6
Butylbenzylphthalate	85-68-7	4	10	---	---
Carbazole	86-74-8	5	10	---	---
Chrysene	218-01-9	3	10	---	---
Di-n-butylphthalate	84-74-2	4	10	220	---
Di-n-octylphthalate	117-84-0	4	10	---	---
Dibenzo(a,h)-anthracene	53-70-3	4	10	---	---

Target Compound	CAS Number	Method Detection Limit[a] (Fg/L)	Reporting Limit[b] (Fg/L)	MEG[c] (Fg/L)	Federal MCL (Fg/L)[d]
SEMIVOLATILES (SW-846 3520A/8270C) (Continued)					
Dibenzofuran	132-64-9	4	10	---	---
Diethylphthalate	84-66-2	3	10	5,000	---
Dimethylphthalate	131-11-3	3	10	---	---
Fluoranthene	206-44-0	5	10	---	---
Fluorene	86-73-7	4	10	---	---
Hexachlorocyclopentadiene	77-47-4	2	10	50	---
Hexachloroethane	67-72-1	3	10	1	---
Indeno(1,2,3-cd)-pyrene	193-39-5	4	10	---	---
Isophorone	78-59-1	4	10	---	---
N-Nitrosodiphenylamine	86-30-6	4	10	---	---
N-Nitroso-di-n-propylamine	621-64-7	4	10	---	---
Naphthalene	91-20-3	3	10	25	---
Nitrobenzene	98-95-3	4	10	---	---
Phenanthrene	85-01-8	5	10	---	---
Phenol	108-95-2	4	10	4,000	---
Pyrene	129-00-0	4	10	---	---
SEMIVOLATILES (SW-846 3520A/8310)					
Benzo(a)pyrene	50-32-8	0.021	0.1	---	0.2
Pyrethrins, total	---	0.70	5	---	
Rotenone	---	0.34	2	4	---

6. DATA COLLECTION, REDUCTION, AND REPORTING

6.1 LABORATORY DATA COLLECTION

For inorganic and general organic analyses where the instruments are not directly coupled to computerized data systems, the raw data are instrument responses in the form of meter, recorder, or printer output. The technician performing the analysis enters the bench-generated data into a bound laboratory workbook specific for each parameter. All entries are made inink. These data consist of instrumental responses (absorbances, percent transmittances, etc.), standard and spike concentrations, sample numbers, and any other pertinent information. The workbooks are under the control of the group supervisor/manager who is responsible for their security. For computerized instruments, the output is in the form of printer output and files on magnetic disks, which are filed by sample delivery group.

For chromatographic organic analyses, the raw data are instrument responses inthe form of chromatograms, integrator output, or computer-generated data files. The chromatograms and printer output are stored in project-specific files. The data files are archived onmagnetic tape.

6.2 DATA REDUCTION

Data reduction includes all processes that change either the values or numbers of data items. The data reduction processes used in the laboratory include establishment of calibration curves, calculation of sample concentrations from instrument responses, and computation of QC parameters.

All field instruments are direct-reading instruments; that is, the data do not need to be reduced. No manual temperature compensation for pH or conductivity is necessary, neither is it necessary to calculate a cell constant for conductivity.

6.2.1 Calibration

Calibration of an analytical instrument involves the delineation of the relationship between a response of the instrument and the amount or concentration of an analyte introduced into the instrument. The graphical depiction of this relationship is often referred to as the calibration curve. The curve is prepared by measuring the responses of a series of solutions of the analyte (calibration standards) with known concentrations. In order to perform quantitative measurements, this relationship must be established prior to the analysis of any samples, and thus, is termed initial calibration.

The choice of a calibration model for the analytical system depends upon the analytical technique. Table 6-1 gives the formulas for the calibration models discussed in this section. The simplest model, generally used for chromatographic methods, uses calibration factors or response factors

as a measure of the slope of the calibration relationship and assuming that the curve passes through the origin. Under ideal conditions, the factors will not vary with the concentration of the standard; however, some variation is to be expected. The variation is generally measured as the relative standard deviation. Linearity through the origin is assumed when the relative standard deviation is less than the method specific criterion.

If the relative standard deviation exceeds the method-specified criterion stated for chromatographic methods, least-squares regression can be used to fit a curve using the standard concentration-response data. This is the model used for most non-chromatographic methods. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit. For definitive date, in general, r must be $0.99 for chromatographic data, and $0.995 for non-chromatographic methods, e.g., atomic absorption methods for metals determinations.

For most spectrophotometric analyses, the sample concentrations are calculated from the measured instrument responses using a calibration curve. The sample concentrations are calculated from a regression equation fitted to calibration data. For gravimetric and titrimetric analyses, the calculations are performed according to equations given in the method.

6.2.1.1 Chromatographic Methods

For chromatographic analyses, the unknown concentrations can be determined using response factors with either internal or external standardization. Depending upon the calibration model chosen, sample concentrations can also be calculated from a regression equation fitted to calibration data.

6.2.1.2 Significant Figures and Units

The number of significant figures in the reported data is consistent with the limits of uncertainty inherent in the analytical method. The units used in reporting data are those commonly used for the analyses performed. Concentrations in liquid samples are expressed in terms of weight per unit volume (e.g., milligrams per liter [mg/L] or micrograms per liter [Fg/L]). Concentrations in solid or semisolid matrices are expressed in terms of weight per unit weight (e.g., milligrams per kilograms [mg/kg]). In addition, solid concentrations are converted to a dry-weight basis, using the percent solids of the sample.

6.2.2 Sample Calculations

The reduction of instrument responses to sample concentrations takes different forms for different types of methods (Table 6-2). These calculations are generally performed by instrument associated computerized data systems. Calculations are manually confirmed as part of the data review process.

6.3 DATA REPORTING

6.3.1 Laboratory Data Reporting

After all analyses are completed and approved for release by the Laboratory Section Chiefs and QC Chemists, the data are forwarded to the laboratory reports group, where they are assembled into a draft report. The reports group assembles the final data report by incorporating the data packages for each analysis associated with the reported samples. The reports group is responsible for assembling the data packages and other report-related information, such as copies of COC, communication record, and non-conformance forms. The analytical data report will include the following items: all sample identification numbers, date(s) collected, date(s) analyzed, analytical results, detection limits, units, methods identification, project name/location, laboratory identification (name/address/phone number), and approval signature(s). A sample laboratory report Table of Contents is shown in Attachment A-4. Thereport is prepared and reviewed by a member of the Reports staff (someone other than the preparer) for compliance with report deliverables requirements.

The report is then reviewed by the Laboratory Project Manager, who signs the report narrative to certify that the report meets the Data Quality Objectives for precision, accuracy, and completeness specified for this project. After completion of the review of the data report, the report is forwarded to the CTO Manager who incorporates the laboratory report into the final project report. The laboratory copy of the report is filed in the appropriate laboratory Central Project File.

6.3.2 Electronic Data Deliverables

In addition to a hardcopy data report, the laboratory will submit an electronic data deliverable for each data set. The electronic data deliverable is in a dBASE IV format and contains the results of all field samples and blanks for all target analytes. Results of laboratory QC samples and tentatively identified compounds (gas chromatograph/mass spectrometry methods) will not be included. Table 6-3 lists information included in the electronic data deliverable

6.3.3 Field Data Reporting

Field records are evaluated by the site manager for the following:

- Completeness
- Identification of valid samples
- Identification of anomalous field test data
- Accuracy and precision of field data and measurement.

The review of field record completeness checks that requirements for field activities in the work plan have been fulfilled, that complete records exist for each field activity, and that the procedures specified in the work plan have been implemented. Field documentation must ensure sample integrity and provide sufficient information to characterize each field event. The results of the completeness check are documented by the site manager, and any data affected by incomplete records are identified at this time.

The identification of valid samples involves interpreting and evaluating the field records to detect problems affecting representativeness of field samples. Field records can indicate whether a well is properly constructed; well development records can indicate whether correct development has occurred. Field audits are another source of data for review. The judgements for data validity will be documented in the technical report, and field data associated with incorrect field work will be identified. Anomalous field data will be identified and explained to the extent possible in the technical report.

TABLE 6-1 CALIBRATION MODELS

Application	Formula	Symbols
Linear regression calibration curves	$R = C\,a_1 + a_0$	C = Concentration of the calibration standard R = Instrument response a_0 = Intercept of regression curve (instrument response when concentration is zero) a_1 = Slope of regression curve (change in response per change in concentration)
Calibration factors[a]	$CF = \frac{A_x V_f}{C\,V_i}$	C = Concentration of the calibration standard CF = Calibration factor A_x = Peak size of target compound in sample extract V_f = Final volume of extracted sample (mL) V_i = Initial volume of sample extracted (mL)
Response factors[b]	$RF = \frac{C_{is}\,A_x V_f}{C\,A_{is}\,V_i}$	C = Concentration of the calibration standard RF = Internal standard response factor C_{is} = Concentration of the internal standard (Fg/L) A_x = Area of the characteristic ion for the target compound V_f = Final volume of extracted sample (mL) A_{is} = Area of the characteristic ion for the internal standard V_i = Initial volume of sample extracted (mL)

(a) Used for quantitation by the external standard technique.
(b) Used for quantitation by the internal standard technique.

TABLE 6-2 SAMPLE CONCENTRATION FORMULAS

Application	Formula	Symbols
Concentrations calculated from linear regression calibration curves	$C = (R - a_0)/a_1$	C = Analytical concentration R = Instrument response a_0 = Intercept of regression curve (instrument response when concentration is zero) a_1 = Slope of regression curve (change in response per change in concentration)
Concentrations calculated from calibration factors[a]	$C = \frac{A_x V_f}{CF\ V_i}$	C = Concentration (µg/L) CF = Calibration factor A_x = Peak size of target compound in sample extract V_f = Final volume of extracted sample (mL) V_i = Initial volume of sample extracted (mL)
Concentrations calculated from response factors[b]	$C = \frac{C_{is} A_x V_f}{RF\ A_{is} V_i}$	C = Concentration (µg/L) RF = Internal standard response factor C_{is} = Concentration of the internal standard (µg/L) A_x = Area of the characteristic ion for the target compound V_f = Final volume of extracted sample (mL) A_{is} = Area of the characteristic ion for the internal standard V_i = Initial volume of sample extracted (mL)
Solid samples[c]	$K = \frac{C\ V\ D}{W\ (\%S/100)}$	K = Dry-weight concentration (mg/kg) C = Analytical concentration (mg/L) V = Final volume (mL) of processed sample solution D = Dilution factor W = Wet-weight (g) of as-received sample taken for analysis %S = Percent solids of as-received sample

(a) Used for quantitation by the external standard technique.
(b) Used for quantitation by the internal standard technique.
(c) Used to calculate the dry-weight concentration of a solid sample from the analytical concentration of the processed sample.

TABLE 6-3 ELECTRONIC DATA DELIVERABLE FOR CHEMICAL DATA

Data Field	Data Type	Field Width	Data Field Description
SAMPLE_NO	Character	30	Field-assigned sample identifier as listed on the chain-of-custody.
TRUNCATE	Character	15	If the field sample ID listed on the chain-of-custody is truncated by the laboratory for use with the laboratory software, the truncated laboratory sample ID should appear in this field
LAB_ID	Character	15	Laboratory sample identifier
LABORATORY	Character	25	Laboratory name
BATCH_NO	Integer	10	Laboratory code for sample batch
ASSOC_BLNK	Character	15	Laboratory code for method blank for sample batch
QC_TYPE	Character	15	Normal, duplicate, matrix spike, etc.
COLL_DATE	Integer	8	Date of collection
REC_DATE	Integer	8	Date sample was received by the laboratory
EXTR_DATE	Integer	8	Date sample was extracted or prepared by the laboratory
ANAL_DATE	Integer	8	Date sample was analyzed
SDG	Character	15	Laboratory report number
PROJECT_NO	Character	10	Project number or CTO number
PARAMETER	Character	45	Name of analyte
CAS_NO	Character	10	Chemical Abstract Service registry number (if available)
FRACTION	Character	5	Metals = ‘M,’ Volatiles = ‘OV’? Semivolatiles/BNAs = ‘OS,’ Pesticides = ‘PEST,’ PCBs = ‘PCB,’ Radionuclides = ‘RAD,’ Miscellaneous = ‘MISC’
METHOD	Character	20	Abbreviated reference to a published method. Examples: SW6010, SW8270, EPA 300.0
LAB_RESULT	Numeric	15.4	Reported value I units specified in the UNITS field containing the proper number of significant digits. The % Recovery shall be placed in this field for matrix spike results.
UNITS	Character	5	Units of measure
LAB_QUAL	Character	2	Laboratory qualifier as reported on one Form I
IDL	Numeric	10.4	Instrument Detection Limit
MDL	Numeric	10.4	Method Detection Limit
CRDL_CRQL	Numeric	10.4	Laboratory Reporting Limit
DIL_FACTOR	Integer	5	Dilution factor
PCT_MOIST	Numeric	5	Percent moisture for soil samples; blank for water samples
COMMENTS	Character	20	Analytical result qualifier or comment other than that listed in the LAB_QUAL field. Example: Reanalysis.

7. INTERNAL QUALITY CONTROL CHECKS

A QC program is a systematic process that controls the validity of analytical results by measuring the accuracy and precision of each method and matrix, developing expected control limits, using these to detect anomalous events and requiring corrective action techniques to prevent or minimize the recurrence of these events.

The accuracy and precision of sample analyses are influenced by both internal and external factors. Internal factors are those associated with sample preparation and analysis. Internal factors are monitored by the use of internal QC samples.

External factors are associated with sample collection. They are monitored by the use of field QC samples, which are identified as field and trip blanks.

7.1 INTERNAL QUALITY CONTROL SAMPLES

7.1.1 Method (Reagent) Blank

The method (reagent) blank is used to monitor laboratory contamination. This is usually a sample of laboratory reagent water or soil matrix treated with all the reagents and in the same manner as the sample (i.e., digested, extracted, and distilled). One method blank is prepared and analyzed every day that samples are prepared.

7.1.2 Fortified Method Blank Spike (Laboratory Control Sample)

Normally, fortified method blank samples are analyzed with each batch of 20 or fewer samples. These samples generally consist of laboratory reagent-grade water or solid matrix fortified with the analytes of interest for single-analyte methods and selected analytes for multi-analyte methods according to the appropriate analytical method. They are prepared and analyzed with the associated sample batch. The analyte recovery from each is used to monitor analytical accuracy.

7.1.3 Fortified Sample (Matrix Spike)

A fortified sample (matrix spike) is an aliquot of a field sample which is fortified with the analyte(s) of interest and analyzed to monitor matrix effects associated with a particular batch of samples. Duplicate fortified samples (matrix spike) will be performed for every batch of 20 or fewer samples for organic analyses.

7.1.4 Surrogates

Surrogates are organic compounds that are similar to analytes of interest in chemical composition, extraction, and chromatography, but are not normally found in environmental samples. These compounds are spiked into all blank, standards, samples, and spiked samples prior to analysis for organic parameters. Generally, surrogates are not used for inorganic analyses. Percent recoveries are calculated for each surrogate. Surrogates shall be spiked into samples according to the appropriate analytical method (Chapter 6). Surrogate spike recoveries shall fall within the control limits set in accordance with procedures specified in the method. Surrogate recoveries will not be calculated if sample dilution causes the surrogate concentration to fall below the quantitation limit.

7.2 FIELD BLANK QUALITY CONTROL SAMPLES

These samples are not included specifically as laboratory QC samples but are analyzed when submitted. Data for these QC samples are reported with associated samples. Field blank QC samples are specifically discussed in Chapter 3 and will be collected as specified in Chapter6.

7.3 APPLICATION OF CONTROLS

Analytical quality control results for each batch are compared with the control limits (Attachment A-1) to determine if the data are compliant with the method requirements. If the limits are exceeded, the specified corrective action is initiated.

8. PREVENTIVE MAINTENANCE

Periodic preventive maintenance is required for all sensitive equipment. Instrument manuals will be kept on file for reference if equipment needs repair. The troubleshooting chapter of factory manuals may be used in assisting personnel in performing maintenance tasks. The frequency of preventive maintenance for field equipment is indicated in each operating instruction manual. Field equipment is checked by field personnel under the supervision of the field coordinators.

It is the responsibility of EA's Technical Services Group's Field Coordinator to conduct all preventive maintenance. Major instruments in the laboratory are covered by annual service contracts with manufacturers. Under these agreements, regular preventive maintenance visits are made by trained service personnel. Maintenance is documented and maintained in permanent records by the individual responsible for each instrument.

Section Chiefs are responsible for implementation and documentation of the program. The Laboratory Quality Assurance Manager reviews implementation to verify compliance through internal audits. For each operational group, the preventive maintenance program includes the following:

- Listing of the instruments and equipment that are including in the program
- Frequency of maintenance considering manufacturer's recommendations and/or previous experience with equipment
- For each instrument in the program, a file is maintained for the following information:
  - List of spare parts maintained by the laboratory
  - External service contracts
  - Items to be checked and/or serviced during maintenance and directing for performing maintenance (if external service is not provided of if not stated in manufacturer's instrument manuals).

Specific preventive maintenance practices and frequency for laboratory equipment are described in Table 8-1.

TABLE 8-1 LABORATORY PREVENTIVE MAINTENANCE PROCEDURES

Instrument	Item Checked/Serviced	Frequency
GC/MS	• Change column	As needed
	• Hard tune with calibration gas (PFTBA)	As needed
	• Removal of 2-3 in. from the injection end of the capillary columns	As needed
	• Injection port liner replacement	As needed
	• Replace injection port septum	As needed
	• Clean ion source	As needed
	• Check vacuum pump oil level	Monthly
	• Check carrier gas tanks	Daily
	• Replace or recondition vent traps	Monthly
	• Mechanical pump oil	Monthly
	• Vacuum chaff filter	Quarterly
	• Turbo pump oil	Semi-annually
	• Water filter (if applicable)	Annually
	• Computer air filter	Semi-annually
	• Card cage air filter	Semi-annually
	• Source-clean ceramics, polish lenses	Semi-annually
	• Clean poles and ceramics	As needed
	• Clean contacts on the component boards	As needed
	• Replace septum	As needed
	• Change fuses	As needed
Refrigerators/Freezers	Temperature checked and logged	Daily on each work day
	Compartment cleaned	Quarterly
Walk-In Coolers	Temperature checked and logged	Daily on each work day
	Unit cleaned	Quarterly
Balances	Service representative calibration	Annually
	Internal weight train, gears, electronics	Annual service
Thermometers	Calibrated	Annually
Class S Weights	Calibrated	Annually
Deionized/Organopure Water	Conductivity check	Weekly
	Ion-exchange bed changed	Weekly
	Replace filters	As needed
Vacuum Pumps and Air Compressor	Check performance	Weekly
	Lubrication, belts, etc.	As needed
Water Baths	Water level	Added as needed
	Bath cleaned	6 months

9. DATA QUALITY ASSESSMENT

9.1 LABORATORY DATA ASSESSMENT

Data assessment is a systematic process of reviewing data against a set of criteria to identify outliers or errors and to delete suspect values or to flag them for the user. The QC data produced are reviewed by the analyst, QC Chemist, and Quality Services staff throughout sample analysis and data generation using the criteria and procedures described in this chapter to validate data integrity during collection and reporting of analytical data. Data review checklists are used to document the performance and review of the QC and analytical data.

9.1.1 Responsible Personnel

Review of analytical and QC data is initially performed by the responsible analyst. The data are checked for errors in transcription, calculations, and dilution factors and for compliance with QC requirements. Failure to meet method performance QC criteria results in reanalysis of the sample or lot. After the initial review is completed, the data are collected fromsummary sheets, workbooks, or computer files and assembled into a data package.

The next level of data review is the responsibility of the QC Chemist, a senior level chemist who is charged with 100 percent data review of assigned data packages. The QC Chemist checks the data packages and compare all results for all analyses performed in their respective areas. During this review, total and dissolved results are compared, analytical species are reviewed to ensure that the total is equal to or less than the sum of all the species analyzed, and may review data against historical results if the project has an adequate database for comparison.

The Quality Services Manager is responsible for 10 percent review of all laboratory reports prior to release to the client.

9.1.2 Criteria

The areas routinely reviewed at all levels include the following:

- Proper COC and sample handling procedures followed
- Parametric holding times met
- Samples prepared and analyzed according to specified methods
- Instrumentation calibrated according to specified methods
- Spike (surrogate or standard) recoveries within specified ranges
- Blanks prepared and analyzed as required
- Calculations performed correctly and verified
- Transcription of raw and final data correct
- Detection limits determined correctly and within required limits.

Any problems discovered during the review and the correction actions necessary to resolve them are communicated to the responsible Laboratory Manager, who discusses the findings with the Laboratory Quality Assurance Manager for resolution.

9.2 FIELD DATA ASSESSMENT

Assessment of the field data is the prime responsibility of the CTO Manager, who addresses the following areas:

- Proper COC, sample handling, and decontamination procedures followed
- Samples collected according to specified methods
- Field instrumentation calibrated according to specified methods
- QC samples (e.g., blanks, replicates) collected as required
- Field data sheets and logbooks completed and in agreement with sample container labels and COC forms.

9.3 FINAL REPORT REVIEW

A reviewer designated by the CTO Manager examines the final laboratory data for consistency with previous data and the hydrogeological characteristics of the site. Compliance with study plan requirements are also reviewed. Final assessment is the responsibility of the Program QA Officer or designated quality reviewers.

9.3.1 Analytical Data Quality Review

An analytical data quality review of the laboratory data is performed in lieu of data validation to ensure that the related data quality objectives presented in the project-specific QAPP were met. The following items would be reviewed and the findings documented in an appendix entitled *Analytical Data Quality Review* to each monitoring event report:

- Field sampling program quality control is assessed to indicate whether all QC sampling was performed.

- Laboratory analytical quality control program is reviewed and states the methods by which the laboratory analyzed the samples as well as analyses that may have deviated from those listed in the QAPP.

- Sample holding times are reviewed to determine if there are potential impacts on the sample data results from holding time anomalies.

- The precision of the laboratory results is assessed by comparing matrix spike/matrix spike duplicate relative percent difference data against the control limits identified in the QAPP. These data are used to determine if biases exist in the data.

- The accuracy of the data is assessed by comparing the results of surrogate compounds used by the laboratory against the control limits listed in the QAPP. Surrogate compounds are used to measure the ability of the laboratory to purge the targetanalytes from the environmental samples. Also assessed are the matrix spike/matrix spike duplicate recoveries and laboratory control samples recoveries compared to the control limits to check for analytical accuracy and method bias.

- Completeness of the data is calculated by comparing the actual number of samples collected in the field to the number of samples proposed in the LTMP for field completeness. Analytical completeness is also reviewed and is based on the number of acceptable analytical results compared to the total number of analytical results.

- Field quality control blanks are evaluated for the potential of contamination that may be introduced during field activity or laboratory analyses.

- Duplicate field samples are compared to one another based on relative percent difference values to measure the cumulative effects of both field and laboratory precision.

- Method detection limits, presented in tabular format in an appendix to the monitoring event reports, list the minimum concentration of a substance that can be measured and reported with 99 percent confidence.

10. CORRECTIVE ACTIONS

10.1 OBJECTIVES

The objectives of the corrective action procedures presented below are to ensure that recognized errors in performance of sample and data acquisition leads to effective remedial measures and that those steps required to correct an existing condition are documented to provide assurance that any data quality deficiencies are recognized in later interpretation and are not recurrent in the course of the project.

10.2 RATIONALE

Many times corrective measures are undertaken by project staff in a timely and effective fashion but go undocumented. Such incidents may be of a recurrent type that might not be recognized by other staff performing the same activity. In other cases, corrective actions are of a complex nature and may require scheduled interactions between departmental groups. In either case, documentation in a formal or informal sense can reinforce the effectiveness and duration of the corrective measures taken.

10.3 CORRECTIVE ACTION METHODS

Corrective action are of two kinds: immediate and long-term.

10.3.1 Immediate Corrective Actions

Immediate corrective actions are of a minor or routine nature such as correcting malfunctioning equipment, correction of data transcription errors, and other such activities routinely made in the field, laboratory or office by technicians, analysts and other project staff. These should be documented as prescribed in the project QC procedures, as required. Specific documentation should be limited to notations in logbooks, notebook, or on data sheets or other such forms. Such notations should be initiated and dated by the person performing the corrective action.

10.3.2 Long-Term Corrective Actions

Long-term corrective action shall be used to identify and eliminate causes of non-conformances which are of a complex nature and that are formally reported between management groups. A formal system for reporting and recording these corrective actions shall use the following procedure.

10.4 CORRECTIVE ACTION PROCESS

For either immediate or long-term corrective actions, steps comprising closed-loop corrective action system are as follows:

- Define the problem
- Assign responsibility for investigating the problem
- Investigate and determine the cause of the problem
- Determine a corrective action to eliminate the problem
- Assign and accept responsibility for implementing the corrective action
- Establish effectiveness of the corrective action and implement the correction
- Verify that the corrective action has eliminated the problem.

Non-conformance events associated with analytical work are documented using the laboratory NCRs which are reviewed and approved by the Laboratory Quality Assurance Manager.

10.5 CORRECTIVE ACTION REPORT REVIEW AND FILING

Immediate and long-term corrective actions require review to assure that, during the time of non-conformance, erroneous data were not generated or that, if possible, correct data were acquired instead. Such confirmation and review is the responsibility of the supervisor of the staff implementing the corrective action. Confirmation shall be acknowledged by notation and dated signature on the affected data record or appropriate form or by memorandum to cognizant project management. Such corrective action forms and memoranda shall be retained on file by responsible task leaders and filed centrally by the CTO Manager.

10.6 CORRECTIVE ACTIONS REPORTS TO MANAGEMENT

The Program QA Officer shall provide project management with corrective action reports. The CTO Manager is informed verbally of analytical non-conformance events as soon as possible and decisions made after evaluation are documented in the NCR. Copies of each NCR are maintained in the report file, and addressed in the final data report.

11. QUALITY ASSURANCE REPORTS

Fundamental to the success of this QA/QC is the active participation of the CTO Manager and the Program QA Officer in the project. The CTO Manager and the Program QA Officer will be aware of project activities and will participate in development, review, and operation of the project. Project management will be informed of QA activities through the receipt, review, and/or approval of:

- Project-specific QA project plans
- Corporate and project-specific QA/QC plans and procedures
- Corrective action notices
- NCRs.

Periodic assessment of field and laboratory QA/QC activities and data accuracy, precision, and completeness will be conducted and reported by the laboratory. Items to be included in the QA reports are the summary of results for the performance or the system audit and, where applicable:

- Assessment of adherence to work scope and schedule for the audited task
- Assessment of the precision, accuracy, and completeness of sample batches and subsequent status of data processing and analyses
- Significant QC problems and the status of any ongoing corrective actions
- Changes to the QAPP
- Status of the implementation of the QAPP.

Attachment A-1

Summary of Laboratory Quality Control Requirements and Corrective Action Procedures

ATTACHMENT A-1

SUMMARY OF LABORATORY QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTION PROCEDURES[a]

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
SW-846 3010A/6010A - Metals by ICP			
Holding Time	6 months from sampling	Digestion/analysis completed within holding time.	Notify client, determine if laboratory to proceed or if client will resample.
Initial Calibration	Established daily; verified immediately with high standard after initial calibration	1. Initial calibration with blank and three standards covering the linear range of instrument. 2. High standard verification must be "5% of true value.	1. Validate standard. If standard still exceeds acceptance criteria, obtain fresh, certified standards. 2. Recalibrate instrument. 3. Document actions taken.
Calibration Blank	10%	Concentrations of any analyte may not exceed RL.	1. If >MDL but <RL, take appropriate corrective action to determine the cause of and correct the problem, and report data without qualification. 2. If >MDL and >RL, and samples have concentrations >10X the blank concentration, take corrective action (as above) and qualify reported data. 3. If >MDL and >RL, and samples have concentrations equal to or <10X the blank concentration, take corrective action (as above) and reprocess the entire sample batch. 4. Document all actions.
Calibration Verification	Immediately after initial calibration, and every 10 samples thereafter	1. ICV %R is 90%-110% 2. CCV %R is 90%-110%	1. Validate standard. If standard still exceeds acceptance criteria, obtain fresh, certified standards. 2. Recalibrate instrument and reanalyze ass samples since last acceptable CCV. 3. Document actions taken.
Interelement Check Sample (ICS)	Beginning and end of each analytical run	Concentration of analyte subject to potential spectral interference is within 20 percent of known value.	1. Recalibrate instrument and reanalyze interelement check sample. 2. Check interelement correction factors or background correction points, and update if necessary. 3. Document actions taken.
Method Blank	1 per analytical batch	Concentrations of any analyte may not exceed RL.	1. If >MDL but <RL, take appropriate corrective action to determine the cause of and correct the problem, and report data without qualification. 2. If >MDL and >RL, and samples have concentrations >10X the blank concentration, take corrective action (as above) and qualify reported data. 3. If >MDL and >RL, and samples have concentrations equal to or <10X the blank concentration, take corrective action (as above) and reprocess the entire sample batch. 4. Document all actions.

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
SW-846 3010A/6010A - Metals by ICP (Continued)			
LCS	1 per analytical batch	Recoveries of target analytes are within project specific control limits for precision and accuracy (Appendix A-2).	1. Check instrument parameters, sensitivity and linearity. Correct any problems. 2. Validate LCS preparation. If error is found, reprepare and reanalyze the method blank, LCS and all field samples in the batch. 3. If LCS is valid, evaluate against project specific DQOs and report data if there is not impact on data usability. 4. If data are not usable, reprepare and reanalyze the method blank, LCS and all field samples in the batch. 5. If repreparation of samples is not possible, qualify data, and note in the report narrative. 6. Document all actions taken in a Nonconformance Record and in the report narrative.
MS	1 per analytical batch	1. Recoveries of target analytes are within 75%-125%	1. Verify spike concentration is $25 percent of the unspiked concentration. 2. Check that correct spiking solutions and amounts were used. 3. Check method blanks and LCS recovery. 4. Reanalyze samples if laboratory error is suspected. 5. Analyze a post-digestion spike to confirm matrix interference. 6. Document actions taken. in the report narrative.
MSD	1 per analytical batch	1. Recovery of target analytes within 75%-125% 2. %RPD must be "20%	1. Verify spike concentration is $25 percent of the unspiked concentration. 2. Check that correct spiking solutions and amounts were used. 3. Check method blanks and LCS recovery. 4. Reanalyze samples if laboratory error is suspected. 5. Document actions taken in the report narrative.
Post Digestion Spike	Recovery of target analytes in MS is outside 80%-120%.	Recovery of target analytes should be within 85%-115%.	1. Verify that correct spiking solutions and amounts were used. 2. Qualify data as biased due to matrix interferences. 3. Document actions taken in the report narrative.
SW-846 Method 3020A/7841 - Thallium by GFAA			
Holding Time	From sampling: 6 months	Digestion/analysis completed within holding time.	Notify client, determine if laboratory to proceed or if client will resample.
Initial Calibration	Established daily	1. Initial calibration with blank and a minimum of three standards covering the linear range of instrument. 2. Initial calibration correlation coefficient equals or exceeds 0.995.	1. Validate standard. If standard still exceeds acceptance criteria, obtain fresh, certified standards. 2. Recalibrate instrument. 3. Document actions taken.

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
SW-846 Method 3020A/7841 - Thallium by GFAA (Continued)			
Calibration Blank	10%	Concentrations of any analyte may not exceed RL.	1. If >MDL but <RL, take appropriate corrective action to determine the cause of and correct the problem, and report data without qualification. 2. If >MDL and >RL, and samples have concentrations >10X the blank concentration, take corrective action (as above) and qualify reported data. 3. If >MDL and >RL, and samples have concentrations equal to or <10X the blank concentration, take corrective action (as above) and reprocess the entire sample batch. 4. Document all actions.
Calibration Verification	Immediately after initial calibration, and every 10 samples thereafter	1. ICV %R is 90%-110% 2. CCV %R is 90%-110%	1. Validate standard. If standard still exceeds acceptance criteria, obtain fresh, certified standards. 2. Recalibrate instrument and reanalyze all samples since last acceptable CCV. 3. Document actions taken.
Method Blank	1 per analytical batch	Concentrations of any analyte may not exceed the project Reporting Limit.	1. If >MDL but <RL, take appropriate corrective action to determine the cause of and correct the problem, and report data without qualification. 2. If >MDL and >RL, and samples have concentrations >10X the blank concentration, take corrective action (as above) and qualify reported data. 3. If >MDL and >RL, and samples have concentrations equal to or <10Xthe blank concentration, take corrective action (as above) and reprocess the entire sample batch. Document all actions.
LCS	1 per analytical batch	Recoveries of target analytes are within project specific control limits for precision and accuracy (Appendix A-2).	1. Check instrument parameters, sensitivity and linearity. Correct any problems. 2. Check LCS preparation. If error is found, reprepare and reanalyze the method blank, LCS and all field samples in the batch. 3. If LCS is valid, evaluate against project specific DQOs and report data if there is not impact on data usability. 4. If data are not usable, reprepare and reanalyze the method blank, LCS and all field samples in the batch. 5. If repreparation of samples is not possible, qualify data, and note in the report narrative. 6. Document all actions taken in a Nonconformance Record and in the report narrative.
Analytical Spike	1 per sample	Spike recovery must be 85% -115%.	1. If spike recovery is <40%, dilute the sample and rerun with another spike. If after dilution, spike recovery is still <40%, report data with ?E? qualifier. 2. If the spike recovery is $40% and the sample absorbance or concentration is less than 50% of the spike, report sample results to the IDL. 3. If the sample absorbance or concentration is $50% of the spike, and the spike recovery is outside 85%-115%, quantitate sample by method of standard additions (MSA).
MSA Spike	Recovery of target analyte in analytical spike is outside 85%-115%	Correlation coefficient r $0.995	1. If r <0.995, rerun MSA once. 2. If r <0.995 again, quantitate and qualify data. 3. Document actions taken in the report narrative.

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
SW-846 Method 3020A/7841 - Thallium by GFAA (Continued)			
MS	1 per analytical batch	1. Recoveries of target analytes are within 75%-125%.	1. Verify that the spike concentration is at least 25% of the unspiked concentration. 2. Verify that correct spiking solutions and amounts were used. 3. Check method blanks and LCS recovery. 4. Reanalyze samples if laboratory error is suspected. 5. Document actions taken.
MSD	1 per analytical batch	1. Recoveries of target analytes are within 75%-125%	1. Verify that the spike concentration is at least 25% of the unspiked concentration. 2. Verify that correct spiking solutions and amounts were used. 3. Check method blanks and LCS recovery. 4. Reanalyze samples if laboratory error is suspected. 5. Document actions taken in the report narrative.
SW-846 7470A in Water - Mercury by CVAA			
Holding Time	28 days	Digestion/analysis completed within holding time.	Notify client, determine if laboratory to proceed or if client will resample.
Initial Calibration	Established daily	1. Initial calibration with blank and three standards covering the linear range of instrument. 2. Initial calibration correlation coefficient equals or exceeds 0.995.	1. Validate standard. If standard still exceeds acceptance criteria, obtain fresh, certified standards. 2. Recalibrate instrument. 3. Document actions taken.
Calibration Blank	10%	Concentrations of any analyte may not exceed RL.	1. If >MDL but <RL, take appropriate corrective action to determine the cause of and correct the problem, and report data without qualification. 2. If >MDL and >RL, and samples have concentrations >10X the blank concentration, take corrective action (as above) and qualify reported data. 3. If >MDL and >RL, and samples have concentrations equal to or <10X the blank concentration, take corrective action (as above) and reprocess the entire sample batch. 4. Document all actions.
Calibration Verification	Immediately after initial calibration, and every 10 samples thereafter	1. ICV %R is 90%-110% 2. CCV %R is 80%-120%	1. Validate standard. If standard still exceeds acceptance criteria, obtain fresh, certified standards. 2. Recalibrate instrument and reanalyze ass samples since last acceptable CCV. 3. Document actions taken.
Method Blank	1 per analytical batch	Concentrations of any analyte may not exceed the project Reporting Limit.	1. If >MDL but <RL, take appropriate corrective action to determine the cause of and correct the problem, and report data without qualification. 2. If >MDL and >RL, and samples have concentrations >10X the blank concentration, take corrective action (as above) and qualify reported data. 3. If >MDL and >RL, and samples have concentrations equal to or <10X the blank concentration, take corrective action (as above) and reprocess the entire sample batch. Document all actions.

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
SW-846 7470A in Water - Mercury by CVAA (Continued)			
LCS	1 per analytical batch	Recoveries of target analytes are within project specific control limits for precision and accuracy (Appendix A-2).	1. Check instrument parameters, sensitivity and linearity. Correct any problems. 2. Validate LCS preparation. If error is found, reprepare and reanalyze the method blank, LCS and all field samples in the batch. 3. If LCS is valid, evaluate against project specific DQOs and report data if there is not impact on data usability. 4. If data are not usable, reprepare and reanalyze the method blank, LCS and all field samples in the batch. 5. If repreparation of samples is not possible, qualify data, and note in the report narrative. 6. Document all actions taken in a Nonconformance Record and in the report narrative.
MS	1 per analytical batch	1. Recoveries of target analytes are within 75%-125%	1. Verify that correct spiking solutions and amounts were used. 2. Check method blanks and LCS recovery. 3. Reanalyze samples if laboratory error is suspected. 4. Document actions taken.
MSD	1 per analytical batch	1. Recoveries of target analytes are within 75%-125%	1. Verify that the spike concentration is at least 25 percent of the unspiked concentration. 2. Verify that correct spiking solutions and amounts were used. 3. Check method blanks and LCS recovery. 4. Reanalyze samples if laboratory error is suspected. 5. Document actions taken in the report narrative.
SW-846 Method 5030B/5035/8260B Volatile Organic Compounds by GC/MS and Vinyl Chloride by SW-846 Method 5030B/5035/8260B Modified for SIM by GC/MS			
Holding Time	14 days from sampling	Analysis is completed within holding time.	Notify client, determine if laboratory to proceed or if client will resample.
Tuning	Every 12 hours	Within limits of method	Adjust instrument parameters.
Calibration Curve	Established initially at 5 concentration levels, verified every 12 hours at mid level	1. Initial calibration %RSD for all CCCs is #30%; %RSD for all non-CCCs is #15%. If %RSD for any target analyte is >15%, construct a calibration curve using linear regression: r $ 0.990 2. RF for SPCCs is greater than the method specified minimum 3. Continuing calibration %D for CCCs from initial calibration is less than 20 percent; RF for SPCCs is method specified minimum	1. Recalibrate instrument. 2. Reanalyze samples since last criteria met. 3. Document actions taken.

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
SW-846 Method 5030A/8260B Volatile Organic Compounds by GC/MS (Continued)			
Method Blank	1 per analytical batch	Concentrations of any analyte may not exceed the project Reporting Limit.	1. If >MDL but <RL, take appropriate corrective action to determine the cause of and correct the problem, and report data without qualification. 2. If >MDL and >RL, and samples have concentrations >10X the blank concentration, take corrective action (as above) and qualify reported data. 3. If >MDL and >RL, and samples have concentrations equal to or <10X the blank concentration, take corrective action (as above) and reprocess the entire sample batch. Document all actions.
LCS	1 per analytical batch	Recoveries of target analytes are within project specific control limits for precision and accuracy (Appendix A-2).	1. Check instrument parameters, sensitivity and linearity. Correct any problems. 2. Validate LCS preparation. If error is found, reprepare and reanalyze the method blank, LCS and all field samples in the batch. 3. If LCS is valid, evaluate against project specific DQOs and report data if there is not impact on data usability. 4. If data are not usable, reprepare and reanalyze the method blank, LCS and all field samples in the batch. 5. If repreparation of samples is not possible, qualify data, and note in the report narrative. 6. Document all actions taken in a Nonconformance Record and in the report narrative.
Surrogate Spike	All laboratory QC and field samples.	Recoveries of surrogate spiking compounds are within project specific control limits.	1. Examine all QC, including calibration and quantitation. 2. If surrogates in LCS and/or MB are out-of-control reprepare/reanalyze the entire batch. 3. If samples cannot be reprepared, qualify data. 4. If surrogate spike in LCS and MB are acceptable but out-of-control for samples, examine preparation of samples. If no errors or problems are discovered for samples preparation, a matrix effect is assumed. 5. If errors are discovered in preparation of samples, reprepare/reanalyze the entire batch. 6. Document actions taken in a Nonconformance Record, and in the analytical report
Internal Standard Retention Times	Internal standards are added to all calibration standards, LCS, samples and blanks	The retention time for any internal standard in the CCV or samples must be within 30 seconds from the retention time in the mid-point standard level of the most recent initial calibration sequence.	1. If the retention time for any internal standard in the CCV or samples changes by more than 30 seconds from the retention time in the mid-point standard level of the most recent initial calibration sequence, then the chromatographic system must be inspected for malfunctions and corrections must be made, as required. 2. When corrections are made, reanalysis of samples analyzed while the systemwas malfunctioning is required.
Internal Standard Responses	Internal standards are added to all calibration standards, LCS, samples and blanks	The EICP area for any internal standard in the CCV should be within a factor of two (-50% to +100%) from that in the mid-point standard level of the most recent initial calibration sequence.	1. If the EICP area for any internal standard in the CCV changes by a factor of two (-50% to +100%) from that in the mid-point standard level of the most recent initial calibration sequence, the mass spectrometer must be inspected for malfunctions and corrections must be made, as appropriate. 2. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is required.

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
SW-846 Method 5030A/8260B Volatile Organic Compounds by GC/MS (Continued)			
MS/MSD	1 set per batch	Recoveries of spiked target analytes are within LCS limits	1. If method blank, LCS and calibration meet acceptance criteria, check that spiking was properly performed. 2. If there is no evidence of error, out-of-control recoveries may be attributed to matrix effects. Repreparation and re-analysis are not required. 3. Qualify data and document in analytical narrative.
SW-846 3520A/8270C - Semivolatile Organics by GC/MS			
Holding Time	Aqueous: extract within 7 days of sampling; analyze within 40 days of extraction.	Extraction and analysis are completed within holding time.	Notify client, determine if laboratory to proceed or if client will resample.
Tuning	Every 12 hours	Within limits of method	Adjust instrument parameters.
Calibration Curve	Established initially at 5 concentration levels, verified every 12 hours at mid level	1. Initial calibration %RSD for all CCCs is #30%; %RSD for all non-CCCs is #15%. If %RSD for any target analyte is >15%, construct a calibration curve using linear regression: r$0.990 2. RF for SPCCs is >0.05. 3. Continuing calibration %D for CCCs is " 20 % from initial calibration; RF for SPCCs is >0.05.	1. Reanalyze check standard. 2. If similar results are obtained recalibrate instrument. 3. Reanalyze all samples analyzed since last criteria were met. 4. Document actions taken.
Method Blank	1 per analytical batch	Concentrations of any analyte may not exceed the project Reporting Limit.	1. If >MDL but <RL, take appropriate corrective action to determine the cause of and correct the problem, and report data without qualification. 2. If >MDL and >RL, and samples have concentrations >10X the blank concentration, take corrective action (as above) and qualify reported data. 3. If >MDL and >RL, and samples have concentrations equal to or <10X the blank concentration, take corrective action (as above) and reprocess the entire sample batch. Document all actions.
LCS	1 per analytical batch	Recoveries of target analytes are within project specific control limits for precision and accuracy (Appendix A-2).	1. Validate instrument parameters, sensitivity and linearity. Correct problems and document. 2. Validate standard and LCS preparation. Correct any problems and document. 3. Evaluate against project specific DQOs and report data if there is not impact on data usability. 4. If data are not usable, reprepare and reanalyze the method blank, LCS and all field samples in the batch. 5. If repreparation of samples is not possible, qualify data, and note in the report narrative. 6. Document all actions taken in a Nonconformance Record and in the report narrative. 7. Document actions taken.

QC Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
SW-846 3520A/8270C - Semivolatile Organics by GC/MS (Continued)			
Surrogate Spike	All laboratory QC and field samples.	Recoveries of surrogate spiking compounds are within project specific control limits.	1. Examine all QC, including calibration and quantitation. 2. If surrogates in LCS and/or MB are out-of-control reprepare/reanalyze the entire batch. 3. If samples cannot be reprepared, qualify data. 4. If surrogate spike in LCS and MB are acceptable but out-of-control for samples, examine preparation of samples. If no errors or problems are discovered for samples preparation, a matrix effect is assumed. 5. If errors are discovered in preparation of samples, reprepare/reanalyze the entire batch. 6. Document actions taken in a Nonconformance Record, and in the analytical report
Internal Standard Retention Times	Internal standards are added to all calibration standards, LCS, samples and blanks	The retention time for any internal standard in the CCV or samples must be within 30 seconds from the retention time in the mid-point standard level of the most recent initial calibration sequence.	1. If the retention time for any internal standard in the CCV or samples changes by more than 30 seconds from the retention time in the mid-point standard level of the most recent initial calibration sequence, then the chromatographic system must be inspected for malfunctions and corrections must be made, as required. 2. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is required.
Internal Standard Responses	Internal standards are added to all calibration standards, LCS, samples and blanks	The EICP area for any internal standard in the CCV should be within a factor of two (-50% to +100%) from that in the mid-point standard level of the most recent initial calibration sequence.	1. If the EICP area for any internal standard in the CCV changes by a factor of two (-50% to +100%) from that in the mid-point standard level of the most recent initial calibration sequence, the mass spectrometer must be inspected for malfunctions and corrections must be made, as appropriate. 2. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is required.
MS/MSD	1 set per batch	Recoveries of spiked target analytes are within LCS limits	1. If method blank, LCS and calibration meet acceptance criteria, check that spiking was properly performed. 2. If there is no evidence of error, out-of-control recoveries may be attributed to matrix effects. Reprepaparation and re-analysis are not required. 3. Qualify data, and document in analytical narrative.

Attachment A-2

Quality Control Criteria for Precision and Accuracy for Matrix Spikes, Surrogate Spikes, and Laboratory Control Samples

ATTACHMENT A-2

QUALITY CONTROL CRITERIA FOR PRECISION AND ACCURACY FOR MATRIX SPIKES, SURROGATE SPIKES, AND LABORATORY CONTROL SAMPLES[a]

QC Parameter	Spiking Compounds	Accuracy (%R)[a]	Precision[b]
SW-846 3010A/6010A Metals by ICP			
MS/MSD	Aluminum	75-125	<20
	Antimony	75-125	<20
	Barium	75-125	<20
	Beryllium	75-125	<20
	Cadmium	75-125	<20
	Chromium	75-125	<20
	Cobalt	75-125	<20
	Copper	75-125	<20
	Iron	75-125	<20
	Manganese	75-125	<20
	Nickel	75-125	<20
	Silver	75-125	<20
	Vanadium	75-125	<20
	Zinc	75-125	<20
LCS	Aluminum	80-120	<12
	Antimony	80-120	<10
	Barium	80-120	<13
	Beryllium	80-120	<8
	Cadmium	80-120	<10
	Calcium	80-120	<10
	Chromium	80-120	<10
	Cobalt	80-120	<8
	Copper	80-120	<9
	Iron	80-120	<9
	Magnesium	80-120	<11
	Manganese	80-120	<11
	Nickel	80-120	<9
	Potassium	80-120	<12
	Silver	80-120	<12
	Sodium	80-120	<13
	Vanadium	80-120	<9
	Zinc	80-120	<9
SW-846 7470A Mercury by CVAA			
MS/MSD	Mercury	75-125	<20
LCS	Mercury	80-120	<18
SW-846 7841 Thallium by GFAA			
MS/MSD	Thallium	75-125	<20
LCS	Thallium	80-120	<15

(a) Laboratory Control Sample (LCS) limits are based on historical performance data and are updated annually.
(b) Precision for LCS is calculated as the moving range for successive LCS recoveries;precision for matrix spikes is listed as relative percent difference.

QC Parameter	Spiking Compounds	Accuracy (%R)[a]	Precision[b]
SW-846 5030B/8260B Volatile Organic Compounds by GC/MS (25 mL purge)			
Surrogate	1,2-Dichloroethane-d4	65-135	Not applicable
	4-Bromoflurobenzene (BFB)	69-125	Not applicable
	Dibromofluoromethane	75-129	Not applicable
	Toluene-d8	82-120	Not applicable
LCS/MS/MSD	1,1,1-Trichloroethane	60-140	<20
	1,1,2,2-Tetrachloroethane	60-140	<20
	1,1,2-Trichloroethane	60-140	<20
	1,1-Dichloroethane	60-140	<20
	1,1-Dichloroethene	60-140	<20
	1,2-Dichlorobenzene	60-140	<20
	1,2-Dichloroethane	60-140	<20
	1,2-Dichloropropane	60-140	<20
	1,3-Dichlorobenzene	60-140	<20
	1,4-Dichlorobenzene	60-140	<20
	2-Butanone	60-140	<20
	2-Chloroethylvinylether	60-140	<20
	2-Hexanone	60-140	<20
	4-Methyl-2-pentanone	60-140	<20
	Acetone	60-140	<20
	Benzene	60-140	<20
	Bromodichloromethane	60-140	<20
	Bromoform	60-140	<20
	Bromomethane	60-140	<20
	Carbon disulfide	60-140	<20
	Carbon tetrachloride	60-140	<20
	Chlorobenzene	60-140	<20
	Chloroethane	60-140	<20
	Chloroform	60-140	<20
	Chloromethane	60-140	<20
	cis-1,3-Dichloropropene	60-140	<20
	Dibromochloromethane	60-140	<20
	Ethylbenzene	60-140	<20
	Methylene chloride	60-140	<20
	Styrene	60-140	<20
	Tetrachloroethene	60-140	<20
	Tetrahydrofuran	60-140	<20
	Toluene	60-140	<20
	Total 1,2-dichloroethene	60-140	<20
	Total xylenes	60-140	<20
	trans-1,3-dichloropropene	60-140	<20
	Trichloroethene	60-140	<20
	Trichlorofluoromethane	60-140	<20
	Vinyl acetate	60-140	<20
	Vinyl chloride	60-140	<20

QC Parameter	Spiking Compounds	Accuracy (%R)[a]	Precision[b]
SW-846 3520A/8310 Semivolatile Organics			
Surrogate	Benzo(e)pyrene	30-150	---
	4,4'-Dibromooctafluorobiphenyl	25-150	---
	p-Terphenyl	30-150	---
LSC/MS/MSD	Benzo[a]pyrene	52-123	<30
	Rotenone	20-130	<35
	Pyrethrins, total	20-130	<35
SW-846 8151 Semivolatile Organics			
Surrogate	DCAA	50-130	---
LCS/MS/MSD	Pentachlorophenol	40-220	<40
SW-846 3520A/8270C Semivolatile Organics by GC/MS			
Surrogate Spike	Nitrobenzene d5	35-114	---
	2-Fluorobiphenyl	43-116	---
	Terphenyl-d14	33-141	---
	2-Fluorophenol	21-100	---
	Phenol-d5	10-94	---
	2,4,6-Tribromophenol	10-123	---
LCS/MS/MSD	Phenol	38-91	<33
	2-Chlorophenol	42-94	<32
	1,4-Dichlorobenzene	28-90	<38
	N-Nitroso-di-n-propylamine	53-115	<38
	1,2,4-Trichlorobenzene	33-94	<38
	4-Chloro-3-methylphenol	45-97	<32
	Acenaphthene	49-103	<33
	4-Nitrophenol	52-117	<40
	2,4-Dinitrotoluene	57-115	<35
	Pentachlorophenol	38-119	<50
	Pyrene	45-114	<43

Attachment A-3

Table of Contents for Laboratory Data Report

ATTACHMENT A-3

TABLE OF CONTENTS FOR LABORATORY DATA REPORT

Section	Page
1. NARRATIVE	010000
A. Analytical Narrative	
B. Methods (Table 1)	
C. Data Qualifiers (Table 2)	
2. CHAIN-OF-CUSTODY	020000
3. VOLATILES DATA	030000
A. Quality Control Summary	030000
1. Surrogate Percent Recovery	030000
2. Matrix Spike/Matrix Spike Duplicate Summary	030000
3. Laboratory Control Sample Summary	030000
4. Method Blank Summary	030000
5. GC/MS Tuning, BFB	030000
5. Internal Standard Area Summary	030000
B. Sample Data	030000
1. Data for Sample	030000
C. Standards Data	030000
1. Initial Five-Point Calibration	030000
2. Continuing Calibration Check	030000
D. Raw Quality Control Data	030000
1. BFB Tune Data	030000
2. Method Blank	030000
3. Matrix Spike Data	030000
4. Matrix Spike Duplicate Data	030000
5. Laboratory Control Sample Data	030000
E. Laboratory Logs	030000
1. Standards Preparation Logs	030000
2. Injection Logs	030000
F. Technical Review Checklist and Other Analysis Documentation	030000
4. SEMIVOLATILES DATA	040000
A. QC Summary	040000
1. Surrogate Percent Recovery	040000
2. Matrix Spike/Matrix Spike Duplicate Summary	040000
3. Laboratory Control Sample Summary	040000
4. Method Blank Summary	040000
5. GC/MS Tuning, DFTPP	040000
6. Internal Standard Area Summary	040000

Section	Page
5. GENERAL INORGANICS DATA	060000
A. Analytical Results	060000
B. Quality Control Data	060000
1. Initial and Continuing Calibration	060000
2. Method Blank Summary	060000
3. Matrix Spike Summary	060000
4. Duplicate Summary	060000
5. Laboratory Control Sample	060000
C. Raw Data	060000
D. Laboratory Logs	060000
1. Digestion/Distillation Logs	060000
2. Standards Preparation Logs	060000
3. Instrument Logs	060000
E. Technical Review Checklist and Other Analysis Documentation	060000