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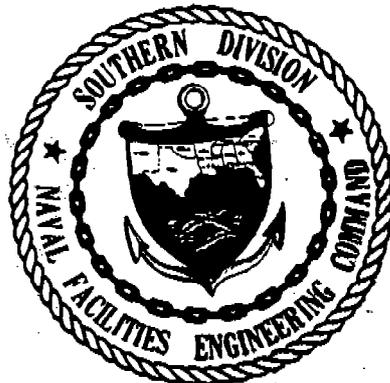


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OCTOBER 1991

RFI WORK PLAN
VOLUME II OF III
SAMPLING AND ANALYSIS PLAN

U.S. NAVAL STATION
MAYPORT, FLORIDA



SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA
29411-0068

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RCRA FACILITY INVESTIGATION WORKPLAN

**VOLUME II. SAMPLING AND ANALYSIS PLAN
U.S. NAVAL STATION
MAYPORT, FLORIDA**

UIC: N60201

Contract No. N62467-89-D-0317

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LIST OF ACRONYMS AND ABBREVIATIONS

ABB-ES	ABB Environmental Services, Inc.
AFFF	Aqueous Film Forming Foam
AIMD	Aircraft Intermediate Maintenance Department
AOC	Area of Concern
ASTM	American Society of Testing and Materials
BLS	Below Land Surface
BOD ₅	Biochemical Oxygen Demand
CAA	Clean Air Act
CAMP	Corrective Action Management Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action-Navy
CO	Corporate Officer
CPF	Carcinogen Potency Factors
CRP	Community Relations Plan
CSF	Carcinogen Slope Factor
CWA	Clean Water Act
DFM	Diesel Fuel, Marine
EIC	Engineer in Charge
EP	Equilibrium Partitioning
ESI	Expanded Site Investigation
FDER	Florida Department of Environmental Regulation
FTC	Fleet Training Center
GC	Gas Chromatograph
g/d/ft	gallon per day per foot
HASO	Health and Safety Officer
HASP	Health and Safety Plan
HEA	Health Environmental Assessment
HEED	Health and Environmental Effects Document
HEEP	Health and Environmental Effects Profile
HSWA	Hazardous and Solid Waste Amendments of 1984
IAS	Initial Assessment Study
ICP	Inductively Coupled Plasma
ID	inner diameter
IRP	Installation Restoration Program
IRIS	Integrated Risk Information System

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LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

MCL	Maximum Contaminant Level
mg/l	milligrams per liter
MPT	Mayport
MSL	mean sea level
NACIP	Navy Assessment and Control of Installation Pollutants
NADEP	Naval Avionics Depot
NAS	Naval Air Station
NAVSTA	Naval Station
NEESA	Naval Energy and Environmental Support Activity
NGVD	National Geodetic Vertical Datum of 1929
NIRP	Navy Installation Restoration Program
NOAA	Nation Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NSC	Naval Supply Center
OWTP	Oily Waste Treatment Plant
PCB	Polychlorinated biphenyl
PM	Program Manager
QA	Quality Assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act of 1976, as amended
RFA	RCRA Facility Assessment
RfD	The reference dose
RFI	RCRA Facility Investigation

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LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RSD	Risk-Specific Dose
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act of 1986
SAS	Special Analytical Services
SCS	Soil Conservation Service
SDWA	Safe Drinking Water Act
SOUTHNAV-	Southern Division Naval Facilities Engineering Command
FACENGCOCM	
SI	Site Inspection
SIMA	Shore Intermediate Maintenance Activity
SMP	Site Management Plan
SOP	Standard Operating Procedure
SOW	Statement of Work
SPHEM	Superfund Public Health Evaluation Manual
SQC	Sediment Quality Criteria
SUPSHIPS	Supervisor of Shipbuilding
SWDA	Solid Waste Disposal Act
SWMU	Solid Waste Management Unit
TBC	To be considered
TCL	Target Compound List
TD	Technical Director
TOM	Task Order Manager
TRB	Technical Review Board
TSCA	Toxic Substances Control Act
TSS	Total Suspended Solids
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
VOA	Volatile Organic Compound Analyses
VSI	Visual Site Inspection

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EXECUTIVE SUMMARY

This three-volume set presents the planning documents for undertaking a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at the U.S. Naval Station (NAVSTA), Mayport, Florida.

The purpose of the Mayport RFI is to provide the information necessary to conduct a health and environmental assessment and to design corrective measures, if required, for each of the solid waste management units (SWMUs) identified in the station hazardous waste management permit (H016-118598) issued March 25, 1988. To achieve this objective, the RFI will collect data sufficient to determine the nature and extent of any releases of contaminants and the potential pathways of contaminant migration via air, land, surface water, and groundwater.

The RFI planning documents consist of the following plans presented in three volumes.

- Volume I Workplan
 - Data Management Plan
 - Project Management Plan

- Volume II Sampling and Analysis Plan
 - Site Management Plan
 - Quality Assurance Plans

- Volume III Health and Safety Plan

Together the three volumes present the scope of the RFI with associated methodology and rationale; quality assurance and health and safety procedures; data storage, handling, and presentation formats; and the project management approach.

The RFI conducted at NAVSTA Mayport will be consistent with the requirements of the Hazardous and Solid Waste Amendments (HSWA) permit. The following sites have been identified as solid waste management units and are included in the RFI at NAVSTA Mayport. Site numbering and nomenclature are in accordance with the U.S. Environmental Protection Agency (USEPA) RCRA Facility Assessment, September 1989.

SWMU 1	Landfill A
SWMU 2	Landfill B
SWMU 3	Landfill D
SWMU 4	Landfill E
SWMU 5	Landfill F
SWMU 6	Waste Oil Pit
SWMU 7	Oily Waste Treatment Plant Sludge Beds
SWMU 8	Oily Waste Treatment Plant Percolation Pond
SWMU 9	Oily Waste Treatment Plant
SWMU 10	RCRA Hazardous Waste Storage Area
SWMU 11	Fuel Spill Area
SWMU 12	Neutralization Basin

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SWMU 13	Old Fire Training Area
SWMU 14	Mercury/Oily Waste Spill Area
SWMU 15	Old Pesticide Handling Area
SWMU 16	Old Transformer Storage Yard
SWMU 17	Carbonaceous Fuel Boiler
SWMU 22	Building 1600 Blasting Area

Existing well and sample location designations were defined under the Navy Installation Restoration Program (NIRP). For consistency, the same well and sample location designation scheme will be maintained. Therefore, well and sample designations may vary from SWMU numbers. NIRP site numbers and SWMUs will be cross referenced as needed.

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1.0 INTRODUCTION

ABB Environmental Services, Inc. (ABB-ES), under contract to Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), has prepared this Sampling and Analysis Plan (SAP) for a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at the Naval Station (NAVSTA) Mayport, Florida. This SAP contains the field procedure information required to complete the tasks described in the NAVSTA Mayport Workplan (Volume I).

The purpose of the SAP is to ensure that all information and data are valid and properly documented in an effort to provide representative data to characterize the environmental setting, source, and releases of hazardous constituents at each Solid Waste Management Unit (SWMU) at NAVSTA Mayport. It also provides the mechanism for planning and approving field activities. The SAP will be amended or revised, on an as-needed basis, during the RFI as the requirements for field activities are reassessed or rescoped.

The NAVSTA Mayport Workplan (Volume I) contains the rationale and overall approach for the proposed RFI activities. It also provides additional background information and includes a review of the existing database for the SWMUs. The RFI, described in the Workplan and detailed in this SAP, includes the following activities: magnetometer survey, monitoring well installation, monitoring well measuring point survey, aquifer hydraulic properties testing, groundwater sampling, surface soil sampling, surface water and sediment sampling, soil gas screening, and chemical laboratory analyses. Each RFI activity will be conducted in accordance with U.S. Navy and U.S. Environmental Protection Agency (USEPA) guidelines, the SAP, and the site-specific Health and Safety Plan (HASP). Changes in the established guidelines and protocols made because of field circumstances will be recorded and documented. Procedures and documentation for field changes and corrective action are presented in Section 3.1.11 of this SAP. SOUTHNAVFACENGCOM and the USEPA Region IV Administration will be consulted for comment and approval before any changes are made in the investigation scope if in the judgement of the Task Order Manager (TOM) and RFI Task Leader, unanticipated site conditions or intermediate findings require significant changes in the RFI strategy.

The SAP is divided into five major parts: the Site Management Plan (SMP) (Section 2.0), the Field Sampling Plan (FSP) (Section 3.0), the Comprehensive Quality Assurance Project Plan (QAPP) (Appendix A), the Site-Specific Quality Assurance Plan (QAP) (Appendix B), and CH₂M Hill Laboratory QAPP (Appendix C) for the Navy's environmental programs. These plans include the following types of information.

- The SMP includes the operations plan outlining the field team organization and responsibilities to the project. The SMP also addresses site security and control of access by unauthorized personnel.
- The FSP includes sampling and analytical objectives and the number, type, and location of samples to be collected during the field investigation.

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- The Comprehensive QAPP specifies the project quality assurance requirements and procedures, quality assurance requirements and procedures for field activities, and quality assurance requirements and procedures for sample analysis and data management.
- The site-specific QAP includes outlines of task objectives, task organization, analytical programs, and sample numbers for each site, and presents Technical Memoranda for project-specific activities such as drilling, subsurface soil sampling, monitoring well installation, groundwater sampling, surface soil sampling, sediment sampling, surface water sampling, decontamination procedures, slug tests, soil gas measurements, and field screening for polychlorinated biphenyls (PCB).
- The CH₂M Hill Quality Assurance Project Plan includes Standard Operating Procedures and Quality Assurance/Quality Control objectives and procedures for laboratory chemical analysis.

Background information on Naval Station Mayport and the subject SWMUs is presented in Volume I, Workplan. Investigation rationale and strategies are also discussed in Volume I. Volume II, SAP, presents the specific procedures and methods to be followed during field investigations at each SWMU.

The regional location of NAVSTA Mayport is presented in Figure 1-1. SWMU locations are presented in Figure 1-2. A listing of the SWMUs addressed by the SAP is presented in Table 1-1. The reader is referred to Volume I, Workplan, for background information and investigation rationale. Volume III contains the Health and Safety Plan (HASP) which presents the project's health and safety program for field activities.

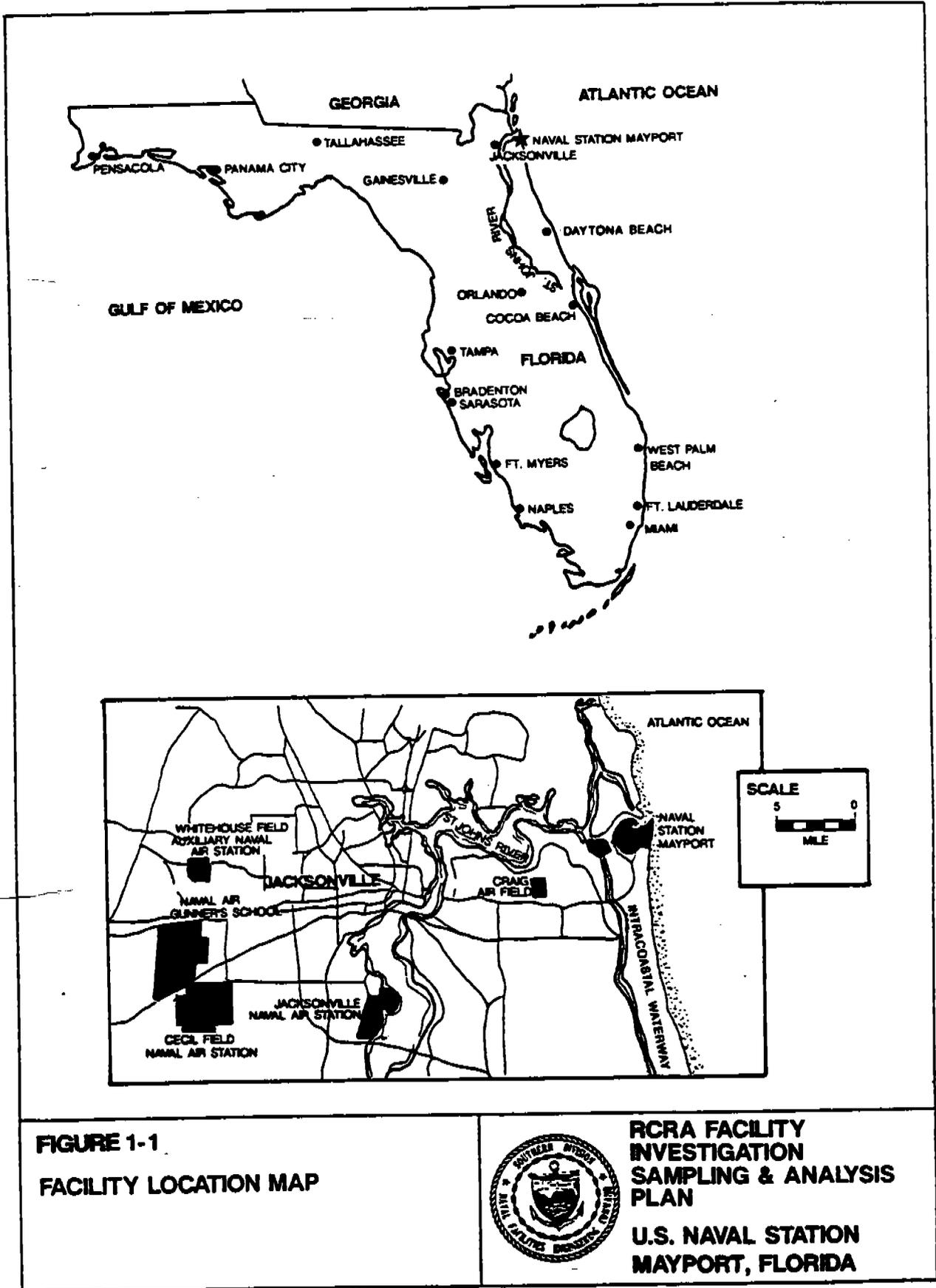
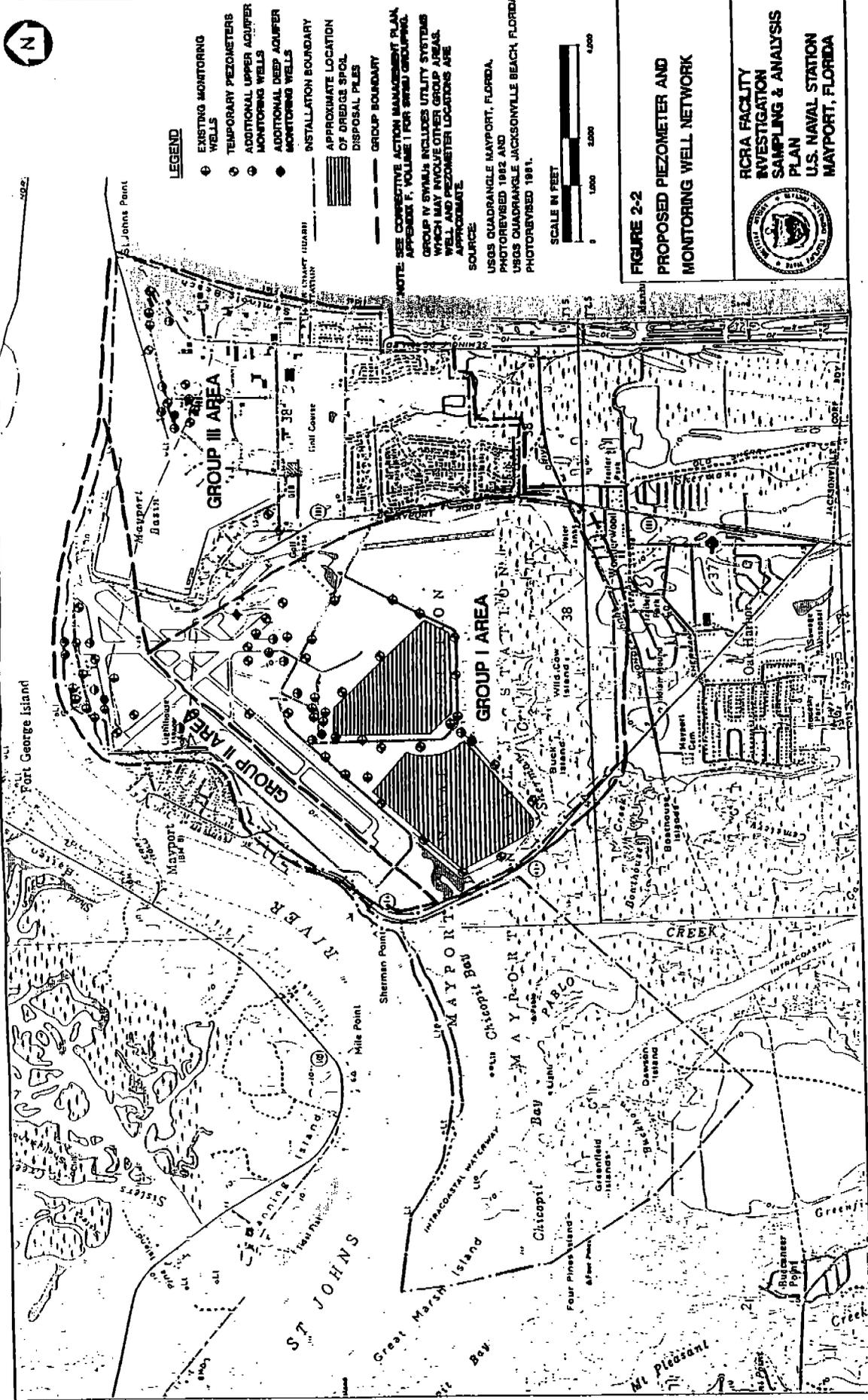


FIGURE 1-1
FACILITY LOCATION MAP



**RCRA FACILITY
 INVESTIGATION
 SAMPLING & ANALYSIS
 PLAN**

**U.S. NAVAL STATION
 MAYPORT, FLORIDA**



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**Table 1-1
Solid Waste Management Units**

Sampling and Analysis Plan
NAVSTA Mayport
Mayport, Florida

RFA SWMU No. ¹	HWSA SWMU No. ²	NIRP Site No. ³	Site Name	Studies Which Include Site		
				IAS	ESI	RFI
1	A	1	Landfill A	Yes	Yes	Yes
2	B	2	Landfill B	Yes	Yes	Yes
3	C	4	Landfill D	Yes	Yes	Yes
4	D	5	Landfill E	Yes	Yes	Yes
5	E	6	Landfill F	Yes	Yes	Yes
6	F	8	Waste Oil Pit	Yes	Yes	Yes
7	G	8A	OWTP Sludge Beds	No	No	Yes
8	H	8B	OWTP Percolation Pond	No	No	Yes
9	I	8C	OWTP	No	No	Yes
10	J	8D	RCRA Hazardous Waste Storage Area	No	No	Yes
11	K	9	Fuel Spill Area	Yes	Yes	Yes
12	L	11	Neutralization Basin	Yes	No	Yes
13	M	13	Old Fire Training Area	Yes	Yes	Yes
14	N	14	Mercury/Oily Waste Spill Area	Yes	Yes	Yes
15	O	15	Old Pesticide Handling Area	Yes	No	Yes
16	P	16	Old Transformer Storage Yard	Yes	Yes	Yes
17	Q	17	Carbonaceous Fuel Boiler	No	No	Yes
22	NA	NA	Building 1600 Blasting Area	No	No	Yes

¹Designation used in draft RCRA Facility Assessment, A.T. Kearney, Inc., 1989.

²Designation used in HSWA Permit No. FL9 170 024 260, March 25, 1988.

³Designation used in NIRP Expanded Site Investigation, E.C. Jordan, 1988.

Notes: RFA = RCRA (Resource Conservation and Recovery Act) Facility Assessment, A.T. Kearney, 1989 (draft).
 HSWA = Hazardous and Solid Waste Amendments Permit No. H016-118598.
 NIRP = Naval Installation Restoration Program.
 SWMU = Solid Waste Management Unit.
 IAS = Initial Assessment Study, Environmental Science and Engineering, 1985.
 ESI = Expanded Site Investigation, E.C. Jordan, 1988.
 RFI = RCRA Facility Investigation.
 OWTP = Oily Waste Treatment Plant.

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2.0 SITE MANAGEMENT PLAN (SMP)

This section provides general operating guidelines for access, security, and the field team organization that will be implemented during RFI activities. The proposed project organization is presented in Figure 2-1.

2.1 SITE CONTROL

2.1.1 Site Access Access to the base in general and to any restricted areas will be with one security pass per vehicle. All information on personnel involved in the project and a copy of the contract for the project will be provided to security at least 2 weeks before the field work begins.

General site layout and sample collection locations are presented in the FSP (Section 3.0). All exploration and sampling stations are located onsite (Figure 2-2). NAVSTA Mayport will be responsible for obtaining keys to gates and locking caps of existing monitoring wells for those areas on the station.

It is anticipated that limited access improvements to boring locations will be required in the wooded areas adjacent to the landfills. The drilling subcontractor will be responsible for boring location access improvements including brush removal and tree cutting. Such access improvements will be cleared beforehand with NAVSTA Mayport. Sampling locations and routes of access will be staked and marked with flags to facilitate locating sampling sites during future investigative activities.

2.1.2 Site Security It is anticipated that full security (i.e., fencing) cannot be established at any of the drilling locations. Therefore, at active boring locations, open casings will be secured overnight by fastening the rotary drive head over the upper end of the casing. Finished monitoring wells will be secured by the installation of protective steel casings over well risers. The protective steel casings will be fixed in the ground with concrete and equipped with locking caps.

2.1.3 Communications Field personnel will use telephones while on the base to communicate with off-base parties and will have a list of emergency phone numbers available at all times. Personnel conducting onsite work in one area of the NAVSTA Mayport will use two-way radios with frequencies approved by the Navy to maintain a communication link with personnel working in other areas. Daily communications for access needs and scheduling site operations will be coordinated with one representative from the Public Works Department, NAVSTA Mayport. As of this writing, the representative from the NAVSTA Mayport will be Mr. Mike Davenport.

2.1.4 Field Operations Drill rigs will either be left in a secured area or be disabled each night before personnel leave a site. Final approval for boring locations will be given by NAVSTA Mayport's representative during a site reconnaissance conducted prior to the beginning of the field work. Potable water, which is necessary for drilling and decontamination procedures, will be obtained at fire hydrant locations specified by the Public Works Department.

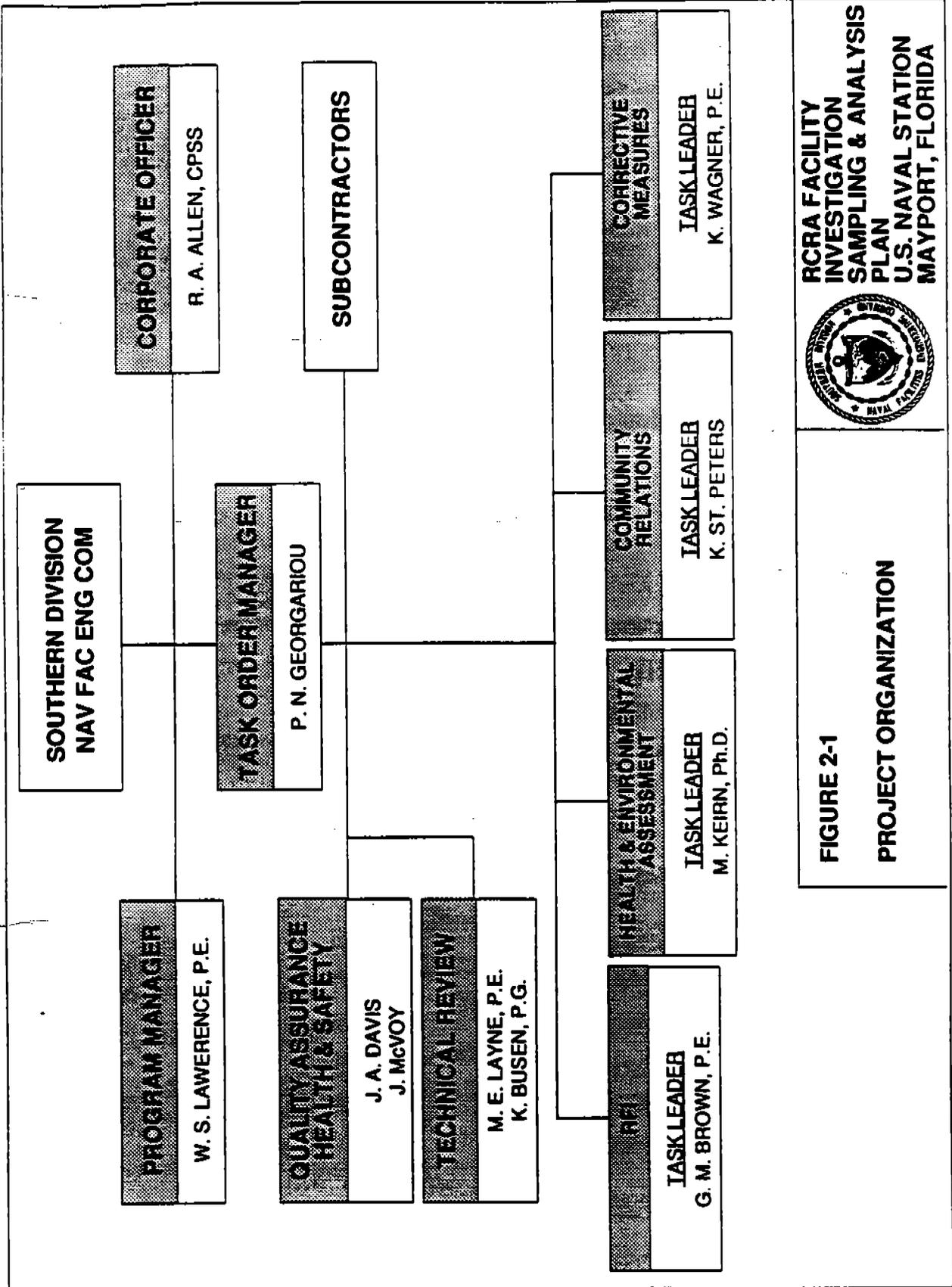
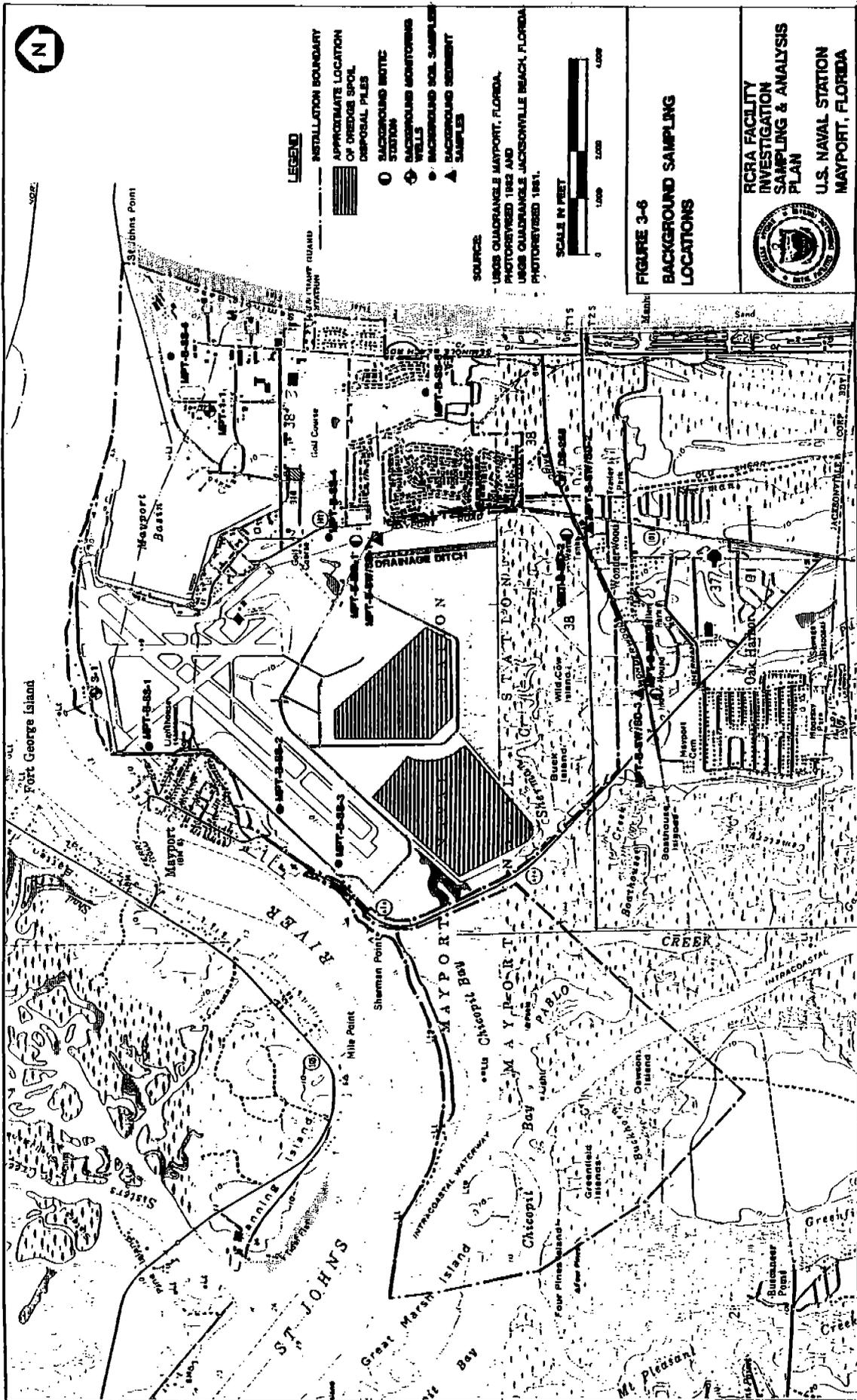


FIGURE 2-1
PROJECT ORGANIZATION

**RCRA FACILITY
INVESTIGATION
SAMPLING & ANALYSIS
PLAN
U.S. NAVAL STATION
MAYPORT, FLORIDA**



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2.1.5 Decontamination Facilities The field work at the NAVSTA Mayport sites will require mobilization and field support of subcontractors, sampling crews, and survey crews. Staging and decontamination facilities will be needed to conduct these operations. Staging of field operations will be done from vehicles used by site investigation personnel and subcontractors. These vehicles will be parked in uncontaminated areas identified for each site and will not require decontamination.

Decontamination zones for personnel and equipment will be established during the reconnaissance for each site. All contaminated materials and protective gear will either be disposed of or containerized in these areas before site personnel proceed to the clean zone.

A heavy equipment decontamination zone will be designated at each site. Drill rigs, casings, rods, and associated downhole equipment plus well casing and screen will be decontaminated and steam cleaned prior to setting up at each boring or monitoring well location. In addition, the drill rig and all tools will be decontaminated prior to entering and leaving NAVSTA Mayport. Sampling tools will be decontaminated more frequently as required by the sampling protocol established in Section 6.3 of the QAPP (Appendix A) and the procedures in the project-specific Technical Memorandum "Decontamination Procedures," Appendix B, Volume II.

2.1.6 Disposal of Wastes All borehole cuttings, development water, drill fluids, drill cuttings, and water resulting from monitoring well and piezometer installation and development will be contained in Department of Transportation (DOT) 17-C open top, 55-gallon drums, permanently labeled by well number and stored in a location designated by the NAVSTA Mayport's Environmental Coordinator.

Field monitoring of fluids and solids generated by monitoring well and piezometer installation and development will be done for field screening and health and safety monitoring using a portable OVA or PID. All drummed materials will be sampled and analyzed for Toxicity Characteristic Leaching Procedure (TCLP) (USEPA Method 1311). Determination of the proper method of disposal for investigation derived wastes will be made upon assessment of TCLP and site field investigation analytical data.

Material found to exceed TCLP concentration limits established in 40 CFR 261.24 will be transported to a suitable disposal facility by Defense Reutilization and Marketing Organization (DRMO). Materials found not to exceed TCLP limits will be disposed onsite under the supervision of NAVSTA Mayport's Environmental Coordinator.

2.2 PROJECT ORGANIZATION AND MANAGEMENT Figure 2-1 shows the program organization and its principal lines of communication for the NAVSTA Mayport RFI. The responsibilities of the ABB-ES program positions and support organizations are described in the Project Management Plan, Volume I, Work Plan.

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The following is a list of key project staff. Resumes of key personnel are located in Appendix B, Volume I. Revisions and identification of additional personnel may be made prior to the initiation of RFI activities. A list of emergency numbers is also contained in the HASP.

ABB Environmental Services

Raymond A. Allen, III, Corporate Officer
William S. Lawrence, Program Manager
Philip Georgariou, Task Order Manager
Gregory Brown, P.E., RFI Task Leader
Jack Davis, HSO
John McVoy, QAO
Michael Keirn, Ph.D., Health and Environmental Assessment

SOUTHNAVFACENGCOM

Jim Reed, Engineer-in-Charge

NAVSTA Mayport

Mike Davenport, Environmental Coordinator

Technical Staff and Field Personnel. Qualified technical staff and field personnel from ABB-ES or their subcontractors will accomplish specific tasks such as well installation, sample collection, subcontractor oversight, data analysis, and report preparation. Oversight of staff activities will be accomplished by the management team described above. Specific roles and responsibilities for staff members are described in Section 3.1.2, Field Personnel Responsibilities.

2.3 SCHEDULE. Implementation of RFI activities will be accomplished in a phased-approach due to the number of SWMUs and the diversity of their past and/or present operations. The assumptions, tasks, sequences, and durations are described in the CAMP located in Appendix F, of Volume I. The project schedule as summarized in the Corrective Action Management Plan (CAMP), shows the tasks and activities for the NAVSTA Mayport RFI. This schedule will begin upon the approval of the Workplan and the Notice to Proceed. The schedule assumes ready access to the sites. The schedule also assumes there will be no delays due to the securing of required permits. The schedule may also be modified by the nature and extent of regulatory review cycles and new data collected during the RFI.

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3.0 FIELD SAMPLING PLAN (FSP)

The RFI field program, as presented in this FSP, has been designed to provide the necessary data required to meet the objectives of the NAVSTA Mayport RFI (see Section 3.1 of the Workplan, Volume I, and Section 2.0 of the CAMP, Appendix F, Volume I). The objectives of the field investigation are as follows:

- locate contaminated source areas,
- assess the nature and extent of contaminants found in soil, groundwater, surface water, and sediments,
- characterize regional and local hydrogeology,
- provide the database to undertake the health and environmental assessment, and
- obtain the required data to evaluate corrective action requirements.

Table 3-1 presents the tasks to be undertaken to achieve these objectives. The investigations have been planned using existing data (see Volume I, Workplan, Section 3.5) as a basis for the numbers and locations of investigative tasks. Adjustments to the proposed investigations may be made during the RFI as additional data become available. Such adjustments will result from discussions among the Field Operations Leader (FOL), the Project Technical Director, the TOM, and SOUTHNAVFACENCOM's EIC.

3.1 GENERAL SITE OPERATIONS.

3.1.1 Field Technical Guidance The purpose of the RFI is to collect data characterizing the nature and distribution of contamination at 18 NAVSTA Mayport SWMUs and to provide an adequate database for the performance of a Health and Environmental Assessment. The basic requirement for all work conducted under the Navy Installation Restoration Program (NIRP) is that data collected maintain consistent quality. Data must be precise, accurate, representative, complete, and comparable.

To meet these objectives, site activities will be conducted under the guidance of the Comprehensive QAPP (Appendix A) and the site-specific QAP (Appendix B). USEPA and naval technical guidance documents will also be used when guidance for a specific task is not provided in the Comprehensive QAPP or the site-specific QAP. These guidance documents are referenced whenever possible in the description of the field procedures. Copies of the referenced sections of the guidance documents along with this SAP will be maintained in the field trailer and reviewed with the field team before the start of each task. It is the responsibility of the FOL to acquaint field personnel with procedures to undertake the RFI field program.

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Table 3-1
Field Investigation Tasks

Sampling and Analysis Plan
NAVSTA Mayport
Mayport, Florida

Task	Description
1	Preliminary activities Specifications, bidding and award Permitting Site reconnaissance Mobilization
2	Geophysics Magnetometer survey at SWMU 1
3	Hydrogeologic investigation Monitoring well installation Piezometer installation Well measuring point survey Potentiometric surface survey Aquifer hydraulic properties testing Groundwater sampling
4	Surface water and sediment investigation
5	Surface soil investigation near SWMU 2
6	Soil gas investigation at SWMU 1
7	Potential receptor survey

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3.1.2 Field Personnel Responsibilities The project staff and field team for the RFI activities will work under the direction of the TOM and RFI Task Leader and will consist of the following personnel.

Field Operations Leader. The FOL in conjunction with personnel from NAVSTA Mayport's Public Works Department, will have the prime responsibility of providing secure areas for samples, waste materials, and equipment storage. The FOL is responsible for day-to-day review of the field activities performed onsite, overall management and coordination of the field work, and supervision and scheduling of work. The FOL will maintain consistency and require that field teams follow project-specific plans and that the implementation of field investigations are in compliance with appropriate guidelines.

Field or Rig Geologist. The geologist's responsibilities include overseeing boring and monitoring well activities, including the appropriate logging and documentation; ensuring that standard and approved drilling and monitoring well installation methods are followed; and ensuring that pertinent drilling and testing information is obtained during drilling.

Project Hydrologist. The hydrologist is responsible for planning and overseeing groundwater and surface water measurements and tests so that appropriate and valid results are obtained; determining the number of data points, sampling stations, wells, and reference measuring points needed to adequately define surface water and groundwater flow and enable groundwater contour mapping; and assessing the groundwater flow regime and identifying subsurface conditions that would affect flow.

Project Biologist. The biologist is responsible for planning and overseeing data collection and analysis related to the environmental assessment. As such, the project biologist works closely with other team members in developing the scope of work for the RFI and in data analysis throughout the RFI process.

Sampling Team Leader. The sampling team leader's responsibilities include monitoring procedures and requirements related to sampling and chain-of-custody according to appropriate guidelines.

Field Analyst(s). The field analyst's responsibilities include onsite gas chromatograph (GC) analyses including calibration, quality control, recording of results, and maintenance of the field equipment.

Sampling Personnel. The sampling personnel are responsible for the proper collection, preservation, packaging, documentation, and initial chain-of-custody of samples until released to another party for storage or transport to the analytical laboratory.

Health and Safety Officer. The HSO is responsible for monitoring activities during site work and enforcing the HASP. The HSO will have the authority to stop work if conditions exceed allowable limits and, as appropriate, will assume certain sampling responsibilities.

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Site-Safety Officer. For this project, the project HSO may not be onsite at all times. Therefore, a sampling team member will be designated as Site Safety Officer to monitor procedures and report inconsistencies to the HSO. The designee will have the power to stop work should conditions exceed allowable limits.

Drilling Subcontractor. The drilling subcontractor is responsible for obtaining drilling permits and clearances; supplying all services (including labor, equipment, and materials) required to perform the drilling, testing, and well installation program; and conducting necessary maintenance and quality control of required equipment. The drilling subcontractor will be responsible for following decontamination procedures specified in the SAP and HASP. Upon completion of the work, the drilling subcontractor will be responsible for demobilizing all equipment, cleaning up any materials deposited onsite during drilling operations, and properly backfilling or grouting any borings.

Other Subcontractors. Survey subcontractors will also be onsite and will be responsible for completion of their respective activities.

It should be noted that field team members will assume the duties of several of the positions described above.

3.1.3 Personal Protection A HASP has been prepared as part of the RFI Workplan (Volume III). The HASP provides information regarding the required levels of protection for various tasks. The HASP also details personal decontamination procedures.

3.1.4 Mobilization Activities Following SOUTHNAVFACENCOM approval of the project's Workplan and the issuance of a written Notice to Proceed, arrangements will be made to place a command post onsite, schedule a field sampling crew, and have sampling and health and safety equipment shipped to the site. Provisions for electrical power and a telephone will also be made.

Additional mobilization activities will include familiarizing the sampling crew with this FSP and applicable field technical guidelines prior to initiating the investigation.

3.1.5 Sample Identification and Chain of Custody All samples collected during the field investigation will be labeled with a unique sample identification code that identifies the site, sample location, sample type, and series numbers for sample locations with multiple samples.

The samples at the NAVSTA Mayport (MPT) sites will be labeled using the following system.

- Site. Always MPT-XXX, where "XXX" refers to the site number, production well number, or stream sampling location.

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Sample Type.

MS - monitoring well soil
MW - monitoring well water
MG - monitoring well gas
MR - monitoring well rock core

BS - test boring soil
BW - test boring water
BG - test boring gas
BR - test boring rock core

SS - surface soil
SW - surface water
SG - soil gas
VG - landfill vent gas

QT - quality control trip blank
QS - quality control sampler blank
QF - quality control filtration blank
QM - lab quality control method blank
FB - quality control field blank

RW - raw water
RI - raw influent
FI - final effluent
SL - sludge

SD - sediment
WT - waste
WP - wipe
CT - concrete
AT - asphalt

AG - ambient air (gases), grab sample
LG - ambient air (gases), long-term sample
PS - test pit soil
PW - test pit water

DW - draining water
WY - water supply
LT - leachate
PC - primary clarifier effluent
SC - secondary clarifier effluent

Sample Location. Sample locations will be indicated by a number that corresponds to the sample collection location and will be used in combination with the sample type. For example, sample MPT-XXX-SW-3 is a surface water sample collection at location 3 as shown on a site plan for Site XXX.

Sample Number. For circumstances where multiple samples will be collected from the same location, each sample will be consecutively numbered. For example, MPT-XXX-SW-3-01 and MPT-XXX-SW-3-02 are surface water samples collected at the same location but at different times. For soil borings, the number designating the boring location will be followed by a sample depth range in parenthesis. A sample collection at MPT-XXX-BS-01 from a depth of 4 to 5 feet would be designated:

MPT-XXX-BS-01(4-5)-1

For duplicates, a letter designation will be used for the duplicate sample. For example, the duplicate of MPT-XXX-BS-01(4-5)-1 will be:

MPT-XXX-BS-01(4-5)A-1

If a duplicate is taken at that point again, the number would become:

MPT-XXX-BS-01(4-5)A-2

Chain-of-custody procedures as outlined in Section 7.0 of the QAPP (Appendix A) will be followed during all RFI activities. A complete listing of groundwater, soil, sediment, sludge, surface water, and quality control sample identifications is presented in the site-specific QAP (Appendix B).

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3.1.6 Sample Container, Preservation, and Holding Time Requirements Sample container, preservation, and holding time requirements are specified in Section 6.0 of the Comprehensive QAPP (Appendix A). Samples requiring preservation will be preserved immediately following collection.

3.1.7 Sample Packaging, Shipping, and Tracking Samples will be packaged and shipped in accordance with procedures presented in Section 7.2 of the Comprehensive QAPP (Appendix A). The FOL will be responsible for coordinating with the Laboratory Coordinator (LC), who will contact the analytical laboratory for each shipment of samples.

The LC will be contacted at least 1 week before each sampling episode and arrangements will be made to have spikes and blanks prepared and picked up. The LC will be informed of any changes in the number and types of samples as the changes occur. The analytical laboratory will be contacted on the day of each shipment of samples and provided with the following information:

- dates the samples were shipped,
- types of samples,
- number of samples, and
- airbill number.

For purposes of scheduling, the analytical laboratory will track sample shipment, receipt, analysis, and data validation and will be responsible for forwarding this information to the LC who will then forward copies to SOUTHNAVFACENGCOM's EIC.

3.1.8 Documentation Bound, weather-proof field notebooks will be maintained by the field team. Team members shall record all information related to sampling time, weather conditions, unusual events (e.g., well tampering), field measurements, etc.

In addition to the field notebooks, a site logbook shall be maintained by the FOL. This log will contain a summary of the day's activities and will reference field notebooks when applicable. Various field reports will also be maintained. Field reports for this project shall include boring logs, monitoring well installation reports, and the various forms discussed in Section 3.2.7 of this FSP.

3.1.9 Performance of Field Audits During field activities, a Quality Assurance/Quality Control audit of procedures will be performed by the QA officer as described in Section 12.0 of the Comprehensive QAPP. The QA officer will accompany personnel into the field to verify that the site FSP is being followed. Audit findings will be documented and distributed to project team members and the project file.

3.1.10 Quality Control Samples Quality control samples generated for laboratory analyses during the NAVSTA Mayport RFI will include duplicate samples, laboratory referee replicate samples (if requested by either Florida Department of Environmental Regulation (FDER) or USEPA), spiked samples, trip blanks, field blanks, and equipment blanks. Trip blanks and spiked samples will be provided

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by the laboratory. Specific requirements are described in Section 11.0 of the QAPP, Appendix A.

3.1.11 Field Changes and Corrective Action The FOL or his designee is responsible for all site activities. In this role, the FOL may, at times, be required to adjust the site program to accommodate site-specific needs. When such a change is determined to be necessary, written notification will be submitted by the initiator of the change to the TOM and SOUTHNAVFACENGCOC's EIC, and a copy will be attached to the file copy of the affected document. If unacceptable, the actions during the period of deviation will be evaluated to determine the significance of the departure from established program practices.

Changes made in the field to a site program will be documented on a Field Change Request Form (Figure 3-1). This form will be signed by the initiator and the TD. Field Change Requests will be numbered sequentially, starting with the number 1.

The RFI Task Leader is responsible for the control, tracking, and implementation of the identified site program changes. Completed Field Change Request Forms will be distributed to affected parties that will include, at a minimum, SOUTHNAVFACENGCOC's EIC and the PM, TOM, QAO, and FOL.

3.1.12 Field Instruments Numerous field monitoring and screening instruments will be used during the field investigation and may include the following:

- temperature probe,
- specific conductance meter,
- pH meter,
- Eh meter,
- photoionization or flame ionization meter,
- radiation meter,
- dual detector, percentage O₂/ percentage Lower Explosive Limits (LEL), and
- electronic water level meter.

Each instrument will be calibrated according to the manufacturer's operating manual prior to each day's use. Calibration will be documented on the Field Instrumentation Quality Assurance Record (Figure 3-2). During calibration, an appropriate maintenance check will be performed on each piece of equipment. If damaged or failed parts are identified during the daily maintenance check and it is determined that the damage could impact the instrument's performance, the instrument will be removed from service until the identified parts are repaired or replaced. An equivalent piece of equipment will be substituted for the downed instrument to maintain schedule.

3.1.13 Decontamination Procedures Field sampling equipment will be decontaminated using the procedures outlined in Section 6.3 of the Comprehensive QAPP (Appendix A). Each step of the decontamination procedure will be reviewed by field team members during the mobilization phase of the project.

QUALITY ASSURANCE PROJECT PLAN
SOUTHERN DIVISION CONTRACT NO. _____
REVISION NO. _____
REVISION DATE _____

ACTIVITY _____

PROJECT NO. _____

INITIATOR _____ LOCATION _____ DATE _____

TO _____ LOCATION _____ DATE _____

DESCRIPTION:

REASON FOR CHANGE:

RECOMMENDED ACTIONS:

FIELD OPERATIONS LEADER (Signature) _____ DATE _____

FINAL DISPOSITION:

TASK LEADER _____ DATE _____

DISTRIBUTION: Program Manager _____ Others as Required _____
Task Leader _____
Southern Division EIC _____
Project Manager _____
Quality Assurance Manager _____
Field Operations Leader _____

FIGURE 3-1
FIELD CHANGE REQUEST FORM



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FIELD INSTRUMENTATION QUALITY ASSURANCE RECORD

PROJECT JOB NO. DATE

EQUIP. TYPE/I.D.	BATTERY COND.	CALIBRATION INFORMATION		
_____	_____	pH 4 _____	pH 7 _____	pH 10 _____
_____	_____	pH 4 _____	pH 7 _____	pH 10 _____
_____	_____	pH 4 _____	pH 7 _____	pH 10 _____
_____	_____	COND STD. _____ / _____	COND STD. _____ / _____	
_____	_____	COND STD. _____ / _____	COND STD. _____ / _____	
_____	_____	COND STD. _____ / _____	COND STD. _____ / _____	
DISSOLVED OXYGEN	_____	AVG. WINKLER VALUE _____	PPM	METER VALUE _____ PPM CORR _____
REDOX	_____	ZINBELL SOL. VALUE _____	METER VALUE _____	CORR _____
TOXICIZATION METER	_____	ZERO/ZERO AIR? <input type="checkbox"/> YES <input type="checkbox"/> NO	SPAN GAS VALUE _____	PPM EQUIV. _____
OTHER	_____		METER VALUE _____	PPM EQUIV. _____

FLUIDS MATERIALS RECORD

DEIONIZED WATER SOURCE: ECJ STAGING PORT. SYSTEM OTHER _____

TRIP BLANK WATER SOURCE: ECJ LAB, LOT NO. _____
 OTHER, ID _____

DECONTAMINATION FLUID: METHYL HYDRATE, LOT NO. _____ OTHER _____ LOT NO. _____

SAMPLER BLANK WATER SOURCE: ECJ STAGING PORT. SYSTEM OTHER _____

MNCS/D.I. RINSE SOLUTION: ECJ STAGING, ID _____

PRESERVATION CHEMICAL LOT I.D.'S: CHEMICALS USED: HNO3 LOT NO. _____
 H2SO4 LOT NO. _____
 HCL LOT NO. _____
 NaOH LOT NO. _____
 ZNAC LOT NO. _____

FILTRATION PAPER I.D.:
 MANUF/TYPE _____
 LOT NO. _____

SAMPLER SIGNATURE _____

STANDARDS

MANUF. _____
 LOT NO. _____

FIGURE 3-2
FIELD INSTRUMENTATION
QUALITY ASSURANCE RECORD



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3.1.14 RFI Waste Management All potentially hazardous wastes generated during the RFI will be placed in Department of Transportation (DOT) approved 55-gallon drums and stored onsite in a secure area. Wastes that will be handled in this way include:

- nitric acid solution and ethanol/methanol from decontamination,
- disposable protective clothing,
- disposable sampling equipment,
- well development and purge water, and
- soil cuttings from the drilling program.

NAVSTA Mayport, through the Defense Reutilization and Marketing Office, will be responsible for the removal and disposal of these drums.

All non-contaminated waste materials generated on site will be collected and bagged for appropriate disposal as normal domestic waste.

3.2 RFI FIELD PROGRAM OVERVIEW. Seven major tasks have been delineated for the RFI field investigation. The tasks include Preliminary Activities, the Geophysics Program, the Hydrogeologic Investigation, the Surface Water and Sediment Investigation, the Surface Soil Investigation, the Soil Gas Investigation, and the Potential Receptors Survey.

The primary tasks to be undertaken include the installation of upgradient and downgradient monitoring wells; the determination of geological characteristics at each well location; sampling and analysis of groundwater, sediment, surface soil, surface water, and sludge; characterization of known source areas and groundwater contaminants; and identification of potential receptors. The following sections present a detailed discussion of the tasks that will be undertaken to complete the RFI field program.

3.2.1 Preliminary Activities Preliminary activities associated with the RFI at NAVSTA Mayport include securing subcontractors to perform the monitoring well and piezometer installations and well measuring point survey, arranging for the acquisition of necessary permits and other authorizations, conducting a reconnaissance of the sites to determine logistics (i.e., location of exploration, decontamination stations, etc.), and mobilization of equipment and supplies to NAVSTA Mayport.

The mobilization subtask consists of field personnel orientation and equipment mobilization, and will be performed at the initiation of the subsurface investigation and sampling program. A field team orientation meeting will be held to familiarize personnel with site history, health and safety requirements, and field procedures.

Equipment mobilization will include the procurement or rentals (if appropriate) and set-up of the following items:

- field office (portable trailer),
- sampling equipment,
- health and safety equipment,

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- decontamination materials, and
- utility hook-ups, if necessary.

3.2.2 Geophysics Program A magnetometer survey will be conducted at SWMU 1 using a Fisher TW-6^m magnetometer or equivalent in the area northwest of the reported landfill boundary where 27 drums of xylene were discovered during excavation for the expansion of the wastewater treatment plant in 1989. The magnetometer will detect buried objects, if present, and further define the boundaries of the landfill. Approximate location of the area to be surveyed is described in Section 3.3.2.

3.2.3 Hydrogeologic Investigation The hydrogeologic investigation at the 18 SWMUs located at NAVSTA Mayport is composed of five tasks. These tasks include:

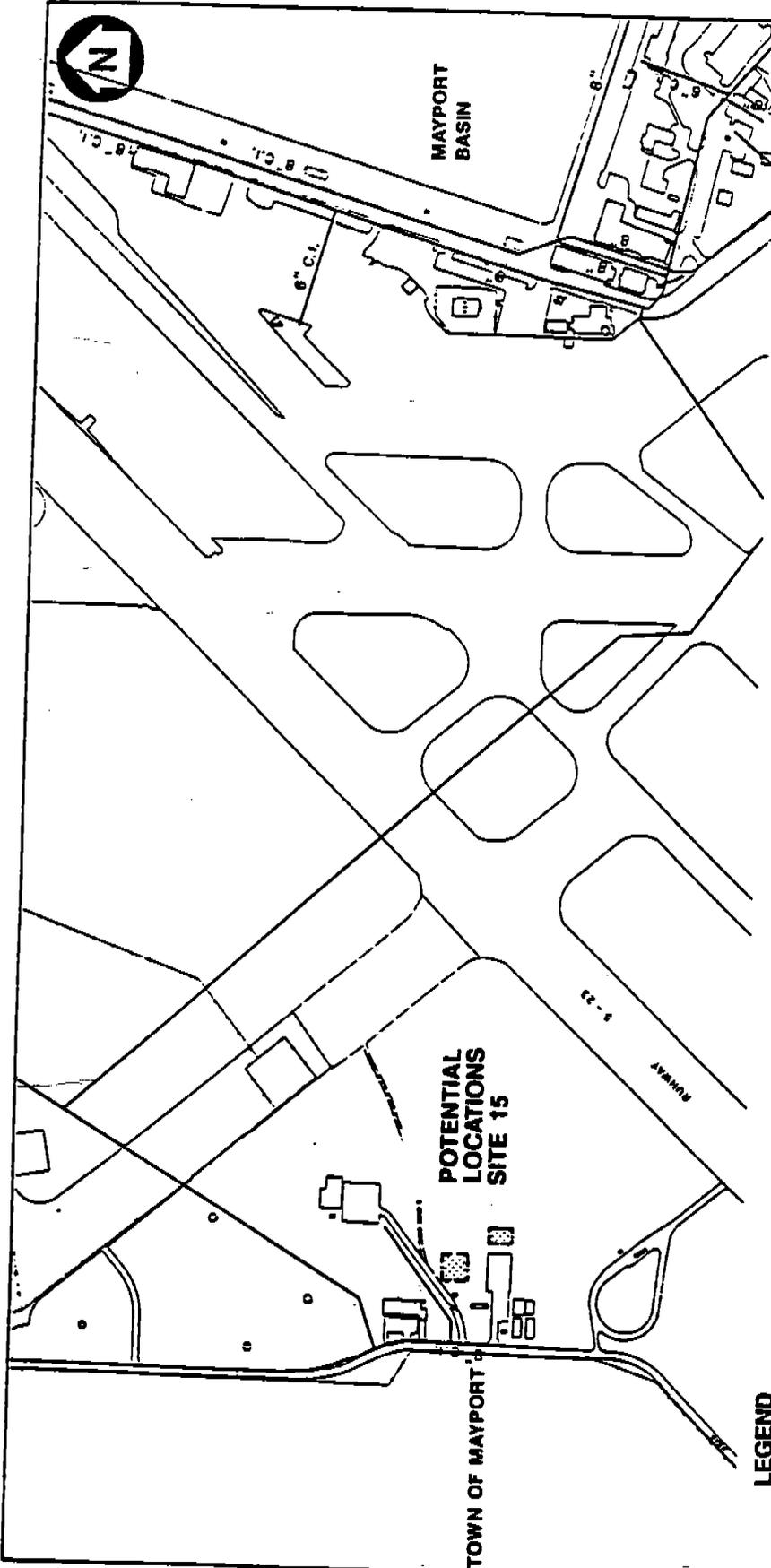
1. monitoring well and piezometer installation,
2. groundwater sampling and analysis,
3. well measuring point survey,
4. potentiometric surface survey, and
5. aquifer hydraulic properties investigation.

Information derived from these tasks will be used to provide data to conduct a Health and Environmental Assessment and develop a corrective action plan, if necessary.

3.2.3.1 Monitoring Well and Piezometer Installation Twenty-seven monitoring wells are scheduled for installation at NAVSTA Mayport (Table 3-2). These wells will be distributed between 8 paired well clusters and 11 individual monitoring wells. This program is designed to monitor groundwater quality as well as define groundwater flow characteristics. Proposed monitoring well specifications are presented in Section 3.3. Typical details for monitoring wells installations are presented in Figures 3-3A through 3-3D. Existing well construction details are presented in Appendix D of Volume I, Workplan, for reference. Installation procedures were described in the Final ESI Report (E.C. Jordan, April 1988). Boring logs for these existing are presented in Appendix E of Volume I Workplan for reference.

Boreholes for surficial aquifer monitoring well installation will be advanced using the hollow-stem auger (HSA) technique. Boreholes for secondary aquifer monitoring wells will be advanced by a combination of HSA and rotary technique. Standard penetration tests (ASTM designation: D 1586-84) will be conducted at 5-foot intervals throughout each overburden boring. Overburden samples collected with the split-spoon sampler will be logged (ASTM Designation: D 2488-84) by the onsite field geologist for the purpose of identifying geological characteristics at each well location. The field geologist will visually determine soil types using the Unified Soil Classification System. Boring logs of subsurface conditions will be prepared based on field observations.

Figures 3-3A, 3-3B, 3-3C, and 3-3D present typical monitoring well and piezometer installation details for NAVSTA Mayport. The rationale for well depths and screen placement are presented in Volume I, Workplan. Well screens for the shallow surficial aquifer monitoring wells will be placed to extend from



APPROX. AREA OF SITE LOCATION

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**FIGURE 3-19
SITE PLAN
(SITE 15)
SWMU 15 - OLD PESTICIDE AREA**



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Table 3-2
Summary of Monitoring Well Installations

Sampling and Analysis Plan
NAVSTA Mayport
Mayport, Florida

SWMU Number	Monitoring Well No.
1	MPT-1-4DD MPT-1-4S MPT-1-5D MPT-1-5S MPT-1-6D MPT-1-6S MPT-1-7DD MPT-1-7S
2, 3, 4, 5, and 22	MPT-2-11S MPT-2-12D MPT-2-12S MPT-2-16DD MPT-2-16S MPT-2-17DD MPT-2-17S MPT-22-1
6, 7, 8, 9, and 10	MPT-8-4S MPT-8-5DD MPT-8-5S
13	MPT-13-4S MPT-13-5S MPT-13-6S
14	MPT-14-3S
15	MPT-15-1S
16	MPT-16-1D MPT-16-2S MPT-16-2D

Notes: SWMU = solid waste management unit.
S = Shallow Surficial Aquifer.
D = Deep Surficial Aquifer.
DD = Secondary Aquifer.

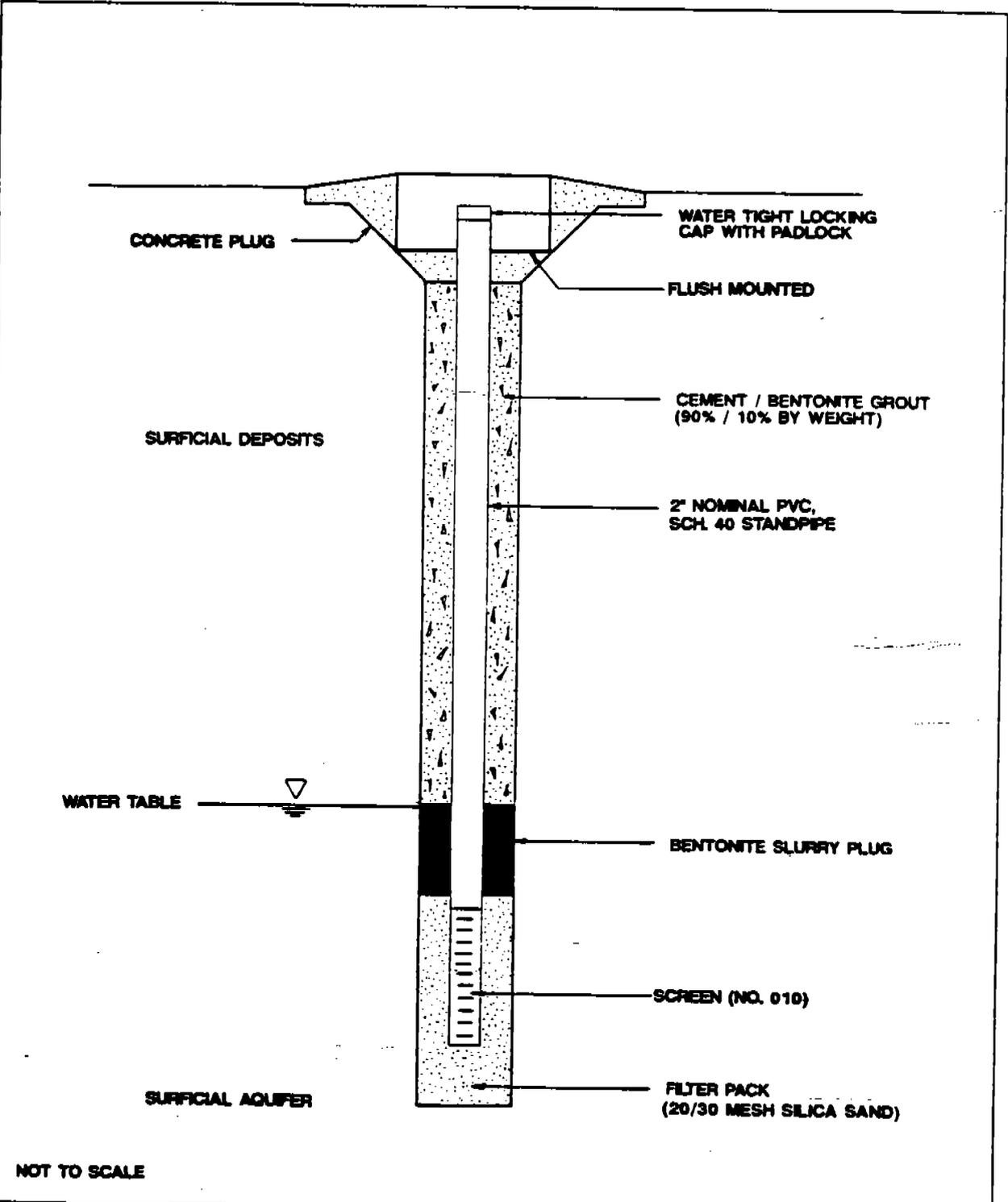


FIGURE 3-3A
PIEZOMETER INSTALLATION DETAIL
(SURFICIAL AQUIFER)



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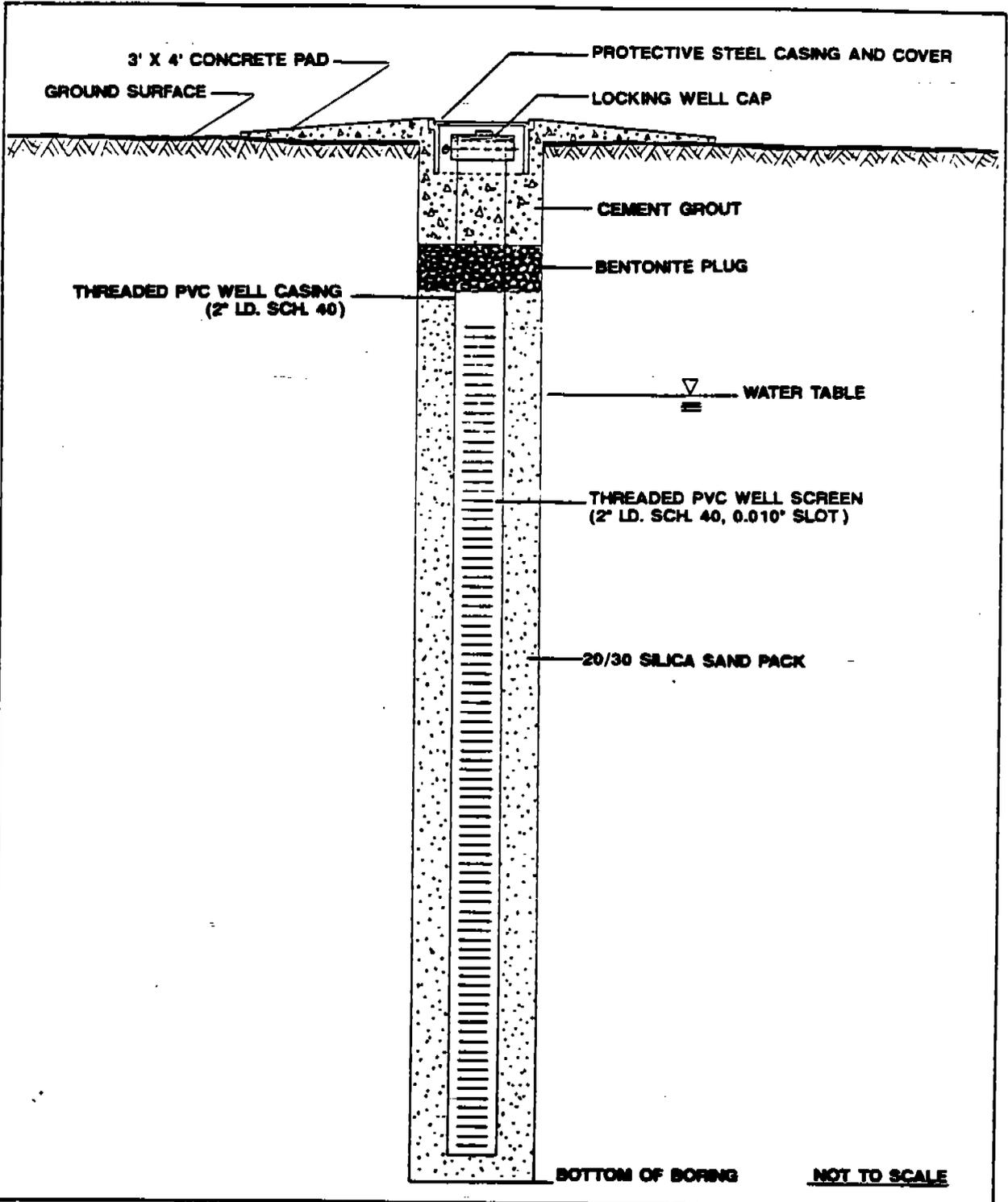
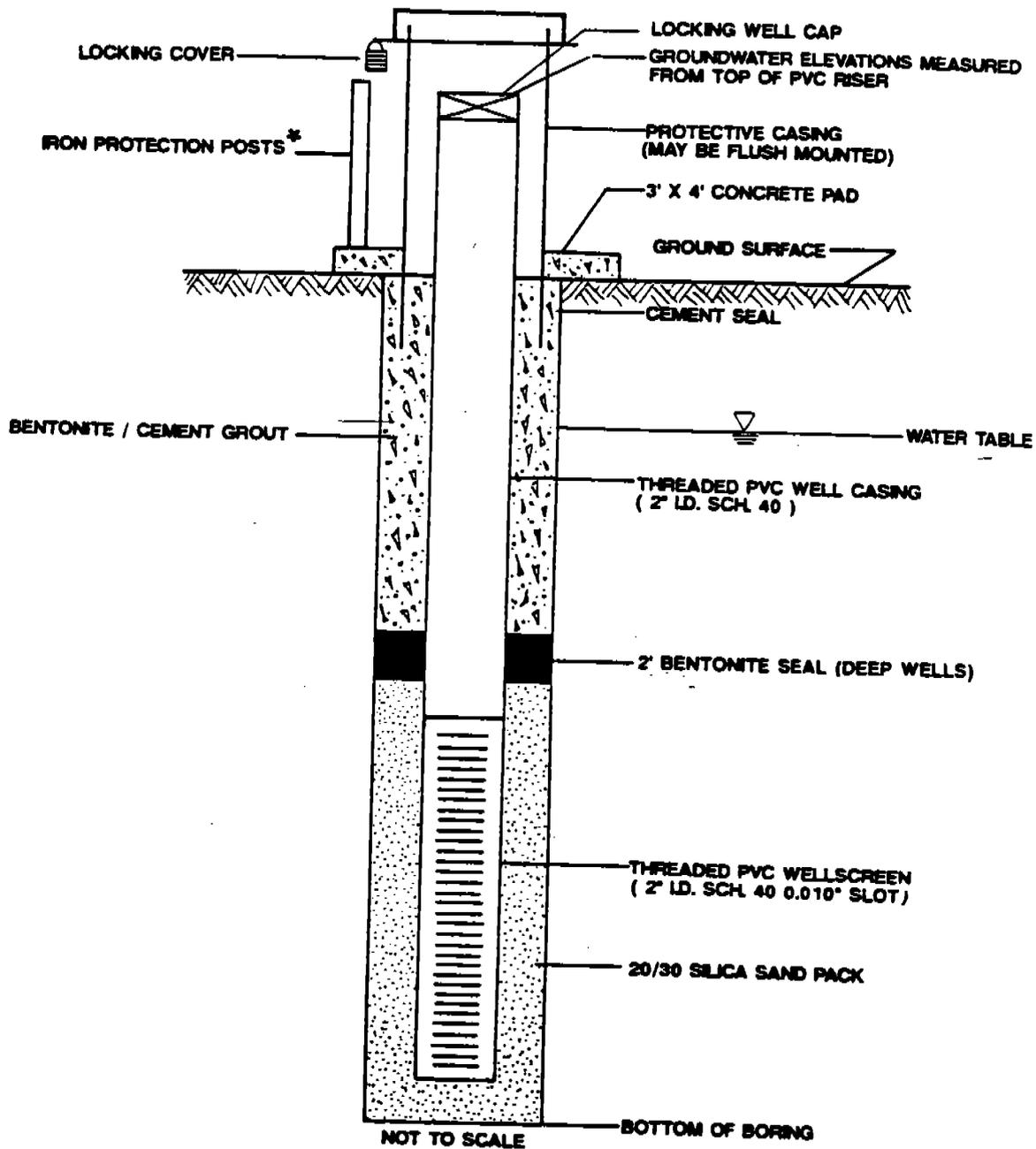


FIGURE 3-3B
TYPICAL SHALLOW MONITORING
WELL INSTALLATION DETAIL
(SURFICIAL AQUIFER)



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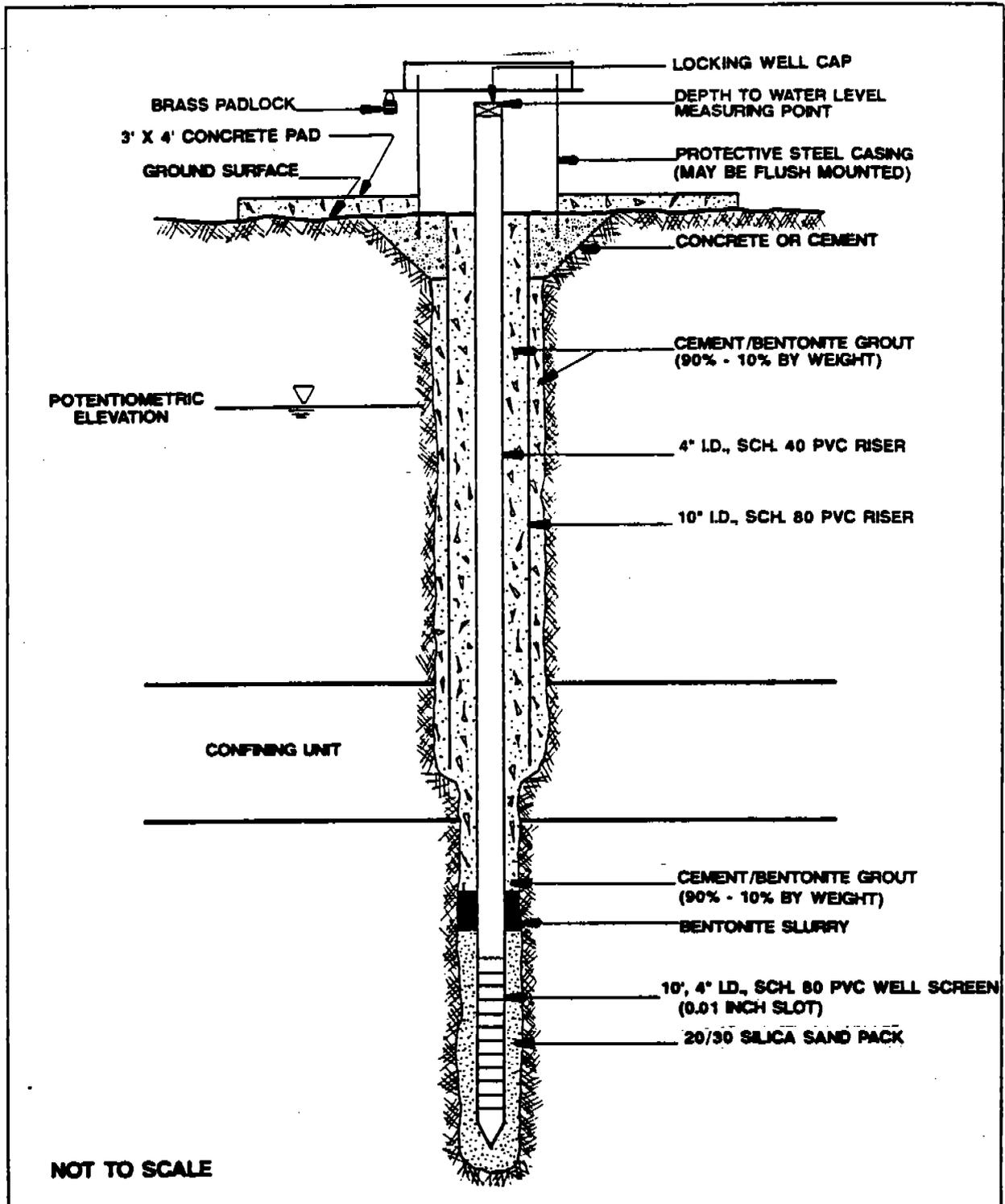


* INSTALLED ONLY AT BORING LOCATIONS WHERE THERE IS A RISK OF DAMAGE TO THE MONITORING WELL FROM EQUIPMENT OPERATIONS OR VEHICULAR TRAFFIC.

FIGURE 3-3C
TYPICAL DEEP MONITORING WELL
INSTALLATION DETAIL
(SURFICIAL AQUIFER)



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NOT TO SCALE

**FIGURE 3-3D
MONITORING WELL
INSTALLATION DETAIL
DOUBLE CASED WELL
(SECONDARY AQUIFER)**



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approximately 2 to 3 feet above the water table to approximately 8 feet below the water table (Figure 3-3B). Wells will be constructed of 2-inch inside diameter (ID), flush-threaded, Schedule 40 PVC riser pipe with a 10-foot section of 0.010-inch slotted PVC well screen. The annulus around the screen will be packed using 20/30 grade silica sand to approximately 6 inches above the screen. Shallow wells will have a 6-inch fine grained sand layer placed over the silica sand pack to prevent the grout mixture from influencing groundwater quality.

Deep wells in the shallow surficial aquifer will have at least a 2-foot bentonite pellet seal above the top of the sand pack (Figure 3-3C). Upon hydration of the bentonite or placement of the fine-grained sand layer, the annular space above the bentonite or fine-grained sand seal will be tremie grouted with a bentonite/cement slurry to the surface to eliminate any vertical conduits created during the drilling process. Material and construction of the monitoring wells will conform with SOUTHNAVFACENCOM's *Guidelines for Groundwater Monitoring Well Installation* (March 27, 1989) (Appendix D) and Chapter 40 A-3, Florida Administrative Code (FAC), *Regulation of Wells as Enforced by the St. Johns River Water Management District*. Borehole construction and monitoring well installation methods are described in Technical Memoranda in Appendix B, Volume II.

Deep wells constructed to the top of the Hawthorn Group will be double-cased. The depth to the upper part of the Hawthorn Group is estimated to be 100 to 125 feet below land surface (bls). For each deep well, the outer casing will be constructed of 10-inch ID Schedule 80 PVC (Figure 3-3D). This material specification is an exception to SOUTHNAVFACENCOM's guidelines (Appendix D). However, it has been approved by the EIC. The inner casing will be constructed of 4-inch ID Schedule 40 PVC. A 14-inch diameter borehole will be bored through the overburden and into the first clay confining layer (estimated to be between 25 to 50 feet bls depending on the location at the site). The surface casing will then be placed into the borehole and sealed with grout. The borehole and outer casing will extend into the clay confining layer a minimum of 5 feet. The outer casing shall be grouted by the tremie method. The grout will be pumped into the annular space between the outer casing and the borehole wall. This will be accomplished by placing the tremie tube in the annular space and pumping the grout from the bottom of the borehole to the surface. The grout seal will be allowed to set at least 24 hours before drilling through it to install the inner casing. The grout mixture used to seal the outer annular space will be a cement/bentonite grout (90/10 by weight). The drilling contractor will verify the mixture in the field using a mud scale.

When drilling through the seal, care will be taken to prevent cracking, shattering, and/or washing out of the seal. If caving conditions exist so that the outer casing cannot be sufficiently sealed by grouting, the outer casing shall be pressure driven into place with a grout seal placed at the bottom of the casing.

The well screen will be approximately 10 feet in length (depending on the observed stratigraphy) with a slot size of 0.010 inch. A filter pack composed of 20/30 silica sand will be placed around the well screen. A 2- to 3-foot bentonite slurry plug will be placed above the filter pack. The annulus above the bentonite seal (between the lower borehole and the inner casing, and the

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surface casing and the inner casing) will be grouted with a cement grout (90/10 by weight).

An aboveground protective steel casing will be installed and secured with concrete into the ground over each well riser. The steel casings will be equipped with locking covers and "keyed-alike" brass padlocks. A concrete pad will be placed at land surface around each protective casing to secure the casing and to prevent surface runoff from entering the borehole. The aboveground parts of both the well riser and protective casing will be vented. Wells will be identified using SOUTHNAVFACENCOM's identification scheme (Appendix D). In vehicular traffic areas four, protective steel posts will be installed around the monitoring well in accordance with SOUTHNAVFACENCOM's specifications (Appendix D). Well installation and development will be done in accordance with SOUTHNAVFACENCOM specifications (Appendix D). Any deviation from these specifications will require prior approval from the EIC, RFI Task Leader, and Region IV Administrator.

Temporary piezometers will be installed at various locations. Boreholes for the piezometer installation will be advanced to 5 feet below water surface using the HSA technique. Hand augers may be used when feasible. Piezometers will be constructed of 2-inch ID, Schedule 40 PVC with a 5-foot section of 0.010-inch slotted PVC well screen. The annulus around the screen will be packed using 20/30 grade silica sand. Once the piezometers are installed, they will be surveyed and water level measurements will be collected and plotted to determine groundwater flow direction. Upon completion of the investigation, the piezometers will be removed and the borehole will be tremie grouted to the land surface with neat cement.

Piezometers (in addition to existing and new monitoring wells) will be used to obtain groundwater elevation data for the shallow water table aquifer at or near each SWMU. Piezometers will be installed vertically so that they penetrate the aquifer to a depth that is below the expected low water table elevation. The last available groundwater elevation measurements were taken during the Expanded Site Inspection (ESI) on October 8, 1987. These data indicated that groundwater varied in depth below ground level from 0.14 foot (MPT-2-3) to 10.64 feet (MPT-8-3) with an average depth over the entire NAVSTA Mayport of 4.85 feet. To compensate for potential variations caused by tidal influences, piezometers will be installed at least 5 feet below the observed groundwater elevations found during installation.

Overall average piezometer depth will be about 10 feet bls. However, individual piezometers will vary from installation to installation. The following estimates of piezometer depths are presented based on previous groundwater elevations measured during the ESI (E.C. Jordan, 1988).

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<u>RFA SWMU Location</u>	<u>Typical Depth (feet)</u>
SWMU 1	14
SWMU 2, 3, 4, and 5	8
SWMU 6, 7, 8, 9, and 10	14
SWMU 11, 12, and 16	13
SWMU 13 and 22	8
SWMU 14	8
SWMU 15 and 17	(Presently unknown; to be determined in the field.)

Actual depths will be determined based on groundwater levels encountered during piezometer installation.

3.2.3.2 Groundwater Sampling and Analysis A total of 55 groundwater samples are scheduled to be collected from the new and existing monitoring wells located at the sites under investigation at NAVSTA Mayport. All samples will be collected in accordance with procedures discussed in Section 6.7.2 of the Comprehensive QAPP (Appendix A). All samples will be sent to the laboratory for analyses of the constituents listed in Section 3.4 of this SAP. Specific well installation and groundwater sampling locations are discussed in Section 3.3. The rationale for well installation and sample locations are presented in Volume I, Workplan.

3.2.3.3 Well Measuring Point Survey Subsequent to monitoring well installation, a well elevation and location survey will be conducted by a State of Florida-registered land surveyor. The spatial position, elevation of well measuring point, and ground elevation will be surveyed for the new monitoring wells and piezometers installed at NAVSTA Mayport. Spatial coordinates for wells and piezometers will be referenced to the NAVSTA Mayport grid coordinate system (i.e., Florida Rectangular Grid System, East Zone). All elevations will be based on the National Geodetic Vertical Datum (NGVD) of 1929. These locational data will be convertible to other coordinate systems that may be required by State or Federal regulatory agencies.

Third order accuracy will be required for the survey. Horizontal locations will be located to an accuracy of 0.1 foot and elevations will be surveyed to an accuracy of 0.01 foot.

3.2.3.4 Potentiometric Surface Survey To further characterize the gradient and direction of groundwater flow and the effects of tidal fluctuations, a piezometer and tidal influence study will be conducted at each site. The piezometer study will include the installation of approximately 30 temporary piezometers at locations shown on the Figure 2-2 "Proposed Piezometer and Monitoring Well Network." Piezometers will be manually installed with a hand auger where feasible to a minimum depth of 5 feet below the water table. HSA technique may be used at other locations. In the event of sloughing sands, drilling mud may be mixed and poured into the borehole while advancing the boring. At each location, a 2-inch, flush-threaded PVC casing with a 5-foot screen section will be installed to total depth in each borehole. Where possible, a filter pack should be installed around each screen interval. The remaining annular space will be

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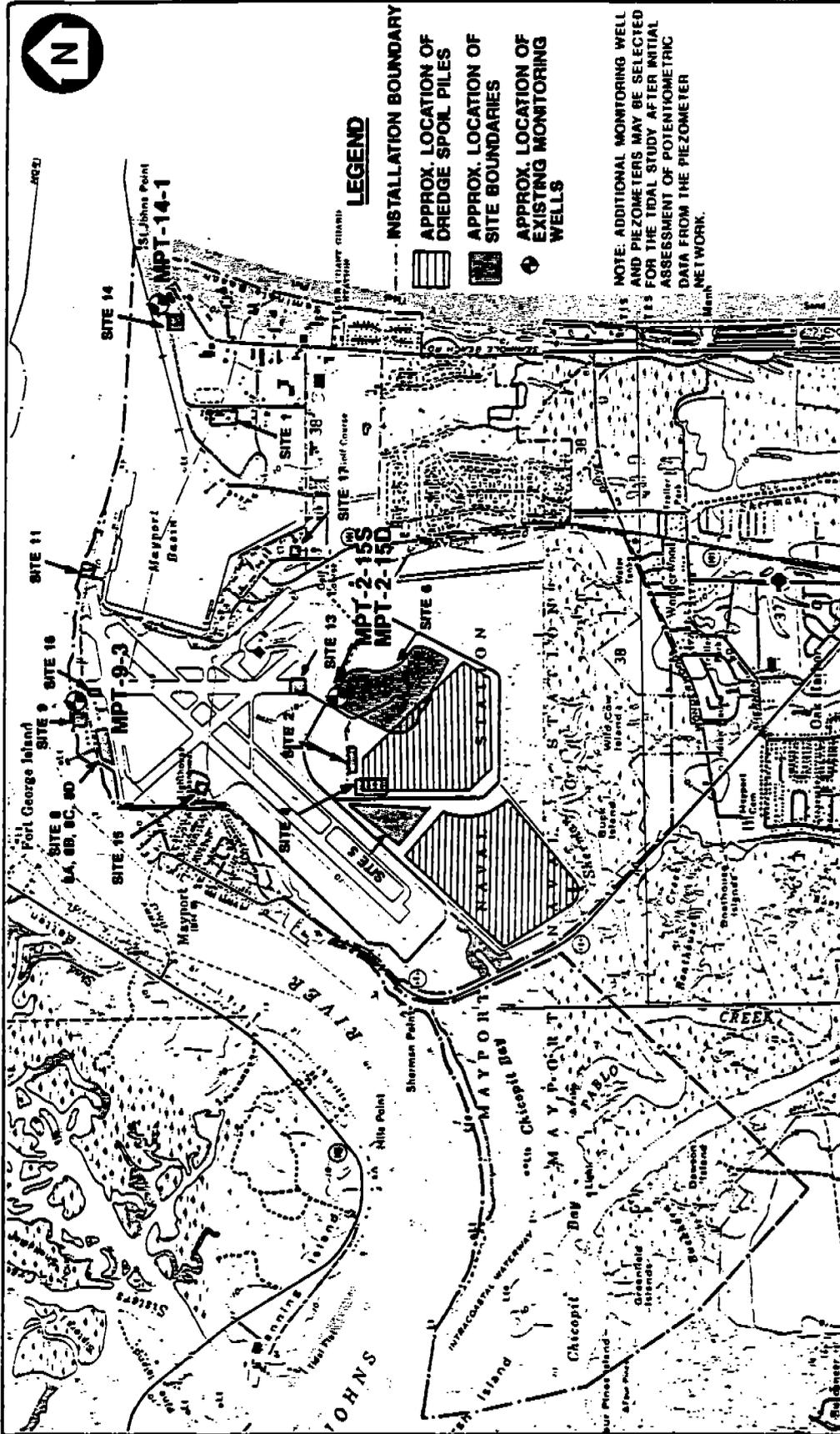
grouted to land surface with cement to stabilize each piezometer for surveying and water level measurements. The PVC casing should stick up a minimum of 3 feet for easy visual identification in less traveled areas. In high traffic areas, piezometers will be elevated only slightly above land surface to reduce damage risks. Upon completion of the piezometer installation phase, top-of-casing elevations will be obtained and incorporated with existing data points (i.e., existing and newly installed monitoring wells) to develop potentiometric surface maps. To assist in determining seasonal fluctuations, water levels will be obtained monthly from all monitoring points for a 1-year period. Potentiometric surface maps will then be produced for each month's datum and incorporated into the RCRA Corrective Action Program at NAVSTA Mayport.

In addition, water levels from selected monitoring wells in different areas of the base will be monitored every hour for a 2-day (48-hour) period to determine possible tidal affects for each investigative site. Monitoring during a 48-hour period will ensure that a minimum of two complete tidal cycles are studied. A staff gauge will be installed at all potentially impacted water bodies (i.e., the Atlantic Ocean, the St. Johns River, and tidal marshes) to compare groundwater level fluctuations with tidal fluctuations. At the completion of the study the data will be tabulated and water level data will be reduced and analyzed. Scheduling of the study will be correlated with a time period of predicted large tidal differences between mean higher high water (MHHW) and mean lower low water (MLLW) to provide significant changes in groundwater table fluctuations during the study. Figure 3-4 presents some of the monitoring well locations proposed for the tidal influence study. Additional monitoring wells may be selected based on the initial findings obtained from the piezometer network which will be installed first.

3.2.3.5 Aquifer Hydraulic Properties In order to characterize the hydraulic properties in the upper zone of the surficial aquifer, slug tests of new and existing monitoring wells will be undertaken. Single-hole permeability tests (slug tests) will be performed on each monitoring well. Both rising and falling head slug tests will be performed in each individual well except for wells that are screened across the water table. In this case, only rising head tests will be performed. Data will be analyzed by either the method of Cooper and others (1967) for confined conditions or the method of Bouwer and Rice (1976) for unconfined conditions. Details on undertaking the slug test are presented in the site-specific QAP (Appendix B).

Calculated values of hydraulic conductivity (K) will be evaluated by means of a one-way analysis of variance to determine if a significant difference in K exists in the surficial aquifer underlying NAVSTA Mayport. Comparisons shall be made at the 95 percent significance level. Should significant differences exist, a Tukey's test or equivalent statistical technique will be run to test for significant differences between individual pairs of sample means.

3.2.4 Surface Water and Sediment Investigation In that marshes, swamps, and the St. Johns River are the primary receiving water bodies for both groundwater and overland flow, sampling stations have been established to collect surface water and/or sediment samples for laboratory analysis at SWMU 1; SWMU Grouping 2, 3, 4, and 5; SWMU Grouping 6, 7, 8, 9, and 10; SWMU 13; SWMU 14; and the background

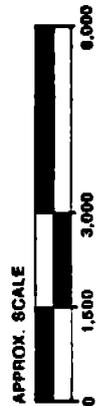


RCRA FACILITY INVESTIGATION SAMPLING & ANALYSIS PLAN

U.S. NAVAL STATION MAYPORT, FLORIDA



FIGURE 3-4
TIDAL FLUCTUATION MONITORING WELLS



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stations. Locations of these sampling stations are discussed and shown in Section 3.3 on a site-by-site basis. The rationale for sample locations is discussed in Volume I, Workplan. The intent of the program is to evaluate whether the surrounding wetlands and rivers have been impacted by contamination at NAVSTA Mayport. Data derived from this subtask will be used in the environmental assessment.

3.2.4.1 Number and Location of Sampling Stations Excluding duplicates 9 surface water, 11 sediment, and 4 sludge samples will be collected from the locations described in Section 3.3. These sample locations are approximate and may be relocated based on actual site conditions. All samples will be sent to the laboratory for analyses of the constituents specified in Section 3.4 of this SAP.

3.2.4.2 Sampling Procedures All samples will be collected in accordance with procedures discussed in Sections 6.7.3 (surface water) and 6.6.5 of the Comprehensive QAPP (Appendix A) and the Technical Memorandum (Appendix B). Surface water samples will be collected by dipping the sampler container directly into the water. If the water is not deep enough to permit the use of this method, a glass or stainless steel beaker will be used to transfer the sample into the container. Sediment samples will be collected using a stainless steel scoop or Shelby tube, mixed in a glass or Teflon[™]-coated stainless-steel pan, and placed into the sample container. Sediment samples for volatile organic analysis will be removed from the stream using a core liner and capped with a Teflon[™] plug or sheet as the liner is being extracted from the sediment.

3.2.5 Surface Soil Investigation Surface or near-surface soil samples will be collected from six site groupings (SWMU 2, 3, 4, and 5; SWMU 14; SWMU 15; SWMU 16; SWMU 17; SWMU 22; and background sampling stations) under investigation at NAVSTA Mayport. The rationale behind the surface soil program is to assess the concentration of contaminants in the surface soil due to releases (e.g., spills, fly ash, and landfill waste) of contaminants at NAVSTA Mayport. Data derived from this investigation will be used in the environmental assessment and the Corrective Action Plan if it is required.

3.2.5.1 Number and Location of Sampling Stations Excluding duplicates, a total of 41 surface soil samples will be collected from the locations described in Section 3.3. These sample locations are approximate and may be relocated based on actual site conditions. All samples will be sent to the laboratory for analyses of the compounds listed in Section 3.4 of this SAP.

3.2.5.2 Sampling Procedures All surface soil samples will be collected in accordance with procedures discussed in Section 6.6.4 of the Comprehensive QAPP (Appendix A) and the Technical Memorandum (Appendix B). Surface soil samples will be generally obtained from a depth of 0.5 to 1.5 feet below land surface, unless otherwise specified, by using a stainless-steel hand auger or trowel. Surface soil samples to be analyzed for volatile organic compounds will be collected using a core sampler and capped with a Teflon[™] seal.

3.2.6 Soil Gas Investigation At least 12 soil gas samples will be collected using an electrically driven soil gas probe around the perimeter of SWMU 1 to measure the concentration of organic vapors, if present, that may be migrating

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from the landfill. The rationale for performing a soil gas survey at SWMU 1 is described in Volume I, Workplan. The presence of organic vapors at the landfill has not been assessed in previous investigations at NAVSTA Mayport. This program is designed to monitor soil gas concentrations, if present, at SWMU 1 and accumulation of organic vapors beneath the Jacksonville Shipyard, Inc., maintenance buildings located at Site 1, (Figure 3-5).

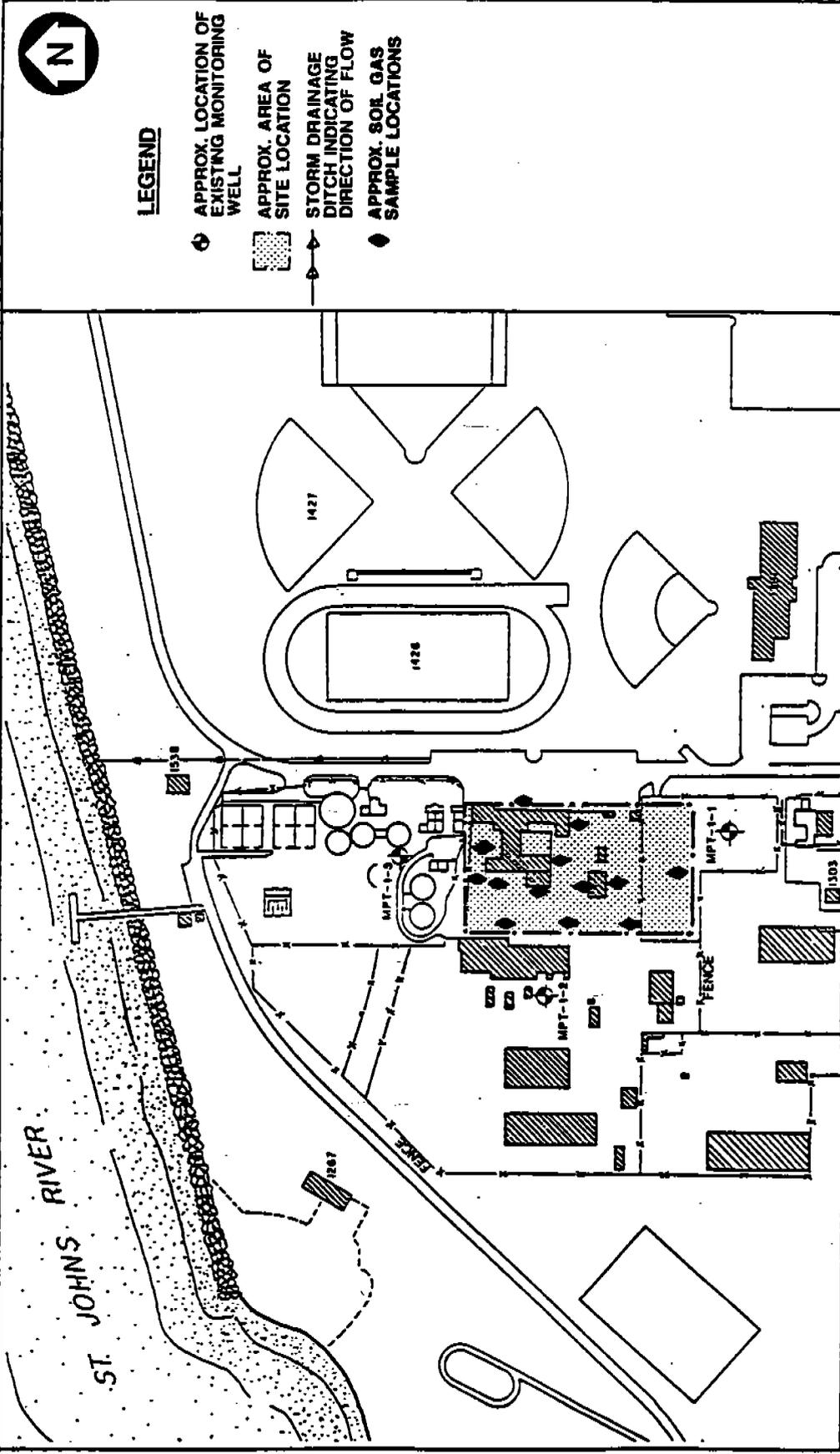
The soil gas probe consists of 2.5-foot sections of hollow stainless-steel rod (5/8-inch OD) that are connected to a slotted stainless-steel point. The rods and point are driven to the desired depth of soil gas monitoring with an electric slap hammer. The slap hammer is then disconnected from the rods and polyethylene tubing is connected from the top of the rods to an air bladder pump. The air in the gas probe will be purged for 3 minutes with the air bladder pump prior to obtaining a representative soil gas sample from the sampling interval. This procedure is described in more detail in a Technical Memorandum included in the Site-Specific QAPP (Appendix B).

An organic vapor analyzer (OVA) will be used to monitor soil gas in the gas probes. The OVA has the capability of distinguishing between methane gas and other organic vapors with the aid of a charcoal filter. By making this distinction, it may be possible to determine if the concentration of vapors exceeds safety limits and poses a potential hazard. If elevated levels of organic vapors are observed in any samples, additional samples will be collected and field analyzed to define the extent of contamination.

3.2.7 Biological Field Investigation The goal of the biological field investigation is to collect information from the field that is required to conduct the environmental assessment portion of the Health and Environmental Assessment (HEA). The methods used in the field are those outlined in *Ecological Assessment at Hazardous Waste Sites: A Field and Laboratory Reference* (EPA/600/3-89/013). The objectives of the biological field investigation include:

- identification of basic environmental characteristics,
- identification of important aquatic and terrestrial organisms (receptors),
- identification of areas of contamination and ecological effects,
- estimation of the magnitude and variation of toxic effects, and
- identification of contaminant levels in aquatic biota.

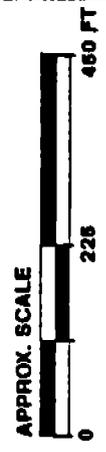
The biological field investigation will be conducted in a phased approach. Phase I will address the first two objectives : identification of basic environmental characteristics and identification of receptors. This will be accomplished by conducting aquatic and terrestrial field surveys of a qualitative nature. The qualitative aquatic and terrestrial field surveys are described in Sections 3.2.7.2 and 3.2.7.3, respectively.



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**FIGURE 3-5
 (SITE 1)
 SWMU 1 - LANDFILL A, SOIL GAS
 SAMPLING LOCATIONS**



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The Phase II biological investigation will address the last three objectives. These objectives are addressed by conducting quantitative surveys (bioassessment methods) as described in Sections 3.2.7.2 and 3.2.7.3. Bioassessment methods can be applied to determine the ecological effects of contamination. A Phase II investigation will be conducted only in the drainage ditch system around SWMU 2, 3, 4, and 5 (NIRP Sites 2, 4, 5, and 6) and at the reference (background) locations in Sherman Creek. The rationale and details for implementing the investigation are described in Sections 3.2.7.2 and 3.2.7.3. There is insufficient information on the present extent of contamination of surface water, sediment and soil or the potential releases of contaminated groundwater to surface waters to recommend or propose details on bioassessment methods at other sites. Phase II studies at other sites may be implemented dependant upon the results of the release characterizations and the Phase I biological field investigation.

Biota sampling under Phase I or II of the St. Johns River is not presently recommended. Information on aquatic receptors in the St. Johns River will be gathered from local wildlife officials, the St. Johns River Water Management District, the Natural Heritage Society, and other available information. Phase I or II biota studies will be conducted based upon a review of release characterization data. Table 3-3 provides a summary of the biological investigations to be conducted in relation to each individual site. The components of the Phase I and Phase II investigations are described in detail in the following sections.

3.2.7.1 Identification of Basic Environmental Characteristics Basic environmental characteristics of the sites to be identified include the distribution of major habitat types (e.g., grasslands, forests, lakes, streams, or wetlands), the general physical and chemical characteristics of the aquatic environments, and vegetation types.

The distribution of habitat (ecosystem) types was previously mapped in the Initial Assessment Study (IAS) (Environmental Science and Engineering, 1986). For the purposes of the RFI the habitats map will be verified and updated, where appropriate, based upon a visual survey by a field biologist.

To assist in determining environmental setting conditions, physical and chemical characteristics of the aquatic environments will be measured as part of the aquatic survey as described in Section 3.2.7.2. Vegetation types will be identified as part of the terrestrial survey as described in Section 3.2.7.3.

3.2.7.2 Aquatic Biota Survey Background aquatic biota surveys will be conducted at the locations indicated on Figure 3-6. Site-specific aquatic biota survey locations are presented in Sections 3.3.3, 3.3.7, and 3.3.8. Qualitative and quantitative surveys will be conducted at all reference locations (MPT-B-BIO-1, MPT-B-BIO-2, and MPT-B-BIO-3) as well as the six locations (MPT-2-BIO-3, MPT-2-BIO-4, MPT-2-BIO-5, MPT-2-BIO-6, MPT-2-BIO-8, and MPT-2-BIO-9) in the drainage ditches surrounding SWMU 2, 3, 4, and 5. Three qualitative aquatic surveys will be conducted in tidal ponds near SWMU 14 and one qualitative survey will be conducted at the golf course drainage ditch. If other areas providing aquatic

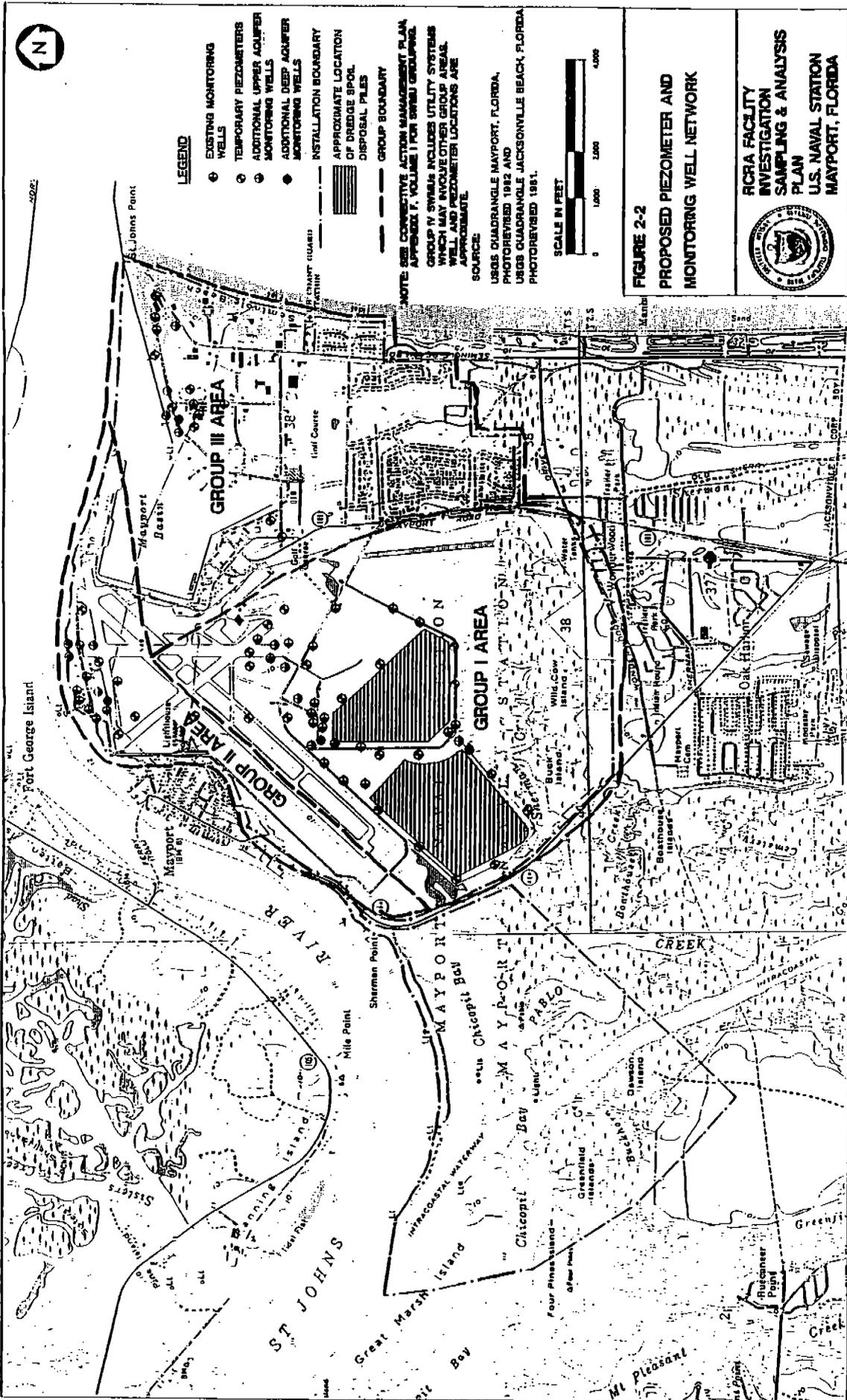
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**Table 3-3
Biological Investigation**

Sampling and Analysis Plan
NAVSTA Mayport
Mayport, Florida

Site No.	Aquatic Survey		Terrestrial Survey	
	Qualitative	Quantitative	Qualitative	Quantitative
1	St. Johns River - pending	Pending	NR	NR
2, 4, 5, and 6	Drainage Ditches Sherman Creek	Yes Yes	Yes Yes	Pending Pending
8, 8A, 8B, 8C, and 8D	St. Johns River - pending	Pending	NR	NR
9	NR	NR	NR	NR
11	NR	NR	NR	NR
13	Drainage to golf course	Pending	NR	NR
14	Tidal ponds	NR	NR	NR
	St. Johns River - pending	Pending	NR	NR
	Storm drainage ditches - NR	NR	NR	NR
15	NR	NR	Pending	NR
16	NR	NR	NR	NR
17	NR	NR	NR	NR

Note: NR = not recommended.



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habitat are identified during the course of the field investigation these will be surveyed in a qualitative manner also.

Qualitative Aquatic Survey. The qualitative survey includes measurement and recording of basic physical and chemical characteristics of the aquatic environments. The measurements include depth, stream size, flow, types of bottom substrate, water clarity, conductivity, salinity, pH, temperature, and dissolved oxygen levels. The measurements will be recorded in a field log book and then transferred to a data summary sheet for each site (Figure 3-7).

Instruments for the measurement of pH, salinity, temperature, conductivity, and dissolved oxygen levels and their calibration and use are described in Section 8.2 of the Comprehensive QAPP.

The objective of the qualitative survey will be to collect as many different species of aquatic organisms in a given aquatic environment as possible. The information will be used to identify potential receptors of contamination. Aquatic organisms will be collected from as many different habitats as possible (riffle, pool, etc.). Sampling will be conducted with dredges (Ekman™ or petite Ponar™) to sample benthic organisms, D-frame aquatic dip net to sample organisms residing on aquatic vegetation, minnow traps and/or net seines for capturing fish and crustaceans, and a plankton tow for the collection of algae and zooplankton.

The use of sampling devices as well as the processing and transport of biological samples is covered in detail in Appendix B, site-specific QAP. Biological samples will be sorted if possible in the field, preserved, and transported to the laboratory for taxonomic identification.

Quantitative Survey. The quantitative aquatic survey can comprise one or more various bioassessment techniques. Bioassessment techniques are applied to determine the ecological effects of contamination. Results of bioassessments can be used to determine the occurrence of areas of contamination and ecological effects and can be used to estimate the magnitude and variation of toxic effects.

Available bioassessment methods for determining the extent of ecological effects in the aquatic environment measure the structure and function of aquatic benthic communities, the structure and productivity of periphyton communities, and the structure and function of fish communities. All of these methods have been reviewed by USEPA as to their applicability to hazardous waste sites (USEPA, 1989).

The bioassessment method that will be used at the biological survey locations in the drainage ditch system surrounding SWMU 2, 3, 4, and 5 and the reference locations in Sherman Creek measures the structure and function of aquatic benthic communities (biological integrity). Chapter 17-3 of the FAC defines biological integrity in terms of the Shannon-Weaver diversity index of benthic macro-invertebrates. Replicate Ponar™ dredge samples will be taken at each survey location for the purposes of collecting, enumerating, and identifying benthic organisms. The information will be used to determine the Shannon-Weaver diversity index and other indices of biological integrity as listed in Table 3-4.

BIOLOGICAL SAMPLING DATA SHEET
AQUATIC SURVEYS

LOG. NO. _____

Site: _____ Type of Sample: _____ Date: _____
 Water Body: _____ Number of Samples: _____ Time (24 hr clock): _____
 Location: _____ Equipment Used: _____ Collector(s): _____
 County: _____ Weather (present): _____
 Township: _____ (past): _____ Preservative(s): _____
 Contaminants of Concern: _____

Terrain Characteristics: Land Use (500 m radius) Stream Cover (Overall upstream view) Stream Gradient

Urban _____ Upland Conifer _____ Flat _____ Dense (75%-100% shaded) _____ Pool _____
 Cultivated _____ Swamp hardwood _____ Rolling _____ Partly open (15-75%) _____ Riffle _____
 Pasture _____ Swamp Conifer _____ Hilly _____ Open (0-25%) _____ Cascade _____
 Upland hardwood _____ Marsh _____ Mountain _____ Flat _____

Physical Characteristics of Bottom (estimate % of each component over 12m stretch of site)

Bedrock _____ Gravel (1/8"-3") _____ Large Woody Debris _____
 Boulders (>10") _____ Sand (<1/8") _____ Detritus _____
 Rubble (3"-10") _____ Silt-caly-muck _____ Leaf litter _____

Habitat Width (): _____
 Depth (): _____
 Flow (c /): _____ meter type _____
 pH: _____ n.o. _____
 Water (color, etc.): _____ secchi: _____
 Immediate shore: _____
 Temperature Air: _____ water _____
 Notes: _____

Observations and Notes: (Check off and describe)
 Fish: _____
 Algae: _____
 Macrophytes: _____
 Submergent or emergent: _____
 Invertebrates: _____
 Mammals: _____
 Discharges: _____
 Distance from outfall: _____
 Plume characteristics: _____
 Foreign matter: _____
 Obstructions: _____
 Other: _____

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FIGURE 3-7
BIOLOGICAL SAMPLING
DATA SHEET FORM
AQUATIC SURVEYS

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Table 3-4
Indices of Biological Integrity

Sampling and Analysis Plan
NAVSTA Mayport
Mayport, Florida

Taxa Richness

Number of taxa collected per sample and assumed to represent the number of taxa in the community of interest.

Fisher et al. (1943); Lloyd & Ghelordl (1964)

Diversity Indices

$$H^1 = \sum p_i \log_2 p_i \quad \text{Shannon-Weaver Index (Shannon and Weaver, 1963)}$$

where: H^1 = Shannon Weaver Index
 p_i = n_i/N ; the proportion of total number of individuals in the i th species
 n_i = importance value for species i (i.e., number of individuals)
 N = total of importance value

Evenness Indices

$$J = \frac{H^1}{\log_2 S} \quad \text{Pielou (1966)}$$

where: J = Index; evenness
 H^1 = Shannon Weaver Index
 S = total number of species (in all samples or in community)

Community Similarity Indices

Compares a reference to a station of comparison for similar species:

Community Loss Index =

$$\frac{d-a}{e}$$

where: a = number of taxa common to both samples
 d = number of taxa present in reference
 e = number of taxa present in station of comparison

Percent Contribution of Dominant Taxa

Ratio of taxonomic group with the most individuals to the total number of organisms.

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Collection and processing of benthic macroinvertebrate samples is detailed in Appendix B, Site-specific QAP.

The magnitude and variation of toxic effects can be determined by use of aquatic or sediment bioassay. Marine bioassays for aqueous samples will be those recommended for use in by the FDER. Recommended test protocols and test species are:

- the inland silverside (*Menidia beryllina*) Larval Survival and Growth Test;
- the Mysis (*Mysidopsis bahia*) Survival, Growth, and Fecundity Test;
- Sea Urchin (*Arbacia punctulata*) Fertilization Test; and
- Algal (*Champia parvula*) Reproduction Test.

The protocols for these tests are established by the USEPA in Weber and others. (1988).

Marine sediment bioassay protocols are currently being drafted by the ASTM and should be available for use at sites with sediment contamination.

The implementation of bioassays will depend upon the results of the release characterizations for each site. Bioassays may be used for sites with extensive sediment, surface water, or soil contamination to determine the toxicity of the contamination in the respective media. Bioassays with contaminated environmental media provide information on the toxicity of the actual mixture of contaminants at a particular site. Selection of the appropriate test and test organism will be made on a site-specific basis depending upon the conditions at the site and the objectives of the bioassay.

3.2.7.3 Terrestrial Biological Survey

Qualitative Survey. The qualitative terrestrial survey includes vegetation identification with subsequent classification of habitat types. With this information and information on the natural history of indigenous organisms, it is possible to describe the types of birds, mammals, amphibians, and reptiles that may reside within the habitats.

Vegetation types will be identified as to dominant species and the classification of the major vegetation community types for land near and on the sites. Some vegetative survey information is available in the IAS report. This information will be incorporated into the study and verified. Plant identifications will be recorded in a field log book including notation of the keys used to accomplish identification. Vegetated areas and certain plant specimens will be photographed in order to document identifications. Any available information on vegetation from remote sensing or aerial photography will be incorporated to map vegetational boundaries.

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Wetlands identification will be according to the Federal Manual for the Identification and Delineation of Wetlands by the *Routine Onsite Determination Method* (USACE, 1989). Wetlands classification will be accomplished by a review of National Wetlands Inventory Maps for the area and a field survey by a qualified wetlands biologist.

A qualitative terrestrial survey will be conducted at SWMU 2, 3, 4, and 5. No other sites afford any appreciable area of terrestrial habitat and there are no nearby areas of terrestrial habitat.

Quantitative Survey. The quantitative terrestrial survey includes implementation of bioassessment methods, which can identify the extent of soil contamination and ecological effects as well as the magnitude and variation of toxic effects. For sites with extensive soil contamination, soil bioassays or quantitative vegetation sampling may be employed. USEPA soil bioassay protocols are specified in *Protocols for Short Term Toxicity Screening of Hazardous Waste Sites* (USEPA, 1989) and are available for:

- earthworm (*Eisenia foetida*) survival,
- lettuce (*Lactuca sativa*) seed germination, and
- lettuce (*Lactuca sativa*) root elongation.

3.2.7.4 Analyses of Chemical Contamination in Aquatic Biota If bioaccumulative chemicals are measured in sediments at a site, sampling of aquatic organisms for analysis of tissue may be required to determine if exposures for aquatic organisms are occurring, if contaminants are being transported in aquatic food chains, and if humans are potentially exposed via diet. Selection of organisms to be collected for tissue analysis will depend upon the type of contamination and the availability of biota.

Collection of aquatic biota for analysis of chemical contamination will be conducted at the six aquatic biota survey locations in the drainage ditch system surrounding SWMU 2, 3, 4, and 5. The sediments of the ditch are known to be contaminated with DDT and people have been observed taking organisms from the ditch by seining. As there is no information on the types of organisms residing in the ditch, a particular species for collection cannot be identified. It is proposed to collect a bivalve mollusc and crustacean. Molluscs and crustaceans will be collected by dredge or seining from each of the six locations and analyzed. Collection, transport, and analysis of the biota samples is specified in the site-specific QAP for sampling and analysis of aquatic biota (Appendix B).

3.2.8 Health and Environmental Assessment The Health and Environmental Assessment (HEA) will be conducted according to the principles outlined in the RFI guidance with some methods being taken from guidance available for CERCLA RI/FS risk assessments. The HEA is designed to provide the information necessary for the regulatory agency to evaluate the need for interim corrective measures.

3.2.8.1 Constituents of Concern This section will summarize what environmental media are contaminated in relation to each site. Constituents of concern will be equivalent to the chemicals detected in soil, sediment, surface water,

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groundwater, and biota. Inorganic chemicals will be considered to be "of concern" in soil or sediment if they exceed background levels as determined for the installation.

The analytical data from the exploration and sampling program will be summarized in a manner that can be used to evaluate human health and ecological risks. Summary statistics will be calculated for each medium (groundwater, soil, sediment, surface water, and biota) sampled at each site in the following manner.

Site	Chemical	Average Concentration Measured	Maximum Concentration Measured	Detection Frequency
------	----------	--------------------------------------	--------------------------------------	------------------------

The average concentration of the chemical measured will be the most probable exposure point concentration for that particular medium and the maximum will be the worst case exposure point concentration.

3.2.8.2 Health Assessment

Identification of Exposure Pathways. Potential exposure pathways are evaluated in Table 3-5 including environmental medium, points of exposure, and exposed populations. Groundwater is not expected to be a medium of exposure (with the exception of contributing to surface water or sediment contamination). The surficial aquifer at NAVSTA Mayport is the only one presently identified as contaminated and it has not been identified as a source of water (potable or otherwise) on site. Present information indicates that there is no migration of contaminated groundwater off site as the base is surrounded on three sides by surface water.

The exposure pathways that will be evaluated are for surface water, sediment, soil, and biota. Exposures will be estimated for adults only for surface water, sediment, and soil as all of the sites have restricted access (open only to base personnel) and are not located near base housing. There is no indication that children could gain access to any of the site areas. Exposures to contaminated biota will be evaluated for both adults and children. Net seining has been observed in the ditch system surrounding SWMU 2, 3, 4, and 5. The seining was conducted by base personnel but there is a possibility that the biota could be consumed by children as the personnel, take their "catch" home.

Identification of Exposure Assumptions. The RFI guidance for HEA clearly states exposure assumptions for exposures via ingestion of water (surface or groundwater), ingestion of soil, or inhalation of air (Table 3-6). These exposure assumptions are provided in Tables 3-7 to 3-10. The proposed assessment differs from the exposures considered in the HEA criteria in the following areas:

- Ingestion of surface water or groundwater by drinking will not be considered; instead incidental ingestion of surface water will be evaluated (this lowers amounts ingested from 2 liters per day to 5 ml per day).

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**Table 3-5
Exposure Pathways for Health Assessment**

Sampling and Analysis Plan
NAVSTA Mayport
Mayport, Florida

Environmental Medium	Point of Exposure	Route of Exposure	Exposed Population	Status
Surface Waters	Facility wide in drainage ditch system and tidal ponds near Site 14.	Dermal absorption and incidental ingestion.	Adults (base personnel)	Current
Sediment	Facility wide in drainage ditch and tidal ponds.	Dermal absorption and incidental ingestion.	Adults (base personnel)	Current
Soils	Potential at all sites except neutralization basin.	Dermal absorption and incidental ingestion.	Adults	Current
Groundwater	None, surficial aquifer is not used as a potable water source.	-	-	Current
Biota	Drainage ditch system surrounding Sites 2, 4, 5, and 6.	Ingestion.	Adults (base personnel; possibly children)	Current

**Table 3-6
Exposure Assumptions for Health Based Criteria**

Sampling and Analysis Plan
NAVSTA Mayport
Mayport, Florida

Medium	Carcinogens	Systemic Toxicants
Surface soils		
Average body weight	70 kilograms	16 kilograms
Years of exposure	70 years	5 years
Frequency of contact	0.1 gram 365 days/year	0.2 gram 365 days/year
Water		
Average body weight	70 kilograms	70 kilograms
Years of exposure	70 years	70 years
Amount ingested	2 liters/day	2 liters/day
Frequency of contact	365 days/year	365 days/year
Air		
Average body weight	70 kilograms	70 kilograms
Years of exposure	70 years	70 years
Amount inhaled	20 m ³ air/day	20 m ³ air/day
Frequency of contact	365 days/year	365 days/year

Note: m³ = cubic meters.

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Table 3-7
Surface Water Exposure
Parameters for Adults

Sampling and Analysis Plan
NAVSTA Mayport
Mayport, Florida

	Most Probable	Realistic Worst
Average body weight	70 kilograms	70 kilograms
Surface area exposed ¹	2,300 cm ²	2,830 cm ²
Incidental ingestions of surface water	1 milliliter	5 milliliters
Frequency of contact	TBD	TBD
Duration of contact to surface water	TBD	TBD
Years of exposure	TBD	TBD

¹Anderson et. al., 1985 - arms, hands, legs.
Notes: cm² = square centimeters.
TBD = to be determined after receptor survey.

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**Table 3-8
Soil Exposure Parameters for Adults**

Sampling and Analysis Plan
NAVSTA Mayport
Mayport, Florida

	Most Probable	Realistic Worst
Average body weight	70 kg	70 kg
Surface area exposed ¹	2,300 cm ²	2,830 cm ²
Incidental ingestion of soils ²	50 mg	100 mg
Soil unit deposition ³	0.5 mg/cm ²	1.5 mg/cm ²
Sediment contacted ⁴	11.5 g/event	18.9 g/event
Frequency of exposure	TBD	TBD
Years of exposure	TBD	TBD

¹Anderson et. al., 1985; forearms and hands.

²LaGoy, 1987.

³Schaun, 1984.

⁴Surface area times sediment unit deposition.

Note: kg = kilogram.
cm² = square centimeter.
mg = milligrams.
g/event = grams per event.
TBD = to be determined after receptor survey.

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Table 3-9
Sediment Exposure Parameters for Adults

Sampling and Analysis Plan
NAVSTA Mayport
Mayport, Florida

	Most Probable	Realistic Worst
Average body weight	70 kg	70 kg
Surface area exposed ¹	2,300 cm ²	2,830 cm ²
Sediment unit deposition ²	0.001 g/cm ²	0.001 g/cm ²
Sediment ingested ²	50 mg	100 mg
Sediment contacted ³	5 g/event	6.2 g/event
Frequency of exposure ⁴	TBD	TBD
Years of exposure	TBD	TBD

¹Anderson et. al., 1985 - forearms and hands.

²LaGoy, 1987.

³Schaun, 1984.

⁴TBD

Notes: kg = kilogram.
cm² = square centimeter.
g = grams.
mg = milligrams.
g/event = grams per event.
TBD = to be determined after receptor survey.

Table 3-10
Biota Exposure Parameters for Adults

Sampling and Analysis Plan
NAVSTA Mayport
Mayport, Florida

	Most Probable	Realistic Worst
Average body weight	70 kg	70 kg
Frequency of exposure	TBD	TBD
Years of exposure	TBD	TBD
Among ingested	0.442 g/day clams 0.291 g/day oysters	

Notes: kg = kilogram.
TBD = to be determined after receptor survey.
g/day = grams per day.

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- Direct contact as well as incidental ingestion of surficial soil will be evaluated.
- Direct contact as well as ingestion of surface water will be evaluated.
- Ingestion of contaminated biota via diet will be evaluated.

Calculation of Exposure Body Doses. Exposure doses are the amounts of a chemical (usually expressed in mg/kg/day) that an individual is exposed to given certain exposure point concentrations in environmental media (Section 3.2.8.1) and certain exposure assumptions (body weight, frequency of exposure etc.,). Exposure parameters are listed in Tables 3-7 to 3-10 and the equations that will be used to derive exposure body doses are provided in Table 3-11.

The toxicokinetic factor (TKF) is defined as the ratio of the estimated absorption factor for the site-specific medium and route of exposure of the known or estimated absorption factor for the laboratory study from which the cancer potency factor or the reference dose was derived. Use of this factor allows appropriate adjustments to be made if the efficiency of absorption is known or expected to differ because of physiological effects and/or matrix or vehicle effects.

TKF can be less than one or greater than one, depending on the particular circumstances at hand. If it is thought that absorption from the site-specific exposure is the same as absorption in the laboratory study, then the TKF is 1.0.

In the absence of detailed toxicological information on every compound of interest, it has been common practice for risk assessors to use a default value of 1.0. This approach is not adequately protective of public health in some cases, because there are many cases in which it is expected that absorption from the site-related exposure would be higher than that in the laboratory study.

For lead and carcinogenic polyaromatic hydrocarbons (PAHs), specific TKFs can be derived based on a review of relevant toxicological data. For the other contaminants of concern, estimated compound-specific TKFs will be based on a conservative, internally consistent algorithm as shown in Table 3-12. The procedure requires that the route of exposure and the vehicle be known for all studies from which cancer potency factors or reference doses were derived by USEPA. This information will be discussed in the dose-response profile for each contaminant of concern. The algorithm requires the use of numerous assumptions regarding systemic absorption of the constituents.

Available dose-response values are derived from several types of studies. For example, most oral values are derived from studies in which animals are administered the test compound orally either by gavage, in drinking water, or in diet. The oral dose-response values can also be based on inhalation studies.

The assumptions employed in deriving TKF values are discussed below.

- Absorption from gavage is similar to absorption from drinking water studies.

TABLE 3-11
EQUATIONS USED TO DERIVE EXPOSURE BODY DOSES

RCRA FACILITY INVESTIGATION
U.S. NAVAL STATION
MAYPORT, FLORIDA

1. Direct Contact, Sediment

$$\text{Average daily dose over lifetime } (\mu\text{g per kg per day}) = \text{Concentration in medium } (\mu\text{g per g}) \times \text{Exposed surface area } (\text{cm}^2) \times \text{Sediment deposition } (\text{g per cm}^2) \times \frac{1}{\text{Body weight (kg)}} \times \frac{\text{Events per year}}{365 \text{ days}} \times \text{TKF} \times \frac{\text{Years exposure}}{70 \text{ year lifetime}}$$
2. Ingestion, Sediment

$$\text{Average daily dose over lifetime } (\mu\text{g per kg per day}) = \text{Concentration in medium } (\mu\text{g per g}) \times \frac{\text{Quantity of sediment ingested (g per event)}}{\text{Body weight (kg)}} \times \frac{\text{Events per year}}{365 \text{ days}} \times \text{TKF} \times \frac{\text{Years exposure}}{70 \text{ year lifetime}}$$
3. Direct Contact and Incidental Ingestion

$$\text{Average daily dose over lifetime } (\mu\text{g per kg per day}) = \left\{ \left(\frac{\text{Hours Event}}{\text{Event}} \times \frac{\text{Exposed surface area } (\text{cm}^2)}{\text{Body weight (kg)}} \times \text{TKF} \times \frac{\text{Amount ingested (g per event)}}{1,000 \text{ ml}} \right) + \left(\frac{\text{Permeability constant (cm per hr)}}{\text{Body weight (kg)}} \times \frac{\text{Sediment deposition (g per cm}^2)}{\text{Body weight (kg)}} \times \frac{\text{Events per year}}{365 \text{ days}} \times \text{TKF} \times \frac{\text{Years exposure}}{70 \text{ year lifetime}} \right) \right\} \times \frac{\text{Events per year}}{365 \text{ days}} \times \frac{\text{Years exposure}}{70 \text{ year lifetime}}$$
4. Direct Contact and Ingestion of Soils
Same as sediments.
5. Ingestion of Fish and Shellfish

$$\text{Average daily dose over lifetime } (\mu\text{g per kg per day}) = \frac{\text{Amount ingested (g per event)}}{\text{Body weight (kg)}} \times \text{TKF} \times \frac{1}{\text{Body weight (kg)}} \times \text{BCF (ml per g)} \times \frac{1 \text{ liter}}{1,000 \text{ ml}} \times \frac{\text{Frequency (events per 365 days)}}{\text{Years exposure}} \times \frac{\text{Years exposure}}{70 \text{ year lifetime}}$$

TKF = Toxicokinetic Factor
BCF = Bioconcentration Factor

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**Table 3-12
Toxicokinetic Factors**

Sampling and Analysis Plan
NAVSTA Mayport
Mayport, Florida

Study Type	Dermal Soil	Oral Soil	Oral Water
Gavage	¹ 0.05/0.25	0.10/0.50	1.0/1.0
Drinking water	0.05/0.25	0.10/0.50	1.0/1.0
Diet	² 0.10/0.50 ³ 0.01/1.0	0.50/1.0	1.0/1.5
Inhalation	⁴ 0.05/0.25	⁴ 0.10/0.50	⁴ 1.0/1.4

- Notes:
- ¹ Most probable case/realistic worst case.
 - ² Organics except PAHs.
 - ³ Inorganics except lead.
 - ⁴ Multiplied by an absorption factor from inhalation study, if appropriate.

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- Absorption of compounds from drinking water in humans is similar to absorption in laboratory animals from drinking water or gavage.
- Absorption of compounds from drinking water in humans is similar to or greater than absorption in laboratory animals from diet study.
- Absorption of volatile compounds via inhalation in animals is similar to absorption from drinking water. That is, in both cases absorption is assumed to be very high.

Skin Permeability Factors. The estimation of exposure doses resulting from incidental direct contact and ingestion of surface water requires the use of a skin permeability constant in units of centimeters per hour (cm/hr). This method assumes that the behavior of compounds dissolved in water is described by Fick's law. In Fick's law, the steady state flux of the solute across the skin milligrams per square centimeter per hour (mg/cm²/hr) equals the permeability constant (kp) in cm/hr times the concentration difference of the solute across the membrane (mg/cm³). This approach is discussed in USEPA (1984a and 1988).

At this time, experimentally determined permeability constants exist for only a limited number of chemical compounds.

Because of the lack of available permeability constants for the majority of contaminants and the poor quality of the existing data on the few constituents for which there are data, a generic approach to estimating permeability constants will be undertaken. It is suggested in USEPA (1984a; 1988) that one can reasonably assume in cases where data are lacking that contaminants are carried through the skin as a solute dissolved in water. In this case, the permeability constant of water can be substituted for the compound-specific permeability constant. This approach is reasonable for highly water-soluble compounds. On the other hand, for the compounds that are highly lipid-soluble, this approach may underestimate the dermal absorption of contaminants from dilute aqueous solutions.

Experimental data confirms this prediction for certain compounds. For instance, Roberts and others (1977) experimentally determined the permeability constants for a series of phenolic compounds. These are all higher than the 8×10^{-4} cm/hr value for water (2×10^{-4} to 6×10^{-2} cm/hr with most being approximately 1×10^{-3} cm/hr). In addition, Scheuplein and Blank (1971) showed for a series of alcohols that the permeability constants for the higher homologs were higher than for water (1×10^{-3} for propanol to 8×10^{-2} for decanol).

For the public health assessment it will be assumed that the permeability constants for inorganic constituents and organic constituents having low octanol-water partition coefficients ($\log K_{ow}$ less than 2.0) are equal to the permeability constant for water. The constant for water is taken as 8×10^{-4} cm/hr according to Blank and others (1984). This value is similar to values determined by others. Because skin permeability to water is dependent on the degree of hydration of the skin, this value, which was derived from studies of fully hydrated skin, gives a high estimate of water permeability. Such a value is appropriate for situations in which absorption of contaminants may occur during

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playing in streams or leachate. These are activities associated with fully or partially hydrated skin, therefore, these numbers will yield a conservative risk estimate.

It will be conservatively assumed that contaminants having high octanol-water coefficients ($\log K_{ow}$ greater than or equal to 2.0) have high skin permeability constants and a constant an order of magnitude greater than water's constant was assumed (i.e., 8×10^{-3} cm/hr).

Exposure-Limit Criteria. The RFI Guidance Manual provides exposure limit criteria in the form of "Health Based Criteria." The criteria are levels of contaminants in a medium that present an unacceptable risk to a receptor under certain intake assumptions. The intake assumptions are provided in Table 3-6. Unacceptable risk is defined as exceeding an excess lifetime cancer risk of 10^{-6} for Class A and B carcinogens and 10^{-5} for Class C carcinogens, or exceeding the reference dose (RfDs) for noncarcinogens. Exposure point concentrations (Section 3.2.8.1) will be compared with the HEA exposure limit criteria for soil and air. The health based criteria for water assume consumption of the water and will not be used for comparisons.

Risk Assessment. Carcinogenic risk estimates will be determined by multiplying the body-dose level for each carcinogen by its USEPA carcinogenic potency value. This estimate represents an individual's incremental cancer risk. To put these incremental risk levels into perspective, they are evaluated against a target risk level.

Target risk levels have been adopted from USEPA guidelines, which state that the total incremental carcinogenic risk for an individual resulting from exposure at a hazardous waste site should be between 10^{-4} and 10^{-7} . Therefore, remedial alternatives should reduce total potential carcinogenic risks to levels less than 10^{-4} (USEPA, 1986).

Noncarcinogenic risk estimates will be determined by dividing body-dose levels for each noncarcinogen by the relevant standard, criterion, or guideline, resulting in a ratio called a risk ratio. The sum of the individual risk ratios for specific contaminants at a site is called a hazard index for the mixture. If this ratio is less than or equal to 1.0, no adverse health effects are anticipated from the predicted body-dose level. If the ratio is greater than 1.0, the predicted body-dose level could potentially cause adverse health effects. This determination is necessarily imprecise because derivation of the relevant standards or guidelines involves the use of multiple safety factors. In addition, the risk ratios for individual compounds should properly be summed only if their target organs or mechanisms of action are identical. Therefore, the potential for adverse health effects for a mixture having a hazard index in excess of 1.0 must be assessed on a case-by-case basis.

EPA's Integrated Risk Information System (IRIS) will be the primary source for the standards and guidelines used in the risk ratios. Spreadsheets will be used to calculate risks for carcinogens and noncarcinogens for each site and for each media. Within these two classes of chemicals, both the most probable and realistic worst case are analyzed to characterize a risk range.

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3.2.8.3 Environmental Assessment

Identification of Exposure Pathways. Risks associated with exposures to surface water and sediments will be evaluated based upon information from the release characterizations for each site. The potential points of exposure are the drainage ditch system around SWMU 2, 3, 4, and 5, the tidal ponds near SWMU 14, Sherman Creek; and the St. Johns River. Risks associated with soil contamination will also be evaluated as necessary on terrestrial organisms on or near SWMU 2, 3, 4, and 5. Potentially exposed aquatic and terrestrial populations will be identified during the receptor survey. Exposure point concentrations for each environmental media will be the same as those determined for the health assessment. Tissue residues of contaminants in aquatic biota will be used to determine dietary exposures for predatory mammals and birds.

Exact exposure pathways that will be evaluated will be determined based upon the types of contaminants detected, the occurrence of sensitive aquatic and terrestrial organisms, and the occurrence of threatened, rare, or endangered species. Specific exposure pathways will be developed for rare or endangered species that could potentially be exposed to contamination.

Ecological Criteria. Criteria for contaminants detected in environmental media will be collected. Criteria are levels of contaminants in surface water or sediments that are protective of chronic or acute toxic effects to aquatic life. Criteria are available in the form of:

- Ambient Water Quality Criteria (AWQC; USEPA, 1986),
- Florida Water Quality Standards (Chapter 17-550, FAC),
- Interim Sediment Quality Criteria (SQC; USEPA, 1989), and
- USEPA non-polluted threshold value.

Dose-Response Data. Dose-response information on the acute and chronic effects of the constituents of concern on aquatic and terrestrial organisms will be collected and summarized. Information will be for organisms which are or could be located in the aquatic and terrestrial environments near the sites or are closely related to the indigenous fauna. The method of Suter and others (1986) will be applied to dose-response information to extrapolate effects from one species to another and to provide a measure of uncertainty associated with toxicity estimates.

The dose-response information will be included in ecotoxicity profiles for each constituent of concern. The toxicity profiles will provide information on the long and short-term effects of the constituents of concern upon aquatic and terrestrial wildlife. The information will indicate what species are sensitive to certain contaminants and will also indicate those chemicals that tend to bioconcentrate in biota and biomagnify within food chains.

Risk Assessment. Risks for aquatic wildlife will be evaluated by comparing ecological criteria with exposure point concentrations of contaminants in sediments and surface water. If the ratio of the exposure concentration to the criteria exceeds 1.0, a risk is assumed. Exposure concentrations in sediment will be compared with SQC and surface exposures will be compared with AWQC.

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A quantitative uncertainty, or joint probability analysis, will be performed comparing the exposure estimates in surface water with dose-response information or criteria to provide estimates of risk. The method is according to that of Suter and others (1986). The final risk estimate is interpreted as the probability that an expected exposure will exceed the criteria given the variability in both the exposure estimate and the variability associated with the criteria value. Probabilities of adverse effects are calculated for groups of aquatic organisms including fish, molluscs, crustaceans, and algae. The probabilities imply the percentage of species within the group that would experience acute or chronic toxic effects.

The results of bioassessment studies conducted will be interpreted and included in the risk analyses. Only one bioassessment study is initially recommended in the drainage ditch system surrounding SWMU 2, 3, 4, and 5. The results of the quantitative survey of benthic macroinvertebrates in the drainage ditch system will indicate if impacts to aquatic life are presently occurring. Significant impacts will be defined as the reduction of the Shannon-Weaver diversity index to below 75 percent of the reference location index value. Areas of significant impacts and environmental contamination of sediment and surface water can then be identified.

Risks will be discussed qualitatively for: nearby sensitive ecosystems; exposure routes not addressed by quantitative criteria; and the presence of chemicals that cause secondary effects (alter pH or dissolved oxygen or change habitat).

3.3 EXPLORATION AND SAMPLING PROGRAM. The exploration and sampling program for the RFI at NAVSTA Mayport has been designed to characterize the nature and extent of contamination at those sites where releases have been verified, and to verify the presence of contaminants at the remaining sites. Samples of soil, sediment, sludge, surface water, and groundwater selected for testing will be analyzed using USEPA SW-846 (*Test Methods for Evaluating Solid Wastes, Third Edition*) methods to identify and quantify chemical contaminants. The analytical program for the RFI is discussed in Section 3.4. Target analytes and methods have been selected based on the contaminants detected at each site during the ESI, and the wastes known or suspected to be present at each site.

The following sections describe the specific number and locations of sampling stations and the procedures to be used for the exploration and sampling program at those sites identified in the HSWA permit for NAVSTA Mayport. Additional background information and history of operations for all sites may be found in Volume I, Workplan, Section 3.5.

3.3.1 Background Field Investigation In order to document the background concentration of contaminants in areas of the base that have not been affected by past waste management practices, samples of soil, sediment, and groundwater will be collected and analyzed for 40 CFR 264, Appendix IX parameters (Table 3-13).

Six background soil samples and three background sediment samples will be collected at the locations shown in Figure 3-6. Background soil samples will be collected from the area west of the main runway (SS-B-1, SS-B-2, and SS-B-3), in

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Table 3-13
Appendix IX, Groundwater Monitoring List

Sampling and Analysis Plan
NAVSTA Mayport
Mayport, Florida

Parameter	Methods	Parameter	Methods
Acenaphthylene	8100	delta-BHC	8080
	8270		8250
Acetone	8240	gamma-BHC; lindane	8080
Acetophenone	8270		8250
Acetonitrile; methyl cyanide	8015	bis(2-Chloroethoxy)methane	8270
2-Acetylaminofluorene; 2-AAF	8270	bis(2-Chloroethyl)ether	8270
Acrolein	8030	bis(2-Chloro-1-methylethyl) ether;	8010
	8240	2,4-Dichlorodisopropyl ether	8270
Acrylonitrile	8030	bis(2-Ethylhexyl)phthalate	8060
	8240		8270
Aldrin	8080	Bromodichloromethane	8010
	8270		8240
Allyl chloride	8010	Bromoform; tribromomethane	8010
	8240		8240
4-Aminobiphenyl	8270	4-Bromophenyl phenyl ether	8270
Aniline	8270	Butyl benzyl phthalate; benzyl	8060
Anthracene	8100	butyl phthalate	8270
	8270	Cadmium	8010
Antimony	8010		7130
	7040		7131
	7041	Carbon disulfide	8240
	8270	Carbon tetrachloride	8010
Aramite	6010		8240
Arsenic	7060	Chlordane	8080
	7061		8250
	8010	p-Chloroaniline	8270
	7080	Chlorobenzene	8010
Barium	8020		8020
	8240		8240
Benzene	8100	Chlorobenzilate	8270
	8270	p-Chloro-m-cresol	8040
Benzo(a)anthracene; Benzanthracene	8100		8270
	8270	Chloroethane; ethyl chloride	8010
Benzo(b)fluoranthene	8100		8240
	8270	Chloroform	8010
Benzo(k)fluoranthene	8100		8240
	8270	2-Chloronaphthalene	8120
Benzo(ghi)perylene	8100		8270
	8270	2-Chlorophenol	8040
Benzo(a)pyrene	8100		8270
	8270	4-Chlorophenyl phenyl ether	8270
Benzyl alcohol	8270	Chloroprene	8010
	6010		8240
Beryllium	7090	Chromium	6010
	7091		7190
	8080		7191
alpha-BHC	8250	Chrysene	8100
	8080		8010
beta-BHC	8250	1,2-Dichloroethane; ethylene	8240
	6010	dichloride	8010
Cobalt	7200	1,1-Dichloroethylene; vinylidene	8240
	7201	chloride	8010
Copper	6010	trans-1,2-Dichloroethylene	8240
	7210		8010

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Table 3-13 (Continued)
Appendix IX, Groundwater Monitoring List

Sampling and Analysis Plan
NAVSTA Mayport
Mayport, Florida

Parameter	Methods	Parameter	Methods
m-Cresol	8270		8240
o-Cresol	8270	2,4-Dichlorophenol	8040
p-Cresol	8270		8270
Cyanide	9010	2,6-Dichlorophenol	8270
2,4-D; 2,4-Dichlorophenoxyacetic acid	8150	1,2-Dichloropropane	8010
4,4'-DDD	8080		8240
	8270	cis-1,3-Dichloropropene	8010
4,4'-DDE	8080		8240
	8270	trans-1,3-Dichloropropene	8010
4,4-DDT	8080		8240
	8270	Dieldrin	8080
Diallate	8270		8270
Dibenz(a,h)anthracene	8100	Diethyl phthalate	8060
	8270		8270
Dibenzofuran	8270	0,0-Diethyl 0-2-pyrazinyl phosphorothioate; thionazin	8270
Dibromochloromethane; chlorodibromomethane	8240	Dimethoate	8270
1,2-Dibromo-3-chloropropane; DBCP	8010	p-(Dimethylamino)azobenzene	8270
	8240	7,12-Dimethylbenz(a)anthracene	8270
	8270	3,3'-Dimethylbenzidine	8270
1,2-Dibromoethane; Ethylene dibromide	8010	alpha, alpha-Dimethylphenethylamine	8270
	8240	2,4-Dimethylphenol	8040
Di-n-butyl phthalate	8060		8270
	8270	Dimethyl phthalate	8060
o-Dichlorobenzene	8010		8270
	8020	m-Dinitrobenzene	8270
	8120	4,6-Dinitro-o-cresol	8040
	8270		8270
m-Dichlorobenzene	8010	2,4-Dinitrophenol	8040
	8020		8270
	8120	2,4-Dinitrotoluene	8090
	8270		8270
p-Dichlorobenzene	8010	2,6-Dinitrotoluene	8090
	8020		8270
	8120	Dinoseb; DNBP; 2-sec-butyl-4,6-dinitrophenol	8150
	8270	D-n-octyl phthalate	8270
3,3'Dichlorobenzidine	8270		8060
trans-1,4-Dichloro-2-butene	8240		8270
Dichlorodifluoromethane	8010	1,4-Dioxane	8015
	8240	Diphenylamine	8270
1,1-Dichloroethane	8010	Disulfoton	8140
	8240		8270
Endosulfan I	8080	Methacrylonitrile	8015
	8250		8240
Endosulfan II	8080	Methapyrilene	8270
Endosulfan sulfate	8080	Methoxychlor	8080
	8270		8270
Endrin	8080	Methyl bromide; bromomethane	8010
	8250		8240
Endrin aldehyde	8080	Methyl chloride; chloromethane	8010
	8270		8240

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Table 3-13 (Continued)
Appendix IX, Groundwater Monitoring List

Sampling and Analysis Plan
NAVSTA Mayport
Mayport, Florida

Parameter	Methods	Parameter	Methods
Ethyl benzene	8020 8240	3-Methylcholanthrene	8270
Ethyl methacrylate	8015 8240 8270	Methylene bromide; Dibromomethane	8010 8240
Ethyl methanesul fonate	8270	Methylene chloride; Dichloromethane	8010 8240
Famphur	8270	Methyl ethyl ketone; MEK	8015 8240
Fluranthrene	8100 8270	Methyl iodide; Iodomehtane	8010 8240
Fluorene	8100 8270	Methyl methacrylate	8015 8240
Heptachlor	8080 8270	Methyl methanesul fonate	8270
Heptachlor epoxide	8080 8270	2-Methylnaphthalene	8270
Hexachlorobenzene	8120 8270	methyl parathion; Parathion methyl	8140 8270
Hexachlorobutadiene	8120 8270	4-Methyl-2-pentanone; Methyl isobutyl ketone	8015 8240
Heachlorocyclopentadiene	8120 8270	Naphthalene	8100 8270
Hexachloroethane	8120 8270	1,4-Naphthoquinone	8270
Hexachlorophene	8270	1-Naphthylamine	8270
Hexachloropropene	8270	2-Naphthylamine	8270
2-Hexanone	8240	Nickel	6010 7520
Indeno(1,2,3-cd)pyrene	8100 8270	o-Nitroaniline	8270
Isobutyl alcohol	8015	m-Nitroaniline	8270
Isodrin	8270	p-Nitroaniline	8270
Isophorone	8090 8270	Nitrobenzene	8090 8270
Isosafrole	8270	o-Nitrophenol	8040 8270
Kepon	8270	p-Nitrophenol	8040 8270
Lead	6010 7420 7421	4-Nitroquinoline 1-oxide	8270
Mercury	7470	N-Nitrosodi-n-butylamine	8270
N-Nitrosodipropylemine; Di-n-propyl- nitrosamine	8270	N-Nitrosodiethylamine	8270
N-Nitrosomethylethylamine	8270	N-Nitrosodimethylamine	8270
N-Nitrosomorpholine	8270	N-Nitrosodiphenylamine	8270
N-Nitrosopiperidine	8270	2,3,7,8-TCDD; 2,3,7,8-Tetrachloro- dibenzo-p-dioxin	8280
N-Nitrosopyrrolidine	8270	1,2,4,5-Tetrachlorobenzene	8270
5-Nitro-o-toluidine	8270	1,1,1,2-Tetrachloroethane	8010 8240
Parathion	8270	1,1,2,2-Tetrachloroethane	8010 8240
Polychlorinated biphenyls; PCBs	8080 8250	Tetrachloroethylene; Perchloro- ethylene; Tetrachloroethene	8010 8240
Polychlorinated dibenzo-p-dioxins; PCDDs	8280	2,3,4,6-Tetrachlorophenol	8270
Polychlorinated dibenzofurans; PCDFs	8280	Tetraethyl dithiopyrophosphate; Sulfotepp	8270
Pentachlorobenzene	8270	Thallium	8010 7840

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Table 3-13 (Continued)
Appendix IX, Groundwater Monitoring List

Sampling and Analysis Plan
NAVSTA Mayport
Mayport, Florida

Parameter	Methods	Parameter	Methods
Pentachloroethane	8240		7841
	8270	Tin	7870
Pentachloronitrobenzene	8270	Toluene	8020
Pentachlorophenol	8040		8240
	8270	o-Toluidine	8270
Phenacetin	8270	Toxaphene	8080
Phenanthrene	8100		8250
	8270	1,2,4-Trichlorobenzene	8270
Phenol	8040	1,1,1-Trichloroethane; Methyl- chloroform	8240
	8270		
p-Phenylenediamine	8270	1,1,2-Trichloroethane	8010
Phorate	8140		8240
	8270	Trichloroethylene; Trichloroethene	8010
2-Picoline	8240		8240
	8270	Trichlorofluoromethane	8010
Pronamide	8270		8240
Propionitrile; Ethyl cyanide	8015	2,4,5-Trichlorophenol	8270
	8240	2,4,6-Trichlorophenol	8040
Pyrene	8100		8270
	8270	1,2,3-Trichloropropane	8010
Pyridine	8240		8240
Safrole	8270	0,0,0-Triethyl phosphorothioate	8270
Selenium	6010	sym-Trinitrobenzene	8270
	7740	Vanadium	6010
	7741		7910
Silver	6010		7911
	7760	Vinyl acetate	8240
Silvex; 2,4,5-TP	8150	Vinyl chloride	8010
Styrene	8020		8240
	8240	Xylene (total)	8020
Sulfide	9030		8240
2,4,5-T; 2,4,5-Trichlorophenoxyacetic acid	8150	Zinc	6010
			7950

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the wooded area between Mayport Road and the golf course (SS-B-4), south of Lake Wonderwood in the base housing area (SS-B-5), and in a wooded area in the northeast corner of the base (SS-B-6). Background sediment samples will be collected from tributaries to Sherman Creek just outside the base boundary (SD-B-1 and SD-B-2) and from a drainage ditch west of Mayport Road and south of the golf course (SD-B-3).

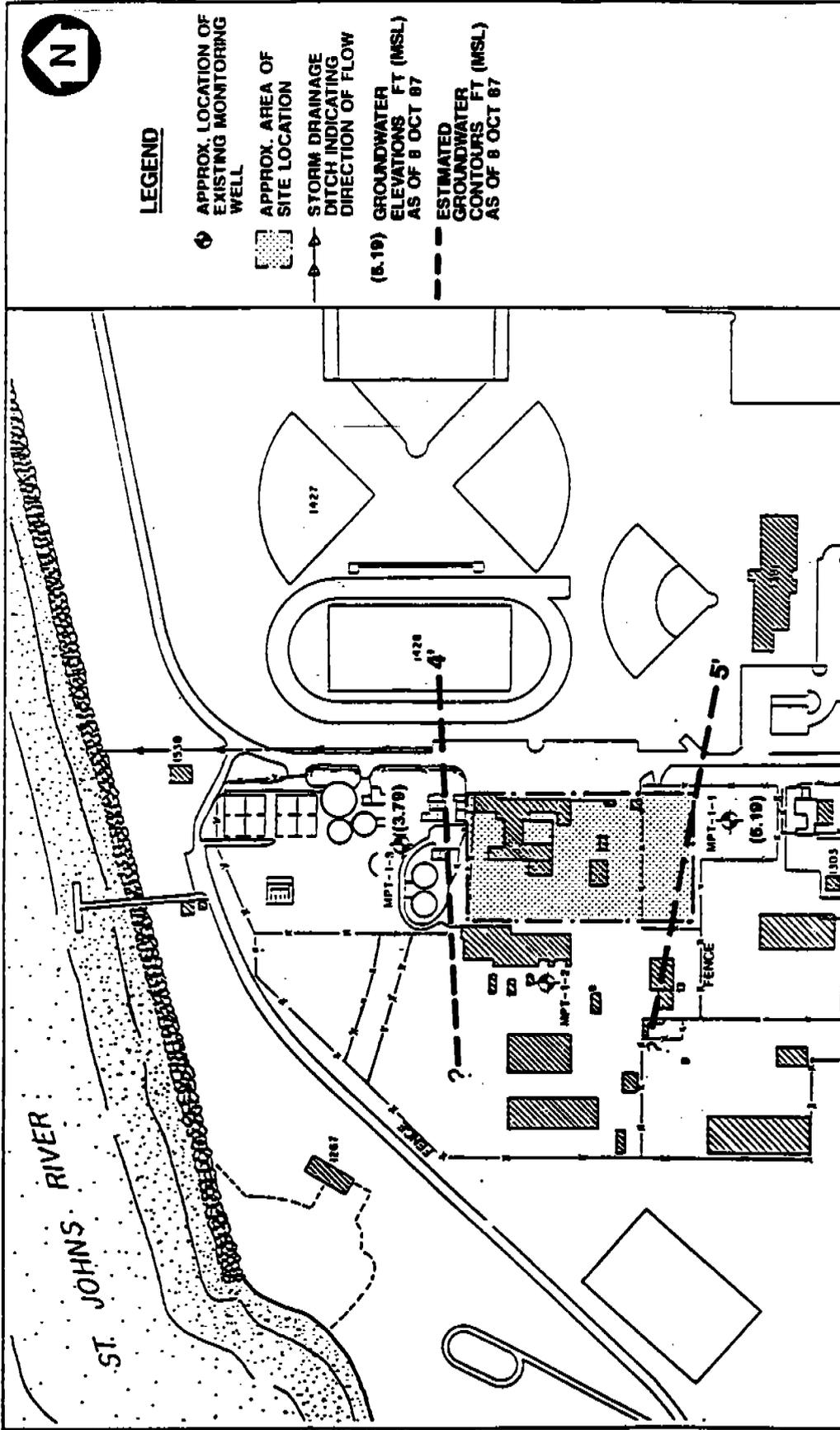
Background groundwater samples will be collected from Duval County monitoring well DS-263 located off Wonderwood Drive south of the Naval Station, provided that the well can be located and permission obtained from the county (approximate location is shown on Figure 3-6).

Monitoring well MPT-1-1 and Geraghty and Miller monitoring well S-1 will also be used as background sampling locations. Monitoring well MPT-1-1 is located just south of the Jacksonville Shipyards at Site 1 (see Figure 3-8) and is upgradient of any contamination originating from that site. No contaminants were observed in the sample obtained from monitoring well MPT-1-1 during the ESI. Geraghty and Miller monitoring well S-1 is located south of NIRP Sites 8B and 8D, and is upgradient of any release originating from those sites (see Figure 3-12). If alternative locations for background sampling are determined to be necessary, they will be located in consultation with and with approval of the EIC and Regional Administrator.

All background samples will be analyzed for 40 CFR 264 Appendix IX parameters, including metals, (USEPA Methods 6010, 7470, and 7870) volatile organics (USEPA Method 8240), and pesticides and PCBs (USEPA Method 8080). Organochlorine pesticides were used for many years for mosquito control at NAVSTA Mayport, and used oils were also used for insect control and dust suppression at the base, therefore, trace concentrations of these contaminants may be found in the background samples.

3.3.2 SWMU 1, Landfill A SWMU 1 consists of a former landfill that was operated from 1942 to 1960. The site is located east of the Mayport Basin under an area currently occupied by Jacksonville Shipyards, which is a tenant on NAVSTA Mayport (see Figure 1-2). SWMU 1 occupied approximately 4 acres and consisted of a series of trenches approximately 15 feet wide, 400 feet long, and 8 feet deep. The site received industrial and sanitary wastes during the years of operation. These wastes included waste oils, solvents, mercury lamps, asbestos, sulfuric acid, pesticide cans, and general garbage and construction rubble.

3.3.2.1 Results of Previous Investigation Three monitoring wells (MPT-1-1, MPT-1-2, and MPT-1-3) were installed in the vicinity of SWMU 1 during the ESI (Figure 3-8). Soil and groundwater samples were collected and analyzed for priority pollutants. Elevated levels of 4,4'-DDE were measured in a groundwater sample obtained from monitoring well MPT-1-2 (0.01 $\mu\text{g}/\ell$) and in both a soil sample (58 $\mu\text{g}/\text{kg}$) and a groundwater sample (0.14 $\mu\text{g}/\ell$) obtained at monitoring well MPT-1-3. Elevated levels of lead (122 $\mu\text{g}/\ell$) and cadmium (1.0 $\mu\text{g}/\ell$) were also detected in the groundwater sample from monitoring well MPT-1-3.



LEGEND

- ⊕ APPROX. LOCATION OF EXISTING MONITORING WELL
- ▨ APPROX. AREA OF SITE LOCATION
- STORM DRAINAGE DITCH INDICATING DIRECTION OF FLOW
- (8.19) GROUNDWATER ELEVATIONS FT (MSL) AS OF 8 OCT 87
- ESTIMATED GROUNDWATER CONTOURS FT (MSL) AS OF 8 OCT 87

RCRA FACILITY INVESTIGATION SAMPLING & ANALYSIS PLAN
U.S. NAVAL STATION MAYPORT, FLORIDA



FIGURE 3-8
SITE PLAN
(SITE 1 - LANDFILL A)
SWMU 1 - LANDFILL A



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3.3.2.2 Exploration Program, SWMU 1 (NIRP Site 1) The rationale for the data gathering activities at Site 1 is described in Volume I, Workplan. In summary, the objectives of the data gathering activities at SWMU 1 are to:

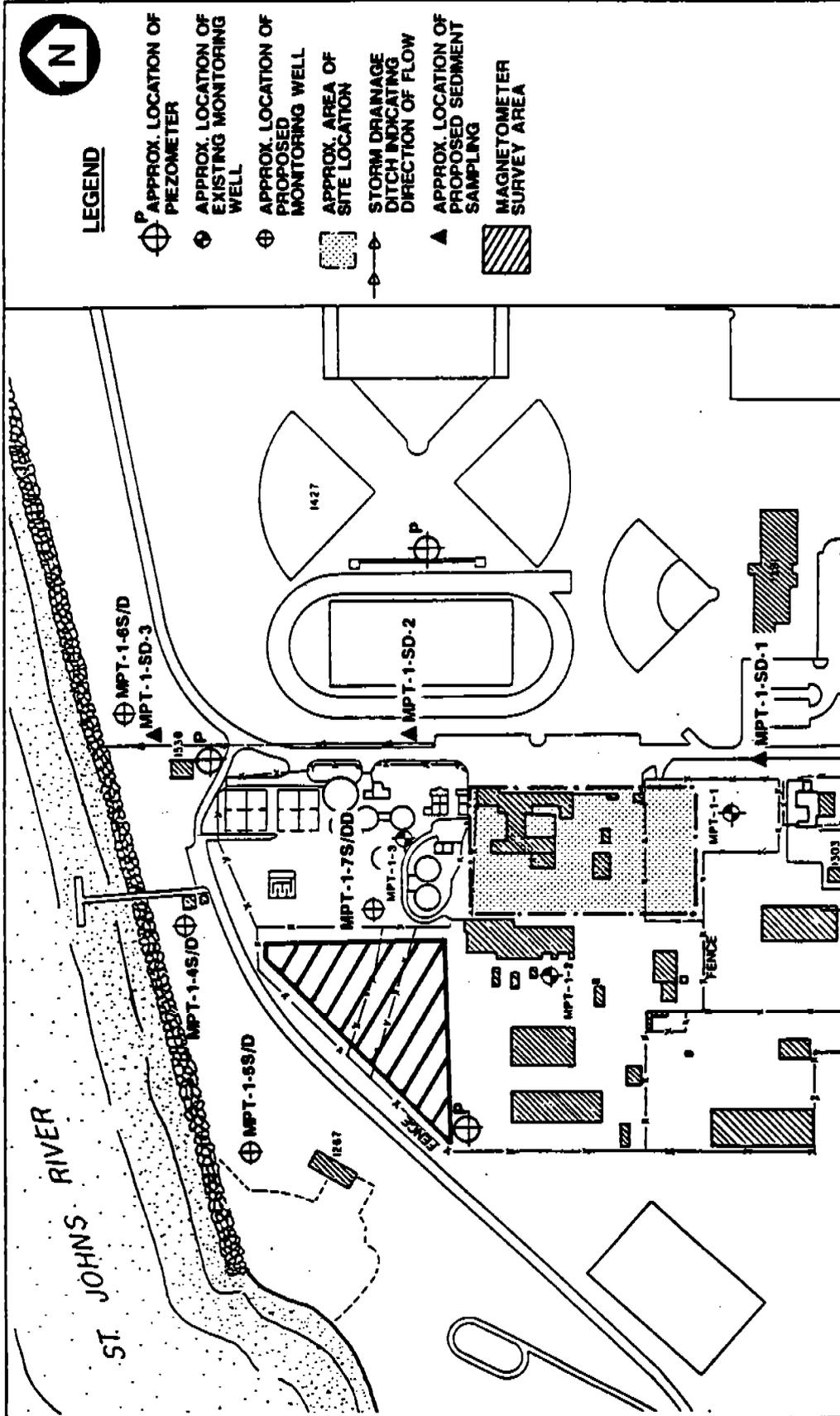
- characterize the horizontal extent of Landfill A using geophysical techniques;
- assess the potential for build-up of volatile organic compound vapors in the vadose zone near surface structures;
- obtain additional site-specific data to characterize groundwater flow rates and directions;
- obtain groundwater quality data to characterize potential groundwater contamination, plume extent, and general water quality at the site;
- obtain subsurface soil samples to characterize the horizontal and vertical extent of contamination at the site, obtain general parameters for contaminant fate and transport, and provide design criteria for potential corrective measures; and
- obtain sediment samples to assess the storm drain conveyance system as a migration pathway.

The exploration program at SWMU-1 (Landfill A) (Figure 3-8) includes the following data gathering activities:

- conducting a magnetometer survey of the suspect area northwest of site;
- conducting a soil gas survey;
- installing four monitoring well clusters composed of paired wells;
- sampling and analyzing of subsurface soil during borehole construction for monitoring wells;
- sampling and analyzing of groundwater at new and existing monitoring wells; and
- sampling and analysis of sediment samples from inverts of the storm drain conveyance system.

The sample locations at SWMU 1 are presented in Figures 3-5 and 3-9. In addition to these site-specific activities, piezometers will be installed as part of the facility-wide piezometer network to supplement local and regional data on groundwater flow rate and direction, as well as assess tidal and seasonal influences. These activities are described in Section 3.2.3, Hydrologic Investigation.

The sample media, sample locations, number of samples, estimated number of QA/QC samples, and sample analyses are summarized in Table 3-14a for SWMU 1. The data



**RCRA FACILITY
INVESTIGATION
SAMPLING & ANALYSIS
PLAN
U.S. NAVAL STATION
MAYPORT, FLORIDA**



**FIGURE 3-9
LOCATION OF EXPLORATIONS
(SITE 1)
SWMU 1**



Table S-14a: Summary of Samples to be Collected at SWMU 1, Landfill A.

SWMU Site	Sample Location	Sample Designation	Sample Type	Media	USEPA Method			USEPA Method		USEPA Method		General Physical/Chemical (Soil)	General Water Quality (Water)
					8240 VOA	8270 SOA	7470 Metals	8060 Pest/PCB	6010, 7470	8060 Pest/PCB			
1	MPT-1-4S	MPT-1-MS-4S(X-X)-1	monitoring well soil	soil	1	1	1	1	1	1	1	0	
1	MPT-1-6S	MPT-1-MS-6S(X-X)-1	monitoring well soil	soil	1	1	1	1	1	1	1	0	
1	MPT-1-8S	MPT-1-MS-8S(X-X)-1	monitoring well soil	soil	1	1	1	1	1	1	1	0	
1	MPT-1-7S	MPT-1-MS-7S(X-X)-1	monitoring well soil	soil	1	1	1	1	1	1	1	0	
			subtotal:		4	4	4	4	4	4	4	0	
1	TBD	MPT-1-MS-XS(X-XA)-1	well soil duplicates		1	1	1	1	1	1	1	0	
			total:		5	5	5	5	5	5	5	0	
1	MPT-1-1	MPT-1-MW-1-1	monitoring well water	water	1	1	1	1	1	1	1	1	
1	MPT-1-2	MPT-1-MW-2-1	monitoring well water	water	1	1	1	1	1	1	1	1	
1	MPT-1-3	MPT-1-MW-3-1	monitoring well water	water	1	1	1	1	1	1	1	1	
1	MPT-1-4S	MPT-1-MW-4S-1	monitoring well water	water	1	1	1	1	1	1	1	1	
1	MPT-1-4D	MPT-1-MW-4D-1	monitoring well water	water	1	1	1	1	1	1	1	1	
1	MPT-1-6S	MPT-1-MW-6S-1	monitoring well water	water	1	1	1	1	1	1	1	1	
1	MPT-1-6D	MPT-1-MW-6D-1	monitoring well water	water	1	1	1	1	1	1	1	1	
1	MPT-1-8S	MPT-1-MW-8S-1	monitoring well water	water	1	1	1	1	1	1	1	1	
1	MPT-1-8D	MPT-1-MW-8D-1	monitoring well water	water	1	1	1	1	1	1	1	1	
1	MPT-1-7S	MPT-1-MW-7S-1	monitoring well water	water	1	1	1	1	1	1	1	1	
1	MPT-1-7D	MPT-1-MW-7D-1	monitoring well water	water	1	1	1	1	1	1	1	1	
			subtotal:		11	11	11	11	11	11	11	11	
1	TBD	MPT-1-MW-XA-1	well water duplicates		2	2	2	2	2	2	2	0	
			total:		13	13	13	13	13	13	13	11	

Note:

Because well and sample designations were established during the NIPP investigations, the RFI will continue to use this designation scheme.
 See Table 1-1 for NIPP/SWMU Site Numbers cross-reference.
 Subsurface soil sample depths will be based on field observations. In general, soil samples will be collected just above the observed groundwater elevation unless field observations indicate more desirable sample depths (e.g., visual or field screening indications of contamination).
 VOA - Volatile Organic Compound Analyses
 SOA - Semivolatile Organic Compound Analyses
 Pest - Pesticides
 PCB - polychlorinated biphenyls
 TBD - To be determined during field activities

Table 3-14a: Summary of Samples to be Collected at SWMU 1, Landfill A.

SWMU Site	Sample Location	Sample Designation	Sample Type	Media	USEPA Method		USEPA Method		General Physical/Chemical (Soil)	General Water Quality (Water)
					8240 VOA	8270 SOA	7470 Metals	8080 Pest/PCB		
1	MPT-1	MPT-1-80-1-1	sediment	sediment	1	1	1	1	0	0
1	MPT-1	MPT-1-80-2-1	sediment	sediment	1	1	1	1	0	0
1	MPT-1	MPT-1-80-3-1	sediment	sediment	1	1	1	1	0	0
			subtotal:		3	3	3	3	0	0
1	TBD	MPT-1-80-X-1	sediment duplicates		1	1	1	1	0	0
			total:		4	4	4	4	0	0
1	MPT-1	MPT-1-QT-1	QC trip blank	water	1	0	0	0	0	0
1	MPT-1	MPT-1-QT-2	QC trip blank	water	1	0	0	0	0	0
1	MPT-1	MPT-1-QT-3	QC trip blank	water	1	0	0	0	0	0
1	MPT-1	MPT-1-QT-4	QC trip blank	water	1	0	0	0	0	0
			subtotal:		4	0	0	0	0	0
1	MPT-1	MPT-1-Q8-1	QC sampler blank	water	1	1	1	1	0	0
1	MPT-1	MPT-1-Q8-2	QC sampler blank	water	1	1	1	1	0	0
1	MPT-1	MPT-1-Q8-3	QC sampler blank	water	1	1	1	1	0	0
1	MPT-1	MPT-1-Q8-4	QC sampler blank	water	1	1	1	1	0	0
			subtotal:		4	4	4	4	0	0
1	MPT-1	MPT-1-FB-1	QC field blank	water	1	1	1	1	0	0
1	MPT-1	MPT-1-FB-2	QC field blank	water	1	1	1	1	0	0
1	MPT-1	MPT-1-FB-3	QC field blank	water	1	1	1	1	0	0
1	MPT-1	MPT-1-FB-4	QC field blank	water	1	1	1	1	0	0
			subtotal:		4	4	4	4	0	0

Note:

Because well and sample designations were established during the NRP investigations, the RFI will continue to use this designation scheme.

See Table 1-1 for NRP/SWMU Site Numbers cross-reference.

Subsurface soil sample depths will be based on field observations. In general, soil samples will be collected just above the observed groundwater elevation unless field observations indicate more desirable sample depths (e.g., visual or field screening indications of contamination).

VOA - Volatile Organic Compound Analytes

SOA - Semivolatile Organic Compound Analytes

Pest - Pesticides

PCB - polychlorinated biphenyls

TBD - To be determined during field activities

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gathering activities are composed of the field activities subtasks listed below. Because many of the field activities subtasks will be repeated at other sites, they are described as standard operation procedures in project-specific Technical Memoranda located in Appendix B, Site-Specific Quality Assurance Plan. Site-specific elements particular to SWMU 1 are discussed in subsequent sections, and standard operating procedures are referenced where necessary. Subtasks of data gathering activities at SWMU 1 include:

- magnetometer survey,
- soil gas measurement,
- drilling and subsurface soil sampling,
- well construction and development,
- groundwater sampling, and
- sediment sampling.

Magnetometer Survey. The magnetometer survey will use a Fisher™ TW-6 or equivalent. The survey will be conducted in the northwest area shown in Figure 3-9. Prior to conducting the survey, field personnel will perform the following tasks.

1. Field personnel will identify and mark on a site map all potential cultural influences such as fences, powerlines, or underground utilities.
2. Stake the area with survey flags in a square grid approximately 10 feet on centers. The grid will be oriented in a north-south, east-west alignment. The grid row and columns will be labeled using a local cartesian coordinate system.
3. The coordinate system will be referenced point to a permanent reference near the site (such as a building corner or similar structure) so that it may be re-established in the future. Simple field measurements using a flexible tape is sufficient for grid layout and benchmark reference. The benchmark reference will be recorded in the field log book.
4. Field personnel will calibrate the magnetometer in accordance with manufacturer's instructions. The magnetometer will be calibrated at the beginning of each survey day and at intermediate intervals as recommended by the manufacturer.
5. Photographs will be taken during the survey as a visual record of the grid geometry.

The field personnel will conduct the survey in phases. Phase I will consist of an initial survey of the general area following the flagged grid lines to identify any obvious anomalies. The survey will be conducted along the grid lines in both the north-south and east-west directions. Anomaly locations will be tagged and the locations recorded in the field log book using the cartesian coordinate system. Potential cultural influences will be noted.

Phase II will refine the dimensions of any anomalies discovered during the first phase. Field personnel will take measurements between staked grid rows and

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columns to delineate the anomalies. Magnetometer readings will be recorded with grid location data so that contours of magnetometer responses can be prepared.

Phase III will be composed of a "hunt and seek" strategy where judgmental readings will be taken in intermediate areas of the grid where no anomalies were discovered during Phase I. New anomalies will be tagged and their locations recorded as in Phase I.

Phase IV will refine the dimensions of any anomalies discovered during Phase III. Field personnel will take measurements between staked grid rows and columns to delineate the anomalies. Magnetometer readings will be recorded with grid location data so that contours of magnetometer responses can be prepared.

Soil Gas Investigation. At least 12 soil gas samples will be collected using an electrically driven soil gas probe around the perimeter of SWMU 1 to measure the concentration of organic vapors, if present, that may be migrating from the landfill. The rationale for performing a soil gas survey at SWMU 1 is described in Volume I, Workplan. The presence of organic vapors at the landfill has not been assessed in previous investigations at NAVSTA Mayport. This program is designed to monitor soil gas concentrations, if present, at SWMU 1 and any accumulation of organic vapors beneath the Jacksonville Shipyard, Inc., maintenance buildings located at Site 1, (Figure 3-5).

The soil gas probe consists of 2.5-foot sections of hollow stainless-steel rod (5/8-inch outer diameter (OD) which are connected to a slotted stainless-steel point. The rods and point will be driven to the desired depth of soil gas monitoring with an electric slap hammer. The slap hammer will then be disconnected from the rods and polyethylene tubing will then be connected from the top of the rods to an air bladder pump. The air in the gas probe will be purged for 3 minutes with the air bladder pump prior to obtaining a representative soil gas sample from the sampling interval. This procedure is described in more detail in a Technical Memorandum included in the Site-Specific QAP (Appendix B).

An OVA will be used to monitor soil gas in the gas probes. The OVA has the capability of distinguishing between methane gas and other organic vapors with the aid of a charcoal filter. By making this distinction, it may be possible to determine if the concentration of vapors exceeds safety limits and poses a potential hazard. If elevated levels of organic vapors are observed in any samples, additional samples will be collected and field analyzed to define the extent of contamination.

Drilling and Subsurface Soil Sampling. Drilling and subsurface soil sampling will be accomplished as described in the Technical Memorandum, Drilling and Subsurface Soil Sampling, Appendix B. A summary of the location, frequency, and sample types is presented in Table 3-14a. Borehole locations are presented in Figure 3-9. Table 3-14b summarizes the borehole depths and monitoring well specifications anticipated for SWMU 1.

Table 3-14b: Summary of New Monitoring Wells at SWMU 1, Landfill A.

SWMU Site	Well ID	Well		Estimated		Borehole Diameter (Inches)	Screen Length (feet)	Surface-Casing			Geologic Strata
		Diameter (Inches)	Depth (feet)	Depth (feet)	Inside Diameter (Inches)			Boring Diameter (Inches)			
1	MPT-1-4DD	4	125	8	10	50	10	14	U. H.		
1	MPT-1-4S	2	15	6	10	N/A	N/A	N/A	S. D.		
1	MPT-1-5D	2	30	6	5	N/A	N/A	N/A	S. D.		
1	MPT-1-5S	2	15	6	10	N/A	N/A	N/A	S. D.		
1	MPT-1-6D	2	30	6	5	N/A	N/A	N/A	S. D.		
1	MPT-1-6S	2	15	6	10	N/A	N/A	N/A	S. D.		
1	MPT-1-7D	2	30	6	5	N/A	N/A	N/A	S. D.		
1	MPT-1-7S	2	15	6	10	N/A	N/A	N/A	S. D.		

Note:

See Table 1-1 for NIRIP/SWMU Site Numbers cross-reference.

Well Identification Hydrologic Location:

- S = Shallow Surficial Aquifer
- D = Deep Surficial Aquifer
- DD = Secondary Aquifer

Geologic Strata:

- U. H. = Upper Hawthorn
- S. D. = Surficial Deposit

Well casing for all wells will be Schedule 40 PVC.

Surface casing material for secondary aquifer wells will be Schedule 80 PVC.

Screen slot size will be 0.010 inches.

Filter packs will be 20/30 silica sand.

Grout will be cement/bentonite (90/10).

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Well Construction and Development. Well construction and development will be accomplished as described in the Technical Memorandum, Well Construction and Development, Appendix B. Typical installation details for each well type are presented in Figure 3-3A through Figure 3-3D. A summary of the location, frequency, and sample types is presented in Table 3-14a. Well locations are presented in Figure 3-9. Table 3-14b summarizes the monitoring well specifications anticipated for SWMU 1. Actual completion depths and screened intervals will be determined during borehole drilling based on field observations.

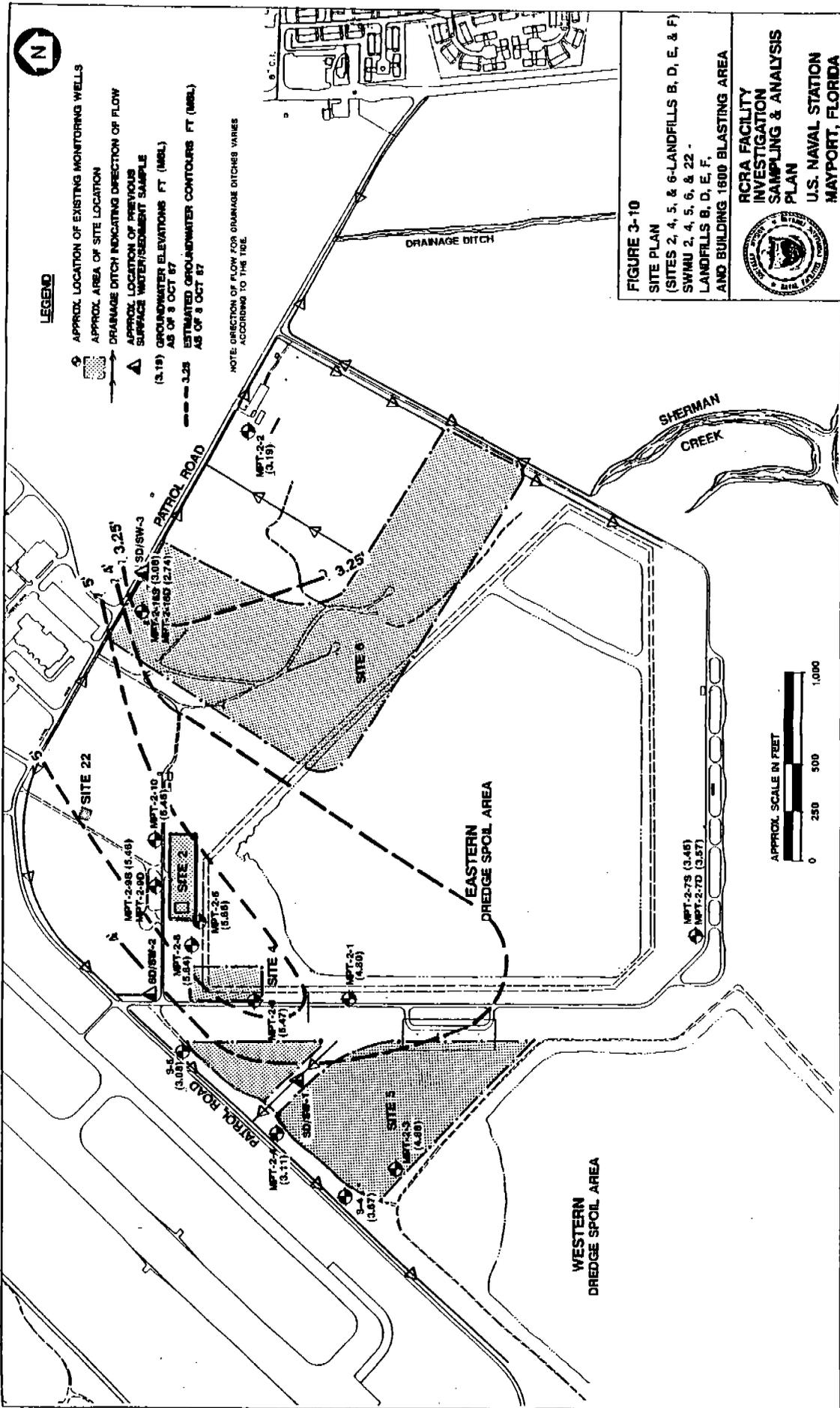
Wells will be clustered in pairs and completed at multiple depths at each cluster in order to refine characterization of groundwater hydrology and quality as described in Volume I, Workplan. One well will be completed in the Upper Hawthorn Group. The borehole for this well will be constructed first in order to get local stratigraphic information. This well will be double-cased to prevent cross contamination between water bearing zones. The outer case will be keyed at least 5 feet into the first aquitard encountered, which is estimated to be approximately 25 to 30 feet at this site. Actual depths will be determined in the field based on observation of conditions by a qualified geologist.

One well at each cluster will be completed in the upper surficial aquifer to a depth of approximately 15 feet. The wells will be screened their entire saturated length. The well screens will extend approximately 3 feet above the encountered water table. The remaining three wells (i.e., excluding the deep Upper Hawthorn well) will be completed at approximate depths of 25 to 30 feet, or to the top of the first confining unit if one is encountered in the upper surficial aquifer. The screened interval will be 5 feet.

Groundwater Sampling. The location, frequency, and sample types of groundwater are summarized in Table 3-14a. Well locations are presented in Figure 3-9. Table 3-14b summarizes the monitoring well specifications anticipated for SWMU 1. Groundwater sampling will be accomplished as described in the Technical Memorandum, Groundwater Sampling, Appendix B.

Sediment Sampling. The location, frequency, and sample types of sediment are summarized in Table 3-14a. Sediment sampling locations are presented Figure 3-9. Sediment sampling will be accomplished as described in the Technical Memorandum, Sediment and Surface Water Sampling, Appendix B.

3.3.3 SWMU 2, 3, 4, 5, and 22, Landfills B, D, E, F, and Building 1600 Blasting Area SWMU 2 (NIRP Site 2) is a landfill that was operated as a trench and fill landfill from 1960 to 1964 and as an area fill landfill from 1979 to 1980. The site is located north of the eastern dredge spoil area (Figure 3-10). The area was subsequently covered with soil and paved. An ordnance storage yard now occupies the site. The former landfill was approximately 2 acres in size. It consisted of a series of trenches that were approximately 15 feet wide, 300 feet long, and 8 feet deep. The trenches are known to have intersected the water table. Combustible items floating on water in the trenches were burned daily. Items disposed of in the landfill included waste oils, other petroleum products, mercury lamps, asbestos, sulfuric acid, pesticide cans, and general refuse.



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SWMU 3 (NIRP Site 4) is a former landfill that was operated from 1963 to 1965. The site is located southwest of SWMU 2 and extends under the northwestern corner of the eastern dredge spoil area (see Figure 3-10). Site 4 occupied approximately 3 acres and consisted of several pits (eight are estimated) constructed by dragline. Each pit was approximately 40 feet by 40 feet and 8 feet deep, and intersected the water table. Items were dumped into standing water contained in the pits. Disposed wastes included waste oil, mercury, solvents, asbestos, acids, pesticide containers, sanitary wastes, and construction rubble.

SWMU 4 (NIRP Site 5) is a landfill that was operated as a trench and fill landfill from 1963 to 1966 and as an area fill landfill from 1974 to 1980. The site is located west of SWMU 3 and north of the NAVSTA Mayport western dredge spoil area (see Figure 3-10). The site consists of two adjacent areas divided by a drainage ditch with a total acreage of approximately 11 acres. The trenches on this site were constructed with a dragline and were approximately 15 feet wide, 750 feet long, and 8 feet deep. These trenches intersected the water table and wastes were disposed into standing water. Wastes disposed of at Site 5 are similar to those disposed of at SWMU 2 and 3.

SWMU 5 (NIRP Site 6) is located south of Patrol Road and north of the eastern dredge spoil area (see Figure 3-10). The SWMU 5 landfill was operational from 1966 to 1985. Originally the site was a trench and fill operation. Upon completion of the trench and fill operation and addition of a soil cover, a surface disposal operation was initiated. The site encompasses approximately 24 acres and originally consisted of trenches (constructed by dragline) that were 8 feet deep, 15 feet wide, and several hundred feet long. The trenches intersected the shallow aquifer and wastes were disposed of into standing water. Items disposed of in the landfill were the same as those at SWMU 2, 3, and 4.

SWMU 22 (Building 1600 Blasting Area) is a fenced area located just to the northeast of Building 1600, which is located in the central part of Mayport to the north of the northeast dredge spoil disposal area. Abrasive media blasting is conducted in a sheet metal Baker's hut on a concrete base and foundation. The base extends past the quonset hut approximately 10 feet and is encircled by a chain link fence. A dust collector attached to the back of the building collects dust and abrasives during blasting operations. The equipment blasted in this area is largely ground support equipment, most of which is painted with yellow enamel paint and zinc-containing primers. The abrasive media used for blasting is Black Beauty™ (a preparatory glass blasting media). The area has been in use since about 1986.

Soil samples will be collected from the area immediately outside of the fenced concrete base and the samples will be analyzed for the presence of metals. The purpose of this sampling is to characterize the extent and the nature of any releases from this SWMU.

3.3.3.1 Results of Previous Investigation As part of the ESI, a terrain conductivity survey was conducted in the landfill area in an attempt to determine if a leachate plume extends beyond the surface water drainage ditches. However, the presence of brackish groundwater relatively close to the land surface made it impossible to distinguish the presence of any leachate plume. Eleven shallow

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soil borings (MPT-2-1, MPT-2-2, MPT-2-3, MPT-2-4, MPT-2-5, MPT-2-6, MPT-2-7S, MPT-2-8, MPT-2-9S, MPT-2-10, and MPT-2-15S) and three deep soil borings (MPT-2-7D, MPT-2-9D, and MPT-2-15D) were completed with monitoring well installations in the landfill area. The shallow monitoring wells are about 10 feet deep, and the deeper wells are 25 feet deep. Deep monitoring well screens are placed below a clay layer observed at 1 to 4 feet below mean sea level. Soil samples were collected from each boring just above the water table. Groundwater samples were collected from each new monitoring well and from two existing wells (S4 and S5). Three sediment and surface water samples were collected from the drainage ditches. Sample locations are shown in Figure 3-10.

Volatile Organics. Chlorobenzene (44 $\mu\text{g}/\text{kg}$) and toluene (553 $\mu\text{g}/\text{kg}$) were detected in a soil sample obtained at Site 2 from boring MPT-2-5.

Volatile organic compounds were not detected in groundwater samples obtained from Site 4 but were present in soil samples. Chlorobenzene (37 $\mu\text{g}/\text{kg}$), toluene (232 $\mu\text{g}/\text{kg}$), and 1,1,1-trichloroethane (122 $\mu\text{g}/\text{kg}$) were detected in the soil sample obtained from boring MPT-2-8 but not in a field duplicate of that sample.

No volatile organics were detected in soils at Site 5, but groundwater contained both benzene (1 $\mu\text{g}/\text{l}$) and chlorobenzene (139 $\mu\text{g}/\text{l}$) in a sample obtained from monitoring well MPT-2-3.

Volatile organics were also detected in a surface water sample (SW-1) obtained from a ditch that crosses Site 5. This sample contained both trans-1,2-dichloroethene (6 $\mu\text{g}/\text{l}$) and vinyl chloride (3 $\mu\text{g}/\text{l}$).

No volatile organics were detected in soil, groundwater, surface water, or sediment samples collected at Site 6.

Semivolatile Organics. The only semivolatile organic detected at Site 2 was di-n-butyl phthalate. This compound was found in the groundwater sample collected from monitoring well MPT-2-9S at a concentration of 20 $\mu\text{g}/\text{l}$. PCB-1260 was detected in the soil sample obtained from boring MPT-2-9 at 2,576,000 $\mu\text{g}/\text{kg}$. This concentration exceeds the Toxic Substances Control Act (TSCA) standard of 50,000 $\mu\text{g}/\text{kg}$ for removal of PCB-contaminated soil. Priority pollutant pesticides were not detected in either soil or groundwater samples collected at Site 2.

The semivolatile organic compounds bis(2-ethylhexyl)phthalate (15 $\mu\text{g}/\text{l}$) and 2,4-dimethylphenol (13 $\mu\text{g}/\text{l}$) were detected in groundwater at Site 4. No PCBs or pesticides were detected in groundwater but PCB-1260 and heptachlor were detected in soils. PCB-1260 was detected in the soil sample obtained from boring MPT-2-6 at 990 $\mu\text{g}/\text{kg}$, which does not exceed the TSCA standard of 50,000 $\mu\text{g}/\text{kg}$ for removal. Heptachlor was detected in the soil sample obtained from the field duplicate MPT-2-8 DUP at 6 $\mu\text{g}/\text{kg}$.

The pesticide 4,4'-DDD was detected in a surface water sample collected from the drainage ditch that crosses Site 5. Surface water sample SW-1 contained 4,4'-DDD at 20 $\mu\text{g}/\text{l}$.

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Semivolatile organics detected in groundwater at Site 6 include acenaphthene (35 $\mu\text{g}/\text{l}$) and bis(2-ethylhexyl)phthalate (20 to 35 $\mu\text{g}/\text{l}$). A groundwater sample from monitoring well MPT-2-15S contained heptachlor at 0.03 $\mu\text{g}/\text{l}$. Surface water sample SW-3 contained 4,4'-DDE at 0.01 $\mu\text{g}/\text{l}$. Soils from boring MPT-2-2 contained PCB-1260 at 190 $\mu\text{g}/\text{kg}$. As mentioned, this concentration is below the TSCA standard of 50,000 $\mu\text{g}/\text{l}$ set as a clean-up level by the USEPA.

Metals. Priority pollutant metals detected at Site 2 consist of total lead in groundwater samples obtained from monitoring wells MPT-2-5 (2 $\mu\text{g}/\text{l}$) and MPT-2-10 (4 $\mu\text{g}/\text{l}$).

Soil samples collected from Site 4 contained no detectable levels of priority pollutant metals. However, groundwater contained both cadmium and lead. A groundwater sample from monitoring well MPT-2-8 contained total cadmium at 0.9 $\mu\text{g}/\text{l}$. The same sample also contained total lead at 160 $\mu\text{g}/\text{l}$. The groundwater sample from monitoring well MPT-2-5 also contained lead at a concentration of 2 $\mu\text{g}/\text{l}$.

Both chromium and lead were detected in groundwater at Site 5. Total lead was detected in monitoring well S-4 at a concentration of 5 $\mu\text{g}/\text{l}$. The concentration of total chromium found in groundwater from monitoring wells MPT-2-4, S-4, and S-5 was 100 $\mu\text{g}/\text{l}$. Chromium was also detected in surface water sample SW-1 at 100 $\mu\text{g}/\text{l}$.

Total lead was detected at 4 $\mu\text{g}/\text{l}$ in the groundwater sample obtained from monitoring well MPT-2-2 near Site 6.

3.3.3.2 Exploration Program, SWMU 2, 3, 4, and 5 (NIRP Site 2, 4, 5 and 6), and SWMU 22 The rationale for the data gathering activities at Site 1 is described in Volume I, Workplan. In summary, objectives of the data gathering activities at SWMU 2, 3, 4, 5, and 22 are to:

- obtain additional site-specific data to characterize groundwater flow rates and directions;
- obtain groundwater quality data to characterize potential groundwater contamination, plume extent, and general water quality at the site;
- obtain subsurface soil samples to: characterize the horizontal and vertical extent of contamination at the site, obtain general parameters for contaminant fate and transport, and provide design criteria for potential corrective measures;
- obtain sediment and surface water samples to assess the storm drain conveyance system as a migration pathway; and
- characterize localized PCB contamination of surface soils near the MPT-2-9 well cluster.

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The exploration program at SWMU 2, 3, 4, 5, and 22 (Landfills B, D, E, and F, and Building 1600 Blasting Area) (Figure 3-10) includes the following data gathering activities:

- installing eight monitoring wells,
- sampling and analyzing subsurface soil during borehole construction for monitoring wells,
- sampling and analyzing of groundwater at new and existing monitoring wells, and
- sampling and analyzing sediment and surface water samples from the storm drain conveyance system, and
- sampling and analyzing surface soil for PCB contamination

The locations of these activities at SWMU 2, 3, 4, 5 and 22 are presented in Figure 3-11. In addition to these site-specific activities, piezometers will be installed as part of the facility-wide piezometer network to supplement local and regional data on groundwater flow rate and direction, as well as assess tidal and seasonal influences. These activities are described in Section 3.2.3, Hydrologic Investigation.

The sample media, sample locations, number of samples, estimated number of QA/QC samples, and sample analyses are summarized in Table 3-15a for SWMU 2, 3, 4, 5, and 22. The data gathering activities are composed of the field activities subtasks listed below. Because many of the field activities subtasks will be repeated at other sites, they are described as standard operation procedures in project-specific Technical Memoranda located in Appendix B, site-specific Quality Assurance Plan. Site-specific elements particular to SWMU 2, 3, 4, 5, and 22 are discussed in subsequent sections, and standard operating procedures are referenced where necessary. Subtasks of data gathering activities at SWMU 2, 3, 4, 5, and 22 include:

- drilling and subsurface soil sampling,
- well construction and development,
- groundwater sampling,
- sediment sampling, and
- surface and near-surface soil sampling.

Drilling and Subsurface Soil Sampling. Drilling and subsurface soil sampling will be accomplished as described in the Technical Memorandum, Drilling and Subsurface Soil Sampling, Appendix B. A summary of the location, frequency, and sample types is presented in Table 3-15a. Borehole locations are presented in Figure 3-11. Table 3-15b summarizes the borehole depths and monitoring well specifications anticipated for SWMUs 2, 3, 4, 5, and 22.

Table 3-15a: Summary of Samples to be Collected at SWMUs 2,3,4,5, and 22 (Landfill B, C, D, E, and Building 1000 Blasting Area).

SWMU Site	Sample Location	Sample Designation	Sample Type	Media	USEPA Method			USEPA Method		General Physical/Chemical (Soil)	General Water Quality (Water)
					8240 VOA	8270 SOA	7470 Metals	6080 Pesticide/PCB	6010, 7470		
2,3,4,5,22	MPT-22-1	MPT-22-MS-1(X-X)-1	monitoring well soil	soil	1	1	1	1	1	1	0
	MPT-2-16S	MPT-2-MS-16S(X-X)-1	monitoring well soil	soil	1	1	1	1	1	1	0
	MPT-2-17S	MPT-2-MS-17S(X-X)-1	monitoring well soil	soil	1	1	1	1	1	1	0
			subtotal:	soil	3	3	3	3	3	3	0
2,3,4,5,22	TBD	MPT-X-MS-XS(X-X)-1	well soil duplicates	soil	1	1	1	1	1	1	0
			total:	soil	4	4	4	4	4	4	0

Note:

Because well and sample designations were established during the NIRP investigations, the RFI will continue to use this designation scheme. See Table 1-1 for NIRP/SWMU Site Numbers cross-reference. Subsurface soil sample depths will be based on field observations. In general, soil samples will be collected just above the observed groundwater elevation unless field observations indicate more desirable sample depths (e.g., visual or field screening indications of contamination).
 VOA - Volatile Organic Compound Analyses
 SOA - Semivolatile Organic Compound Analyses
 Pest - Pesticides
 PCB - polychlorinated biphenyls
 TBD - To be determined during field activities

Table 3-15c: Summary of Samples to be Collected at SWMUs 2,3,4,5, and 22 (Landfills B, C, D, E, and Building, 1600 Blasting Area).

SWMU Site	Sample Location	Sample Designation	Sample Type	Media	USEPA Method			USEPA Method		General Physical/Chemical (Soil)	General Water Quality (Water)
					8240 VOA	8270 SOA	8080 Metals	8080 Pest/PCB			
2,3,4,5,22	MPT-22-1	MPT-22-MW-1-1	monitoring well water	water	1	1	1	1	0	1	
2,3,4,5,22	MPT-2-1	MPT-2-MW-1-1	monitoring well water	water	1	1	1	1	0	1	
2,3,4,5,22	MPT-2-2	MPT-2-MW-2-1	monitoring well water	water	1	1	1	1	0	1	
2,3,4,5,22	MPT-2-3	MPT-2-MW-3-1	monitoring well water	water	1	1	1	1	0	1	
2,3,4,5,22	MPT-2-4	MPT-2-MW-4-1	monitoring well water	water	1	1	1	1	0	1	
2,3,4,5,22	MPT-2-5	MPT-2-MW-5-1	monitoring well water	water	1	1	1	1	0	1	
2,3,4,5,22	MPT-2-6	MPT-2-MW-6-1	monitoring well water	water	1	1	1	1	0	1	
2,3,4,5,22	MPT-2-7S	MPT-2-MW-7S-1	monitoring well water	water	1	1	1	1	0	1	
2,3,4,5,22	MPT-2-7D	MPT-2-MW-7D-1	monitoring well water	water	1	1	1	1	0	1	
2,3,4,5,22	MPT-2-8	MPT-2-MW-8-1	monitoring well water	water	1	1	1	1	0	1	
2,3,4,5,22	MPT-2-9S	MPT-2-MW-9S-1	monitoring well water	water	1	1	1	1	0	1	
2,3,4,5,22	MPT-2-9D	MPT-2-MW-9D-1	monitoring well water	water	1	1	1	1	0	1	
2,3,4,5,22	MPT-2-10	MPT-2-MW-10-1	monitoring well water	water	1	1	1	1	0	1	
2,3,4,5,22	MPT-2-16S	MPT-2-MW-16S-1	monitoring well water	water	1	1	1	1	0	1	
2,3,4,5,22	MPT-2-16D	MPT-2-MW-16D-1	monitoring well water	water	1	1	1	1	0	1	
2,3,4,5,22	MPT-2-16S	MPT-2-MW-16S-1	monitoring well water	water	1	1	1	1	0	1	
2,3,4,5,22	MPT-2-16D	MPT-2-MW-16D-1	monitoring well water	water	1	1	1	1	0	1	
2,3,4,5,22	MPT-2-17S	MPT-2-MW-17S-1	monitoring well water	water	1	1	1	1	0	1	
2,3,4,5,22	MPT-2-17D	MPT-2-MW-17D-1	monitoring well water	water	1	1	1	1	0	1	
2,3,4,5,22	TBD	MPT-X-MW-XA-1	well water duplicates	water	2	2	2	2	0	0	
total:					21	21	21	21	0	19	

Note: Because well and sample designations were established during the NIRP investigations, the RFI will continue to use this designation scheme. See Table 1-1 for NIRP/SWMU Site Numbers cross-reference. Subsurface soil sample depths will be based on field observations. In general, soil samples will be collected just above the observed groundwater elevation unless field observations indicate more desirable sample depths (e.g., visual or field screening indications of contamination). VOA - Volatile Organic Compound Analyses SOA - Semivolatile Organic Compound Analyses Pest - Pesticides PCB - polychlorinated biphenyls TBD - To be determined during field activities

Table 3-15a: Summary of Samples to be Collected at SWMUs 2,3,4,5, and 22 (Landfills B, C, D, E, and Building 1 (000 Standing Area))

SWMU Site	Sample Location	Sample Designation	Sample Type	Media	USEPA Method		USEPA Method		USEPA Method		General Physical/Chemical (Soil)	General Water Quality (Water)	
					8240 VOA	8270 SOA	6010, 7470 Metals	8080 Pesticides	8010, 7480				
2,3,4,5,22	MPT-22	MPT-22-SB-1(0.5-1)-1	surface soil	soil	1	1	1	1	1	1	0	0	
	MPT-22	MPT-22-SB-1(2.5-3)-1	surface soil	soil	1	1	1	1	1	1	0	0	
	MPT-22	MPT-22-SB-2(0.5-1)-1	surface soil	soil	1	1	1	1	1	1	0	0	
	MPT-22	MPT-22-SB-2(2.5-3)-1	surface soil	soil	1	1	1	1	1	1	0	0	
	MPT-22	MPT-22-SB-3(0.5-1)-1	surface soil	soil	1	1	1	1	1	1	0	0	
	MPT-22	MPT-22-SB-3(2.5-3)-1	surface soil	soil	1	1	1	1	1	1	0	0	
	MPT-22	MPT-22-SB-4(0.5-1)-1	surface soil	soil	1	1	1	1	1	1	0	0	
	MPT-22	MPT-22-SB-4(2.5-3)-1	surface soil	soil	1	1	1	1	1	1	0	0	
	subtotal:				soil	6	6	6	6	6	6	0	0
	total:				soil	6	6	6	6	6	6	0	0
2,3,4,5,22	MPT-2	MPT-2-SW-4-1	surface water	water	1	1	1	1	1	1	0	1	
	MPT-2	MPT-2-SW-5-1	surface water	water	1	1	1	1	1	1	0	1	
	MPT-2	MPT-2-SW-6-1	surface water	water	1	1	1	1	1	1	0	1	
	MPT-2	MPT-2-SW-7-1	surface water	water	1	1	1	1	1	1	0	1	
	MPT-2	MPT-2-SW-8-1	surface water	water	1	1	1	1	1	1	0	1	
	subtotal:				water	6	6	6	6	6	6	6	
	total:				water	6	6	6	6	6	6	6	
	2,3,4,5,22	MPT-2	MPT-2-SD-4-1	sediment	sediment	1	1	1	1	1	1	0	0
		MPT-2	MPT-2-SD-6-1	sediment	sediment	1	1	1	1	1	1	0	0
		MPT-2	MPT-2-SD-6-1	sediment	sediment	1	1	1	1	1	1	0	0
MPT-2		MPT-2-SD-7-1	sediment	sediment	1	1	1	1	1	1	0	0	
MPT-2		MPT-2-SD-8-1	sediment	sediment	1	1	1	1	1	1	0	0	
subtotal:				sediment	6	6	6	6	6	6	6		
total:				sediment	6	6	6	6	6	6	6		
2,3,4,5,22		TBD	MPT-2-SD-XA-1	sediment duplicate	sediment	1	1	1	1	1	1	0	0
		TBD	MPT-2-SD-XA-1	sediment duplicate	sediment	1	1	1	1	1	1	0	0

Note:
 Because well and sample designations were established during the NIRP investigations, the RFI will continue to use this designation scheme.
 See Table 1-1 for NIRP/SWMU Site Numbers cross-reference.
 Subsurface soil sample depths will be based on field observations. In general, soil samples will be collected just above the observed groundwater elevation unless field observations indicate more desirable sample depths (e.g., visual or field screening indications of contamination).
 VOA - Volatile Organic Compound Analyses
 SOA - Semivolatile Organic Compound Analyses
 Pest - Pesticides
 PCB - polychlorinated biphenyls
 TBD - To be determined during field activities

Table 3-15a: Summary of Samples to be Collected at SWMUs 2,3,4,5, and 22 (Landfills B, C, D, E, and Building 1000 Stacking Area).												
SWMU Site	Sample Location	Sample Designation	Sample Type	Media	USEPA Method				USEPA Method		General Physical/Chemical (Boil)	General Water Quality (Water)
					8240 VOA	8270 SOA	7480 Metals	8090 Pest/PCB	8010, 7470	8090		
2,3,4,5,22	MPT-2	MPT-2-QT-1	QC trip blank	water	1	0	0	0	0	0	0	0
	MPT-2	MPT-2-QT-2	QC trip blank	water	1	0	0	0	0	0	0	0
	MPT-2	MPT-2-QT-3	QC trip blank	water	1	0	0	0	0	0	0	0
	MPT-2	MPT-2-QT-4	QC trip blank	water	1	0	0	0	0	0	0	0
subtotal:					4	0	0	0	0	0	0	0
2,3,4,5,22	MPT-2	MPT-2-QS-1	QC sampler blank	water	1	1	1	1	1	0	0	0
	MPT-2	MPT-2-QS-2	QC sampler blank	water	1	1	1	1	1	0	0	0
	MPT-2	MPT-2-QS-3	QC sampler blank	water	1	1	1	1	1	0	0	0
	MPT-2	MPT-2-QS-4	QC sampler blank	water	1	1	1	1	1	0	0	0
subtotal:					4	4	4	4	4	0	0	0
2,3,4,5,22	MPT-2	MPT-2-FB-1	QC field blank	water	1	1	1	1	1	0	0	0
	MPT-2	MPT-2-FB-2	QC field blank	water	1	1	1	1	1	0	0	0
	MPT-2	MPT-2-FB-3	QC field blank	water	1	1	1	1	1	0	0	0
	MPT-2	MPT-2-FB-4	QC field blank	water	1	1	1	1	1	0	0	0
subtotal:					4	4	4	4	4	0	0	0

Note:

Because well and sample designations were established during the NIRP investigations, the RIF1 will continue to use this designation scheme.
 See Table 1-1 for NIRP/SWMU Site Numbers cross-reference.
 Subsurface soil sample depths will be based on field observations. In general, soil samples will be collected just above the observed groundwater elevation unless field observations indicate more desirable sample depths (e.g., visual or field screening indications of contamination).
 VOA - Volatile Organic Compound Analytes
 SOA - Semivolatile Organic Compound Analytes
 Pest - Pesticides
 PCB - polychlorinated biphenyls
 TBD - To be determined during field activities

Table 3-15b: Summary of New Monitoring Wells at SWMUs 2,3,4,5, and 22 (Landfills B,C,D,E, and Building 1600 Blasting Area)

SWMU Site	Well ID	Surface-Casing Surface-Casing Surface-Casing										Geologic Strata	
		Estimated Depth (feet)	Well Diameter (inches)	Borehole Diameter (inches)	Screen Length (feet)	Estimated Depth (feet)	Inside Diameter (inches)	Boring Diameter (inches)	Estimated Depth (feet)	Well Diameter (inches)	Borehole Diameter (inches)		
2,3,4,5,&22	MPT-2-11S	15	2	6	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	S. D.
2,3,4,5,&22	MPT-2-12D	25	2	6	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	S. D.
2,3,4,5,&22	MPT-2-12S	15	2	6	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	S. D.
2,3,4,5,&22	MPT-2-16DD	100	4	8	10	50	10	10	10	14	14	14	U. H.
2,3,4,5,&22	MPT-2-16S	15	2	6	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	S. D.
2,3,4,5,&22	MPT-2-17DD	100	4	8	10	50	10	10	10	14	14	14	U. H.
2,3,4,5,&22	MPT-2-17S	15	2	6	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	S. D.
2,3,4,5,&22	MPT-22-1S	15	2	6	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	S. D.

Note:

See Table 1-1 for NIRP/SWMU Site Numbers cross-reference.

Well Identification Hydrologic Location:

S = Shallow Surficial Aquifer

D = Deep Surficial Aquifer

DD = Secondary Aquifer

Geologic Strata:

U. H. = Upper Hawthorn

S. D. = Surficial Deposit

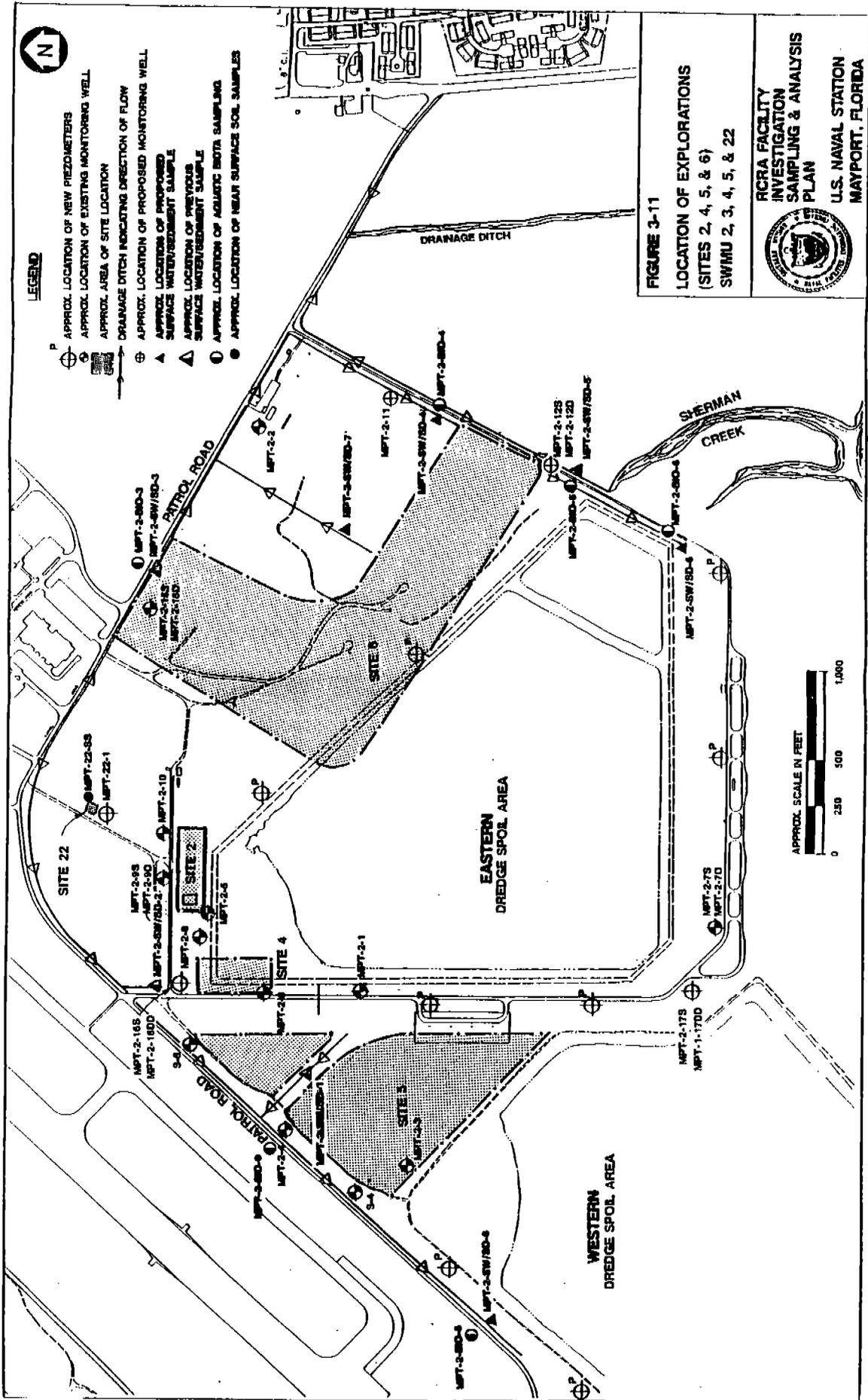
Well casing for all wells will be Schedule 40 PVC.

Surface casing material for secondary aquifer wells will be Schedule 80 PVC.

Screen slot size will be 0.010 inches.

Filter packs will be 20/30 silica sand.

Grout will be cement/bentonite (90/10).



LEGEND

- ⊕ APPROX. LOCATION OF NEW PIEZOMETERS
- ⊕ APPROX. LOCATION OF EXISTING MONITORING WELL
- ⊕ APPROX. AREA OF SITE LOCATION
- DRAINAGE DITCH INDICATING DIRECTION OF FLOW
- ⊕ APPROX. LOCATION OF PROPOSED MONITORING WELL
- ▲ APPROX. LOCATION OF PROPOSED SURFACE WATER TREATMENT SAMPLE
- ▲ APPROX. LOCATION OF PREVIOUS SURFACE WATER TREATMENT SAMPLE
- ⊕ APPROX. LOCATION OF AQUATIC BIOTA SAMPLING
- ⊕ APPROX. LOCATION OF NEAR SURFACE SOIL SAMPLES

FIGURE 3-11

LOCATION OF EXPLORATIONS
 (SITES 2, 4, 5, & 6)
 SWMU 2, 3, 4, 5, & 22

**RCRA FACILITY
 INVESTIGATION
 SAMPLING & ANALYSIS
 PLAN**

**U.S. NAVAL STATION
 MAYPORT, FLORIDA**



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Well Construction and Development. Well construction and development will be accomplished as described in the Technical Memorandum, Well Construction and Development, Appendix B. Typical installation details for each well type are presented in Figure 3-3A through Figure 3-3D. A summary of the location, frequency, and sample types is presented in Table 3-15a. Well locations are presented Figure 3-9. Table 3-15b summarizes the monitoring well specifications anticipated for SWMU 2, 3, 4, 5, and 22. Actual completion depths and screened intervals will be determined during borehole drilling based on field observations.

One well will be completed in the Upper Hawthorn Group. The borehole for this well will be constructed first in order to get local stratigraphy information. This well will be double-cased to prevent cross-contamination between water bearing zones. The outer casing will be keyed at least five feet into the first aquitard encountered, which is estimated to be approximately 25 to 30 feet at this site. Actual depths will be determined in the field based on observation of conditions by a qualified geologist.

Other wells at each location will be completed in the upper surficial aquifer to a depth of approximately 15 to 20 feet. The wells will be screened their entire saturated length. The well screens will extend approximately 3 feet above the water table.

Groundwater Sampling. The location, frequency, and sample types of groundwater are summarized in Table 3-15a. Well locations are presented in Figure 3-11. Table 3-15b summarizes the monitoring well specifications anticipated for SWMUs 2, 3, 4, 5, and 22. Groundwater sampling will be accomplished as described in the Technical Memorandum, Groundwater Sampling, Appendix B.

Sediment and Surface Water Sampling. The location, frequency, media, and sample types of sediment and surface water are summarized in Table 3-15a. Sediment and surface water sampling locations are presented in Figure 3-11. Sediment sampling will be accomplished as described in the Technical Memorandum, Sediment and Surface Water Sampling, Appendix B.

Surface Soil PCB Contamination Characterization Sampling and Analysis. PCB Surface soil contamination will be characterized using a non-random sampling grid located in the area around monitoring well cluster MPT-2-9. Sample points will be configured in a triangular geometry (Technical Memorandum, Sampling Grid Layout for PCB Soil Sampling, Appendix B).

Surface and near surface soil samples will be collected in accordance with the Technical Memorandum, Surface Soil Sampling, Appendix B. Duplicate soil samples will be collected at each grid point. One sample will be packaged, labeled, and preserved for possible laboratory analysis using USEPA Method 8080 in accordance with procedures described in Section 3.1, Volume II, Sampling and Analysis Plan. The remaining duplicate will be analyzed on-site using a PCB screening kit for soil (CLOR-N-SOIL[™]). Use of the PCB screening kit is described in the instructions provided by the vendor. A copy is presented in Appendix B, Volume II, Sampling and Analysis Plan, for reference.

INTERIM FINAL

The duplicates of soil samples tested positive for PCB with the field kit will be sent to the laboratory for confirmatory analysis by USEPA Method 8080. Appropriate chain-of-custody documentation will be used and QA/QC samples will be collected in accordance with the QAPP, Appendix A, Volume II, Sampling and Analysis Plan.

3.3.4 SWMU 6, 7, 8, 9, and 10 (NIRP Sites 8, 8A, 8B, 8C, and 8D), Oily Waste Treatment Plant (DWTP) and Hazardous Waste Storage Facility SWMU 8, the inactive waste oil pit, is located on the western end of a fuel farm located adjacent to the St. Johns River (Figure 3-12). The site, which is presently covered by SWMU 8A, consisted of a pit excavated to a depth of approximately 6 feet and was approximately 0.2 acre in size. Triangular in shape, the pit was used from 1973 to 1978 to store waste oily bilge water pumped to the pit directly from ships. In addition, the site received waste oils and other wastes potentially mixed with waste oil including solvents, transformer oils, and pesticides.

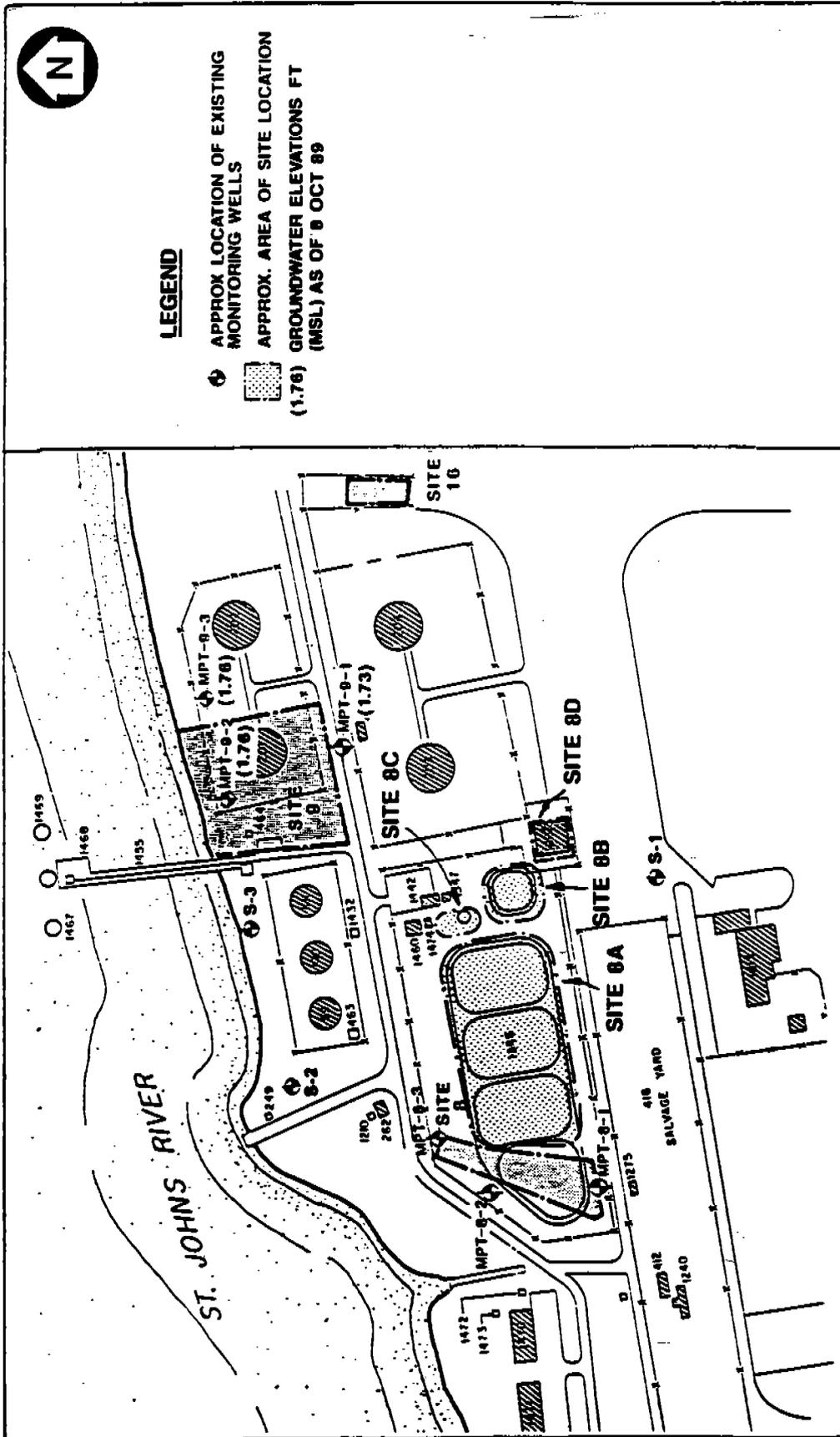
Adjacent to the old waste oil pit (SWMU 6) is an active, permitted [National Pollutant Discharge Elimination System (NPDES) Permit No. FLO033308], oily waste treatment facility. This facility treats oily bilge wastes from ships based at Mayport. The facility typically is operated 8 hours a day (except when large quantities of bilge water necessitate longer operation) at an average daily flow of 45,507 gallons per day. Due to the areal size of this facility and the different processes involved in treatment, the active facility has been divided into 3 SWMUs by the USEPA. A description of the facility and the processes classified as SWMUs is presented in Volume I, Workplan.

3.3.4.1 Results of Previous Investigation The ESI principally addressed inactive sites. Because the oily waste treatment system (sites 8A, 8B, 8C) and the hazardous waste storage facility (Site 8D) are currently operating, they were not included in the ESI.

Three monitoring wells (MPT-8-1, MPT-8-2, and MPT-8-3) were installed at Site 8 during the ESI (see Figure 3-12). Soil samples collected just above the water table in each boring and groundwater samples from each well were analyzed for priority pollutants.

Volatile Organics. Trichlorofluoromethane was found in a soil sample collected in boring MPT-8-1 but was not detected in groundwater. Trichlorofluoromethane is a highly volatile fluorocarbon commonly known as Freon 11. Benzene (2 $\mu\text{g}/\text{l}$) and ethyl benzene (12 $\mu\text{g}/\text{l}$) were detected in the groundwater samples from monitoring wells MPT-8-2 and MPT-8-3 and are indicative of petroleum contamination.

Endrin aldehyde (0.05 $\mu\text{g}/\text{l}$) and γ -BHC (0.03 $\mu\text{g}/\text{l}$) were also detected in the groundwater sample collected from monitoring well MPT-8-3. Approximately 0.9 foot of free petroleum hydrocarbon product was observed in monitoring well MPT-8-3, and a high concentration of unidentified hydrocarbons in the groundwater sample from that well resulted in elevated analytical detection limits for base-neutral and acid extractable organics.



LEGEND

- ⊕ APPROX LOCATION OF EXISTING MONITORING WELLS
- ▨ APPROX. AREA OF SITE LOCATION (1.76) GROUNDWATER ELEVATIONS FT (MSL) AS OF 8 OCT 89

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**FIGURE 3-12
SITE PLAN
(SITES 8, 8A, 8B, 8C, 8D, 9, & 16)
SWMU 6, 7, 8, 9, 10, 11, AND 16**



INTERIM FINAL

Other Organics. Naphthalene and bis(2-ethylhexyl)phthalate were detected in the groundwater sample collected from monitoring well MPT-8-2. Naphthalene (46 $\mu\text{g}/\ell$) is indicative of petroleum contamination and bis(2-ethyl-hexyl)phthalate is a constituent of plastics.

Inorganics. Total lead was detected at 2 $\mu\text{g}/\ell$ in the groundwater sample collected from monitoring well MPT-8-2.

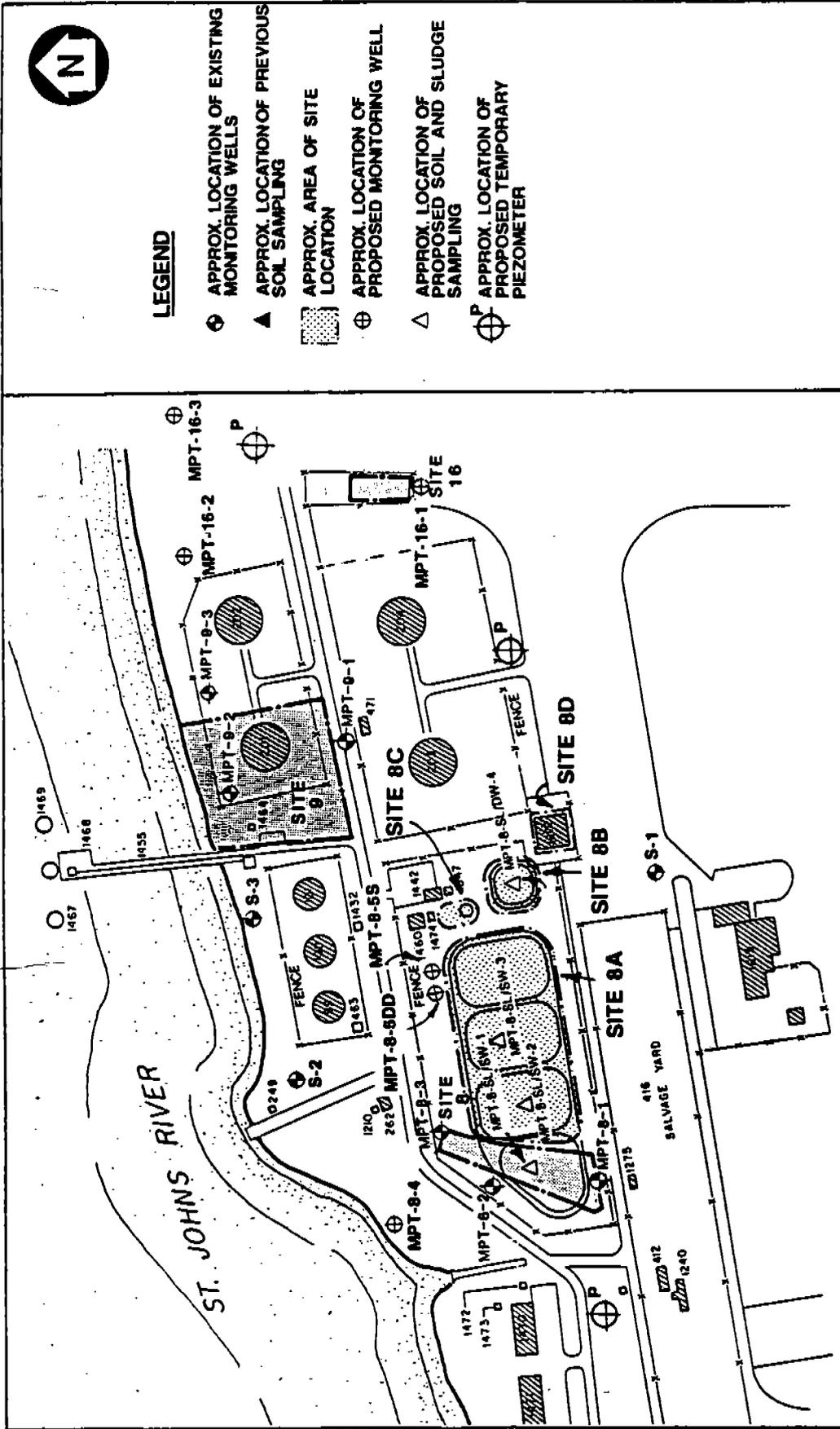
3.3.4.2 Exploration Program, SWMU 6, 7, 8, 9, and 10 (NIRP Site 8, 8A, 8B, 8C, and 8D) The rationale for the data gathering activities at SWMU 6, 7, 8, 9, and 10 is described in Volume I, Workplan. In summary, objectives of the data gathering activities at SWMU 6, 7, 8, 9 and 10 are to:

- obtain additional site-specific data to characterize groundwater flow rates and directions;
- obtain groundwater quality data to characterize potential groundwater contamination, plume extent, and general water quality at the site;
- obtain subsurface soil samples to: characterize the horizontal and vertical extent of contamination at the site, obtain general parameters for contaminant fate and transport, and provide design criteria for potential corrective measures; and
- obtain sediment and surface water samples from SWMU 7 and SWMU 8 to further characterize potential source contaminants.

The exploration program at SWMU 6, 7, 8, 9, and 10 (Waste Oil Pit/Sludge Drying Bed, OWTP Sludge Drying Beds, OWTP Percolation Pond, the OWTP, and Hazardous Waste Storage Area) includes the following data gathering activities:

- installation of monitoring wells in the secondary aquifer of the Upper Hawthorn Group and the surficial aquifer of the surficial deposits,
- sampling and analysis of subsurface soil during borehole construction for monitoring wells,
- sampling and analysis of groundwater at new and existing monitoring wells, and
- sampling and analysis of sediment and surface water from SWMU 7 and SWMU 8.

The locations of these activities at SWMU 6, 7, 8, 9, and 10 are presented in Figure 3-13. In addition to these site-specific activities, piezometers will be installed as part of the facility-wide piezometer network to supplement local and regional data on groundwater flow rate and direction, as well as assess tidal and seasonal influences. These activities are described in Section 3.2.3, Hydrologic Investigation.



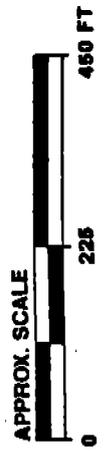
LEGEND

- ⊕ APPROX. LOCATION OF EXISTING MONITORING WELLS
- ▲ APPROX. LOCATION OF PREVIOUS SOIL SAMPLING
- ⊕ APPROX. LOCATION OF PROPOSED MONITORING WELL
- ⊕ P APPROX. LOCATION OF PROPOSED SOIL AND SLUDGE SAMPLING
- ⊕ P APPROX. LOCATION OF PROPOSED TEMPORARY PIEZOMETER

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**FIGURE 3-13
LOCATIONS OF EXPLORATIONS
(SITE 8, 8A, 8B, 8C, 8D, 9, AND 16)
SWMU 6, 7, 8, 9, 10, 11, AND 16**



INTERIM FINAL

The sample media, sample locations, number of samples, estimated number of QA/QC samples, and sample analyses are summarized in Table 3-16a for SWMU 6, 7, 8, 9, and 10. The data gathering activities are composed of the field activities subtasks listed below. Since many of the field activities subtasks will be repeated at other sites, they are described as standard operation procedures in project-specific Technical Memoranda located in Appendix B, Site-specific Quality Assurance Plan. Site-specific elements particular to SWMU 6, 7, 8, 9, and 10 are discussed in subsequent sections, and standard operating procedures are referenced where necessary. Subtasks of data gathering activities at SWMU 6, 7, 8, 9, and 10 include:

- drilling and subsurface soil sampling,
- well construction and development,
- groundwater sampling, and
- sediment, sludge, and surface water sampling.

Drilling and Subsurface Soil Sampling. Drilling and subsurface soil sampling will be accomplished as described in the Technical Memorandum, Drilling and Subsurface Soil Sampling, Appendix B. A summary of the location, frequency, and sample types is presented in Table 3-16a. Borehole locations are presented in Figure 3-13. Table 3-16b summarizes the borehole depths and monitoring well specifications anticipated for SWMU 6, 7, 8, 9, and 10.

Well Construction and Development. Well construction and development will be accomplished as described in the Technical Memorandum, Well Construction and Development, Appendix B. Typical installation details for each well type are presented in Figures 3-3A through Figure 3-3D. A summary of the location, frequency, and sample types is presented in Table 3-16a. Well locations are presented Figure 3-13. Table 3-16b summarizes the monitoring well specifications anticipated for SWMU 6, 7, 8, 9, and 10. Actual completion depths and screened intervals will be determined during borehole drilling based on field observations.

One well will be completed in the Upper Hawthorn Group. The borehole for this well will be constructed first in order to get local stratigraphic information. This well will be double-cased to prevent cross contamination between water bearing zones. The outer casing will be keyed at least 5 feet into the first aquitard encountered, which is estimated to be approximately 25 to 30 feet bls at this site. Actual depths will be determined in the field based on observations of conditions by a qualified geologist.

Other wells at each location will be completed in the upper surficial aquifer to a depth of approximately 15 to 20 feet. The wells will be screened their entire saturated length. The well screens will extend approximately 3 feet above the water table.

Groundwater Sampling. The location, frequency, and sample types of groundwater are summarized in Table 3-16a. Well locations are presented in Figure 3-13. Table 3-16b summarizes the monitoring well specifications anticipated for SWMU 6, 7, 8, 9, and 10. Groundwater sampling will be accomplished as described in the Technical Memorandum, Groundwater Sampling, Appendix B.

Table 3-10a:

Summary of Samples to be Collected at
SWMUs 6, 7, 8, 9, 10, 11, and 16
(OWTP Facilities, HW Storage Area, Fuel Spill Area, and Old Transformer Storage Yard).

SWMU Site	Sample Location	Sample Designation	Sample Type	Media	USEPA Method			USEPA Method			General Physical/Chemical (Soil)	General Water Quality (Water)
					8240 VOA	8270 SOA	7470 Metals	8080 Pest/PCB	8010, 7470			
6,7,8,9,10,11,&16	MPT-8S	MPT-8-MS-5S(X-X)-1	monitoring well soil	soil	1	1	1	1	1	1	1	0
6,7,8,9,10,11,&16	MPT-8D	MPT-8-MS-5D(X-X)-1	monitoring well soil	soil	1	1	1	1	1	1	1	0
6,7,8,9,10,11,&16	MPT-16	MPT-16-MS-1(X-X)-1	monitoring well soil	soil	1	1	1	1	1	1	1	0
6,7,8,9,10,11,&16	MPT-16	MPT-16-MS-2(X-X)-1	monitoring well soil	soil	1	1	1	1	1	1	1	0
6,7,8,9,10,11,&16	MPT-16	MPT-16-MS-3(X-X)-1	monitoring well soil	soil	1	1	1	1	1	1	1	0
			subtotal:	soil	6	6	6	6	6	6	6	0
6,7,8,9,10,11,&16	TBD	MPT-X-MS-XS(X-X)-1	well soil duplicates	soil	2	2	2	2	2	2	2	0
			total:	soil	7	7	7	7	7	7	7	0
6,7,8,9,10,11,&16	MPT-8	MPT-8-MW-1-1	monitoring well water	water	1	1	1	1	1	1	0	1
6,7,8,9,10,11,&16	MPT-8	MPT-8-MW-2-1	monitoring well water	water	1	1	1	1	1	1	0	1
6,7,8,9,10,11,&16	MPT-8	MPT-8-MW-3-1	monitoring well water	water	1	1	1	1	1	1	0	1
6,7,8,9,10,11,&16	MPT-8	MPT-8-MW-4-1	monitoring well water	water	1	1	1	1	1	1	0	1
6,7,8,9,10,11,&16	MPT-8	MPT-8-MW-5S-1	monitoring well water	water	1	1	1	1	1	1	0	1
6,7,8,9,10,11,&16	MPT-8	MPT-8-MW-5D-1	monitoring well water	water	1	1	1	1	1	1	0	1
6,7,8,9,10,11,&16	MPT-9	MPT-9-MW-1-1	monitoring well water	water	1	1	1	1	1	1	0	1
6,7,8,9,10,11,&16	MPT-9	MPT-9-MW-2-1	monitoring well water	water	1	1	1	1	1	1	0	1
6,7,8,9,10,11,&16	MPT-9	MPT-9-MW-3-1	monitoring well water	water	1	1	1	1	1	1	0	1
6,7,8,9,10,11,&16	MPT-10	MPT-10-MW-1-1	monitoring well water	water	1	1	1	1	1	1	0	1
6,7,8,9,10,11,&16	MPT-10	MPT-10-MW-2-1	monitoring well water	water	1	1	1	1	1	1	0	1
6,7,8,9,10,11,&16	MPT-10	MPT-10-MW-3-1	monitoring well water	water	1	1	1	1	1	1	0	1
			subtotal:	water	12	12	12	12	12	12	0	12
			total:	water	2	2	2	2	2	2	0	0
			total:	water	14	14	14	14	14	14	0	12

Note:

Because well and sample designations were established during the NIRP investigations,

the RFI will continue to use this designation scheme.

See Table 1-1 for NIRP/SWNU Site Numbers cross-reference.

Subsurface soil sample depths will be based on field observations. In general, soil samples will be collected just above the observed groundwater elevation unless field observations indicate more desirable sample depths (e.g., visual or field screening indications of contamination).

VOA - Volatile Organic Compound Analyses

SOA - Semivolatile Organic Compound Analyses

Pest - Pesticides

PCB - polychlorinated biphenyls

TBD - To be determined during field activities

Table 3-10a: Summary of Samples to be Collected at SWMUs 6, 7, 9, 10, 11, and 16 (OWTP Facilities, HW Storage Area, Fuel Spill Area, and Old Transformer Storage Yard).												
SWMU Site	Sample Location	Sample Designation	Sample Type	Media	USEPA Method			USEPA Method			General Physical/Chemical (Soil)	General Water Quality (Water)
					8240 VOA	8270 SOA	7470 Metals	7480 Pests/PCB	8010.			
6,7,8,9,10,11,16	MPT-8	MPT-8-SW-1	surface water	water	1	1	1	1	0	1	1	
	MPT-8	MPT-8-SW-2	surface water	water	1	1	1	1	0	1	1	
	MPT-8	MPT-8-SW-3	surface water	water	1	1	1	1	0	1	1	
	MPT-8	MPT-8-SW-4	surface water	water	1	1	1	1	0	1	1	
			subtotal:	water	4	4	4	4	0	4	4	
			surface water duplicates	water	1	1	1	1	0	0	0	
			total:	water	5	5	5	5	0	4	4	
6,7,8,9,10,11,16	MPT-8	MPT-8-SL-1	sediment/sludge	sediment	1	1	1	1	0	1	1	
	MPT-8	MPT-8-SL-2	sediment/sludge	sediment	1	1	1	1	0	1	1	
	MPT-8	MPT-8-SL-3	sediment/sludge	sediment	1	1	1	1	0	1	1	
	MPT-8	MPT-8-SL-4	sediment/sludge	sediment	1	1	1	1	0	1	1	
			subtotal:	sediment	4	4	4	4	0	4	4	
			sediment duplicates	sediment	1	1	1	1	0	0	0	
			total:	sediment	5	5	5	5	0	4	4	

Note:

Because well and sample designations were established during the NIRP investigations, the RFI will continue to use this designation scheme.

See Table 1-1 for NIRP/SWMU Site Numbers cross-reference.

Subsurface soil sample depths will be based on field observations. In general, soil samples will be collected just above the observed groundwater elevation unless field observations indicate more desirable sample depths (e.g., visual or field screening indications of contamination).

VOA - Volatile Organic Compound Analyses

SOA - Semivolatile Organic Compound Analyses

Pest - Pesticides

PCB - polychlorinated biphenyls

TBD - To be determined during field activities

Table 3-10a: Summary of Samples to be Collected at SWMUs 6, 7, 8, 9, 10, 11, and 18 (OWTP Facilities, HW Storage Area, Fuel Spill Area, and Old Transformer Storage Yard)

SWMU Site	Sample Location	Sample Designation	Sample Type	Media	USEPA Method		USEPA Method		USEPA Method	
					8240 VOA	8270 SOA	7480 Metals	8080 Pas/PCB	6010, 7470	General Physical/Chemical (Soil)
6,7,8,9,10,11,18,16	MPT-8,9,10	MPT-8-QT-1	QC trip blank	water	1	0	0	0	0	0
6,7,8,9,10,11,18,16	MPT-8,9,10	MPT-8-QT-2	QC trip blank	water	1	0	0	0	0	0
6,7,8,9,10,11,18,16	MPT-8,9,10	MPT-8-QT-3	QC trip blank	water	1	0	0	0	0	0
6,7,8,9,10,11,18,16	MPT-8,9,10	MPT-8-QT-4	QC trip blank	water	1	0	0	0	0	0
		subtotal:		water	4	0	0	0	0	0
6,7,8,9,10,11,18,16	MPT-8,9,10	MPT-8-Q8-1	QC sampler blank	water	1	1	1	1	0	0
6,7,8,9,10,11,18,16	MPT-8,9,10	MPT-8-Q8-2	QC sampler blank	water	1	1	1	1	0	0
6,7,8,9,10,11,18,16	MPT-8,9,10	MPT-8-Q8-3	QC sampler blank	water	1	1	1	1	0	0
6,7,8,9,10,11,18,16	MPT-8,9,10	MPT-8-Q8-4	QC sampler blank	water	1	1	1	1	0	0
		subtotal:		water	4	4	4	4	0	0
6,7,8,9,10,11,18,16	MPT-8,9,10	MPT-8-FB-1	QC field blank	water	1	1	1	1	0	0
6,7,8,9,10,11,18,16	MPT-8,9,10	MPT-8-FB-2	QC field blank	water	1	1	1	1	0	0
6,7,8,9,10,11,18,16	MPT-8,9,10	MPT-8-FB-3	QC field blank	water	1	1	1	1	0	0
6,7,8,9,10,11,18,16	MPT-8,9,10	MPT-8-FB-4	QC field blank	water	1	1	1	1	0	0
		subtotal:		water	4	4	4	4	0	0

Note: Because well and sample designations were established during the NIRP investigations, the RFI will continue to use this designation scheme. See Table 1-1 for NIRP/SWMU Site Numbers cross-reference. Subsurface soil sample depths will be based on field observations. In general, soil samples will be collected just above the observed groundwater elevation unless field observations indicate more desirable sample depths (e.g., visual or field screening indications of contamination).
 VOA - Volatile Organic Compound Analyses
 SOA - Semivolatile Organic Compound Analyses
 Pest - Pesticides
 PCB - polychlorinated biphenyls
 TBD - To be determined during field activities

**Table 3-16b: Summary of New Monitoring Wells at SWMUs 6,7,8,9,10,11, and 16.
(OWTP Facilities, HW Storage Area, Fuel Spill Area, and
Old Transformer Storage Yard).**

SWMU Site	Well ID	Well				Screen Length (feet)	Surface-Casing Surface-Casing Surface-Casing				Geologic Strata
		Estimated Depth (feet)	Diameter (inches)	Borehole Diameter (inches)	Boring Diameter (inches)		Estimated Depth (feet)	Inside Diameter (inches)	Boring Diameter (inches)		
6,7,8,9,10&11	MPT-8-4S	15	2	6	10	N/A	N/A	N/A	N/A	S. D.	
6,7,8,9,10&11	MPT-8-5DD	125	4	8	10	50	10	14	14	U. H.	
6,7,8,9,10&11	MPT-8-5S	15	2	6	10	N/A	N/A	N/A	N/A	S. D.	
16	MPT-16-1D	30	2	6	5	N/A	N/A	N/A	N/A	S. D.	
16	MPT-16-2S	15	2	6	10	N/A	N/A	N/A	N/A	S. D.	
16	MPT-16-2D	15	2	6	10	N/A	N/A	N/A	N/A	S. D.	

Note:

See Table 1-1 for NIRP/SWMU Site Numbers cross-reference.

Well Identification Hydrologic Location:

- S - Shallow Surficial Aquifer
- D - Deep Surficial Aquifer
- DD - Secondary Aquifer

Geologic Strata:

- U. H. - Upper Hawthorn
- S. D. - Surficial Deposit

Well casing for all wells will be Schedule 40 PVC.

Surface casing material for secondary aquifer wells will be Schedule 80 PVC.

Screen slot size will be 0.010 inches.

Filter packs will be 20/30 silica sand.

Grout will be cement/bentonite (90/10).

INTERIM FINAL

Sediment, Sludge and Surface Water Sampling. The location, frequency, media, and sample types for sediment, sludge, and surface water are summarized in Table 3-16a. Sediment and surface water sampling locations are presented in Figure 3-13. Sediment sampling will be accomplished as described in the Technical Memorandum, Sediment and Surface Water Sampling, Appendix B.

The newly installed monitoring wells plus existing monitoring wells S-1, S-2, and S-3 will be surveyed and water level measurements will be collected from the new and existing monitoring wells at SWMU 6, 7, 8, 9, and 10 and plotted to create a potentiometric surface map.

3.3.5 SWMU 11 (NIRP Site 9), Fuel Spill Area SWMU 11 is located in the Naval Supply Center (NSC) fuel farm (see Figure 3-12). This site was identified from stained soil samples obtained during a boring program that was part of a road construction plan. Although the source and quantity of fuel is unknown, it is believed that it originated in the fuel farm area. It is suspected that the fuel is either JP-4, JP-5, or diesel fuel-marine (DFM).

3.3.5.1 Results of Previous Investigations Three monitoring wells were installed in the vicinity of SWMU 11 during the ESI (see Figure 3-12). Soil samples were collected from each boring just above the water table, and groundwater samples were collected from each well.

Volatile Organics. Methylene chloride (186 $\mu\text{g}/\text{kg}$) was found in the soil sample obtained from boring MPT-9-3; however, it was not detected in any of the groundwater samples taken from SWMU 11.

Other Organics. Naphthalene (120 $\mu\text{g}/\ell$) was detected in the groundwater sample collected from monitoring well MPT-9-2. The naphthalene is most likely a contaminant from a fuel spill. The pesticides β -BHC (0.07 $\mu\text{g}/\ell$) and 4,4'-DDE (0.04 $\mu\text{g}/\ell$) were detected in the groundwater sample collected from monitoring well MPT-9-1.

Inorganics. Total lead in groundwater was detected in monitoring wells MPT-9-2 (2 $\mu\text{g}/\ell$) and MPT-9-3 (3 $\mu\text{g}/\ell$). Total mercury detected in the groundwater sample obtained from monitoring well MPT-9-3 was 0.8 $\mu\text{g}/\ell$.

3.3.5.2 Exploration Program, SWMU 11 (NIRP Site 9) The rationale for the data gathering activities at SWMU 11 is described in Volume I, Workplan. In summary, objectives of the data gathering activities at SWMU 11 are to:

- obtain additional site-specific data to characterize groundwater flow rates and directions;
- obtain groundwater quality data to characterize potential groundwater contamination, plume extent, and general water quality at the site; and
- obtain subsurface soil samples to: characterize the horizontal and vertical extent of contamination at the site, obtain general parameters for contaminant fate and transport, and provide design criteria for potential corrective measures.

INTERIM FINAL

The exploration program at SWMU 11 (Fuel Spill Area) includes the following data gathering activities:

- installing monitoring wells in the surficial aquifer of the surficial deposits,
- sampling and analyzing of subsurface soil during borehole construction for monitoring wells, and
- sampling and analyzing groundwater at new and existing monitoring wells.

The locations of these activities at SWMU 11 are presented in Figure 3-13. In addition to these site-specific activities, piezometers will be installed as part of the facility-wide piezometer network to supplement local and regional data on groundwater flow rate and direction, as well as assess tidal and seasonal influences. These activities are described in Section 3.2.3, Hydrologic Investigation.

The sample media, sample locations, number of samples, estimated number of QA/QC samples, and sample analyses are summarized in Table 3-16a for SWMU 11. The data gathering activities are composed of the field activities subtasks listed below. Because many of the field activities subtasks will be repeated at other sites, they are described as standard operation procedures in project-specific Technical Memoranda located in Appendix B, site-specific Quality Assurance Plan. Site-specific elements particular to SWMU 11 are discussed in subsequent sections, and standard operating procedures are referenced where necessary. Subtasks of data gathering activities at SWMU 11 include:

- drilling and subsurface soil sampling,
- well construction and development, and
- groundwater sampling.

Drilling and Subsurface Soil Sampling. Drilling and subsurface soil sampling will be accomplished as described in the Technical Memorandum, Drilling and Subsurface Soil Sampling, Appendix B. A summary of the location, frequency, and sample types is presented in Table 3-16a. Borehole locations are presented in Figure 3-13. Table 3-16b summarizes the borehole depths and monitoring well specifications anticipated for SWMU 11.

Well Construction and Development. Well construction and development will be accomplished as described in the Technical Memorandum, Well Construction and Development, Appendix B. Typical installation details for each well type are presented in Figures 3-3A through Figure 3-3D. A summary of the location, frequency, media, and sample types is presented in Table 3-16a. Well locations are presented in Figure 3-13. Table 3-16b summarizes the monitoring well specifications anticipated for SWMU 11. Actual completion depths and screened intervals will be determined during borehole drilling based on field observations.

INTERIM FINAL

Wells at each location will be completed in the upper surficial aquifer to a depth of approximately 15 to 20 feet. The wells will be screened their entire saturated length. The well screens will extend approximately 3 feet above the water table.

Groundwater Sampling. A summary of location, frequency, and sample types is presented in Table 3-16a. Well locations are presented in Figure 3-13. Table 3-16b summarizes the monitoring well specifications anticipated for SWMU 11. Groundwater sampling will be accomplished as described in the Technical Memorandum, Groundwater Sampling, Appendix B.

Sediment, Sludge, and Surface Water Sampling. A summary of location, frequency, media, and sample types is presented in Table 3-16a. Sediment and surface water sampling locations are presented in Figure 3-13. Sediment sampling will be accomplished as described in the Technical Memorandum, Sediment and Surface Water Sampling, Appendix B.

3.3.6 SWMU 12 (NIRP Site 11), Neutralization Basin The neutralization basin is located in the northern part of NAVSTA Mayport (see Figure 1-2), approximately 40 feet to the north of the Boiler Plant, Building 1241 (Figure 3-14). The basin is approximately 75 feet from the St. Johns River and is used to store treatment effluent from the anion/cation exchange process used in the boiler plant. The original neutralization basin was first put into operation in February of 1971 and consisted of an asphalt base covered with a synthetic liner. The liner and asphalt were in good condition until the liner was damaged by a hurricane in 1985.

A new basin was constructed and was first operated in January of 1987. The new basin, which is currently in use, is constructed of 6-inch-thick concrete on top of 12 inches of compacted soil. The concrete is covered with a Hypalon liner. The basin is 6 feet deep, 59 feet wide, and 78 feet long. Influent from the boiler building enters the basin through a 6-inch underground pipeline. The basin is divided into two cells, and the effluent is discharged through sewer pipes to the on-base Wastewater Treatment Facility. Release controls for the unit include 6-foot-high berms on all sides of the basin and flow rate controls in the regenerate systems.

The neutralization basin was determined to be a RCRA hazardous waste management unit during a FDER site inspection on February 23, 1987, because the effluent entering the basin sometimes had a pH less than 2 or greater than 12.5. FDER issued NAVSTA Mayport a Notice of Violation (OGC Case No. 87-0539, June 10, 1987) for operating a hazardous waste surface impoundment and required NAVSTA Mayport to submit a closure plan for the unit.

A closure plan and groundwater monitoring plan for the neutralization basin were approved by FDER in December of 1988. The closure plan proposed soil, basin water, and basin sediment sampling to demonstrate clean closure for the unit, to be verified by 1 year of quarterly groundwater sampling and analysis. NAVSTA Mayport plans to continue to use the Neutralization Basin, after closure, for management of nonhazardous boiler regenerant water.

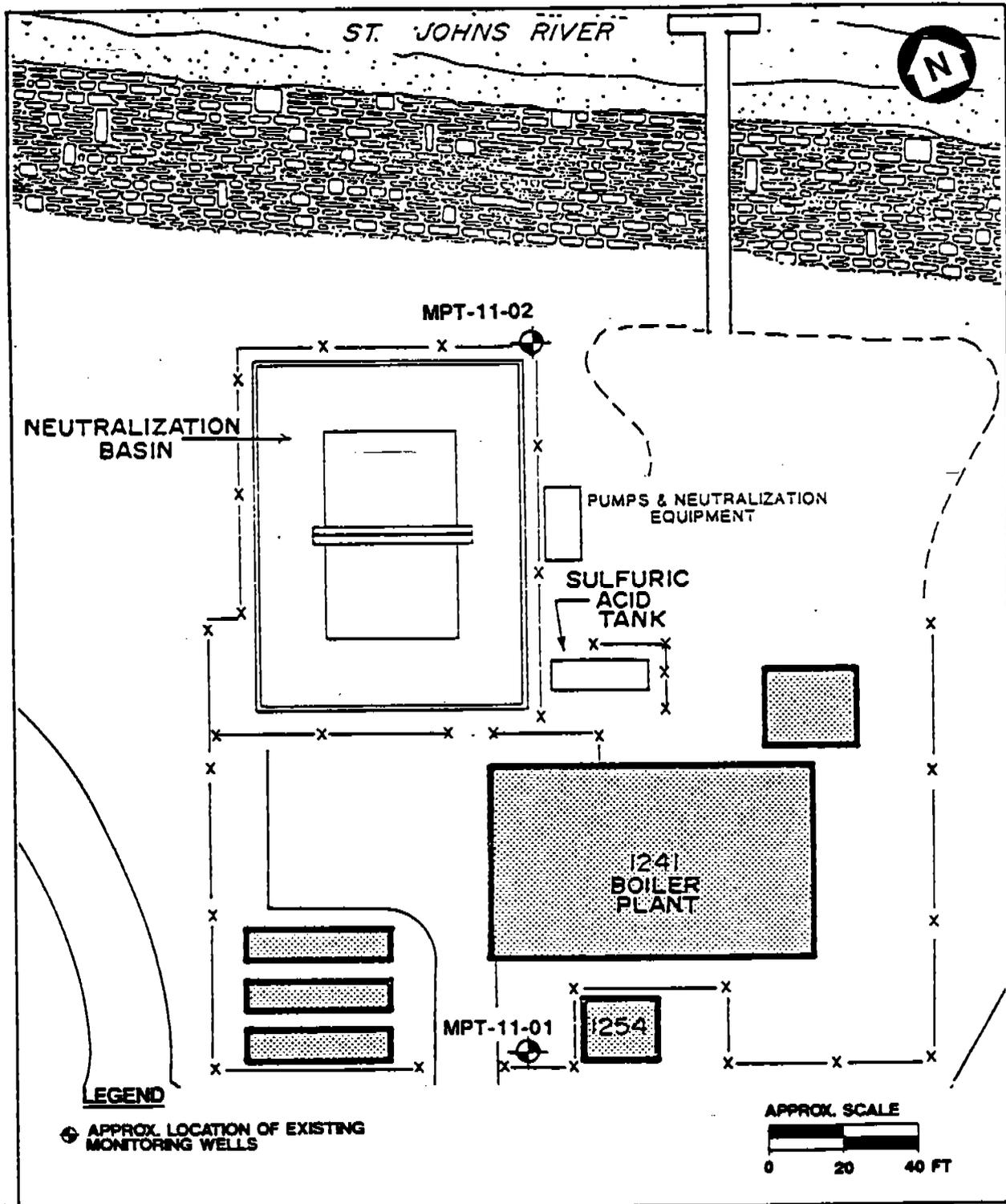


FIGURE 3-14
SITE PLAN
(SITE 11)
SWMU 12 - NEUTRALIZATION BASIN



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Soil and basin influent water samples were recently collected from the Neutralization Basin and the two proposed monitoring wells were installed.

Closure is in process, but has not been completed and approved by FDER. No contamination has been found at Site 11, and no additional investigations are planned during the RFI.

3.3.7 SWMU 13 (NIRP Site 13). Old Fire Fighting Training Area SWMU 13 includes three areas (identified by old aerial photos) located at the end of an old runway, which is currently occupied by the Aircraft Intermediate Maintenance Division (AIMD) building (Figure 3-15). These sites were used as fire fighting training areas from 1973 to 1982. The training areas consisted of low, earthen berms constructed on the abandoned asphalt runway. Materials used in the training exercises included waste oil, mercury wastes, solvents, and fuels (JP-4, JP-5, and DFM). Fuels and other items not combusted during training exercises remained in the pit or ran off the sides of the runway.

During construction of the AIMD building (Building 1553), the southernmost fire fighting training area was disturbed to a depth of 4 to 6 feet for the construction of a new pipeline. The soils were spread over the area and the area was paved with asphalt as part of a parking lot. The two northern areas are now covered by buildings, roads, parking areas, and grassy medians.

3.3.7.1 Results of Previous Investigation Three monitoring wells (MPT-13-1, MPT-13-2, and MPT-13-3) were installed in the vicinity of SWMU 13 during the ESI (see Figure 3-15). Soil and groundwater samples were collected from each boring and analyzed for priority pollutant volatile and semivolatile organics, pesticides and PCBs, and metals. The only contaminants observed in these samples were lead at a concentration of 2 $\mu\text{g}/\text{l}$ in the groundwater at monitoring well MPT-13-3, and mercury at a concentration of 5.3 $\mu\text{g}/\text{l}$ in a groundwater sample obtained from monitoring well MPT-13-1.

3.3.7.2 Exploration Program, SWMU 13 (NIRP Site 13) The rationale for the data gathering activities at SWMU 13 is described in Volume I, Workplan. In summary, objectives of the data gathering activities at SWMU 13 are to:

- obtain additional site-specific data to characterize groundwater flow rates and directions;
- obtain groundwater quality data to characterize potential groundwater contamination, plume extent, and general water quality at the site;
- obtain subsurface soil samples to: characterize the horizontal and vertical extent of contamination at the site obtain general parameters for contaminant fate and transport and provide design criteria for potential corrective measures; and
- obtain sediment samples to assess the storm drain conveyance system as a migration pathway.

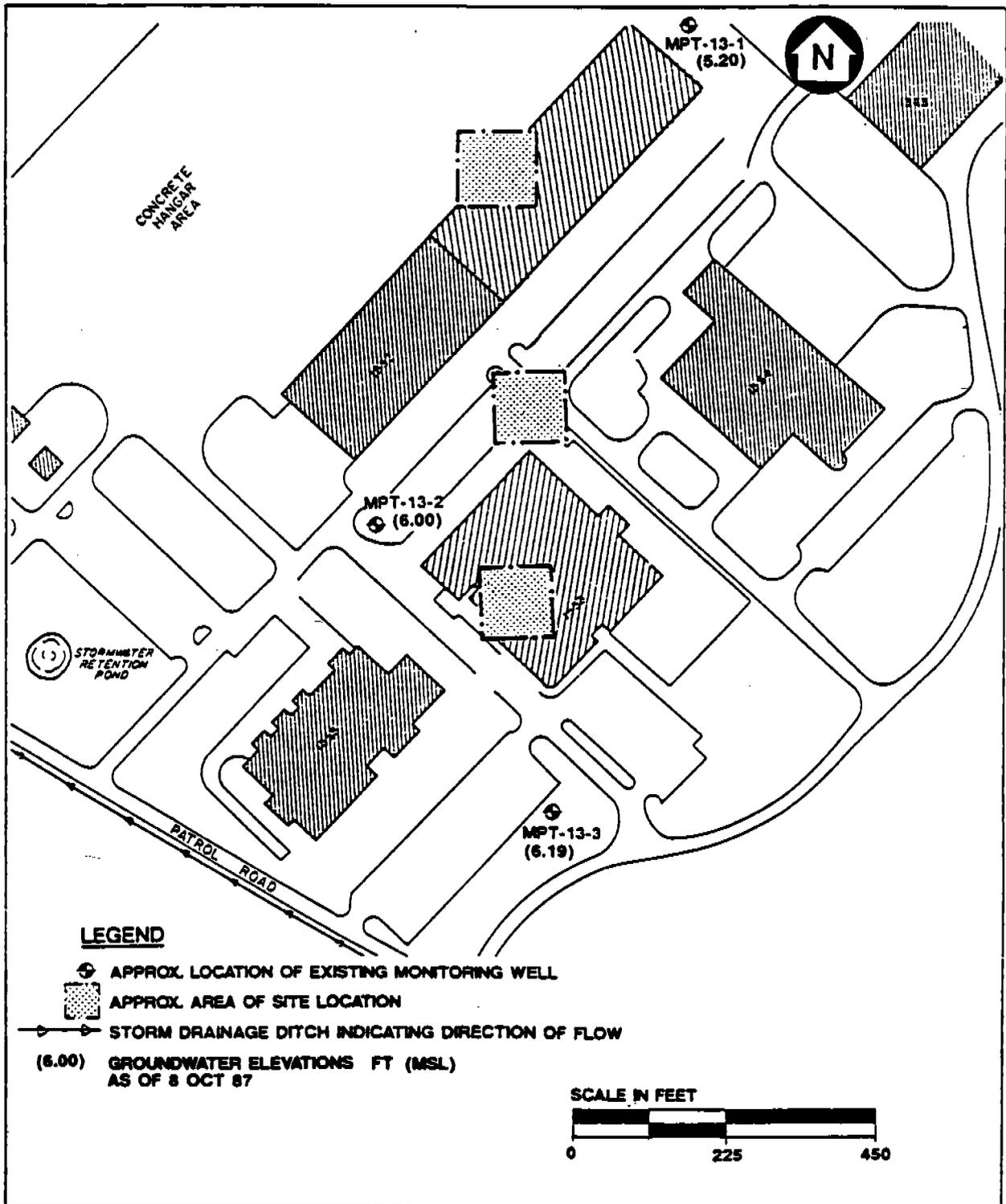


FIGURE 3-15
SITE PLAN
(SITE 13)
SWMU 13 - OLD FIRE FIGHTING
TRAINING AREAS



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The exploration program at SWMU 13 (Fuel Spill Area) includes the following data-gathering activities:

- installing 3 monitoring wells in the surficial aquifer;
- sampling and analyzing subsurface soil during borehole construction for monitoring wells;
- sampling and analyzing groundwater at new and existing monitoring wells; and
- sampling and analyzing sediment samples from inverts of storm drain conveyance system.

The locations of these activities at SWMU 13 are presented in Figure 3-16. In addition to these site-specific activities, piezometers will be installed as part of the facility-wide piezometer network to supplement local and regional data on groundwater flow rate and direction, as well as assess tidal and seasonal influences. These activities are described in Section 3.2.3, Hydrologic Investigation.

The sample media, sample locations, number of samples, estimated number of QA/QC samples, and sample analyses are summarized in Table 3-17a for SWMU 13. The data gathering activities are composed of the field activities subtasks listed below. Because many of the field activities subtasks will be repeated at other sites, they are described as standard operating procedures in project-specific Technical Memoranda located in Appendix B, site-specific Quality Assurance Plan. Site-specific elements particular to SWMU 13 are discussed in subsequent sections, and standard operating procedures are referenced where necessary. Subtasks of data gathering activities at SWMU 13 include:

- drilling and subsurface soil sampling,
- well construction and development,
- groundwater sampling, and
- sediment sampling.

Drilling and Subsurface Soil Sampling. Drilling and subsurface soil sampling will be accomplished as described in the Technical Memorandum, Drilling and Subsurface Soil Sampling, Appendix B. A summary of the location, frequency, and sample types is presented in Table 3-17a. Borehole locations are presented in Figure 3-16. Table 3-17b summarizes the borehole depths and monitoring well specifications anticipated for SWMU 13.

Well Construction and Development. Well construction and development will be accomplished as described in the Technical Memorandum, Well Construction and Development, Appendix B. Typical installation details for each well type are presented in Figures 3-3A through Figure 3-3D. A summary of the location, frequency, media, and sample types is presented in Table 3-17a. Well locations are presented Figure 3-16. Table 3-17b summarizes the monitoring well specifications anticipated for SWMU 13. Actual completion depths and screened

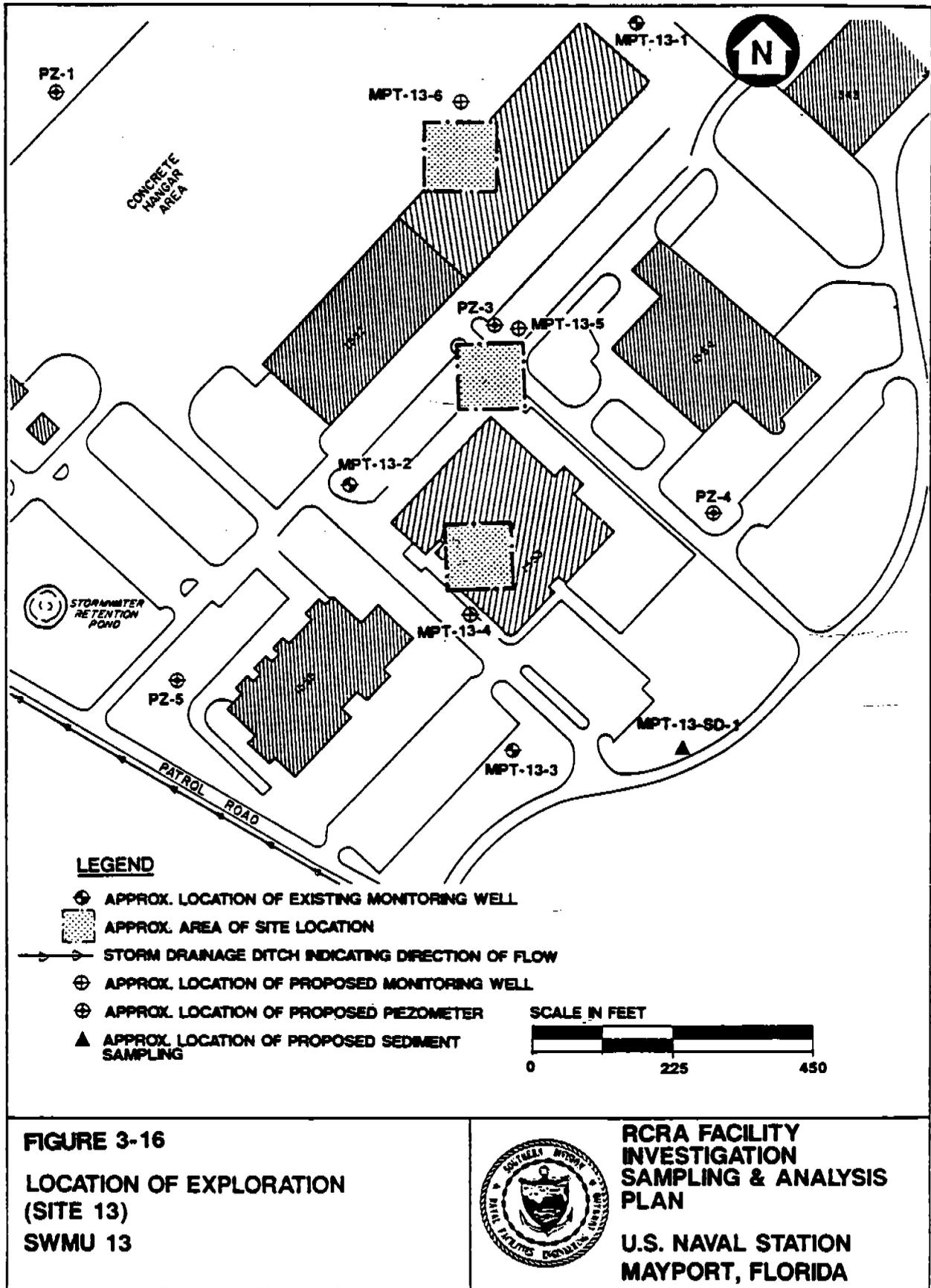


Table 3-17a: Summary of Samples to be Collected at SWMU 13 (Old Firefighting Training Area).											
SWMU Site	Sample Location	Sample Designation	Sample Type	Media	USEPA Method			USEPA Method		General Physical/Chemical (Soil)	General Water Quality (Water)
					8240 VOA	8270 SOA	6010, 7470 Metals	8080 Pests/PCB	USEPA Method		
13	MPT-13-4	MPT-13-MB-4(X-X)-1	monitoring well soil	soil	1	1	1	1	1	1	0
13	MPT-13-5	MPT-13-MB-6(X-X)-1	monitoring well soil	soil	1	1	1	1	1	1	0
13	MPT-13-6	MPT-13-MB-6(X-X)-1	monitoring well soil	soil	1	1	1	1	1	1	0
			subtotal:	soil	3	3	3	3	3	3	0
13	MPT-13-TB	MPT-13-MB-X(X-XA)-1	well soil duplicates	soil	1	1	1	1	1	1	0
			total:	soil	4	4	4	4	4	4	0
13	MPT-13-1	MPT-13-MW-1-1	monitoring well water	water	1	1	1	1	1	1	1
13	MPT-13-2	MPT-13-MW-2-1	monitoring well water	water	1	1	1	1	1	1	1
13	MPT-13-3	MPT-13-MW-3-1	monitoring well water	water	1	1	1	1	1	1	1
13	MPT-13-4	MPT-13-MW-4-1	monitoring well water	water	1	1	1	1	1	1	1
13	MPT-13-5	MPT-13-MW-5-1	monitoring well water	water	1	1	1	1	1	1	1
13	MPT-13-6	MPT-13-MW-6-1	monitoring well water	water	1	1	1	1	1	1	1
			subtotal:	water	6	6	6	6	6	6	6
			total:	water	7	7	7	7	7	7	7
13	MPT-13-TB	MPT-13-MW-XA-1	well water duplicates	water	1	1	1	1	1	1	0
			total:	water	7	7	7	7	7	7	7

Note:

Because well and sample designations were established during the NIRP investigations, the RFI will continue to use this designation scheme.
 See Table 1-1 for NIRP/SWMU Site Numbers cross-reference.
 Subsurface soil sample depths will be based on field observations. In general, soil samples will be collected just above the observed groundwater elevation unless field observations indicate more desirable sample depths (e.g., visual or field screening indications of contamination).
 VOA - Volatile Organic Compound Analyses
 SOA - Semivolatile Organic Compound Analyses
 Pest - Pesticides
 PCB - polychlorinated biphenyls
 TBD - To be determined during field activities

Table 3-17a: Summary of Samples to be Collected at SWMU 13 (Old Firefighting Training Area).										
SWMU Site	Sample Location	Sample Designation	Sample Type	Media	USEPA Method		USEPA Method		USEPA Method	
					9240 VOA	9270 SOA	7480 Metals	8060 Pesticides	7470 Physical/Chemical (Soil)	8060 General Water Quality (Water)
13	MPT-13	MPT-13-QT-1	QC trip blank	water	1	0	0	0	0	0
13	MPT-13	MPT-13-QT-2	QC trip blank	water	1	0	0	0	0	0
13	MPT-13	MPT-13-QT-3	QC trip blank	water	1	0	0	0	0	0
13	MPT-13	MPT-13-QT-4	QC trip blank	water	1	0	0	0	0	0
			subtotal:	water	4	0	0	0	0	0
13	MPT-13	MPT-13-QS-1	QC sampler blank	water	1	1	1	1	0	0
13	MPT-13	MPT-13-QS-2	QC sampler blank	water	1	1	1	1	0	0
13	MPT-13	MPT-13-QS-3	QC sampler blank	water	1	1	1	1	0	0
13	MPT-13	MPT-13-QS-4	QC sampler blank	water	1	1	1	1	0	0
			subtotal:	water	4	4	4	4	0	0
13	MPT-13	MPT-13-FB-1	QC field blank	water	1	1	1	1	0	0
13	MPT-13	MPT-13-FB-2	QC field blank	water	1	1	1	1	0	0
13	MPT-13	MPT-13-FB-3	QC field blank	water	1	1	1	1	0	0
13	MPT-13	MPT-13-FB-4	QC field blank	water	1	1	1	1	0	0
			subtotal:	water	4	4	4	4	0	0

Note:

Because well and sample designations were established during the NIRP investigations, the RFI will continue to use this designation scheme.

See Table 1-1 for NIRP/SWMU Site Numbers cross-reference.

Subsurface soil sample depths will be based on field observations. In general, soil samples will be collected just above the observed groundwater elevation unless field observations indicate more desirable sample depths (e.g., visual or field screening indications of contamination).

VOA - Volatile Organic Compound Analyses

SOA - Semivolatile Organic Compound Analyses

Pest - Pesticides

PCB - polychlorinated biphenyls

TBD - To be determined during field activities

**Table 3-17b: Summary of New Monitoring Wells at SWMU 13.
(Old Firefighting Training Area).**

SWMU Site	Well ID	Estimated		Well Diameter (inches)	Borehole Diameter (inches)	Screen Length (feet)	Surface-Casing Surface-Casing Surface-Casing			Geologic Strata
		Depth (feet)	Depth (feet)				Estimated Depth (feet)	Inside Diameter (inches)	Boring Diameter (inches)	
13	MPT-13-4S	15	2	6	6	10	N/A	N/A	N/A	S. D.
13	MPT-13-5S	15	2	6	6	10	N/A	N/A	N/A	S. D.
13	MPT-13-6S	15	2	6	6	10	N/A	N/A	N/A	S. D.

Note:

See Table 1-1 for NIRP/SWMU Site Numbers cross-reference.

Well Identification Hydrologic Location:

S = Shallow Surficial Aquifer

D = Deep Surficial Aquifer

DD = Secondary Aquifer

Geologic Strata:

U. H. = Upper Hawthorn

S. D. = Surficial Deposit

Well casing for all wells will be Schedule 40 PVC.

Surface casing material for secondary aquifer wells will be Schedule 80 PVC.

Screen slot size will be 0.010 inches.

Filter packs will be 20/30 silica sand.

Grout will be cement/bentonite (90/10).

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intervals will be determined during borehole drilling based on field observations.

Wells at each location will be completed in the upper surficial aquifer to a depth of approximately 15 feet. The wells will be screened their entire saturated length. The well screens will extend approximately 3 feet above the encountered water table.

Groundwater Sampling. A summary of location, frequency, and sample types is presented in Table 3-17a. Well locations are presented in Figure 3-16. Table 3-17b summarizes the monitoring well specifications anticipated for SWMU 13. Groundwater sampling will be accomplished as described in the Technical Memorandum, Groundwater Sampling, Appendix B.

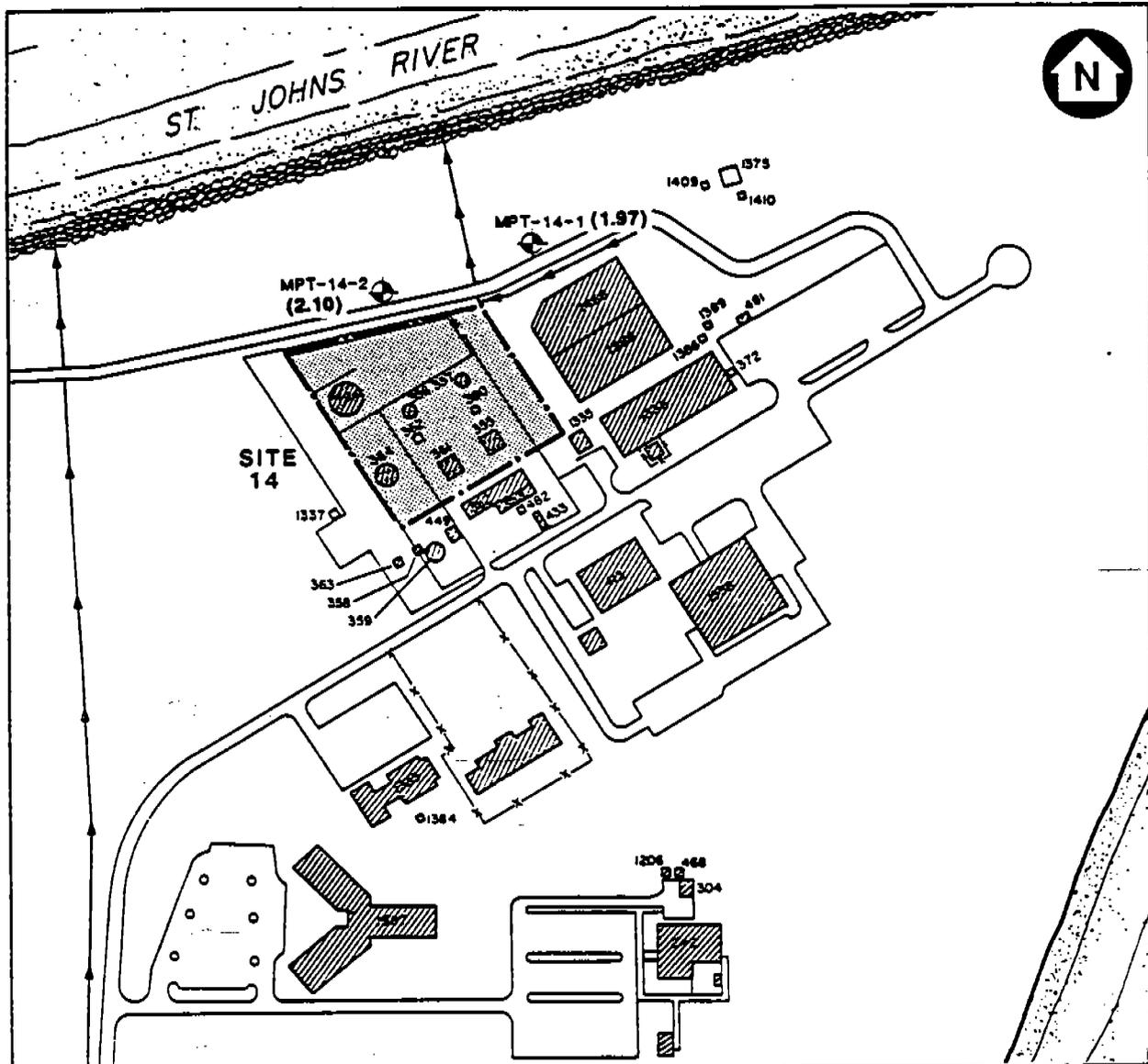
Sediment Sampling. A summary of location, frequency, and sample types is presented in Table 3-17a. Sediment sampling locations are presented in Figure 3-16. Sediment samples will be taken immediately upstream from SWMU 13, immediately downstream near the site boundary, and immediately upstream of the junction with the stormwater drainage ditch along the Patrol Road. Sediment sampling will be accomplished as described in the Technical Memorandum, Sediment and Surface Water Sampling, Appendix B.

3.3.8 SWMU 14 (NIRP Site 14). Mercury/Oily Waste Spill Site SWMU 14 is located west of the Fleet Training Center (FTC), Building 1456 (Figure 3-17). The site, constructed in 1977, consisted of two areas located on or adjacent to a concrete pad used for fire fighting training activities. One of the areas was used for storage of 55-gallon drums containing mercuric nitrate wastes. In the past, drums have occasionally rusted, allowing the mercuric nitrate solution to leach into the soils adjacent to the concrete pad. The other area is located around an oil-water separator. This separator removes oily wastes from wastewaters generated during fire fighting training exercises. In the past the unit has malfunctioned and contaminated the soils directly behind Building 1456 with oils and oily wastes.

3.3.8.1 Results from Previous Investigation Two monitoring wells (MPT-14-1 and MPT-14-2) were installed in the vicinity of Site 14 during the ESI (see Figure 3-17). Soil and groundwater samples were collected and analyzed. No volatile, semivolatile, organochlorine pesticides, or PCB compounds were detected in either the soil or groundwater sample. Total mercury was detected in the groundwater sample from monitoring well MPT-14-2 at a concentration of 1.8 $\mu\text{g}/\text{l}$.

3.3.8.2 Exploration Program, SWMU 14 (NIRP Site 14) The rationale for the data gathering activities at SWMU 14 is described in Volume I, Workplan. In summary, objectives of the data gathering activities at SWMU 14 are to:

- obtain additional site-specific data to characterize groundwater flow rates and directions;
- obtain groundwater quality data to characterize potential groundwater contamination, plume extent, and general water quality at the site;



LEGEND

-  APPROX. LOCATION OF EXISTING MONITORING WELLS
-  APPROX. AREA OF SITE LOCATION
-  STORM DRAINAGE DITCH INDICATING DIRECTION OF FLOW
- (2.10) GROUNDWATER ELEVATIONS FT (MSL) AS OF 8 OCT 87

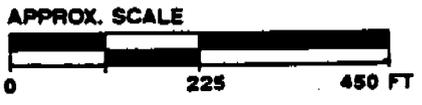


FIGURE 3-17
SITE PLAN
(SITE 14)
SWMU 14 - MERCURY/OILY
WASTE SPILL SITE



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- obtain subsurface soil samples to: characterize the horizontal and vertical extent of contamination at the site obtain general parameters for contaminant fate and transport, and to provide design criteria for potential corrective measures;
- obtain sediment and surface water samples to assess the storm drain conveyance system as a migration pathway; and
- verify potential soil contamination near associated Site SWMU 54A.

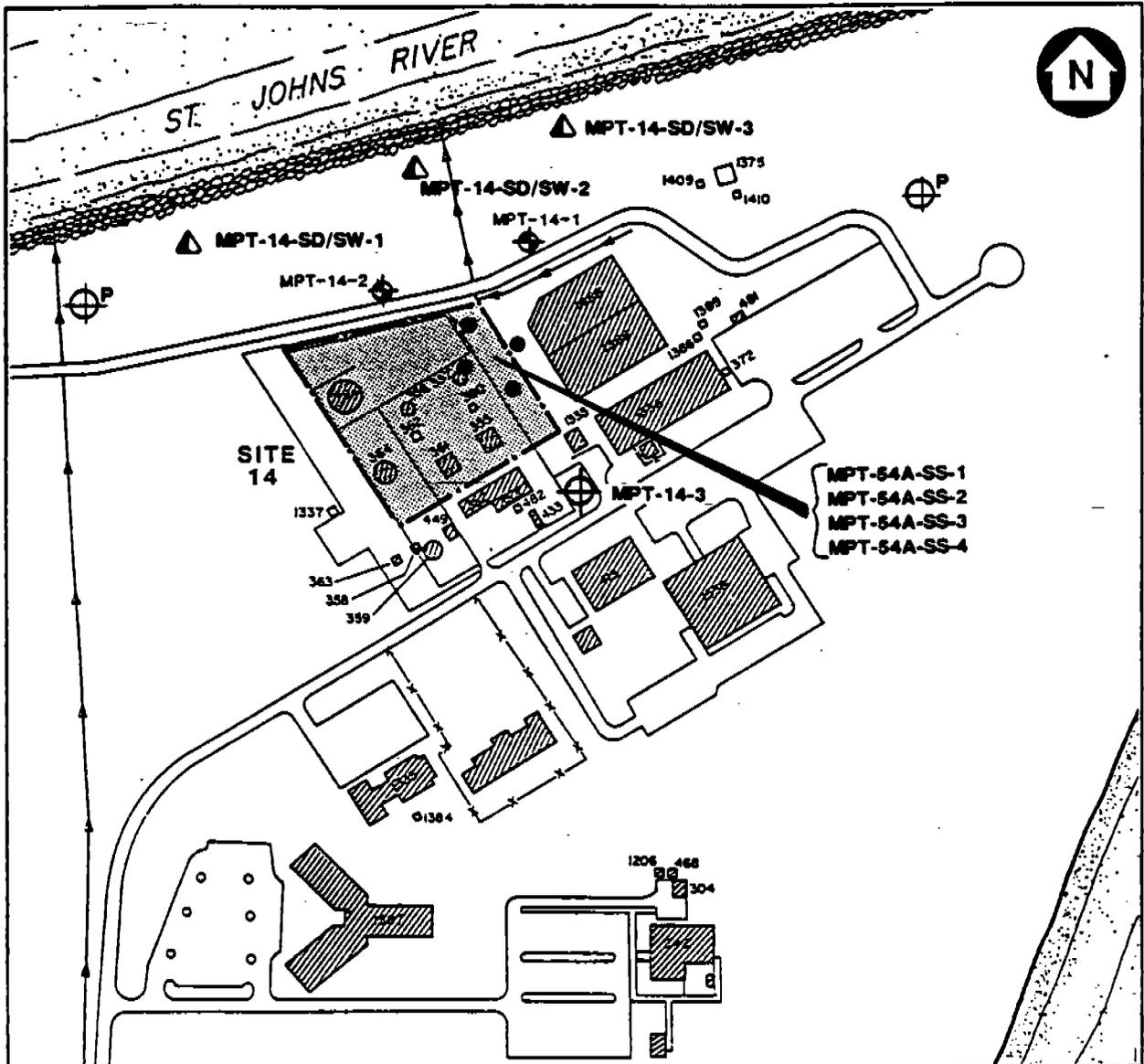
The exploration program at SWMU 14 (Mercury/Oily Waste Spill Site) includes the following data gathering activities:

- installing a monitoring well in the surficial aquifers;
- sampling and analyzing subsurface soil during borehole construction for monitoring wells;
- sampling and analyzing groundwater at new and existing monitoring wells;
- sampling and analyzing sediment and surface water samples from inverts of the storm drain conveyance system; and
- collecting near surface soil samples to verify potential contamination.

The locations of these activities at SWMU 14 are presented in Figure 3-18. In addition to these site-specific activities, piezometers will be installed as part of the facility-wide piezometer network to supplement local and regional data on groundwater flow rate and direction, as well as assess tidal and seasonal influences. These activities are described in Section 3.2.3, Hydrologic Investigation.

The sample media, sample locations, number of samples, estimated number of QA/QC samples, and sample analyses are summarized in Table 3-18a for SWMU 14. The data-gathering activities are composed of the field activities subtasks listed below. Because many of the field activities subtasks will be repeated at other sites, they are described as standard operation procedures in project-specific Technical Memoranda located in Appendix B, Site-Specific Quality Assurance Plan. Site-specific elements particular to SWMU 14 are discussed in subsequent sections, and standard operating procedures are referenced where necessary. Subtasks of data gathering activities at SWMU 14 include:

- drilling and subsurface soil sampling;
- well construction and development;
- groundwater sampling;
- sediment sampling; and
- surface and near-surface soil sampling.



LEGEND

- APPROX. LOCATION OF EXISTING MONITORING WELLS
- APPROX. AREA OF SITE LOCATION
- STORM DRAINAGE DITCH INDICATING DIRECTION OF FLOW
- APPROX. LOCATION OF PROPOSED MONITORING WELL
- APPROX. LOCATION OF PROPOSED SURFACE SOIL SAMPLING
- APPROX. LOCATION OF PROPOSED SEDIMENT/SURFACE WATER SAMPLING
- APPROX. LOCATION OF PROPOSED PIEZOMETERS

APPROX. SCALE



FIGURE 3-18

**LOCATION OF EXPLORATION
(SITE 14)
SWMU 14**



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Table 3-10a: Summary of Samples to be Collected at SWMU 14 (Mercurically Waste Spill Area)

SWMU Site	Sample Location	Sample Designation	Sample Type	Media	USEPA Method		USEPA Method		USEPA Method		General Physical/Chemical (Soil)	General Water Quality (Water)
					8240 VOA	8270 SOA	8010, 7470	8080 Metals	8080 Pest/PCB			
14	MPT-14-3	MPT-14-MS-3(X-X)-1	monitoring well soil	soil	1	1	1	1	1	1	1	0
			subtotal:	soil	1	1	1	1	1	1	1	0
14	MPT-14-3	MPT-14-MS-X(X)-1	well soil duplicates	soil	1	1	1	1	1	1	0	0
			total:	soil	2	2	2	2	2	2	1	0
14	MPT-14-1	MPT-14-MW-1-1	monitoring well water	water	1	1	1	1	1	1	0	1
			total:	water	1	1	1	1	1	1	0	1
14	MPT-14-2	MPT-14-MW-2-1	monitoring well water	water	1	1	1	1	1	1	0	1
			total:	water	1	1	1	1	1	1	0	1
14	MPT-14-3	MPT-14-MW-3-1	monitoring well water	water	1	1	1	1	1	1	0	1
			subtotal:	water	3	3	3	3	3	3	0	3
14	MPT-14-TB	MPT-14-MW-XA-1	well water duplicate	water	1	1	1	1	1	1	0	0
			total:	water	4	4	4	4	4	4	0	3
14	MPT-54A	MPT-54A-SS-1	Surface soil samples	soil	1	1	1	1	1	1	0	0
			total:	soil	1	1	1	1	1	1	0	0
14	MPT-54A	MPT-54A-SS-2	Surface soil samples	soil	1	1	1	1	1	1	0	0
			total:	soil	1	1	1	1	1	1	0	0
14	MPT-54A	MPT-54A-SS-3	Surface soil samples	soil	1	1	1	1	1	1	0	0
			total:	soil	1	1	1	1	1	1	0	0
14	MPT-54A	MPT-54A-SS-4	Surface soil samples	soil	4	4	4	4	4	4	0	0
			total:	soil	4	4	4	4	4	4	0	0
14	MPT-54A	MPT-54A-SS-XA	Soil Duplicate	soil	1	1	1	1	1	1	0	0
			total:	soil	5	5	5	5	5	5	0	0
14	MPT-14	MPT-14-QT-1	QC trip blank	water	1	0	0	0	0	0	0	0
			total:	water	1	0	0	0	0	0	0	0
14	MPT-14	MPT-14-QT-2	QC trip blank	water	1	0	0	0	0	0	0	0
			total:	water	2	0	0	0	0	0	0	0
14	MPT-14	MPT-14-QS-1	QC sampler blank	water	1	1	1	1	1	1	0	0
			total:	water	1	1	1	1	1	1	0	0
14	MPT-14	MPT-14-QS-2	QC sampler blank	water	1	1	1	1	1	1	0	0
			total:	water	2	2	2	2	2	2	0	0
14	MPT-14	MPT-14-FB-1	QC field blank	water	1	1	1	1	1	1	0	0
			total:	water	1	1	1	1	1	1	0	0
14	MPT-14	MPT-14-FB-2	QC field blank	water	1	1	1	1	1	1	0	0
			total:	water	2	2	2	2	2	2	0	0

Note:

Because well and sample designations were established during the NIRP investigations, the RFI will continue to use this designation scheme.
 See Table 1-1 for NIRP/SWMU Site Numbers cross-reference.
 Subsurface soil sample depths will be based on field observations. In general, soil samples will be collected just above the observed groundwater elevation unless field observations indicate more desirable sample depths (e.g., visual or field screening indications of contamination).
 VOA - Volatile Organic Compound Analyses
 SOA - Semivolatile Organic Compound Analyses
 Pest - Pesticides
 PCB - polychlorinated biphenyls
 TBD - To be determined during field activities

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Drilling and Subsurface Soil Sampling. Drilling and subsurface soil sampling will be accomplished as described in the Technical Memorandum, Drilling and Subsurface Soil Sampling, Appendix B. A summary of the location, frequency, and sample types is presented in Table 3-18a. Borehole locations are presented in Figure 3-18. Table 3-18b summarizes the borehole depths and monitoring well specifications anticipated for SWMU 14.

Well Construction and Development. Well construction and development will be accomplished as described in the Technical Memorandum, Well Construction and Development, Appendix B. Typical installation details for each well type are presented in Figures 3-3A through Figure 3-3D. A summary of the location, frequency, media, and sample types is presented in Table 3-18a. Well locations are presented in Figure 3-18. Table 3-18b summarizes the monitoring well specifications anticipated for SWMU 14. Actual completion depths and screened intervals will be determined during borehole drilling based on field observations.

Wells at each location will be completed in the upper surficial aquifer to a depth of approximately 15 feet (same geologic strata as previous wells). The wells will be screened their entire saturated length. The well screens will extend approximately 3 feet above the water table.

Groundwater Sampling. The location, frequency, and sample types for groundwater are summarized in Table 3-18a. Well locations are presented in Figure 3-18. Table 3-18b summarizes the monitoring well specifications anticipated for SWMU 14. Groundwater sampling will be accomplished as described in the Technical Memorandum, Groundwater Sampling, Appendix B.

Sediment Sampling. The location, frequency, and sample types for sediment are summarized in Table 3-18a. Sediment sampling locations are presented in Figure 3-18. Sediment samples will be taken immediately upstream from SWMU 14, immediately downstream near the site boundary, and immediately upstream of the junction with the stormwater drainage ditch along the Patrol Road. Sediment sampling will be accomplished as described in the Technical Memorandum, Sediment and Surface Water Sampling, Appendix B.

Surface Soil Sampling. The location, frequency, and sample types for surface soil are summarized in Table 3-18a. Well locations are presented in Figure 3-18. Surface and near-surface soil sampling at associated SWMU 54A (Oil-Water Separator) will be accomplished as described in the Technical Memorandum, Surface Soil Sampling, Appendix B.

3.3.9 SWMU 15 (NIRP Site 15), Old Pesticide Area The old pesticide area was reportedly located in former Building 484 on the western side of the station (Figure 3-19). The area was in use for approximately 1 year from 1963 to 1964. Pesticides and pesticide application equipment were stored in a shed attached to the southwestern corner of the building. Pesticide mixing and formulating activities were conducted at the job site. However, the cleaning of spray equipment occurred adjacent to the building. Rinse waters from washing activities were discarded directly onto the soils of the area. The IAS estimated

**Table 3-18b: Summary of New Monitoring Wells at SWMU 14.
(Mercury/Oily Waste Spill Area).**

SWMU Site	Well ID	Estimated Depth (feet)	Well Diameter (inches)	Borehole Diameter (inches)	Screen Length (feet)	Surface-Casing			Surface-Casing		Geologic Strata
						Estimated Depth (feet)	Inside Diameter (inches)	Boring Diameter (inches)	Estimated Depth (feet)	Inside Diameter (inches)	
14	MPT-14-3S	15	2	6	10	N/A	N/A	N/A	N/A	N/A	S. D.

Note:

See Table 1-1 for NRP/SWMU Site Numbers cross-reference.

Well Identification Hydrologic Location:

- S - Shallow Surficial Aquifer
- D - Deep Surficial Aquifer
- DD - Secondary Aquifer

Geologic Strata:

- U. H. - Upper Hawthorn
- S. D. - Surficial Deposit

Well casing for all wells will be Schedule 40 PVC.

Surface casing material for secondary aquifer wells will be Schedule 80 PVC.

Screen slot size will be 0.010 inches.

Filter packs will be 20/30 silica sand.

Grout will be cement/bentonite (90/10).

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less than 55 gallons of contaminants were spilled during the brief period of use (Environmental Science and Engineering, 1986).

No investigations were conducted at SWMU 15 during the ESI. Surface soil and groundwater samples will be collected at SWMU 15 as part of the RFI. Due to the uncertainty of the location of SWMU 15, four surface soil samples will be collected around each of the two areas suspected of being where the pesticide mixing and cleaning operations were located.

3.3.9.1 Exploration Program, SWMU 15 (NIRP Site 15) The rationale for the data gathering activities at SWMU 15 is described in Volume I, Workplan. In summary, objectives of the data gathering activities at SWMU 15 are to:

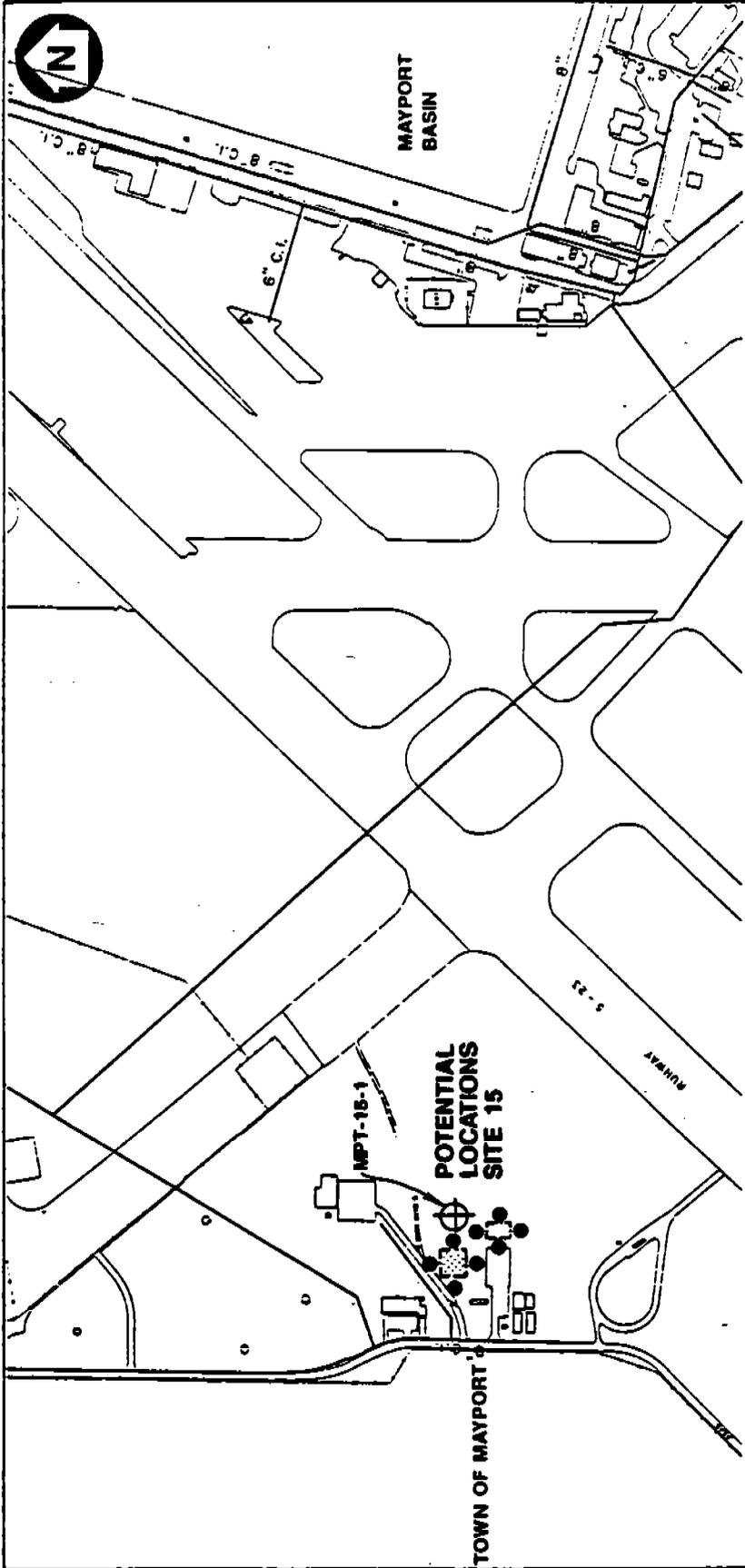
- obtain groundwater quality data to characterize potential groundwater contamination, plume extent, and general water quality at the site;
- obtain subsurface soil samples to: characterize the horizontal and vertical extent of contamination at the site, obtain general parameters for contaminant fate and transport, and provide design criteria for potential corrective measures; and
- verify and characterize potential soil contamination.

The exploration program at SWMU 15 (Old Pesticide Area) includes the following data gathering activities:

- installing of a monitoring well in the surficial aquifer,
- sampling and analyzing of subsurface soil during borehole construction for monitoring wells;
- sampling and analysis of groundwater at the new monitoring well; and
- collecting near surface soil samples to verify and characterize potential contamination.

The locations of these activities at SWMU 15 are presented in Figure 3-20. In addition to these site-specific activities, piezometers will be installed as part of the facility-wide piezometer network to supplement local and regional data on groundwater flow rate and direction, as well as assess tidal and seasonal influences. These activities are described in Section 3.2.3, Hydrologic Investigation.

The sample media, sample locations, number of samples, estimated number of QA/QC samples, and sample analyses are summarized in Table 3-19a for SWMU 15. The data gathering activities are composed of the field activities subtasks listed below. Because many of the field activities subtasks will be repeated at other sites, they are described as standard operation procedures in project-specific Technical Memoranda located in Appendix B, Site-Specific Quality Assurance Plan. Site-specific elements particular to SWMU 15 are discussed in subsequent



LEGEND

-  APPROX. AREA OF SITE LOCATION
-  APPROX. LOCATION OF PROPOSED SHALLOW SOIL SAMPLING
-  APPROX. LOCATION OF PROPOSED MONITORING WELL



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**FIGURE 3-20
 LOCATION OF EXPLORATIONS
 (SITE 15)
 SWMU 15**

Table 3-10a: Summary of Samples to be Collected at SWMU 15 (Old Pesticide Area)

SWMU Site	Sample Location	Sample Designation	Sample Type	Media	USEPA Method			USEPA Method		USEPA Method	
					8240 VOA	8270 SOA	7470 Metals	8060 Pest/PCB	6010, 7470 Physical/Chemical (Soil)	General Water Quality (Water)	
15	MPT-15	MPT-15-S8-1-1	surface soil sample	soil	1	1	1	1	1	0	0
15	MPT-15	MPT-15-S8-1-2	surface soil sample	soil	1	1	1	1	1	0	0
15	MPT-15	MPT-15-S8-2-1	surface soil sample	soil	1	1	1	1	1	0	0
15	MPT-15	MPT-15-S8-2-2	surface soil sample	soil	1	1	1	1	1	0	0
15	MPT-15	MPT-15-S8-3-1	surface soil sample	soil	1	1	1	1	1	0	0
15	MPT-15	MPT-15-S8-3-2	surface soil sample	soil	1	1	1	1	1	0	0
15	MPT-15	MPT-15-S8-4-1	surface soil sample	soil	1	1	1	1	1	0	0
15	MPT-15	MPT-15-S8-4-2	surface soil sample	soil	1	1	1	1	1	0	0
15	MPT-15	MPT-15-S8-5-1	surface soil sample	soil	1	1	1	1	1	0	0
15	MPT-15	MPT-15-S8-5-2	surface soil sample	soil	1	1	1	1	1	0	0
15	MPT-15	MPT-15-S8-6-1	surface soil sample	soil	1	1	1	1	1	0	0
15	MPT-15	MPT-15-S8-6-2	surface soil sample	soil	1	1	1	1	1	0	0
15	MPT-15	MPT-15-S8-7-1	surface soil sample	soil	1	1	1	1	1	0	0
15	MPT-15	MPT-15-S8-7-2	surface soil sample	soil	1	1	1	1	1	0	0
15	MPT-15	MPT-15-S8-8-1	surface soil sample	soil	1	1	1	1	1	0	0
15	MPT-15	MPT-15-S8-8-2	surface soil sample	soil	1	1	1	1	1	0	0
15	TBD	MPT-15-S8-8-2A	surface soil duplicate	soil	1	1	1	1	1	0	0
subtotal:					16	16	16	16	16	0	0
total:					2	2	2	2	2	0	0
15	MPT-15	MPT-15-M8-1(X-X)-1	monitoring well soil	soil	1	1	1	1	1	1	0
subtotal:					1	1	1	1	1	1	0
15	TBD	MPT-15-M8-1(X-X)A-1	well soil duplicates	soil	1	1	1	1	1	0	0
total:					2	2	2	2	2	1	0
15	MPT-15-1	MPT-15-MW-1-1	monitoring well water	water	1	1	1	1	1	0	1
subtotal:					1	1	1	1	1	0	1
15	MPT-15-1	MPT-15-MW-1A-1	well water duplicates	water	1	1	1	1	1	0	0
total:					2	2	2	2	2	0	1

Note:

Because well and sample designations were established during the NIRP investigations,

the RFI will continue to use this designation scheme.

See Table 1-1 for NIRP/SWMU Site Numbers cross-reference.

Subsurface soil sample depths will be based on field observations. In general, soil samples will be collected

just above the observed groundwater elevation unless field observations indicate more desirable sample depths

(e.g., visual or field screening indications of contamination).

VOA - Volatile Organic Compound Analyses

SOA - Semivolatile Organic Compound Analyses

Pest - Pesticides

PCB - polychlorinated biphenyls

TBD - To be determined during field activities

Table 3-10a: Summary of Samples to be Collected at SWMU 15 (Old Pesticide Area).

SWMU Site	Sample Location	Sample Designation	Sample Type	Media	USEPA Method			USEPA Method		USEPA Method		General Physical/Chemical (Soil)	General Water Quality (Water)
					8240 VOA	8270 SOA	8080 Pest/PCB	6010, 7470	7480 Metals				
15	MPT-15	MPT-15-QT-1	QC trip blank	water	1	0	0	0	0	0	0	0	
15	MPT-15	MPT-15-QT-2	QC trip blank	water	1	0	0	0	0	0	0	0	
			subtotal:	water	2	0	0	0	0	0	0	0	
15	MPT-15	MPT-15-Q8-1	QC sampler blank	water	1	1	1	1	1	1	0	0	
15	MPT-15	MPT-15-Q8-2	QC sampler blank	water	1	1	1	1	1	1	0	0	
			subtotal:	water	2	2	2	2	2	2	0	0	
15	MPT-15	MPT-15-FB-1	QC field blank	water	1	1	1	1	1	1	0	0	
15	MPT-15	MPT-15-FB-2	QC field blank	water	1	1	1	1	1	1	0	0	
			subtotal:	water	2	2	2	2	2	2	0	0	

Note:

Because well and sample designations were established during the NIRP investigations, the RFI will continue to use this designation scheme. See Table 1-1 for NIRP/SWMU Site Numbers cross-reference. Subsurface soil sample depths will be based on field observations. In general, soil samples will be collected just above the observed groundwater elevation unless field observations indicate more desirable sample depths (e.g., visual or field screening indications of contamination).
 VOA - Volatile Organic Compound Analyses
 SOA - Semivolatile Organic Compound Analyses
 Pest - Pesticides
 PCB - polychlorinated biphenyls
 TBD - To be determined during field activities

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sections, and standard operating procedures are referenced where necessary. Subtasks of data gathering activities at SWMU 15 include:

- drilling and subsurface soil sampling,
- well construction and development,
- groundwater sampling, and
- surface and near-surface soil sampling.

Drilling and Subsurface Soil Sampling. Drilling and subsurface soil sampling will be accomplished as described in the Technical Memorandum, Drilling and Subsurface Soil Sampling, Appendix B. A summary of the location, frequency, media, and sample types is presented in Table 3-19a. Borehole locations are presented in Figure 3-20. Table 3-19b summarizes the borehole depths and monitoring well specifications anticipated for SWMU 15.

Well Construction and Development. Well construction and development will be accomplished as described in the Technical Memorandum, Well Construction and Development, Appendix B. Typical installation details for each well type are presented in Figures 3-3A through Figure 3-3D. A summary of the location, frequency, media, and sample types is presented in Table 3-19a. Well locations are presented in Figure 3-20. Table 3-19b summarizes the monitoring well specifications anticipated for SWMU 15. Actual completion depths and screened intervals will be determined during borehole drilling based on field observations.

The monitoring well will be completed in the upper surficial aquifer to a depth of approximately 15 feet. The well will be screened their entire saturated length. The well screen will extend approximately 3 feet above the water table.

Groundwater Sampling. A summary of location, frequency, and sample types for groundwater is presented in Table 3-19a. The well location is presented Figure 3-20. Table 3-19b summarizes the monitoring well specifications anticipated for SWMU 15. Groundwater sampling will be accomplished as described in the Technical Memorandum, Groundwater sampling, Appendix B.

Surface Soil Sampling. A summary of location, frequency, and sample types for surface soil is presented in Table 3-19a. Surface and near-surface soil sampling will be accomplished as described in the Technical Memorandum, Surface Soil Sampling, Appendix B.

3.3.10 SWMU 16 (NIRP Site 16). Old Transformer Storage Yard SWMU 16 is located in the NSC fuel farm on the east side of Tank 204 (see Figure 3-12). The site was situated on an abandoned runway and was used from 1981 to 1987 to store out-of-service transformers. At the time of the IAS, approximately 30 non-PCB containing transformers were stored in the area. All transformers had been removed by the time of the ESI in late 1987. Minor spills or leaks have occurred during storage at the site. It is not known if PCB transformers were stored in this area; therefore, it is unknown whether any PCB oils have been spilled.

Two soil samples were collected west of SWMU 16 during the ESI. Analysis of the samples showed pesticides, but no PCBs. Concentrations of pesticides in the soil

**Table 3-19b: Summary of New Monitoring Wells at SWMU 15.
(Old Pesticide Area).**

SWMU Site	Well ID	Estimated Depth (feet)	Well Diameter (inches)	Borehole Diameter (inches)	Screen Length (feet)	Surface-Casing Surface-Casing Surface-Casing			Geologic Strata	S. D.
						Estimated Depth (feet)	Inside Diameter (inches)	Boring Diameter (inches)		
15	MPT-15-1S	15	2	6	10	N/A	N/A	N/A		

Note:

See Table 1-1 for NIRP/SWMU Site Numbers cross-reference.

Well Identification Hydrologic Location:

- S = Shallow Surficial Aquifer
- D = Deep Surficial Aquifer
- DD = Secondary Aquifer

Geologic Strata:

- U. H. = Upper Hawthorn
- S. D. = Surficial Deposit

Well casing for all wells will be Schedule 40 PVC.

Surface casing material for secondary aquifer wells will be Schedule 80 PVC.

Screen slot size will be 0.010 inches.

Filter packs will be 20/30 silica sand.

Grout will be cement/bentonite (90/10).

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samples ranged from 3 $\mu\text{g}/\text{kg}$ of 4,4'-DDD to 50 $\mu\text{g}/\text{kg}$ of 4,4'-DDT. These concentrations are comparable to pesticide levels observed at other sites throughout NAVSTA Mayport and are believed to reflect a residual concentration from many years of pesticides application for insect control on the base.

3.3.10.1 Exploration Program, SWMU 16 (NIRP Site 16) The rationale for the data gathering activities at SWMU 16 is described in Volume I, Workplan. In summary, objectives of the data gathering activities at SWMU 16 are to:

- obtain additional site-specific data to characterize groundwater flow rates and directions;
- obtain groundwater quality data to characterize potential groundwater contamination, plume extent, and general water quality at the site;
- obtain subsurface soil samples to: characterize the horizontal and vertical extent of contamination at the site, obtain general parameters for contaminant fate and transport, and provide design criteria for potential corrective measures; and
- characterize potential PCB contamination of surface soils.

The exploration program at SWMU 16 (Old Transformer Storage Yard) includes the following data gathering activities:

- installing three monitoring wells in the surficial aquifer;
- sampling and analyzing of subsurface soil during borehole construction for monitoring wells;
- sampling and analyzing of groundwater at new and existing monitoring wells; and
- surface and near-surface soil sampling.

The locations of these activities at SWMU 16 are presented in Figure 3-13. In addition to these site-specific activities, piezometers will be installed as part of the facility-wide piezometer network to supplement local and regional data on groundwater flow rate and direction, as well as assess tidal and seasonal influences. These activities are described in Section 3.2.3, Hydrologic Investigation.

The sample media, sample locations, number of samples, estimated number of QA/QC samples, and sample analyses are summarized in Table 3-16a for SWMU 16. The data gathering activities are composed of the field activities subtasks listed below. Because many of the field activities subtasks will be repeated at other sites, they are described as standard operation procedures in project-specific Technical Memoranda located in Appendix B, site-specific Quality Assurance Plan. Site-specific elements particular to SWMU 16 are discussed in subsequent sections, and standard operating procedures are referenced where necessary. Subtasks of data gathering activities at SWMU 16 include:

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- drilling and subsurface soil sampling,
- well construction and development,
- groundwater sampling, and
- surface and near-surface soil sampling.

Drilling and Subsurface Soil Sampling. Drilling and subsurface soil sampling will be accomplished as described in the Technical Memorandum, Drilling and Subsurface Soil Sampling, Appendix B. A summary of the location, frequency, media, and sample types is presented in Table 3-16a. Borehole locations are presented in Figure 3-13. Table 3-16b summarizes the borehole depths and monitoring well specifications anticipated for SWMU 16.

Well Construction and Development. Well construction and development will be accomplished as described in the Technical Memorandum, Well Construction and Development, Appendix B. Typical installation details for each well type are presented in Figure 3-3A through Figure 3-3D. A summary of the location, frequency, media, and sample types is presented in Table 3-16a. Well locations are presented Figure 3-20. Table 3-16b summarizes the monitoring well specifications anticipated for SWMU 16. Actual completion depths and screened intervals will be determined during borehole drilling based on field observations.

Wells at each location will be completed in the upper surficial aquifer to a depth of approximately 15 feet. The wells will be screened their entire saturated length. The well screens will extend approximately 3 feet above the water table.

Groundwater Sampling. A summary of location, frequency, and sample types for groundwater is presented in Table 3-16a. Well locations are presented in Figure 3-9. Table 3-16b summarizes the monitoring well specifications anticipated for SWMU 16. Groundwater sampling will be accomplished as described in the Technical Memorandum, Groundwater Sampling, Appendix B.

Surface Soil PCB Contamination Characterization Sampling and Analysis. PCB surface soil contamination will be characterized using a non-random sampling grid. A hexagonal sampling grid composed of triangular elements will be superimposed over the site. The dimensions of the grid are based on the USEPA guidance *Verification of PCB Spill Cleanup by Sampling and Analysis* (EPA-560/5-85-026; August 1985). The number of sample points in a grid of this geometry is 37 (Appendix B, Volume II). Additional judgmental sample locations may be chosen depending on site conditions observed during field activities.

Duplicate samples will be collected simultaneously during field activities. The duplicates of positive samples will be sent for laboratory analysis to confirm field results and to quantify site contamination by laboratory means (i.e., USEPA Method 8080). Upon initial horizontal site characterization, additional samples will be collected at lower depths (e.g., 12 inches and greater) to characterize the vertical extent of PCB contamination within surface areas where PCB concentrations greater than 50 $\mu\text{g}/\text{kg}$ were found. The number of subsurface soil samples will be dependent on previous findings.

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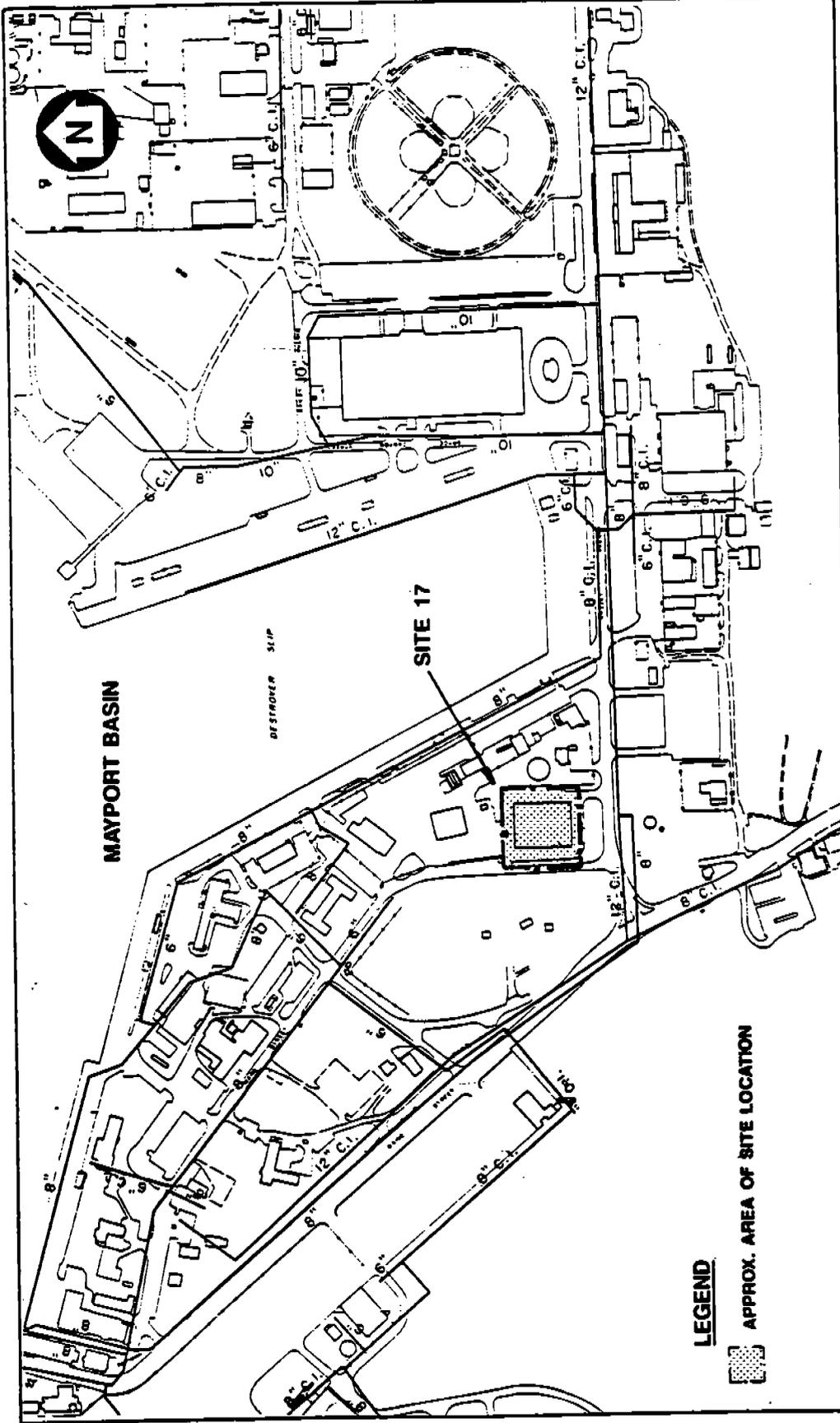
Surface and near surface soil samples will be collected in accordance with the Technical Memorandum, Surface Soil sampling, Appendix B. Duplicate soil samples will be collected at each grid point. One sample will be packaged, labeled, and preserved for possible laboratory analysis using USEPA Method 8080 in accordance with procedures described in Section 3.1, Volume II, Sampling and Analysis Plan. The remaining duplicate will be analyzed on-site using a PCB screening kit for soil (CLOR-N-SOILSM). Use of the PCB Screening Kit is described in the instructions provided by the vendor. A copy is presented in Appendix B for reference.

The duplicates of soil samples tested positive for PCB with the field kit will be sent to the laboratory for confirmatory analysis by USEPA Method 8080. Appropriate chain-of-custody documentation will be used and QA/QC samples will be collected in accordance with the QAPP, Appendix A.

3.3.11 SWMU 17 (NIRP Site 17). Carbonaceous Fuel Boiler Since 1979, the carbonaceous fuel boiler, located in Building 1430 (Figure 3-21), has been used to dispose of refuse and burnable garbage generated by both NAVSTA Mayport and the onbase housing area. Solid waste is sorted and all unburnable large metal scrap and items too large for the incinerator are removed. The scrap metal is sold to an off-station contractor for disposal. The large items are placed in the wet ash bin and hauled to an off-base landfill. Small metal items such as cans are put into the incinerator and the unburned metals removed with the wet ash. The incinerator is contractor-operated 24 hours a day and has a design capacity of 48 tons per day with a current loading of 42 to 45 tons per day. Waste oil and diesel fuel are used to augment burning. The waste oil (collected from various locations on-station and also recovered from bilge water and berthed ships) is obtained from the NSC fuel farm.

Heat from the incinerator is used to generate steam for ships docked at Mayport Basin. The boiler has an operating pressure of 180 pounds per square inch. Blowdown is continuous and is used to quench the ash generated by the incinerator. Phosphate and sulfite are used to treat the boiler water. Fly ash is trapped in a multi-cyclone filter and disposed of with the wet ash. Wet ash is removed from the bottom of the incinerator and placed in a dumpster. Ash was taken to the station landfill (Sites 2, 5, and 6) until early 1985. Current ash disposal is at an off-station landfill. Approximately 6,260 cubic yards of wet ash and fly ash are generated yearly.

Currently, the carbonaceous fuel boiler is permitted under FDER Permit # A019-17873. Monitoring of stack emissions has been performed by the City of Jacksonville, Department of Health, Welfare & Bio-Environmental Services. Therefore, no stack monitoring is proposed in this investigation. Instead, available information on stack emission quality will be obtained and summarized from State and city sources. Ash analysis has also been performed. Results of these tests will be reviewed for completeness and included in the evaluation of Site 17.



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FIGURE 3-21
 SITE PLAN
 (SITE 17)
 SWMU 17 - CARBONACEOUS
 FUEL BOILER

LEGEND
 [Hatched Box] APPROX. AREA OF SITE LOCATION



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3.3.11.1 Exploration Program, SWMU 17 (NIRP Site 17) The rationale for the data gathering activities at SWMU 17 is described in Volume I, Workplan. In summary, objectives of the data gathering activities at SWMU 17 are to verify and characterize potential soil contamination near SWMU 17.

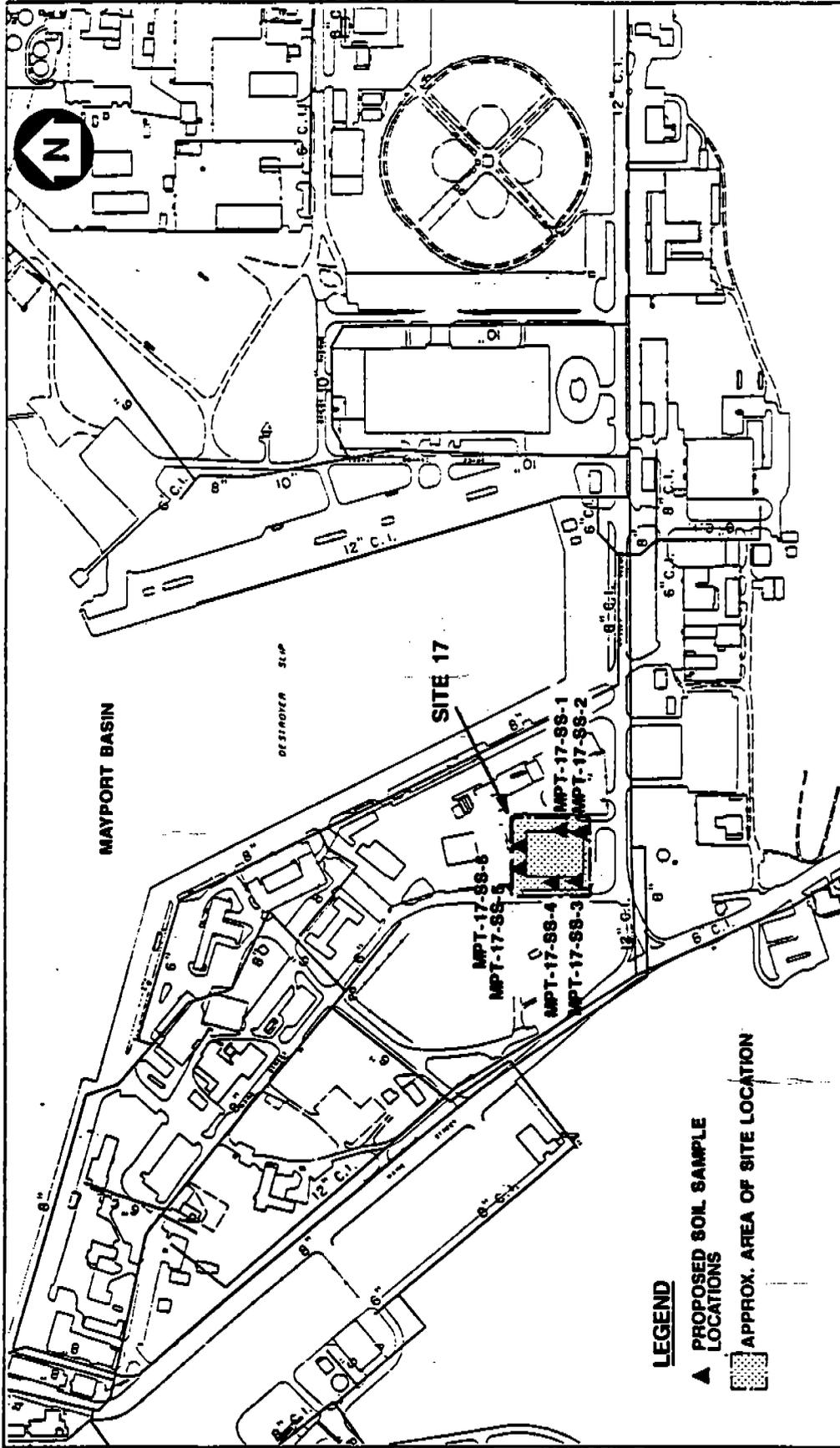
The exploration program at SWMU 17 (Old Transformer Storage Yard) includes surface and near-surface soil sampling.

The locations of these activities at SWMU 17 are presented in Figure 3-22. In addition to these site-specific activities, piezometers will be installed as part of the facility-wide piezometer network to supplement local and regional data on groundwater flow rate and direction, as well as assess tidal and seasonal influences. These activities are described in Section 3.2.3, Hydrologic Investigation.

The sample media, sample locations, number of samples, estimated number of QA/QC samples, and sample analyses are summarized in Table 3-20a for SWMU 17. The data-gathering activities consist of surface and near-surface soil sampling. Since many of the field activities subtasks will be repeated at other sites, they are described as standard operating procedures in project-specific Technical Memoranda located in Appendix B, site-specific Quality Assurance Plan. Site-specific elements particular to SWMU 17 are discussed in subsequent sections, and standard operating procedures are referenced where necessary.

Surface Soil Sampling. Surface soil locations are presented in Figure 3-22. The sample media, sample locations, number of samples, estimated number of QA/QC samples, and sample analyses are summarized in Table 3-20a for SWMU 17. Surface soil samples will be collected in accordance with the Technical Memorandum, Surface Soil Sampling, Appendix B.

3.4 ANALYTICAL PROGRAM The analytical program for the RFI at NAVSTA Mayport is summarized in Table 3-21. Gas chromatography methods have been specified for most organic analyses in order to achieve increased sensitivity over GC/MS methods. Analytes and typical reportable detection limits for the specified methods are shown in Tables 3-22 through 3-25. Table 3-26 presents the general water quality parameters that will be measured. The number of quality control samples (including duplicates and field blanks) to be collected was determined in accordance with the generic QAPP, Appendix A, Volume II.



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FIGURE 3-22

LOCATION OF EXPLORATION (SITE 17)

SWMU 17

Table 3-20a: Summary of Samples to be Collected at SWMU 17 (Carbonaceous Fuel Boiler)										
SWMU Site	Sample Location	Sample Designation	Sample Type	Media	USEPA Method			USEPA Method		
					8240 VOA	8270 SOA	8010, 7470 Metals	8080 Pest/PCB	General Physical/Chemical (Soil)	General Water Quality (Water)
17	MPT-17	MPT-17-SS-1(0.5-1.5)	soil samples	soil	1	1	1	1	0	0
17	MPT-17	MPT-17-SS-2(0.5-1.5)	soil samples	soil	1	1	1	1	0	0
17	MPT-17	MPT-17-SS-3(0.5-1.5)	soil samples	soil	1	1	1	1	0	0
17	MPT-17	MPT-17-SS-4(0.5-1.5)	soil samples	soil	1	1	1	1	0	0
17	MPT-17	MPT-17-SS-5(0.5-1.5)	soil samples	soil	1	1	1	1	0	0
17	MPT-17	MPT-17-SS-6(0.5-1.5)	soil samples	soil	1	1	1	1	0	0
17	MPT-17	MPT-17-SS-7(0.5-1.5)	soil samples	soil	1	1	1	1	0	0
17	MPT-17	MPT-17-SS-X(0.5-1.0)A	soil duplicates	soil	6	6	6	6	0	0
			total:	soil	7	7	7	7	0	0
17	MPT-17	MPT-17-QT-1	QC trip blank	water	1	0	0	0	0	0
17	MPT-17	MPT-17-QT-2	QC trip blank	water	1	0	0	0	0	0
			subtotal:	water	2	0	0	0	0	0
17	MPT-17	MPT-17-QS-1	QC sampler blank	water	1	1	1	1	0	0
17	MPT-17	MPT-17-QS-2	QC sampler blank	water	1	1	1	1	0	0
			subtotal:	water	2	2	2	2	0	0
17	MPT-17	MPT-17-FB-1	QC field blank	water	1	1	1	1	0	0
17	MPT-17	MPT-17-FB-2	QC field blank	water	1	1	1	1	0	0
			subtotal:	water	2	2	2	2	0	0

Note:

Because well and sample designations were established during the NRP investigations, the RFI will continue to use this designation scheme.
 See Table 1-1 for NRP/SWMU Site Numbers cross-reference.
 Subsurface soil sample depths will be based on field observations. In general, soil samples will be collected just above the observed groundwater elevation unless field observations indicate more desirable sample depths (e.g., visual or field screening indications of contamination).
 VOA - Volatile Organic Compound Analyses
 SOA - Semivolatile Organic Compound Analyses
 Pest - Pesticides
 PCB - polychlorinated biphenyls
 TBD - To be determined during field activities

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Table 3-21
Summary of Chemical Analyses

Sampling and Analysis Plan
NAVSTA Mayport
Mayport, Florida

U.S. Environmental Protection Agency SW-846								
Sample Source	Media	Method 8240 VOA	Method 8270 SVOA	Method 6010, 7470, 7480 Metals	Method 8080 Pest/PCB	General Parame- ters (soil)	General Water Quality	Totals
Background	Soil	6	6	6	6	6	0	30
	Sediment	3	3	3	3	0	0	12
	Groundwater	3	3	3	3	0	3	12
Site 1	Soil	4	4	4	4	4	0	20
	Sediment	3	3	3	3	0	0	12
	Groundwater	11	11	11	11	0	11	55
SWMU 2, 3, 4, 5, 6, and 22	Soil	11	11	11	11	3	0	47
	Groundwater	19	19	19	19	0	19	95
	Sediment	5	5	5	5	0	0	20
	Surface water	5	5	5	5	0	5	25
* SWMU 6, 7, 8, 9, 10, 11, and 16	Soil	5	5	5	5	5	0	25
	Groundwater	12	12	12	12	0	12	60
	Sludge	4	4	4	4	0	4	20
	Surface water	4	4	4	4	0	4	20
SWMU 13	Soil	3	3	3	3	3	0	15
	Groundwater	6	6	6	6	0	6	30
SWMU 14	Soil	5	5	5	5	1	0	21
	Groundwater	3	3	3	3	0	3	15
* SWMU 15	Soil	17	17	17	17	1	0	69
	Groundwater	1	1	1	1	0	1	5
SWMU 17	Soil	6	6	6	6	0	0	24
Subtotal	Soil/Sediment/Sludge	72	72	72	72	23	0	311
	Water	64	64	64	64	0	68	324
Duplicates	Soil and Sediment	17	17	17	17	0	0	68
	Water	12	12	12	12	0	0	48
Sampler blanks	Water	22	22	22	22	0	0	88
Field blanks	Water	22	22	22	22	0	0	88
Trip blanks	Water	22	0	0	0	0	0	22
Total	Soil/Sediment/Sludge	89	89	89	89	23	0	379
	Water	142	120	120	120	0	68	<u>570</u> 949

Notes: VOA = Volatile organic aromatics.
SVOA = semivolatile organic aromatics.
Pest/PCB = pesticide/polychlorinated biphenyls.
SWMU = Solid Waste Management Unit.

TABLE 3-22: APPENDIX IX - GROUND WATER MONITORING LIST (VOLATILES)

COMMON NAME	CAS RN	PQL (ug/L)			METHOD 2	PQL (ug/L)	METHOD 3	PQL (ug/L)	REP. LIMIT	REP. LIMIT
		METHOD 1	METHOD 2	METHOD 3					WATER	SOIL
Acetone	67-84-1	8240	100					10	10	
Acetonitrile; Methyl cyanide	75-05-8	8015	100					100	100	
Acrotoin	107-02-8	8030	5	8240	5			100	100	
Acrylonitrile	107-13-1	8030	5	8240	5			100	100	
Allyl chloride	107-05-1	8010	5	8240	100			5	5	
Benzene	71-43-2	8020	2	8240	5			5	5	
Bromodichloromethane	75-27-4	8010	1	8240	5			5	5	
Bromoform; Tribromomethane	75-26-2	8010	2	8240	5			5	5	
Carbon disulfide	75-15-0	8240	5					5	5	
Carbon tetrachloride	58-23-5	8010	1	8240	5			5	5	
Chlorobenzene	108-90-7	8010	2	8020	2	8240	5	5	5	
Chloroethane; Ethyl chloride	75-00-3	8010	5	8240	10			10	10	
Chloroform	87-89-3	8010	0.5	8240	5			5	5	
Chloroprene	126-99-8	8010	50	8240	5			200	200	
Dibromochloromethane; Chlorodibromomethane	124-48-1	8010	1	8240	5			5	5	
1,2-Dibromo-3-chloropropane; DBCP	96-12-8	8010	100	8240	5		10	10	10	
1,2-Dibromoethane; Ethylene dibromide	108-83-4	8010	10	8240	5			5	5	
trans-1,4-Dichloro-2-butene	110-57-8	8240	5					5	5	
Dichlorodifluoromethane	75-71-8	8010	10	8240	5			10	10	
1,1-Dichloroethane	75-34-3	8010	1	8240	5			5	5	
1,2-Dichloroethane; Ethylene dichloride	107-06-2	8010	0.5	8240	5			5	5	
1,1-Dichloroethylene; Vinylidene chloride	75-35-4	8010	1	8240	5					
trans-1,2-Dichloroethylene	156-90-5	8010	1	8240	5					
1,2-Dichloropropane	78-87-5	8010	0.5	8240	5			5	5	
cis-1,3-Dichloropropene	10081-01-5	8010	20	8240	5			5	5	
trans-1,3-Dichloropropene	10081-02-6	8010	5	8240	5			5	5	
1,4-Dioxane	123-91-1	8015	150					200	200	
Ethylbenzene	100-41-4	8020	2	8240	5			5	5	
2-Hexanone	581-78-8	8240	50					10	10	
Isobutyl alcohol	78-83-1	8015	50					200	200	

PQL: Practical Quantitation Limits

TABLE 3-22: APPENDIX IX - GROUND WATER MONITORING LIST (VOLATILES)

COMMON NAME	CAS RN	POL (µg/L)			METHODO 3			REP. LIMIT WATER	REP. LIMIT SOIL
		METHOD 1	POL (µg/L)	METHOD 2	POL (µg/L)	METHOD 3	POL (µg/L)	µg/L	µg/Kg
Methacrylonitrile	126-99-7	8015	5	8240	5			5	5
Methyl bromide; Bromomethane	74-83-9	8010	20	8240	10			10	10
Methyl chloride; Chloromethane	74-87-3	8010	1	8240	10			10	10
Methylene bromide; Dibromomethane	74-95-3	8010	15	8240	5			5	5
Methylene chloride; Dichloromethane	75-09-2	8010	5	8240	5			5	5
Methyl ethyl ketone; MEK	78-93-3	8015	10	8240	100			10	10
Methyl iodide; Iodomethane	74-88-4	8010	40	8240	5			10	10
Methyl methacrylate	80-62-6	8015	2	8240	5			10	10
4-Methyl-2-pentanone; Methyl isobutyl ketone	108-10-1	8015	5	8240	50			10	10
Pentachloroethane	76-01-7	8240	5	8270	10			10	10
Propionitrile; Ethyl cyanide	107-12-0	8015	80	8240	5			100	100
Styrene	100-42-5	8020	1	8240	5			5	5
1,2,4,5-Tetrachlorobenzene	95-94-3	8270	10						
1,1,1,2-Tetrachloroethane	830-20-6	8010	5	8240	5			5	5
1,1,2,2-Tetrachloroethane	79-34-5	8010	0.5	8240	5			5	5
Tetrachloroethylene; Perchloroethylene; Tetrachloroethene	127-18-4	8010	0.5	8240	5			5	5
Toluene	108-88-3	8020	2	8240	5			5	5
1,1,1-Trichloroethane; Methylchloroform	71-55-6	8240	5					5	5
1,1,2-Trichloroethane	78-00-5	8010	0.2	8240	5			5	5
Trichloroethylene; Trichloroethene	79-01-5	8010	1	8240	5			5	5
Trichlorofluoromethane	75-89-4	8010	10	8240	5			5	5
1,2,3-Trichloropropane	96-18-4	8010	10	8240	5			5	5
Vinyl acetate	108-05-4	8240	6					50	50
Vinyl chloride	75-01-4	8010	2	8240	10			10	10
Xylene (total)	1330-20-7	8020	5	8240	5			5	5

POL: Practical Quantitation Limits

TABLE 3-23: APPENDIX IX - GROUND WATER MONITORING LIST (SEMI-VOLATILES)

COMMON NAME	CAS RN	POL (ug/L)					REP. LIMIT WATER (ug/L)	REP. LIMIT SOIL (ug/Kg)
		METHOD 1	METHOD 2	METHOD 3	METHOD 4	PQL (ug/L)		
Acenaphthene	83-32-9	8100	200	10		10	330	
Acenaphthylene	208-96-8	8100	200	10		10	330	
Acetophenone	98-86-2	8270	10			10	330	
2-Acetylaminofluorene; 2-AAF	53-96-3	8270	10			10	330	
4-Aminobiphenyl	9287-1	8270	10			50	1650	
Aniline	62-53-3	8270	10			10	330	
Anthracene	120-12-7	8100	200	10		10	330	
Aramite	140-57-8	8270	10			50	1650	
Benzo[a]anthracene; Benzenanthracene	56-55-3	8100	200	10		10	330	
Benzo[b]fluoranthene	205-99-2	8100	200	10		10	330	
Benzo[k]fluoranthene	207-08-9	8100	200	10		10	330	
Benzofluoropyrene	191-24-2	8100	200	10		10	330	
Benzofluoropyrene	50-32-8	8100	200	10		10	330	
Benzyl alcohol	100-51-6	8270	20			10	330	
Bis(2-chloroethoxy)methane	111-91-1	8270	10			10	330	
Bis(2-chloro-1-methylethyl) ether; 2,2-Di-chloroisopropyl ether	108-80-1	8010	100	10		10	330	
Bis(2-ethylhexyl) phthalate	117-81-7	8060	20	10		10	330	
4-Bromophenyl phenyl ether	101-56-3	8270	10			10	330	
Butyl benzyl phthalate; Benzyl butyl phthalate	85-68-7	8060	5	10		10	330	
p-Chloroaniline	106-47-8	8270	20			10	330	
p-Chloro-m-cresol	59-50-7	8040	5	20		20	330	
2-Chloronaphthalene	91-58-7	8120	10	10		10	330	
2-Chlorophenol	86-57-8	8040	5	10		10	330	
4-Chlorophenyl phenyl ether	7005-72-3	8270	10			10	330	
Chrysene	218-01-9	8100	200	10		10	330	
m-Cresol	108-39-4	8270	10			10	330	
o-Cresol	96-58-7	8270	10			10	330	
p-Cresol	106-44-5	8270	10			10	330	
Dibenz[a,h]anthracene	53-70-3	8100	200	10		10	330	
Dibenzofuran	132-94-9	8270	10			10	330	
Di-n-butyl phthalate	84-74-2	8060	5	10		10	330	
o-Dichlorobenzene	96-50-1	8010	2	5		5	330	
m-Dichlorobenzene	541-73-1	8010	5	5		5	330	
p-Dichlorobenzene	106-46-7	8010	2	5		5	330	
3,3'-Dichlorobenzidine	91-94-1	8270	20	10		10	330	
2,4-Dichlorophenol	120-83-2	8040	5	5		5	330	
2,6-Dichlorophenol	87-65-0	8270	10	10		10	330	
Diethyl phthalate	84-66-2	8060	5	10		10	330	
p-(Dimethylamino)azobenzene	90-11-7	8270	10	10		10	330	
7,12-Dimethylbenz[a]anthracene	60-97-6	8270	10	10		10	330	

PQL: Practical Quantitation Limits

TABLE 3-23: APPENDIX IX - GROUND WATER MONITORING LIST (SEMI-VOLATILES)

COMMON NAME	CAS RN	POL (ug/L)				REP. LIMIT		REP. SOIL ug/Kg
		METHOD 1	METHOD 2	METHOD 3	METHOD 4	WATER ug/L	SOIL ug/Kg	
3,3-Dimethylbenzidine	119-93-7	8270	10			10	330	
alpha, alpha-Dimethylphenethylamine	122-09-8	8270	10			50	1650	
2,4-Dimethylphenol	105-67-8	8040	5	8270	10	10	330	
Dimethyl phthalate	131-11-3	8080	5	8270	10	10	330	
m-Dinitrobenzene	99-05-0	8270	10					
4,6-Dinitro-o-cresol	534-52-1	8040	150	8270	50			
2,4-Dinitrophenol	51-25-5	8040	150	8270	50	60	1600	
2,4-Dinitrotoluene	121-14-2	8090	0.2	8270	10	10	330	
2,6-Dinitrotoluene	806-20-2	8090	0.1	8270	10	10	330	
Di-n-octyl phthalate	117-84-0	8060	30	8270	10	10	330	
Diphenylamine	122-38-4	8270	10			10	330	
Ethyl methacrylate	87-63-2	8015	10	8240	5	8270	10	
Ethyl methanesulfonate	62-50-0	8270	10			10	330	
Fluoranthene	209-44-0	8100	200	8270	10	10	330	
Fluorene	88-79-7	8100	200	8270	10	10	330	
Hexachlorobenzene	118-74-1	8120	0.5	8270	10	10	330	
Hexachlorobutadiene	87-68-3	8120	6	8270	10	10	330	
Hexachlorocyclopentadiene	77-47-4	8120	5	8270	10	10	330	
Hexachloroethane	87-72-1	8120	0.5	8270	10	10	330	
Hexachlorophene	70-30-4	8270	10			50	1650	
Hexachloropropene	1888-71-7	8270	10			50	1650	
Indeno[1,2,3-cd]pyrene	183-39-5	8100	200	8270	10	10	330	
Isochlorone	78-59-1	8090	80	8270	10	10	330	
Isoeetrole	120-58-1	8270	10			50	1650	
Methapyrene	91-80-5	8270	10			50	1650	
Methylchloranthrene	56-49-5	8270	10					
Methyl methanesulfonate	68-27-3	8270	10					
2-Methylnaphthalene	91-57-9	8270	10			10	330	
Naphthalene	91-20-3	8100	200	8270	10	10	330	
1,4-Naphthoquinone	130-15-4	8270	10			50	1650	
1-Naphthylamine	134-32-7	8270	10			50	1650	
2-Naphthylamine	91-59-8	8270	10			50	1650	
o-Nitroaniline	88-74-4	8270	50					
m-Nitroaniline	99-09-2	8270	50					
p-Nitroaniline	100-01-6	8270	50					
Nitrobenzene	98-06-3	8090	40	8270	10	10	330	
o-Nitrophenol	88-75-5	8040	5	8270	10	10	330	
p-Nitrophenol	100-02-7	8040	10	8270	50			
4-Nitroquinoline 1-oxide	56-67-5	8270	10					
N-Nitrosodi-n-butylamine	924-16-3	8270	10			10	330	
N-Nitrosodiallylamine	55-18-5	8270	10			10	330	

TABLE 3-23: APPENDIX IX - GROUND WATER MONITORING LIST (SEMI-VOLATILES)

COMMON NAME	CAS RN	METHOD 1		METHOD 2		METHOD 3		METHOD 4		REP. LIMIT WATER	REP. LIMIT SOIL
		POL (ug/L)	ug/L	ug/Kg							
N-Nitrosodimethylamine	62-76-9	8270	10							10	330
N-Nitrosodiphenylamine	88-30-6	8270	10							10	330
N-Nitrosodipropylamine; Di-n-propylnitrosamine	621-64-7	8270	10								
N-Nitrosomethylmethanamine	10595-95-8	8270	10								
N-Nitrosomorpholine	59-89-2	8270	10								
N-Nitrosopiperidine	100-75-4	8270	10								
N-Nitrosopyrrolidine	930-55-2	8270	10								
6-Nitro-o-toluidine	98-55-8	8270	10								
Pentachlorobenzene	608-93-5	8270	10								
Pentachloronitrobenzene	92-08-8	8270	10								
Pentachlorophenol	87-88-5	8040	5	8270	50					50	1650
Phenacetin	62-44-2	8270	10							10	330
Phenanthrene	85-01-8	8100	200	8270	10					10	330
Phenol	108-95-2	8040	1	8270	10					10	330
p-Phenylenediamine	106-50-3	8270	10								
2-Picoline	109-06-8	8240	5	8270	10					50	1650
Pronamide	23950-58-5	8270	10							10	330
Pyrene	129-00-0	8100	200	8270	10					10	330
Pyridine	110-86-1	8240	5	8270	10					50	1650
Saltrols	94-58-7	8270	10							60	1650
2,3,4,6-Tetrachlorophenol	58-90-2	8270	10							10	330
o-Toluidine	98-53-4	8270	10							10	330
1,2,4-Trichlorobenzene	120-82-1	8270	10							10	330
2,4,6-Trichlorophenol	98-98-4	8270	10							60	1650
2,4,6-Trichlorophenol	88-06-2	8040	5	8270	10					10	330
sym-Trinitrobenzene	99-35-4	8270	10								

TABLE 3-24: APPENDIX IX - GROUND WATER MONITORING LIST (PESTICIDES)

COMMON NAME	CAS RN	METHOD 1	POL(ug/L)	METHOD 2	POL(ug/L)	REP. LIMIT	REP. LIMIT
						WATER	SOIL
						ug/L	ug/Kg
Aldrin	308-00-2	8080	0.05	8270	10	0.01	0.4
alpha-BHC	319-84-6	8080	0.05	8250	10	0.01	0.4
beta-BHC	319-85-7	8080	0.05	8250	40	0.02	0.8
delta-BHC	319-86-8	8080	0.1	8250	30	0.01	0.4
gamma-BHC; Lindane	58-89-9	8080	0.05	8250	10	0.01	0.4
Chlordane	57-74-9	8080	0.1	8250	10	0.1	4
Chlorobenzilate	510-15-6	8270	10			1.0	40
2,4-D; 2,4-Dichlorophenoxyacetic acid	94-75-7	8150	10			2.5	50
4,4'-DDD	72-64-8	8080	0.1	8270	10	0.02	0.8
4,4'-DDE	72-55-9	8080	0.05	8270	10	0.02	0.8
4,4'-DDT	50-28-3	8080	0.1	8270	10	0.02	0.8
Dieldrin	2303-16-4	8270	10			1.0	40
Dinoseb; DNBP; 2-sec-Butyl-4,6-dinitrophenol	60-57-1	8080	0.05	8270	10	0.02	0.8
Endosulfan I	88-85-7	8150	1	8270	10	2.5	
Endosulfan II	859-98-8	8080	0.1	8250	10	0.02	0.8
Endosulfan sulfate	33213-05-9	8080	0.05			0.02	0.8
Endrin	1031-07-8	8080	0.5	8270	10	0.02	0.8
Endrin aldehyde	72-20-8	8250	10			0.02	0.8
Heptachlor	7421-63-4	8270	10			0.02	0.8
Heptachlor epoxide	76-44-8	8080	0.05	8270	10	0.01	0.4
Isoflorin	1024-57-3	8080	1	8270	10	0.01	0.4
Kepone	465-73-6	8270	10			0.03	1.2
Methoxychlor	143-50-0	8270	10			0.20	8
Polychlorinated biphenyls; PCBs	72-43-5	8080	2	8270	10	0.04	1.6
Silvex; 2,4,5-TP	See Note 7	8080	50	8250	100		
2,4,5-T; 2,4,5-Trichlorophenoxyacetic acid	83-72-1	8150	2			0.5	10
Toxaphene	93-76-5	8150	2			0.5	20
O,O-Diethyl O-2-pyrazinyl phosphorothioate; Thionazin	8001-35-2	8080	2	8250	10	0.5	50
Dimethoate	287-87-2	8270	10			1.0	50
Disulfoton	60-51-5	8270	10			5.0	50
Famphur	288-04-4	8140	2	8270	10	1.0	50
Methyl parathion; Parathion methyl	52-85-7	8270	10			1.0	50
Parathion	268-00-0	8140	0.5	8270	10	1.0	50
Phorate	56-38-2	8270	10			1.0	50
Tetraethyl dithiopyrophosphate; Sulfotopp	288-02-2	8140	2	8270	10	1.0	50
O,O,O-Triethyl phosphorothioate	3689-24-5	8270	10			1.0	50
	126-68-1	8270	10				

PQL: Practical Quantitation Limits

TABLE 3-26. APPENDIX IX - GROUND WATER MONITORING LIST (INORGANICS)

COMMON NAME	CAS RN	CHEMICAL ABSTRACTS SERVICE INDEX NAME	METHOD 1			METHOD 2			METHOD 3			REP. LIMITS WATER	REP. LIMITS SOIL
			POL (ug/L)	ug/L	mg/kg								
Antimony	(Total)	Antimony	6010	300	7040	2000	7041	30	60	12			
Arsenic	(Total)	Arsenic	6010	500	7060	10	7061	20	10	2			
Barium	(Total)	Barium	6010	20	7080	1000		200	200	40			
Beryllium	(Total)	Beryllium	6010	3	7080	50	7081	2	5	1.0			
Cadmium	(Total)	Cadmium	6010	40	7130	50	7131	1	5	1.0			
Chromium	(Total)	Chromium	6010	70	7190	500	7191	10	10	2.0			
Cobalt	(Total)	Cobalt	6010	70	7200	500	7201	10	50	10			
Copper	(Total)	Copper	6010	50	7210	200		25	25	5.0			
Cyanide	67-12-5	Cyanide	9010	40				5	5	0.5			
Lead	(Total)	Lead	6010	40	7420	1000	7421	10	3	0.5			
Mercury	(Total)	Mercury	7470	2					0.2	0.1			
Nickel	(Total)	Nickel	6010	50	7520	400			40	5.0			
Selenium	(Total)	Selenium	6010	750	7740	20	7741	20	5	1.0			
Silver	(Total)	Silver	6010	70	7780	100			10	2.0			
Sulfide	18498-25-8	Sulfide	6030	10000					100	4			
Thallium	(Total)	Thallium	6010	400	7840	1000	7841	10	10	2.0			
Tin	(Total)	Tin	7870	8000					500	100			
Vanadium	(Total)	Vanadium	6010	80	7910	2000	7911	40	50	10			
Zinc	(Total)	Zinc	6010	20	7950	50			20	4.0			

PQL: Practical Quantitation Limits

TABLE 3-26. GENERAL WATER QUALITY PARAMETERS.	
ANALYSIS	USEPA METHOD
Color	110.2
Hardness (as CaCO ₃)	130.2
pH (as s.u.)	150.1
TDS	160.1
Calcium (as Ca)	215.1
Copper (as Cu)	220.2
Iron (as Fe)	236.2
Magnesium (as Mg)	242.1
Manganese (as Mn)	243.2
Sodium (as Na)	273.1
Zinc (as Zn)	289.2
Alkalinity (as CaCO ₃)	310.1
Chloride (as Cl)	325.3
Nitrogen, Ammonia	350.1
Nitrogen, Kjeldahl	351.2
Sulfate (as SO ₄)	375.4
Sulfide, Hydrogen	376.1
Oil & Grease	413.1
Total Organic Carbon	415.1

Note: s.u. - Standard Units; TDS - Total Dissolved Solids.

INTERIM FINAL

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INTERIM FINAL

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APPENDIX A

COMPREHENSIVE QUALITY ASSURANCE PROJECT PLAN

1.0

QUALITY ASSURANCE PROGRAM PLAN
UNITED STATES DEPARTMENT OF THE NAVY
INSTALLATION RESTORATION PROGRAM

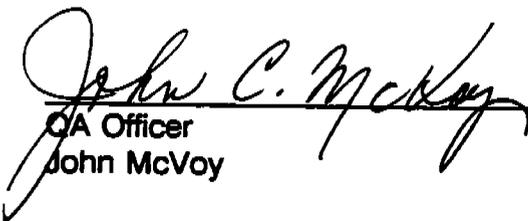
APPROVED FOR:

ABB ENVIRONMENTAL SERVICES INC.



Program Manager

10/8/91
Date



QA Officer
John McVoy

10/8/91
Date



Task Order Manager

10-8-91
Date

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3.0 PROGRAM DESCRIPTION

3.1 PURPOSE

The purpose of this generalized Quality Assurance Program Plan (QAPP) is to indicate prime responsibilities and prescribe requirements for assuring that the specific site investigations undertaken by ABB Environmental Services Inc. (ABB-ES) for the Installation Restoration Program (IRP) are planned and executed in a manner consistent with quality assurance objectives. This QAPP provides guidance and specifications to assure that:

- o field determinations and analytical results are valid through preventive maintenance, calibration and analytical protocols;
- o samples are identified and controlled through sample tracking systems and chain-of-custody (COC) protocols;
- o records are retained as documentary evidence of the quality of samples, applied processes, equipment, and results;
- o generated data are validated and their use in calculations is documented;
- o calculations and evaluations are accurate, appropriate and consistent throughout the projects; and
- o safety is maintained by requiring inclusion of the Health and Safety staff function in the project organization.

3.2 SCOPE

The requirements of this QAPP apply to all ABB-ES and subcontractor activities as appropriate for each specific project undertaken.

The prime responsibilities indicated in Section 4.0 extend to all quality-related controls and activities. The quality control (QC) and quality assurance (QA) elements described in each section are aimed at preventing isolated sub-standard or erroneous actions from occurring in essential areas.

The content and format of the QAPP is based on "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans - QAMS-005/80" prepared by U.S. Environmental Protection Agency's (USEPA) Office of Research and Development.

This QAPP establishes, among other things, the procedures to be followed for conducting site investigations. Since each site investigation will require data gathering efforts and likely will require field measurements, an addendum to this QAPP will be prepared for each phase of the site investigation. The site-specific QAPP addendum will be included for each phase of the Work Plan.

3.3 PROGRAM SUMMARY

The Department of Defense (DOD) has initiated the Installation Restoration Program (IRP) as a component of compliance with the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) as modified by the Superfund Amendments and Reauthorization Act (SARA). The IRP will be performed in accordance with USN management guidance and in compliance with the requirements of the National Contingency Plan (NCP), the Resource Conservation and Recovery Act (RCRA) and other applicable or appropriate and relevant requirements. The IRP was established by the DOD to identify the locations and contents of past disposal sites at their installations and to eliminate the hazards to public health (both real and potential) in an environmentally responsible manner. The IRP is implemented in the following four phases.

Phase I - Records Search. Phase I consists of an installation-wide records search and personnel interviews to collect and evaluate evidence regarding the potential for contamination at the installation.

Phase II - Confirmation/Quantification. Phase II consists of on-site investigations, including physical and chemical analyses to ascertain and quantify the existence and extent of contamination, and to identify necessary corrective measures if contamination is present. Phase II may consist of one or more stages of investigation to gather data necessary for either eliminating the site from the IRP or implementing Phase IV.

Phase III - Technical Development. Phase III consists of the implementation of research requirements and the development of technology for objective assessment of environmental effects. A Phase III requirement can be identified at any time during the program.

Phase IV - Remedial Actions. The objective of Phase IV is to select and implement control measures that will comply with DOD, USN, USEPA, and state regulatory agency policies regarding past hazardous waste disposal sites. This is usually accomplished in two steps: Phase IV-A, design of remedial actions; and Phase IV-B, implementation of remedial actions.

To facilitate the conduct of the IRP program under the guidelines of the SARA of 1986 and Executive Order 12580, the Phase II/IV-A program will generally be conducted as a Remedial Investigation/Feasibility Study (RI/FS). Phase II activities will generally be referred to as the Remedial Investigation (RI). Remedial Action Planning (Phase IV-A) will generally be referred to as the Feasibility Study (FS).

3.4 MAJOR TASK SUMMARY

The IRP activities to be undertaken at DOD sites by ABB-ES will consist of scientific and engineering investigations and studies which include multiple tasks and subtasks within each Phase. Each task will be described in the site-specific Work Plan.

3.4.1 Sampling and Analytical Program

Field activities associated with the site investigations will include geophysical explorations and sampling of soil, sediment, surface water, groundwater and air, as appropriate for each site. The specific sampling plan for each site will be described in the task Work Plan and QAPP addendum.

The analytical program is described in Section 9. Analyses will be performed by two laboratories. One laboratory will analyze duplicate samples to provide an external measure of analytical quality. Methodologies may include those utilized by USEPA under the Safe Drinking Water Act (SDWA), CERCLA, SARA, RCRA, and the Clean Water Act (CWA).

3.4.2 Deliverables

Technical progress and financial management reports will be submitted each month. Major reports will be submitted at the completion of each phase. Additional outputs include this QAPP, Work Plans, the site-specific QA addenda, and site-specific Health and Safety Plans (HASP). A specific list of deliverables is to be included in each Work Plan.

3.4.3 Schedule

The Work Plans will include a schedule of activities for each site.

4.0 PROGRAM ORGANIZATION AND RESPONSIBILITIES

4.1 ORGANIZATION

ABB-ES operates under a matrix system in which personnel belong to functional departments and, at the same time, are assigned to projects. Functional departments are responsible for developing and maintaining ABB-ES's engineering and scientific disciplines. They provide for personnel training and the establishment of engineering and scientific standards. Each project's organization is responsible for achieving project objectives, complying with program guidelines and achieving project objectives.

This portion of the QAPP addresses the program organization. Those who are assigned to a project within the program organization are responsible for properly utilizing functional organization resources. In this way, the entire resources of ABB-ES are made available to each project, but responsibility for initiating services and for ensuring acceptable results remains within the program organization. This responsibility carries with it the authority to initiate, modify, and, if necessary, stop activities, as appropriate for the assurance of project quality. It is the Quality Assurance Coordinator's (QAC) role to assist the Task Order Managers (TOM) in meeting project goals while providing an independent evaluation of product quality.

4.2 SPECIFIC RESPONSIBILITIES

Figure 4-1 shows a typical program organization and its principal lines of communication. The responsibilities of the ABB-ES program positions and support organizations are summarized below.

Corporate Officer. The Corporate Officer (CO) is Mr. Raymond A. Allen, III, CPSS. He is responsible for committing the corporate resources necessary to conduct the program work activities; for supplying corporate-level input for problem resolution; and for assisting the Program Manager and Task Order Manager as needed during project implementation.

Program Manager. The Program Manager (PM), to be determined, is responsible for the overall SOUTHNAVFACENCOM program. Some specific responsibilities of her role include:

- oversee and manage the overall multi-installation Comprehensive Long-term Environmental Action, Navy (CLEAN) Program,
- identify overall program needs and facilitate meeting those needs;
- direct resources as appropriate for effective and timely completion of program activities;
- ensure overall program quality assurance,

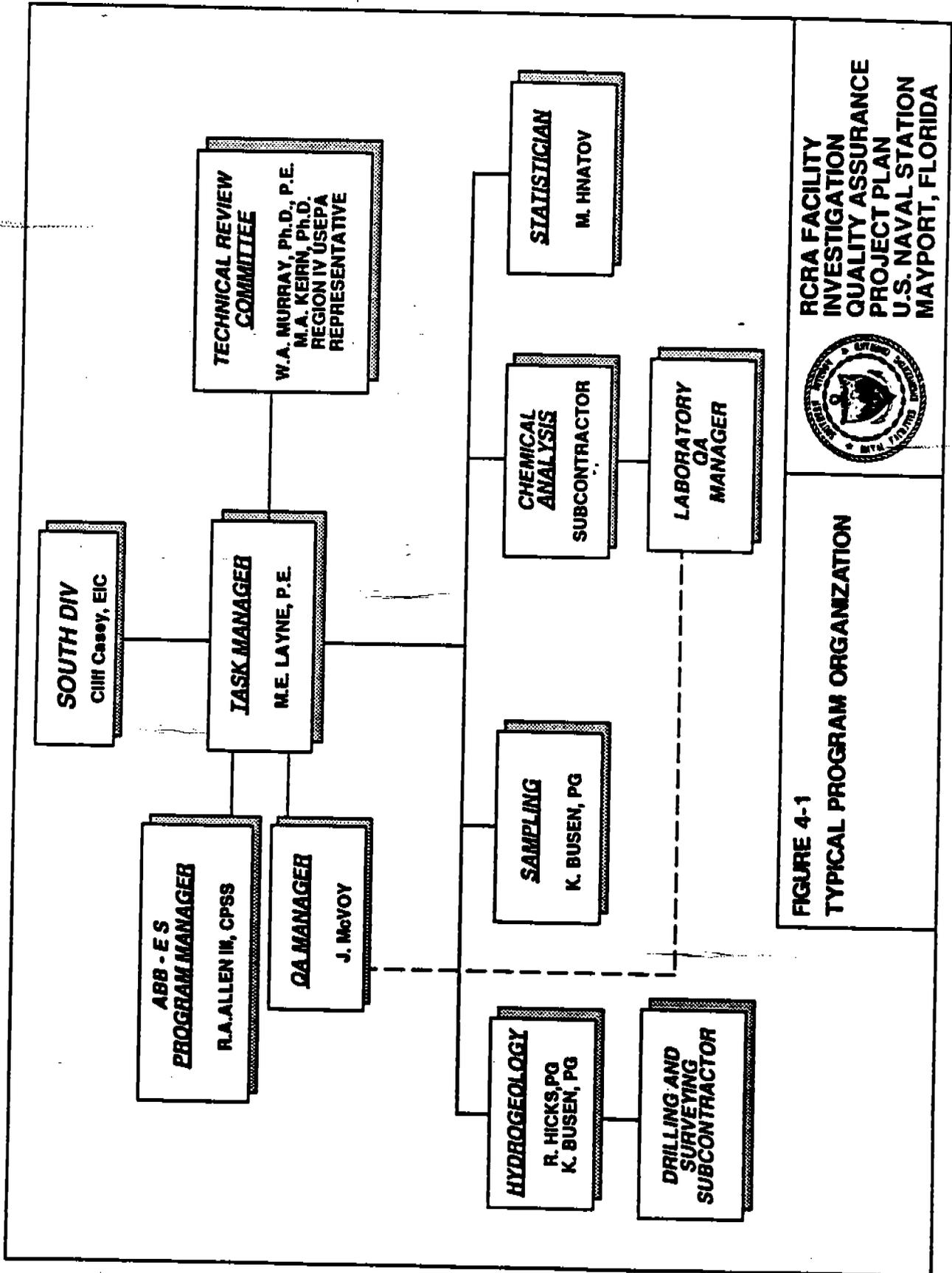


FIGURE 4-1
TYPICAL PROGRAM ORGANIZATION



**RCRA FACILITY
INVESTIGATION
QUALITY ASSURANCE
PROJECT PLAN
U.S. NAVAL STATION
MAYPORT, FLORIDA**

- promote technical and programmatical information transfer, and
- establish contracts and negotiate amendments.

Task Order Manager. Mr. Philip Geogariou will hold the position of the Task Order Manager (TOM). In this role he is responsible for the management of scope, schedule, and budget for the NAVSTA Mayport project. Some specific responsibilities of his role include:

- assuming overall project management responsibility for the project to the Navy,
- establishing and overseeing all subcontracts for support services,
- initiating project activities,
- implementing the subcontracting plan to significantly involve small and disadvantaged business in the program,
- participating in the Workplan preparation and staff assignments,
- identifying and fulfilling equipment and other resource requirements,
- monitoring task activities to ensure compliance with established budgets, schedules, and the scope of work,
- regularly interacting with the SOUTHNAVFACENCOM Engineer-in-Charge (EIC), the Installation's Commanding Officer, and others, as appropriate, on the status of the project,
- preparing monthly technical, management and cost progress reports, and
- ensuring that appropriate financial record and reporting requirements are met.

RFI Task Leader. Mr. Gregory M. Brown, P.E. will hold the position of RFI Task Leader. Mr. Brown will be responsible for the technical effectiveness of field investigations, data analysis, and investigation conclusions and recommendations. He will assist the TOM to assure adequate technical resources are applied to the project in order to achieve the RFI goal and objectives. He will also assist the TOM in the efficient allocation of these resources over the life-cycle of the project.

Contracts Administrator. Ms. Laurie Huffman will hold the position of Contracts Administrator for the NAVSTA Mayport RFI project. This position is established to assist the TOM with the important tasks of day-to-day scope, schedule and budget monitoring both within ABB-ES and between ABB-ES and the U.S. Navy's EIC. It is expected that project decisions will be occurring frequently; therefore,

it is necessary to anticipate and immediately implement the administrative actions (initiate internal work orders, follow-up on support needs, amend subcontracts, track cost-charges, etc.) to carry out the program plans.

Technical Review Board. A Technical Review Board (TRB), made up of senior technical staff from the ABB-ES team, will assist the TOM by providing review of the technical aspects of the project to assure that the services reflect the accumulated experience of the firm; that they are produced in accordance with the corporate policy; and that they meet the intended needs of SOUTHNAVFACENGCOM's EIC. The primary function of this board is to assure the application of technically sound methodologies and the development of defensible data, interpretations, and conclusions. Members of the TRB are Ms. Peggy Layne, P.E. and Mr. Ken Busen, P.G.

Quality Assurance and Health and Safety Coordinators. The TOM is supported by a Quality Assurance Officer (QAO) and a Health and Safety Officer (HSO). The QAO will assure that appropriate Navy and USEPA protocols are followed and will be responsible for the development of the Site-Specific QAPP (Appendix B). The QAO will work with the TOM to ensure that established quality control procedures are implemented. The HSO is responsible for ensuring that the project team complies with the Health and Safety Program. He/she is also responsible for seeing that a Health and Safety Plan is developed for each site activity.

Other key line positions are the technical activity leaders, i.e., the senior or most-experienced individual in each technical area of the project. These technical activity leaders are identified on the Project Organization Chart.

The following is a list of key project staff. Revisions and identification of additional personnel may be made prior to the initiation of RFI activities. A list of emergency numbers is also contained in the HASP.

ABB Environmental Services

Raymond A. Allen, III, Corporate Officer
To be determined, Program Manager
Philip Geogariou, Project Manager
Gregory Brown, P.E., RFI Task Leader
Jack Davis, HSO
John McVoy, QAO
Michael Keirn, Ph.D., Health and Environmental Assessment

SOUTHNAVFACENGCOM

Jim Reed, Engineer-in-Charge

NAVSTA Mayport

Mike Davenport, Environmental Coordinator

Technical Staff and Field Personnel. Qualified technical staff and field personnel from ABB-ES or their subcontractors will accomplish specific tasks such as well installation, sample collection, subcontractor oversight, data analysis, and report preparation. Oversight of staff activities will be accomplished by the management team described above. Specific roles and responsibilities for

staff members are described in Section 3.1.2, Field Personnel Responsibilities.

2.3 SCHEDULE. Implementation of RFI activities will be accomplished in a phased-approach due to the number of SWMUs and the diversity of their past and/or present operations. The assumptions, tasks, sequences, and durations are described in the Correction Action Management Plan (CAMP) located in Appendix F, of Volume I. The project schedule as summarized in the Corrective Action Management Plan (CAMP), shows the tasks and activities for the NAVSTA Mayport RFI. This schedule will begin upon the approval of the Workplan and the Notice to Proceed. The schedule assumes ready access to the sites. The schedule also assumes there will be no delays due to the securing of required permits. The schedule may also be modified by the nature and extent of regulatory review cycles and new data collected during the RFI.

5.0 QUALITY ASSURANCE OBJECTIVES

5.1 GENERAL

The quality of measurements made during this study will be determined by the following characteristics: accuracy; precision; representativeness; completeness; and comparability. Specific objectives for each characteristic are established to develop sampling protocols, and identify applicable documentation, sample handling procedures and measurement system procedures. These objectives are established based on site conditions, objective of the project, and knowledge of available measurement systems. The subsequent use of these measurements in calculations and evaluations is also subjected to aspects of this QAPP as described in the following sections.

5.2 REPRESENTATIVENESS

Measurements will be made so that results are as representative of the media (e.g., air, soil, water) and conditions being measured, as possible. Sampling protocols will be developed to assure that samples collected are representative of the media. Sample handling protocols (e.g., storage, transportation) are selected to protect the representativeness of the collected sample. Proper documentation will establish that protocols have been followed and sample identification and integrity assured.

Sample collection and field handling will be in accordance with the standard procedures contained in this QAPP.

5.3 PRECISION AND ACCURACY

Precision, the ability to replicate a value, and accuracy, the ability to obtain a true value, are addressed for all data generated. Data quality objectives for precision and accuracy are established for each major parameter to be measured at the site. These objectives are based on prior knowledge of the capabilities of the measurement system to be employed, selected in accordance with the requirements of the project. The precision and accuracy requirements vary, depending on their intended use. For example, a screening tool to identify the general extent of chemical distribution will not require the same precision and accuracy required to define the exact nature and amount of chemicals present at specific locations. Section 9.2 contains information regarding analytical procedures.

Calculations performed with the data generated are also checked for accuracy by the TD or their designees, and precision, i.e. comparability of calculation efforts between tasks, is assured by the QA0.

5.4 COMPLETENESS

The characteristic of completeness is a measure of the amount of valid data obtained compared to the amount that was expected to be obtained under normal conditions. The amount of valid data expected is established based on the measurements required to accomplish project objectives. The number of ground-water, surface water, sediment, and air samples to be obtained is specified for each site in the QAPP Addendum. Because sampling and waste characterization activities often rely on a field protocol, the QAPP Addendum would provide an upper limit on the number of samples to be collected. For example, multiple depth soil sample collection may be specified, but rock outcroppings may be encountered prior to reaching the specified depth. In that case, it would not be possible to obtain a predetermined number of soil samples. The extent of completeness must therefore be reviewed on a relative basis for sample collection activities. Completeness of data handling systems is described in Sections 10.0, 12.0 and 14.0.

5.5 COMPARABILITY

The characteristic of comparability reflects both internal consistency of measurements made at the site and expression of results in units consistent with other organizations reporting similar data. Each value reported for a given measurement should be similar to other values within the same data set and within other related data sets. Comparability of data and measuring procedures must also be addressed. This characteristic implies operating within the calibrated range of an instrument and utilizing analytical methodologies which produce comparable results (e.g., data obtained for total recoverable phenolics via wet chemistry is not necessarily comparable to data obtained for phenol via Gas Chromatography/Mass Spectrometry (GC/MS)).

Measurements compared to similar measurements which appear as "outliers" will be reassessed. Units of measurement will be externally comparable by utilizing the appropriate standard units for each measurement system.

5.6 QUALITY ASSURANCE OBJECTIVES

For ABB-ES's efforts under the IRP, the quality assurance objectives are:

- o to collect sufficient background information and current chemical characterization data to assess each site and recommend action alternatives;
- o to collect sufficient field, sampler and trip blank samples and field duplicates to allow an assessment of sample representativeness and sample collection protocol precision;

- o to analyze sufficient internal duplicates, blanks, reference standards and matrix spike samples to allow an assessment of analytical precision and accuracy. Sufficiency of analytical QC procedures is specified by the referenced methods (see Section 9.2); and
- o to produce documented, consistent and technically defensible reports.

6.0 SAMPLING PROCEDURES

6.1 GENERAL

The quality of sample collection techniques is assured by keying the technique used to both the media/matrix to be sampled and the analytes of interest. For example, samples intended for semi-volatile organic analyte (SVOA) analyses are collected in glass bottles; samples for volatile organic analyte (VOA) analyses are collected in Teflon-septum-capped glass vials with "zero" headspace to minimize diffusive and evaporative losses; and most samples for inorganic analyses are collected in linear polyethylene bottles. Sample containers provided by ABB-ES are prepared in a manner consistent with USEPA protocol, as noted in the following section.

Acquisition of environmental samples also requires specialized collection techniques to preserve their integrity and ensure that a representative portion of the source is collected. Media-specific sample collection techniques are specified in the following sections.

Further, unless the proper sample bottle preparation and sample preservation measures are taken in the field, sample composition can be altered by contamination, degradation, biological transformation, chemical interactions, and other factors during the time between sample collection and analysis. Typical sample bottle preparation protocols are presented in Section 6.2. Steps taken to maintain the in-situ characteristics required for analysis may include refrigeration of samples at 4°C, freezing, pH adjustment, and chemical fixation. Samples are preserved according to the protocol established for the specific analytical method selected to obtain the desired data. Tables 6-1 and 6-2 provide more specific information.

Sample Labels and Records

Sample labels will be prepared prior to initiation of work, generally using the computerized label system. Sample labels will include a blank space for the name of the sampler. Each sample will require several containers dependent on the intended analysis to be performed. The pH and specific conductance of each aqueous sample will be determined in the field. At the time the sample is obtained, a sample record will be completed. In addition to the sample record, documentation will include:

- o a plan of the site;
- o sample label numbers;
- o a description of the sample site;
- o other physical descriptors of the sample site (e.g., stream width, groundwater depth, etc.);

TABLE 6-1
SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS
CERCLA/RCRA SAMPLES

	Concentration	Container	Sample Size	Preservation	Holding Time
<u>WATER</u>					
Organics GC & GC/MS	VOA	glass	2 x 40 ml	Cool to 4°C	7 days
	<u>Extractables</u>				
	Low	amber glass	2 x 80 oz. or 4 x 1 l	Cool to 4°C	5 days to extraction
	Medium	wide-mouth glass	4 x 32 oz.	None	40 days after extraction Same as above
Inorganics	<u>Metals</u>				
	Low	polyethylene	1 l	HNO ₃ to pH <2	6 months (Hg-28 days)
	Medium	wide-mouth glass	16 oz.	None	6 months
	<u>Cyanide</u>				
	Low	polyethylene	1 l	NaOH to pH >12	14 days
	Medium	wide-mouth glass	16 oz.	Cool to 4°C	
Organic/Inorganic	High Hazard	8-oz. wide-mouth glass	6 oz.	None	14 days
COD	--	polyethylene	0.5 l	H ₂ SO ₄ to pH <2	28 days
TOC	--	polyethylene	0.5 l	HCl to pH <2	28 days
Oil & Grease	--	glass	1.0 l	H ₂ SO ₄ to pH <2	28 days
Phenols	--	glass	1.0 l	H ₂ SO ₄ to pH <2	28 days
General Chemistry	--	polyethylene	1.0 l	H ₂ SO ₄ to pH <2 None	28 days --
<u>SOIL</u>					
Organics GC & GC/MS	VOA	2 oz. wide-mouth glass	2 oz.	Cool to 4°C	10 days
	<u>Extractables</u>				
	Low/Medium	4 oz. wide-mouth glass	4 oz.	Cool to 4°C	10 days to extraction 40 days after extraction
Inorganics	Low/Medium	4 oz. wide-mouth glass	4 oz.	Cool to 4°C	NA
Organic/Inorganic	High Hazard	8 oz. wide-mouth glass	6 oz.	None	NA
Dioxin	All	4 oz. wide-mouth glass	4 oz.	None	NA
EP Toxicity	All	250 ml polyethylene	200 grams	None	NA
<u>AIR</u>					
Volatile Organics	Low Medium	Charcoal or Tenax Tube 7 cm long, 6mm OD, 4mm ID	100 l air	Cool to 4°C	NA

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 SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS
 CMA SAMPLES

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Parameter Name	Container ¹	Type	Size	Preservation ²	Maximum Holding Time ³
Bacterial Tests					
Coliform, fecal and total	P, G	P, G	250 ml	Cool, 4°C, 0.008% H ₂ S ₂ O ₃	6 hours
Fecal streptococci	P, G	P, G	250 ml	Same as above	6 hours
Inorganic Tests					
Acidity	P, G	P, G	100 ml	Cool, 4°C	14 days
Alkalinity	P, G	P, G	100 ml	Cool, 4°C	14 days
Ammonia	P, G	P, G	1000 ml	Cool, 4°C, H ₂ SO ₄ to pH <2	28 days
Biochemical oxygen demand	P, G	P, G	200 ml	Cool, 4°C	48 hours
Bromide	P, G	P, G	100 ml	None required	28 days
Biochemical oxygen demand, carbonaceous	P, G	P, G	100 ml	Cool, 4°C	48 hours
Chemical oxygen demand	P, G	P, G	100 ml	Cool, 4°C, H ₂ SO ₄ to pH <2	28 days
Chloride	P, G	P, G	100 ml	None required	28 days
Chlorine, total residual	P, G	P, G	in field	None required	Analyze immediately
Color	P, G	P, G	50 ml	Cool, 4°C	48 hours
Cyanide, total and amenable to chlorination	P, G	P, G	1 l	Cool, 4°C, NaOH to pH >12, 0.6g ascorbic acid	14 days
Fluoride	P	P	100 ml	None required	28 days
Hardness	P, G	P, G	100 ml	HNO ₃ to pH <2, H ₂ SO ₄ to pH <2	6 months
Hydrogen ion (pH)	P, G	P, G	25 ml	None required	Analyze immediately
Kjeldahl and organic nitrogen	P, G	P, G	1 l	Cool, 4°C, H ₂ SO ₄ to pH <2	28 days
Metals					
Chromium VI	P, G	P, G	100 ml	Cool, 4°C	24 hours
Mercury	P, G	P, G	150 ml	HNO ₃ to pH <2	28 days
Metals, except chromium VI and mercury	P, G	P, G	1-5 parameters-100ml 6-10 parameters-125ml >10 parameters-150ml	Same as above	6 months
Nonconventional Pollutants					
Nitrate	P, G	P, G	100 ml	Cool, 4°C	48 hours
Nitrate-nitrite	P, G	P, G	50 ml	Cool, 4°C, H ₂ SO ₄ to pH <2	28 days
Nitrite	P, G	P, G	100 ml	Cool, 4°C	48 hours
Oil and grease	G	G	1 l	Cool, 4°C, H ₂ SO ₄ to pH <2	28 days
Organic carbon	P, G	P, G	10 ml	Cool, 4°C, H ₂ SO ₄ to pH <2	28 days
Orthophosphate	P, G	P, G	50 ml	Cool, 4°C, HCl or H ₂ SO ₄ to pH <2	28 days
Oxygen, dissolved probe	G	G	in field	Filter immediately, cool, 4°C	48 hours
Winkler	G	G	200 ml	None required	Analyze immediately
Phenols	G	G	1 l	Fix on site and store in dark	8 hours
Phosphorus (elemental)	G	G	100 ml	Cool, 4°C, H ₂ SO ₄ to pH <2	28 days
Phosphorus, total	P, G	P, G	150 ml	Cool, 4°C	48 hours
Residue, total	P, G	P, G	200 ml	Cool, 4°C, H ₂ SO ₄ to pH <2	28 days
Residue, filterable	P, G	P, G	200 ml	Cool, 4°C	7 days
Residue, nonfilterable (TSS)	P, G	P, G	200 ml	Cool, 4°C	48 hours
Residue, settleable	P, G	P, G	200 ml	Cool, 4°C	7 days
Residue, volatile	P, G	P, G	1 l	Cool, 4°C	48 hours
Silica	P	P	200 ml	Cool, 4°C	7 days
			see metals		28 days

TABLE
SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS
CWA SAMPLES

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Parameter Name	Container ¹	Size	Type	Preservation ²	Maximum Holding Time ³
Specific conductance	P, G	25 ml		Cool, 4°C	28 days
Sulfate	P, G	250 ml		Cool, 4°C	28 days
Sulfide	P, G	200 ml		Cool, 4°C, add zinc acetate plus sodium hydroxide to pH > 9	7 days
Sulfite	P, G	100 ml		None required	Analyze immediately
Surfactants	P, G	400 ml		Cool, 4°C	48 hours
Temperature	P, G	in field		None required	Analyze
Turbidity	P, G	40 ml		Cool, 4°C	48 hours
<u>Organic Tests</u>					
Purgeable halocarbons	G, Teflon-lined septum	40 ml		Cool, 4°C, 0.008% Na ₂ S ₂ O ₄	14 days ⁵
Purgeable aromatic hydrocarbons	Same as above	40 ml		Cool, 4°C, 0.008% Na ₂ S ₂ O ₄ , HCl to pH 2	14 days ⁵
Acrolein and acrylonitrile	Same as above	40 ml		Cool, 4°C, 0.008% Na ₂ S ₂ O ₄ , Adjust pH to 4-5	14 days ⁵
Phenols	G, Teflon-lined cap	1 l		Cool, 4°C, 0.008% Na ₂ S ₂ O ₄	7 days until extraction, 40 days after extraction
Benzidines	Same as above	1 l		Same as above	7 days until extraction
Phthalate esters	Same as above	1 l		Cool, 4°C	7 days until extraction
Nitrosamines	Same as above	1 l		Cool, 4°C, store in dark,	40 days after extraction
PCBs, acrylonitrile	Same as above	1 l		0.008% Na ₂ S ₂ O ₄	Same as above
Nitroaromatics and isophorone	Same as above	1 l		Cool, 4°C	Same as above
Polynuclear aromatic hydrocarbons	Same as above	1 l		Cool, 4°C, 0.008% Na ₂ S ₂ O ₄ , store in dark	Same as above
Alloethers	Same as above	1 l		Same as above	Same as above
Chlorinated hydrocarbons	Same as above	1 l		Cool, 4°C, 0.008% Na ₂ S ₂ O ₄	Same as above
TCDB	Same as above	1 l		Cool, 4°C, 0.008% Na ₂ S ₂ O ₄	Same as above
Volatile Organics	G, Teflon-lined septum	40 ml		Cool, 4°C	14 days ⁵
Semi-Volatiles	G, Teflon-lined cap	1 l		Cool, 4°C	7 days until extraction, 40 days after extraction
<u>Pesticides Tests</u>					
Pesticides	Same as above	1 l		Cool, 4°C, pH 5-9	Same as above
<u>Radiological Tests</u>					
Alpha, beta and radium	P	1 l		INO ₃ to pH < 2	6 months

¹ Appropriate sample containers: P = polyethylene, G = glass.

² Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until composition and sample splitting is completed.

³ Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples (preserved, as required) may be held before analyses and still be considered valid. Some samples may not be stable for the maximum time period given in the table. A permittee or monitoring laboratory is obligated to hold the sample for a shorter time if knowledge exists to show that this is necessary to maintain sample stability.

⁴ Use Na₂S₂O₄ (sodium thiosulfate) only if chlorine is present.

⁵ 7 days if unpreserved.

- o photographs of the sample site may be taken showing the sampling equipment and/or unusual conditions (orientation of photograph must be shown on sketch map); and
- o chain-of-custody documentation (see Section 7).

Sample Shipment

Preparation of samples for shipment is performed in the following manner:

1. Label bottles with sample number and sample type (e.g. influent to treatment, effluent from treatment). Each sample set will have a unique sample number. Labels will be secured with tape.
2. Check Department of Transportation (DOT) regulations to insure that samples are packaged correctly for transportation. Should any problems or questions arise with preparation of samples for shipment, contact the task leader.
3. Package samples in the approved shipping container. Laboratory paperwork is to be included with the samples. Ensure samples are cooled to recommended temperature prior to sealing shipping container.
4. Ship samples immediately to the appropriate laboratory via an overnight carrier. Laboratory name and address should be clearly marked on the shipping container.
5. Inform the Laboratory Services Coordinator (LSC) that the samples have been shipped.

6.2 PREPARATION OF SAMPLE CONTAINERS

In order to maintain comparability with data to be generated through USEPA's National Contract Laboratory Program (CLP), ABB-ES has chosen to acquire precleaned sample containers through either I-CHEM RESEARCH INC., the supplier to USEPA-CLP, or through an approved laboratory which utilizes the same procedures. The procedures used by I-CHEM are detailed below.

6.2.1. Semivolatile Organic Analyte Containers (1-liter amber glass bottles and 4oz. clear glass jars)

1. Wash containers, closures, and teflon liners in hot tap water with laboratory grade non-phosphate detergent.
2. Rinse three times with tap water.
3. Rinse with 1:1 nitric acid.
4. Rinse three times with ASTM Type 1 deionized water.

5. Rinse with pesticide grade methylene chloride.
6. Oven dry.
7. Remove containers, closures, and teflon liners from oven.
8. Place teflon liners in closures and place closures on containers. Attendant to wear gloves and containers not to be removed from preparation room until sealed.

6.2.2 Elemental Parameter, Cyanide and Miscellaneous Parameter Containers (1-liter 500, 250, 125 and 60ml clear and 1-liter amber polyethylene bottles)

1. Wash bottles, closures, and teflon liners with hot tap water with laboratory grade non-phosphate detergent.
2. Rinse three times with tap water.
3. Rinse with 1:1 nitric acid.
4. Rinse three times with ASTM Type 1 deionized water.
5. Air dry in contaminant-free environment.
6. Place liners in closures and place closures on bottles. Attendant to wear gloves and bottles not to be removed from preparation room until sealed.

6.2.3 Volatile Organic Analyte Containers (40ml glass vials and 2-oz glass jars)

1. Wash vials, septa, and closures in hot tap water with laboratory grade non-phosphate detergent.
2. Rinse three times with tap water.
3. Rinse three times with ASTM Type 1 deionized water.
4. Oven dry vials, septa, and closures.
5. Remove vials, septa, and closures from oven.
6. Place septa in closures, teflon side down, and place on vials. Attendant to wear gloves and vials not to be removed from preparation room until sealed.

6.2.4 Preparation of Pump Tubing

Adequate lengths of 3/8 inch ID teflon tubing and 3/8 inch ID silicon tubing will be prepared by ABB-ES if pump tubing is specified for the sampling episode. The tubing preparation procedure is:

be prepared by ABB-ES if pump tubing is specified for the sampling episode. The tubing preparation procedure is:

1. Pump detergent solution through system for 2 minutes.
2. Pump clean hot water through system for 2 minutes or until clear, whichever is longer.
3. Pump blank water through system for 2 minutes.
4. Pump decontamination fluid specified in the site specific QAPP through system for 2 minutes.
5. Pump blank water through system for 2 minutes.
6. Seal tubing ends, wrap and label with date of cleaning.

6.2.5 Automatic Composite Sample Containers

The ABB-ES procedure for cleaning the 5-gallon, 3-gallon, or 2½-gallon glass bottles is:

1. Wash bottles and teflon-lined caps thoroughly with hot detergent water.
2. Rinse bottles and teflon-lined caps with hot tap water.
3. Rinse bottles and teflon-lined caps with blank water.
4. Allow bottles to completely dry.
5. In a well ventilated area (e.g., a laboratory hood), rinse the bottles with dichloromethane or acetone. Rinse the bottles making sure that every part of the bottle comes in contact with the dichloromethane or acetone. Three hundred ml can be used to clean up to 16 bottles at one cleaning.
6. Allow bottles to dry in a well-ventilated area for at least 24 hours.
7. Heat teflon-lined caps at 250°F for one hour or replace teflon-lined caps with new properly cleaned teflon.
8. After bottles have dried, cap the bottles using a pair of surgical gloves.

6.3 DECONTAMINATION PROCEDURES

Equipment to be decontaminated during the project may include: (1) drill rig; (2) tools; (3) monitoring equipment; (4) respirators; (5) sample containers; (6) truck or trailer and (7) laboratory equipment.

All decontamination will be done by personnel in protective gear appropriate for the level of decontamination, determined by the Site Safety Officer. The decontamination work tasks will be split or rotated among support and work crews. Decontamination procedures within the trailer (if used) should take place only after other personnel have cleared the "hot area", moved to the clean area and the door between the two closed.

Miscellaneous tools and samplers will be dropped into a plastic pail, tub or other container. They will be brushed off and rinsed (outside, if possible) and transferred into a second pail to be carried to further decontamination stations. They will be washed with non-phosphate a detergent solution rinsed with deionized water, rinsed with pesticide grade organic free water if available. Decontaminated sampling equipment will then be wrapped in aluminum foil (shiny sideout) and stored in an uncontaminated area.

6.3.1 Drilling Rig/Backhoe and Tools

It is anticipated that the drill rigs/backhoes will be contaminated during test pit/borehole activities. They will be cleaned with high pressure water or portable high pressure steam followed by soap and water wash and rinse. Other solvents may be used if necessary. Loose material will be removed by brush. The person performing this activity will usually be at Level D protection plus splash protection.

6.3.2 Sample Containers

Exterior surfaces of sample bottles will be decontaminated prior to packing for transportation to the analytical laboratory. Sample containers will be wiped clean at the sample site, but it will be difficult to keep the sample containers completely clean. The samples will be taken to the decontamination area. Here they will be further cleaned as necessary and transferred to a clean carrier and the sample identities noted and checked off against the chain-of-custody record. The samples, now in a clean carrier, will be stored in a secure area prior to shipment.

6.3.3 Monitoring Equipment

Monitoring equipment will be protected as much as possible from contamination by draping, masking or otherwise covering as much of the instruments as possible with plastic without hindering the operation of the unit. The HNU meter, for example, can be placed in a clear plastic bag which allows reading of the scale and operation of the knobs. The HNU sensor can be partially wrapped, keeping the sensor tip and discharge port clear.

The contaminated equipment will be taken from the drop area and the protective coverings removed and disposed of in the appropriate containers. Any direct or obvious contamination will be brushed or wiped with a disposable paper wipe. The units can then be taken inside in a clean plastic tub, wiped off with damp disposable wipes and dried. The units will be checked, standardized and recharged as necessary for the next day's operation. They will then be prepared with new protective coverings.

6.3.4 Respirators

Respirators will be decontaminated daily. Taken from the drop area, the masks will be disassembled, the cartridges set aside and the rest placed in a cleansing solution. (Parts will be precoded, e.g., #1 on all parts of mask #1.) After an appropriate time within the solution, the parts will be removed and rinsed off with tap water. The old cartridges will be marked so as to indicate length of usage (if means to evaluate the cartridges' remaining utility are available) or will be discarded into the contaminated trash container for disposal. In the morning the masks will be re-assembled and new cartridges installed if appropriate. Personnel will inspect their own masks to be sure of proper readjustment of straps for proper fit.

6.3.5 Decontamination Trailer or Truck and Staging Area

The decontamination trailer or truck, if used, will be cleaned daily. This will include vacuuming with a vacuum having a water filter to capture dust particles. The area will be wet mopped with cleanser and again with clean water. Work bench areas will be wiped down. Wash buckets and the cleaning area will be decontaminated and made ready for the next day's use.

6.3.6 Laboratory Equipment

Sample handling areas and equipment will be cleaned/wiped down daily. Disposable wipes will be used and discarded into a plastic bag. These will subsequently be taken to and placed in the disposal drum for final disposition. For final cleanup, all equipment will be disassembled and decontaminated. Any equipment which cannot be satisfactorily decontaminated will be disposed of (e.g., glassware, covers for surfaces) as previously indicated.

6.4 SAMPLING SITE LOCATION

The rationale for each sampling site location is identified in the site work plan. To permit proper evaluation of the sample analysis results it is important that the actual location of the samples be properly documented. If possible, sampling sites will be marked in the field with stakes or flagging. All sampling site locations will be accurately referenced on a base map. Photographs of sampling sites are taken as necessary to document site conditions.

6.5 AIR SAMPLING

Short-term sampling is most often utilized when real-time monitoring is desired. Equipment for real-time monitoring must be calibrated according to manufacturer's instructions prior to use. Typical equipment includes:

- o oxygen deficiency meter;
- o combustible gas monitor (explosimeter);

- o chemically reactive indicating tubes (e.g., Drager) for specific compounds (HCN, H₂S etc.);
- o photoionization (PI) survey meter (total volatile organics); and
- o organic vapor analyzer (OVA) (total or specific volatile organics).

All real-time monitoring results are recorded on the appropriate field data sheets (Figure 6-1).

6.6 SOIL SAMPLING

6.6.1 General

Soil sampling programs are undertaken to define the location, nature and concentration of contaminants in a site subsurface. The location and distribution of contaminants at a given site are governed by many factors, including:

- o site operation or waste disposal practices;
- o site design;
- o site closure;
- o waste characteristics;
- o site topography and surface drainage;
- o climate; and
- o site geology.

Development of a soil sampling plan that will effectively reveal the distribution and magnitude of contamination at a specific site requires at a minimum:

- o an assessment of the factors listed above;
- o evaluation of the methodology and results of any previous sampling and analysis programs which may have been completed at the site; and
- o definition of the scope and objectives of the project.

A number of techniques have been developed to obtain samples from various depths below the ground surface. The techniques described herein are those normally employed by ABB-ES. They have been selected to provide practical, efficient means of obtaining samples in a manner consistent with safety protocol and QA/QC requirements. Additionally, they employ equipment that is normally available for use.

Samples will be collected in the following order:

1. background,
2. volatile organic aromatics,
3. semivolatile organic aromatics,
4. pesticides/herbicides, and
5. metals.

AIR QUALITY MONITORING RECORD

SITE _____

SAMPLE STATION _____

DATE _____

ON-SITE TIME - START _____ END _____

INSTRUMENT _____

AMBIENT WEATHER DATA

TEMP. - °F _____

HUMIDITY _____

BAROMETRIC PRESSURE _____

CONDITIONS (i.e., FOG, RAIN) _____

WIND SPEED / DIRECTION _____

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE

NOTES _____

SIGNATURE

FIGURE 6-1
AIR QUALITY MONITORING RECORD



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 PROJECT PLAN
 U.S. NAVAL STATION
 MAYPORT, FLORIDA**

The selection of sampling techniques to be employed at a given site is based upon the depth from which samples must be obtained and the nature of the soils to be sampled. The sampling techniques are categorized by the depths at which each is applicable:

- o shallow samples are from depths of less than about 5 feet, usually less than 2 feet;
- o intermediate samples are from depths up to about 15 feet; and
- o deep samples are generally from depths greater than 15 feet.

Maintaining proper records is a significant aspect of sample taking. At the time samples are obtained, the following must be recorded by the sampler:

- o sample site location (e.g., grid coordinates baseline station and offset, or the location plotted on a map or aerial photograph);
- o sample type and depth;
- o date and time of sampling;
- o project and sample designations;
- o sampler identification; and
- o analyses requested.

Additionally, the sampler must initiate chain-of-custody (COC) procedures and describe the sample site in adequate detail to allow the analytical results to be properly interpreted and, if necessary, to allow collection of additional samples from the same sample site. ABB-ES uses preprinted labels, standardized record forms and photographs to expedite this process and ensure uniformity of records. The sampling protocols and recordkeeping requirements for the types of samples described in the following pages vary according to the sampling techniques. Additional requirements may also be established on a site-specific basis. The entire soil sampling process is designed and conducted in a manner that provides samples suitable for the intended analyses and that are properly documented.

6.6.2 Deep Samples

Objective

To obtain deep soil samples suitable for chemical analysis.

Approach

For soil sampling from depths greater than about 15 feet, borings are usually employed.¹ Borings are normally completed as either cased or augered holes.

Boring Methods

The boring methods employed at a given site are selected on the basis of the site's subsurface conditions. ABB-ES has prepared detailed drilling specifications that govern the drilling subcontractor's efforts. These specifications are modified on a site specific basis to reflect the needs of each project. Principal boring methods are described in the following section.

Cased Borings. Casing is used to support the boring as it is advanced. The casing is driven or drilled to the sample elevation and soil remaining in the interior of the casing is washed out with drilling fluid. Potable water or air is normally used to wash out the casing. The samples are retrieved from undisturbed soils below the bottom of the casing. The advantages of this drilling technique are:

- o relative simplicity of procedure;
- o relatively low risk of personnel exposure;
- o can be used to obtain soil samples from a wide range of subsurface conditions;
- o can be used to obtain samples from depths greater than 100 feet; and
- o good availability of equipment.

The disadvantages of cased borings arise from the need to use a drilling fluid. When sampling pervious soils, such fluids can permeate ahead of the casing. This can result in contamination of the underlying pervious soils if drilling fluids are recirculated. To prevent contamination, drilling fluids may be used only once. Further, the drilling fluids and cuttings removed from the hole may require collection, containerization, and transportation to a suitable disposal site. When drilling fluids are recirculated, as may be done when drilling through relatively low permeability soils, each borehole will generate relatively small quantities of spoils. However, when new fluid must be continually introduced into the hole, management of drilling fluids and spoils can result in significantly increased cost over auger borings. Management of drilling fluids is further complicated under freezing conditions.

¹Backhoes can excavate test pits considerably deeper than 15 feet, however, such deep pits are very difficult to sample at discrete depths. Further, deep test pits can pose significant safety risks. Thus, Jordan does not normally use such pits.

Auger Borings. With this technique, hollow stem augers are advanced into the soil. Drill cuttings are compressed laterally and carried upwards on the auger flights. The bottom of the auger is blocked with a plug while the auger is advanced. When the desired sampling depth is reached, the plug is withdrawn and a sample is obtained from below the bottom of the augers. The advantages of the hollow stem auger technique include:

- o relative simplicity of procedure;
- o relatively low risk of personnel exposure;
- o can be used to obtain soil samples from a wide range of subsurface conditions;
- o drilling fluids are generally not required; and
- o good availability of equipment.

The disadvantages of the hollow stem auger technique include:

- o difficulty in penetrating excessively cobbly or bouldery soils; and
- o difficulty in sampling granular soils below the water table since without drill fluids there is no practical means to maintain hydrostatic equilibrium in the borehole. When the plug is withdrawn, water and sediment from outside the augers may enter the borehole, potentially causing contamination and difficulty in sampling undisturbed soil below the bottom of the augers.

Other Methods. Other methods (casing advancer systems, cable tool, mud rotary, and bucket auger) are available. These methods, however, are either similar to those already discussed or not readily applicable to work at contaminated sites. They may, however, be considered for use on a site-specific basis.

Sampling of Test Borings

Types of Samplers. Test boring samples are normally taken from undisturbed soil below the depth of the casing or auger with either a thin wall tube or split spoon sampler.

Thin Wall Tube Sampler - Thin wall tube samplers are used in fine-grained or cohesive soils. Because the tube only causes minor disturbance of the soil being collected, the tubes are typically used to obtain soil specimens for geotechnical laboratory testing. The sampler is lowered to the bottom of the borehole and pushed into undisturbed soil. When the sampler is withdrawn, it contains a cylinder of soil. A thin wall tube consists of thin steel with a sharpened edge, usually about 30 inches long. Typical tubes range from about two inches to four inches in diameter. The tube is attached to a sampler head, containing a check valve which is in turn coupled to the drill rods. After the thin wall sampler has been withdrawn from the boring, it is removed from the drill rod and placed in a frame.

The tube is then taken to a laboratory and the cylinder of soil is forced from the tube with a hydraulic jack.

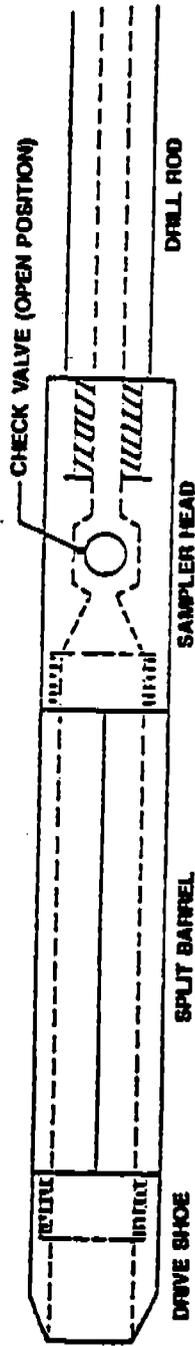
Split Spoon Sampler - A split spoon sampler may be used to sample all types of soil. This sampler consists of a split steel tube or sample barrel threaded at both ends. A sharpened drive shoe secures the bottom of the barrel and an adaptor secures the top. The adaptor is threaded to connect directly to the drill rods and contains a check valve (see Figure 6-2). The split spoon is driven into undisturbed soil below the casing or hollow stem auger (see Figure 6-3). After the sampler has been driven, it is withdrawn from the borehole and the sampler is opened by removing the drive shoe and adaptor.

Sample Collection. The drilling monitor will take charge of the sampling device as soon as it is withdrawn from the borehole and opened. The sample will be collected and documented, employing the procedures as outlined below.

1. Scan the soil with a PI detector and record measurements.
2. Photograph any portions selected for chemical analysis, showing an appropriate visual scale (optional). Note: Sampler to put on new disposable gloves before proceeding!
3. Remove the portion(s) of the sample selected for chemical analysis and place it into appropriate containers using a clean spatula. Soil intended for VOA analysis should be placed in 2-oz. wide-mouth glass jar and capped as quickly as possible. The 2-oz. containers should be filled as near to capacity as practicable to minimize volatilization of the sample into the container headspace. Soil intended for other types of analyses should be placed in appropriate containers and capped.
4. Visually examine the sample and record its characteristics (e.g., texture, color, consistency, moisture content, layering and other pertinent data), and classify using the Unified Soil Classification System.
5. Place the remainder of the sample in a 16-ounce "soil jar". This sample portion will be used for headspace PI measurement and for any physical materials testing that is required.
6. Discard any excessively disturbed or loose material found in the sampler which may not be representative of the interval sampled. This material will be discarded with boring spoils at each boring location.
7. Decontaminate the sampling device in accordance with the procedure specified in Section 6.3.

In some instances, none of the samples from a given boring will be prepared for chemical analysis. In these instances, steps 2 and 3 of the procedure listed above are omitted and the sample is placed in one or more "soil jars."

SPLIT SPOON SAMPLER



SPLIT SPOON SAMPLER DISASSEMBLED

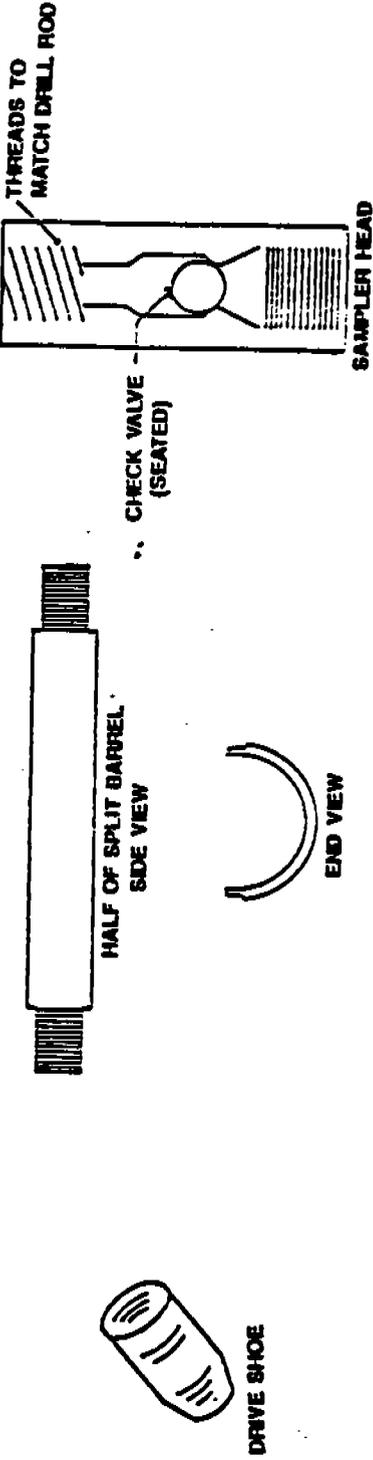


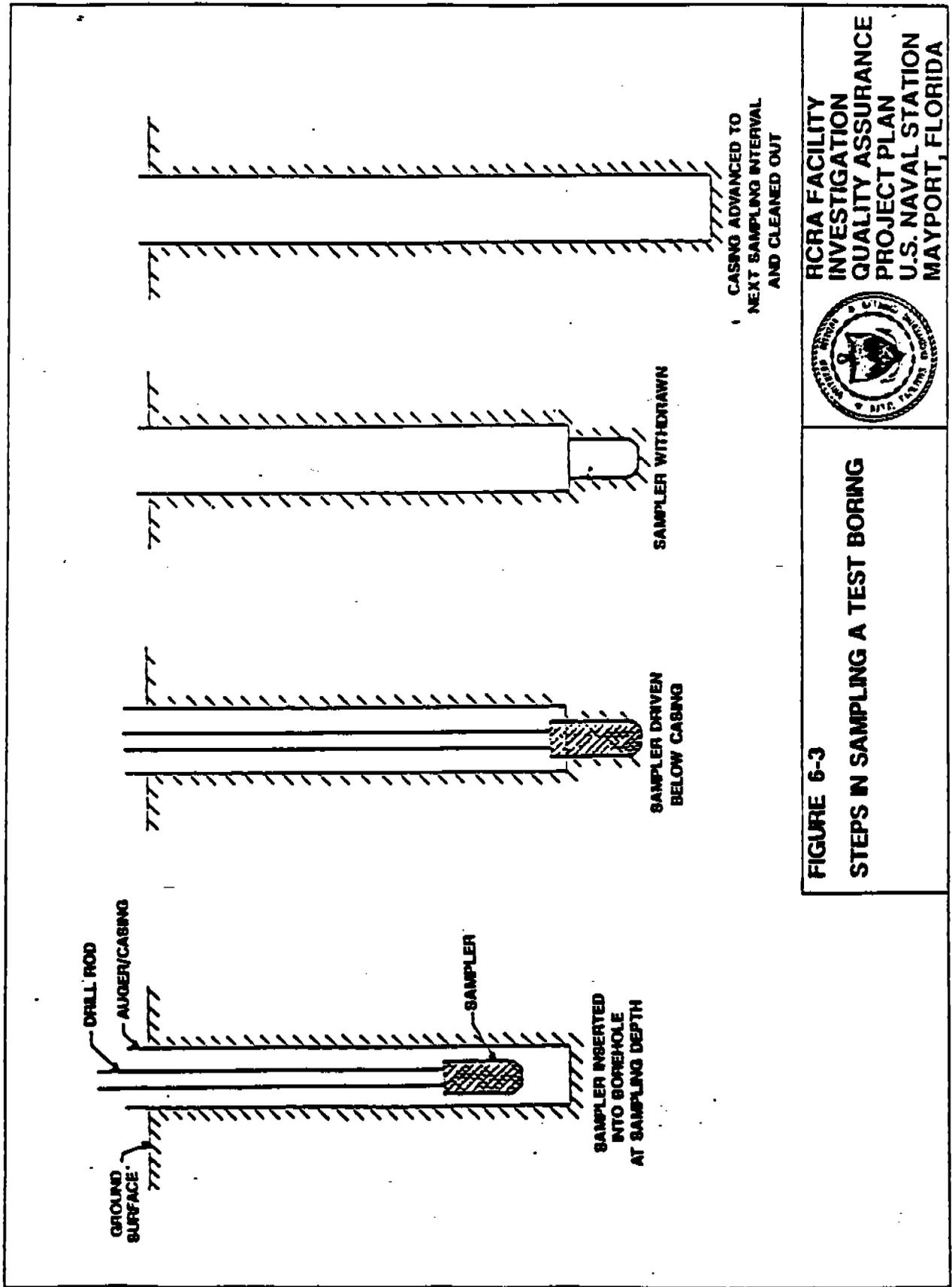
FIGURE 6-2

SPLIT SPOON SAMPLER

NOTE: NOT TO SCALE



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MAYPORT, FLORIDA**





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FIGURE 6-3
 STEPS IN SAMPLING A TEST BORING

Immediately after the samples are collected, all labeled vials and jars are checked for completeness of the sampling objective and chain-of-custody procedures are initiated. The boring log is also updated at this time by the drilling monitor. Boring logs may be completed by the driller, but for purposes of completeness and documentation a separate boring log is also compiled by the drilling monitor. The boring logs will include interpretations of subsurface materials and conditions encountered, sample locations, and other notes pertinent to how the boring was conducted. The drilling monitor's boring log can be completed in a site field book or on a boring log form (see Figure 6-4).

The sampler must exercise considerable care while collecting samples for analysis. Some methods to assure that high quality samples are collected are described below.

1. Make sure that the sample is obtained from undisturbed soil below the casing or auger. This is accomplished by monitoring or checking the drill crew's measurements, observing the sampling process and examining the sample once it is retrieved.
2. Carefully remove and discard portions of the sample that may have become contaminated by contacting the casing, auger, or drilling fluids.
3. Conserve sample volume since under certain soil conditions it may be difficult or impossible to achieve good sample recovery with either split spoons or thin wall tubes.

Procedures employed to prevent cross-contamination during test boring sampling operations include the following:

- o Samples are taken immediately after the boring is advanced to the desired sampling elevation.
- o The sampling tools are decontaminated prior to taking each sample.
- o The drilling contractor is not permitted to use oil, grease or other petroleum based lubricants on the drill rods, casing or sampling tools.
- o The drilling technique and procedures to be utilized, particularly the use of drilling fluids, are carefully evaluated for each site.

6.6.3 Intermediate Depth Samples

Objective

To obtain soil samples from depths of up to 15 feet for chemical analysis.

TITLE:		LOG of WELL:		BORING NO.					
CLIENT:				PROJECT NO:					
CONTRACTOR:			DATE STARTED:		COMPL. TO:				
METHOD:		CASE SIZE:	BORE DIA:	PROTECTION LEVEL:					
TOC ELEV. FT.		MONITOR DIST.:	TOT DPTH FT.	DPTH TO S. FT.					
LOGGED BY:		WELL DEVELOPMENT DATE:		SITE:					
DEPTH FT.	LABORATORY SAMPLE ID.	SAMPLE	RECOVERY	HEADSPACE (Spnd)	SOIL/ROCK DESCRIPTION	LITHOLOGIC SYMBOL	SOIL CLASS	BLOWS/6-IN	WELL DATA
5									
10									
15									
20									
25									
30									

PAGE 1 of SAMPLE ABB ENVIRONMENTAL SERVICES, INC.

FIGURE 6-4

SOIL BORING LOG



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Approach

Although test borings can be employed to obtain samples from any depth (as described in Section 6.6.2), backhoe excavated test pits are often more practical and cost effective at intermediate depths.

The major advantages of test pit sampling programs are:

- o Samples of any size can be obtained.
- o The subsurface is exposed in the test pit revealing the sample site geology and facilitating sample collection and recovery.
- o Availability of equipment is good.

There are three factors that must be considered when designing a test pit sampling program:

- o the depth at which samples can be effectively obtained;
- o site-specific safety issues, including contamination potential and test pit stability; and
- o impact on groundwater.

Sampling Procedures

To expedite the sampling and recordkeeping efforts and to minimize periods of potential exposure during the excavation of test pits, the sampling crew will have sufficient tools and equipment to sample each pit prior to requiring decontamination. The backhoe and tools will be decontaminated between each test pit. The backhoe bucket and boom will be decontaminated as required during excavation of each test pit.

The actual layout of each test pit, temporary staging area and spoils pile will be predicated on site conditions and wind direction at the time the test pit is made. During excavation, sampling and logging of each test pit, the backhoe operator and all site personnel will remain upwind or crosswind of the test pit and spoils pile. Wind direction will be monitored by means of a wind sock or other banner located in a prominent position visible to all personnel.

Preselection and the use of hand and horn signals is important during completion of test pits due to noise levels around the machine. The sampling crew and backhoe operator will rehearse appropriate signals ahead of time and be thoroughly familiar with their meaning. All personnel should be equipped with air blast horn devices, especially when wearing respiratory safety gear which hinders communication.

Sampling of unopened buried drums is excluded from this test pitting protocol. ABB-ES undertakes such work on a site-specific basis and utilizes appropriate safety and sampling protocols for each instance.

Test pits are logged as they are excavated. Records of each test pit will be made on prepared forms or in a field book. If the log is made in a field book it will be transcribed to prepared forms. These records include plan and profile sketches of the test pit showing all materials encountered, their depth and distribution in the test pit and sample locations. These records will also include safety and sample screening information. An example test pit record form is shown as Figures 6-5 and 6-5A. ABB-ES has found this format useful since it provides all necessary sampling, monitoring and subsurface records for each test pit in a concise and uniform manner. This format also provides a cross-check with chain-of-custody records and sample label counts.

The actual depth and type of samples obtained from each test pit will be selected at the time the test pit is excavated. Sufficient samples are usually obtained and analyzed to quantify contaminant distribution as a function of depth for each test pit. Additional samples of each waste phase and any fluids encountered in each test pit may be collected.

Test pits are excavated and sampled in the following manner: =

1. The sampler and backhoe operator will plan the excavation.
2. The backhoe operator will excavate the test pit in several depth increments.
3. After each increment, the operator will wait while the sampler inspects the test pit to decide if conditions are appropriate for sampling. Practical depth increments range from 2 to 4 feet.
4. The backhoe operator, who will have the best view of the test pit, will immediately cease digging if:
 - o any fluid phase or groundwater seepage is encountered in the test pit,
 - o any drums or other potential waste containers are encountered, or
 - o distinct changes of material are encountered.

This action is necessary to permit proper sampling of the test pit and to prevent a breach of safety protocol.

For instance, should any fluids or seepage be encountered, they could, after suitable screening and monitoring, be sampled. Waste and sludge deposits could likewise be sampled before proceeding. Should uncollapsed drums be encountered, the test pit would be terminated, backfilled and redug at an adjacent location.

5. The test pit is sampled as described in the following sections.

Sampling from Ground Surface. To sample the pit from the ground surface, two methods have been used. The method is selected in the field at the time the test pit is sampled.

- a. Samples can be obtained from the backhoe bucket. The sampler or crew chief will direct the backhoe operator to remove material from the selected depth or location within the test pit. The bucket will be brought to the surface and moved away from the pit. The sampler will approach the bucket and monitor its contents with the PI meter. If granular or loose soils and/or uniform materials are encountered, the sample will be obtained directly from the bucket. The sample is collected from the center of the bucket and placed in sample jars using a clean trowel or spatula.

If a composite sample is desired, several depths or locations within the pit are selected and a bucket is filled from each area. A sample bottle is filled from each bucket and then emptied into a mixing surface (e.g., butcher paper or plastic sheet) and thoroughly stirred prior to being placed into the sample jars. The disposable mixing surfaces are discarded into the test pit when it is backfilled.

If cohesive soils or multiphase conditions are encountered (e.g., the bucket contains a mixture of soil and sludge) the sampler will proceed as above if practical; if not, he will direct the backhoe operator to empty the bucket onto the ground. He will then obtain the sample from the interior of soil clods or lumps of sludge using a clean trowel or spatula.

- b. Samples can be obtained directly from the test pit. This is necessary when soil conditions preclude obtaining suitable samples from the backhoe bucket (e.g., caving or excessive mixing of soils or wastes within the test pit) or when samples from relatively small discrete zones within the test pit are required. This approach is also required to sample seepage occurring at discrete levels or zones in the test pit. In these circumstances, samples will be obtained by means of extendable handled tools: scrapers, trowels, spoons or cups. The face of the test pit is scraped to remove the smeared zone that has contacted the backhoe bucket. The material to be sampled, if a solid, is then removed from the test pit wall by means of long handled scoops or trowels. The sample is then thoroughly stirred on a clean disposable mixing surface and placed in sample jars. If fluids are removed from the pit they are placed in a mixing jar as obtained. They are then decanted into sample jars.

In-Pit Sampling Safety. While samples can be obtained directly from the test pit, as noted above, it is ABB-ES policy that personnel will sample and log pits from the ground surface except as provided for by the following criteria:

- o The project will benefit significantly from the improved quality of the test pit logging and sampling data obtained if personnel enter a test pit rather than conduct such operations from the ground surface.
- o There is no practical alternative means of obtaining such data.
- o The site safety officer determines that such action can be accomplished without breaching site safety protocol. This determination will be based on actual monitoring of the test pit after it is dug (including, at a minimum, measurements of volatile organics, explosive gases and available oxygen).
- o An experienced geotechnical professional determines that the test pit is stable or is made stable prior to entrance of any personnel in accordance with 29 CFR 1926.652 (Special Trenching Requirements).

If all of these conditions are satisfied, one person will enter the test pit. On potentially hazardous waste sites, this individual will be dressed in safety gear as required by the conditions in the pit. This person will be affixed to a safety rope and continuously monitored while in the pit. A second individual will be fully dressed in appropriate protective gear and on stand-by during all pit entry operations. The individual entering the pit will remain therein for as brief a period as practical commensurate with performance of his work. After removing the smeared zone, samples are obtained with a trowel or spoon.

Sampling in the Vicinity of Drums. Should collapsed or highly-corroded drums be encountered which are obviously empty and pose no unusual threat, the test pit could be continued after appropriate monitoring. If possible, the test pit is sampled from the ground surface by means of long-handled scoops or trowels. As described above, the face of the test pit must be first scraped to remove the smeared zone that has contacted the backhoe bucket. Attempts to sample drums or containers also could be made from the ground surface, with appropriate safety procedures. After sampling, the test pit would be backfilled.

6.6.4 Shallow Samples

Objective

To obtain samples of surface and near surface soils suitable for chemical analysis.

Approach

Shallow soils samples are usually obtained by using one of the following devices:

- o split-spoon sampler;
- o hand auger or corer;
- o trowel or spoon; and
- o spade.

The split-spoon sampler was described in Section 6.6.2. Two distinct types of hand augers are available: a cup-type auger and a screw-type auger. Use of either device is generally limited to the upper portion of the soil profile (less than five feet). These augers are best suited for obtaining composite samples from relatively shallow depths and in relatively loose soils. Use of trowels or spades is straightforward but usually limited to sampling very shallow depths (less than 18 inches).

Soil samples can be either grab or composite, depending on the objective of the sampling program. In grab sampling, the soil jar can be filled directly which is usually desirable for VOA samples. In composite sampling, several methods are available:

- o Samples can be composited over depth at a single spot.
- o Samples can be composited laterally, in which one sample is comprised of several (usually three or four) soil specimens in the vicinity of the sampling site.

Composite samples are mixed in the same manner as composite test pit samples (see Section 6.6.3).

Immediately after taking a sample, the sampler fills the containers required for the requested analyses, attaches the labels, initiates COC procedures and completes the field sample data record.

6.6.5 Sediment Samples

Objective

To obtain samples of the sediment found in streams, ponds or other water bodies for chemical analysis.

Approach

Sediment samples are usually taken in conjunction with surface water samples to help define the partitioning of the contaminants between the soil and water. The exact location of each sampling station will be established in the field at the time of sampling. The sample site will be noted on a site plan or aerial photograph and marked in the field with flagging and a four-foot wooden stake. The stake will be labeled with the sample site number.

If both water and sediment samples are to be collected at a given sampling site, the water samples will be collected prior to the sediment sample. The sediment samples will be collected in the following manner:

1. The sampler will select the sample site, locate it on a site map or aerial photograph and set the wooden stake.

2. Where sediments are to be obtained in wetlands, a grab sample will be obtained in the immediate vicinity of any associated surface water sample. Unless otherwise specified, grab or composited samples will be obtained from the surface of the sediment.
3. The sampler will photograph the sample site (if specified for the project), complete the required records and initiate COC procedures.

Sediment sampling information is recorded on the surface water/sediment field data record form (presented later as Figure 6-8) or may be recorded in a field book.

The recommended sediment collection devices are Teflon or glass coring tubes for shallow wadeable water, and gravity corers in deeper waters. Scoops and drag buckets are not recommended because they cause a great degree of disturbance to the sediment. However, in special applications in deeper water, dredges such as the Eckman and Ponar can be used if precautions are taken to minimize the sediment disturbance.

In shallow, wadeable waters, the direct use of a core liner or tube (five-inch) is recommended. The tube is pushed into the substrate until approximately 1 inch (2.5 centimeters) 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. Before the bottom part of the core is pulled above the water surface, it too is capped. 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 hands 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 will have a hole in it to allow water to pass through when the tube is pushed in, and will be lined with sheet Teflon. Handles will be attached to the sides of the collar. After the tube is driven in, a wide circular motion will be used to help loosen the core for easy removal; take off the collar device; cap the top of the tube (as described above); pull it up out of the sediment layer; and cap the bottom of the tube before removing it from the water.

Another method of obtaining recently deposited sediments in shallow, wadeable waters with a core tube, is to use the tube as a horizontal scoop. The tube is placed on its side on the sediment surface and carefully inserted into the sediment so that the top inside surface is just at the sediment/water interface. It is important to disturb the fines as little as possible. After the tube is filled, both ends will be capped with a Teflon plug, as described above, before the tube is removed from the sediment. If this method is used with a tube having an outer diameter of 2 inches and wall thickness of 1/8-inch, only the top 2

inches of sediment will be sampled (allowing a 1-millimeter clearance between the sediment surface and top inside of the tube).

A minimum of 500 grams of sediment is collected at each site. Therefore, one tube with a 4-inch-long core, outer diameter of 2 inches, and wall thickness of 1/8 inch is adequate for one sample (the volume of each core would be approximately 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 ($\pi r^2 L$). 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 metal 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 extrusions and permits the use of the core liners as sample containers for shipment to the laboratory.

Substantially different procedures are required to sample sediments in larger streams, lakes or other deep water bodies. Such work is normally accomplished from a raft or boat. If significant thicknesses of sediment must be sampled, test boring techniques will likely be employed.

In deep waters and hard substrates, a gravity corer or thin-wall tube sampler may be required to collect sediment samples. These samplers rely on the weight and gravity to penetrate the bottom.

A gravity corer is easily operated by a two-person crew from a boat or any structure extending over the water surface. The equipment, fastened to a flexible line of rope or wire, is lowered to within 2 or 3 meters of the bottom. Terminal velocity is generally achieved within this distance (Bouma, 1969), and better accuracy and corer orientation is obtained than with a free fall from the surface. The corer is retrieved to the surface, cutting head unscrewed, and liner with sediment removed. Caution must be exercised at this point not to lose the sample, particularly if it is coarse grained. Only those corers that have some water in the core tubes above the sediment should be retained. This ensures that the sediment surface is intact and provides a reference point for determining the sample depth below the sediment/water interface. After the core liner has been removed from the barrel, the bottom and top of the liner should be capped and stored upright in an ice-filled cooler for delivery to the lab. The operation is repeated with a new liner until sufficient samples for sample analysis are obtained.

If both water and sediment samples are to be collected at a given sampling site, the water samples will be collected prior to the sediment sample.

6.7 WATER SAMPLING

6.7.1 General

Water sampling programs are undertaken to define the location, nature and concentration of contaminants in site groundwater, surface water, and/or wastewater. The location and distribution of contaminants at a given site are governed by many factors, including:

- o site operation or waste disposal practices;
- o site design;
- o site closure;
- o waste characteristics;
- o site topography and surface drainage;
- o climate; and
- o site hydrogeology.

Development of a water sampling plan that will effectively reveal the distribution and magnitude of contamination at a specific site requires:

- o an assessment of the factors listed above;
- o evaluation of the methodology and results of any previous sampling and analysis programs which have been completed at the site; and
- o definition of the scope and objectives of the project.

Many of the sampling procedures are consistent for all types of water sampling. General considerations are presented here and are discussed in more detail in the following sections.

Sample Collection

Water sample containers are generally filled directly from the source, sampler or pump discharge without special considerations. A major exception is the collection of VOA samples. Volatile Organic Analyte samples must be collected as specified below. Each sample is taken in duplicate.

1. Uncap the sample bottle, taking care not to touch the teflon-faced septa. If the septa is contaminated in any way, it should be replaced.
2. If a chlorine residual is potentially present, check for chlorine content with KI paper or a chlorine residual comparator. If a residual chlorine content is detected, add three drops of ten (10) percent sodium thiosulfate to the sample container prior to filling the bottle.

3. Fill the sample vial slowly from ~~bailer~~ or pump discharge, minimizing air entrainment, until the vial overflows.
4. Place the teflon-faced silicon rubber septa on the convex meniscus, teflon side (shiny side) down and screw cap on.
5. Invert the bottle, tap lightly, and check for air bubbles.
6. 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.

Sample Preservation

The following preservation procedures are examples of typical preservation protocols specific to the indicated analyses. More detail is provided in Tables 6-1 and 6-2.

Volatile Organic Analytes - Fill the sample bottle as previously described. If chlorine is detected, ten (10) percent sodium thiosulfate should be added (three drops) to the sample container prior to filling the container. Place samples on ice until shipment. Also note that if hold times are anticipated to exceed 7 days, the sample should be preserved with HCl to less than pH 2.*

Semi-volatile Organic Analytes - Fill the sample bottle, seal with a teflon-lined cap, and place on ice for shipment.

Elements - Following any required filtration, fill the sample bottle, preserve the sample to less than pH 2* with nitric acid, seal container, and place sample on ice for shipment.

Biochemical Oxygen Demand/Residue - Fill sample bottle, seal, and place on ice for shipment.

Chemical Oxygen Demand/Total Organic Carbon/Ammonia - Fill sample bottle as described above, add sulfuric acid until less than pH 2*, cap bottle, and place sample on ice for shipment.

Total Recoverable Phenolics - Fill sample bottle and, if chlorine is present, add one ml of ten percent sodium thiosulfate. Add sulfuric acid until pH is less than 2.* Cap sample and place on ice for shipment.

Cyanide - Fill the sample bottle, and if chlorine is present, add one ml of ten percent ascorbic acid. Add 10 N sodium hydroxide to a pH greater than 12, cap bottle, and place sample on ice for shipment.

Oil and Grease - Fill sample bottle, add sulfuric acid until pH is less than 2.* Cap bottle, and place sample on ice for shipment. Do not composite oil and grease samples.

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, pH paper should be used. 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 to approximately 1.5 ml/1l sample.

6.7.2 Groundwater/Domestic Well Sampling

Objective

To obtain samples of groundwater from new and existing wells suitable for chemical analysis.

Approach

The groundwater sampling locations are selected to delineate the distribution of chemicals and to quantify, to the extent possible, the contaminated groundwater plume in the aquifers underlying the site. The actual sampling points are then selected following review of the locations of the existing groundwater wells (monitoring and domestic) in the vicinity of the site. New monitoring wells may be installed to supplement the existing array. The rationale for their location is normally described in the site work plan.

The sampling locations will be indicated on a site map. Preprinted labels will be prepared for all groundwater samples (using the computerized label system). These samples will consist of various containers for each location and will be analyzed for the parameters selected for the project. A sample splitting flow chart is illustrated in Figure 6-6. The pH and specific conductance of each sample will be determined in the field. Selection of either glass or plastic containers is dependent on the types of analyses that are to be performed. Appropriate containers are specified in Tables 6-1 and 6-2.

6.7.2.1 Monitoring of Groundwater Wells Monitoring of groundwater wells will proceed from the upgradient or background wells to the downgradient or contaminated wells as best as can be determined. The monitoring procedure is as follows:

1. Check the well for proper identification and location.
2. Measure and record the distance from the top of the casing to the ground surface.
3. After unlocking the well and removing any well caps, measure and record the ambient and well-mouth organic vapor levels using the photoionization meter. If the ambient air quality at breathing level reaches 5 ppm, the sampler shall utilize the appropriate safety equipment as described in the HASP.

4. Measure and record the distance between the top of the well and the top of the protective casing.
5. Using the electronic water level meter, measure and record the static water level in the well and the depth to the well bottom to the nearest 0.01 foot. Upon removing the water level wire, rinse it with ethanol:methanol 90:10 v/v and then either potable or deionized (DI) water (as specified for the site).
6. Calculate the volume of stagnant water in the well. Volume in liters equals 0.154 times the square of the inside diameter of the well (in inches) times the depth of water (in feet).

6.7.2.2 Sampling of Groundwater Monitoring Wells Following the measurements and calculations described above, sampling will commence in the sequence below, utilizing the appropriate purging technique (1a through 1d):

1. Lower the submersible pump or peristaltic pump intake into the well. For shallow groundwater situations, the intake of the suction tubing or of the submersible pump will be lowered to the top of the well screen and the well purged of the required volumes. Available alternatives to this procedure may be utilized in certain situations:
 - a. If the well screen is very large, making pumping from the top impractical, the suction line or submersible pump should be lowered to the approximate mid-point of the screened portion of the well.
 - b. If the well is situated in tight formations such as tills, clays or rock, the purging of the well should be performed from near the top of the well screen. Pumping or purging at this level until 1 to 3 volumes have been purged will facilitate removal of standing well water without creating a large artificial gradient in the well.
 - c. Upon client request, and when conditions permit, the pump intake may be placed just below the water surface and purging initiated. As the water surface lowers, the pump intake is lowered to remain below the water surface.
 - d. When using a submersible pump in conjunction with an inflatable packer system, the packer should be placed just above the top of the well screen and inflated according to the packer manufacturer's instructions. The volume of stagnant water to be purged should be recalculated based on the depth below the packer. The packer is not deflated until sampling is complete.
2. Connect the instrumentation header to the pump discharge and begin flushing the well. Monitor the in-situ parameters (pH, Eh, temperature, and specific conductivity) and measure the volume of groundwater being pumped. Alternately, in-situ parameters may be monitored in a

beaker filled from the pump discharge. Purging of the standing well water is considered complete when the following is achieved:

- o a minimum of three well volumes has been purged, and in situ parameters have stabilized; or
 - o five well volumes have been purged; or
 - o the well has been pumped dry.
3. Record the in situ parameters.
 4. After purging, lower the bailer to the middle of the screened interval or mid-point of the static water level. If the analysis to be performed is for lighter-than-water chemical species, then the bailer should be lowered to the top of the water column for sample collection.
 5. Collect the sample(s).

Volatile and semivolatile samples are filled directly from a bailer with as little agitation as possible.

Other samples will be placed directly into the appropriate container from the bailer or pump discharge.

Where filtration is required, an inline filter should be used if possible. Vacuum and pressure filtration are acceptable alternatives to an in-line device. Filtration procedures are described in Table 6-3. Note that all groundwater samples scheduled for analysis of elemental parameters will not be filtered.

6. Remove the pump or bailer from the well and decontaminate the pump, tubing or bailer by flushing with decontamination fluid specified in Section 6.3. Up to one gallon of the solvent is used as needed. Rinse the bailer with one gallon of potable or DI water. Rinse again with potable or DI water.
7. Complete sample data record (Figure 6-7) after each well is sampled.
8. Secure the well cap and lock.

Domestic Wells. Domestic water supply wells will be sampled in a similar manner, with the exception of using the in-place pumping equipment. The sampling point will be determined at the time of sampling, and will be as close to the pump as practical at each location. Domestic supply samples will not be taken from taps delivering aerated, softened or filtered water. Faucet aerators will be removed if possible before sampling. The water tap will be turned on and run for at least 5 minutes before the sample is taken to flush stagnant water from the system. All sample containers will be filled with water

TABLE 6-3

STANDARD FIELD FILTRATION PROCEDURES

A. IN-LINE FILTRATION

EQUIPMENT

1. A portable 102-~~mm~~ acrylic backflushing filter unit
2. 102-~~mm~~ diameter filter papers. 0.45 μm membrane filters
3. DI rinse water
4. 20% v/v nitric acid rinse solution

PROCEDURES

1. Attach in-line filter assembly, after assembling filter paper into filter holder to discharge line of sampling pump. Open by-pass valve completely.
2. Turn sampling pump on slowly, turn by-pass valve closed allowing flow into the filter. Remove trapped air through the filter bleed valve, if necessary.
3. Discard the initial 100 ml \pm of filtrate. Collect subsequent filtrate into sample bottle.
4. Rinse barrel and filter holder assembly between samples with three rinses of reagent water. The rinse sequence when elemental parameters will be analyzed is: DI water - 20% v/v nitric acid - DI water.

TABLE 6-3 (Continued)
STANDARD FIELD FILTRATION PROCEDURES

B. VACUUM FILTRATION

EQUIPMENT

1. Two sets of either glass funnel type or self-contained polysulfone filters with sintered glass discs or polysulfone filter plates
2. 47-mm diameter filter papers, 0.45 μm membrane filters
3. Vacuum pump or ISCO peristaltic pump with silicone tubing
4. DI rinse water
5. 20% v/v nitric acid rinse solution

PROCEDURES

1. Thoroughly rinse sintered glass disc, filter funnel, and stem or polysulfone filter units with DI water.
2. On the basis of visual clarity of sample, prefiltering with larger pore filters may be required. If sample has a heavy clay content, organics, or suspended matter, prefiltration through a 3.0 or 5.0- μm membrane filter may be necessary.
3. Place membrane filter on filter holder with minimum handling.
4. Attach filter holder with filter to filter funnel and receiver.
5. Swirl and slowly pour sample bottle into filter funnel.
6. Attach suction tubing to filter flask and vacuum pump (or ISCO pump). Pump is tuned on in the vacuum mode.
7. Filter a small portion of the sample and discard filtrate after rinsing flask with sample filtrate.
8. If prefiltering was required, pass sample through a 0.45- μm membrane filter using another filtering apparatus.
9. Transfer filter sample to appropriate bottles.
10. Rinse filtration equipment between samples with at least three rinses of DI water. The rinse sequence, when elemental parameters are to be analyzed, is: DI water - 20% v/v nitric acid - DI water.

TABLE 6-3 (Continued)

STANDARD FIELD FILTRATION PROCEDURES

C. PRESSURE FILTRATION

EQUIPMENT

1. Pressure filter apparatus consisting of 1 liter barrel filter, filter holder, and pressure hose connectors.
2. Source of pressurized gas, i.e., tank of nitrogen, argon, etc.
3. 147 mm filter papers, 0.45- μ m membrane filter.
4. Place filter holder and filter onto barrel assembly, making sure to align O-ring for a positive seal.
5. Attach swing-away bolts and tighten hand-tight.
6. Turn over filter assembly and attach pressure hose assembly.
7. Slowly turn on pressurized gas and increase pressure regulator to a maximum of 20 psi.
8. Collect filtrate from bottom of barrel assembly.
9. Rinse barrel and filter holder assembly between samples with three rinses of DI water. The rinse sequence when elemental parameters will be determined is: DI water - 20% v/v nitric acid - DI water.

GROUNDWATER FIELD SAMPLE DATA RECORD

PAGE _____ OF _____

PROJECT _____ JOB NO _____

STATION NO/LOCATION _____ DATE _____

SKETCH ON BACK YES NO PHOTOGRAPHS YES NO ROLL NO/EXPOSURE NO _____

FIELD DATA

TIME: START _____ AIR TEMP _____
 END _____ WEATHER _____

WATER DEPTH _____ TOP WELL WELL DEPTH _____ WELL MATERIAL _____
 TOP CASING WELL DIAM. _____

WELL STICK-UP _____ WELL/CASING _____

SAMPLING EQUIPMENT USED _____ VOLUME PURGED _____

FIELD DATA COLLECTION IN SITU _____ VCA LEVEL (PPM) AMBIENT _____
 IN BOTTLE _____ SAMPLE LOCATION _____

SAMPLE PURGE DATA

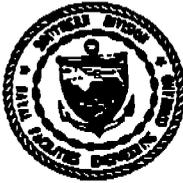
_____ GAL @ _____ °C SP. COND. _____ @ 25°C PH _____ Eh _____
 _____ GAL @ _____ °C SP. COND. _____ @ 25°C PH _____ Eh _____
 _____ GAL @ _____ °C SP. COND. _____ @ 25°C PH _____ Eh _____
 _____ GAL @ _____ °C SP. COND. _____ @ 25°C PH _____ Eh _____

BOTTLE ID	LAB ID	VOL	MATERIAL	FILTERED	PRES./VOL	ANALYSIS REQUESTED

REMARKS/OBSERVATIONS _____

SAMPLER _____

**FIGURE 6-7
 GROUNDWATER FIELD SAMPLE DATA
 RECORD**



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directly from the tap and the samples processed as described for monitoring well samples except that samples collected for elemental parameters will not be filtered so that the sample will represent actual ingestion. Components of the plumbing system will be noted to assist in data interpretation.

6.7.3 Surface Water

Objective

To obtain surface water samples, commonly referred to as ambient water samples, to characterize the physical and/or chemical status relative to a pristine condition, and to establish the degree and extent of contamination.

Approach

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

- o depth of water body;
- o flow rate;
- o stratification;
- o specific gravity/solubility of anticipated analytical parameters;
- o seasonal variations; and
- o analytical parameters of interest.

The sample will be taken in the following manner:

1. Collect the sample from the surface water body by immersing a clean beaker or the sample bottle. 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.
2. Directly fill the appropriate sample containers from the sampling device if needed.
3. Measure the following parameters, if possible, by direct immersion of instrument probes into the water body:
 - o photoionization meter reading;
 - o temperature measurement;
 - o pH measurement;
 - o specific conductance measurement; and
 - o any other site-specific field measurements required.

If direct measurement is not possible, measure these parameters from water remaining in the sampling device or another sample bottle. This information will be recorded on the sample data record, sample labels will be completed and chain-of-custody procedures will be initiated.

4. Complete the sample data record (Figure 6-8).

SURFACE WATER / SEDIMENT FIELD SAMPLE DATA RECORD

PROJECT _____ JOB NO _____

STATION NO / LOCATION _____ DATE _____

SKETCH ON BACK ^{YES} ^{NO} PHOTOGRAPHS ^{YES} ^{NO} ROLL NO / EXPOSURE NO _____

FIELD DATA

TIME: START _____ AIR TEMP. _____

END _____ WEATHER _____

WATER DEPTH @ SAMPLE LOCATION _____ WIDTH OF STREAM _____

TYPE OF STREAM SAMPLE _____ SAMPLE METHOD _____

STREAM VELOCITY MEASUREMENTS YES NO

FIELD DATA COLLECTED IN SITU TEMP _____ °C

IN BOTTLE SP. COND _____ @ 25°C pH _____

DISSOLVED OXYGEN _____ PPM METER VOA LEVEL (PPM) AMBIENT _____

WINKLER SAMPLE LOCATION _____

HEADSPLAZ _____

TYPE / DESCRIPTION OF SEDIMENT _____

DEPTH OF SEDIMENT SAMPLE _____ EQUIPMENT USED _____

BOTTLE ID	LAB ID	VOL	MATERIAL	FILTERED	PRES./VOL	ANALYSIS REQUESTED

REMARKS / OBSERVATIONS _____

SAMPLER _____

**FIGURE 6-8
SURFACE WATER / SEDIMENT SAMPLE
DATA RECORD**



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Surface water samples may also be composited over time, as described in Section 6.7.4.

6.7.4 Wastewater

Objective

The objective of wastewater discharge sampling, commonly referred to as source sampling, is to characterize a treated, untreated or partially treated waste stream in terms of flow rate, volume, chemical constituents and physical properties. Source sampling is employed in treatability studies, regulated effluent compliance determination, process control and identification of potential contributors to a contamination incident. It often requires 24-hour composite sample collection, continuously for multiple 24-hour periods.

Approach

Based on existing data, or during initial site reconnaissance, sampling locations will be selected in accordance with project goals, i.e. to procure a sample which appropriately represents the properties being investigated. Special emphasis is required prior to sampling to accurately define the goals of sampling and assess the impact of sampling methodologies on analytical requirements and the intended use of analytical results. The need to measure the flow rate of the stream and the accuracy required must also be assessed in light of project goals. In many cases, very accurate flow monitors may exist, or must be installed by the sampling crews. However, in certain instances, only knowledge of total volume is required. In any case, this aspect of source sampling must be integral to the selection of sampling technique.

Sampling Location. Sampling locations will be chosen to provide the most representative sample (e.g. if two outfalls are present, sample in the stream just below where the water is mixed). Samples will be taken in the center of the channel where the flow and mixing is greatest, and never near the end of a dead end piping line. The techniques (e.g., depth of sampling, method of sampling) will be uniform among the samples procured within a given facility or area to the extent possible.

Sampling Procedures

Automatic Composites. Conditions permitting, automatic composite samplers (ISCO 1580 super-speed) will be set up at each sample location. Constant time - constant volume samples will normally be collected. The following is the procedure for the composite sampler set-up:

1. Transport the composite samplers to the sampling points.
2. Place sampler such that suction line is as short as possible. Use AC power whenever possible.
3. Place silicon tubing in sampler and cut teflon suction line to desired length. Insert teflon tubing into silicon tubing and secure with hose clamps.

4. Collect sampler blank according to blank procedures.
5. Secure the sampler tubing to obtain a representative sample. Rigid conduit or stainless steel weights should be used to secure the tubing so that it is facing into the waste stream. The intake line should be situated at a turbulent location and at a depth between 1/3 and 1/2 the channel depth. The teflon tubing must extend beyond the rigid conduit.
6. Calibrate the composite samplers with a graduated beaker. Aliquot volumes for a 24-hour composite with a 20-minute interval between samples are as follows:

130 ml/20 minutes for a 2.5 gallon composite
160 ml/20 minutes for a 3.0 gallon composite
260 ml/20 minutes for a 5.0 gallon composite

(See ISCO manual for sampler instructions.)
7. Place appropriate sampler jug in the base of the sampler. Pack ice around sampler container.
8. Remove cap and teflon liner from sample jar and place in a secure place.
9. Secure ISCO control unit to the sampler base (a cylindrical sampler extension neck will be necessary when a five-gallon jug is used).
10. Monitor the first sample aliquot to ensure proper operation.
11. Check the composite sampler at least every four hours to ensure that it is operating properly and adequately iced. Spent desiccant should be replaced with dry desiccant when necessary.
12. If improper volumes of sample are noted, take necessary steps to correct sampler malfunction. If the sampler is pulling too little sample, increase the sample aliquot volume or decrease the time between sample intervals. If the sampler is pulling too much sample, stir the composite, discharge the excess and recalibrate the ISCO to draw the appropriate volume.
13. Allow composite sampler to run for 24 hours.
14. Replace composite container with a clean jug at the end of each 24-hour period.
15. Replace the silicon and teflon tubing with new tubing at the completion of each 72-hour period. Sampler blanks must be run every time the tubing is changed.

Manual Composites. In certain instances, manual compositing will be required. Sludge locations with a high solids content, pressurized discharge lines, and inaccessible sample locations are a few examples that require manual compositing. The following procedures should be used:

1. Determine the desired volume and frequency of sample aliquots.
2. Procure sample. If a discharge line is used, be sure to clear line of any debris, etc. so that a fresh, uniform sample is obtained. If aliquots are drawn from a wet well, manhole, or other location by means of an intermediate container, be sure to thoroughly rinse the container prior to drawing sample.
3. Repeat Step 2 at the appropriate intervals until the desired volumes have been collected and composited in the appropriate container. The composite container should be iced at all times.

Grab Samples. In situ measurements for pH and temperature will be taken concurrent with grab samples. Grab samples will be taken according to the following procedure:

1. Determine the time interval at which samples will be collected.
2. Identify any sample locations at which a chlorine residual is present.
3. Collect the appropriate samples. The preferred method for grab sampling is immersion of the sample bottle or appropriate beaker in the waste stream. The container should be thoroughly rinsed with sample and then filled. Samples should be taken from a turbulent section of the waste stream at a depth of one-third to one-half the stream depth to ensure a well-mixed, representative sample. If the physical characteristics of the sample point prevent this, samples may be collected through the ISCO pump unit. Before doing this, purge the suction line (switch to reverse) then run (switch to forward) until the pump discharge is uniform. Bottles may be filled directly from the pump discharge. In the event that neither procedure is appropriate, samples may be collected by means of a stainless steel bucket. Should this be necessary, the bucket must be thoroughly rinsed with the wastewater prior to sample collection.

Sample Handling

The procedures for handling the listed sample fractions are described in the following sections:

Composite Samples. Samples for SVOA, Inorganics, Biochemical Oxygen Demand (BOD)/Residue, and Chemical Oxygen Demand (COD)/Total Organic Carbon (TOC)/ammonia analyses are all taken from the sample composite container. The composite sample must be blended to provide a homogeneous mixture, including a representative suspension of any solids in the container. No specific method is

required; hand stirring with clean glass rods or mechanical stirring with paddles that are teflon-coated is acceptable. Metal mixing devices may not be used.

General steps for splitting a composite sample are:

1. Line up all appropriate bottles into which the sample must be poured (COD/TOC/ammonia, BOD/Residue, SVOA and elements).
2. Blend the sample and sequentially fill each sample bottle one-third full.
3. Gently swirl the composite, return to the first bottle, fill an additional one-third of each bottle.
4. Repeat the same pattern and fill the last one-third of each.
5. Leave some head space so that any preservative chemicals required may be added. Preservation requirements are described in Section 6.7.1 and Tables 6-1 and 6-2.
6. If appropriate, record data on the Field Sample Data Sheet (Figure 6-9).

Grab Samples. VOA, cyanide, oil and grease, and total recoverable phenolics samples are taken as grab samples in the field. These samples may be composited in the lab. The waste streams must be tested for the presence of chlorine. Potassium iodide starch paper can be used to detect a chlorine residual. If plant personnel suspect a chlorine residual and the KI test is negative, it should be assumed that chlorine is present. Preserve the grab samples as described in Section 6.7.1.

6.8 SOIL GAS

Soil gas samples are collected from the vadose zone to assist in contaminant source location. ABB-ES may subcontract both sampling and analysis for this task on a site-specific basis. Organizational details will appear in each site's Work Plan. ABB-ES's procedure is described below. Subcontractor procedures will be included in site QAPP Addenda.

6.8.1 General Soil Gas Procedures

Soil gas surveys are used to help identify and characterize the extent of subsurface contamination. Soil gas just below the surface is analyzed for volatile organic compounds (VOCs) present in the soil or migrating upward from deeper contamination. The main advantage of this method is that large areas can be investigated at a lower cost than drilling or test pitting.

The soil gas sample can be obtained using a variety of methods. A probe is driven into the ground to a depth determined by site-specific hydrogeologic conditions. This probe can be a modified split spoon apparatus, a slide bar, or

a hollow probe inserted after augering. Once the probe is in place, teflon tubing is connected to a pump drawing 100-150 ml/min. An air tight syringe pierces the teflon tubing to remove the gas sample. The sample is then injected into the field gas chromatograph (Photovac 10 series or equivalent) to determine the absence or presence of target VOCs. Cross-contamination in the sampling procedure is avoided by changing the teflon tubing and thorough decontamination of the probes between samples.

A number of gas chromatographs can be used that meet the portability and sensitivity requirements. ABB-ES will use a Photovac 10S50 equipped with a photoionization detector (PID) unless otherwise noted. A teflon column and precolumn packed with 5% SE-30 is used for separation. The column length will be left to the analyst's discretion. Target compounds usually include benzene, toluene, trans-1,2-dichloroethane (t-1,2-DCE), trichloroethylene (TCE), and perchloroethylene (PCE). A three-point calibration curve will be run for target compounds. Quality control will consist of method blanks, syringe blanks, and duplicates.

6.9 HYDROCARBON SCREEN FOR SOIL/SEDIMENT AND WATER SAMPLES

6.9.1 Scope and Application

This is a heated headspace capillary GC-PID/FID (in series) method applicable to the determination of hydrocarbons (i.e. gasoline, fuel oil) in soil/sediment and water samples.

The estimated method detection limit (MDL) for each parameter in water is as follows:

	$\mu\text{g}/\text{l}$
gasoline	10
fuel oil	50
hexane	10
benzene	10
toluene	10
xylenes	10
methyl tert-butyl ether (MTBE)	20

The MDL for soil/sediment samples may differ from those listed, depending upon the nature of interferences in the sample matrix.

6.9.2 Summary of Method

An inert gas (helium) is bubbled through a 5 ml water sample or 5 g soil sample (5 ml of water) contained in a specially designed purging chamber at 65°C. The compounds of interest are transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent trap where the compounds are trapped. After purging is completed, the trap is heated and back flushed with the inert gas to desorb the compounds on to a gas chromatographic column (DB-5). The gas chromatograph is temperature programmed to separate the compounds which are detected with a photoionization detector and a flame ionization detector in series.

7.0 SAMPLE CUSTODY

7.1 GENERAL

ABB-ES has established a program of sample chain-of-custody (COC) that is followed during sample handling activities in both field and laboratory operations. This program is designed to assure that each sample is accounted for at all times. To maintain this level of sample monitoring, computer-generated sample container labels and shipping manifests are normally employed. Field data sheets, COC records, and analytical request forms (ARF) must also be completed by the appropriate sampling and laboratory personnel for each sample.

The objective of the ABB-ES sample custody identification and control system is to assure, to the extent practicable, that:

- o all samples scheduled for collection, as appropriate for the data required, are uniquely identified;
- o the correct samples are analyzed and are traceable to their records;
- o important sample characteristics are preserved;
- o samples are protected from loss or damage;
- o any alteration of samples (e.g., filtration, preservation) is documented;
- o a forensic record of sample integrity is established; and
- o client confidentiality is maintained.

The advantages of a computer-based COC system over field marking systems are:

- o all required samples are indicated on preprepared labels and shipping manifests; and
- o once the computer-generated label is affixed to the bottle and covered with clear plastic tape, sample identification is virtually unalterable without evidence.

The COC protocol followed by the sampling crews involves:

- o Documenting procedures and amounts of reagents or supplies (e.g., filters) which become an integral part of the sample from sample preparation and preservation.
- o Recording sampling locations, sample bottle identification, and specific sample acquisition measures on the appropriate forms.

- o Using prepared sample labels to document all information necessary for effective sample tracking.
- o Completing standard field data record forms to establish sample custody in the field before sample shipment (see Section 6).

Prepared labels are normally developed for each sample to be collected. Each label is numbered to correspond with the appropriate sample(s) to be collected. A summary of the labels prepared, with space for sample tracking and notations, is also printed. This sample manifest assists sample control in the field and is eventually retained as part of the project file. Examples of prepared labels and sample manifests are shown in Figures 7-1 and 7-2.

The COC record is used to:

- o document sample handling procedures including sample location, sample number and number of containers corresponding to each sample number;
- o document the sample; and
- o document the COC process.

The COC description section requires:

- o the sample number and sample bottle identification number, where applicable;
- o the names of the sampler(s) and the person shipping the samples;
- o the date and time that the samples were delivered for shipping; and
- o the names of those responsible for receiving the samples at the laboratory.

A COC record is shown in Figure 7-3.

The COC record is completed in quadruplicate. Two copies accompany the samples to the laboratory, another is kept by the sample crew chief and transferred to the Laboratory Services Coordinator (LSC) and the last copy is maintained in the project file. Additional copies can be provided if needed for the project.

7.2 SAMPLE SHIPMENTS

Packing

Sample containers are generally packed in picnic coolers for shipment. Bottles are to be packed tightly so that no motion is possible. Styrofoam, vermiculite, and "bubble pack" are suitable for most instances. (High-hazard samples require different packing.) Ice is placed in double "Ziploc" bags and added to the cooler along with all paperwork in a separate "Ziploc" bag. The cooler top

ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 100	ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 101	ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 102
ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 103	ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 104	ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 105
ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 106	ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 107	ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 108
ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 109	ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 110	ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 111
ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 112	ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 113	ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 114
ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 115	ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 116	ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 117
ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 118	ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 119	ARC COMPANY DATE: 10-10-77 EXT: 1000 1000 HL E.C. JORDAN CO.	TIME: 120



FIGURE 7-1
EXAMPLE COMPUTERIZED LABELS

is then taped shut. Custody seals and taping of bottle caps may be required for certain samples, particularly those analyzed through the USEPA Contract Laboratory Program.

Shipping

The standard procedure followed for shipping environmental samples to the analytical laboratory is:

1. All shipping of environmental samples collected by ABB-ES personnel must be done through Federal Express or equivalent overnight delivery service.
2. Prior to leaving for the field, the person responsible for sample collection must notify the LSC of the number, type and approximate collection and shipment dates for the samples. If the number, type or date of shipment changes due to site constraints or program changes, the task leader must notify the LSC of the changes. This notification from the field also needs to occur when sample shipments will arrive on Saturdays. The LSC will coordinate sample pick-up with the laboratory.
3. If prompt shipping and laboratory receipt of the samples cannot be guaranteed (i.e. Sunday arrival), the samplers will be responsible for proper storage of the samples until adequate transportation arrangements can be made.
4. Project Managers must notify the LSC when samples collected by clients are going to be shipped to the laboratory.

The LSC keeps the laboratory informed of all field sampling activities. This communication is critical to allow the laboratory enough time to prepare for the samples' arrival.

The samples are shipped to the laboratory together with the COC documents, and the ARF.

Figure 7-4 is an example sample tracking form. This form provides the initial information the LSC requires. The laboratory is notified from the field by telephone of shipment. Sample collection and shipment documentation are sent to the LSC. Sample receipt log, COC and ARF are returned to the LSC by the laboratory.

Due to the nature of the IRP, additional sample/data tracking procedures are employed. The procedure described below allows each TD to verify receipt of analytical data for his Task's samples and provides a dynamic means for assessing the status of a sampling/analysis event. The tracking report also provides a cross reference between field sample identification and laboratory sample identification.

7.3 DATA TRACKING & HANDLING

7.3.1 Data Tracking

1. Prior to initiating a sampling episode, create a task-specific Sample Tracking Form (Figure 7-4). Enter the ABB-ES sample location, type sample (media), and then place an "X" in the top half of each square of the column for which an analysis is proposed. Copy the resulting tracking form, along with projected sampling dates and name of analytical laboratory, and send it to the LSC. The LSC will then contact the analytical laboratory and pass on the above information.
2. While the sampling episode is underway, complete the task-specific Sample Tracking Form based on the chain-of-custody records. Enter the date sampled, date shipped, analytical laboratory, airbill number, and then place an "x" in the bottom half of each square in the column for which an analysis is actually requested. When entering field duplicates, identify it with a sample identifier plus a "D", i.e., MW-101D. If a replicate sample is sent to a second laboratory, identify it with a sample identifier plus a "R", i.e., MW-101R. Identify the second laboratory in the appropriate column. Send a copy of the resulting tracking form, along with a copy of all COCs and ARFs, to the LSC at the completion of the sampling episode.
3. The LSC will maintain an electronic sample tracking database. In addition to the information contained in the sample Tracking Form, the data base will keep track of when the data results are due, sample status, and any problems or changes encountered by the analytical laboratory. As analytical data are received from the laboratory, the samples will be logged in as "Analyses Received" in the sample tracking database. Results will then be forwarded to the Project Manager and stored in a task-specific trans-file.

7.3.2 Data Handling

1. Create a task-specific analytical data file. Be sure to modify the parameter list as appropriate for your particular investigation.
2. Enter the data:
 - o Include all data modifiers, i.e. "B", "J" or brackets.
 - o Do not enter any data not generated by ABB-ES without specific authorization from the QAO.
 - o Enter all 'Tentatively Identified Compounds' with a spectral match greater than 90 percent.
 - o Do not separate data packages unless a copy of the data package cover letter is attached to all parts of the package.

3. Check the data entered for accuracy and completeness.
4. Update the data tracking form as described in Data Tracking #3 above.

8.0 CALIBRATION PROCEDURES AND FREQUENCY

8.1 CALIBRATION PROCEDURES FOR LABORATORY EQUIPMENT

These procedures are described in the Standard Operating Procedures prepared by the participating laboratory submitted separately.

8.2 CALIBRATION PROCEDURES AND FREQUENCY FOR FIELD INSTRUMENTS

Each piece of equipment will be calibrated prior to each day's use. Data is recorded on a form similar to that shown as Figure 8-1. The procedures described below apply to the specific instrument noted. If other instruments are used, the manufacturer's calibration procedures are followed.

8.2.1 Y.S.I. S-C-T Meter (Model No. 33)

Temperature Probe.

1. Using a National Bureau of Standards-approved thermometer, immerse both probes into a beaker of water and note any differences for the field probe.
2. Recalibrate as necessary.

Specific Conductance Meter.

1. Calibrate meter and probe using the calibration control and the red-line on the meter dial (Y.S.I. S-C-T Meter, Model No. 33).
2. Turn the function switch to read conductivity x 10 and then depress the cell test button, noting the deflection. If the needle falls more than 2 percent of the reading, clean the probe and retest.
3. Using at least two buffer solutions, which will most likely bracket the expected values for conductivity, note accuracy of the water and probe and clean probe if necessary.

8.2.2 Specific Ion Meter

pH Probe.

1. Place electrodes and buffer solutions in a water bath at the temperature of the water to be sampled. After temperature equilibrium, measure temperature and adjust the temperature compensation knob for this temperature.
2. If using refillable probes, remove electrode cap and check that filling solution is above the filling mark.

FIELD INSTRUMENTATION QUALITY ASSURANCE RECORD

PAGE _____ OF _____

PROJECT JOB NO. DATE

EQUIPMENT TYPE/I.D.	BATTERY CONDITION	CALIBRATION INFORMATION
_____	_____	pH 4 _____ pH 7 _____ pH 10 _____
_____	_____	pH 4 _____ pH 7 _____ pH 10 _____
_____	_____	pH 4 _____ pH 7 _____ pH 10 _____
_____	_____	COND. STD. _____ / _____ COND. STD. _____ / _____
_____	_____	COND. STD. _____ / _____ COND. STD. _____ / _____
_____	_____	COND. STD. _____ / _____ COND. STD. _____ / _____
DISSOLVED OXYGEN	_____	AVERAGE WINKLE VALUE _____ METER VALUE _____ ppm CORR _____
REDOX	_____	ZOBELL SOLUTION VALUE _____ METER VALUE _____ CORR _____
PHOTOIONIZATION METER	_____	ZERO/ [] YES SPAN GAS VALUE _____ ppm EQUIV. ZERO AIR? [] NO
OTHER	_____	METER VALUE _____ ppm EQUIV.

FLUIDS MATERIALS RECORD

DEIONIZED WATER SOURCE: [] ECJ STAGING [] PORTABLE SYSTEM [] OTHER _____

TRIP BLANK WATER SOURCE: [] ECJ LAB, LOT NO. _____ [] OTHER, I.D. _____

DECONTAMINATION FLUID: [] METHYL HYDRATE, LOT NO. _____ [] OTHER _____ LOT NO. _____

SAMPLER BLANK WATER SOURCE: [] ECJ STAGING [] PORTABLE SYSTEM [] OTHER _____

HNO3/D.I. RINCE SOLUTION: [] ECJ STAGING, I.D. _____

PRESERVATION CHEMICAL LOT I.D.'s: CHEMICALS USED: [] HNO3 LOT NO. _____ [] H2SO4 LOT NO. _____
[] HCL LOT NO. _____ [] NaOH LOT NO. _____
MANUF/TYPE _____ LOT NO. _____ [] ZNAOC LOT NO. _____

FILTRATION PAPER I.D.: MANUF/TYPE _____ LOT NO. _____

STANDARDS: MANUF. _____ LOT NO. _____

SAMPLER SIGNATURE _____

FIGURE 8-1

FIELD INSTRUMENTATION QUALITY ASSURANCE RECORD



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3. Immerse the probe in the pH 7 buffer solution and adjust the calibration control to read the appropriate pH. Check the pH buffer solution for correct pH value at the equilibrated temperature.
4. Remove the probe, rinse with distilled water and then immerse in either the pH 4 or pH 10 buffer solution, depending on the expected pH of the sample.
5. If the meter does not register the correct pH for that buffer solution, adjust the calibration knob on the back of the instrument to obtain the pH of the buffer.
6. After rinsing, insert the pH probe into the flow cell and allow the probe to come to equilibrium with the sample water.
7. The pH probe is stored in the ambient air overnight.

Eh Probe.

1. Check that the platinum probe is clean and the platinum band or tip is unoxidized. If dirty, polish with emery paper.
2. Immerse the standard solution, Zobell solution, and probe in a water bath at the temperature of the water to be sampled. After the temperature has equilibrated, immerse the probe and the reference probe, if required, into the Zobell solution. Record the mV reading and the temperature and compare with the expected value ($\pm 10-20$ mV).
3. Rinse the probe with distilled water or probes and insert into the flow cell. Allow for temperature equilibration and record the sample Eh.
4. At the end of the day, the probes should be stored in water.

8.2.3 Tripar Analyzer

Temperature Calibration.

Temperature Zero Adjustment - Connect the temperature sensor and select temperature as the display parameter. Remove the rear access cover exposing the sensor calibration potentiometers.

Prepare an ice water slurry and place the temperature sensor in the solution. Allow the temperature sensor to stabilize for approximately one minute while stirring the sensor in the solution vigorously. Using the adjustment tool provided in the rear cover, adjust the temperature "zero" potentiometer for a reading of 0.00°C on the system display.

Temperature Span Adjustment - Prepare a test solution to be used for temperature calibration. A beaker of water at room temperature works well as it will not be changing rapidly in temperature. Place the Tripar

temperature sensor in the test solution and allow to stabilize for approximately one minute. Using a precision laboratory thermometer, measure the temperature of the test solution. At the Tripar rear panel, adjust the temperature "CAL" potentiometer until the Tripar display reads the value of the calibration solution.

Best results will be obtained if the temperature "ZERO" and "SPAN" calibration procedures are repeated.

Conductivity Calibration. From time to time, it will be required to calibrate the Tripar conductivity circuit. A simple two-point calibration procedure is utilized by first adjusting the conductivity zero and then the span.

Conductivity Zero Adjustment - With the conductivity sensor clean, dry, and in air, adjust the conductivity "zero" potentiometer for a reading of 0000 on the Tripar display.

Conductivity Span Adjustment - Totally immerse the Tripar conductivity sensor in calibration solution of known conductance. Note that the reading displayed on the Tripar is a temperature corrected value to 25°C. Therefore, the value of the standard solution must be calculated to 25°C. Also, the value of the calibration solution should fall in the upper 50 percent of the ranges to be calibrated; i.e., adjustment of the 1000 micromho range should be accomplished with a 500 to 1000 micromho standard. Once the sensor has stabilized in the solution for approximately one minute, adjust the conductivity "CAL" potentiometer at the Tripar rear panel for a reading on the display equal to the temperature corrected value of the standard solution.

Best results will be obtained if the conductivity zero and span procedures are repeated.

pH Calibration.

pH Standardization - The pH sensor should be standardized before each use after long storage. First, moisten the electrode body with tap water and carefully remove the plastic storage cap covering the tip of the electrode. Care should be taken not to bend the body of the electrode as this can result in damage to the internal element.

For first time use after long storage, immerse the lower end of the electrode in tap water for 30 minutes. This hydrates the pH bulb and prepares the ceramic wick for contact with test solutions. If air bubbles are present in the pH bulb, shake the electrode downward to fill the bulb with solution.

Prepare a small sample of pH 7.00 buffer solution and measure the temperature of the buffer. Rinse the pH electrode with distilled water and immerse the pH bulb in the reference buffer. Set the compensation dial in the Tripar front panel to the temperature of the buffer, allow several minutes for the sensor to reach equilibrium and stir the sensor slightly to

dislodge any possible air bubbles from the electrode tip. Using the "Standardize" potentiometer, adjust for a reading of 7.00 on the Tripar display.

pH Slope Adjustment - Very infrequently, the pH slope adjustment may require re-calibration. This adjustment is available at the Tripar readout rear panel. To accomplish this adjustment, prepare a test solution of pH 4.00 or 10.00. Measure the temperature of the solution and make the appropriate setting at the pH "Compensation" dial. Rinse the pH electrode in distilled water and immerse in the buffer solution. Allow several minutes for the sensor to equilibrate and stir the electrode slightly. Using the pH "Slope" potentiometer available at the rear panel, adjust the Tripar readout module for a reading equal to the value of the buffer solution. For best results, the pH "Standardize" and "Slope" adjustments should be repeated at least once.

Note that some interference may be seen on the pH reading if the Tripar conductivity sensor is present in the same test solution as the pH sensor.

8.2.4 Photoionization Meters

HNU - Photoionization meters will be calibrated in the field and checked at each new sampling event. With the probe attached to the instrument turn the function switch to the battery check position. The needle on the meter should read within or above the green battery area on the scale plate. If the needle is in the lower position of the battery arc, the instrument should be recharged prior to any calibration. If red LED comes "on", the battery should be recharged. Next, turn the function switch to the on position. In this position the UV light source should be on.

To zero the instrument, turn the function switch to the standby position and rotate the zero potentiometer until the meter reads zero. Clockwise rotation of the zero potentiometer produces an upscale deflection while counterclock-wise rotation yields a downscale deflection. If the span adjustment setting is changed after zero is set, the zero should be rechecked and adjusted if necessary. Wait 15-20 seconds to ensure that the zero reading is stable. If necessary, readjust the zero. The instrument is now ready for calibration by switching the function switch to the proper measurement range.

Using non-toxic analyzed gas mixtures available from the manufacturer in pressurized containers, connect the cylinder with the analyzed gas mixture to the end of the probe with a piece of tubing. Open the valve of the pressurized container until a slight flow is indicated and the instrument draws in the volume of sample required for detection. Now adjust the span potentiometer so that the instrument is reading the stated value of the calibration gas.

If the instrument span setting is changed, the instrument should be turned back to the standby position and the electronic zero should be readjusted if necessary. If the instrument does not calibrate, it may be necessary to clean the probe or the lamp connection.

Photovac T.I.P. - Turn power switch on by first pulling knob out and then up. Allow T.I.P. to warm up for 5 minutes prior to use. Turn span knob to max (9) and zero knob to zero. Attach "zero air" cylinder to T.I.P. inlet using PVC tubing. Zero instrument using zero knob only. (T.I.P. is very sensitive so stable reading of absolute zero is difficult and not necessary to achieve.) Next, attach isobutylene cylinder to T.I.P. inlet. Use the span knob to adjust T.I.P. reading to the concentration number on the isobutylene cylinder (usually 60 ppm). Remove cylinder. T.I.P. is now calibrated and ready for use. (Calibration should be checked often as T.I.P. has tendency to drift.) When finished, turn power off by pulling switch out and down. Recharge instrument overnight. (Battery charger must be pushed into place and then screwed into bottom of T.I.P.)

8.2.5 Organic Vapor Analyzer

The following information is presented as general guidelines. Specific OVA field protocols are generally site-specific and would be included with the site QAPP addendum. OVAs will be calibrated in the field and checked at each new sampling event.

Equipment Set-up:

Set up the Photovac 10A10 in a temperature-stable environment at least eight to ten hours before beginning analyses. Attach AC power cord to Photovac and plug into 110V power outlet. Attach recorder AC power cord to Linear recorder and plug into 110V power outlet. If fully charged, internal battery packs provide 6 to 8 hours operation as a portable instrument.

Connect coaxial cable to "output" jack on Photovac, and plug opposite end into +/- input jacks on records. If positive meter reading on the Photovac gives negative recorder response, reverse polarity of recorder by reversing plug in +/- jacks. Attach gas supply to either "carrier in" port and measure flow rate on "vent" and "out" ports with a bubble flow meter. Proper flow rate is 10-15 ml/min during analysis; -5 ml/min on standby or overnight. Reduce flow rate for overnight flush by adjusting the air tank pressure regulator. Note: Use only "Zero grade" or better air as carrier. Plastic tubing is preferred for the connection.

Equipment Operation:

Use only air-tight syringes with sharp pointed needles to introduce samples into the Photovac. Any bend in the needle will damage the septum and analyzer will not be reliable. Pierce the septum of the sample container and rinse the syringe three or four times by working the plunger back and forth before filling with sample. Remove syringe and quickly adjust volume and make injection with no hesitation. Never remove or loosen caps or valves on sample containers. Once the septum on a sample container is pierced, complete all analyses on that sample as soon as possible, as some loss of contaminants may occur.

Never interrupt the carrier gas (air) supply without first turning the detector off! Change air tanks when pressure reaches -300 psig, or at the end of the day

if analyses are to be performed the following day (detector off while changing). Set Photovac attenuation on 100 and range on xl. Start gas flow at 10 ml/min. Place "charge" switch in off position and turn detector switch on 30 minutes prior to beginning of analysis. Turn recorder chart drive off, and with the input voltage switch set at 100 mV, turn the recorder power on. Using the "zero" and "attenuation" knobs on the recorder, set so that a zero reading on the Photovac meter gives zero plot on the recorder, and so that 100 reading on Photovac gives full scale reading on recorder. (Turn the "offset" knob on the Photovac to make meter reading change.)

Turn the "offset" knob fully counterclockwise. Meter reading should be 20-50 percent of full scale. If higher, either the air supply is contaminated or the column needs to be flushed. The instrument can still be used in this condition, but the detector can easily be overloaded. Wait until reading is 20-50 percent if possible before analysis. Set the attenuation on the Photovac to the desired setting (e.g., 100 for "unknown" or dirty samples; 10 for low ppm standards or clean samples).

Rotate the offset knob clockwise until meter (and recorder) reads -10 percent of full scale. Set the column selector switch to the desired column. Use column #1 (10 inches long) for screening unknown samples by injecting a small (~ five- μ l) amount in port #1 to determine how much sample to inject in column #2 (four feet long) for analytical purposes. Use the results of this initial small injection on column #1 to avoid overloading column #2. If column #2 is overloaded, it may take hours or even days before it is useful again.

Reset the offset (if necessary) to give 10 percent full scale reading. Wait for meter to stabilize. Set recorder chart speed to 1 cm/min and turn chart drive on (flip switch up to cm/min setting). Inject sample or standard into proper port in a smooth motion and note on the recorder chart the moment of injection. Note on the chromatogram the sample or standard identification, volume injected, column #, range and attenuation (e.g., 100 x 1), chart speed and date.

Let chromatogram run until all compounds have eluted and the baseline has stabilized before making another injection (-15-20 minutes for column #1, -30-60 minutes for column #2). Run standard mix every five or six samples to monitor changes in retention times or response. To interpret chromatograms, measure retention times from point of injection (1 cm = 1 min, or appropriate scale). Measure peak height from baseline to estimate quantity of a given compound, relating sample peak retention time and height to that of known standards. Peak height is directly proportional to concentration and to volume injected (e.g., if a 50 μ l injection of a 5 ppm standard gives a 5 cm peak with retention time of 114 seconds, a sample with a 3 cm peak at 112 seconds may contain 3 ppm of the same compounds if 50 μ l was injected).

Typical Standards, Retention Times, Response Factors for the Photovac 10A10. The retention times and response factors below are estimates based on laboratory work under controlled conditions (20°C and a carrier flow of 10-15 ml/min). Actual retention times and response factors must be acquired in the field under identical conditions to those under which samples will be run.

A table like that shown below must be generated prior to analysis of actual samples. Documentation must also include attenuation settings, column identification, head pressure and ambient conditions.

<u>Compound</u>	<u>Mixed Standard Concentration (ppm)</u>	<u>Retention Time (seconds)</u>	<u>Response 50 μl Injection (cm)</u>
methylene chloride	5.0	50	-10
1,1-dichloroethane	10.0	63	4.5
1,2-dichloroethane	20.0	100	4.5
benzene	1.0	110	6.5
toluene	2.0	285	5.8
1,1,2,2-tetrachloroethylene	2.0	340	7.1
chlorobenzene	2.0	435	7.3
xylenes	10.0	615,665,800	1.0,4.3,1.3

9.0 ANALYTICAL PROCEDURES

9.1 SELECTION OF PARAMETERS

Laboratory analyses may be scheduled for air, water, sediment, soil or waste samples. Based on historical information regarding potentially hazardous material use and disposal, previous site assessments and legislative mandates, ABB-ES may select some or all of the following parameter groups for analysis at a particular site:

- o volatile organics;
- o extractable organics;
- o pesticides/PCBs;
- o elements/inorganics; and
- o extraction procedure toxicity (EPTox).

Any additional laboratory analyses will be presented and their selection justified in the site-specific QAPP addendum. Individual contaminants comprising the analytical fractions noted above are contained in USEPA's Hazardous Substance List and/or the analytical methods selected.

9.2 SELECTION OF PROCEDURES

The analytical procedures appropriate for the majority of this program were selected based upon the IRP's legislative mandate - CERCLA. The level of analytical quality and forensic documentation indicated by this mandate normally leads to a selection of the USEPA CLP Caucus Organics Protocol (COP) and Caucus Inorganics Protocol (CIP). These state-of-the-art analytical protocols were developed with the basic requirement of legally defensible data outputs as a central criterion. Analytical protocols and data deliverables are specified in USEPA's solicitation Statement of Work for the CLP.

In some instances, however, the above protocols are not appropriate. For example, the implementation of a water supply study would require the analytical procedures to be selected based upon the requirements of the SDWA.

Each site-specific QAP addendum will list the methods selected for that task. A typical summary appears as Table 9-1. Note that the selection of CLP methods requires that the laboratory analyze matrix spike and matrix spike duplicate (MS/MSD) samples as part of laboratory QC. The sampling program must provide sufficient sample to accomplish this. For every 20 sample batches or for a group of samples less than 20 collected within a 30 day period, one sample set must be collected in triplicate. The location of triplicate sampling should be selected to best enhance the achievement of project objectives.

Table 9-1
Example Summary of Analytical Methods
for Site-Specific QAP Addendum

Analytical Data

<u>Matrix/Parameter</u>	<u>Analytical Method</u>
<u>Site 19B. Maintenance Area Around Hangers</u>	
Water: Purgeable Organics	EPA Method 624
Semivolatile Organics	EPA Method 625
Pesticides/PCBs	EPA Method 608
PP Metals	EPA Method 200.7
<u>Site 20B. Abandoned Underground Storage Tanks and Fuel Pits</u>	
Water: Purgeable Organics	EPA Method 624
Semivolatile Organics	EPA Method 625
Pesticides/PCBs	EPA Method 608
PP Metals	EPA Method 200.7
<u>Site 21B. Rubble Landfill</u>	
Soil: Purgeable Organics	EPA Method 8240
Semivolatile Organics	EPA Method 8250
Pesticides/PCBs	EPA Method 8080
PP Metals	EPA Method 6010
<u>Site 22B. Old Fire Demonstration Area</u>	
Soil: Lead	EPA Method 6010
<u>Site 23B. Drainage Ditch Leading to Sandy Creek</u>	
Sediment: Purgeable Organics	EPA Method 8240
Semivolatile Organics	EPA Method 8250
Pesticides/PCBs	EPA Method 8080
PP Metals	EPA Method 6010
Soil: Lead	EPA Method 6010
Polynuclear Aromatic Hydrocarbons	EPA Method 8100
Water: Purgeable Organics	EPA Method 624
Semivolatile Organics	EPA Method 625
Pesticides/PCBs	EPA Method 608
PP Metals	EPA Method 200.7

10.0 DATA REDUCTION, INTERPRETATION, VALIDATION AND REPORTING

Data reduction is the process of converting measurement system outputs to an expression of the parameter which is consistent with the comparability objective. Calculations made during data reduction are described in the referenced analytical methods.

Interpretation of measurements by ABB-ES is a systematic process of reviewing a body of data to provide assurance that the data are adequate for their intended use. The process includes the following activities:

- o auditing measurement system calibration and calibration verification;
- o auditing QC activities;
- o screening data sets for outliers;
- o reviewing data for technical credibility vs. the sample site setting;
- o auditing field sample data records and COC;
- o checking intermediate calculations; and
- o certifying the process above.

Field data collection and interpretation will follow the process illustrated as Figure 10-1. Prior to data collection, determinations are made regarding the data to be gathered in the field and the methodology to be used. Once the data are obtained, they will be reviewed and assessed as to their adequacy. If it is determined that the initial data collection concept did not provide adequate data, the entire process may need to be repeated to identify and correct data inadequacies.

For the IRP projects, formal data validation in accordance with USEPA's functional guidelines will not be performed by ABB-ES with the exception of interpretation to account for laboratory method blank contamination. However, the analytical events will be documented and forensic records kept to allow validation to occur at a later date, if required.

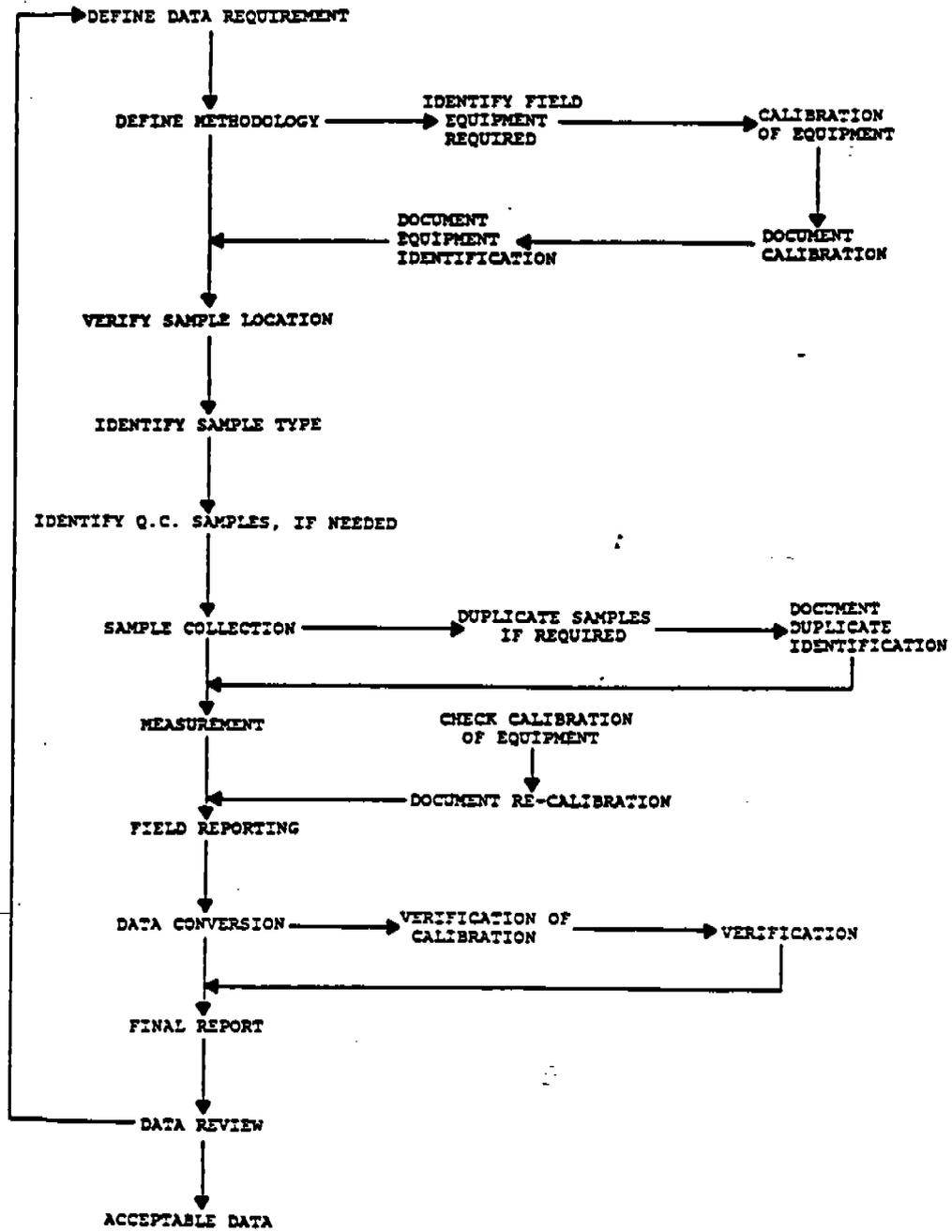


FIGURE 10-1
FIELD DATA COLLECTION
AND VALIDATION



RCRA FACILITY
INVESTIGATION
QUALITY ASSURANCE
PROJECT PLAN
U.S. NAVAL STATION
MAYPORT, FLORIDA

11.0 INTERNAL QUALITY CONTROL

11.1 MEASUREMENT SYSTEMS

Quality control procedures have been established for ABB-ES's field activities. Field QC activities include the use of calibration standards and blanks for pH, specific conductance, temperature and photoionization measurements. Special samples to be submitted to the laboratory include:

- o trip blanks;
- o duplicates;
- o sampler blanks; and
- o filtration blanks.

These samples provide a quantitative basis for evaluating the data reported.

Trip Blanks

Trip blanks are required for assessing the potential for contaminating samples with volatile organic compounds during sampling or in transit. The trip blank consists of a VOA sample container which is shipped to the site with the other VOA sample containers and filled onsite with reagent water. A trip blank is included with each shipment of samples scheduled for volatile organic analysis and will be analyzed with the other VOA samples.

Duplicates

Duplicates of soil, waste, groundwater, surface water and sediment samples will be submitted for analysis of all parameters specified for the original samples at a rate of 10% of the samples analyzed, or a minimum of 1 per event for each media sampled at each site.

These duplicates are intended to assess the homogeneity of the sampled media and the precision of the sampling protocol. True duplicates of soil, sediment and waste samples are not possible because chemicals are typically not uniformly distributed in these materials.

In addition, when specified by DON, samples will be submitted to a second "referee" laboratory. In order to maximize the utility of the data thus generated, ABB-ES will collect the specified level of replicates at the same locations originally duplicated. These samples will be forwarded to a second laboratory approved for this purpose (i.e., the specified number of referee replicate samples collected will, effectively, be triplicate sampling in some locations).

Sampler Blanks

A minimum of one sampler blank for the bailer, sampling pump, and/or tubing assembly is scheduled during monitoring well sampling. Volatile and semi-volatile organics or inorganics present within the bailer, pump apparatus, or

discharge tubing are assessed by collecting a sample of reagent water passed through the sampling apparatus after washing with the decontamination solution followed by at least one rinse with reagent water.

A minimum of two soil sampler blanks are collected during each field event; one at initiation and another at completion of activities. Volatile and semivolatile organics or inorganics present within or on the sampling apparatus where intimate contact with the sample occurs, i.e., split spoon, trowel and Shelby tubes, are assessed by rinsing the sampling apparatus with reagent water following decontamination. Rinsates are collected directly into the appropriate soil jar.

Filtration Blanks

Groundwater monitoring well samples scheduled for analysis of inorganic parameters will not be filtered. — In order to assess the cleaning procedures of the filtration apparatus, the potential for cross-contamination, and the potential contribution to the sample from the filter itself, a filtration blank will be collected for approximately every 15 samples filtered. The filtration blank will be prepared by passing reagent water through a freshly-cleaned filtration apparatus, then preserving the sample (if required) for the analyses planned. This sample may also be prepared by filtration of the sampler blank aliquot scheduled for inorganic analysis.

Completeness

Completeness of scheduled sample collection will be controlled in the field by comparing a computer generated label inventory with samples actually collected each day. Daily checking of field data sheets and comparison of transport and chain-of-custody logs will provide further control of documentation and completeness.

Evaluating Laboratory Assays of QC Control Samples and Field Replicates

Establishment of specific criteria for evaluation depends to a great extent on the number of field and quality control samples for each media sampled, the quality of chemical data generated and how the data will be used in interpreting, evaluating and assessing the site. Chemical assay results of a particular sample may be used for more than one purpose. Chemical assay results of quality control samples may be considered differently depending on how the data will be used.

At least the following items are evaluated by the professional responsible for assessing site conditions:

- o Quality of Laboratory Data:
 - acceptable
 - provisional
 - unacceptable

- o Method Limitations:
 - dynamic range
 - accuracy
 - method detection limits (MDL)
 - practical quantitation level (PQL)
 - precision

- o Sampling/Analysis Scope and Results:
 - number of replicates at one location
 - number of samples on site/media
 - background/downgradient distribution
 - consistency/trends of chemical assay data collected at site
 - agreement with existing site information

- o Use of Data:
 - chemical distribution and transport at the site (generally order of magnitude comparisons)
 - compliance with standards, regulations, response objectives
 - presence or absence of chemical
 - treatability
 - disposal method for media containing chemicals
 - risk assessment
 - litigation

11.2 QUALITY REVIEW OF STUDIES AND REPORT PREPARATION

The purpose of quality reviews through the course of studies, designs and reports is to ensure that the service, designs and documents produced by each department meet currently accepted professional standards. The level of effort for each assignment will vary depending on type of assignment, duration and size. Review of small projects may entail periodic discussions between Technical Staff, the TD and PM. Quality control on larger assignments may require that the review personnel be involved. Quality control reviews should be scheduled on a routine basis, but the option of holding a QC review at any time is always open. The time required to plan, schedule, and conduct QC reviews should be considered part of all other design, writing and checking phases of a project.

Each assignment is normally divided into phases for internal QC reviews. At each phase, the review should include client goals, contractual commitments, technical merit, timing, budget, assignment of appropriate personnel, department coordination, project problem resolution, documentation, and consistency with company policy. Key elements to the success of any QC review are identification of problem areas, communication to implement solutions, and follow-up. Due to the complexity and interlocking nature of the IRP tasks, reviews have been scheduled weekly to ensure rapid communication.

Quality control during the preparation of studies and reports relies on documentation of data utilized and peer review of conclusions drawn from the assembled data base. The comparability objective established for the project is of particular importance when data are derived from many sources (i.e., the data

base is comprised of secondary measurements). Documentation of secondary data typically is accomplished via data verification/tracking checklists with accompanying written criteria describing "acceptable" data to insure consistency in data selection. This allows all data base components to be traced to the primary generator and forces a review of data quality as the data base is developed. All project personnel are responsible for utilization and monitoring of this process; compliance is audited by the QAO. Upon completion of the data base, data interpretation, evaluation, and report preparation commence. Interpretation may require consultation with ABB-ES's statistician and/or use of computerized statistical routines. Documentation is also prepared for statistical manipulation methodologies. Data evaluation incorporates peer review to provide broad-based insight to data correlations and interactions.

To enhance the professional quality of the company's studies and reports, discipline managers will also:

- o require that reports refer to and are consistent in scope with the project proposal and contract; and
- o require that report language and contents be chosen to foster client's understanding of risks and uncertainties by distinguishing fact from opinion and identifying risks and limitations in a clear and informative manner.

Implementation of QC for reports involves the use of a review routing and sign-off forms. The Technical Director provides final review and release for all deliverables.

12.0 AUDITS

Quality assurance audits are performed to assure and document that QC measures are being utilized to provide data of acceptable quality and that subsequent calculations, interpretation and other project outputs are checked and validated. Both scheduled and unscheduled audits are provided for in the QA program.

System and performance audits may be conducted by the QAO. The TRB may conduct project audits of calculations, interpretations and reports which are based on the measurement system outputs.

12.1 SYSTEMS AUDIT

A system audit may be conducted on all components of measurement systems to determine proper selection and utilization. The systems audit includes evaluation of both field and laboratory procedures.

Organization and Personnel. The project organization is reviewed for compliance with the proposed organization and for clarity of assigned responsibility. Personnel assigned to the project will be reviewed to determine that assigned responsibility, skill and training of the personnel are properly matched. The Task Manager maintains firsthand knowledge of his team's capabilities and will discuss the organization's efficacy with the QAO. Assigned personnel may be interviewed by the QAO during an audit.

Facilities and Equipment. The audit will address whether field equipment and analytical instruments are selected and used to meet requirements specified by the project objectives stated in the QAPP. Equipment and facilities provided for personnel health and safety may also be evaluated. Calibration and documentation procedures for instruments used in the field also receives attention.

Analytical Methodology. A review of analytical methodology in regard to the data requirements for the project will be performed. An on-site observation of analyst technique, data reduction and record keeping may be performed if determined necessary. Periodic review of precision and accuracy data is essential.

Sampling and Sample Handling Procedure. An audit of scheduled samples vs samples collected vs samples received for analysis may be performed. Field documentation may be reviewed. If deemed necessary, a site visit will be made to assure that designated control procedures are practiced during sampling activities.

Data Handling. During a system audit, the QAO will review data handling procedures with the TD. Accuracy, consistency, documentation, and appropriate selection of methodologies will be discussed.

12.2 PERFORMANCE AUDIT

These audits are intended primarily for analytical data generation system and are provided in the laboratory's QAP.

12.3 PROJECT REVIEW

Project reviews are scheduled and conducted by the department responsible for the project. The intent of project reviews is to assess scope compliance and overall technical quality of the contracted services. Senior technical staff, selected by the Department Manager, apply the accumulated experience of the company to a service during the conduct of the work. A project review is appropriate at, for instance, work plan finalization, selection of design criteria, end of field program, determination of conclusion and recommendations, or the traditional stages of design completion. Documentation of the project review, especially identified action items and their follow-up, is essential to maximizing the utility of these reviews. Figure 12-1 provides an example project review record.

12.4 QA AUDIT REPORT

A written report of the QA project audit is prepared to include:

- o an assessment of project team status in each of the major project areas;
- o clear statements of areas requiring improvement or problems to be corrected. Recommendation and assistance will be provided regarding proposed corrective actions or system improvements. If no action is required, the report will state that the QA audit was satisfactorily completed; and
- o a timetable for any corrective action required.

Figure 12-2 provides an example QA Audit Report. Distribution of the report will include the TRB, CO, TD, and PM.

FIGURE 12-1
PROJECT REVIEW RECORD

Project Name:
Project No.:
Site/Location:
Client:
Project Type:

Date:
Project Professional:

Department:

Objective of the Review:

Reviewers: 1.
2.
3.

Consensus Review Comments:

- 1.
- 2.
- 3.
- 4.
- 5.

Follow-up Actions:

- 1.
- 2.
- 3.

Date Follow-up Completed:

Project Professional: _____

Department Manager: _____

Distribute when completed to: VP-QA, Dept. Mgr., Project File, Reviewers

FIGURE 12-2
QUALITY ASSURANCE AUDIT REPORT

Project: _____

Project No.: _____ Quality Assurance Coordinator: _____

Project Aspects Audited: _____

Laboratory/Technical Director: _____

Audit Conducted By: _____ for the period _____ to _____

Date of Audit: _____

Personnel Interviewed: _____

Purpose and Objectives of the Project Aspects Audited

Brief Description of the Sampling and Analytical Requirements

FIGURE 12-2 (Continued)
RESULTS OF THE QUALITY ASSURANCE AUDIT

Organization and Personnel

Facilities Utilized

Analytical Methodologies

FIGURE 12-2 (Continued)
RESULTS OF THE QUALITY ASSURANCE AUDIT

Sampling and Sample Handling

Quality Control Measures Utilized

Data Handling

FIGURE 12-2 (Continued)
RESULTS OF THE QUALITY ASSURANCE AUDIT

Quality Assurance Deficiencies

Recommended Corrective Actions and Schedule

Distribution:

Signed Date

Title

Reviewed by Date

Title

13.0 PREVENTIVE MAINTENANCE

13.1 ANALYTICAL INSTRUMENTATION

Preventive maintenance of analytical instrumentation is addressed by the selected laboratories' standard operating procedures.

13.2 FIELD INSTRUMENTS

Preventive maintenance of field equipment is performed by analysts and staging area staff and routinely precedes each sampling event; more extensive maintenance is performed on the basis of hours in use. Sampling crews report on the performance of the equipment after each sampling event. Critical spare parts are kept in stock.

14.0 DATA ASSESSMENT

14.1 GENERAL

The purpose of data quality assessment is to assure that data generated under the program are accurate and consistent with project objectives. The quality of data will be assessed based on the precision, accuracy, consistency and completeness of the data that are generated.

Data quality assessment will be conducted in three phases:

Phase 1

Prior to data collection, sampling and analysis procedures are evaluated in regard to their ability to generate the appropriate, technically acceptable information required to achieve project objectives. This QAPP meets this requirement by establishing project objectives defined in terms of parameters, analytical methods, and required sampling protocols.

Phase 2

During data collection, results will be assessed to assure that the selected procedures are efficient and effective and that the data generated provides sufficient information to achieve project objectives. The appropriateness of the precision and accuracy of selected measurement systems will also be evaluated. In general, evaluation of data will be based on performance audits, results of duplicate and spiked sample analyses, and review of completeness objectives.

Documentation may include:

- o number of replicate samples collected;
- o number of replicate, spike and field blank samples analyzed;
- o identification of statistical techniques, if used, to measure central tendency, dispersion, or testing for outliers;
- o use of historical data and its reference; and
- o identification of analytical method.

Phase 3

Following completion of data collection activities, an assessment of the adequacy of the data base generated in regard to completing project objectives will be undertaken by the QAO and Task Manager. Recommendations for improved quality control will be developed, if appropriate. In the event that data gaps are identified, the auditor may recommend the collection of additional raw data to fully support the project's findings and recommendations.

Each phase of the assessment will be conducted in conjunction with appropriate project staff.

14.2 PROCEDURES TO ASSESS PRECISION AND ACCURACY

Assessment of precision and accuracy of analytical data is accomplished via review of duplicate analyses (precision) and surrogate spike recovery (accuracy) both in reagent water and sample matrices. Precision is generally expressed as the coefficient of variation (CV). Accuracy is expressed as percent recovery. Precision must be assessed for each matrix since distribution of contaminants may be non-homogeneous, especially in non-water matrices. Precision in samples must be reviewed with knowledge of the matrix and level of analyte present. Corrective action or documentation of substandard precision is a laboratory responsibility. Accuracy, too, must recognize the impact of matrix interferences. Optional surrogate/spike recoveries are generally specified by the analytical method for reagent water under defined conditions. Each method which provides quality control requirements and acceptance criteria also specifies the method of generating the data to be reviewed. It is the laboratory's responsibility to attempt to identify the source of substandard recoveries and either take corrective action or document the cause.

Calculations are presented below:

$$\%R = \frac{\text{observed value}}{\text{theoretical value}} \times 100$$

$$CV = (S/X) \times 100$$

where %R = percent recovery

CV = coefficient of variation

S = sample standard deviation

X = mean value of data set

Completeness is generally assessed as a percentage of data intended to be generated, and is most often utilized in Phase 3 of the data assessment process.

15.0 CORRECTIVE ACTION

Corrective or preventive action is required when potential or existing conditions are identified that may have an adverse impact on data quantity or quality. Corrective action could be immediate or long-term. In general any member of the program staff who identifies a condition adversely affecting quality can initiate corrective action by notifying in writing his or her supervisor and the QAO. The written communication will identify the condition and explain how it may affect data quality or quantity.

15.1 IMMEDIATE CORRECTIVE ACTION

Immediate corrective action is usually applied to spontaneous, non-recurring problems, such as an instrument malfunction. The individual who detects or suspects nonconformance to previously established criteria or protocol in equipment, instruments, data, methods, etc., will immediately notify his/her supervisor. The supervisor and the appropriate task leader will then investigate the extent of the problem and take the necessary corrective steps. If a large quantity of data is affected, the task leader must prepare a memorandum to the Project Manager and the QAO. These individuals will collectively decide how to proceed. If the problem is limited in scope, the task leader will decide on the corrective action measure, document the solution and notify the Technical Director and the QAO in memorandum form.

15.2 LONG-TERM CORRECTIVE ACTION

Long-term corrective action procedures are devised and implemented to prevent the recurrence of a potentially serious problem. The QAO will be notified of the problem and will conduct an investigation to determine the severity and extent of the problem. He will then file a corrective action request with the Technical Director and Technical Review Board (TRB).

In case of dispute between the TRB and the PM, the Corporate Officer (CO) will make a final determination for the company.

Corrective actions may also be initiated as a result of other activities, including:

- o Performance Audits;
- o System Audits;
- o Laboratory/field comparison studies; and
- o QA project audits conducted by the TRB or QAO.

The QAO will be responsible for documenting all notifications, recommendations, and final decisions. The PM and the QAO will be jointly responsible for notifying program staff and implementing the agreed upon course of action. The QAO will be responsible for verifying the efficacy of the implemented actions. The development and implementation of preventive and corrective actions will be

timed, to the extent possible, so as to not adversely impact either project schedules or subsequent data generation/processing activities. The QAO will also be responsible for developing and implementing routine program controls to minimize the need for corrective action.

16.0 REPORTS TO MANAGEMENT

Summary audit reports may be prepared coincident to the completion of each Task to inform task staff and management of QA status. A final audit report for each project will also be prepared. The reports would include:

- o periodic assessment of measurement data accuracy, precision and completeness;
- o results of performance audits and/or systems audits;
- o significant QA problems and recommended solutions for future projects; and
- o status of solutions to any problems previously identified.

Additionally, any incidents requiring corrective action will be fully documented. Procedurally, the QAO will prepare the reports to management. These reports will be addressed to the Technical Director and the Technical Review Board. The summary of findings shall be factual, concise and complete. Any required supporting information will be appended to the report.

ATTACHMENT A
SITE-SPECIFIC QUALITY ASSURANCE PLAN FORMAT

Site-Specific Quality Assurance Plan

IRP - SITE NAME

Task: (Number & Title)

Task Objective:

Subtasks

Standard Protocol Selected

Sample Wells

reference section #
of QAPP or explain
protocol to be used

Task Organization

Name

Function

Subcontractors

Function

Local Contacts

Function

Insert Sampling Data

Sample Identification/Cross Reference

ECJ ID No.

Sample Locations

APPENDIX B
SITE-SPECIFIC QUALITY ASSURANCE PLAN

QUALITY ASSURANCE PLAN

Task: NAVSTA Mayport RCRA Facility Investigation.

Task Objectives:

- Further assess the nature and distribution of contaminants found in the soil, sediment, groundwater, and surface water.
- Further characterize local hydrogeology.
- Provide the necessary data base for the Health and Environmental Assessment.

Subtasks:

Soil Sampling	Technical Memorandum (attached)
Surface Soil Sampling	Technical Memorandum (attached)
Sediment Sampling	Technical Memorandum (attached)
Monitoring Well/Piezometer	Technical Memorandum (attached)
Groundwater Sampling	Technical Memorandum (attached)
Surface Water Sampling	Technical Memorandum (attached)
Laboratory Analysis	CH ₂ M Hill Laboratory QAPP (Appendix C)
In-Situ Hydraulic Conductivity Test	Technical Memorandum (attached)
Electric Driven Soil Gas Probe	Technical Memorandum (attached)
PCB Field Screening	Technical Memorandum (attached)
Qualitative Aquatic Survey	Technical Memorandum (attached)
Quantitative Benthic Macroinvertebrate Sampling	Technical Memorandum (attached)
Sampling of Molluscs and Crustaceans for Tissue Analysis	Technical Memorandum (attached)

Task Organization:

<u>Name</u>	<u>Function</u>
J. McVoy	Program Manager
P. Georgariou	HSO, QAO
G. Brown	Project Manager
M. Keirn	RFI Task Leader
	Health and Environmental Assessment

<u>Subcontractors</u>	<u>Function</u>
CH ₂ M Hill Laboratory	Chemical Analysis
E.A. Engineering	Taxonomy
To be determined	Well/Piezometer Installation
To be determined	Monitoring Well Survey
To be determined	Tissue Analysis/Bioassay

TECHNICAL MEMORANDUM

PREPARED BY: Eric Blomberg

DATE: November 1989

TITLE: ELECTRIC DRIVEN SOIL GAS PROBE

PURPOSE: The purpose of this technical memorandum (TM) is to provide technical guidance pertaining to the operation and sampling of an electric driven soil gas probe. These procedures are intended to establish baseline practices to assist Technical Directors and Site Managers in preparing and implementing site-specific workplans. The procedures that follow are not to be interpreted as a rigorous standard and some deviations are anticipated based on site conditions.

SCOPE: The electric driven soil gas probe discussed in the TM is a quick and relatively inexpensive method to verify a subsurface gas release, and if necessary, to characterize the nature, extent, and rate of migration of the gaseous material through the soil.

It is very important to monitor methane gas due to its explosive properties when it reaches high concentrations. Methane gas can also serve as a carrier gas, indicating the possible migration of hazardous compounds away from the source area. Other gases such as carbon dioxide and sulfur dioxide may also serve as indicators.

In addition to the above mentioned gaseous compounds, the total organic vapor concentration in the soil gas can be determined with the aid of an Organic Vapor Analyzer (OVA). Individual compounds (i.e. benzene or toluene) can be identified by using a field gas chromatograph (GC). With the results from the analyses above, the lateral and vertical extent of the gaseous plume can be determined.

EQUIPMENT:

Electric slap hammer
Connecting shaft
Slotted stainless steel point or retractable point
Rod connecting bolts
Teflon tape
5/8-inch hollow stainless steel rods
Crescent wrench
Extension cord
Polyethylene tubing
Air bladder pump
Organic Vapor Analyzer (OVA)
Tedlar bags
Gas Chromatograph (GC)
Jack

PROCEDURE:

Assembly of the Electric Gas Probe

1. Choose the slotted point that is best suited for the soil where the soil gas exploration will take place. In sandy soils the point with slots on the surface will give the best results. For clayey and silty sands, the retractable slotted point is most effective because the fine soil particles cannot plug the slots. Neither point is very effective in clays and it is not recommended that this method be used in clayey soils.
2. Heavily wrap the bolt protruding from the point with Teflon tape to ensure a good seal and prevent leakage during sampling. The Teflon tape will also prevent the point from vibrating loose and disconnecting down the hole.
3. Connect the point to a 2.5-foot section of rod and tighten firmly with a crescent wrench.
4. Attach the connecting shaft to the rod with a Teflon taped bolt and tighten firmly.
5. Lock the electric slap hammer to the connecting shaft and drive the point and rod into the ground.
6. Continue to add and drive 2.5-foot sections of rod until the desired depth of soil gas sampling is reached.

Electric Gas Probe Sampling

1. Once the depth of soil sampling is reached, the hammer and connecting shaft are disconnected from the driven string of rods.
2. A fitting with polyethylene tubing is screwed to the top of the exposed rod.
3. The tubing is connected to an air bladder pump and the air in the string of rods is purged for 3 minutes to ensure a representative soil gas sample is obtained from the respective sampling depth.
4. Once the gas probe has been purged, an OVA is connected to the discharge port of the bladder pump and a reading of total organic vapor concentration is obtained. After the reading is taken, a carbon filter (which filters all organic vapors except methane) can be attached to the OVA and the methane concentration at the respective sampling depth can be determined.
5. A soil gas sample can also be collected from the pump in a Tedlar bag and analyzed on a field GC to identify compounds other than methane that may be present.

6. Several soil gas samples can be collected from the same location at different depths.
7. Once all the soil gas samples have been collected from the sampling location, the rods and point are pulled from the ground with a customized jack especially designed for this system.
8. The point and the rods should be decontaminated between sampling locations to prevent cross contamination. The point and rods should be scrubbed with a cleanser (i.e. Alconox) and water, rinsed with deionized water, rinsed with isopropyl alcohol, and rinsed again with deionized water.

TECHNICAL MEMORANDUM

PREPARED BY: Gregory M. Brown

DATE: September 23, 1991

TITLE: DRILLING AND SUBSURFACE SOIL SAMPLING

PURPOSE: To provide technical guidance and standard operating procedures for drilling and subsurface soiling sampling at Naval Station Mayport, Florida. It presents the methods for borehole construction and subsurface soil sampling using hollow-stem auger technique and split-spoon samplers, specific for conditions expected to be encountered at Naval Station Mayport during RCRA Facility Investigations (RFI).

SCOPE: Hollow-stem auger, split-spoon subsurface soil sampling, and field screening of soil samples. Standard operating procedures for related activities such as monitoring well installation are presented in the applicable Technical Memorandum.

Drilling. Drilling activities will be used to collect subsurface soil samples and to construct groundwater monitoring wells. Monitoring wells completed in the Surficial Deposits will be drilled with hollow stem augers (HSA). Monitoring wells completed in the Upper Hawthorn Group will be drilled by a combination of HSA in the Surficial Deposits and rotary technique to the Upper Hawthorn. The Upper Hawthorn wells will be constructed with surface casings (double-cased).

General groundwater monitoring well construction details specific to Naval Station Mayport are described in Section 3.2.3.1, Volume II, Sampling and Analysis Plan. Figures 3-3a through 3-3d of Volume II, Sampling and Analysis Plan, present typical monitoring well installation details. Well construction methods and materials are described in applicable Technical Memoranda (WELL CONSTRUCTION AND DEVELOPMENT and "Southern Division Naval Facilities Engineering Command Guidelines for Groundwater Monitoring Well Installation") located in the Site Specific QAP, Appendix B, Volume II, Sampling and Analysis Plan.

A truck-mounted drill rig with high torque capacity such as the Failing F-6 auger rig will be used to install the wells in the Surficial Deposits and the initial portions of the Upper Hawthorn monitoring wells. A rotary rig, such as a Speed Star, will be used to drill the Upper Hawthorn wells below the depth of the surface casing (keyed into an upper confining unit) to their completion depth. Surface casings will be used for wells completed in the Upper Hawthorn to minimize cross contamination between water-bearing zones.

Auger cuttings will be collected and placed in containers until analytical data indicate the appropriate method of disposal for these materials as described in Section 2.1.6, Volume II, Sampling and Analysis Plan. Drilling fluids will also be containerized. Augers, rods, bits, mud pits, temporary surface casings, and other intrusive equipment will be decontaminated accord-

ing to referenced standard operating procedures (Decontamination Procedures, Appendix B, Volume II).

Drilling activities will be documented through completion of boring logs. Bound field logbook(s) will also be kept to record data not recorded on the boring logs. Documentation will be completed in accordance with Section 3.1.8, Volume II, Sampling and Analysis Plan.

Subsurface Soil Sampling. Subsurface soil samples will be collected in the surficial deposits while drilling monitoring wells (refer to applicable sections in Volume II, Sampling and Analysis Plan, for boring and sample locations at each site). Borings will be advanced by hollow stem augers (HSAs) in the Surficial Deposit. Soil samples will be collected at five-foot intervals using split-spoon samplers. Borings will be logged by a qualified geologist in accordance with the Unified Soil Classification System. Soil samples will be field screened using an OVA or equivalent as described below.

Soil samples for laboratory chemical analysis will be collected from selected borings at just above groundwater level. Judgmental samples may be collected if visual inspection or field screening data from an OVA (or equivalent) indicates potential contamination. Depth to groundwater will vary from site to site, but is expected to be approximately 10-feet below surface on average over the facility.

Samples for physical parameters will be collected in the next adjacent sample interval (i.e., five-feet below) after collection of the samples for laboratory analysis. The following procedures for boring and collection of subsurface soil samples within the Surficial Deposit are described below.

1. Drilling and sampling equipment (e.g., split-spoons) coming into contact with site soils will be decontaminated prior to sampling, between sampling locations, and at the completion of work using standard operating procedures.
2. Store decontaminated equipment on clean, polyethylene sheeting or wrapped in aluminum foil or plastic bags between uses. Following decontamination, do not allow sampling equipment to touch the ground prior to use.
3. A truck-mounted drill rig will be used to advance the hollow stem auger. Locate the boring point from the appropriate "Location of Exploration" figures in Volume II, Sampling and Analysis Plan. Clear the area for above ground and subsurface utilities. Set up drilling equipment and exclusion zone, as specified in the Health and Safety Plan.
4. The borings will be drilled through the Surficial Deposit using hollow stem augers. The borings will be logged by a qualified engineer or geologist.
5. Obtain background or HNU, OVA, or TIP readings. Obtain readings at the borehole and in the breathing zone while drilling and col-

lecting samples. Record organic vapor readings in the field logbook.

6. Soil samples will be continuously collected using 2-inch O.D., 18-inch long, steel split-spoon samplers (Standard Penetration Test ASTM D1586-84).
7. Collect samples at five-foot intervals through the Surficial Deposit. Remove any disturbed material from the top of the sample interval. Fill sample containers by collecting soil material from the entire sample interval. For borings where samples are to be chemically analyzed, perform headspace field screening on a portion of the sample, as described below. Record organic vapor readings in field logbook.
8. Number and label the sample containers as directed in Section 3.1.5, Volume II, Sampling and Analysis Plan.
9. Complete field documentation and chain-of-custody records for each sample selected for analysis, according to Section 3.1, Volume II, Sampling and Analysis Plan.
10. Decontaminate the outside of the sample containers.
11. Preserve the samples according to Section 3.1.6, Volume II, Sampling and Analysis Plan.
12. Follow the packaging and shipping protocol described in Section 3.1.7, Volume II, Sampling and Analysis Plan.

Field Screening. The following procedures will be followed to field screen subsurface soil samples.

1. Collect soil sample from split-spoon sampler.
2. Transfer approximately 100 to 200 cubic centimeters of sample to a sealable plastic bag using a clean stainless steel spoon. Seal the remaining portion of the sample in an appropriate container and label according to Section 3.1.5, Volume II, Sampling and Analysis Plan.
3. Agitate the sample in the bag in order to break up the soil matrix and maximize the surface area of soil which is in contact with the headspace.
4. Insert the instrument probe of the HNu, OVA, or TIP inside the bag, sealing around the opening as much as possible.
5. Read the concentration of organic vapors after a pre-determined equilibrium period has elapsed (at least 30 seconds) or after the instrument read-out has stabilized.

6. Record the organic vapor concentration and gross physical characteristics of the sample (e.g., dry, wet, sandy, clayey, discolored). Verify that the original sample number is recorded with this data so that sample selection for laboratory analyses can be made.
7. Review the headspace screening data after completion of subsurface soil sampling at the boring location, and select samples for laboratory analyses which show elevated organic vapor levels.
8. Dispose of un-selected samples with the auger cuttings.

TECHNICAL MEMORANDUM

PREPARED BY: Gregory M. Brown

DATE: September 23, 1991

TITLE: WELL CONSTRUCTION AND DEVELOPMENT

PURPOSE: To provide technical guidance and standard operating procedures for well construction and development at Naval Station Mayport, Florida. It presents the construction and development methods for shallow and deep single-cased monitoring wells completed in the surficial aquifer, and deep double-cased monitoring wells completed in the Secondary Aquifer (Upper Hawthorn Group), specific for conditions expected to be encountered at Naval Station Mayport during RCRA Facility Investigation (RFI).

SCOPE: Construction and development of Surficial and Secondary Aquifer monitoring wells at Naval Station Mayport. Standard operating procedures for related activities such as drilling, subsurface soil sampling, and groundwater sampling are presented in other applicable Technical Memoranda.

Well Construction. Monitoring wells completed in the Surficial Aquifer (of the Surficial Deposits) will be constructed with 2-inch I.D. Schedule 40 PVC with flush-threaded joints. Monitoring wells completed in the Secondary Aquifer (of the Hawthorn Group) will be constructed with 4-inch I.D. Schedule 40 PVC with flush-threaded joints. Typical well completion details are shown in Figures 3-3a through 3-3d, Volume II, Sampling and Analysis Plan. No solvents or cement will be used in well fabrication.

Well installation operations will be performed by the drilling subcontractor and documented by the field geologist/engineer. The drilling subcontractor will supply materials and equipment necessary to perform drilling, construction and installation of the monitoring wells, grout boreholes, develop monitoring wells, containerize drilling by-products and related fluids, and operate a decontamination station, as specified - he Field Operations Leader.

Materials. Well materials shall be new and undamaged. Materials which are damaged or determined to be not in accordance with desired specifications will be rejected. Equipment and materials will be decontaminated as described in the

Technical Memorandum, Decontamination Procedures, Appendix B, Volume II, Sampling and Analysis Plan, prior to use and will be stored in a fashion that will adequately protect them from contamination or degradation.

Surface Casings. PVC surface casings will be used in the construction the Upper Hawthorn Group monitoring wells as opposed to stainless steel recommended by the "Guidelines for Monitoring Well Installation", due to the potential

corrosive environment posed by surficial aquifer water quality. The surface casings will be keyed into at least the upper five feet of the first encountered sound confining unit. These casings will limit the potential for downward contaminant migration from the Surficial Deposit soils.

Cement/Bentonite. A cement/bentonite grout will be used with the surface casings of wells constructed within the Upper Hawthorn Group. The cement/bentonite grout will be placed by tremie at the bottom of the initial wide-diameter open borehole to at least a three-foot thickness. The surface casing will be centered into this cement/bentonite grout plug before it hardens. Cement/bentonite grout will then be placed by tremie in the annular space between the surface casing and the borehole. After the grout has set, the borehole will be advanced through the cement/bentonite plug to the required depth by drilling inside the installed surface casing.

Well Pipe. Well casing for the Upper Hawthorn Group monitoring wells will consist of 4-inch I.D. Schedule 40, flush-threaded PVC riser pipe. Well casing for the Surficial Deposits monitoring wells will consist of 2-inch I.D. Schedule 40, flush-threaded PVC riser pipe. The casing for wells will extend from the top of the well screen to approximately 2 feet above ground surface. Monitoring wells in areas of vehicular traffic will be flush mounted with Christie Boxes or equivalent to minimize surface hazards. Well casing will be capped with a vented cap of same size. No solvents or cements will be used to connect sections of pipe. Teflon tape may be used as an added seal on the riser threads. Stainless steel centralizers may be used at 20 foot intervals for monitoring wells installed deeper than 50 feet.

Well Screen. Well screen for the Upper Hawthorn Group monitoring wells will consist of 4-inch I.D. Schedule 40 flush-threaded with slots of No. 10 size (0.010-inch). Well screen for the Surficial Aquifer monitoring wells will consist of 2-inch I.D., flush-threaded, PVC pipe with slots of No. 10 (0.010-inch). Shallow (10 to 15 feet) Surficial Aquifer wells will be screened their entire saturated thickness to approximately 3 feet above the encountered groundwater table. Deep (25 to 30 feet) Surficial Aquifer Wells screen lengths will be 5 feet. Upper Hawthorn wells screen lengths will be approximately 10 feet. No solvents or cements will be used to connect sections of screen. Teflon™ tape may be used on threads to promote a tighter seal.

Sand Pack Material. The annular space between the well screen and the borehole wall will be backfilled with clean, washed, well-graded, silica sand compatible with the formation. Filter material shall be uniformly graded and of an appropriate size range so that no significant loss of filter material will occur during development (less than 10 percent loss).

Buffer Sand. A 1- to 2-foot thick (approximate) buffer sand layer will be placed above the sand pack. The sand will be a very fine sugar sand. It will be used to restrict the bentonite grout from infiltrating into the sand pack placed around the screened interval.

Bentonite Grout. The annular space between the well casing and the borehole or permanent casing (if installed) will be grouted from the top of the buffer sand to the ground surface. A high-solids bentonite grout with low permeability

ty, will be used on well . The bentonite rout will be mixed to manufacturer's recommendations. A mud scale will be used to verify proper grout mixture. The grout will be tremied into place.

Protective Steel Casing. A 4-inch I.D. or larger, 5-foot long, protective steel casing with hinged and lockable steel cap shall be installed over the monitoring well casing. The protective casing shall be embedded into the cement/bentonite grout prior to hardening. The protective casing shall be installed so that the well cap can be easily removed and the hinged casing top will move freely. Upon completion of the installation of each monitoring well, the well will be marked on the protective steel casing in the field by stenciling (with spray paint) well designation numbers. A drainage hole will be provided in the protective steel casing at the top of the cement surface seal (maximum 2 inches above surface seal). Casings will be equipped with common-key locks.

Concrete Pad and Protective Posts. A minimum 4-inch-thick, 3-foot by 4-foot concrete pad shall be installed at ground surface around the protective steel casing. The concrete pad will be constructed using Sakrete, Quikrete, or similar concrete mix and will not be installed for at least 24 hours after setting the protective steel casing in the cement/bentonite grout. Wells in areas with vehicular traffic will be flush mounted using Christie Boxes or equivalent. Others will be installed with protective posts painted a conspicuous color.

Monitoring Well Installation. The installation of the surface casings for the Upper Hawthorn monitoring wells will require the following steps.

1. The Upper Hawthorn Group monitoring wells will require surface casings. A 10-inch I.D. surface casing will be installed through a boring advanced by using a 14-inch outside diameter hollow stem auger. Subsurface soil samples will be obtained from selected monitoring well borings as described in the Technical Memorandum, DRILLING AND SUBSURFACE SOIL SAMPLING, Appendix B, Volume II, Sampling and Analysis Plan. The hole will be drilled into at least the upper 5 feet of the first upper confining unit and a 10-inch Schedule 40 PVC casing set to the bottom. The total depth of the surface casing will be approximately 50 feet below land surface (bls) depending on location.
2. A minimum two-foot thick cement/bentonite plug will be placed at the bottom of the upper wide-diameter borehole and a nominal 10-inch Schedule 40 PVC casing centered in the grout before it hardens. A tremie pipe will be used to grout the annular space between the 10-inch casing and the borehole from the bottom of the boring to land surface. The cement/bentonite grout will be allowed to harden for 24 hours.
3. A 9 7/8-inch tricone bit will be used to further advance the borehole down into the Upper Hawthorn unit (approximately 110 feet bls) by drilling within the installed surface casing.

4. After the surface casing is installed and drilling has been completed to the Upper Hawthorn, the well screen and riser pipe will be lowered down the boreholes to their intended depths and will be completed as described below.

The following procedures will be followed for installation of monitoring wells in the shallow Surficial Aquifer, deep Surficial Aquifer, and Upper Hawthorn units.

1. Depth of the completed boring will be measured with a weighted tape. Boreholes will be drilled approximately 1 to 2 feet below the intended bottom of the screened interval in order to permit placement of a layer of buffer sand in the bottom of the hole. If the borehole has been drilled greater than 2 feet below the intended bottom of the screened interval, bentonite grout will be used to backfill the excess space in the bottom of the borehole. Depth measurements will be made with a weighted tape during placement of bentonite grout. A sufficient amount of borehole space will be retained above the backfill to permit placement of approximately a 1- to 2-foot layer of buffer sand.
2. Place approximately 1- to 2-foot layer of buffer sand in bottom of hole. If bentonite grout has been placed in the bottom of hole, remeasure depth of hole prior to placement of the buffer sand layer.
3. Well screen, casing, end plug, and centralizers (if used) will be assembled. All printed marks on the casing and screen materials should be removed during decontamination prior to use.
4. Lower the well assembly through the permanent surface casing and borehole until resting on the layer of buffer sand (taking care to verify proper depth setting of well materials). In wells greater than 50 feet deep, stainless steel centralizers may be placed above the screen and approximately every 20 feet to the surface. The well materials shall be held in a slight strain to allow the pipe to hang straight. The well construction contractor will assure that the upper Hawthorn wells are plumbed vertical.
5. Begin adding the filter pack sand. Repeated depth measurements of the bottom of the hole will be taken to monitor the level of the filter material and detect any bridging of sand that may occur. Sufficient time shall be allowed for the filter material to settle through the water column within the casing/borehole. A tremie pipe may be used to place filter material in wells deeper than 50 feet. The filter material will extend from the layer of buffer sand at the base of the well screen to at least 1 foot (preferably 1 to 2 feet) above the top of the well screen.
6. A buffer sand layer approximately 1- to 2-feet thick will be placed above the sand pack material prior to grouting.

7. The remaining annulus will then be grouted from the top of the buffer sand to the ground surface with a high-solids grout. The grout will be tremied into the annulus to the ground surface.
8. A protective steel casing will be centered over the well casing and inserted into the grouted annulus prior to grout hardening.
9. No sooner than 24 hours after grouting, the concrete pad shall be installed next to the monitoring well protective casing. The concrete pad will be sloped to allow drainage away from the well. The protective casing will be painted with a rust-preventative, conspicuously colored, paint. Flush mounted Christie Boxes or equivalent will be used in areas with vehicular traffic.
10. The elevation of the top of each well riser pipe and the adjacent land surface will be surveyed to the nearest 0.01 foot by a registered professional land surveyor no sooner than 48 hours following completion of the monitoring wells.

Drilling Material Samples. To identify possible contaminants in materials used for drilling activities, the field sampling personnel responsible for borehole drilling, well construction, and well development will collect one sample from each of the following materials:

- Monitoring well filter pack sand;
- Bentonite;
- Grout slurry;
- Drilling mud; and
- Municipal water used for drilling fluid.

Each sample will be analyzed for RCRA Appendix IX volatile organics, semi-volatile, and metals.

Well Development. Following monitoring well installation, each well will be developed to increase yield and to remove fluids that may have been introduced during drilling operations. Development will be initiated no sooner than 24 hours following the completion of grouting. Development will proceed by pumping or by hand bailing. Each well will be developed by removing a minimum of 10 well volumes of water or until well is free of apparent turbidity. At well locations with very slow recharge or little water, wells will be developed dry 3 times. Water removed from the wells during the development will be contained for subsequent treatment or disposal.

The following procedures will be used for well development:

1. Approach the well from an upwind direction, obtain and record OVA, TIP or HNu readings at the well head (with cap off) and in the breathing zone. The field team may continue to work in modified Level D personnel protection if the OVA/HNu readings do not exceed the action level set in the Site Health and Safety Plan.

2. Check the well for above-ground damage.
3. Equipment used during development will be decontaminated using the procedures in the Technical Memorandum, DECONTAMINATION PROCEDURES. Appendix B, Volume II, Sampling and Analysis Plan.
4. Measure and record the depth from the top of the well casing to the top of static water level in the well casing. Measure the total depth of the well relative to the top of casing. Calculate the height of water column (feet) and standing volume (gallons) of water in the well based upon known well details from installation records or measured total depth of well.
5. If a submersible pump is used for development, lower the decontaminated pump into the well to a point approximately 1 foot above the bottom of the well. Begin pumping. If a bailer is used, bail the well from the bottom of the screened interval using the bailer to frequently surge the well prior to bringing the bailer to the surface.
6. Development will continue until at least 10 well volumes have been removed or until well is free of apparent turbidity. At well locations with very slow recharge or little water, wells will be developed dry 3 times. Noticeable odors, discoloration, and turbidity or suspended sediment content should also be noted and described on the field sheet or field notebook.
7. Additional surging, with approval of the Field Operations Leader, may be required to suspend sediment for removal from the wells if greater than 6 inches of sediment is measured in the bottom of the well.
8. Upon completion, record the following information on the appropriate field sheet or in the field notebook:
 - date and time of start of well development;
 - initial static water level;
 - total depth of well;
 - well development method;
 - volume of water removed;
 - date and time of well development completion; and
 - post pumping/bailing water level.
9. Decontaminate equipment used during development of well following the procedures in the Technical Memorandum, DECONTAMINATION PROCEDURES. Appendix B, Volume II, Sampling and Analysis Plan.;
10. Replace well cap and lock protective casing; and
11. Store development water until appropriate arrangements can be made for proper treatment or disposal.

TECHNICAL MEMORANDUM

PREPARED BY: Gregory M. Brown
DATE: September 23, 1991
TITLE: GROUNDWATER SAMPLING

PURPOSE: To provide technical guidance and standard operating procedures for groundwater sampling at Naval Station Mayport, Florida. It presents the groundwater sampling methods for shallow and deep single-cased monitoring wells completed in the surficial aquifer, and deep double-cased monitoring wells completed in the Secondary Aquifer (Upper Hawthorn Group), specific for conditions expected to be encountered at Naval Station Mayport during RCRA Facility Investigation (RFI).

SCOPE: Groundwater sampling methods for monitoring wells at Naval Station Mayport. Standard operating procedures for related activities such as drilling, subsurface soil sampling, and monitoring well construction are presented in other applicable Technical Memoranda.

Groundwater samples will be collected from each of the newly installed monitoring wells upon completion of well development. New wells will not be sampled for at least 48 hours after development. Wells will be sampled upon significant recharge, but no later than 24 hours after purging. Prior to each sampling event, groundwater levels and total depths of the wells will be measured on the same day. The procedures to be followed for collection of these data are as follows.

1. Approach the well from an upwind direction, obtain and record OVA/HNu readings at the well head (with cap off) and in the breathing zone.
2. Check the well for above-ground damage.
3. Equipment used during sampling will be decontaminated using the procedures outlined in the Technical Memorandum, DECONTAMINATION PROCEDURES, Appendix B, Volume II, Sampling and Analysis Plan.
4. Measure and record the depth from the top of the well casing to the top of static water level in the well casing. Calculate the height of water column (feet) and standing volume (gallons) of water in the well based upon known well details from installation records or measured total depth of well.

Cast acrylic, Teflon™, or stainless steel bailers with nominal 0.25-inch diameter nylon (or equal material) cord or stainless-steel and Teflon bladder pumps will be used to sample groundwater. The purging and sampling procedures that will be used to collect groundwater samples from wells are summarized below.

1. Decontaminated bailers or pumps will be used to purge each well. Record time of initiating and stopping bailing and/or pumping activities on field sheet or in field book.
2. Purge the well by removing three well volumes of water or until the well is purged dry. Water purged from the wells will be collected and containerized. Wells purged to dryness will be allowed to recharge to static water levels or for approximately 12 hours prior to sampling. Temperature, pH, and specific conductance readings will also be collected while purging the wells. The last set of readings will be recorded as the actual readings from each well.
3. Wells will be sampled using cast acrylic, Teflon™, or stainless steel bailers, or stainless-steel and Teflon bladder pumps. If samples are collected from a well using a bladder pump, the pump flow rate will be turned down to a slow steady stream prior to filling the sample jars. This is especially important for filling volatile organic sample containers.
4. Fill the sample bottles in the following sequence:
 - volatile organic compounds;
 - semi-volatile and other organic analyses (as required); and
 - metals samples.

Use the first bailer of water to fill the volatile organic analyses (VOA) vials. Fill the VOA vials such that a meniscus is formed on the rim of the vial and carefully cap the bottle. Tip the bottle upside down, tap on capped end, and inspect for air bubbles. Should noticeable air bubbles appear, repeat the process until an air-free sample is obtained. Use subsequent bailers to fill the remaining sample containers.

5. Place the samples in a secure shipping container after decontamination of the outside of the sample bottles.
6. The following information will be recorded on the field sheet:
 - project name;
 - project number;
 - date;
 - well number;
 - personnel present;
 - sample number;
 - nature of any visible well damage;

- OVA/HNu readings;
 - water level before purging (depth below top of casing);
 - time begin purge;
 - time end purge;
 - water level after purging (depth below top of casing);
 - approximate volume of water removed during purging;
 - sample time;
 - temperature;
 - conductivity;
 - pH;
 - pH meter check before and after sample analysis;
 - preservation, if applicable; and
 - other data as required.
7. Replace well cap and lock protective casing.
 8. Complete field documentation and chain-of-custody records for each sample according to Section 3.1, Volume II, Sampling and Analysis Plan.
 9. Decontaminate the outside of the sample containers.
 10. Preserve the samples according to Section 3.1, Volume II, Sampling and Analysis Plan.
 11. Follow the packaging and shipping protocol described in Section 3.1, Volume II, Sampling and Analysis Plan.

TECHNICAL MEMORANDUM

PREPARED BY: Gregory M. Brown

DATE: September 23, 1991

TITLE: SEDIMENT AND SURFACE WATER SAMPLING

PURPOSE: To provide technical guidance and standard operating procedures for sediment and surface water sampling at Naval Station Mayport, Florida. It presents the sediment and surface water sampling methods specific for conditions expected to be encountered at Naval Station Mayport during RCRA Facility Investigations (RFI).

SCOPE: Sediment and surface water sampling methods for the RFI at Naval Station Mayport. Standard operating procedures for related activities are presented in other applicable Technical Memoranda.

Surface water and sediment samples will be taken from the drainage conveyance system at the site to assess its potential to accumulate and/or transport contamination from potential source locations. The data will also be used to assess potential risks to the environment.

Sediment Samples. Sediment samples should be collected under dry conditions when standing water is absent, if possible. When conditions are dry, sediment sampling should follow the protocols described in the Technical Memorandum, SURFACE SOIL SAMPLING, Appendix B, Volume II, Sampling and Analysis Plan, for collecting surface soil samples. If standing water is present at the sediment sampling location, surface water samples should be obtained prior to sediment sampling. Applicable health and safety procedures should be followed for work near open water. A "buddy" system shall be used. Sediment samples will be collected under wet conditions by the following procedures:

1. Approach sampling location from downstream. Mark location with survey stakes and tape. Document sample location with a photograph.
2. Decontaminate sampling equipment prior to each sampling location using the procedures described in the Technical Memorandum, DECONTAMINATION PROCEDURES, Appendix B, Volume II, Sampling and Analysis Plan.
3. Number samples and label containers as directed in Section 3.1, Volume II, Sampling and Analysis Plan.
4. Collect the sediment sample with a decontaminated stainless steel push tube (e.g., a Shelby tube). Collect the sample by pushing the tube into the sediment to the desired depth. Work the tube to loosen the sample and carefully remove the tube without losing the

sample. Extrude the sample from the tube with a new wooden dowel and place the sample into a clean glass jar with Teflon™-lined lid.

5. If retrieval is unfeasible, obtain the sample by using a decontaminated stainless steel scoop attached to a piece of conduit pipe with strapping tape or a scoop bracket. Dip the scoop into the sediments and place the sample into a clean glass jar with Teflon™-lined lid. Document the method of sampling.
6. Document the sampling activities performed at each location, including chain-of-custody forms, according to Section 3.1, Volume II, Sampling and Analysis Plan.
7. Decontaminate the outside of the sample containers using the procedures in the Technical Memorandum, DECONTAMINATION PROCEDURES, Appendix B, Volume II, Sampling and Analysis Plan.
8. Preserve samples according to Section 3.1, Volume II, Sampling and Analysis Plan.
9. Proceed to next sampling location.
10. When all sediment samples are collected, package containers following the procedures in Section 3.1, Volume II, Sampling and Analysis Plan.

Surface Water Samples. Surface water samples should be collected before sediment if wet conditions exist. Applicable health and safety procedures should be followed for work near open water. Surface water samples will be collected utilizing the procedures below.

1. Approach sampling location from downstream. Mark location with survey stakes and tape. Document sample location with a photograph.
2. Decontaminate sampling equipment prior to each sampling location using the procedures described in the Technical Memorandum, DECONTAMINATION PROCEDURES, Appendix B, Volume II, Sampling and Analysis Plan.
3. Number samples and label containers as directed in Section 3.1, Volume II, Sampling and Analysis Plan.
4. Collect surface water with a decontaminated wide-mouth glass jar, glass or stainless-steel beaker or pond sampler. Collect the sample by inverting the container while entrapping air. Submerge the container to a depth of approximately 1 foot. Rotate the container quickly to expel the air and collect the water sample. Remove the container quickly while avoiding collection of sediment. Close the container.

5. Obtain a second sample in a clean container and measure the pH, temperature, and specific conductance in the field. Thoroughly rinse the container with deionized water between sampling locations.
6. Document the sampling activities performed at each location, including chain-of-custody forms, according to Section 3.1, Volume II, Sampling and Analysis Plan.
7. Decontaminate the outside of the sample containers using the procedures in the Technical Memorandum, DECONTAMINATION PROCEDURES, Appendix B, Volume II, Sampling and Analysis Plan.
8. Preserve samples according to Section 3.1, Volume II, Sampling and Analysis Plan.
9. Proceed to next sampling location.
10. When all surface water samples are collected, package containers following the procedures in Section 3.1, Volume II, Sampling and Analysis Plan.

TECHNICAL MEMORANDUM

PREPARED BY: Gregory M. Brown

DATE: September 23, 1991

TITLE: DECONTAMINATION PROCEDURES

PURPOSE: To provide technical guidance and standard operating procedures for decontamination procedures during field activities at Naval Station Mayport, Florida. It presents the decontamination procedures required for specific conditions expected to be encountered at Naval Station Mayport during RCRA Facility Investigation (RFI).

SCOPE: Decontamination procedures for the RFI at Naval Station Mayport. Standard operating procedures for related activities are presented in other applicable Technical Memoranda.

Decontamination of personnel and equipment will be performed to minimize the possibility of transport of contaminants off-site and between work areas, and to assure sample integrity. Sampling equipment coming in contact with soil and sediment and water will be decontaminated prior to sampling, between sampling locations, between boring intervals, and at completion of the work. This will minimize the potential for cross-contamination.

Decontamination of equipment will occur at the exclusion zone of the intrusive activities and at a main decontamination station. Small sampling and field equipment (e.g., trowels, bowls, sample containers, etc.) will be cleaned at the exclusion zone, while a central decontamination station will be established for cleaning of augers, drilling bits, large tools, drill rig, monitoring well supplies, and other large items.

Teflon[™] and/or glass sampling equipment used for trace organics and/or metal sample collection will be decontaminated in accordance with USEPA Region IV ECB SOPQAM requirements using the following procedures:

1. Equipment will be washed thoroughly with laboratory detergent and water using a brush to remove any particulate matter or surface film.
2. The equipment will be rinsed thoroughly with tap water.
3. Rinse equipment with at least a 10 percent nitric acid solution.
4. Rinse equipment thoroughly with tap water.
5. Rinse equipment thoroughly with deionized water.
6. Rinse equipment twice with pesticide-grade isopropanol and allow to air dry.

7. Wrap equipment in one layer of aluminum foil. Roll edges of foil into a "tab" to allow for easy removal. Seal the foil wrapped equipment in plastic and date.
8. Rinse the Teflon® or glass sampling equipment thoroughly with tap water in the field as soon as possible after use.

When this sampling equipment is used to collect samples that contain oil, grease, or other hard to remove materials, it may be necessary to rinse the equipment several times with pesticide-grade acetone or hexane to remove the materials before proceeding with Step 1. In extreme cases, it may be necessary to steam clean the field equipment before proceeding with Step 1. If the field equipment cannot be cleaned utilizing these procedures, it should not be used.

Small and awkward equipment such as vacuum bottle inserts and well bailers may be soaked in the nitric acid solution instead of being rinsed with it. Fresh nitric acid solution should be prepared for each cleaning session.

Stainless steel or metal sampling equipment used for trace organics and/or metal sample collection will be decontaminated in accordance with USEPA Region IV ECB SOPQAM requirements using the following procedures:

1. Wash equipment thoroughly with laboratory detergent and water using a brush to remove any particulate matter or surface film.
2. Rinse equipment thoroughly with tap water.
3. Rinse equipment thoroughly with deionized water.
4. Rinse equipment twice with pesticide-grade isopropanol and allow to air dry for at least 24 hours.
5. Wrap equipment in one layer of aluminum foil. Roll edges of foil into a "tab" to allow for easy removal. Seal the foil wrapped equipment in plastic and date.
6. Rinse the stainless steel or metal sampling equipment thoroughly with tap water in the field as soon as possible after use.

Well sounders and tapes used to measure groundwater levels will be decontaminated in accordance with the following procedures:

1. Wash with laboratory detergent and tap water.
2. Rinse with tap water.
3. Rinse with deionized water.
5. Allow to air dry.

4. Wrap equipment in polyethylene bags or sheeting to prevent contamination during storage or transit.

The following procedures will be used to decontaminate the Goulds Pump used for well purging. Always disconnect the pump control box from the generator before cleaning.

1. Using a brush, scrub the exterior of the contaminated hose and pump with soapy water (e.g., using Alconox™).
2. Rinse the soap from the outside of pump and hose with tap water.
3. Rinse the tap water residue from the outside of pump and hose with deionized water.
4. Equipment should be placed in a polyethylene bag or wrapped with polyethylene film to prevent contamination during storage or transit.

Large equipment (e.g., drill rig, augers) will be decontaminated using the procedures outlined below.

1. Move equipment to decontamination station after sampling/field activities are complete.
2. Decontaminate equipment using a high pressure steam cleaner with a soap cycle and water cycle. Scraping and scrubbing may be necessary to remove encrusted material. Items should be placed on sawhorses, pallets, or the equivalent to prevent contact with the ground.
3. Rinse the equipment with potable water.
4. Place equipment on polyethylene sheeting, sawhorses, or clean pallets and allow to dry.

Sampling and field equipment should not contact the ground surface prior to the next sampling location. Wrap appropriate equipment (i.e., monitoring well installation supplies) in polyethylene (plastic) sheeting. Decontamination fluids will be contained for subsequent treatment or disposal.

TECHNICAL MEMORANDUM

PREPARED BY: Gregory M. Brown

DATE: September 30, 1991

TITLE: SAMPLING GRID LAYOUT FOR PCB SOIL SAMPLING

PURPOSE: To provide the background for the sampling grid designs used during PCB soiling sampling at Naval Station Mayport, Florida. This TM presents the rationale for the sampling grid designs to be used by sampling personnel. Detailed discussions of underlying principles are presented in the references. A copy of the procedures for using the PCB screening fit is also included.

SCOPE: Presents the calculations for sample spacings and grid layout for field verification of PCB contaminated soils at SWMU 16 (NIRP Site 16), the Old Transformer Storage Area, and SWMU 2 (NIRP Site 2), Landfill B.

- REFERENCES:
1. *Verification of PCB Spill Cleanup by Sampling and Analysis*; U.S. Environmental Protection Agency; EPA-560/5-85-026; August 1985.
 2. *Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup*; U.S. Environmental Protection Agency; EPA-560/5-86-017; May 1986.
 3. *Statistical Methods for Environmental Pollution Monitoring*; Gilbert, Richard O.; Van Nostrand Reinhold Company, New York; 1987.

A non-random sampling strategy of near surface soils coupled with field and laboratory analyses will be used to characterize PCB contamination at SWMU 16 and SWMU 2. A triangular grid layout will be used at both locations. The grid designs at each SWMU are presented in the attached sketches. Although similar, the basis of the grid layouts differ slightly for each site.

SWMU 16 (NIRP Site 16) Old Transformer Storage Area. SWMU 16 is described in Section 2.3.2.10 of Volume I, Workplan. Its boundaries are known and the area of suspected contamination is shown in Figure 3-5, Volume I. Since the area of contamination is known with some certainty and the geometry of the site is symmetrical, the grid layout scheme presented in References 1 and 2 were used for a circular spill configuration. Based on the attached sketch and calculations, a hexagonal grid composed of triangular elements with 37 sample points is chosen. Grid point spacing is approximately 15 feet between sample locations, and the distance between grid rows is approximately 13 feet.

It is suggested that the sampling crew will be composed of at least three personnel to improve the efficiency of laying-out the grid and to assure an accurate configuration. Field personnel will establish the grid by first identifying the center of the sample area as shown on the attached sketch. Using the center of the sampling area as the initial reference, other sample points will be marked using survey flags in accordance with the specified grid spacing. Sample points will be labeled according to the row and column number presented in the sketch.

After the grid has been established and measured to assure that the dimensions conform with the grid design, photographs will be taken as a visual record of the grid layout. Soil samples will be collected as described in Section 3.3.10 (Volume II) and the Technical Memorandum, Surface Soil Sampling (Appendix B, Volume II). Decontaminated sampling equipment will be used at each sample location. Sampling equipment will be decontaminated following the procedures described in the Technical Memorandum, Decontamination Procedures (Appendix B, Volume II).

Soil samples will be analyzed using the CLOR-N-SOIL™ PCB Screening Kit for Soil. Duplicate samples will also be collected, packaged, labeled, and preserved for possible laboratory analyses by USEPA Method 8080. Duplicates of soil samples which are positive for PCB using the field kit will be sent under chain-of-custody to the laboratory for analysis.

SWMU 2 (NIRP Site 2) Landfill B. SWMU 2 is described in Section 3.5.2 of Volume I, Workplan and is presented in Figure 3-4. PCB was detected in near surface soils during installation of the monitoring well cluster MPT-2-9S/D. No data exist to determine the boundaries of PCB contamination at this location. Because of the uncertainty of the extent of PCB contamination, a different methodology is used to design the grid at this site. A non-random sampling strategy using a triangular grid pattern is designed using the power curves presented by Gilbert (Reference 3). A copy of the power curve for a triangular grid is attached for reference. Assuming an acceptable Type II error rate of 5% (i.e., assuming a "clean" site when it is actually "dirty") and a circular "hotspot" with a radius of 5 feet, a triangular sample grid with a spacing of 10 feet between sample points is required. The assumptions and calculations are presented on the attached power curve and sketch. Details of the statistical principles are described in Reference 3.

An initial grid layout with 50 sample locations over an assumed area of contamination is presented in the attached sketch of the site. If contamination is detected at the fringes of the grid, it may be expanded by addition of more sample points consistent with the grid pattern until non-detectable levels are obtained. This will confirm the boundaries of the contamination with an acceptable level of confidence.

It is suggested that the sampling crew will be composed of at least three personnel to improve the efficiency of laying-out the grid and to assure an accurate configuration. Field personnel will establish the grid by first identifying the center of the sample area as shown on the attached sketch around the monitoring well cluster MPT-2-9S/D. Using this as the initial starting point of the grid, other sample points will be marked using survey

flags in accordance with the specified grid spacing. Sample points will be labeled according to the row and column number presented in the sketch.

After the grid has been established and measured to assure that the dimensions conform with grid design, photographs will be taken as a visual record of the grid layout. Soil samples will be collected as described in Section 3.3.3 (Volume II) and the Technical Memorandum, Surface Soil Sampling (Appendix B, Volume II). Decontaminated sampling equipment will be used at each sample location. Sampling equipment will be decontaminated following the procedures described in the Technical Memorandum, Decontamination Procedures (Appendix B, Volume II).

Soil samples will be analyzed using the CLOR-N-SOIL[™] PCB Screening Kit for Soil. Duplicate samples will also be collected, packaged, labeled, and preserved for possible laboratory analyses by USEPA Method 8080. Duplicates of soil samples which are positive for PCB using the field kit will be sent under chain-of-custody to the laboratory for analysis.

r, RADIUS = 50'

NO. OF SAMPLES = 37

S, DISTANCE BETWEEN SAMPLE POINTS = $0.3r = 0.3(50) = 15'$

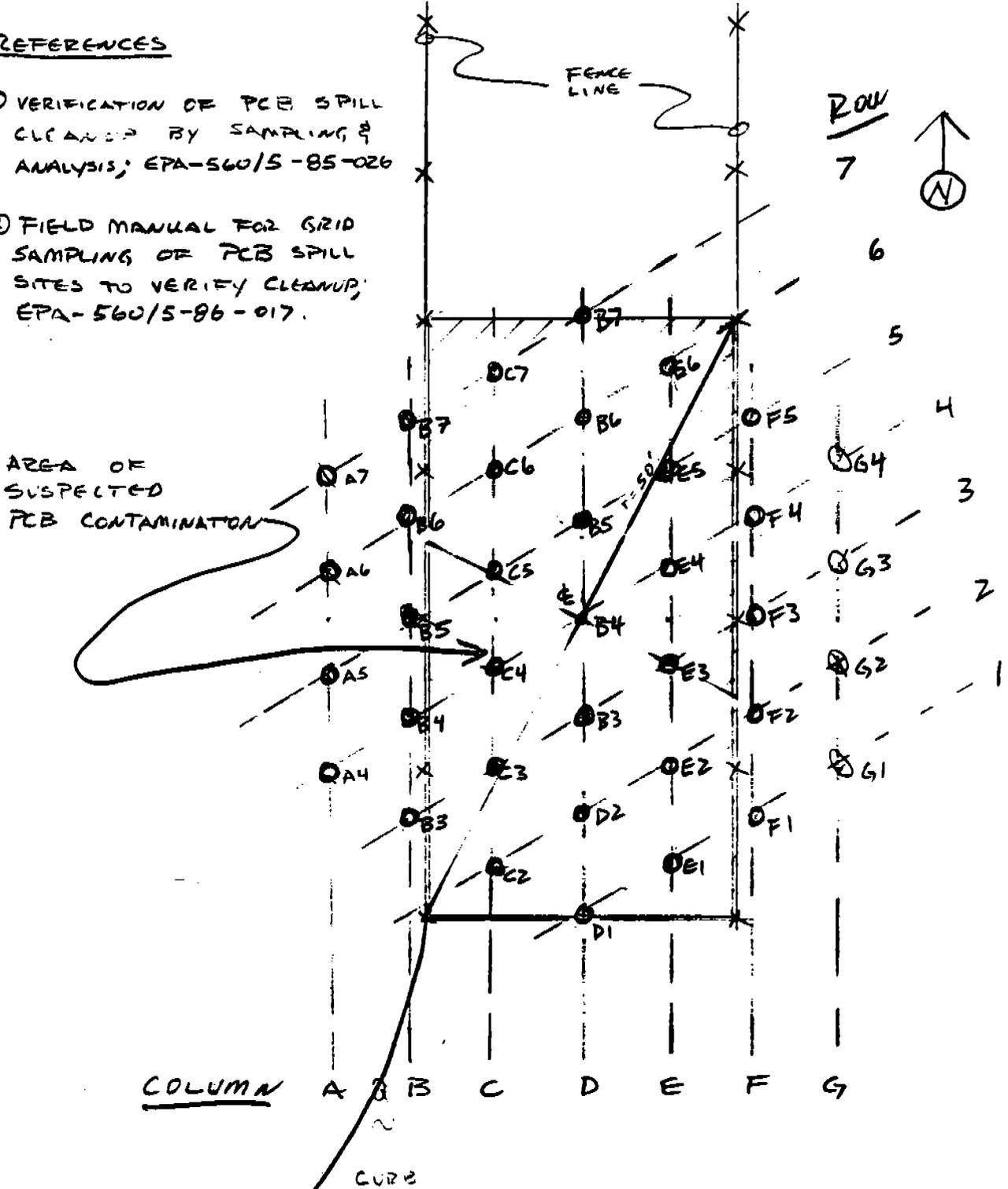
U, DISTANCE BETWEEN ROWS = $0.26r = 0.26(50) = 13'$

REFERENCES

① VERIFICATION OF PCB SPILL
CLEANUP BY SAMPLING &
ANALYSIS; EPA-560/5-85-026

② FIELD MANUAL FOR GRID
SAMPLING OF PCB SPILL
SITES TO VERIFY CLEANUP;
EPA-560/5-86-017.

AREA OF
SUSPECTED
PCB CONTAMINATION

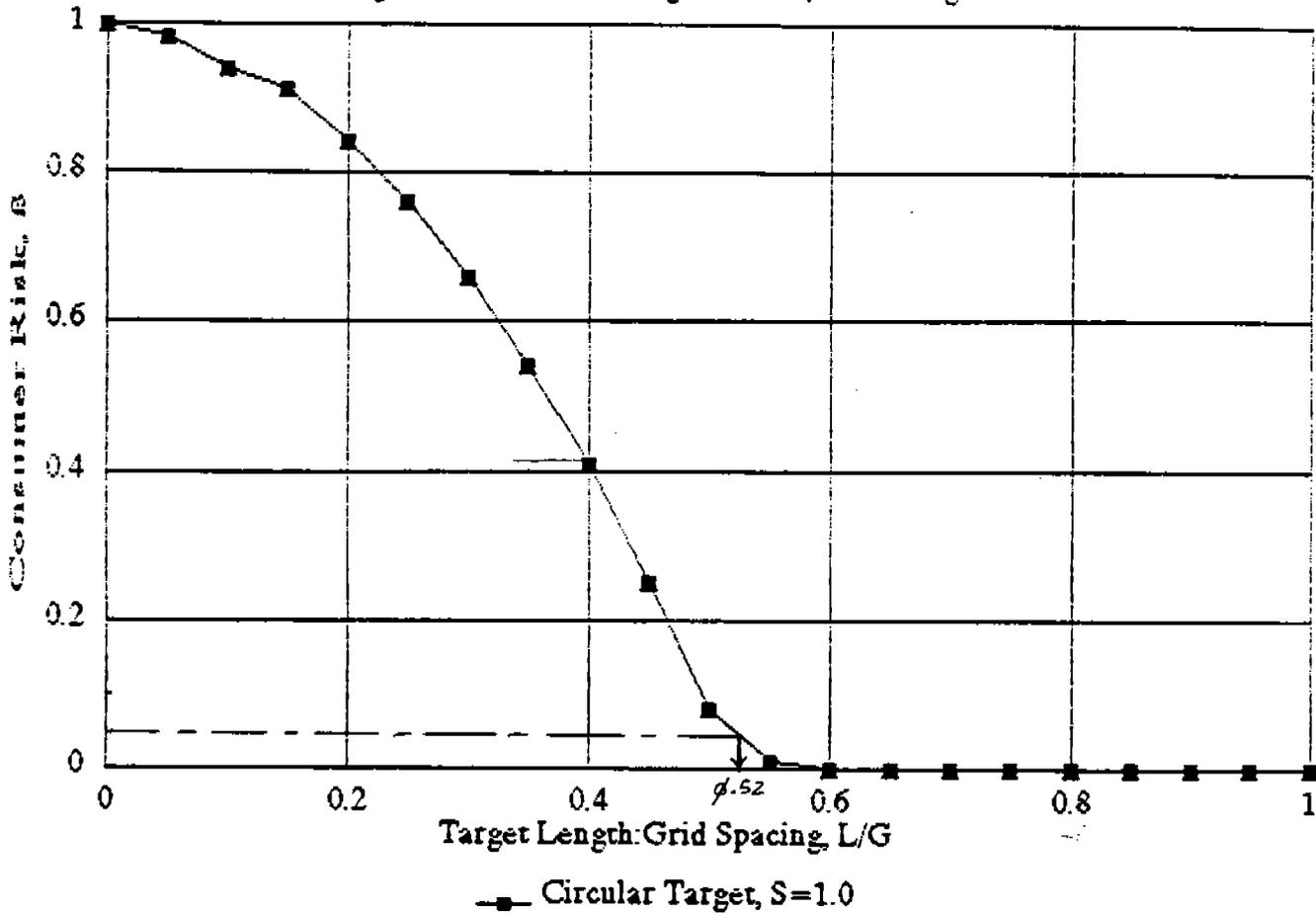


42 SHEETS 3 SQUARE
43 SHEETS 3 SQUARE
44 SHEETS 3 SQUARE



GME
9/77

Figure 1: Curve Relating L/G to β , for Triangular Grid.



(Reference: Gilbert, 1987)

ASSUMPTIONS:

- ① AN OBJECTIVE OF SAMPLING & ANALYSIS IS SITE CHARACTERIZATION. A FALSE NEGATIVE (TYPE II ERROR) OF 5% IS ACCEPTABLE AT THIS PHASE OF THE INVESTIGATION.
- ② THE TARGET "HOTSPOT" OF INTEREST IS CIRCULAR WITH A RADIUS OF 5 FEET.

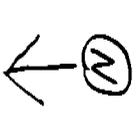
⇒ GRID SPACING, $G = \frac{L}{(L/G)} = \frac{5}{0.52} = 9.6 \text{ feet}$

SAY 10 FEET

GMB
9/23/16

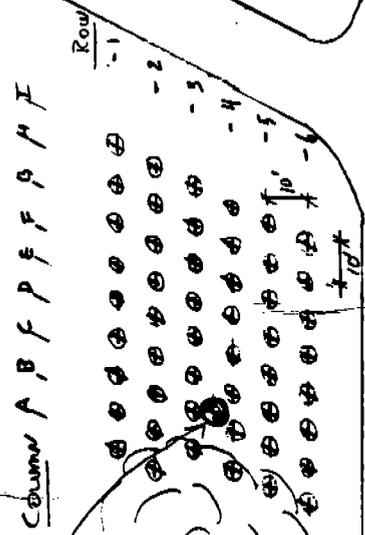
SWIMU <
NAVSTA MAYPORT

DRAINING GRID
LAYOUT



⊕ SAMPLE GRID POINT
NOTE: EAST-WEST GRID SPACING IS 10 FEET. SPACING BETWEEN ROWS IS ALSO 10 FEET.
REFERENCE: GILBERT, 1987.

GRASS & GRAVEL



WELL CLUSTER
MPT-2-9S
MPT-2-9D

ESTABLISHED GROWTH
OF PINES & PALMETTOS

ASPHALT ROAD

STEEL BUILDING

ASPHALT PAVEMENT

SITE 2

FENCE

TECHNICAL MEMORANDUM

PREPARED BY: Gregory M. Brown

DATE: September 23, 1991

TITLE: SURFACE SOIL SAMPLES

PURPOSE: To provide technical guidance and standard operating procedures for surface soil sampling at Naval Station Mayport, Florida. It presents the surface soil sampling methods specific for conditions expected to be encountered at Naval Station Mayport during RCRA Facility Investigation (RFI).

SCOPE: Soil sampling methods for the RFI at Naval Station Mayport. Standard operating procedures for related activities are presented in other applicable Technical Memoranda.

The following procedures shall be followed when collecting surface and shallow soil samples:

1. Sampling equipment coming into contact with soil samples will be decontaminated prior to sampling, between sampling locations, and at the completion of work using the procedures outlined in the Technical Memorandum, DECONTAMINATION PROCEDURES, Appendix B, Volume II, Sampling and Analysis Plan.
2. Store decontaminated equipment on clean polyethylene sheeting or wrapped in aluminum foil or plastic bags between uses. Following decontamination, do not allow sampling equipment to touch the ground prior to use.
3. Number the samples and label containers as directed in Section 3.1, Volume II, Sampling and Analysis Plan.
4. Locate the sample location and mark with a surveyor's flag or equivalent.
5. Obtain background HNu, OVA, or TIP readings. Obtain readings at soil surface and in breathing zone while collecting samples. Record organic vapor readings in the field logbook.
6. Remove sticks, leaves, and other surface debris in vicinity of sampling location.
7. Surface and shallow soil samples will be collected using a soil hand auger.

8. Surface samples will be collected no deeper than 0 to 6-inches. Shallow surface samples will be collected by auguring through clean backfill to the interface with native soils. Collect the sample at this interval. After retrieval, depth of hole will be measured with a clean, metal ruler or mark on the auger. Place the sample in a clean glass jar and label. Preserve in accordance with Section 3.1, Volume II, Sampling and Analysis Plan.
9. Photograph sampling locations. Measure sample location relative to local reference landmarks and make entry into logbook.
10. Proceed to next sample point and repeat steps 4 through 9, using decontaminated sampling equipment.
11. Complete field documentation and chain-of-custody records for each sample according to Section 3.1, Volume II, Sampling and Analysis Plan.
12. Decontaminate the outside of the sample containers.
13. Preserve the samples according to Section 3.1, Volume II, Sampling and Analysis Plan.
14. Follow the packaging and shipping protocol described in Section 3.1, Volume II, Sampling and Analysis Plan.

TECHNICAL MEMORANDUM

PREPARED BY: R. Michael Nugent

DATE:

TITLE: FIELD SCREENING FOR PCBs

PURPOSE: To provide guidance for undertaking field screening for PCBs using the Dexsil Corporation's CLOR-N-Soil™ PCB screening kit for soil.

SCOPE: This Technical Memorandum outlines the procedures to be followed for screen PCB concentrations in soils. The intent of the field screening procedure is to delineate the extent of PCB contaminated soil based upon positive or negative colorimetric results.

The PCB screening kit works on the principal of chloride determination after stripping them off of organic compounds. Inorganic chlorides are removed prior to stripping of chloride ions from the organic compounds. In that the procedure detects any organic halogenated containing compound, there is a possibility of false positive results.

EQUIPMENT: CHLOR-N-SOIL™ PCB screening kit containing the following items:

- portable scale,
- plastic tube with white cap,
- stainless steel soil scoop,
- extraction solvent in glass vial,
- 10cc syringe,
- plastic filter,
- plastic pipette,
- plastic tube with black cap containing a gray and a clear ampule,
- plastic tube with brown cap containing buffer solution and two ampules.

PROCEDURE:

- 1) Remove the white cap from the empty plastic test tube and attach the alligator clip from the scale to the rim of the test tube. Using the steel scoop add enough soil sample to the plastic test tube until the scale reads 16 grams. This means a total of 10 grams of soil has been added to the tube. Disconnect the scale from the test tube.
- 2) Remove the cap from the glass tube containing the extraction solvent and pour the entire contents into the plastic test tube containing the soil. Replace the white cap on the plastic tube. Break any soil lumps by squeezing the sides of the tube and shake the tube vigorously for the one minute. Then allow the tube to settle for two minutes. Tap the bottom of the tube on any hard

surface to compact the soil sample (this may not be necessary with all soil types).

- 3) While the soil is settling, remove the plastic filter from the foil pouch by poking the tip through the bag (do not open the pouch ahead of time). Remove the plunger and attach the large end of the blue tube snugly to the syringe body. This should be a tight fit. Open the black-capped tube and insert the blue column partially into the tube so the syringe body is vertical.
- 4) Using the plastic pipette, remove as much of the extraction solvent as possible from above the soil layer and dispense it into the syringe up to the 7cc line. If a water layer is evident be careful not remove any of the water as this will interfere with the test. Try not to remove any of the soil either, as this may clog the filter. Replace the plunger in the syringe and push the solvent through the blue tube. Apply only enough pressure so that it takes about a minute for all of the solvent to pass through the filter. Fill the polyethylene tube to the 5 ml line with the extraction solvent. Pull back on the syringe plunger to stop the flow of solvent through the tube. Remove the syringe column assembly from the polyethylene tube and replace the black cap on the tube. Replace the white cap on the tube that contains the soil and place the tube back in the box.
- 5) Break the colorless ampule (lower) in the black-capped tube by compressing the sides of the tube. Shake for 10 seconds. Break the gray ampule (top) and shake vigorously for 10 seconds. Allow the react for one minute, shaking intermittently several times.
- 6) Remove the black cap from tube 2 and the brown cap from tube 3. Pour the entire buffer solution from the tube 3 into black cap tightly on tube 2 and shake vigorously for 10 seconds. Vent the tube by unscrewing the black cap $\frac{1}{2}$ turn. Close securely and shake for 10 seconds more. Vent the cap once again and close the cap securely. The solvent should no longer appear gray. Stand the tube upside down on its cap and allow to settle for 2 minutes.
- 7) Position tube 2 (containing both the solvent and buffer solution) over the open top of tube 3 and open the nozzle on the black cap. Be sure to point the nozzle away from the operator while opening it, and check that the nozzle is completely open. Dispense exactly 5 ml of the buffer solution into tube 3 (up to line). Replace the brown cap on tube 3 and close the dispenser cap on tube 2.
- 8) Break the brown-dotted ampule (lower) in tube 3 and shake for 10 seconds. Break the colored ampule and shake for 10 seconds. Observe color. If the solution appears purple, the soil sample contains less than 50 ppm PCB. If it appears yellow or colorless, it may contain more than 50 ppm PCB and should be tested further by a PCB specific method.

CLOR-N-SOIL™

PCB Screening Kit

Disposable test kit for determining PCB contamination in soil.

EACH KIT CONTAINS

1. A portable scale for weighing the soil sample.
2. An empty plastic tube with a white cap (tube #1).
3. A stainless steel soil scoop.
4. A glass vial containing extraction solvent.
5. A 10cc syringe.
6. A foil bag containing a plastic filter.
7. A plastic pipette.
8. A tube with black dispenser cap containing a gray ampule and a colorless one (tube #2).
9. A brown-capped polyethylene tube containing 7 ml of buffer solution, a brown-capped ampule, and a red-green ampule (tube #3).



COMPLETE INSTRUCTIONS

STEP 1. Remove the white cap from the empty plastic test tube and attach the alligator clip from the scale to the rim of the test tube. Using the steel scoop add enough soil sample to the plastic test tube until the scale reads 10 grams. This means a total of 10 grams of soil has been added to the tube. Discard the scale from the test tube.

STEP 2. Remove the cap from the glass tube containing the extraction solvent and pour the entire contents into the plastic test tube containing the soil. Replace the white cap on the plastic tube. Break any soil lumps by squeezing the sides of the tube and shake the tube vigorously for one minute. Then slide the tube to settle for two minutes. To the bottom of the tube on any hard surface to compact the soil sample (this may not be necessary with all soil types).

STEP 3. While the soil is settling, remove the plastic filter from the foil pouch by passing the foil through the bag (do not open the pouch ahead of time). Remove the plunger and attach the large end of the blue tube snugly to the syringe body. This should be a tight fit. Open the black-capped tube and insert the blue column partially into the tube so the syringe body is vertical.

STEP 4. Using the plastic pipette, remove as much of the extraction solvent as possible from above the soil layer and dispense it into the syringe up to the 7cc line. If a water level is evident be careful not to remove any of the water as this will interfere with the test. Try not to remove any of the soil either, as this may clog the filter. Replace the plunger in the syringe and push the solvent through the blue tube. Apply only enough pressure so that it takes about a minute for all of the solvent to pass through the filter. Fill the polyethylene tube to the 5 ml line with the extraction solvent. Pull back on the syringe plunger to stop the flow of solvent through the tube. Remove the syringe-column assembly from the polyethylene tube and replace the black cap on the tube. Replace the white cap on the tube that contains the soil and place the tube back in the box.

STEP 5. Break the colorless ampule (lower) in the black-capped tube by compressing the sides of the tube. Shake for 10 seconds. Break the gray ampule (top) and shake vigorously for 10 seconds. Allow to react for one minute, shaking occasionally several times.

STEP 6. Remove the black cap from tube 2 and the brown cap from tube 3. Pour the entire buffer solution from tube 3 into tube 2 which contains the gray-brown solvent. Replace the black cap tightly on tube 2 and shake vigorously for 10 seconds. Vent the tube by unlatching the black cap 1/4 turn. Close securely and shake for 10 seconds more. Vent the cap once again and close the cap securely. The solvent should no longer appear gray. Stand the tube upside down on its cap and allow to settle for 2 minutes.



STEP 7. Position tube 2 containing both the solvent and buffer solution over the open top of tube 3 and open the nozzle on the black cap. Be sure to point the nozzle away from the operator while opening it, and check that the nozzle is completely open. Dispense exactly 2 ml of the buffer solution into tube 3 (up to line). Replace the brown cap on tube 3 and close the dispenser cap on tube 2.

STEP 8. Break the brown-capped ampule (lower) in tube 3 and shake for 10 seconds. Break the colored ampule and shake for 10 seconds. Observe color. If the solution appears purple, the soil sample contains less than 50 ppm PCB. If it appears yellow or orange, it may contain more than 50 ppm PCB and should be tested further by a PCB specific method.

ABOUT THE CLOR-N-SOIL TEST KIT

The kit works on the principle of chrome desmearation. Since PCBs contain chrome the test kit is able to detect them. Any inorganic chromes are removed in the filter tube; however, any organic chrome containing compound will also be detected with the kit and may cause a false positive result.

SIMPLIFIED CHEMISTRY OF THE TEST PROCEDURE

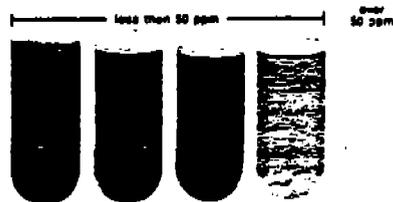
A 10 gram soil sample is weighed out and mixed with an extraction solvent. The solvent and soil are allowed to settle and the solvent is then put through a drying column. The solvent is then treated using metallic sodium to strip the chrome from the PCB molecule. The chrome is then transferred to the aqueous phase and measured with a precise amount of mercuric nitrate and indicator solution. If there is no organic chrome present, the mercury turns red-purple with the indicator; if there are organochlorines present, then the mercury is tied up and no color results.

CAUTION

When crushing glass ampoules, press firmly in the center of the glass ampoule. DO NOT rub against glass in tube. In case of breakage or spillage, wash soil or clothing, wash immediately with large amounts of water. All the solutions in the kit should not be taken internally. PCBs contain organic solvents and should be disposed accordingly.

SUGGESTIONS FOR USE

When weighing out the soil sample, support the scale heavily by resting onto the metal ring at the top of the scale. The scale reads ounces on one side and grams on the other—make sure you are reading the gram side. Make sure that all soil lumps are completely crushed to ensure full extraction of PCB. When pushing the solvent through the drying tube do not force it through too quickly as some contaminants may pass through.



MANUFACTURER'S WARRANTY

This kit is warranted to be free of defects in material and workmanship until the expiration date stamped on the box. Manufacturer's site and exclusive liability under this warranty shall be limited to replacement of any kit that is proved to be defective. Manufacturer shall not be liable for any incidental or consequential damages. Release test results are highly dependent upon the care with which the directions are followed and, consequently, cannot be guaranteed.

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TECHNICAL MEMORANDUM

PREPARED BY: J.A. Burris

DATE: December 1989

TITLE: Qualitative Aquatic Survey

PURPOSE: The purpose of this technical Memorandum (TM) is to provide technical guidance pertaining to qualitative surveys of aquatic life at identified locations in rivers, wetlands, ponds, and lakes. Sampling of streams is covered in a separate TM. These procedures are intended to establish baseline practices to assist Technical Directors and Site Managers in preparing and implementing site specific workplans. The procedures as presented are not to be construed as a rigorous standard and slight deviations are anticipated based upon site condition.

SCOPE: Qualitative aquatic surveys are implemented to characterize the community of organisms present at a chosen location and to provide data on the general physical and chemical characteristics of the aquatic environment at that location. The objective of the survey is to collect as many different resident aquatic organisms as possible at a given location for the purposes of identification.

EQUIPMENT: Ekman dredge (soft substrates)
Petite ponar dredge (hard substrates)
Wash frame or sieve bucket (USGS #30)
D-frame aquatic dip net
Minnow traps
Plankton tow net
Net seines

PROCEDURE:

Qualitative sampling of aquatic organisms is accomplished by use of a variety of equipment designed to capture different types of organisms. For the general survey sampling is conducted with one type of bottom substrate sampler (dredge); with an aquatic dip net; minnow traps; net seines and plankton tow net.

Aquatic survey locations should be carefully considered and chosen to cover as many different types of habitat. Selection of locations should be in accordance with APHA (1986) and should attain the quality assurance and data quality objectives in Chapter 5 of USEPA (1989). A aquatic field survey data sheet is completed at the time of sampling for each survey location.

Bottom Substrate Samplers (Dredges)

The Ekman dredge is used most effectively to sample benthic dwelling organisms in areas with silt, muck and sludge substrates. The Ekman is difficult to use when rocky substrates or debris are present as stones or other objects prevent jaw closure.

The Ekman grab sampler will be operated according to ASTM standard D 4343-84 (reapproved 1988). The petite ponar will be operated according to ASTM standard D 4342-84 (reapproved 1988). One to three samples will be collected at each survey location.

The dredge sample is emptied into a sieve bucket or wash frame and washed until the sample is condensed. If field conditions are amenable, organisms will be removed from the substrate and preserved in labeled containers with 70% ethanol. If samples cannot be sorted in the field then large debris is removed after carefully checking for attached organisms and the entire sample is placed into a labeled container and preserved with 70% ethanol. The samples are then transported to the laboratory for sorting and identification.

Dip Net

The dip net is used to sample organisms that reside in the water column in vegetation and debris.

One to three dip net samples are taken per survey location with a dip net (595 u aperture size or smaller) The dip net is used for sampling in submerged and emergent vegetation, along shorelines, over-hanging banks, tree roots, log jams, fallen trees, bridge structures and fence lines. by sweeping from a downstream to an upstream direction.

All organisms collected are placed in a labeled sample container and preserved with 70% ethanol. The samples are then transported to the laboratory for sorting and identification.

Net Seine

A net seine can be used to collect crustaceans and fish. The size of the seine used will depend upon the size of the area to be sampled. Both ends of the seine will be held by individuals who will pull it along the bottom in the direction of any current. After a distance of 20 to 30 feet, one end of the seine will be worked toward the opposite end and the two ends beached. Fish will be identified, weighed, measured and photographed in the field and returned to the stream unharmed to the extent possible. Species that cannot be readily identified will be weighed, photographed and preserved in 70 percent ethanol and identified later in the laboratory.

Minnow Traps

Minnow traps are used to sample for juvenile fish and minnows. Minnow traps will be set at each survey location according to manufacturers directions and baited with canned dog food. The traps will be retrieved after 24 hours. Minnows will be sorted in the field, counted and photographed. One to three individuals for each morphological type will be preserved in 70% ethanol and returned to the laboratory for identification.

Plankton Tow

A conical tow net will can be used at each survey location to collect phytoplankton and zooplankton qualitative samples. The tow net will be operated according to ASTM Standard D 4132-82 (reapproved 1987) for Sampling Phytoplankton with Conical Tow Nets and ASTM Standard E 1201-87 for Sampling Zooplankton with Conical Tow Nets.

Generally 2 to 3 net casts will be conducted and the samples composited into one sample for each survey location. The phytoplankton/zooplankton samples will be preserved according to ASTM Standard D 4137-82 (reapproved 1987) and ASTM Standard E 1200-87 with either Lugol's iodide solution or formaldehyde solution.

REFERENCES:

APHA. 1986. Standard Methods for the Examination of Water and Wastewater. American Public Health Association, Washington, DC.

USEPA, 1989, Ecological Assessment at Hazardous Waste Sites: A Field and Laboratory Reference, Environmental Research Laboratory, Corvallis, Oregon, EPA/600/3-89/013, March, 1989.

TECHNICAL MEMORANDUM

PREPARED BY: J.A. Burris

DATE: December 1989

TITLE: Quantitative Benthic Macroinvertebrate Sampling

PURPOSE: The purpose of this technical Memorandum (TM) is to provide technical guidance pertaining to quantitative sampling of benthic macroinvertebrates at locations in estuarine environments. These procedures are intended to establish baseline practices to assist Technical Directors and Site Managers in preparing and implementing site specific workplans. The procedures as presented are not to be construed as a rigorous standard and slight deviations are anticipated based upon site condition.

EQUIPMENT: Petite ponar dredge
Wash frame (USGS #30 seive)
Sample containers
Ethanol
Sorting Trays
Forceps
Wash bottle

SCOPE: Quantitative benthic macroinvertebrate sampling provides data on the number and types of organisms within a specific sampling area. From this data measurements of benthic community structure and function can be calculated.

PROCEDURE:

Quantitative benthic survey locations should be carefully considered and chosen to provide information on the extent of impacts. One upstream reference location must be included. Selection of locations should be in accordance with guidelines in APHA (1986) and should attain the quality assurance and data quality objectives in Chapter 5 of USEPA (1989). A aquatic field survey data sheet is completed at the time of sampling for each survey location.

For estuarine environments the Florida Department of Environmental Regulation (FDER) recommends the use of a petite ponar dredge (FDER 1989). The petite ponar will be operated according to ASTM standard D 4342-84 (reapproved 1988). A dredge sample will be collected at each survey location according to guidelines established by the Biology Department of FDER.

A basic macroinvertebrate sample is made up of three individual replicates which are composited to yield the sample values. If the first replicate examined contains more than 200 individuals, however, that replicate may be considered to be the entire sample. The other two replicates may be discarded or not taken, as appropriate. In the case

of grab samples, the first grab taken should be examined in the field to estimate the number of organisms present. If this number is less than 15, additional grabs should be taken until a total of at least 15 organisms is obtained. The number of grabs required to reach this total then becomes one replicate, and two more replicates should be taken, each consisting of the same number of grabs as the first replicate.

The dredge samples will be seived in the field using a U.S. Standard Geological No. 30 sieve bucket or wash frame. Organisms will be removed from the sediment in the field under a hand lens and preserved in 70% ethanol. If sorting in the field is not possible, samples will be condensed and preserved in 70% ethanol for sorting in the laboratory. Sorted samples will be shipped to the taxonomy laboratory for identification of species.

REFERENCES

APHA. 1986. Standard Methods for the Examination of Water and Wastewater. American Public Health Association, Washington, DC.

FDER. 1989. Draft Biological Methods Manual, Biology Section, October, 1989.

USEPA, 1989, Ecological Assessment at Hazardous Waste Sites: A Field and Laboratory Reference, Environmental Research Laboratory, Corvallis, Oregon, EPA/600/3-89/013, March, 1989.

TECHNICAL MEMORANDUM

PREPARED BY: J.A. Burris
DATE: December 1989
TITLE: Sampling of Molluscs and Crustaceans for Tissue Analysis

PURPOSE: The purpose of this technical Memorandum (TM) is to provide technical guidance pertaining to the collection, and transport of molluscs and crustaceans from estuarine environments for chemical analysis. These procedures are intended to establish baseline practices to assist Technical Directors and Site Managers in preparing and implementing site specific workplans. The procedures as presented are not to be construed as a rigorous standard and slight deviations are anticipated based upon site condition.

SCOPE: Shellfish, such as mussels or oysters, are sessile, long-lived, bottom-dwelling filter-feeders that can accumulate heavy metals, pesticides and other toxic organics from ambient water even when these substances are present in concentrations far below the levels detectable by chemical analysis of ambient water. Collection and analysis of such organisms provide information on geographic variation and relative abundance of these substances and long-term trends in presence and/or accumulation of toxic substances in surface waters. The analytical data can also be used in the assessment of human health risks as a measure of chemical exposures via consumption.

PROCEDURE:

Selection of the shellfish species to be collected is determined prior to the study based upon the geographical area of the study and the use of the analytical data. Shellfish are collected by dredge, dip net, trawl, net seine or by hand.

For analyses of organics shellfish are wrapped in aluminum foil, iced immediately and shipped to the laboratory within 24 hours. If a longer holding time is required, the samples are frozen and then shipped on dry ice. Samples to be analyzed for metals are shipped in glass bottles on dry ice or plastic bags.

Prior to analyses at the laboratory the taxonomy of the specimens collected are identified. Samples are stored in the laboratory if necessary in a freezer until preparation time. Frozen samples are allowed to partially thaw at room temperature. The size, number and wet weight of the specimens in the sample are measured and recorded. The bivalve molluscs are opened with a clean knife and the contents removed. Edible portions of crustaceans are removed including tail and "tamale" of lobsters. The tissue is then digested and analyzed according to laboratory analytical procedure.

APPENDIX C

CH₂M HILL QUALITY ASSURANCE PROJECT PLAN

COMPREHENSIVE QUALITY ASSURANCE PLAN

for

CH2M HILL
7201 NW 11th Place
Gainesville, FL 32602
904/331-2442

Prepared by

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Ward Dickens
Ward Dickens, Laboratory Manager

Feb. 8, 1991
(Date)

Kathryn Starcher
Kathryn Starcher, LQAC

Feb. 8, 1991
(Date)

DER QA Officer

(Date)

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APPENDICES

Appendix ID	Title/Description	# of Pages	Revision Date
A	Resumes For CH2M HILL Laboratory Personnel		9/14/90
B	Laboratory Quality Control		12/10/87

FORWARD AND STATEMENT OF POLICY

The Environmental Protection Agency (U.S.E.P.A) has established specific requirements for development of Quality Assurance (QA) Program Plans and Quality Assurance Project Plans. These Quality Assurance Plans are required for environmental monitoring tasks accomplished within EPA as well as its contractors and grantees. By regulation, all Quality Assurance Project Plans must conform in content with QAMS-005/80 "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans".

In Florida, the Department of Environmental Regulation administers the in-state QA Program and has an EPA approved QA Program Plan.

The Florida Department of Environmental Regulation quality assurance policy stipulates that every monitoring and measurement project must have a written and approved Quality Assurance Project Plan (QAPP). A QAPP is a written document, which presents, in specific terms, the policies, organizational objectives, functional activities, and specific quality assurance and quality control (QC) activities designed to achieve the data quality goals of specific project(s) or continuing operation(s). A QAPP is required for each specific project or continuing operation (or group of similar projects or continuing operations).

CH2M HILL is involved with numerous analytical projects for various clients located throughout the State of Florida. This document will serve as our general laboratory quality assurance plan. The Gainesville and the Montgomery CH2M

HILL Laboratories both routinely perform analyses on projects in the State of Florida. The specific analyses performed by each lab varies depending upon analytical coverage and workload.

A site specific QAPP supplement will be provided for each specific site being investigated. The site specific Quality Assurance supplement will follow DER guidelines (DER-QA-001/85) and include the site location, site description, proposed sampling locations, number and types of samples to be collected, project personnel and any additional site specific information necessary to clearly define and describe all Quality Assurance objectives required by the FDER and U.S. EPA guidelines. The QAPP supplement will be prepared, submitted to and approved by FDER prior to the initiation of field activities.

Appropriate sections of the Montgomery and Gainesville CH2M HILL Laboratory General QA Plans will be referenced in each Site Specific QA Supplement.

The Laboratory General QA Plan and the Site Specific QA Supplements will be updated and submitted to FDER in the event that:

- o Changes in CH2M HILL project personnel occur.
- o New previously undefined techniques are implemented.
- o Analyses previously undefined are included.

CH2M HILL LABORATORY QA PLAN

DATE: June 8, 1987

SECTION NO. FWD/SOP

PAGE 3 OF 3

REVISION NUMBER 2

- o QA/QC goals and/or objectives are changed.

- o Changes occur in FDER policies and/or rules.

Section 1

DESCRIPTION OF LABORATORY GOALS

1.0 INTRODUCTION

CH2M HILL's Gainesville Laboratory is committed to the production of quality analytical data for environmental samples. It is recognized that the achievement of quality data depends upon an effective and consistent quality assurance program. The implementation of the quality assurance program is achieved through a team effort of the entire laboratory group, from management to laboratory analyst.

1.1 GENERAL CONSIDERATIONS AND OBJECTIVES

- 1.1.1 Sample integrity must be preserved. The sample integrity is preserved by following documented sample handling procedures relating to the preservation, custody, storage, labeling and record keeping associated with samples received by the laboratory.
- 1.1.2 Proper approved standard analytical methods must be followed. Routine analytical methods and procedures used for sample analysis must be readily available and understood by all analysts using the procedures. The results generated from a method must be evaluated to identify method weaknesses and detect needs for further analyst training.
- 1.1.3 The analytical instrumentation must be in proper working order. Instrument performance and calibration must be documented.
- 1.1.4 The accuracy and precision of analytical methods must be recorded and maintained on a continuing basis. Accuracy and precision data are monitored through the use of control charts for assessing continuing performance and detection of trends.
- 1.1.5 Raw data must be properly reduced and accurately transcribed to the proper reporting format. Various levels of data review from acquisition to the final report are incorporated to reduce possibilities of error.
- 1.1.6 All of the above considerations must be documented to validate the quality of the data.

1.2 OVERVIEW

Table 1-1 gives an overview of the various elements of the QA/QC program as they relate to the duties of the laboratory personnel.

Table 1-1
 QUALITY ASSURANCE PROGRAM

RESPONSIBLE PARTY	ELEMENTS
Analyst	<ul style="list-style-type: none"> Sample analysis Standard curve preparation Preventive maintenance of equipment Data reduction and review QC data recording Ensuring samples are analyzed within specified times Advising lab supervisor and lab manager of analytical anomalies Initiating corrective actions
Laboratory Supervisors	<ul style="list-style-type: none"> Analyst training and verification Data review and reporting Reagent quality control Intralaboratory testing and quality control Corrective actions, initiation, implementation and approval Method implementation
Laboratory Quality Assurance Coordinator	<ul style="list-style-type: none"> Supervision of QA/QC program and procedures Quality assurance reports QA/QC training Data evaluation and verification Quality assurance manual Audit procedures Corrective actions, initiation, implementation and approval
Laboratory Management	<ul style="list-style-type: none"> Review of data and analytical reports Corrective actions, initiation, implementation and approval Assure adherence to all QA/QC procedures

Section 2

LABORATORY ORGANIZATION AND PERSONNEL

2.0 INTRODUCTION

The laboratory staff is organized in such a way that individuals are allowed to specialize in a limited set of activities and become proficient in their area of responsibility. Their time and expertise are not diluted with tasks not immediately associated with their area of responsibility. This contributes to the timeliness, quality, and responsiveness of analytical efforts for project completion.

- 2.1 The organization chart of the Gainesville laboratory is shown in Figure 2-1. Resumes for all laboratory personnel are provided in Appendix 1.

2.2 RESPONSIBILITIES

Brief descriptions of the responsibilities for the individuals who are involved in laboratory management and operation follow.

- 2.2.1 The Laboratory Manager has overall responsibility for administrative management of the laboratory. The Laboratory Manager will interface with clients on all aspects of their projects including progress, problems and recommended solutions. The Laboratory Manager will also work with the Laboratory Quality Assurance Coordinator and laboratory department managers/supervisors in reviewing progress reports, analytical reports, financial reports, and QC reports.

- 2.2.2 The Laboratory Quality Assurance Coordinator (LQAC) is responsible for reviewing and advising on all aspects of QA/QC. The LQAC is responsible for executing quality control procedures and techniques to assure that the laboratory achieves established standards of quality. The LQAC is also responsible for evaluating data quality and maintaining records on related QC charts to ensure adherence to quality assurance programs, and will administer interlaboratory QA efforts, review performance evaluation results, take corrective actions and prepare quality assurance reports to management.

- 2.2.3 The Laboratory Administrative Manager is responsible for the administrative functions of the laboratory, such as records management, billing, and sample custody.

2.2.4 The Client Services Manager is responsible for establishing and maintaining good client relations. The Client Services Manager serves as a liaison between the client and analytical operations of the laboratory, aiding in defining the scope of the work, determining the needs of the client, and circumventing or solving client problems.

2.2.5 The Analytical Department Managers/Supervisors have the responsibility for the technical operations of their departments. They will provide technical direction in conducting laboratory analyses and resolving day-to-day problems. They will also review analytical data for clarity, validity, and adherence to quality control standards.

2.2.6 The analysts perform analytical procedures, data processing, and recording in accordance with SOPs. They are responsible for calibration and preventive maintenance of instrumentation, data reduction, data review, and reporting out-of-control situations.

2.2.7 The sample custodian is responsible for the proper receipt of samples into the laboratory. The sample custodian will maintain the proper records of custody. The sample custodian will also prepare and ship sampling kits.

2.3 PERSONNEL TRAINING

2.3.1 Newly hired employees are given an orientation to the company and to the laboratory. This orientation includes an introduction to company policies and personnel, a review of the job description and how the position integrates with the overall organization, an overview of the QA program, and introductions to the safety and waste disposal programs.

2.3.2 Initial on-the-job training is conducted at the bench by the area supervisor or qualified senior technician. This training involves familiarization with the standard operating procedure(s) and the QC effort involved, and trial runs with QC samples. The readiness of the new employee to assume initial job assignments is assessed and approved by the area supervisor. The employee's competency is measured by performance of QC samples, and further training is conducted as needed.

2.3.3 The laboratory conducts seminars as needed on QA procedures, technical procedures, new procedures, etc. Attendance at these seminars is documented.

2.3.4 CH2M HILL offers a variety of programs employees are encouraged to attend as part of professional development efforts. Participation in outside seminars, conferences, and classes is encouraged and often sponsored by CH2M HILL.

Completion of the CH2M HILL training is documented on the Personal Training Record which is maintained for each employee in the personnel file. Each Personal Training Record is updated on a continuing basis.

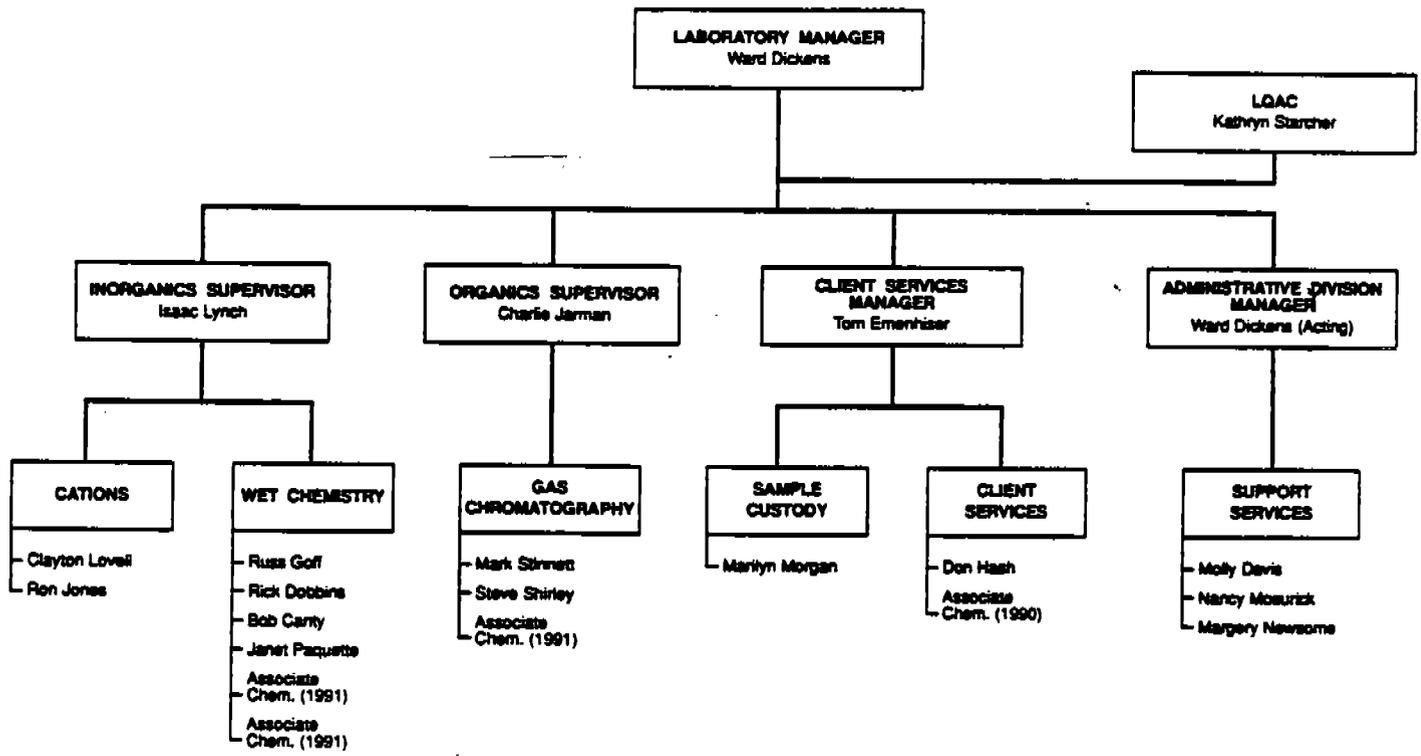


Figure 2-1 Laboratory Organization Chart

Section 3

QUALITY ASSURANCE OBJECTIVES

- 3.0 Quality assurance objectives for method detection limits, precision and accuracy of the analytical methods employed in the CH2M HILL Gainesville laboratory are presented in Tables 3-1 and 3-2. These QA objectives are based on historical in-house data. Where insufficient data are available, EPA published method control data are provided when available.
- 3.1 The control limits for precision and accuracy listed in the tables are routine target values. The actual limits will vary as new data are used to update these limits.
- 3.2 The general requirement of this quality assurance program is to analyze a sufficient number of standards, replicates, blanks and spike samples to effectively evaluate results against numerical QA objectives.

Table 3-1 SAMPLE PREPARATION METHODS			
Sample Preparation Method ¹	Description	Matrix	Sample Preparation For These Methods
EPA-SW 3050	Acid Digestion	Soil, Sediment, Waste	Metals by AAS and GFAA
EPA-SW 1310	EPTOX (Extraction)	Waste	Metals Organics
CLP SOW No.788 ²	Acid Digestion	Water	Metals by AAS and GFAA
EPA-SW 5030	Purge and Trap	Water, Soil, Sediment, Waste	601/602 8010/8020
COE ³ p.3-228(b)	Digestion, TP	Soil, Sediment, Waste	365.1, 365.2
COE ³ p.3-223	Extraction, Soluble Phosphate	Soil, Sediment, Waste	365.1, 365.2
COE ³ p.3-155 Method 2	Digestion for NH ₃	Soil, Sediment, Waste	350.1, 350.2
COE ³ p.3-183	Extraction for Nitrate and Nitrite	Soil, Sediment, Waste	353.1, 353.2
COE ³ p.3-201 Method 1	Digestion for TKN (and Organic Nit.)	Soil, Sediment, Waste	351.3
COE ³ p.3-380	Sample Preparation for BOD	Soil, Sediment, Waste	405.1, 507 (SM)
COE ³ p.3-393	Sample Preparation for COD	Soil, Sediment, Waste	508 (SM)
EPA 335.1	Sample Prep for Amenable CN	Water	335.2 M
EPA-SW 9065	Distillation	Soil, Sediment, Waste	9066, 420.2

¹ METHODS:

EPA Methods for Chemical Analysis of Water and Wastes, US EPA, PB 84-128677, March, 1983.

EPA-SW Test Methods for Evaluation Solid Wastes, US EPA, SW 846, Third Edition, November, 1986.

² Statement of Work for Inorganics Analysis, USEPA Contract Laboratory Program, SOW No. 788

³ Procedures for Handling and Chemical Analysis of Sediment and Water Samples, EPA/Corps of Engineers, May, 1981.

Table 3-2 QUALITY ASSURANCE OBJECTIVES Water Samples (Drinking Water, Surface Water, and Groundwater)					
Parameter	Method Detection Limit (PPB)	Analytical Method ¹	Precision ² (RPD)	Accuracy ³ (% Rec.)	Source ⁴
GENERAL ANALYSES					
pH (units)	0.05	EPA 150.1	0-5.0	--	M
Acidity (as CaCO ₃)	1000	EPA 305.1	0-5.0	--	M
Alkalinity (as CaCO ₃)	1000	EPA 310.1	0-11	85-111	M
Alkalinity, (as CaCO ₃) (Automated)	ID	EPA 310.2	ID	ID	
Color (APHA units)	1	EPA 110.2	0-10	--	D
Conductivity (µmhos/cm)	5	EPA 120.1	0-5.0	--	M
Hardness, calcium (as CaCO ₃)	1,000	EPA 215.2	0-5.0	88-112	M
Hardness, total (as CaCO ₃)	1,000	EPA 130.2	0-11(M) 0-15(L)	91-106	M
Odor (TCN)	--	EPA 140.1	--	--	
Saturation Index (Corrosivity)	--	SM 203	--	--	
Solids, total dissolved	1,000	EPA 160.1	0-10(M) 0-17(L)	--	M
Solids, total suspended	1,000	EPA 160.2	0-9.0(M) 0-40(L)	--	M
Solids, volatile	1,000	EPA 160.4	0-15	--	D
Solids, total	1,000	EPA 160.3	0-20	--	M
Turbidity (NTU)	0.1	EPA 180.1	0-8.0(M) 0-17(L)	--	M
ANIONS					
Bromide	2,000	EPA 320.1	0-15	80-120	D
Chloride, (Titrimetric)	1,000	EPA 325.3	0-5.0(M) 0-26(L)	93-110	M
Chloride, (Automated)	ID	EPA 325.2	ID	ID	
Chlorine	100	EPA 330.3	0-15	85-115	D
Chlorine, (DPD)	100	EPA 330.5	0-5.0(M) 0-17(L)	85-103	M
Cyanide, amenable	5	EPA 335.2 (M)	0-5.0	68-129	M
Cyanide, total	5	EPA 335.2 (M)	0-5.0	68-129	M
Fluoride	10	EPA 340.2	0-5.0(M) 0-22(L)	82-107	M
Sulfate, (Automated-MTB)	1,000	EPA 375.2	0-8.0(M) 0-15(L)	78-118	M
Sulfate, (Turbidimetric)	1,000	EPA 375.4	0-14	70-130	M
Sulfide, (Titrimetric)	1,000	EPA 376.1	0-15	85-115	D
Sulfide, (Colorimetric)	ID	EPA 376.2	0-7.0(M) 0-22(L)	78-129	M

Table 3-2 (continued) QUALITY ASSURANCE OBJECTIVES Water Samples (Drinking Water, Surface Water, and Groundwater)					
Parameter	Method Detection Limit (PPB)	Analytical Method ¹	Precision ² (RPD)	Accuracy ³ (% Rec.)	Source ⁴
CATIONS					
Aluminum, (Flame)	500	EPA 202.1 (M)	0-40	63-145	H
Aluminum, (Furnace)	20	EPA 202.2 (M)	0-17	64-150	H
Antimony, (Flame)	200	EPA 204.1 (M)	0-32	66-138	H
Antimony, (Furnace)	20	EPA 204.2 (M)	0-15	85-115	H
Arsenic, (Furnace)	5	EPA 206.2 (M)	0-15	69-146	H
Arsenic, (Hydride)	2	EPA 206.3	0-25	85-115	H
Barium, (Flame)	200	EPA 208.1 (M)	0-6.0	84-113	H
Barium, (Furnace)	10	EPA 208.2 (M)	10	10	
Beryllium, (Flame)	10	EPA 210.1 (M)	0-5.0	89-106	H
Beryllium, (Furnace)	0.2	EPA 210.2 (M)	0-5.0	82-134	H
Boron	200	SM 404A	0-28	78-114	H
Cadmium, (Flame)	10	EPA 213.1 (M)	0-13	84-110	H
Cadmium, (Furnace)	0.2	EPA 213.2 (M)	0-11	78-113	H
Calcium, (Flame)	1000	EPA 215.1 (M)	0-23	65-129	H
Chromium, hexavalent	500	EPA-SM 7196 (M)	0-40	57-125	H
Chromium, total, (Flame)	50	EPA 218.1 (M)	0-16	90-137	H
Chromium, total, (Furnace)	2	EPA 218.2 (M)	0-21	66-148	H
Cobalt, (Flame)	200	EPA 219.1 (M)	0-14	70-130	H
Cobalt, (Furnace)	2	EPA 219.2 (M)	0-25	78-115	H
Copper, (Flame)	20	EPA 220.1 (M)	0-30	87-106	H
Copper, (Furnace)	2	EPA 220.2 (M)	0-13	76-130	H
Iron, (Flame)	20	EPA 236.1 (M)	0-23	83-116	H
Iron, (Furnace)	2	EPA 236.2 (M)	0-15	70-130	D
Lead, (Flame)	50	EPA 239.1 (M)	0-24	75-125	H
Lead, (Furnace)	2	EPA 239.2 (M)	0-37	69-136	H
Magnesium, (Flame)	50	EPA 242.1 (M)	0-16	72-117	H
Manganese, (Flame)	10	EPA 243.1 (M)	0-39	90-110	H
Manganese, (Furnace)	0.2	EPA 243.2 (M)	0-15	70-130	D
Mercury	0.2	EPA 245.1 (M)	0-5.0	84-123	H
Molybdenum, (Flame)	200	EPA 246.1	0-14	70-130	H
Molybdenum, (Furnace)	2	EPA 246.2	0-15	70-130	D
Nickel, (Flame)	50	EPA 249.1 (M)	0-16	86-109	H
Nickel, (Furnace)	2	EPA 249.2 (M)	0-18	67-134	H
Potassium, (Flame)	10	EPA 258.1 (M)	0-10	60-124	H
Selenium, (Furnace)	5	EPA 270.2 (M)	0-12	61-116	H
Selenium, (Hydride)	2	EPA 270.3	0-14	71-139	H

Table 3-2 (continued) QUALITY ASSURANCE OBJECTIVES Water Samples (Drinking Water, Surface Water, and Groundwater)					
Parameter	Method Detection Limit (PPB)	Analytical Method ¹	Precision ² (RPD)	Accuracy ³ (% Rec.)	Source ⁴
Silica	50	EPA 370.1	0-14	84-120	M
Silver, (Flame)	20	EPA 272.1 (M)	0-8.0	63-139	M
Silver, (Furnace)	0.5	EPA 272.2 (M)	0-20	53-126	M
Sodium, (Flame)	50	EPA 273.1 (M)	0-8.0	63-130	M
Strontium, (Flame)	50	SM 303A	0-13	87-101	M
Thallium, (Flame)	500	EPA 279.1 (M)	0-5.0	86-113	M
Thallium, (Furnace)	2	EPA 279.2 (M)	0-15	70-130	M
Tin, (Flame)	1000	EPA 282.1	0-25	75-125	D
Tin, (Furnace)	5	EPA 282.2	0-25	75-125	D
Titanium, (Flame)	500	EPA 283.1	0-25	75-125	D
Titanium, (Furnace)	10	EPA 283.2	0-25	75-125	D
Vanadium, (Flame)	200	EPA 286.1 (M)	0-14	70-130	M
Vanadium, (Furnace)	4	EPA 286.2 (M)	0-25	75-125	D
Zinc, (Flame)	10	EPA 289.1 (M)	0-21	77-113	M
Zinc, (Furnace)	10	EPA 289.2 (M)	ID	ID	
NUTRIENTS					
Ammonia (as N)	40	EPA 350.2	0-5.0(M) 0-40(L)	72-120	M
Ammonia, (as N) (Automated)	ID	EPA 350.1	ID	ID	
Ammonia, unionized (as N)	40	EPA 350.2	--	--	
Nitrate and Nitrite (as N) (Cd Red.)	20	EPA 353.2	0-5.0	90-110	M
Nitrate and Nitrite (as N) (Hydraz.)	ID	EPA 353.1	ID	ID	
Nitrite (as N) (Automated)	20	EPA 353.2	0-12	76-114	M
Nitrite (as N)	20	EPA 354.1	0-18	86-103	D
Total Kjeldahl Nitrogen (as N)	40	EPA 351.3	0-26	60-126	M
Total Kjeldahl Nitrogen, (as N) (Aut.)	ID	EPA 351.2	ID	ID	
Organic Nitrogen (as N)	ID	EPA 351.3	ID	ID	
Phosphorus, all forms (as P)		EPA 365.2			
hydrolyzable	10		0-15	70-130	D
ortho	10		0-8.0	85-117	M
total	10		0-13	85-114	M
Phosphorus, all forms, (as P) (Aut.)		EPA 365.1			
hydrolyzable	ID		ID	ID	
ortho	ID		ID	ID	
total	ID		ID	ID	
Phosphorus, total, (as P) (Automated)	10	EPA 365.4	0-17	59-137	M

Table 3-2 (continued) QUALITY ASSURANCE OBJECTIVES Water Samples (Drinking Water, Surface Water, and Groundwater)					
Parameter	Method Detection Limit (PPB)	Analytical Method ¹	Precision ² (RPD)	Accuracy ³ (% Rec.)	Source ⁴
OXYGEN DEMAND ANALYSES					
BOD ₅ , total	1,000	EPA 405.1	0-10(H) 0-66(L)	--	H
BOD ₅ , carbonaceous	1,000	SM 507	0-25	--	D
COD	1,000	SM 508	0-15	70-130	D
Dissolved Oxygen	100	EPA 360.1	0-15	--	D
ORGANIC ANALYSES					
Chlorophyll, mg/m ³	1,000	SM 1002G	0-43	--	H
MBAS	25	EPA 425.1	0-72	42-148	H
Oil and Grease	1,000	EPA 413.1	0-29	--	H
Phenols, 4-AAP	2	EPA 420.2	0-20	68-128	H
TOC	100	EPA 415.1	0-29	75-123	H
Volatile Organic Acids	1,500	SM 504B	0-8.0	91-117	H

Table 3-2 (continued) QUALITY ASSURANCE OBJECTIVES Water Samples (Drinking Water, Surface Water, and Groundwater)					
Parameter	Method Detection Limit (PPB)	Analytical Method ¹	Precision ² (RPD)	Accuracy ³ (% Rec.)	Source ⁴
PURGEABLE HALOCARBONS		EPA-40CFR 601			
Chloromethane	1.0		0-72	D-199	M
Bromomethane	1.0		0-35	26-174	M
Vinyl chloride	1.0		0-43	19-174	M
Chloroethane	1.0		0-43	18-180	M
Trichlorofluoromethane	1.0		10	10	
1,1-Dichloroethene	1.0		0-30	21-143	M
Dichloromethane	1.0		0-33	26-135	M
Trans-1,2-Dichloroethene	1.0		0-27	51-135	M
1,1-Dichloroethane	1.0		0-22	55-168	M
Chloroform	1.0		0-19	74-125	M
1,1,1-Trichloroethane	1.0		0-19	69-131	M
Carbon tetrachloride	1.0		0-19	75-135	M
1,2-Dichloroethane	1.0		0-29	61-131	M
Trichloroethane	1.0		0-24	59-149	M
1,2-Dichloropropene	1.0		0-19	75-125	M
Dichlorobromomethane	1.0		0-22	72-131	M
Cis-1,3-Dichloropropene	1.0		0-26	72-124	M
Trans-1,3-Dichloropropene	1.0		0-20	75-123	M
1,1,2-Trichloroethane	1.0		0-19	77-127	M
Tetrachloroethane	1.0	0-23	77-142	M	
Dibromochloromethane	1.0	0-18	70-136	M	
Bromoform	1.0	0-15	71-132	M	
1,1,2,2-Tetrachloroethane	1.0	0-27	63-141	M	
PURGEABLE AROMATICS		EPA-40CFR 602			
Tertiary butyl methyl ether	1.0		0-30	D-239	M
Benzene	1.0		0-13	74-126	M
Toluene	1.0		0-11	82-125	M
Chlorobenzene	1.0		0-11	86-122	M
Ethyl benzene	1.0		0-14	86-127	M
Total xylenes	1.0		0-11	84-132	M
1,3-Dichlorobenzene	1.0		0-12	86-123	M
1,4-Dichlorobenzene	1.0		0-12	84-123	M
1,2-Dichlorobenzene	1.0	0-10	80-125	M	

Table 3-2 (continued) QUALITY ASSURANCE OBJECTIVES Water Samples (Drinking Water, Surface Water, and Groundwater)					
Parameter	Method Detection Limit (PPB)	Analytical Method ¹	Precision ² (RPD)	Accuracy ³ (% Rec.)	Source ⁴
OTHER PURGEABLE ORGANICS					
1,2-Dibromoethane (EDB)	0.02	EPA-40CFR 504	ID	60-140	M
1,2-Dibromo-3-chloropropane	0.02		ID	60-140	M
SW 846 METHODS (EPA-SW)					
GENERAL ANALYSES					
pH (units)	0.05	9040	0-5.0	--	M
Conductivity (µmhos/cm)	5	9050	0-5.0	--	M
Chloride, (Titrimetric)	1.000	9252	0-26	90-110	M
Chloride, (Automated)	ID	9251	ID	ID	
Cyanide, total and amenable	5	9012	0-5.0	68-129	M
Sulfate, (Automated-MTB)	1.000	9036	0-15	78-119	M
Sulfate (Turbidimetric)	1.000	9038	0-14	70-130	M
Sulfide (Titrimetric)	1.000	9030	0-15	85-115	D
CATIONS					
Aluminum, (Flame)	500	7020	0-40	63-145	M
Antimony, (Flame)	200	7040	0-32	66-138	M
Antimony, (Furnace)	20	7041	0-15	85-115	M
Arsenic, (Furnace)	5	7060	0-15	69-146	M
Arsenic, (Hydride)	2	7061	0-25	85-115	M
Barium, (Flame)	200	7080	0-6.0	84-113	M
Barium, (Furnace)	ID	7081	ID	ID	
Beryllium, (Flame)	10	7090	0-5.0	89-106	M
Beryllium, (Furnace)	0.2	7091	0-5.0	82-134	M
Cadmium, (Flame)	10	7130	0-13	84-110	M
Cadmium, (Furnace)	0.2	7131	0-13	78-113	M
Calcium, (Flame)	1000	7140	0-23	65-129	M
Chromium, hexavalent	500	7196	0-40	57-125	M
Chromium, total, (Flame)	50	7190	0-16	90-137	M
Chromium, total, (Furnace)	2	7191	0-21	68-148	M
Cobalt, (Flame)	200	7200	0-14	70-130	M
Cobalt, (Furnace)	1	7201	0-25	70-115	M
Copper, (Flame)	20	7210	0-30	87-106	M
Copper, (Furnace)	2	7211	0-13	76-130	M
Iron, (Flame)	20	7380	0-23	83-116	M

Table 3-2 (continued)
 QUALITY ASSURANCE OBJECTIVES
 Water Samples (Drinking Water, Surface Water, and Groundwater)

Parameter	Method Detection Limit (PPB)	Analytical Method ¹	Precision ² (RPD)	Accuracy ³ (% Rec.)	Source ⁴
Iron, (Furnace)	2	7381	0-15	70-130	D
Lead, (Flame)	50	7420	0-24	75-125	H
Lead, (Furnace)	2	7421	0-37	69-136	H
Magnesium, (Flame)	50	7450	0-16	72-117	H
Manganese, (Flame)	10	7460	0-39	90-110	H
Manganese, (Furnace)	0.2	7461	0-15	70-130	D
Mercury	0.2	7470	0-5.0	84-123	H
Molybdenum, (Flame)	200	7480	0-14	70-130	H
Molybdenum, (Furnace)	2	7481	0-15	70-130	D
Nickel, (Flame)	50	7520	0-16	86-109	H
Potassium, (Flame)	10	7610	0-10	60-124	H
Selenium, (Furnace)	5	7760	0-12	61-116	H
Selenium, (Hydride)	2	7741	0-14	71-139	H
Silver, (Flame)	20	7760	0-8.0	63-139	H
Silver, (Furnace)	0.5	7761	0-20	53-126	H
Sodium, (Flame)	50	7770	0-8.0	63-130	H
Strontium, (Flame)	50	7780	0-13	87-101	H
Thallium, (Flame)	500	7840	0-5.0	86-113	H
Thallium, (Furnace)	2	7841	0-15	70-130	H
Tin, (Flame)	1,000	7870	0-25	75-125	D
Vanadium, (Flame)	200	7910	0-14	70-130	H
Vanadium, (Furnace)	4	7911	0-25	75-125	D
Zinc, (Flame)	10	7950	0-21	77-113	H
ORGANIC ANALYSES					
Oil and Grease	1,000	9070	0-29	--	H
Phenols, 4-AAP	2	9066	0-20	68-126	H
TOC	100	9060	0-29	75-123	H

Table 3-2 (continued) QUALITY ASSURANCE OBJECTIVES Water Samples (Drinking Water, Surface Water, and Groundwater)					
Parameter	Method Detection Limit (PPB)	Analytical Method ¹	Precision ² (RPD)	Accuracy ³ (% Rec.)	Source ⁴
PURGEABLE HALOCARBONS					
		8010			
Chloromethane	1.0		0-72	D-199	M
Bromomethane	1.0		0-35	26-174	M
Vinyl chloride	1.0		0-43	19-174	M
Chloroethane	1.0		0-43	18-180	M
Trichlorofluoromethane	1.0		ID	ID	
1,1-Dichloroethene	1.0		0-30	21-143	M
Dichloromethane	1.0		0-33	26-135	M
Trans-1,2-Dichloroethene	1.0		0-27	51-135	M
1,1-Dichloroethane	1.0		0-22	55-168	M
Chloroform	1.0		0-19	74-125	M
1,1,1-Trichloroethane	1.0		0-19	69-131	M
Carbon tetrachloride	1.0		0-19	75-135	M
1,2-Dichloroethane	1.0		0-29	61-131	M
Trichloroethene	1.0		0-24	59-149	M
1,2-Dichloropropane	1.0		0-19	75-125	M
Dichlorobromomethane	1.0		0-22	72-131	M
Cis-1,3-Dichloropropene	1.0		0-26	72-124	M
Trans-1,3-Dichloropropene	1.0		0-20	75-123	M
1,1,2-Trichloroethane	1.0		0-19	77-127	M
Tetrachloroethene	1.0		0-23	77-142	M
Dibromochloromethane	1.0		0-18	70-136	M
Bromoform	1.0		0-15	71-132	M
1,1,2,2-Tetrachloroethane	1.0		0-27	63-141	M

Table 3-2 (continued)
 QUALITY ASSURANCE OBJECTIVES
 Water Samples (Drinking Water, Surface Water, and Groundwater)

Parameter	Method Detection Limit (PPB)	Analytical Method ¹	Precision ² (RPD)	Accuracy ³ (% Rec.)	Source ⁴
PURGEABLE AROMATICS					
		8020			
Tertiary butyl methyl ether	1.0		0-30	D-239	H
Benzene	1.0		0-13	74-126	H
Toluene	1.0		0-11	82-125	H
Chlorobenzene	1.0		0-11	86-122	H
Ethyl benzene	1.0		0-14	86-127	H
Total xylenes	1.0		0-11	84-132	H
1,3-Dichlorobenzene	1.0		0-12	86-123	H
1,4-Dichlorobenzene	1.0		0-12	84-123	H
1,2-Dichlorobenzene	1.0		0-10	80-125	H

¹ METHODS:

EPA Methods for Chemical Analysis of Water and Wastes, US EPA, PB 84-128677, March, 1983.

(M) EPA procedure modified for Contract Laboratory Program.

SM Standard Methods for the Examination of Water and Wastewater, APHA et al, 16th Edition, 1985.

EPA-SW Test Methods for Evaluation Solid Wastes, US EPA, SW 846, Third Edition, November, 1986. (And Proposed Update Package, 1989.)

EPA-40CFR Code of Federal Register, Protection of the Environment, 40 CFR, App. A to Part 136, July, 1988.

² Precision defined as Relative Percent Difference (RPD). Where two RPD's are given, there is a lower and an upper concentration range.

³ Accuracy defined as Percent Recovery of known spike sample.

⁴ Source of QA Objectives data:

H = from historical laboratory data

M = from published method

D = default values where sufficient data are not available

IL Insufficient Data

(H) High concentration range for duplicate samples

(L) Low concentration range for duplicate samples

Table 3-3 QUALITY ASSURANCE OBJECTIVES Soil, Sediment, and Waste					
Parameter	Method Detection Limit ⁵ (PPB)	Analytical Method ¹	Precision ² (RPD)	Accuracy ³ (% Rec.)	Source ⁴
GENERAL ANALYSES					
pH (units)	0.05	EPA-SW 9045	0-10	--	M
Conductivity (µmhos/cm)	5	EPA-SW 9050	0-10	--	M
Solids, volatile	1,000	EPA 160.4	0-15	--	D
Solids, total	1,000	EPA 160.3	0-20	--	M
Cyanide, total	5	EPA 335.2 (M)	0-15	65-130	M
CATIONS					
Aluminum, (Flame)	500	EPA 202.1 (M)	0-40	63-145	M
Aluminum, (Furnace)	20	EPA 202.2 (M)	0-20	64-150	M
Antimony, (Flame)	200	EPA 204.1 (M)	0-32	66-136	M
Antimony, (Furnace)	20	EPA 204.2 (M)	0-20	60-120	M
Arsenic, (Furnace)	5	EPA 206.2 (M)	0-20	69-146	M
Arsenic, (Hydride)	2	EPA 206.3	0-25	80-120	M
Barium, (Flame)	200	EPA 208.1 (M)	0-15	60-120	M
Barium, (Furnace)	10	EPA 208.2 (M)	10	10	
Beryllium, (Flame)	10	EPA 210.1 (M)	0-15	85-115	M
Beryllium, (Furnace)	0.2	EPA 210.2 (M)	0-10	80-130	M
Cadmium, (Flame)	10	EPA 213.1 (M)	0-15	80-120	M
Cadmium, (Furnace)	0.2	EPA 213.2 (M)	0-15	75-115	M
Calcium, (Flame)	1000	EPA 215.1 (M)	0-25	65-129	M
Chromium, hexavalent	500	SW 7196 (M)	0-40	57-125	M
Chromium, total, (Flame)	50	EPA 218.1 (M)	0-20	85-140	M
Chromium, total, (Furnace)	2	EPA 218.2 (M)	0-21	68-148	M
Cobalt, (Flame)	200	EPA 219.1 (M)	0-15	70-130	M
Cobalt, (Furnace)	2	EPA 219.2 (M)	0-25	70-120	M
Copper, (Flame)	20	EPA 220.1 (M)	0-30	85-110	M
Copper, (Furnace)	2	EPA 220.2 (M)	0-15	70-130	M
Iron, (Flame)	20	EPA 236.1 (M)	0-25	60-120	M
Iron, (Furnace)	2	EPA 236.2 (M)	0-20	70-130	D
Lead, (Flame)	50	EPA 239.1 (M)	0-25	75-125	M
Lead, (Furnace)	2	EPA 239.2 (M)	0-37	69-136	M
Magnesium, (Flame)	50	EPA 242.1 (M)	0-20	70-120	M
Manganese, (Flame)	10	EPA 243.1 (M)	0-39	60-120	M
Manganese, (Furnace)	0.2	EPA 243.2 (M)	0-15	70-130	D
Mercury	0.2	EPA 245.5 (M)	0-10	80-125	M
Molybdenum, (Flame)	200	EPA 246.1	0-20	85-115	M
Molybdenum, (Furnace)	2	EPA 246.2	0-20	70-130	D

Table 3-3 (Continued)
 QUALITY ASSURANCE OBJECTIVES
 Soil, Sediment, and Waste

Parameter	Method Detection Limit ⁵ (PPB)	Analytical Method ¹	Precision ² (RPD)	Accuracy ³ (% Rec.)	Source ⁴
Nickel, (Flame)	50	EPA 249.1 (M)	0-20	90-115	M
Nickel, (Furnace)	2	EPA 249.2 (M)	0-18	67-134	M
Potassium, (Flame)	10	EPA 258.1 (M)	0-15	60-124	M
Selenium, (Furnace)	5	EPA 270.2 (M)	0-15	61-116	M
Selenium, (Hydride)	2	EPA 270.3	0-15	71-139	M
Silver, (Flame)	20	EPA 272.1 (M)	0-10	63-139	M
Silver, (Furnace)	0.5	EPA 272.2 (M)	0-20	53-126	M
Sodium, (Flame)	50	EPA 273.1 (M)	0-10	63-130	M
Thallium, (Flame)	500	EPA 279.1 (M)	0-10	81-118	M
Thallium, (Furnace)	2	EPA 279.2 (M)	0-15	70-130	M
Vanadium, (Flame)	200	EPA 286.1 (M)	0-14	70-130	M
Vanadium, (Furnace)	4	EPA 286.2 (M)	0-25	75-125	D
Zinc, (Flame)	10	EPA 289.1 (M)	0-25	75-115	M
Zinc, (Furnace)	10	EPA 289.2 (M)	10	10	
CATIONS (SW846 Methods) (EPA-SW)					
Aluminum, (Flame)	500	7020	0-40	63-145	M
Antimony, (Flame)	200	7040	0-32	66-138	M
Antimony, (Furnace)	20	7041	0-20	80-120	M
Arsenic, (Furnace)	5	7060	0-20	69-146	M
Arsenic, (Hydride)	2	7061	0-25	80-120	M
Barium, (Flame)	200	7080	0-15	80-120	M
Beryllium, (Flame)	10	7090	0-15	85-115	M
Beryllium, (Furnace)	0.2	7091	0-10	80-130	M
Cadmium, (Flame)	10	7130	0-15	80-120	M
Cadmium, (Furnace)	0.2	7131	0-15	75-115	M
Calcium, (Flame)	1000	7140	0-25	65-129	M
Chromium, hexavalent	500	7196	0-40	57-125	M
Chromium, total, (Flame)	50	7190	0-20	85-140	M
Chromium, total, (Furnace)	2	7191	0-21	68-148	M
Cobalt, (Flame)	200	7200	0-15	70-130	M
Cobalt, (Furnace)	2	7201	0-25	70-120	M
Copper, (Flame)	20	7210	0-30	85-110	M
Iron, (Flame)	20	7380	0-25	80-120	M
Iron, (Furnace)	2	7381	0-20	70-130	D
Lead, (Flame)	50	7420	0-25	75-125	M
Lead, (Furnace)	2	7421	0-37	69-136	M

Table 3-3 (Continued)
 QUALITY ASSURANCE OBJECTIVES
 Soil, Sediment, and Waste

Parameter	Method Detection Limit ⁵ (PPB)	Analytical Method ¹	Precision ² (RPD)	Accuracy ³ (% Rec.)	Source ⁴
Magnesium, (Flame)	50	7450	0-20	70-120	M
Manganese, (Flame)	10	7460	0-39	80-120	M
Mercury	0.2	7471	0-10	80-125	M
Molybdenum, (Flame)	200	7480	0-20	70-130	M
Molybdenum, (Furnace)	2	7481	0-20	70-130	D
Nickel, (Flame)	50	7520	0-20	80-115	M
Potassium, (Flame)	10	7610	0-15	60-124	M
Selenium, (Furnace)	5	7740	0-15	61-116	M
Selenium, (Hydride)	2	7741	0-15	71-139	M
Silver, (Flame)	20	7760	0-10	63-139	M
Sodium, (Flame)	50	7770	0-10	63-130	M
Thallium, (Flame)	500	7840	0-10	81-118	M
Thallium, (Furnace)	2	7841	0-15	70-130	M
Tin, (Flame)	1000	7870	0-25	75-125	D
Vanadium, (Flame)	200	7910	0-14	70-130	M
Vanadium, (Furnace)	4	7911	0-25	75-125	D
Zinc, (Flame)	10	7950	0-25	75-115	M
NUTRIENTS					
Ammonia (as N)	40	EPA 350.2	0-40	70-120	M
Ammonia (as N), (Automated)	ID	EPA 350.1	ID	ID	
Nitrate and Nitrite (as N), (Cd Red.)	20	EPA 353.2	0-10	85-115	M
Nitrate and Nitrite (as N), (Hydraz.)	ID	EPA 353.1	ID	ID	
Total Kjeldahl Nitrogen (as N)	40	EPA 351.3	0-35	60-130	M
Organic Nitrogen (as N)	ID	EPA 351.3	ID	ID	
Phosphate, soluble (as P)	10	EPA 365.2	0-15	80-120	D
Phosphate, soluble (as P), (Automated)	ID	EPA 365.1	ID	ID	
Phosphorus, total (as P)	10	EPA 365.2	0-20	80-120	M
Phosphorus, total (as P), (Automated)	ID	EPA 365.1	ID	ID	
OXYGEN DEMAND ANALYSES					
BOD, total	1,000	EPA 405.1	0-30	--	M
BOD, carbonaceous	1,000	SM 507	0-35	--	D
COD	1,000	SM 508	0-20	70-130	D

Table 3-3 (Continued) QUALITY ASSURANCE OBJECTIVES Soil, Sediment, and Waste					
Parameter	Method Detection Limit ⁵ (PPB)	Analytical Method ¹	Precision ² (RPD)	Accuracy ³ (% Rec.)	Source ⁴
ORGANIC ANALYSES					
Oil and Grease	1,000	SW 9071	0-35	--	M
Phenols, 4-AAP	2	EPA 420.2	0-30	65-135	M
TOC	1000	SW 9060	0-35	70-130	M
PURGEABLE HALOCARBONS					
		SW 8010			
Chloromethane	1.0		0-72	D-199	M
Bromomethane	1.0		0-35	26-174	M
Vinyl chloride	1.0		0-43	19-174	M
Chloroethane	1.0		0-43	18-180	M
Trichlorofluoromethane	1.0		ID	ID	
1,1-Dichloroethene	1.0		0-30	21-143	M
Dichloromethane	1.0		0-33	26-135	M
Trans-1,2-Dichloroethene	1.0		0-27	51-135	M
1,1-Dichloroethane	1.0		0-22	55-168	M
Chloroform	1.0		0-19	74-125	M
1,1,1-Trichloroethane	1.0		0-19	69-131	M
Carbon tetrachloride	1.0		0-19	75-135	M
1,2-Dichloroethane	1.0		0-29	61-131	M
Trichloroethene	1.0		0-24	59-149	M
1,2-Dichloropropane	1.0		0-19	75-125	M
Dichlorobromomethane	1.0		0-22	72-131	M
Cis-1,3-Dichloropropene	1.0		0-26	72-124	M
Trans-1,3-Dichloropropene	1.0		0-20	75-123	M
1,1,2-Trichloroethane	1.0		0-19	77-127	M
Tetrachloroethene	1.0		0-23	77-142	M
Dibromochloromethane	1.0		0-18	70-136	M
Bromoform	1.0		0-15	71-132	M
1,1,2,2-Tetrachloroethane	1.0		0-27	63-141	M

Table 3-3 (Continued) QUALITY ASSURANCE OBJECTIVES Soil, Sediment, and Waste					
Parameter	Method Detection Limit ⁵ (PPB)	Analytical Method ¹	Precision ² (RPD)	Accuracy ³ (% Rec.)	Source ⁴
PURGEABLE AROMATICS		SW 8020			
Tertiary butyl methyl ether	1.0		0-30	D-239	H
Benzene	1.0		0-13	74-126	H
Toluene	1.0		0-11	82-125	H
Chlorobenzene	1.0		0-11	86-122	H
Ethyl benzene	1.0		0-14	86-127	H
Total xylenes	1.0		0-11	84-132	H
1,3-Dichlorobenzene	1.0		0-12	86-123	H
1,4-Dichlorobenzene	1.0		0-12	84-123	H
1,2-Dichlorobenzene	1.0		0-10	80-125	H
<p>¹ METHODS:</p> <p>EPA <u>Methods for Chemical Analysis of Water and Wastes</u>, US EPA, PB 84-128677, March, 1983.</p> <p>(M) EPA procedure modified for Contract Laboratory Program.</p> <p>SM <u>Standard Methods for the Examination of Water and Wastewater</u>, APHA et al, 16th Edition, 1985.</p> <p>SW <u>Test Methods for Evaluation Solid Wastes</u>, US EPA, SW 846, Third Edition, November, 1986. (And Proposed Update Package, 1989.)</p> <p>SW-M SW 846 procedure modified for Contract Laboratory Program.</p> <p>40 CFR <u>Code of Federal Register, Protection of the Environment</u>, 40 CFR, App. A to Part 136, July, 1988.</p> <p>² Precision defined as Relative Percent Difference (RPD). Where two RPD's are given, there is a lower and an upper concentration range.</p> <p>³ Accuracy defined as Percent Recovery of known spike sample.</p> <p>⁴ Source of QA Objectives data:</p> <p>H = from historical laboratory data</p> <p>M = from published method</p> <p>D = default values where sufficient data are not available</p> <p>⁵ Method Detection Limit (MDL) is detection limit on liquid extract; MDL varies depending on percent moisture content, sample volume, etc.</p> <p>ID Insufficient Data</p> <p>(H) High concentration range for duplicate samples</p> <p>(L) Low concentration range for duplicate samples</p>					

Section 4

SAMPLING PROCEDURES

4.0 INTRODUCTION

Field sampling activities are generally conducted by full time field technicians and not by CH2M HILL laboratory personnel. Field sampling techniques for a specific project will be addressed by the project description or by the Quality Assurance Project Plan (QAPP).

4.1 SAMPLING PREPARATION

4.1.1 Preservation and Holding Times

A description of the required types of containers, preservation techniques, and holding times for handling the environmental samples after collection and prior to analysis is presented in the July 1, 1988 issue of the federal Register (40 CFR Chapter 1, Part 136.3, Table II). This information is listed in Table 4-1.

4.1.2 Sample Container Preparation

The sample containers are prepared in accordance with Engineering Support Branch Standard Operation Procedures and Quality Assurance Manual, USEPA Region IV, April 1, 1986.

- Organics sample containers - only new sample bottles are used and are purchased from a commercial supplier. QC documentation of the cleaning procedure is acquired from the supplier and stored by the laboratory. The cleaning procedures are as follows:

For volatiles:

1. Laboratory grade detergent wash and rinse
2. Multiple deionized water rinses
3. Oven drying, capping, and packing under quality controlled conditions

For extractable organics:

1. Laboratory grade detergent wash and rinse
2. Acid, deionized water, and solvent rinses
3. Oven drying, capping, and packing under quality controlled conditions

- Soil sample containers - only new sample bottles are used and are purchased from a commercial supplier. QC documentation of the cleaning procedure is acquired from the supplier and stored by the laboratory. The cleaning procedures are as follows:

For volatiles:

1. Laboratory grade detergent wash and rinse
2. Multiple deionized water rinses
3. Oven drying, capping, and packing under quality controlled conditions

For extractable organics and metals:

1. Laboratory grade detergent wash and rinse
2. Acid, deionized water, and solvent rinses
3. Oven drying, capping, and packing under quality controlled conditions

- Metals sample containers - only new sample bottles are used and are purchased from a commercial supplier. Documentation of the cleaning procedure is acquired from the supplier and stored by the laboratory. The cleaning procedure is as follows:

1. Laboratory grade detergent wash and rinse
2. Acid rinse
3. Multiple deionized water rinses
4. Air drying, capping, and packing under quality controlled conditions

- General inorganic sample containers - only new sample containers are used.

- Laboratory personnel will label the appropriate sample containers indicating the parameter group to be analyzed and preservatives required.

- When required, preservatives may be added to the sample container by lab personnel and/or appropriate containers of preservative will be included in the sample kit.
- Sample containers prepared for a sampling event and not used will be discarded.

4.1.3 Reagents used for sample preservation are listed below:

- HCl: instra-analyzed
- H₂SO₄: reagent grade or instra-analyzed
- HNO₃: Instra-analyzed
- NaOH: Reagent grade pellets
- Zinc Acetate solution: purchased commercially (APHA for sulfide)
- Sodium thiosulfate solution: purchased commercially (10% solution)

For storage of these reagents, see Section 7.2.

Table 4-1
 REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, HOLDING TIMES, AND VOLUMES

PARAMETER/ GROUP	WATER/WASTEWATER				SOIL/SLUDGE			
	CONTAINER ¹	PRESERVATION ²	MAXIMUM HOLDING TIME ³	MINIMUM VOLUME (ML)	CONTAINER ¹	PRESERVATION ²	MAXIMUM HOLDING TIME ³	MINIMUM VOLUME (OZ)
GENERAL AND INORGANICS								
Bacterial Tests	P, G	cool, 4°C, 0.008% Na ₂ S ₂ O ₅ ⁴	6 hrs.	200	--	--	--	--
Acidity	P, G	Cool, 4°C	14 days	250	--	--	--	--
Alkalinity	P, G	Cool, 4°C	14 days	250	--	--	--	--
Ammonia	P, G	Cool, 4°C, H ₂ SO ₄ to pH <2	28 days	2000	P, G	--	--	4
BOD	P, G	Cool, 4°C	48 hrs.	1000	P, G	--	--	--
Bromide	P, G	None required	28 days	1000	--	--	--	--
Chloride	P, G	None required	28 days	250	--	--	--	--
Chlorine, total residual	P, G	None required	Analyze immediately	250	--	--	--	--
COD	P, G	Cool, 4°C, H ₂ SO ₄ to pH <2	28 days	1000	P, G	--	--	4
Color	P, G	Cool, 4°C	48 hrs.	100	--	--	--	--
Conductivity	P, G	Cool, 4°C	28 days	500	P, G	--	--	--
Cyanide, total and amenable to chlorination	P, G	Cool, 4°C, NaOH to pH >12	14 days ⁵	2000	P, G	Cool, 4°C	14 days ⁵	4
Fluoride	P	None required	28 days	100	--	--	--	--
Hardness	P, G	HNO ₃ or H ₂ SO ₄ to pH <2	6 mos.	500	--	--	--	--
pH	P, G	None required	Analyze immediately	100	P, G	Cool, 4°C	--	4
TKN, Organic Nitrogen	P, G	Cool, 4°C, H ₂ SO ₄ to pH <2	28 days	2000	P, G	--	--	4
Nitrate + Nitrite	P, G	Cool, 4°C, H ₂ SO ₄ to pH <2	28 days	250	P, G	Cool, 4°C	28 days	4
Nitrite	P, G	Cool, 4°C	48 hrs.	250	--	--	--	--
Oil and Grease	G	Cool, 4°C, H ₂ SO ₄ to pH <2	28 days	1000	G	Cool, 4°C	28 days	4
TDC	P, G	Cool, 4°C, HCl or H ₂ SO ₄ to pH <2	28 days	250	P, G	Cool, 4°C	28 days	4
Phenols	G	Cool, 4°C, H ₂ SO ₄ to pH <2	28 days	250	G	Cool, 4°C	28 days	4
Phosphorus, total	P, G	Cool, 4°C, H ₂ SO ₄ to pH <2	28 days	250	P, G	Cool, 4°C	28 days	4
Phosphorus, ortho	P, G	Cool, 4°C	48 hrs.	250	P, G	Cool, 4°C	--	4
Solids, total, dissolved, suspended, volatile	P, G	Cool, 4°C	7 days	500	P, G	Cool, 4°C	7 days	4
Solids, Settleable	P, G	Cool, 4°C	48 hrs.	1000	P, G	Cool, 4°C	48 hrs.	32
Silica	P	Cool, 4°C	28 days	250	--	--	--	--

Table 4-1 (Continued)
 REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, HOLDING TIMES, AND VOLUMES

PARAMETER/ GROUP	WATER/WASTEWATER				SOIL/SLUDGE			
	CONTAINER ¹	PRESERVATION ²	MAXIMUM HOLDING TIME ³	MINIMUM VOLUME (ML)	CONTAINER ¹	PRESERVATION ²	MAXIMUM HOLDING TIME ³	MINIMUM VOLUME (OZ)
Sulfate	P, G	Cool, 4°C	28 days	250	--	--	--	--
Sulfide	P, G	Cool, 4°C, add zinc acetate plus NaOH to pH>9	7 days	1000	P, G	Cool, 4°C	--	4
Surfactants	P, G	Cool, 4°C	48 hrs.	1000	--	--	--	--
Turbidity	P, G	Cool, 4°C	48 hrs.	250	--	--	--	--
METALS⁴								
Chromium, hexavalent	P, G	Cool, 4°C	24 hrs.	250	P, G	Cool, 4°C	24 hrs.	4
Mercury	P, G	HNO ₃ to pH<2	28 days	500	P, G	Cool, 4°C	28 days	4
All other metals	P, G	HNO ₃ to pH<2	6 mos.	1000	P, G	Cool, 4°C	6 mos.	4
ORGANICS								
Volatile organics	G/TLS	Cool, 4°C, HCl to pH<2	14 days	2 X 40	G/TLC	Cool, 4°C	14 days	4
Trihalomethane	G/TLS	Cool, 4°C, sodium thiosulfate	14 days	2 X 40	G/TLC	Cool, 4°C	14 days	4
EDS/DACP	G/TLC	Cool, 4°C	28 days	2 X 125	G/TLC	Cool, 4°C	14 days ⁷	4
Semivolatile organics	G/TLC	Cool, 4°C	7 days ⁷	2500	G/TLC	Cool, 4°C	14 days ⁷	4
<p>¹ P = Polyethylene G = Glass TLS = Teflon Lined Septum TLC = Teflon Lined Cap</p> <p>² Sample preservation should be performed immediately upon collection. For composite samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.</p> <p>³ Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid.</p> <p>⁴ Should only be used in the presence of residual chlorine.</p> <p>⁵ Maximum holding time is 24 hrs. when sulfide is present. Optionally all samples may be tested with lead acetate paper before pH adjustments in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is then filtered and NaOH is added to pH>12.</p> <p>⁶ For dissolved metals, samples should be filtered immediately on-site before adding preservatives.</p> <p>⁷ Days to extraction, 40 days to analysis after extraction.</p>								

Section 5

SAMPLE CUSTODY

5.1 FIELD CUSTODY

- 5.1.1 The Analytical Request Form (ARF) (Figure 5-3) documents the number and type of bottles needed for a sampling effort. A label will be secured to each respective sample container in the laboratory prior to delivery to the field team. The dates of preparation and shipment of the sampling kit will be recorded on the ARF. The ARF will be filed as part of the permanent record. When sampling, the field team members will record the date, time, sampling location, and the sampler's signature on the label. The tag or label will serve to identify the sample and will be recorded in the bound field notebook along with information descriptive of the sampling conditions for the particular sample. An example of the sample label that will be used is shown in Figure 5-2.
- 5.1.2 Sample custody in the field will be retained by the sampling team member(s) who collected the samples. The sample will remain in the actual possession of in view of the team member(s) until they have been placed in a designated secure area.
- 5.1.3 Chain-of-custody forms (COC) will be filled out and signed by the sampling team member(s) who collected the sample. Whenever custody is transferred to another sampling team member, a project team member, or a shipping company. The COC will be signed and dated by the individual who relinquishes custody and by the individual who receives the sample. All transfers will follow these same procedures. In the case of a custody transfer to a shipping company, the shipping documents from the bonded courier will be used in lieu of a recipient's signature. The original and one copy of the three-part form will accompany the sample and a copy will be retained by the sampling team leader. Figure 5-2 is an example of the chain-of-custody that will be used during the sampling program.
- 5.1.4 When applicable, a chain-of-custody seal will be affixed to the outside of each cooler if the samples are to be shipped by a bonded shipping company. It will be placed over the cooler seam and then signed and dated. Nylon reinforced tape will be placed over the seal to reduce the potential for accidental tearing. All shipping bills will be saved by the sampling team leader and will become part of the project documentation. Chain-of-custody seals or taping coolers will not be completed if the samples are to be delivered to the lab by sampling team members.

	Environmental Laboratories 7201 N.W. 11th Place Gainesville, FL 32605 PH. (904) 331-2442
Client _____	
Sample Description _____	
Location _____	
Analysis _____	
Preservative _____	
Date _____ By _____	

	Environmental Laboratories 7201 N.W. 11th Place Gainesville, FL 32605 PH. (904) 331-2442
Client _____	
Sample Description _____	
Location _____	
Analysis _____	
Preservative _____	
Date _____ By _____	

Figure 5-1 Labels for Sample Containers

Figure 5-2

CRM QUALITY ANALYTICS CHAIN OF CUSTODY RECORD		PROJECT NAME		CLIENT ADDRESS AND PHONE NUMBER		FOR LAB USE ONLY	
PROJECT NUMBER	PROJECT NAME	CLIENT ADDRESS AND PHONE NUMBER		ANALYSES REQUESTED		LAB#	LAB#
PROJECT MANAGER	COPY TO:	SAMPLING REQUIREMENTS		DATE/TIME		PROJECT NO.	ACK
REQUESTED COMP. DATE	DATE	TIME	DATE/TIME	DATE/TIME	DATE/TIME	VERIFIED	QUOTE#
SIA NO.	DATE	TIME	DATE/TIME	DATE/TIME	DATE/TIME	BS	NO. OF SAMP
CG 1	CG 2	CG 3	CG 4	CG 5	CG 6	PG	OF
OR 1	OR 2	OR 3	OR 4	OR 5	OR 6	REMARKS	
MA 1	MA 2	MA 3	MA 4	MA 5	MA 6		
7	8	9	10	11	12		
13	14	15	16	17	18		
19	20	21	22	23	24		
25	26	27	28	29	30		
31	32	33	34	35	36		
37	38	39	40	41	42		
43	44	45	46	47	48		
49	50	51	52	53	54		
55	56	57	58	59	60		
61	62	63	64	65	66		
67	68	69	70	71	72		
73	74	75	76	77	78		
79	80	81	82	83	84		
85	86	87	88	89	90		
91	92	93	94	95	96		
97	98	99	100	101	102		
103	104	105	106	107	108		
109	110	111	112	113	114		
115	116	117	118	119	120		
121	122	123	124	125	126		
127	128	129	130	131	132		
133	134	135	136	137	138		
139	140	141	142	143	144		
145	146	147	148	149	150		
151	152	153	154	155	156		
157	158	159	160	161	162		
163	164	165	166	167	168		
169	170	171	172	173	174		
175	176	177	178	179	180		
181	182	183	184	185	186		
187	188	189	190	191	192		
193	194	195	196	197	198		
199	200	201	202	203	204		
205	206	207	208	209	210		
211	212	213	214	215	216		
217	218	219	220	221	222		
223	224	225	226	227	228		
229	230	231	232	233	234		
235	236	237	238	239	240		
241	242	243	244	245	246		
247	248	249	250	251	252		
253	254	255	256	257	258		
259	260	261	262	263	264		
265	266	267	268	269	270		
271	272	273	274	275	276		
277	278	279	280	281	282		
283	284	285	286	287	288		
289	290	291	292	293	294		
295	296	297	298	299	300		
301	302	303	304	305	306		
307	308	309	310	311	312		
313	314	315	316	317	318		
319	320	321	322	323	324		
325	326	327	328	329	330		
331	332	333	334	335	336		
337	338	339	340	341	342		
343	344	345	346	347	348		
349	350	351	352	353	354		
355	356	357	358	359	360		
361	362	363	364	365	366		
367	368	369	370	371	372		
373	374	375	376	377	378		
379	380	381	382	383	384		
385	386	387	388	389	390		
391	392	393	394	395	396		
397	398	399	400	401	402		
403	404	405	406	407	408		
409	410	411	412	413	414		
415	416	417	418	419	420		
421	422	423	424	425	426		
427	428	429	430	431	432		
433	434	435	436	437	438		
439	440	441	442	443	444		
445	446	447	448	449	450		
451	452	453	454	455	456		
457	458	459	460	461	462		
463	464	465	466	467	468		
469	470	471	472	473	474		
475	476	477	478	479	480		
481	482	483	484	485	486		
487	488	489	490	491	492		
493	494	495	496	497	498		
499	500	501	502	503	504		
505	506	507	508	509	510		
511	512	513	514	515	516		
517	518	519	520	521	522		
523	524	525	526	527	528		
529	530	531	532	533	534		
535	536	537	538	539	540		
541	542	543	544	545	546		
547	548	549	550	551	552		
553	554	555	556	557	558		
559	560	561	562	563	564		
565	566	567	568	569	570		
571	572	573	574	575	576		
577	578	579	580	581	582		
583	584	585	586	587	588		
589	590	591	592	593	594		
595	596	597	598	599	600		
601	602	603	604	605	606		
607	608	609	610	611	612		
613	614	615	616	617	618		
619	620	621	622	623	624		
625	626	627	628	629	630		
631	632	633	634	635	636		
637	638	639	640	641	642		
643	644	645	646	647	648		
649	650	651	652	653	654		
655	656	657	658	659	660		
661	662	663	664	665	666		
667	668	669	670	671	672		
673	674	675	676	677	678		
679	680	681	682	683	684		
685	686	687	688	689	690		
691	692	693	694	695	696		
697	698	699	700	701	702		
703	704	705	706	707	708		
709	710	711	712	713	714		
715	716	717	718	719	720		
721	722	723	724	725	726		
727	728	729	730	731	732		
733	734	735	736	737	738		
739	740	741	742	743	744		
745	746	747	748	749	750		
751	752	753	754	755	756		
757	758	759	760	761	762		
763	764	765	766	767	768		
769	770	771	772	773	774		
775	776	777	778	779	780		
781	782	783	784	785	786		
787	788	789	790	791	792		
793	794	795	796	797	798		
799	800	801	802	803	804		
805	806	807	808	809	810		
811	812	813	814	815	816		
817	818	819	820	821	822		
823	824	825	826	827	828		
829	830	831	832	833	834		
835	836	837	838	839	840		
841	842	843	844	845	846		
847	848	849	850	851	852		
853	854	855	856	857	858		
859	860	861	862	863	864		
865	866	867	868	869	870		
871	872	873	874	875	876		
877	878	879	880	881	882		
883	884	885	886	887	888		
889	890	891	892	893	894		
895	896	897	898	899	900		
901	902	903	904	905	906		
907	908	909	910	911	912		
913	914	915	916	917	918		
919	920	921	922	923	924		
925	926	927	928	929	930		
931	932	933	934	935	936		
937	938	939	940	941	942		
943	944	945	946	947	948		
949	950	951	952	953	954		
955	956	957	958	959	960		
961	962	963	964	965	966		
967	968	969	970	971	972		
973	974	975	976	977	978		
979	980	981	982	983	984		
985	986	987	988	989	990		
991	992	993	994	995	996		
997							

5.2 LABORATORY CUSTODY

5.2.1 Upon receipt of the samples in the laboratory the sample custodian or designate will examine the cooler or other sample container noting the presence and condition of the custody seals and removing and filing the shipping documents. The sample custodian will then open the container and remove the Chain of Custody. If there is no COC, the client or project manager will be contacted. The sample custodian or Laboratory Manager will create a COC, in consultation with client or project manager. (Creating a COC in this manner is not documentary proof of legal chain of custody.) On the COC the sample custodian will note the following:

- HAZWRAP/NEESA
- QC Level
- Chain of Custody
- Analytical Request
- Custody Seals
- Sample Condition
- Ice
- Temp.
- pH

5.2.2 The sample custodian will then sign the COC and record the date and time of receipt.

5.2.3 The sample custodian will remove the samples from the container or cooler, check the samples against the COC, (noting discrepancies or breakage on COC and notifying the project manager or client immediately). The sample custodian will then organize the samples in a logical manner and give each sample a unique, sequential number. This number will be transcribed to the COC form received with the samples. It is this sample number which will track the sample through the laboratory. The pH of selected aliquots will be checked for compliance with preservation protocol. (pH will not be checked for aliquots collected for volatile organics, THMs, BNAs, Pesticide/PCBs, EDBs, or bacteriologicals.)

5.2.4 The sample custodian will maintain a sample custody log book in which will be recorded:

- Sample numbers
- Client
- Project number
- Date received
- Number of coolers or containers
- Number of aliquots

- Presence of COC
- Special notes or comments

This log book and the completed COC form constitute the documentation of receipt and are retained as part of the laboratory permanent records.

5.2.5 The samples are then removed to the appropriate storage location within the laboratory. Organic and inorganic samples are segregated in separate refrigerated units that are contained within the laboratory. The laboratory is within a locked office building. A receptionist is present during normal business hours. Custody for all samples will be maintained by the laboratory. Samples will be stored for at least 28 days after the final report is sent to the client.

5.2.6 Analysts will obtain sample aliquots for analysis. Each sample has a unique sample number assigned to it. It is this number the analysts will use to identify the sample in sample preparation logs (sample digestates and extracts), analytical run logs, and on the final report. Sample digestates and extracts are stored in designated areas within the laboratory.

5.2.6 Disposal of samples will be in accordance with state and local regulations.

5.2.7 In the event that samples must be sent to another laboratory for analysis, the chain-of-custody procedures mentioned previously are followed. The appropriate samples are packed in a cooler, iced, the chain-of-custody and any other necessary documentation (such as analytical request forms) is included, and the package is sent by the appropriate method of transportation.

5.3 CONTROL OF SOFTWARE

5.3.1 Definition:

Computer software (i.e., computer codes) is defined as a set of instructions by which a computer can perform a given task. Computer software exists in an electronic form on a medium that is readable by the computer on which the software is required to run. Computer software includes the following: (1) source code, (2) executable code, (3) object files, (4) link files, and (5) data files. Computer software can be purchased from a vendor or it can be developed "in-house". A software system includes one or more items of software which work in concert to assist in the performance of a particular task.

Computer software is a tool used in the laboratory to assist personnel in the performance of a particular task. Laboratory computer software does not

perform the mathematical modeling required for the determination of engineering parameters. Thus, the controls placed upon laboratory software are less stringent than those applied to engineering design software.

Computer software that is part of an instrument system (i.e., the analytical measuring device and the computer system interfaced to the measuring device) shall be controlled as part of the instrument system and will not be addressed in this section.

5.3.2 Documentation:

Laboratory computer software shall be documented in a manner appropriate to the application or task in which it is used. As a minimum, each software system shall have a "user guide" which describes the features and operation of the software. Where possible, instructions on how the software is used shall be included in standard operating procedures.

For vendor-supplied software or software purchased from a vendor, the minimum documentation required is the vendor-supplied user manual. If only certain functions of vendor-supplied software are used in the performance of a task, the use of the functions shall be included in standard operating procedures. For software developed "in-house" or software development subcontracted directly by laboratory personnel, the minimum documentation required is a user manual and the source code. The source code, pertinent data relating to the compilation and execution of the source code, and a copy of the user manual shall be maintained by the laboratory information systems manager.

Each computer software and its associated documentation shall be identified by a revision or version number.

5.3.3 Control:

Purchase, development, and/or modification of laboratory computer software shall be controlled in a manner commensurate with its intended use.

Software that is developed "in-house" shall be controlled only after it has been released for use in the laboratory. Control of such software includes the maintenance and storage of source code, user manuals, and associated documentation in a location where they cannot be inadvertently or accidentally changed.

Word processing software (e.g., Word Perfect) is exempt from stringent controls since its products are readily verifiable.

Spreadsheet software (e.g., Lotus 1-2-3) is exempt from stringent controls. However, spreadsheet data files (e.g., .WK1 worksheet files) are to be controlled in a manner commensurate with their intended use; worksheets that are deemed as important to the quality of the analytical results and require long-term storage shall be controlled, whereas worksheets that are used only for calculation convenience and do not require storage shall not be controlled.

Database software (e.g., dBASE, Clarion) shall not be controlled. However, database data files, index files, and associated software that manipulates the data files shall be controlled.

5.3.4 Testing:

Computer software testing is performed during development and prior to release for use in the laboratory. Developmental testing is an ongoing process and is not controlled. Acceptance testing is at the discretion of the intended user of the software. Upon the successful completion of acceptance testing, the software is ready for laboratory use. The requesting party, often the intended user, shall define the scope and conditions for acceptance testing.

5.3.5 Non-conformance Disposition (Errors):

Computer software that is found to produce erroneous results will be removed from laboratory use. Such software shall be "repaired" and tested for compliance before it is returned for use in the laboratory. The extent of the error shall be determined. Data that was affected by the error-producing software shall be reviewed. Erroneous data shall be corrected and resubmitted to the data user, if applicable, along with an explanation for the resubmittal.

5.3.6 Security:

Computer software security shall be commensurate with the sensitivity of the data processed or contained by the software. Access to computer software that processes or contains client information shall be afforded the highest security.

The laboratory manager, area supervisors, and the LQAC are authorized to edit data as necessary.

5.3.7 Archiving:

Raw data from instrument software, spreadsheet calculations, and final reports are stored as hard-copy in permanent storage files.

Section 6

CALIBRATION PROCEDURES AND FREQUENCY

6.0 INTRODUCTION

Calibration and standardization of instruments and reagents is an imperative part of quality analytics. Instrument calibrations and reagent standardizations for the analyses performed in the lab are in accordance with the procedures specified in the referenced method (see Tables 3-1 and 3-2). Table 6-2 provides a synopsis of calibration/standardization procedures for specified parameters or groups of parameters.

LABORATORY EQUIPMENT

6.1 CALIBRATION STANDARDS.

- 6.1.1 All calibration standards, including internal control and surrogate standards, are obtained from chemical suppliers with certification of high purity and concentration. The standards are routinely checked by the laboratory for traceability to NBS Standards Reference Materials (SRMs) or USEPA Reference Standards. These commercial standards are used as stock standards. When received, the date is noted on a label affixed to the container; when opened, the date is noted on the label. These dates are noted in the standards log book.
- 6.1.2 Working standards are made from the stock standards at appropriate concentrations to cover the linear range of the calibration curve. The working standards are used for initial calibration curves, continuing calibration checks and preparation of analyte spiking solutions. Standards logs are maintained containing information about the preparation of working standards which will enable traceability to NBS Standards Reference Materials.
- 6.1.3 For Gas Chromatograph (GC) analyses, all working standards are made fresh from the stock standards each time of use.
- 6.1.4 For Atomic Absorption Spectroscopy, intermediate standards at a concentration of 10 ppm are prepared in 0.2 % (V/V) HNO₃ solution from 1000 ppm stock standards. The 10 ppm intermediate standards may be kept for a week. The working standards used for calibrating the Atomic

Absorption Spectrophotometer will be prepared at the time of analysis and discarded after use.

6.1.5 All standards and reagents used in the inorganic tests are properly standardized prior to use. Titrants are standardized against primary standards prior to each use.

6.1.6 All solutions are normally labeled as follows: name of solution, date prepared, analyst initials, use of solution and method reference. An example of a reagent label is shown in Figure 6-1.

6.2 DOCUMENTATION OF CALIBRATION/STANDARDIZATION

All calibrations and standardizations are recorded in the raw data notebooks or bench sheets for that analytical run.

6.3 INSTRUMENT CALIBRATION TECHNIQUES

6.3.1 Initial Calibration

An initial calibration curve is established using three to five (as specified in the method) standards bracketing the linear range of the curve, with one standard at or near the reporting limit of the method. In addition to the five standards, a calibration blank is run. The curve must meet the accepted correlation coefficient defined by the method (at least 0.995 for most parameters.)

6.3.2 Initial Calibration Verification

An independent standard is used to verify the standard curve. This independent standard is made from a source different from the calibration standards, such as an EPA Reference Standard. If this Initial Calibration Verification Standard (ICVS) does not meet specified criteria, defined by the analytical method, the curve is rejected and the instrument must be recalibrated and reverified before analytical samples can be run.

6.3.3 Continuing Calibration Verification

Continuing Calibration Verification Standards (CCVS) are run every 10 samples or every 2 hrs, whichever is more frequent, and at the end of an analytical run. The CCVS is a mid-range standard, and may be a calibration standard. If the CCVS does not meet criteria defined in the

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analytical method, the instrument must be recalibrated, and all samples run since the last acceptable CCVS rerun.

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	(904) 331-2442 Environmental Lab 7201 N.W. 11th Place Gainesville, Florida 32602
	REFERENCE NUMBER: _____ ELEMENT: _____ CONCENTRATION: _____ DATE PREPARED: _____ INITIAL: _____ EXPIRATION DATE: _____

Figure 6-1 Label for Reagents

TABLE 6-1
 LIST of LABORATORY EQUIPMENT

INSTRUMENT	MANUFACTURER	MODEL
Gas Chromatograph	Varian	6000; with ECD, PID, Hall
	Varian	6000; with PID, Hall
	Varian	3400; with ECD, FID
Purge and Trap Systems	Tekmar	LSC-2000 (2)
	Tekmar	LSC-2
	Tekmar	ALS Autosampler
	Tekmar	4200 Autosampler
	Tekmar	ALS 2016 Autosampler
Data Systems/Integrator (for GCs)	Varian	DS-601
	Varian	DS-651
	Hewlett Packard	3396A Integrator
Atomic Absorption Spectrophotometer with GFAA/Autosampler	Thermo Jarrell Ash	Video 22
	Thermo Jarrell Ash	188
Atomic Absorption Spectrophotometer	Perkin Elmer	2380
Mercury Analyzer	Coleman	51B
TOC Analyzer; with autosampler furnace	Dohrmann	DC-80
	Dohrmann	DC-80
	Dohrmann	PRG-1
Autoanalyzers	Technicon	II (2)
	Technicon	TrAAcs 800
Spectrophotometers	Milton Roy	1001+
	Sequoia-Turner	390
	Bausch and Lomb	Spectronic 710
Balances	ASP	180
	Mettler	H10
	ASP	120P
	ASP	2410
	Ohaus	Autogram 1000
pH Meter	Beckman	ϕ40

TABLE 6-1
 LIST of LABORATORY EQUIPMENT

INSTRUMENT	MANUFACTURER	MODEL
Specific Ion Meter	Orion	901
Dissolved Oxygen Meter	YSI	58
Conductivity Meter	YSI	32
Turbidimeters	Hach	Ratio 1000
	HF	DRT 100B
Incubators, BOD 20°C	Precision Scientific	(2)
Incubator, 35°C ± 0.5°C	Boekel	
Incubator, 44.5°C ± 0.2°C	Blue M	Constant Temp
Ovens	Fisher	338F
	Labline	
	ASP	Tempcon
Muffle Furnace	Thermolyne	1500
Refrigerators	Sears	(3)
	Bally	Walk-In
Bath, dry block	Technicon	BD40
Bath, water	ASP	

6.4 SPECIFIC INSTRUMENT CALIBRATION PROCEDURES

6.4.1 Gas Chromatograph (GC)

Initial Calibration:

Calibration standards containing all analytes to be measured are prepared at five concentration levels bracketing the linear range of the instrument and the concentration level of interest. A spike containing the internal standard and surrogate compounds prepared at a concentration which provides a response similar to the response of the target analytes is added to all standards, blanks, and samples.

Analyze each calibration standard and calculate the relative response factor (RRF) for each of the compounds according to the following equation:

$$RRF = \frac{(A_s) (C_{is})}{(A_{is}) (C_s)}$$

Where:

- A_s = Area of analyte
- A_{is} = Area of internal standard
- C_{is} = Concentration of internal standard
- C_s = Concentration of analyte

Calculate the standard deviation (S) and the relative standard deviation (%RSD) of RRFs for the compounds using the following equation:

$$S = \left| \frac{\sum (RRF_i - RRF_m)^2}{N - 1} \right|^{\frac{1}{2}}$$

Where:

- RRF_i = Individual RRF
- RRF_m = Mean RRF
- N = Number of RRFs

$$\% RSD = \frac{S \times 100}{RRF_m}$$

For the calibration to be valid, the RSD must be less than 30 %. If the RSD is less than 20 %, the RRF of the compound can be assumed to be invariant, and the average RRF can be used for calculations. If the RSD is between 20 % and 30 %, calculations must be made from the calibration curve. Both the slope and the intercept must be used to perform the calculations.

Initial Calibration Verification:

Analyze a Initial Calibration Verification Sample (ICVS). This ICVS must be from a source different from the calibration standards, and should be a midpoint standard.

All parameters in the ICVS must be recovered within 70 - 100 percent. If any parameter exceeds this criterion, a new calibration curve must be established.

Continuing Calibration Verification

The working calibration curve or relative response factor for each analyte must be verified daily by the analysis of a Continuing Calibration Verification Standard (CCVS), which contains all of the parameters of interest at the midpoint concentration level.

Calculate the percent difference (%D) of the RRF for the ICVS from the mean RRF from the initial calibration curve using the following equation:

$$\%D = \frac{(RRF_m - RRF)}{RRF_m} \times 100$$

Where:

RRF_m = The mean relative response factor from the initial calibration curve

RRF = The daily relative response factor

The criteria for acceptable CCVS is 15 %D.

6.4.2 Atomic Absorption Spectrophotometer (AAS)

Initial Calibration:

Prepare and run three to five (as allowed by the instrument) calibration standards and a blank, bracketing the linear range of the instrument and

the concentration range of interest. The curve is acceptable if a minimum correlation coefficient of 0.995 is achieved. The initial calibration is done before any analytical run.

Initial Calibration Verification:

Immediately after the curve is accepted, run an Initial Calibration Verification Sample (ICVS). This ICVS must be a standard from a source different from the calibration standards, such as an EPA known reference sample. The acceptable range for the percent recovery of the ICVS is 90-110% for all metals except mercury. The acceptable range for mercury is 80-120%. If the ICVS is not acceptable, the instrument must be recalibrated and verified before analysis of samples can begin.

Continuing Calibration Verification:

A Continuing Calibration Verification Sample (CCVS) is a mid-range standard (may be the ICVS) run after every 10 samples to verify the continuing calibration of the instrument. The acceptance ranges for the CCVS is the same as for the ICVS. If a CCVS is not acceptable, the instrument must be recalibrated and reverified, and all samples run since the last acceptable CCVS must be rerun.

6.4.3 Autoanalyzers

The same procedures used for AAS calibration apply to the automated procedures. The acceptance range for Percent Recovery for ICVS and CCVS for most automated procedures is 85-115%. The acceptance ranges are defined by the procedure.

6.4.4 Ultraviolet/Visible Spectrophotometer (UV-VIS)

The same procedures used for AAS calibration apply to the colorimetric procedures using a UV-VIS. The acceptance range for Percent Recovery for ICVS and CCVS for most colorimetric procedures is 85-115%. The acceptance ranges are defined by the procedure.

Wavelength calibration checks are performed quarterly.

6.4.5 Other Calibration Procedures

Balances:

Balances are checked with Class S weights daily. The acceptance criteria is ± 0.0002 g.

Incubators, Ovens, Refrigerators:

Temperatures are monitored daily using thermometers calibrated against an NBS grade thermometer.

pH Meters, Conductivity Bridges, Turbidimeters, D.O. Meters, Specific Ion Meters:

Each instrument is calibrated before each use according to procedures and manufacturers' instructions.

Titration:

The titrants for all titrimetric procedures are standardized against primary standards before each use.

Table 6-2
 CALIBRATION PROCEDURES AND FREQUENCY

Parameter/Parameter Group	Method	Calibration/Standardization Procedure	Frequency	Acceptance Range ¹
pH	150.1 EPA	Calibrate instrument with 2 standard buffers	Initially, and after every 10 samples	
Color	110.2 EPA	Calibrate color disks against Pt-Co standards	Annually	
Conductivity	120.1 EPA	Calibrate with standard of appropriate range	Daily, or before each run, whichever is more frequent	
		Calibrate meter with calibration resistors	Quarterly	
Solids		Calibrate balance with Class S weights	Daily, or before each run, whichever is more frequent	
TDS	160.1 EPA			
TSS	160.2 EPA			
Total	160.3 EPA			
Volatile	160.4 EPA			
Turbidity	190.1 EPA	Standardize with secondary standards	Daily, or before each run, whichever is more frequent	
		Calibrate secondary standards against formazin standards	Quarterly	
TITRATIONS		Standardize the titrant against a primary standard solution.	Initially, and at end of run	
Alkalinity	310.1 EPA			
Bromide	320.2 EPA			
Ca Hardness	215.2 EPA			
Tot. Hardness	130.2 EPA			
Chloride	325.3 EPA			
Chlorine	330.3 EPA			
Sulfide	376.1 EPA			
Ammonia	350.2 EPA			
TKN	351.3 EPA			
Cyanide	335.2 CLP-M			
COD	508 SM			
Vol. Org. Acids	504B SM			

Table 6-2
 CALIBRATION PROCEDURES AND FREQUENCY

Parameter/Parameter Group	Method	Calibration/Standardization Procedure	Frequency	Acceptance Range ¹
COLORIMETRIC PROCEDURES				
		Initial calibration: 5 point curve, using standards which bracket the linear range of interest.	Initially	0.995 (CC)
Chlorine	330.5 EPA			
Cyanide	335.2 CLP-M			
Silica	370.1 EPA			
Sulfate	375.4 EPA	ICVS: Verify curve with ICVS	Before each run	85-115 %
Sulfide	376.2 EPA			
Nitrite	354.1 EPA	CCVS: Continual verification of curve, using a mid-range standard.	After each 10 samples	85-115 %
Ammonia	350.2 EPA			
TKN	351.3 EPA			
Phosphorus	365.2 EPA			
COD	508 SM			
MBAS	425.1 EPA			
Chlorophyll	1002G SM			
AUTOMATED ANALYSES				
		Initial calibration: 5 point curve, using standards which bracket the linear range of interest.	Initially	0.995 (CC)
Chloride	325.2 EPA			
Cyanide	335.2 CLP-M			
Sulfate	375.2 EPA			
Ammonia	350.1 EPA	ICVS: Verify curve with ICVS	Immediately after curve is generated.	85-115 %
Nitrate + Nitrite	353.2 EPA			
	353.1 EPA			
TKN	351.3 EPA	CCVS: Continual verification of curve, using a mid-range standard.	After each 10 samples	85-115 %
Phosphorus	365.1 EPA			
Phenol	420.2 EPA			
SPECIFIC ION ANALYSES				
Fluoride	340.2 EPA	Standardize meter with two standards	Initially, and every 2 hrs.	

Table 6-2
 CALIBRATION PROCEDURES AND FREQUENCY

Parameter/Parameter Group	Method	Calibration/Standardization Procedure	Frequency	Acceptance Range ¹
ATOMIC ABSORPTION SPECTROPHOTOMETRIC ANALYSES; FLAME AND FURNACE	200.0 EPA	Initial calibration: 5 point curve, using standards which bracket the linear range of interest.	Initially	0.995 (CC)
		ICVS: Verify curve with ICVS	Immediately after curve is generated.	80-120 % (Hg) 90-110 % (all others)
		CCVS: Continual verification of curve, using a mid-range standard.	After each 10 samples	80-120% (Hg) 90-110 % (all others)
GAS CHROMATOGRAPHY ANALYSES		Initial Calibration: 5 point curve, using standards, containing all analytes of interest, and bracketing the linear range of interest.	Initially.	RSD < 30%
		ICVS: Verify curve with ICVS containing all analytes of interest.	Immediately after curve is generated	70-100 %
		CCVS: Continual verification of curve, using a mid-range standard containing all analytes of interest.	Daily	15 %D

¹Acceptance Range:

% = Percent Recovery.

RSD = Relative Standard Deviation

%D = Percent Difference

CC = Correlation Coefficient

Section 7

ANALYTICAL PROCEDURES

7.0 The procedures for analyzing environmental sample in the laboratory are presented in Section 3 (Tables 3-1 and 3-2).

7.1 **GLASSWARE CLEANING**

7.1.1 General use glassware:

- Wash glassware thoroughly with phosphate-free detergent
- Rinse thoroughly with tap water
- Rinse with 20% HCl
- Rinse at least twice with deionized water
- Dry and store inverted, stoppered, or covered with parafilm or foil in closed cabinets,

7.1.2 Metals glassware:

- If necessary, wash with phosphate-free detergent and rinse with tap water
- Rinse with analyte-free water
- Rinse with 20% HNO₃
- Rinse thoroughly with analyte-free water
- Dry and store inverted, stoppered, or covered with parafilm in closed cabinets designated for metals glassware only

7.1.3 Organics Glassware:

- If necessary, wash with phosphate-free detergent and rinse with tap water
- Rinse with organic-free water
- Rinse with methanol
- Rinse with organic-free water
- Dry in organics-only drying oven and store inverted, stoppered, or covered with foil in closed cabinet designated for organics glassware

7.2 REAGENT STORAGE

7.2.1 Acids are stored in the original containers in separate cabinets designated for acid storage.

7.2.2 Bases are stored in the original containers in separate cabinets designated for storage of bases.

7.2.3 Solvents are stored in the original containers in a separate cabinet designated for solvent storage. This solvent cabinet is in an air conditioned area of the laboratory.

7.2.4 Other dry reagents are stored in the chemical storage area of the laboratory, in closed cabinets. Organic and inorganic reagents are stored in separate cabinets. These cabinets are located in an air conditioned area of the laboratory.

7.3 WASTE DISPOSAL

7.3.1 Mineral acids and bases are adjusted to a neutral pH and discarded.

7.3.2 Cyanide wastes are chlorinated and maintained at a high pH level for 24 hours, then adjusted to a neutral pH and discarded.

7.3.3 Metals digestates are adjusted to a high pH to precipitate the metals and allowed to settle. The supernatant is analyzed for metals. The process is repeated until the supernatant analysis indicates metals levels within

acceptable limits as defined in 40 CFR, Part 261. The supernatant is then adjusted to a neutral pH and discarded.

The sludge from the above process is disposed of by a licensed commercial hazardous waste service.

- 7.3.4 TKN and other mercury wastes are collected and disposed of by a licensed commercial hazardous waste service.
- 7.3.5 Solvents (including sample extracts) are collected and disposed of by a licensed commercial hazardous waste service.
- 7.3.6 Contaminated soils or hazardous samples are disposed of by a licensed commercial hazardous waste service or are returned to the client for disposal.

Section 8

DATA REDUCTION, VERIFICATION, AND REPORTING

8.0 INTRODUCTION

The goal of the laboratory is to provide complete and accurate data. In order to meet this goal, procedures for insuring the accuracy of the data must be followed.

8.1 SAMPLE COLLECTION (FIELD NOTES)

Technicians collecting samples in the field will document their activities in a field notebook or sampling sheet.

8.2 DATA REDUCTION

8.2.1 The analyst is responsible for analyzing the samples within holding times and for the calculations used to reduce data to the final reporting format. All calculations are in accordance with the procedures specified for the various parameters.

8.2.2 Spectrophotometric procedures are calculated by comparing a value (absorbance, transmittance, etc.) for a sample to a standard curve. The curve is generated from three or more known values. A linear curve is expressed by the equation:

$$y = ax + b \qquad \text{EQ. (1)}$$

where:

- y = dependent variable (concentration)
- x = independent variable (absorbance, transmittance, etc.)
- a = slope of the curve
- b = Y-intercept of the curve

After determining the absorbance or transmittance values (y) of known concentrations (x), the slope (a) and Y-intercept (b) of the standard curve may be determined by linear regression. The concentration x for samples with an analytically determined y can be then calculated.

Computers or calculators are used to do the linear regression calculations. Results are recorded in an analytical notebook or on a benchsheet. If a computer printout of results is generated, this is attached to the notebook or bench sheet. (Benchsheets and supporting data are stored in a notebook.)

- 8.2.3 Titrations and other analyses are calculated as single point determinations. The equations for these determinations are specific for each method. The equations take the general form of the equation:

$$C = \frac{A \times B}{V} \quad \text{EQ. (2)}$$

where:

- C = concentration (ie., mg/l)
- A = determination (ie., volume of titrant)
- B = constant (ie., normality of titrant)
- V = amount of sample (ie., volume)

Computers or calculators are used to do the calculations. Results are recorded in an analytical notebook or on a benchsheet. If a computer printout of results is generated, this is attached to the notebook or bench sheet. (Benchsheets and supporting data are stored in a notebook.)

- 8.2.4 Concentrations for organic analyses are calculated using the equation:

$$\text{Concentration} = \frac{A_x \times I_s}{A_{i_s} \times \text{RRF} \times V_o} \quad \text{EQ. (3)}$$

where:

- A_x = Area for the compound to be measured
- A_{i_s} = Area for the internal standard
- I_s = Nanograms of internal standard added
- RRF = Relative response factor
- V_o = Amount of sample purged

The calculations are done by a computer data system. A computer printout of results is generated and is attached to analytical run sheet. Also attached are the chromatograms generated by the analytical run. (Analytical run sheets and supporting data are stored in files.)

8.3 VERIFICATION

8.3.1 To provide complete and accurate data, the reduction, verification, and reporting of analytical data is subjected to several stages of review.

8.3.2 The analyst verifies the calculations for all analyses and the acceptability of all the QC data applicable to the procedure. A QC checklist for each analytical run is signed and dated by the analyst to verify this initial review. (See Figure 8-1.)

8.3.3 The raw data is then reviewed by a supervisor or qualified analyst. All values and QC data are reviewed and the QC checklist is completed, signed and dated to verify the review. The raw data is then entered into the reporting system.

8.3.4 After all the raw data has been reviewed, collected, and entered into the reporting system, a preliminary report is prepared and is reviewed by the area supervisors for accuracy, completeness, and compliance with the requirements stated on the Chain of Custody. A checklist is signed and dated to verify the review. (See Figure 8-2.)

8.3.5 After the preliminary report has been reviewed, the final analytical report is generated. This final report, which will contain the data from all departments, is reviewed for accuracy and completeness by the Client Services department, and the checklist is signed and dated to verify the review. Any unusual analytical problems, corrective actions, or problems related to sample matrix will be included in a case narrative written by the area supervisor or department manager. This case narrative will become a part of the final report. The completed report is signed by the Laboratory Manager or a designate.

8.4 DATA REPORTING

8.4.1 The final report, Chain of Custody, documents associated with the sample group, QC data, the Work-In-Progress documentation, and the review checklists are filed in the Sample Report Files, indexed by sample number. These reports are kept for a minimum of five years.

8.4.2 A completed data package containing the final report and all support documentation requested is sent to the client.

Lab Ref. No.: _____
 Analyte: _____
 Date: _____

QA CHECKLIST

Inorganic Analyses

	<u>ANALYST</u>		<u>REVIEWER</u>	
	<u>YES</u>	<u>NO</u>	<u>YES</u>	<u>NO</u>
1. Initial Calibration Acceptable?	_____	_____	_____	_____
2. ICVS results acceptable?	_____	_____	_____	_____
3. CCVS results acceptable?	_____	_____	_____	_____
4. Instrument blanks acceptable?	_____	_____	_____	_____
5. Method blanks acceptable?	_____	_____	_____	_____
6. LCS results acceptable?	_____	_____	_____	_____
7. MS results acceptable?	_____	_____	_____	_____
8. Duplicate or MSD acceptable?	_____	_____	_____	_____
9. Blanks and control samples run at acceptable frequency?	_____	_____	_____	_____
10. Calculations verified?	_____	_____	_____	_____
11. Significant figures correct for reporting?	_____	_____	_____	_____

COMMENTS/CORRECTIVE ACTIONS: _____

Analyst: _____ Reviewer: _____
 Date: _____ Date: _____

Figure 8-1

Lab Ref. No.: _____
 Analyte: _____
 Date: _____

INORGANICS DATA PACKAGE REVIEW CHECKLIST

I. COMPLETED WIP SHEET	<u>YES</u>	<u>NO</u>
1. Correct analytes analyzed?	_____	_____
2. Detection limits correctly reported? ..	_____	_____
3. Significant figures correct?	_____	_____
4. Units of measure correct?	_____	_____
5. Appropriate QC level met and forms completed?	_____	_____
6. Case narrative (where appropriate) present?	_____	_____
7. Ion balance (where appropriate) within limits?	_____	_____

 Reviewer Date

II. DATA ENTRY and FINAL REPORT	<u>YES</u>	<u>NO</u>
1. Numbers, address, etc. correct (no typos)?	_____	_____
2. Units of measure correct?	_____	_____
3. Footnotes correct?	_____	_____
4. QC forms completed?	_____	_____

 Reviewer Date

III. CLIENT SERVICES	<u>YES</u>	<u>NO</u>
1. All reports correct & compiled?	_____	_____
2. Complete QC data package present?	_____	_____
3. Case narrative/final letter present? ..	_____	_____
4. All reports required by COC present? ..	_____	_____
5. Invoice present?	_____	_____

 Reviewer Date

Figure 8-2

Section 9

INTERNAL QUALITY CONTROL

9.1 QUALITY CONTROL SAMPLES

Quality Control Samples must be scheduled with all batches of samples analyzed for a given matrix and a given parameter. General considerations concerning the types, frequency, and acceptance criteria of Control Samples are discussed below. Specific analytical methods define which control samples are required for that method.

9.1.1 Method Blank

The method blank consists of a deionized (or distilled) water sample prepared in exactly the same manner as the samples (such as extraction, digestion, distillation, etc.). (Also known as Preparation Blank.)

A method blank is prepared with each batch of samples, or for each 20 samples prepared, whichever is most frequent.

If the method blank results exceed the method reporting limits, only those samples with concentrations at least 10X the method blank concentration may be reported. Samples with concentrations less than 10X the method blank concentration must be re-prepped and re-analyzed.

9.1.2 Laboratory Control Samples (LCS)

The LCS sample consists of a spike of the target analyte into a controlled matrix. The spiking concentration should be well within the calibration range of the procedure. The purpose is to measure the laboratory accuracy for the total analytical system. The LCS sample must be processed through all of the preparation and analysis steps in the same manner as samples. (May also be called Method Blank/Spike.)

The LCS for liquid samples can be prepared from EPA reference samples or from verified analytical standards used to calibrate the instrument or titrant.

The LCS must be prepared for each batch of samples prepared.

The LCS is calculated as percent recovery (% R) as given in the following equation:

$$\% R = \frac{OV}{TV} \times 100$$

where:

OV = Observed value
TV = True Value

The LCS data (as % R) must be statistically summarized and processed on control charts. Acceptance criteria are determined from this summary. The acceptance criteria for the LCS will be ± 3 standard deviations from the mean.

If an LCS in an analytical run exceeds the acceptance criteria, the procedure must be examined, any instruments recalibrated, and the LCS re-analyzed. If upon re-analysis the LCS still exceeds the limit, the analysis is out of control. A corrective action report must be initiated to discuss reasons for the problem and corrective actions taken to regain control. The associated batch of samples and another LCS must be re-prepped and re-analyzed.

9.1.3 Duplicate Samples

Duplicate samples are identical aliquots of a sample analyzed separately, but concurrently. They are used to measure the precision of an analysis.

For every batch of samples, or if a batch is larger than 10 samples, for every 10 samples, one duplicate must be analyzed.

Precision is calculated as Relative Percent Difference (RPD) as given in the following equation:

$$RPD = \frac{|D_1 - D_2|}{D_1 + D_2} \times 200$$

where:

D_1 = Sample result
 D_2 = Duplicate result

The duplicate data (as RPD) must be statistically summarized and processed on control charts. Acceptance criteria are determined from this summary.

The acceptance criteria for duplicates will be + 3 standard deviations from the mean RPD.

If a duplicate in an analytical run exceeds the acceptance criteria, the procedure must be examined, any instruments recalibrated, and the duplicate re-analyzed. If upon re-analysis the duplicate still exceeds the limit, the analysis is out of control. A corrective action report must be initiated to discuss reasons for the problem and corrective actions taken to regain control. The associated batch of samples with duplicates may need to be re-prepped and re-analyzed.

9.1.4 Matrix Spikes (MS)

A matrix spike consists of a known amount of the analyte added to a sample. Spikes measure the accuracy of an analysis.

For every batch of samples, or if a batch is larger than 10 samples, for every 10 samples, one spike must be analyzed.

Accuracy is calculated as percent recovery (% R) as given in the following equation:

$$\% R = \frac{SSR - SR}{SA} \times 100$$

where:

SSR = Spiked sample result
SR = Sample result
SA = Amount of spike added

The MS data (as % R) must be statistically summarized and processed on control charts. Acceptance criteria are determined from this summary. The acceptance criteria for matrix spikes will be ± 3 standard deviations from the mean % R.

If a MS in an analytical run exceeds the acceptance criteria, the procedure must be examined, any instruments recalibrated, and the MS re-analyzed. If upon re-analysis the MS still exceeds the limit, the analysis is out of control. A corrective action report must be initiated to discuss reasons for the problem and corrective actions taken to regain control. The associated batch of samples with matrix spikes may need to be re-prepped and re-analyzed.

9.1.5 Matrix Spike Duplicates (MSD)

The matrix spike duplicate is a matrix spike replicated, and is run along with a matrix spike (MS/MSD). MSD may be run in the place of a duplicate for some analytes. The MSD measures the precision as well as accuracy of an analysis.

For every batch of samples, or if a batch is larger than 10 samples, for every 10 samples, one set of MS/MSD must be analyzed. If MS/MSD are run, duplicates and separate spikes usually are not used.

The MS/MSD data must be statistically summarized and processed on control charts. They are calculated as both duplicates and spikes, yielding a RPD and a % R. MS/MSD will be summarized as duplicates and also as matrix spikes, and the acceptance criteria for those Control Samples used.

If either the MS or the MSD in an analytical run exceeds the acceptance criteria, the procedure must be examined, any instruments recalibrated, and the MS and/or MSD re-analyzed. If upon re-analysis the MS or MSD still exceeds the limit, the analysis is out of control. A corrective action report must be initiated to discuss reasons for the problem and corrective actions taken to regain control. The associated batch of samples with MS/MSD may need to be re-prepped and re-analyzed.

9.1.6 Surrogate Spikes

Surrogate spikes are compounds added to every blank, sample, matrix spike, matrix spike duplicate, and standard. They are used to evaluate the analytical efficiency of the method by measuring recovery. Surrogates are brominated, fluorinated, or isotopically labelled compounds not expected to be detected in environmental media. Surrogates are used typically in organic methods. Surrogates are evaluated as percent recovery (% R) using the following equation:

$$\% R = \frac{OV}{TV} \times 100$$

where:

OV = Observed value
TV = True value

The surrogate data (as % R) must be statistically summarized and processed on control charts. Acceptance criteria are determined from this summary. The acceptance criteria for surrogates will be ± 3 standard deviations from the mean % R.

If a surrogate in an analytical run exceeds the acceptance criteria, the procedure must be examined, any instruments recalibrated, and the sample re-analyzed. If upon re-analysis the surrogate still exceeds the limit, the analysis is out of control. A corrective action report must be initiated to discuss reasons for the problem and corrective actions taken to regain control.

9.1.7 Initial Calibration Verification Sample (ICVS)

The ICVS is a sample of known concentration used to verify the calibration of the standard curve for those procedures using a standard curve. This sample must be from a source different from the calibration standards. The ICVS must be run immediately after the calibration standards and evaluated. The ICVS is evaluated as percent recovery (% R) using the following equation:

$$\% R = \frac{OV}{TV} \times 100$$

where:

OV = Observed value
TV = True value

The % R of the ICVS for most analytes must be between 90.0 % and 110.0 %. The actual range for each analyte will be stated with the procedure for that method.

If an ICVS in an analytical run exceeds the acceptance range, the analytical run is out of control and the analyst must stop the run. The procedure must be examined, any instruments recalibrated, and the ICVS re-analyzed. A new curve made with fresh calibration standards may have to be generated. The analytical run cannot proceed until the ICVS is within the acceptable range. A corrective action report must be initiated to discuss reasons for the problem and corrective actions taken to regain control.

9.1.8 Continuing Calibration Verification Sample (CCVS)

The CCVS is an analytical standard run every 10 analytical samples or every 2 hr., whichever is more frequent, to verify the continued calibration of the analytical system. This sample should be at mid-range of the calibration curve and may be a calibration standard or a rerun of the ICVS. The same CCVS should be used throughout the run. The CCVS is evaluated as percent recovery (% R) using the same equation as for the ICVS:

The % R of the CCVS for most analytes must be between 90.0 % and 110.0 %. The actual range for each analyte will be stated with the procedure for that method.

If a CCVS in an analytical run exceeds the acceptance range, the analytical run is out of control and the analyst must stop the run. The procedure must be examined, and any instruments recalibrated and calibration verified. All samples run since the last acceptable CCVS must be re-analyzed. A corrective action report must be initiated to discuss reasons for the problem and corrective actions taken to regain control.

9.1.9 Internal Standards

Internal standards are used for GC procedures. The internal standard consists of one or more compounds that are similar in analytical behavior to the compounds of interest, which are added at set concentrations to all standards, blanks, and samples analyzed. The internal standards are used to calibrate an instrument. (See Section 6.4.1.)

9.2 DOCUMENTATION OF QUALITY CONTROL DATA

9.1.1 Control Charts

LCS, MS, MSD, Duplicates, and Surrogates must be summarized and processed statistically in the form of control charts. A control chart consists of a centerline representing the mean of the QC samples, Warning Limit line(s) (the mean \pm 2s), and Control Limit line(s) (\pm 3s). (Note: RPD Control Charts will have 1 Warning Limit and 1 Control Limit. % R Control Charts will have an upper and a lower Warning and Control Limit.) These Control Charts must be available for easy review by analysts, supervisors, quality control personnel, auditors, and laboratory management.

Spreadsheets are used to collect the data, statistically summarize it and to generate the control charts. Outliers are determined by Student T Test and

are not included in the statistical database. Outliers are automatically flagged as out-of-control events and a Corrective Action Report is generated. Failed MS, MSD, or duplicates which are the result of matrix interferences are addressed in a Case Narrative to the client when required.

9.2.2 Out-of-Control Criteria

In addition to the specific criteria mentioned with each description of the QC samples, the following issues must be considered.

- 9.2.2.1 Failure to achieve initial calibration may indicate instrument maintenance is needed. ICVS failure may also indicate the need for preparing new analytical standards or to investigate other possible errors in the procedure.
- 9.2.2.2 Failure to achieve acceptable recovery on the LCS indicates problems with the performance of the sample preparation procedures. Corrective actions must be initiated and all samples associated with the LCS must be re-prepped and re-analyzed until an acceptable LCS is acquired.
- 9.2.2.3 Repeated failure to achieve method blank criteria indicates a problem with laboratory contamination. Sample analysis must stop until the source of the contamination is located and corrected.
- 9.2.2.4 Poor MS, MSD, or duplicate results may indicate matrix interference problems or poor sampling precision of the sample matrix. Soils are especially complex in nature. The MS/MSD/duplicate data should be reviewed for possible reasons for poor performance. Both accuracy and precision should be evaluated together to provide possible clues to poor performance. Dilution analyses and standard addition procedures can often provide valuable data related to matrix complexity.
- 9.2.2.5 Control chart trends may indicate an out-of-control situation. For example:
- Any three consecutive points are outside of control limits.
 - Any eight consecutive points are on the same side of the center line.
 - Any six consecutive points are such that each point is larger (or smaller) than its immediate predecessor.
 - Any obvious cyclic pattern is seen in the points.

9.2.2 Corrective Actions

Corrective action procedures for out-of-control analytical conditions are the responsibility of the analyst.

Investigations, detected problems, and resolutions must be documented in corrective action reports (CAR). This CAR must be signed by a Division Manager or equivalent and by the Laboratory Quality Assurance Coordinator (LQAC).

9.3 FIELD QC SAMPLES

At regular intervals in the sampling program, QC samples should be collected in the field and analyzed in the laboratory. Types of field QC samples include:

9.3.1 Field Blanks

Analyte-free water placed in sample containers, preserved, and transported with the field samples. Field blanks may be required or recommended for a project and the frequency will be project specific.

9.3.2 Travel Blanks

Analyte-free water placed in sample containers in the laboratory, preserved, and transported to and from the field with the rest of the sampling containers. Travel blanks are required for volatile organic samples. The frequency is one travel blank per cooler of samples.

9.3.3 Equipment Blanks (Rinsates)

The final analyte-free water rinse from the between sampling cleaning of sampling equipment (such as pump or bailer). This blank will test the efficiency of cleaning procedures and indicate the presence of any cross contamination. The usual frequency for equipment blanks is one per twenty samples, but project requirements may vary.

9.3.4 Field duplicates

Samples collected in duplicate. The usual frequency for field duplicates is one per ten samples, but project requirements may vary.

9.3.5 Blind Spike

Analyte-free water spiked with known amounts of analytes and submitted as a regular sample, blind to the laboratory. Blind spikes may be required or recommended for a project and the frequency will be project specific.

Blind spikes are prepared by the LQAC using known reference samples (EPA or equivalent). Information about the reference sample used (code number or description), the method of preparation, the true values and statistical information, and the date of preparation are recorded in a bound notebook.

9.3.6 Blind Blank

Analyte-free water submitted as a regular sample, blind to the laboratory. Blind blanks may be required or recommended for a project and the frequency will be project specific.

Section 10

PERFORMANCE AND SYSTEM AUDITS

10.0 INTRODUCTION

Performance and system audits are an integral part of CH2M HILL's laboratory standard operating procedures.

10.1 EXTERNAL AUDITS

10.1.1 External audit programs in which the laboratory routinely participates include the following:

1. U.S. EPA Safe Drinking Water Audits (semiannually)
2. U.S. EPA Environmental Audits (semiannually)
3. Florida HRS audits for certification (annually)
4. At the mutual convenience of CH2M HILL and the agency, regulatory agencies (such as FDER) may conduct external audits on the lab. These audits may be either on-site systems audits or performance audits conducted by submitting blind spike samples along with other samples being collected.

10.1.2 Details of these programs or specific audit results will be provided upon request.

10.2 INTERNAL SYSTEMS AUDITS

10.2.1 The Laboratory Quality Assurance Coordinator (LQAC) will conduct an analytical QA systems audit on the laboratory semiannually.

10.2.2 On all projects, the Project Quality Assurance Manager (QAM) will perform one field performance audit during the project to ensure that prescribed sampling techniques and chain-of-custody procedures are being followed.

10.2.3 Summaries of audits will be included in the progress reports to the Project Manager.

10.3 INTERNAL PERFORMANCE AUDITS

10.3.1 Double Blind Spikes

Internal performance evaluations will be conducted using EPA reference samples when available, or equivalent commercially prepared samples. These audits will be conducted quarterly on all routinely performed analyses. On selected analyses, double-blind spikes may be performed monthly.

10.3.2 U.S. EPA reference samples or the equivalent are used routinely as Laboratory Control Samples or as corrective action tools.

Section 11

PREVENTIVE MAINTENANCE

11.0 INTRODUCTION

A schedule of preventive maintenance procedures for major laboratory equipment follows. Each analytical instrument has a maintenance notebook in which major maintenance procedures are recorded, and in most cases, a checklist for regular maintenance procedures is kept. Preventive maintenance and the maintenance records are the responsibility of the analyst using the equipment.

11.1 IL VIDEO 22 AA WITH 655 FURNACE AND FASTAC AUTOSAMPLER

11.1.1 Flame Daily:

1. Clean burner head and burner mixing chamber
2. Check level of gases in tanks
3. Check standards (dates); replace as necessary

11.1.2 Furnace Daily

1. Check graphite tubes; replace as necessary
2. Check graphite tube holder as necessary
3. Check and clean inside of furnace as necessary (at least weekly)
4. Check thermo sensor in furnace
5. Check standards; replace as necessary

11.1.3 Autosampler Daily

1. Check nebulizer flow
2. Check sample tip; replace as necessary
3. Align sample tip to graphite tube

11.1.4 Spare Parts List

1. Graphite tubes and holders
2. Spare D₂ background lamp
3. Auto sampler cups
4. "O" ring kit for nebulizer
5. Nebulizer tubing

6. Spare needle for nebulizer
7. Spare glass bead for nebulizer

11.2 VARIAN 6000 GC WITH PURGE AND TRAP

11.2.1 Daily

1. Check all gas cylinders and oxygen traps
2. Monitor purge/desorb gas flows
3. Add DI water to VOA Purger at night
4. Monitor level and age of internal standard/surrogate mix and 601/602 standard
5. Monitor response of photo ionization detector and Hall detector for proper sensitivity
6. Monitor analytical system/water for contamination
7. Check printer pens and paper supply
8. Check Hall detector solvent flow/level

11.2.2 Periodically

1. PID
 - Clean or replace PID lamp
 - Change ceramics
2. Hall Detector
 - Replace nickel reaction tube
 - Change solvent
3. Purge and Trap
 - Clean or replace 6-part valve and transfer lines; replace trap
 - Clean lines in autosamplers
 - Replace defective circuit boards
4. Gas Chromatographs
 - Repack and replace columns
 - Replace defective components
 - Modify system to accept different columns
 - Clean fan filters on data management system

5. Reporting computer
 - Back up files
 - Clean fan filters
6. Maintain a clean work station in instrument room and sample preparation room.

11.2.3 Spare Parts List

1. PID
 - spare lamps
 - cleaning material
 - ceramics
 - quartz jet
2. Hall Detector
 - nickel tubes and associated fittings
 - solvent
3. Purge and Trap
 - ferrules and glassware
 - traps
4. GCs
 - spare columns and packing
 - fittings
 - regulator
 - traps and refill material
 - copper tubing
 - printer, pens, and paper

11.3 TOC ANALYZER (Dohrman DC-80)

11.3.1 Daily

1. Check Cu and Sn scrubbers
2. Check system flow and operation
3. Check Oxygen flow at tank

4. Check reagent levels (persulfate solution, DI water)
5. Check printer paper; replace as necessary

11.3.2 Weekly

1. Adjust and change pump tubes as necessary

11.3.3 Spare Parts List

1. Tubing
2. UV lamp
3. Reactor body assembly
4. Reactor cap assembly with teflon tubing
5. Syringes for manual injection

11.4 TECHNICON AUTOANALYZER II AND TECHNICON TrAAcs 800

11.4.1 Daily

1. Check for leaks in all fittings
2. Check for power to lamp
3. Check strip chart paper or printer paper
4. Check and replace reagents
5. Check air pressure gauge (TrAAcs 800)
6. Clean system at end of use

11.4.2 Weekly

1. Check flow-through cell; clean as needed
2. Check filters; clean as needed
3. Check for wear in pump tubes; replace as needed
4. Check pump roller, grease and clean as necessary

11.4.3 Spare parts list

1. Flow-through cell
2. Tungsten lamps
3. Bubble mixing tubes
4. Glass fittings
5. Tubing (transmission and pump)
6. Sampler cups
7. Pens and paper for recorders or printer
8. Pump lubricating grease

11.5 SPECTROPHOTOMETER

11.5.1 Daily maintenance

1. Check cuvettes; clean as necessary
2. Check lamp
3. Clean filters

11.5.2 Monthly

1. Check wave length calibration

11.5.3 Spare Parts List

1. Matched cuvettes
2. Lamps (tungsten and deuterium)

11.6 BALANCES

11.6.1 Daily maintenance

1. Maintain clean work area and balance
2. Calibrate with internal standards
3. Calibrate with Class S weights

11.6.2 Monthly

1. Calibrate with NBS calibration standards

11.6.3 Annually

1. Service and certification by an outside contractor

11.7 ANALYTICAL CONTINGENCY PLAN

11.7.1 The laboratory has several pieces of analytical equipment in duplicate. This redundancy allows the laboratory to keep performing critical analyses on one instrument while the other is down for repairs.

11.7.2 Major pieces of analytical equipment maintained and operated in duplicate include:

1. Gas chromatographs complete with Hal/PID detectors, data management systems, and purge and trap units.
2. Spectrophotometers (UV-VIS)
3. Analytical precision balances and pan balances
4. Ph meters
5. Specific ion meters
6. Mercury cold vapor analyzers
7. Technicon autoanalyzers
8. BOD₅ incubators

11.7.3 In the event that critical holding times are approaching on a number of samples, the Gainesville laboratory can also off-load to CH2M HILL's Montgomery, Alabama or Redding, California laboratories or to another certified laboratory.

Section 12

PRECISION, ACCURACY, AND METHOD DETECTION LIMIT

12.1 PRECISION

12.1.1 Precision is a measure of the reproducibility of a set of replicate results.

12.1.2 The relative percent difference (RPD) is used to assess precision and is calculated using the following equation:

$$RPD = \frac{|D_1 - D_2|}{D_1 + D_2} \times 200$$

where:

D_1 = Sample result
 D_2 = Duplicate result

12.2 ACCURACY

12.2.1 Accuracy is the nearness of a result or the mean of a set of results to the true or accepted value. Accuracy can be assessed using spiked samples or Laboratory Control Samples.

12.2.2 Spiked samples are assessed by the percent recovery (% R) as calculated using the following equation:

$$\% R = \frac{SSR - SR}{SA} \times 100$$

where:

SSR = Spiked sample result
SR = Sample result
SA = Amount of spike added

12.2.3 LCS samples are assessed by the percent recovery (% R) as calculated using the following equation:

$$\% R = \frac{OV}{TV} \times 100$$

where:

OV = Observed value
TV = True value

12.3 METHOD DETECTION LIMIT

12.3.1 The Method Detection Limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample matrix containing the analyte.

Method detection limits are determined/verified according to procedures given in 40 CFR Part 136, Appendix B.

The procedure:

1. Prepare seven replicates of laboratory standard (analyte spiked into reagent water or control matrix) at a concentration which is between 1 and 5 times the estimated method detection limit.
2. Analyze the seven replicates, carrying through all of the sample extraction, distillation, or other preparation steps, in the same manner as samples.

3. Determine the standard deviation (S) for the seven results.

$$S = \sqrt{\frac{\sum_{i=1}^n x_i^2 - \frac{\left(\sum_{i=1}^n x_i\right)^2}{n}}{n - 1}}$$

where:

- S = Standard deviation
n = number of samples
x_i = analytical results of replicates

4. Calculate the MDL by the following equation:

$$MDL = 3.143 \times S$$

where:

- MDL = Method detection limit
S = Standard deviation

Section 13

CORRECTIVE ACTIONS

13.1 LABORATORY IMPOSED

13.1.1 Corrective actions will be initiated if the quality control criteria indicate an analysis is out of control. Quality control criteria are addressed in Section 9. Types of corrective actions may include:

- Check calculations for accuracy
- Check instrumentation to ensure it is operating properly. Recalibrate if necessary.
- Remake standards and reagents and reanalyze samples.
- Re-prep and re-analyze samples.

13.1.1 The analyst is responsible for initiating corrective actions for analytical problems encountered during analysis of samples. Most problems which occur and are corrected during the analytical run will be explained in the run log or analytical bench sheet for that run. A corrective action report (CAR) may be necessary for some problems encountered, such as complete system failure, chronic calibration failure, or severe matrix interferences.

13.1.2 During data review, the reviewer may initiate corrective actions based on problems or questions arising from the review. A CAR will be initiated.

13.1.3 The Laboratory Quality Assurance Coordinator (LQAC) may initiate corrective actions if a problem is noticed during a QC review of data, a system audit, or a performance audit. A CAR will be initiated.

13.1.4 CARs are signed and dated by Division Managers or equivalent, and by the LQAC. Figure 13-1 is an example of a CAR. CARs will be filed in appropriate department files and in the LQAC's files.

13.2 PROJECT IMPOSED

13.2.1 The Project Quality Assurance Manager (QAM) is the individual authorized to initiate any required corrective actions. The QA will be responsible for evaluating the analytical data and determining if it is acceptable and within the specified project limits. If the data are not acceptable, the QAM will confer with the Project Manager to determine the appropriate corrective actions.

13.3 AGENCY IMPOSED

13.3.1 Any actions deemed necessary by regulatory agencies, such as FDER, will be taken. These actions are most likely to arise from a systems or performance audit, or from data review conducted by the agency.

CAR #: _____

CORRECTIVE ACTION REPORT

ORIGINATOR: _____

DATE: _____

SUBJECT (ie, analyte, instrument, samp. nos.): _____

CONDITION/SITUATION: _____

RECOMMENDED ACTION: _____

Approved by Div.Man./designate: _____
Date: _____

ACTION TAKEN/RESULTS: _____

Signed: _____ Date: _____

Approved by LQAC: _____ Date: _____

Section 14

QUALITY ASSURANCE REPORTS

14.1 ROUTINE REPORTS TO MANAGEMENT

14.1.1 The Laboratory Quality Assurance Coordinator (LQAC) will report quarterly (or more frequently, if appropriate) to the Laboratory Manager concerning issues related to the QA Program.

14.1.2 The issues included in the regular reports may involve:

- Laboratory performance criteria (performance evaluation samples, accuracy and precision ranges, internal double-blind spiking results, method detection limits, etc.)
- Specific QC problems and corrective actions recommended and taken
- Certification status
- Holding time compliance
- Project specific QC performance
- Performance and system audit results

14.1.3 QA/QC problems will be reported to and discussed with laboratory management and personnel as they arise so that timely solutions may be achieved.

14.2 PROJECT SPECIFIC REPORTS

14.2.1 When necessary, the LQAC will prepare QC reports related to specific projects for the project manager or project quality assurance manager. These reports will address QC issues related to the specific projects, such as:

- Assessment of data accuracy, precision, and completeness
- Results of any performance and system audits
- Discussion of any QA problems and recommended solutions

PLANNING AND PREPARATION

Yes or No

1. Was the field audit announced or unannounced?
Comments: _____

2. Was a QA Project Plan prepared for this activity?
Comments: _____

3. Was a site Health and Safety Plan prepared for this activity?
Comments: _____

4. Was a briefing held with project field participants?
Comments: _____

5. Were additional instructions given to project field participants (i.e., changes in project plan)?
Comments: _____

6. Was there a written list of sampling locations and descriptions?
Comments: _____

7. Was there a map of sampling locations available to field personnel?
Comments: _____

- | | <u>Yes</u> | <u>or No</u> |
|--|------------|--------------|
| 8. Was equipment list given to equipment coordinator with adequate lead time?
Comments: _____

_____ | — | — |
| 9. Was laboratory given a list of sample containers with adequate lead time?
Comments: _____

_____ | — | — |
| 10. Were analyses scheduled with the laboratory in advance?
Comments: _____

_____ | — | — |

SAMPLING

General Procedures

	<u>Yes</u>	<u>or No</u>
1. Was permission granted to enter and inspect the facility? Comments: _____ _____ _____	_____	_____
2. Was permission to enter the facility documented? Comments: _____ _____ _____	_____	_____
3. Were sampling locations properly selected? Comments: _____ _____ _____	_____	_____
4. Were samples collected starting with the least likely contaminated and proceeding to the most likely contaminated? Comments: _____ _____ _____	_____	_____
5. Were new disposable rubber gloves worn during sample collection? Comments: _____ _____ _____	_____	_____
6. Was sampling equipment wrapped in aluminum foil or otherwise protected from possible contamination prior to sample collection? Comments: _____ _____ _____	_____	_____
7. If equipment was cleaned in the field, were proper procedures used? Comments: _____ _____ _____	_____	_____

Yes or No

- 8. What field instruments were used during this investigation?
 Comments: _____

- 9. Were field instruments properly calibrated?
 Comments: _____

- 10. Were calibration procedures documented in the field notes?
 Comments: _____

- 11. Were samples chemically field preserved?
 Comments: _____

- 12. Were samples iced?
 Comments: _____

Well Sampling

- 1. Was depth of well determined? _____
- 2. Was depth to water determined? _____
- 3. Was measuring tape properly decontaminated between wells?
 Comments: _____

- 4. Were the above depths to water converted to water level elevations common to all wells?
 Describe how the depths were determined. _____

Yes or No

5. How was the volume of water originally present in each well determined? _____

6. Was the volume determined correctly? _____
7. How was completeness of purging determined?
Volume _____
Measure
Time/Flow rate
Cond./ph/T
8. Was a sufficient volume purged? _____
Was the well over-purged? _____
9. Was the disposal of purge water handled properly?
Comments: _____

10. Was a dedicated (in-place) pump utilized? _____
If no, describe the method of purging (bailer - include type and construction material, pump - include type) _____

11. How were the samples collected? _____
Bailer _____
Pump _____
Combination _____
- Construction material of bailer:
S.S. _____
Teflon _____
PVC _____
Other _____
- Comments: _____

Yes or No

12. If a pump was used, describe how it was cleaned before and/or between wells. _____

13. Were the samples properly transferred from bailer to sample bottles (i.e., was the purgeable sample agitated, etc.)? _____
14. Was the rope or line allowed to touch the ground? _____
15. Was wetted rope or line discarded after use at each well? _____
16. Was cotton or teflon coated rope used? _____
17. Were generators/gas pumps placed in a down wind position from the well during operation? _____

Surface Water Sampling

Yes or No

1. What procedures were used to collect surface water samples? _____

2. Did the samplers wade in the stream during sample collection? _____

If yes:

Did sampler face upstream while collecting sample? _____

Did the sampler insure that roiled sediments were not collected along with water sample? _____

3. Note any deficiencies observed during the collection of the surface water samples? _____

Sediment Sampling

1. What procedures were used to collect the samples? _____

2. Were the samples well mixed prior to placing the sample in the sample container? _____

3. Note any deficiencies observed during the collection of the samples. _____

4. Were samples composited? _____
If so, how were composites collected and mixed? _____

Soil Sampling

Yes or No

1. What procedures were used to collect samples?

2. Were the samples well mixed prior to placing the sample in the sample container? _____
3. Note any deficiencies observed during the collection of the samples. _____

4. Were samples composited? _____
If so, how were composites collected and mixed? _____

Other Sampling

1. What other types of samples were collected during this investigation? _____

2. What procedures were used for the collection of these samples?

QUALITY ASSURANCE/QUALITY CONTROL

Yes or No

(While not all of these QA/QC procedures will be necessary during each sampling activity, the following techniques may be employed. If so, please note.)

1. Did sampling personnel utilize any trip blanks?
2. Did sampling personnel utilize preservative blanks?

If yes, to either of the above questions, list the types and handling of the blanks. _____

3. Were any equipment blanks collected?

If yes, list: _____

4. Were any duplicate samples collected?

If yes, list the types (parameter coverage, etc.) and describe their handling. _____

5. Were any spiked samples utilized?

If yes, list the types (parameter coverage, etc.) and describe their handling. _____

6. Were QA/QC samples specified in the QA Project Plan?

Were the QA/QC samples collected in accordance with the QA Project Plan?

7. Check method used to collect split sample

Filled one large container and then
transferred portions

Sequentially filled bottles

FIELD DOCUMENTATION AND CHAIN-OF-CUSTODY

	<u>Yes</u>	<u>or No</u>
1. Were chain-of-custody records completed for all samples?	—	—
2. Were all samples identified with Sample I.D. tags or labels? Comments: _____ _____ _____	—	—
3. Were Sample I.D. tags or labels filled-out (e.g., completely station no., location, date, time, analyses, signatures of samplers, type preservatives, etc.)? Comments: _____ _____ _____	—	—
4. Did information on Sample I.D. tags or labels and Chain-of-Custody Records match? Comments: _____ _____ _____	—	—
5. Check manner of sample delivery to the lab. ___ Hand delivered by sampling team member ___ Shipped by common carrier If shipped by common carrier: Did the Chain-of-Custody Records indicate the method of sample shipment? Comments: _____ _____ _____		

Yes or No

If shipped by common carrier:

Was a Chain-of-Custody record included with the samples in the shipping container?

Comments: _____

6. Were samples kept under lock and key or kept in a secure place after collection?
7. Were sample tags, Chain-of-Custody forms, and field notebook signed by sampling personnel?
8. Does the field notebook contain adequate information about each sample including the sample I.D. number, date, location, and information necessary to reconstruct the sample?

Comments: _____

9. Were entries to the field notebook made in ink?

Comments: _____

10. Were corrections properly executed with one line through the error in the field notebook?

Comments: _____

11. Was sampling documented with photographs?

If yes, was a photolog maintained?

12. Were amendments to the project plan documented (on the project plan itself, in a project logbook, elsewhere)?

Comments: _____

Table 14-2
LABORATORY AUDIT CHECK LIST

PROJECT NO. _____ DATE OF AUDIT _____

PROJECT MANAGER _____ SIGNATURE OF AUDITOR _____

AUDIT LOCATION _____

YES ___ NO ___ N/A ___ 1. Are bound laboratory sample custody logs used?

Comments: _____

YES ___ NO ___ N/A ___ 2. Has the required information been recorded in the laboratory sample custody log for all samples?

Comments: _____

YES ___ NO ___ N/A ___ 3. Have unique sequential laboratory numbers been assigned to all samples?

Comments: _____

YES ___ NO ___ N/A ___ 4. Have samples been stored in an appropriate secured area?

Comments: _____

YES ___ NO ___ N/A ___ 5. Has sample custody been continuously maintained by laboratory?

Comments: _____

ANALYTICAL METHODS & DATA REPORTING AUDIT CHECKLIST

PROJECT NO. _____ DATE OF AUDIT _____

PROJECT MANAGER _____ SIGNATURE OF AUDITOR _____

AUDIT LOCATION _____

YES ___ NO ___ N/A ___ 1. Have approved analytical methods and procedures been followed?
Comments: _____

YES ___ NO ___ N/A ___ 2. Have approved sample holding times been observed?
Comments: _____

YES ___ NO ___ N/A ___ 3. Has analytical data been presented on type-written forms?
Comments: _____

YES NO N/A 4. Was supporting laboratory QC data presented with sample data?

Comments: _____

YES NO N/A 5. Do the records on file contain adequate information to readily reconstruct the history of each sample from collection through final report of analysis?

Comments: _____

INTERNAL QUALITY CONTROL PROCEDURES AUDIT CHECKLIST

PROJECT NO. _____ DATE OF AUDIT _____

PROJECT MANAGER _____ SIGNATURE OF AUDITOR _____

AUDIT LOCATION _____

YES ___ NO ___ N/A ___ 1. Are current instrument calibration curves, which bracket the analytical range of samples tested, used?
Comments: _____

YES ___ NO ___ N/A ___ 2. Are mid-range standards used to check calibration curves?
Comments: _____

YES ___ NO ___ N/A ___ 3. Are duplicate samples analyzed (10% minimum)?
Comments: _____

YES NO N/A 4. Are "spiked" samples analyzed (10% minimum)?

Comments: _____

YES NO N/A 5. Do spiking procedures follow acceptable protocols for quantity and concentration?

Comments: _____

YES NO N/A 6. Are quality control charts used to track QC precision and accuracy data?

Comments: _____

YES NO N/A 7. Are QC charts kept up-to-date?

Comments: _____

YES ___ NO ___ N/A ___ 8. Have field QC samples (field blanks, bailer blanks, extruder blanks, field duplicates, field spikes, etc.) been analyzed?

Comments: _____

YES ___ NO ___ N/A ___ 9. Are field QC samples "blind" to the laboratory?

Comments: _____

YES ___ NO ___ N/A ___ 10. Have an adequate number of field QC samples been analyzed (approximately 15% of total samples)?

Comments: _____

YES ___ NO ___ N/A ___ 11. Is the precision of the data presented within acceptable limits?

Comments: _____

YES ___ NO ___ N/A ___ 12. Is the accuracy of data presented within acceptable limits?

Comments: _____

YES ___ NO ___ N/A ___ 13. Have recent (one year or less) laboratory performance audit results been provided for each analysis performed?

Comments: _____

YES ___ NO ___ N/A ___ 14. Has the laboratory followed the preventive maintenance procedures as outlined in the QA plan?

Comments: _____

YES ___ NO ___ N/A ___ 15. Is completeness of data acceptable?

Comments: _____

Appendix A
RESUMES FOR CH2M HILL LABORATORY PERSONNEL

THURMAN W. DICKENS, JR.
Laboratory Manager, Gainesville Laboratory

Education

M.S., Analytical Chemistry, Middle Tennessee State University
B.S., Chemistry, Middle Tennessee State University

Experience

Mr. Dickens is the manager of CH2M HILL's Gainesville Environmental Laboratory. As such, he has overall responsibility for laboratory operations, including the Inorganic and Organic Analytical Divisions, the Client Services Department, the Quality Assurance/Quality Control Department, and for administrative functions. In addition, Mr. Dickens is the chairman of the CH2M HILL Laboratories' Quality Assurance/Quality Control Committee, which has the responsibility of reviewing, improving, and expanding quality control procedures within the laboratory organization.

In a previous position, Mr. Dickens supervised the organic division of the Montgomery, Alabama, CH2M HILL laboratory. He supervised the extractions, gas chromatography, and gas chromatography/mass spectrometry sections and was responsible for all operations within his department. Mr. Dickens served as project manager for two major Superfund projects, which involved method development and sample analysis. While at the Montgomery laboratory, he also was primarily responsible for the implementation of advanced automation in the laboratory.

Mr. Dickens is proficient in the use of the Finnigan 4000, 5100, and 4500 GC/MS/DS systems. Since joining CH2M HILL, Mr. Dickens has implemented software and written many user procedures for the Finnigan INCOS and Super INCOS mass spectrometry data systems.

Before joining CH2M HILL, Mr. Dickens was an analytical chemist for a firm located in Tennessee, where his duties included priority pollutant analysis using fused silica capillary column gas chromatography and mass spectrometry, analyzing volatiles using purge and trap, using selected ion monitoring and chemical ionization mass spectrometry for special analysis, and analyzing pesticides and other pollutants using electron capture, flame ionization, and flame photometric detectors.

As an analytical chemist, Mr. Dickens performed data reduction using the latest U.S. Environmental Protection Agency (EPA) protocols, he coordinated sample preparation for subsequent instrumental analysis, and he completed a study comparing the analysis of eight organophosphate pesticides from EPA's Method 614. He is experienced in the techniques of chemical ionization, negative and positive ion

chemical ionization selected ion monitoring, positive chemical ionization, capillary chromatography, mass spectrometry, and flame photometry.

Membership in Professional Organizations

American Chemical Society

Presentation

With P.J. Schrynmeeckers, M.S. Clark, C.H. Kelly, and T. Priest. The Analysis of Part Per Trillion Levels of Polynuclear Aromatic Compounds in Drinking Water. Environmental Lab, Vol. 2, No. 2. April/May 1990.

With D.S. Weinberg. Gas Chromatography/Mass Spectrometric Analysis of Organophosphorus Pesticide Residues. Master's Thesis. Presented at ACS 34th Annual Southeastern Regional, Birmingham, Alabama. November 1982.

07415.GNV

THOMAS C. EMENHISER
Client Services Manager

Education

B.S., Chemistry, University of Florida

Experience

Mr. Emenhiser is the client services manager of the full-service environmental laboratory operating from CH2M HILL's Gainesville, Florida, office. Mr. Emenhiser is responsible for client interface and marketing for the Gainesville Environmental Laboratory. He has more than 17 years of experience in industrial wastewater treatment, hazardous waste assessments, and water quality investigations.

Mr. Emenhiser established the Gainesville laboratory test procedures for analyzing samples for benzene, toluene, and xylenes, the typical indicator parameters for petroleum hydrocarbon contamination studies. Mr. Emenhiser also is knowledgeable in the interpretation of data sets assessing the extent and source (e.g., gasoline, kerosene, diesel fuel) of contamination.

Mr. Emenhiser has been involved in several projects associated with the U.S. Environmental Protection Agency (EPA) RCRA and Superfund programs. He was the project team leader for the Biscayne Aquifer groundwater sampling project, which required sampling of 120 wells in the Miami, Florida, area in accordance with EPA protocols. Mr. Emenhiser maintained field notebooks, chain-of-custody records, and organic/inorganic traffic reports.

Mr. Emenhiser was the field manager for several industrial wastewater characterization and treatability studies, including those conducted for Engelhard Industries at Attapulcus, Georgia, and Hercules, Inc., at their Gibbstown, New Jersey, and Brunswick, Georgia, facilities. His responsibilities on these projects included the characterization of the strength and quantity of wastewater streams to determine their overall pollutant load. Mr. Emenhiser also evaluated alternative experimental techniques (e.g., dissolved air flotation, activated carbon adsorption, jar test coagulation, and bench-scale biological reactors) for development of the optimum treatment/disposal system for the facilities.

Mr. Emenhiser has been involved in several process designs for industrial wastewater treatment facilities and spent 6 months in Caracas, Venezuela, completing a preliminary design for the treatment of upgrader and produced wastewaters for the Lagoven Oil Company.

Mr. Emenhiser also has extensive experience in surface water quality investigations. He has been involved in limiting nutrient investigations and non-point source water

quality and quantity studies in Florida for the Florida Sugar Cane League, Deseret Ranches, and Jacksonville Suburban Utilities.

Publications

With U.P. Singh, J.I. Garcia-Bengochea, and J.E. Orban. Cleanup of Miami Drum Hazardous Waste Site. *Journal of Environmental Engineering*. 1984.

With U.P. Singh. Innovative Sampling Techniques for Ground Water Monitoring at Hazardous Waste Sites. *Ground Water Monitoring Review*. 1984.

With U.P. Singh, N.N. Hatch, J.I. Garcia-Bengochea, and J.E. Orban. Remedial Investigations at Biscayne Aquifer Hazardous Waste Sites. Presented at the American Society of Civil Engineers Specialty Conference on Environmental Engineering, Los Angeles, California. 1984.

With R.J. Bruner, N.N. Hatch, and U.P. Singh. Sampling Procedures for the Biscayne Aquifer Protection Study. Presented at the National Water Well Association's Fourth National Symposium and Exposition on Aquifer Restoration and Ground Water Modeling, Columbus, Ohio. 1984.

With R. Sproul. Effects of Hydrogen-Sulfide in Florida Groundwaters. Presented at the Third Annual Groundwater Symposium of the Northwest Florida Water Management District. 1983.

With E.E. Shannon, and J.J. Smith, Jr. Anaerobic-Aerobic Biopond Treatment of Sugarcane Mill Process Wastewaters. Presented at the 52nd Annual Conference of the Water Pollution Control Federation, Houston, Texas. 1979.

06557.GNV

KATHRYN D. STARCHER
Laboratory Quality Assurance Coordinator

Education

B.S., Biology, Oglethorpe University

Experience

Ms. Starcher is responsible for coordinating the Gainesville environmental laboratory's quality assurance/quality control (QA/QC) program. She has been involved in developing these QA/QC guidelines and the techniques for their implementation, including calibration and maintenance logs, analytical bench sheets, standard operating procedures, and corrective action procedures.

Ms. Starcher has programmed specialized computer spreadsheets and formats for tracking and presenting analytical QC data, certification results, and client QA/QC reports.

Advanced laboratory equipment that Ms. Starcher is familiar with includes atomic absorption spectrophotometers, TOC analyzers, and autoanalyzers. She has experience in a variety of analytical procedures including standard analyses such as BOD, COD, and nutrient and mineral determination, and has assisted with jar tests and bench-scale activated sludge pilot studies. Types of samples she has analyzed include groundwater, surface water, seawater, estuarine water, domestic and industrial wastes, solid wastes, hazardous wastes, plants, soils, and sludge.

Ms. Starcher's previous experience includes supervising laboratory personnel and coordinating work assignments, compiling and summarizing data, maintaining a QC program, preparing equipment and materials for field assignments, and performing laboratory analyses.

For the Sugar Cane Growers Cooperative in Belle Glade, Florida, Mrs. Starcher analyzed industrial process waste, treatment pond wastewater, monitoring canal water, and monitoring well water. She developed a practical cadmium reduction procedure for nitrate nitrogen analysis of the Cooperative's industrial wastewater. She was also involved in phosphorus and kjeldahl nitrogen, BOD, and solids analyses.

Mrs. Starcher analyzed rainwater, agricultural irrigation and runoff water, and shallow monitoring well water for the Florida Sugar Cane League, Clewiston, Florida.

Before joining CH2M HILL, Ms. Starcher taught high school chemistry and physical science in the Duval County, Florida, school system.

Membership in Professional Organizations

Florida Society of Environmental Analysts

GPI06315.151

ISAAC D. LYNCH
Cations/Wet Chemistry Supervisor

Education

A.S., Environmental Science Technology, Santa Fe Community College

Experience

Mr. Lynch is the Inorganic Lab Supervisor for the Gainesville laboratory. His duties include overseeing the wet chemistry and metals analysis operations. Checking data for correlation and quality control, and supervising and training new lab technicians.

Mr. Lynch has 10 years of experience in laboratory work and specializes in inorganic water quality analyses (e.g., primary and secondary drinking water standards). He is skilled in field sampling, performing atomic absorption spectrophotometry, auto analyzer analysis (e.g., AAIL, TRACCS 800), TOC analyses, and wet chemistry analyses.

Membership

Florida Society of Environmental Analysts

GPI07933.151

CLAYTON L. LOVELL
Inorganic Analyst

Education

Graduate, U.S. Army Academy of Health and Sciences, San Antonio, Texas
A.A., Santa Fe Community College

Experience

Mr. Lovell is responsible for independent cation analysis on various environmental matrices, i.e., water, soil, and sludge. He prepares all related standards, oversees acid digestion procedures, maintains and tracks quality control data using a spreadsheet format, and ensures that all analyses are performed in accordance with CLP and HAZWRAP protocol and EPA standard methods.

Mr. Lovell also operates the atomic absorption spectrophotometer/furnace atomizer at CH2M HILL's Gainesville, Florida, laboratory. He has over 6 years of analytical experience in both the environmental and medical fields.

Mr. Lovell worked as a laboratory technician on the aquifer storage recovery (ASR) facility project for the Claude H. Dyal Water Treatment Plant. He performed water quality control and fluoride, iron, color, turbidity, total dissolved solids, and finished and raw water analyses. Mr. Lovell coordinated the collection and processing of distribution and new water main samples for bacteriological certification. He also participated in data collection and analysis for the proposed ASR facility.

Before joining CH2M HILL's laboratory staff, Mr. Lovell was employed at the Claude H. Dyal Water Treatment Plant in Cocoa, Florida. As a laboratory analyst, he performed water quality control and related analyses (for example, fluoride, iron, color, turbidity, TDS, conductivity) on finished and raw water. Mr. Lovell also coordinated the collection and processing of distribution and new water main samples for bacteriological certification. In addition, he participated in data collection and analysis of injection and recovery cycles during testing of an aquifer storage recovery facility.

As a member of the Emergency Services Laboratory at Lettermen Army Medical Center, Mr. Lovell was responsible for independent performance of analysis, quality control, and routine instrumentation maintenance for chemistry, urinalysis, hematology/coagulation, microbiology, and the blood bank.

Professional Licenses

B Level License (Water Treatment), Florida

Membership in Professional Organizations

Florida Water and Pollution Control Operators Association
Florida Society of Environmental Analysts

GPO08258.151

RONALD JONES
Senior Technician

Education

A.S., Environmental Science Technology, Santa Fe Community College

Experience

Mr. Jones has 12 years of experience in the laboratory and the field. In the environmental laboratory of the Gainesville office of CH2M HILL, he performs the following analysis: atomic absorption spectroscopy, total kjeldahl nitrogen, ammonia, cyanide and chemical oxygen demand.

As the supervisor of the Environmental Science Laboratory at Santa Fe Community College in Gainesville, Florida, Mr. Jones gained experience in atomic absorption spectroscopy and gas chromatography. During this time, he also taught the course, "Environmental Sample Analysis."

At Midwest Research Institute in Kansas City, Missouri, Mr. Jones performed sampling and analysis of air and water pollutants and helped with federally funded research projects designed to establish standards in the environmental field. During this time, Mr. Jones worked in Yuma, Arizona for 3 months and served as analyst for a pilot study concerned with partial desalination of the Colorado River.

Professional Societies

Florida Society of Environmental Analysts

GPW07715.151

RUSSELL W. GOFF
Chemist

Education

B.S., Chemistry, Emory University
(M.S., Environmental Engineering, University of Florida, in progress; projected date of completion, 1992)

Experience

Mr. Goff is a chemist in the Inorganic Department of Gainesville's Environmental Laboratory. He is responsible for the tracking and analysis of alkalinity, conductivity, calcium and total hardness, chloride, fluoride, ortho- and total phosphorus, phenols, silicas, hexavalent chromium, chlorine, and oil and grease. He has a working knowledge of the TRACCS 800 auto analyzer, the AAI, and the Dohrman DC 80 total organic chemical analyzer.

Special projects that Mr. Goff has worked on involved phosphorus characterization of soils, trihalomethane formation potentials, and purgeable organic carbon analysis.

As a laboratory assistant in the Department of Pharmacology, Emory University, Mr. Goff ordered products and equipment, handled and disposed of radioactive materials, and monitored levels of radioactivity in the lab.

Mr. Goff worked as a laboratory technician II at Akzo Pharmaceutical in Raleigh, North Carolina, where he conducted microtiter experiments on two coagulation protein projects. He was responsible for the inception and experimentation of the studies and for the statistical interpretation and reduction of the data. He also constructed graphs and charts for data presentation.

Membership in Professional Organizations

American Chemical Society
Florida Society of Environmental Analysts

Honors

Dean's List
Gardner B. Allen Scholarship Recipient
Outstanding College Students of America

GPW10192.151

RICHARD A. DOBBINS
Inorganics Analyst

Education

B.S., Chemistry, University of Florida

Experience

Mr. Dobbins is an inorganics analyst in the environmental laboratory at CH2M HILL's Gainesville, Florida, office. He worked previously as a laboratory assistant at the University of Florida and as an Information Systems Operations Specialist with the U.S. Air Force. For the Air Force, he operated and provided support for both mainframe and microcomputers.

As a laboratory assistant, Mr. Dobbins was responsible annually for preparation of 10,000 compound samples for student analysis in the general chemistry program at the University of Florida. He also prepared and standardized numerous reagents. As a result, he became expert in the proper care and disposal of chemical waste and byproducts. Mr. Dobbins was also in charge of incorporating a micro-computer into the existing recordkeeping process. He designed and wrote several programs that are now used to maintain student, stockroom, and computer usage records. He also wrote user-friendly utility programs that streamlined laboratory operations. Mr. Dobbins was recognized for his outstanding analytical chemistry skills by being nominated for the 1988 Undergraduate Analytical Chemistry Award.

While Mr. Dobbins was in the military, he was in charge of the microcomputer program for Moody Air Force Base in Georgia. He gained diverse and valuable knowledge of small computer design as well as maintenance procedures, packaged software installation and usage, and program development. Mr. Dobbins also increased his knowledge of mainframe computers during this time by filling the positions of Assistant Database Administrator and Assistant Security Officer. His duties in these capacities included operating system and application software maintenance, password and user identification maintenance, computer use tracking and reporting, disk file balancing, and troubleshooting.

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CHARLIE JARMAN
Organics Laboratory Supervisor

Education

B.S. Physics/Math, University of Southern Mississippi

Experience

Mr. Jarman is responsible for the operation of the Gainesville office's chromatography laboratory. His primary duties include final data review, report preparation, instrument maintenance and repair, implementation of new services, and training and supervision of the support staff. He assists with daily analytical tasks when necessary, including analyzing samples, preparing standards, and quality assurance/quality control (QA/QC).

Mr. Jarman has assisted in the installation and method development of two gas chromatographs, two state-of-the-art Purge-and-Trap Concentrators and associated autosamplers, and two computers. In addition, he assisted in the expansion of the laboratory and the installation of a state-of-the-art liquid nitrogen facility.

Mr. Jarman has developed most of the computer programs that are used for report generation and QA/QC. The computer reporting system that he developed and implemented has resulted in a significant decrease in both report turn-around time and processing costs.

Mr. Jarman has supervised all of the major analytical programs and their associated QA/QC requirements. Clients have included the U.S. Air Force, EPA, several major oil companies, a number of large chemical companies, and various Florida and out-of-state environmental agencies.

Mr. Jarman has 12 years of laboratory and instrument experience, including 5 years as a Hewlett Packard field engineer for gas chromatographs, laboratory computer systems, and mass spectrometers. He has worked for two certified EPA Contract Laboratories, where he operated and maintained gas chromatographs and mass spectrometers. While there, he advanced to the level of senior GC/MS operator for both volatile and semi-volatile analyses.

Prior to entering the laboratory field, Mr. Jarman worked as an engineer in the offshore oil industry and as a technical writer in consumer electronics.

GPI07871.151

MARK STINNETT
Environmental Scientist

Education

B.S., Chemistry, Marshall University

Experience

Mr. Stinnett works in the Gainesville, Florida environmental laboratory. His primary responsibilities include laboratory software development, analysis reporting, and gas chromatograph (GC) analysis. He also maintains the laboratory network, assists in the routine operations of the GC section, and coordinates projects for several clients.

Mr. Stinnett is familiar with several different types of laboratory instrumentation, including the IL-ICP 200, the IL-AA 551, the Leco CHN Analyzer, the Parr adiabatic calorimeter, the Elzone particle counter, the Fisher CAT System water titrator, the carbolite ash fusion instrument, and the Fisher 1200 GC. He has performed laboratory testing for chlorine, sulfur, oxidation, mine gases, proximate analysis, neutralization potential, and Geisler and Ruhr dilations.

Mr. Stinnett was previously employed as a laboratory analyst for a coal research center where he was responsible for conducting general coal analysis for quality control. He performed many types of water analyses, with particular emphasis on waterborne metals using inductively coupled plasma and atomic absorption spectroscopy. Mr. Stinnett also conducted particle measurements on fly ash material generated by a pilot-scale coal combustor, and he developed experimental programs for analyzing trace elements in coal and coal ash material. He was also systems operator of a laboratory computer network.

In prior employment, Mr. Stinnett was an environmentalist for the Southern West Virginia Regional Health Council.

GPI08552.151

STEPHEN L. SHIRLEY
Laboratory Analyst

Education

Coursework, Meridian Community College, Santa Fe Community College

Experience

Mr. Shirley is a gas chromatography (GC) analyst in CH2M HILL's organics laboratory in Gainesville, Florida. He is responsible for standardizing GC equipment and verifying calibration on a microcomputer. Mr. Shirley operates the screening GC and reduces the results for analysis on a production GC. He also performs inorganic analysis, including biochemical oxygen demand, total organic chemical, total phosphorus, ortho-phosphorus, and mercury, as needed.

Mr. Shirley prepares and analyzes project and quality assurance/quality control (QA/QC) samples and performs routine maintenance. He is also responsible for maintaining instrument log books, including QA/QC data, and preparing and verifying standards and QA/QC spiking solutions.

Before joining CH2M HILL, Mr. Shirley worked for 6 years in a hydrocarbon well-logging laboratory. His duties included GC operation, computer analysis, wet chemistry analyses, and well logging. Mr. Shirley was also a manager for a well-logging analytical firm in Texas.

GPO07619.151

MARILYN R.P. MORGAN
Senior Sample Coordinator

Education

A.A., General Science, Brevard Community College
B.S., Microbiology, University of Florida

Experience

Ms. Morgan is responsible for coordinating sample kit preparation, shipment, receipt, documentation, and the efficient processing of samples in the Gainesville environmental laboratory.

For sample processing, Ms. Morgan is responsible for sample kit preparation, coordination with field teams, sample receiving/custody, coordination of analyses with other laboratories, data tracking and recording, and client contact.

Ms. Morgan is experienced in atomic absorption spectrophotometry, and mercury, total organic carbon, and total kjeldahl nitrogen determinations.

Before joining CH2M HILL, Ms. Morgan was a chemist for General Electric's Advanced Engineering Laboratory in Alachua, Florida.

GPI07913.151

DONALD E. HASH
Client Services Representative

Education

B.S., Biology (Microbiology), Virginia Polytechnic Institute and State University
Minor: Chemistry and Computer Sciences

Experience

For the CH2M HILL Gainesville environmental lab, Mr. Hash is responsible for sample receiving/custody, sample tracking, data reporting, coordination with field crews, client/customer contact, sample kits/protocols, chain of custody requirements, and coordination with other labs (internal and external), and has performed GC 601/602 analyses.

Prior to joining CH2M HILL, Mr. Hash was a commercial laboratory manager of the Food Chemistry section at ABC Research. He ordered supplies, coordinated technicians/testing, and performed analyses using GC/ECD, GC/FID, GC/TSD, GC/TCD on a wide variety of matrices. Previously at ABC Research, Mr. Hash was a member of the Research Micro Department, where he performed tests on the microbial integrity of foods.

Mr. Hash spent 10 years performing research in the Department of Anaerobic Microbiology at Virginia Polytechnic Institute and State University. During his tenure there, he published four technical papers in international journals and spent 5 years developing software for statistical analyses of bacterial populations in dental patients with periodontitis.

Membership in Professional Organizations

Florida Society of Environmental Analysts
American Chemical Society
American Society for Microbiologists
Association of Official Analytical Chemists

Publications

With W.E.C. Moore, L.V. Holdeman, and E.P. Cato. Polyacrylamide slab gel electrophoresis of soluble proteins for studies of bacterial floras. Applied Environmental Microbiology. 39:900-907. 1980.

With E.P. Cato, L.V. Holdeman, and W.E.C. Moore. Electrophoretic study of Clostridium species. Journal of Clinical Microbiology 15:688-702. 1982.

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MOLLY DAVIS
Administrative Specialist

Education

B.A., Business Administration, University of Florida

Experience

Ms. Davis specializes in administration in the Environmental Laboratory of CH2M HILL's Gainesville office. As such, she is responsible for invoicing, accounts payable and receivable, purchasing, monthly operating reports, and personnel.

Previously, working in a temporary capacity at CH2M HILL, Ms. Davis was a project assistant before being hired full time. In that capacity, she gave support to large projects, such as the Upper Occoquan Sewage Authority Wastewater Treatment Plant design.

GPW10221.151

NANCY MOSURICK
Office Support Specialist

Education

High School Diploma, Gainesville High School
Degree in Travel and Tourism, Advanced Career Training, Jacksonville, Florida

Experience

Ms. Mosurick is primarily responsible for generating work-in-progress and report of analysis sheets in CH2M HILL's Gainesville Environmental Laboratory. She is also responsible for various clerical duties.

After completing work-in-progress and report of analysis sheets, Ms. Mosurick distributes them to the client. She also monitors deadlines and laboratory health and safety procedures.

Clerical duties that Ms. Mosurick is responsible for include processing telephone inquiries; collecting laboratory personnel time sheets; distributing payroll checks; receiving and distributing supplies; distributing mail; making travel and meeting arrangements; and composing and typing correspondence and project-related materials.

Previous to her work with CH2M HILL, Ms. Mosurick was the acting office manager of Empire of America Federal Savings Bank in Gainesville, Florida. As such, she was responsible for the financial tasks of accounts payable/receivable, collections, loan processing, underwriting of loans, escrow analysis, distributing loan monies, preparing bank deposits, and reconciling bank statements.

In that position, Ms. Mosurick was also responsible for the clerical duties of computer programming, filing, distributing incoming and outgoing mail, problem solving, receiving and shipping, typing, research, setting up and retrieving files, and assisting customers.

GPW10569.151

MARGERY N. NEWSOME
Associate Inorganic Chemist

Education

B.A., Chemistry, Converse College

Experience

As an associate inorganic chemist in the Inorganic Department of CH2M HILL's laboratory in Gainesville, Ms. Newsome prepares and analyzes samples for the detection of metals. She preps samples, enters data, and prepares reports. She also runs samples for mercury and EPTOX analysis.

Previously, at the Bowman Gray Research and Development Center, Winston-Salem, North Carolina, Ms. Newsome provided automated, segmented, continuous-flow analysis for the R.J. Reynolds Tobacco Company. She also conducted research to improve the efficiency and accuracy of laboratory operations and she trained and supervised laboratory technicians and aided in annual planning. In a previous position at the research and development center, Ms. Newsome analyzed a component in side-stream smoke for R.J. Reynolds.

At the Bowman Gray School of Medicine, Winston-Salem, North Carolina, Ms. Newsome worked in the Pharmacology Department where she prepared blood assays and analyzed them for signs of high blood pressure.

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Appendix B
LABORATORY QUALITY CONTROL

LABORATORY QUALITY CONTROL AND EVALUATION OF DATA

To ensure the accuracy of analytical data, it is important to evaluate and control the quality and reliability of the analytical testing program. Many factors can and do affect the reliability of data, including sampling site, sampling technique, sample storage and handling, training and experience of the analyst, physical facilities and equipment, quality of reagents and standards, servicing and calibration of instruments, analytical methods and technique, analytical calculations, and a knowledgeable and understanding management. Close control of all phases of the testing program is essential to ensure that the resulting data are of the highest quality. The techniques discussed in this section apply mainly to the control and evaluation of the analytical testing program.

The laboratory manager is responsible for maintaining a continuing record of the data from all quality control checks and for using these data to make decisions on the acceptability of the analytical results as they are acquired. All quality control data generated, problems identified, and corrective actions taken to resolve the problems are to be recorded and provided to the responsible authority when reporting analytical results. As available, quality control (QC) check samples of known value and performance evaluation (PE) samples should be analyzed by the laboratory prior to initiation of the analytical program.

INTRALABORATORY QUALITY CONTROL

As a part of its intralaboratory analytical quality control program, the laboratory must develop single laboratory precision and accuracy criteria for each parameter that it is required to measure. These criteria must compare favorably with published data. Initially, these data may be applied over a broad concentration range. As more data accumulate, the precision and accuracy of the method should be updated and criteria developed for multiple narrower ranges.

Although it is common to refer to the accuracy of data, the quality of analytical data is determined by its precision as well. To ensure high analytical accuracy and precision the U. S. EPA recommends that from 10 to 20 percent of analyses be for quality control purposes.

Accuracy -

Accuracy measures how closely the analytical result, or the average of a set of analytical tests, approaches the actual value of the parameter being measured. Ideally, they should be exactly the same; however, this goal is unlikely because all analytical tests are subject to a number of errors and limits that affect the accuracy of the final results.

Errors affecting analytical measurements can be classified as either systematic (determinate) or random (indeterminate). Systematic errors usually are the result of improper analytical techniques or of inaccurate or faulty instruments (for example, inaccurately calibrated analytical balances). Systematic errors, which cause a consistent error in the final result, can be eliminated by finding and correcting the cause of the error.

Random errors cannot be prevented because there is some uncertainty in every physical measurement. These errors are equally likely to cause a positive or a negative deviation from the true value. Examples of such an error are sample weighing, which usually is accurate to ± 0.1 mg, and pipeting of samples, which--even when done accurately as possible--has an inherent inaccuracy associated with the class of pipet being used.

It is possible to minimize the effect of random errors by performing a series of replicate analyses on the same sample and taking the average of these values. The overall reliability of the resulting average will increase as the number of measurements is increased; however, random errors set a limit to the accuracy of the data. Under normal conditions duplicate or at most triplicate analyses are used.

Precision

Precision is the second consideration in evaluating the quality of data. Precision measures how closely a series of replicate measurements approaches the average. Actually, it is a measure of how well the results can be reproduced. It is frequently assumed that the ability to produce data with a high precision indicates that the results are also highly accurate; however, such is not necessarily the case. It is entirely possible to have excellent precision and poor accuracy, or conversely, excellent accuracy and poor precision.

Consequently, it is necessary to control both accuracy and precision to ensure that reliable data is produced. A number of methods are available for evaluating both accuracy and precision. However, these measures do not include the sampling and handling errors that occur prior to lab receipt of the sample.

MEASUREMENT OF PRECISION

Precision is evaluated by analyzing a set of replicate samples. The simplest measure of precision is to determine the range of a series of replicate samples where range is defined as the difference between the highest and lowest values reported for a given sample. Obviously, the smaller the range the greater the precision for a given replicate set. However, it is generally desirable to have an objective means for rejecting data that is suspected of being incorrect. Since the primary concern in evaluating precision is whether or not an upper control limit has been exceeded and since the range is not independent of concentration it is necessary to develop a table of upper control limits or critical range (R_c) values for all concentration levels of each parameter. An example of such a table for three parameters is given (Table 1).

Critical Range Tables

To determine the precision of the method, a regular program of analyses of replicate aliquots of environmental samples must be carried

out. The precision criterion should be developed from 15 sets of replicate results accumulated over a period of time during the routine analysis program. At least two replicate aliquots of a well mixed sample must be analyzed with each set of 20 samples or less analyzed at a given time. These replicate data must be obtained for each parameter of interest.

For each parameter of interest arbitrarily divide replicate data into limited concentration levels such as those given in Table 1. Determine the range R_i for each duplicate set. Use the value 0.5 for any R_i value which would otherwise be zero. Determine \bar{R} for each concentration level

$$\bar{R} = \frac{\sum_{i=1}^n R_i}{n}$$

The upper control limit (UCL) is then calculated from the Shewhart factor D_4 for ranges based upon duplicate analyses and the average value of range \bar{R} for each concentration level.

$$UCL = D_4 \bar{R} = 3.27 \bar{R}$$

The R_c value is the UCL value rounded to the nearest whole unit at higher concentration levels and to the nearest half unit for the lowest concentration level. However, there can be an exception to this rule, that is illustrated among the low-concentration R_c values for copper (Table 1) that demonstrates an advantage beyond the simplicity of using such tables. The UCL value for copper at 25 to 50 μ /l is inconsistent with the UCL value for adjacent concentration levels, and the R_c value has been adjusted to resolve this inconsistency. Without the table, such inconsistencies could very easily go unnoticed.

The examples in Table 2 illustrate how to use the R_c values in Table 1. This technique, consisting of the development and use of a table of critical-range R_c values at different concentration levels, is recom-

mended to control precision. Normal control chart procedures should be followed regarding identification and verification of the table. The table should be updated periodically as additional, or more current, data become available, or whenever the basic analytical system undergoes a major change. If any difference between duplicate analyses exceeds the critical-range value for the appropriate concentration level, then analyses must be stopped until the problem is identified and resolved, and the frequency should be increased for the next few precision checks. After resolution, the problem and its solution must be documented, and all analyses since the last in-control check must be repeated or discarded.

MEASUREMENT OF ACCURACY

In addition to the initial determination of precision, a program must be maintained to verify that the laboratory accuracy continues under control. The accuracy of an analytical test is evaluated through the use of standard samples, samples that have a known concentration of the constituent of interest. Standards for a number of parameters can be obtained either commercially or from the Environmental Protection Agency; or they may be made up from pure chemicals in the laboratory. These standards may be analyzed directly, or they may be added to unknown samples in a process known as spiking. Spiking is usually more desirable because it includes an evaluation of the effects of interfering substances on the sample being analyzed.

Percent Deviation

Even though it is less dependable than spiked samples, direct analysis of standard samples is sometimes used to assess accuracy. The chief problem with this technique is that it is preferable to work with a sample as close to the unknown sample as possible. Standard samples rarely meet this criterion. The results of analyzing standard samples are expressed as percent deviation from the standard. This parameter is referred to as percent relative error in "Standard Methods," but the EPA calls it percent bias in its "Analytical Quality Control Handbook."

Both sources list standard values of this parameter for various analyses. As in all such procedures, the sample should be analyzed in replicate. Normally, seven replicate analyses of the standard are run to generate the data points to calculate percent deviation.

The percent deviation is calculated using the following procedures:

1. Subtract the theoretical concentration from the average measured concentration as determined by the average of the replicate analyses.
2. Divide the value from Step 1 by the theoretical concentration.
3. Multiply the result from Step 2 by 100. This product is the percent deviation. It will be either negative or positive, depending on whether the measured value was less than or greater than the theoretical value. The appropriate sign should be written as part of the result.
4. The calculated value should be compared with the values published by the EPA or with those in "Standard Methods."

Example:

Calculate percent deviation of the following analysis. A standard sample with a concentration of 15 mg/l is analyzed in triplicate. The results of these analysis are 14.7 mg/l, 15.1 mg/l, and 14.6 mg/l. The average of the three analyses is 14.80. The percent deviation is:

$$\frac{14.80 - 15.00}{15} \times 100, \text{ or } -1.33 \text{ percent}$$

Percent Recovery

Concurrently, calculate the percent recovery (P_i) as follows:

$$P_i = \frac{100 (O_i)}{T_i}$$

Where T_i = the true value, and O_i = the observed value.

After determining the p_i for approximately 15 check standards, calculate the mean (\bar{P}) and standard deviation (S_p) of the percentages as follows:

$$\bar{P} = \frac{\sum_{i=1}^n P_i}{n}$$

and:

$$S_p = \sqrt{\frac{1}{n-1} \left[\sum_{i=1}^n P_i^2 - \frac{(\sum_{i=1}^n P_i)^2}{n} \right]}$$

where n = the number of results available.

If the percent recovery for succeeding check standards is not within the interval of $\bar{P} \pm 2 S_p$, the system should be checked for problems. If problems exist, they must be resolved before continuing with routine analysis. This criteria is tighter than the generally accepted $\bar{P} \pm 3 S_p$ but will result in more accurate data for real samples if these check standards are used to adjust the calibration.

At least one check standard must be analyzed along with each set of 20 samples or less that is analyzed at a given time. This check standard data must be obtained for each parameter of interest.

Record the recovery of all check standards and periodically revise; update, and improve the accuracy criteria.

Spike Recovery

The use of spiked samples, as indicated earlier, is preferable for evaluating accuracy of an analytical procedure because it is performed on a sample that closely resembles the unknown sample. This procedure involves the addition of a spike (T_i , true value) sufficient to approximately double the background concentration level (\bar{X}_i) of the sample selected earlier for replicate analysis. If the original concentration is higher than the midpoint of the standard curve (range of the method), then the concentration of the spike should be approximately one-half the original concentration. If the concentration of the original sample was not detectable, the concentration of the spike should be 5 to 15 times the lower limit of detection. The volume of standard added in aqueous solution should not dilute the sample by more than ten percent. The volume of standard added in an organic solvent solution should be kept small (100 μ l/l or less), so that the solubility of the standard in the water will not be affected.

Analyze the sample, calculate the observed value (O_i), and then calculate the recovery for the spike as follows:

$$P_i = 100(O_i - \bar{X}_i)/T_i$$

where P_i is the percent recovery. If the sample was diluted due to the addition of the spike, adjust \bar{X}_i accordingly.

After determining P_i for at least 15 spike results, calculate the mean percent recovery (\bar{P}) and standard deviation (S_p) of the recovery as follows:

$$\bar{p} = (\sum_{i=1}^n p_i) / n$$

and:

$$S_p = \sqrt{\frac{1}{n-1} \left[\sum_{i=1}^n p_i^2 - \frac{(\sum_{i=1}^n p_i)^2}{n} \right]}$$

Where n = the number of percent recovery values available.

If the percent recovery of the spike is not within the interval of $\bar{p} \pm 3 S_p$, the system accuracy is out of control and the source of this systematic error should be identified and resolved before continuing with routine analysis.

At least one spiked sample must be analyzed along with each set of 20 samples or less that is analyzed at a given time. This spiked data must be obtained for each parameter of interest. Record the recovery data of all spiked analyses and periodically (every 25 to 30 data points) revise, update, and improve the accuracy criteria.

Accuracy Control Charts

Quality control charts provide a means of evaluating day-to-day performance, once sufficient accuracy data is generated. Accuracy data are generated through the analysis of standard and spiked samples. Normally, 15 to 20 sets of spikes are required to provide sufficient data to construct a quality control chart.

The charts (Figure 1) consist of an x axis, which corresponds to the time or order of the results, and a y axis, which is graduated in the units of the test value. The y axis includes an average or control value, an upper and lower control limit, and an upper and lower warning limit. The limits on these charts are calculated from actual analytical results coupled with decisions concerning the acceptable level of variability in the data and the degree to which a technician is willing to accept data that is out of control or reject data that is in control.

The variability in true concentration that is common in environmental analysis means there are no expected values for randomly selected samples, so that the accuracy of laboratory data must be evaluated indirectly through the recovery of standards and spikes. An accuracy control chart for percent recovery can be calculated in the following manner:

The percent recovery is calculated as

$$p = 100 \frac{\text{observed}}{\text{known}}$$

for standards, or

$$p = 100 \frac{\text{observed-background}}{\text{known}}$$

for recovery of spikes into natural water backgrounds. Average percent recovery

$$\bar{p} = \frac{\sum_{i=1}^n p}{n}$$

The standard deviation for percent recovery

$$S_p = \sqrt{\frac{\sum_{i=1}^n p_i^2 - \left(\frac{\sum_{i=1}^n p_i}{n}\right)^2}{n-1}}$$

The upper control limit becomes $UCL = \bar{p} + 3 S_p$ and the lower control limit becomes $LCL = \bar{p} - 3 S_p$. The upper warning limit becomes $UWL = \bar{p} + 2 S_p$, and the lower warning limit becomes $LWL = \bar{p} - 2 S_p$.

Following normal procedures, the control chart must indicate the conditions under which it was developed, i.e., laboratory name, parameter, method of analysis, date of preparation, and any other information unique to the initializing data, such as range of concentration and identification of analyst(s). A control chart is not generally applicable under other conditions.

To verify the control chart, the initializing data should be checked to be sure that none of the values exceeds these new control limits. In addition, if its distribution is proper, about 68 percent of the initializing data should fall within the interval $\bar{P} \pm S_p$. It has been suggested that the control chart is not valid if less than 50 percent of the initializing data falls within this interval.

In applying the control chart, either of the following two conditions would indicate an out-of-control situation:

- a. Any point beyond the control limits
- b. Seven successive points on the same side of the value \bar{P} of the central line

As the limits' names imply, values above the warning limit, but below the control limit, indicate a condition that--though not necessarily out of control--is cause for concern. Based on the assumptions used for constructing the control chart, approximately 5 out of every 100 sets of data should fall above the warning limit. A test can be considered to be out of control when substantially more than 5 percent of the data fall above the warning limit and when data points fall above or below the control limits. In addition, any trend of data toward the control limits is disturbing. All procedure variables should be checked when such a trend is observed to ensure that the limits are not exceeded.

When an out-of-control situation occurs, analyses must be stopped until the problem has been identified and resolved, after which the frequency should be increased for the next few percent-recovery QC checks. The

problem and its solution must be documented, and all analyses since the last in-control point must be repeated or discarded.

A final note of caution regarding use of a single percent-recovery control chart over a broad concentration range is necessary. While good linear relationships usually hold for moderate or high concentration levels this may not be true at very low concentration levels. As a result, for some parameters, it may be necessary to develop separate percent-recovery charts for low concentration levels.

ADDITIONAL ROUTINE QUALITY CONTROL PRACTICES

In addition to the foregoing formal quality control program, certain other practices must be included during routine analyses by the laboratory to eliminate determinate errors and to ensure the quality of the data. These practices include: instrument calibration and performance checks, preparation, and daily check of calibration curves, method blank analyses, and field blank analyses. Some of these operations are common to all analytical methods and some are unique to specific methods.

1. Operations Common to all Methods

- a. Standard Curve - Prior to the analysis of samples, a standard curve that covers the entire working range of the method must be constructed with at least five standards, including one near the upper limit of the concentration range and one near the lower limit of the concentration range. The other standards should be equally spaced throughout the operating concentration range.¹

Each day, if operation is continuous, or prior to analyzing each group of samples, if operation is non-continuous, analyze a minimum of two standards to establish the

¹Every working standard curve prepared shall be assigned a unique serial number.

validity of the original standard curve. These standards should represent the range of the standard curve, i.e., one above and one below the midpoint of the standard curve. If these standards fall outside the established limits, a new standard curve must be constructed. These limits should be established by the analyst as a part of his ongoing quality control program.

- b. Method Blank - A method blank must be determined for each set of samples analyzed and whenever a new source (new container) of reagent or solvent is introduced into the analytical scheme. (NOTE: The individual solvents and reagents should be checked for purity prior to use in determining the method blank of in the analysis of _____ samples.)

To determine the method blank, take a quantity of reagents equivalent to that used in the analysis of the sample and carry them through the entire analytical procedure including all glassware and other materials that come into contact with the sample. Determine a method blank for each class of compounds to be determined.

Reagents having background levels that interfere with the compounds to be determined must be purified and shown to be acceptable or replaced with some that are acceptable prior to proceeding with the analyses. Problems encountered and corrective actions taken should be reported to the responsible authority for information and possible resolution of problems encountered by other analysts.

- c. Field Blanks - A field blank should be analyzed with each set of samples from a given source. This is particularly important whenever automatic samplers are

used for collection of samples. The blanks must be analyzed in the same manner as the sample.

When interferences occur, the analytical results must be discarded unless sufficient data from these blanks is available to permit correction of the results.

2. Equipment Maintenance

A. Maintain equipment inventory

1. Update semi-annually
2. Record to include equipment generic name, number of units, make/model, age/condition, function (field or lab), and location

B. Field equipment

1. Check-out/check-in: record dates, responsible person(s), project number, and where going.
2. When item is returned--clean and check performance before putting away.
3. Repair as required.

C. Prepare and keep current a maintenance/calibration log for equipment listed

1. Record should include: date, condition observed, action taken and result, also include such things as gain settings, detection limits, noise levels, etc.
 - a. Balances--check with standard weight set monthly
 - b. Incubators and ovens--check thermometers temperature settings, and water levels weekly
 - c. Autoclave--temperature/pressure quarterly
 - d. TOC--gain/tune settings daily
 - e. UV-Vis spectrophotometer--wavelength check semi-annually

- f. A.A.--detection limits daily, check compressed air filters quarterly
- g. Color comparator--check against standard solution semi-annually
- h. Turbidimeter--new standards annually
- i. Refrigerator and cold room temperature check monthly
- j. Miscellaneous meters pH, specific ion, DO, cond.

3. Miscellaneous

- A. Keep standby electrodes immersed in water do not allow to dry out
- B. Check conductivity of D.I. water weekly

t TEST

In order to determine whether a set of measurements is statistically comparable to a standard value, such as when a standard sample is being analyzed a statistic called the t Test is employed. This test can be used for evaluating data sets of up to 30 samples. The procedure involves the calculation of the test statistic t and comparison of the calculated value of t with a tabulated t value, which is a function of both the number of data points being considered and the confidence level. Table 3 presents a list of the critical values of t at various confidence levels. The confidence level is indicated by the subscript. Thus, $t_{.050}$ is the value of t at the 95 percent confidence level, while $t_{.010}$ represents the 99 percent confidence interval and so on. A calculated value of t in excess of the tabular value indicates that there are grounds for assuming that a difference exists in the data being compared at the confidence level of the t value being used. The procedures are as follows: to determine whether a series of analyses on a standard sample give results that are comparable to the standard, a data set is compared with a theoretical value by using the t test. The equation for calculating t is:

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$$

where

\bar{x} = the average of the data set

s = the standard deviation of the data set

n = the number of data points, and

μ = the value to which the data set is being compared

As long as the absolute value of t is less than the tabulated value of t , x , and μ can be assumed to be the same.

Example:

The following values were obtained on the analysis of a standard COD sample with a concentration of 220 mg/l. Is it reasonable to assume that the analyses are consistent with the standard value?

Data: $x = 189, 200, 230, 204, 215, 198, 210, \text{ and } 240.$

The average value of x is 211.

The standard deviation s is 17.1.

$$n = 8$$

$$\mu = \text{the standard concentration, } 220$$

$$t = \frac{211 - 220}{17.1/\sqrt{8}} = -1.49$$

Go to Table 3.

An examination of Table 3 shows that the calculated t value (-1.49) when compared to the table values is sufficiently small to prevent rejection of the assumption of comparability at confidence levels as low as 95 percent. In other words, there is a high probability that the test results are the same as the standard and the analytical technique (COD test) can be assumed to be under control.

The t test can be used to determine whether or not a nonstandard method of analysis yields values which are consistent with the standard method and should be used to validate all nonstandard methods or variants.

OUTLINE OF A COMPREHENSIVE QUALITY ASSURANCE PROGRAM

In the following discussion the symbols used represent the results of analysis according to the scheme:

- A₁ = first replicate of sample A
- A₂ = second replicate of sample A
- B = sample taken simulatneously with sample A
- B_{SP} = field spike into sample B
- B_{SL} = laboratory spike into sample B
- D_F = field spike into distilled water
- D_L = laboratory spike into distilled water
- T = true value for all spikes

The laboratory spikes B_{SL} and D_L are the only analyses that may not be necessary. All other analyses must be done simultaneously.

Steps for the Field Personnel

A comprehensive quality assurance program would include the following steps for each parameter in the monitoring study:

- a. Take independent simultaneous samples A and B at the same sampling point. Depending on the parameter, this might involve side-by-side grab samples or composite samplers mounted in parallel.
- b. Split sample A into the equal-volume samples A_1 and A_2 .
- c. Split sample B into equal volumes and add a spike T to one of them; the latter sample becomes sample B_{SF} . As with all spikes, the addition of T should approximately double the anticipated concentration level.
- d. Add the same spike T to a distilled water sample furnished by the laboratory and designate this sample as D_F .

These QC samples must be treated in the same way as routine samples; i.e., the volume, type of container, preservation, labeling, and transportation must be the same for all.

Steps for the Laboratory

The laboratory personnel should perform the following steps for quality assurance:

- a. Analyze the blank and midpoint standards. If results are unsatisfactory, resolve problems before continuing.
- b. Analyze sample D_F . If the percent recovery of T is unsatisfactory, create a similarly spiked, distilled-water sample D_L and analyze to test for a systematic error in the laboratory for fundamental problems with the spike. If the percent recovery of T from D_L is satisfactory, any systematic error occurred before the samples reached the laboratory.
- c. Analyze samples B and B_{SF} . If B is below the detection limit, or if B is greater than $10T$ or less than $0.1T$, disregard

the remainder of this step and proceed to step d. If the percent recovery of T from B_{SF} is unsatisfactory, spike an aliquot of sample B the same way in the laboratory so that a similar recovery can be anticipated. Analyze this sample B_{SL} to test for immediate sample interferences or a bad background result B. If the percent recovery from B_{SL} is satisfactory, then the interference must require a longer delay before analysis, or other special conditions not present in the laboratory, in order to have a noticeable effect upon recovery of the spike.

- d. Analyze A_1 and A_2 . If the absolute (unsigned) difference between these results exceeds the critical value, then precision is out of control.
- e. Calculate the absolute difference between A_1 and B. If it is unsatisfactory, the field sampling procedure did not provide representative samples.

If initial results at each of the laboratory steps were satisfactory, then the validity of the related data has been indisputably established. If results at any step are unsatisfactory, resolution depends upon the problem identified. Laboratory problems may just require that the analyses be repeated, but field problems will usually require new samples. Figure 2 is intended to clarify the interdependence of the preceding laboratory steps b through e.

In Figure 2 it must be noted that there is not way to identify additive sample interferences; i.e., those that have an equal effect upon the background-plus-spike results (B_{SF} or B_{SL}) and the background result B. Recovery of a spike will not show such interferences.

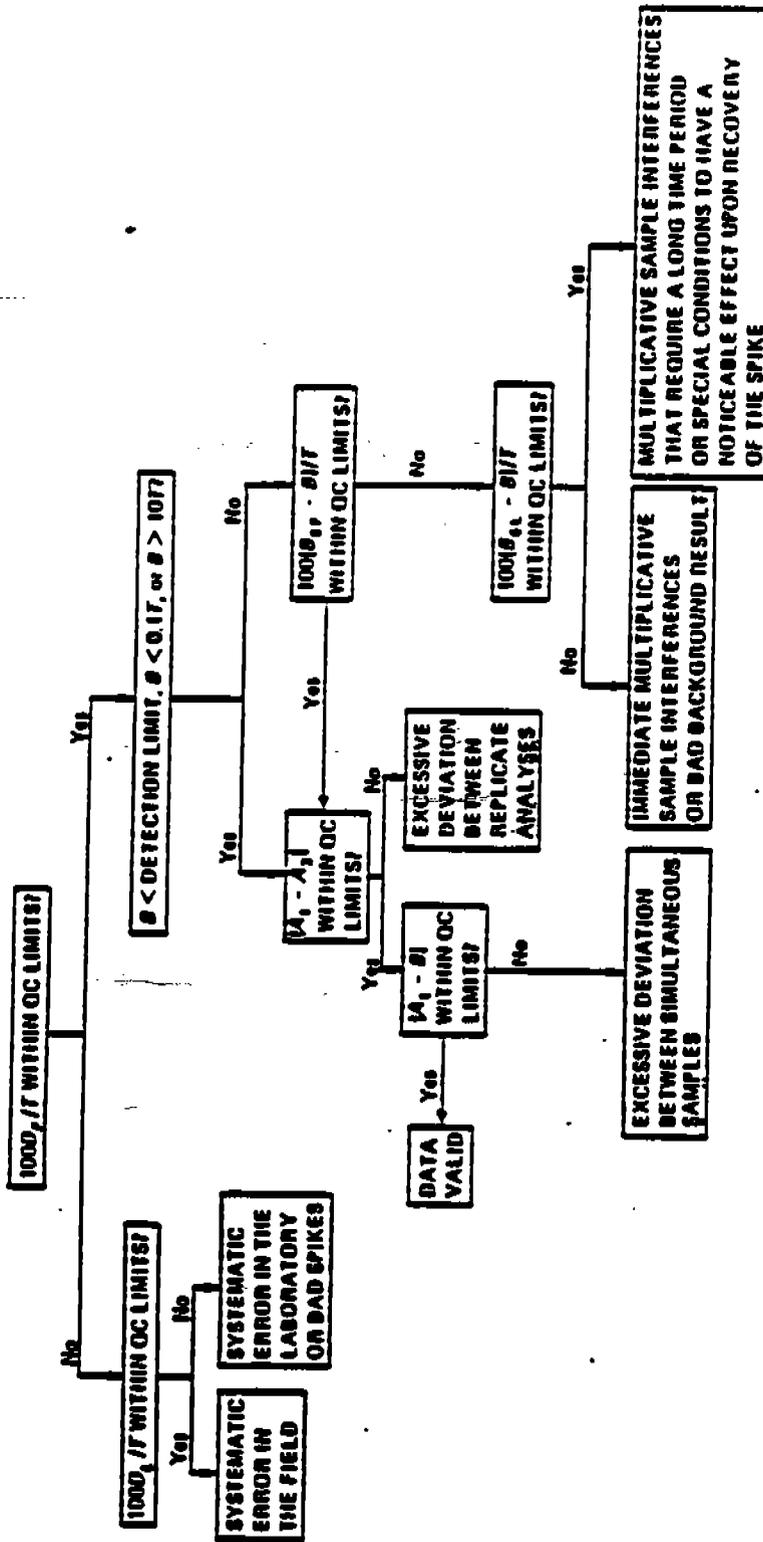


Figure 2. Procedure for evaluating QC data from a monitoring study.

Table 1
 SHEWHART UPPER CONTROL LIMITS (UCL) AND CRITICAL
 RANGE R_c VALUES FOR THE DIFFERENCE BETWEEN
 DUPLICATE ANALYSES WITHIN SPECIFIC CONCENTRATION
 LEVELS FOR THREE PARAMETERS .

Parameter	Concentration Level	UCL	R_c
BOD, 5-day (mg/l)	1 to <10	3.40	3.5
	10 to <25	6.34	6
	25 to <50	10.9	11
	50 to <150	21.3	21
	150 to <300	36.3	36
	300 to <1,000	39.6	40
	1,000 up	579	579
Chromium ($\mu\text{g/l}$)	5 to <10	1.05	1
	10 to <25	1.86	2
	25 to <50	3.66	4
	50 to <150	12.4	12
	150 to <500	249	249
Copper ($\mu\text{g/l}$)	5 to <15	3.04	3
	15 to <25	4.41	4
	25 to <50	3.73	5
	50 to <100	7.62	8
	100 to <200	9.19	9
	200 up	14.9	15

Table 2
 CRITICAL RANGE VALUES FOR VARYING CONCENTRATION LEVELS

Parameter	Duplicates	R	R_c	$R < R_c$	Condition of System
BOD (mg/l)	20 and 24	4	6	Yes	Normal
Chromium ($\mu\text{g/l}$)	60 and 75	15	12	No	Out-of-control
Copper ($\mu\text{g/l}$)	46 and 51	5	15 ^a	Yes	Normal

^aThis R_c value is used because $(46 + 51)/2 = 48.5$, which is between 25 and 50.

Table 3
CRITICAL VALUES OF t

<u>n</u>	<u>t_{0.05}</u>	<u>t_{0.025}</u>	<u>t_{0.01}</u>	<u>t_{0.005}</u>	<u>t_{0.001}</u>	<u>d.f.^a</u>
2	3.078	6.314	12.706	31.821	63.657	1
3	1.886	2.920	4.303	6.965	9.925	2
4	1.638	2.353	3.182	4.541	5.841	3
5	1.533	2.132	2.776	3.747	4.604	4
6	1.476	2.015	2.571	3.365	4.032	5
7	1.440	1.943	2.447	3.143	3.707	6
8	1.415	1.895	2.365	2.998	3.499	7
9	1.397	1.860	2.306	2.896	3.355	8
10	1.383	1.833	2.262	2.821	3.250	9
11	1.372	1.812	2.228	2.764	3.169	10
12	1.363	1.796	2.201	2.718	3.106	11
13	1.356	1.782	2.179	2.681	3.055	12
14	1.350	1.771	2.160	2.650	3.012	13
15	1.345	1.761	2.145	2.624	2.977	14
16	1.341	1.753	2.131	2.602	2.947	15
17	1.337	1.746	2.120	2.583	2.921	16
18	1.333	1.740	2.110	2.567	2.898	17
19	1.330	1.734	2.101	2.552	2.878	18
20	1.328	1.729	2.093	2.539	2.861	19
21	1.325	1.725	2.086	2.528	2.845	20
22	1.323	1.721	2.080	2.518	2.831	21
23	1.321	1.717	2.074	2.508	2.819	22
24	1.319	1.714	2.069	2.500	2.807	23
25	1.318	1.711	2.064	2.492	2.797	24
26	1.316	1.708	2.060	2.485	2.787	25
27	1.315	1.706	2.056	2.479	2.779	26
28	1.314	1.703	2.052	2.473	2.771	27
29	1.313	1.701	2.048	2.467	2.763	28
30	1.311	1.699	2.045	2.462	2.756	29
inf	1.282	1.645	1.960	2.326	2.576	inf

^ad.f. = degrees of freedom.

REFERENCES

1. "Handbook for Analytical Quality Control in Water and Wastewater Laboratories," March, 1979. U.S. Environmental Protection Agency, Cincinnati, Ohio 45268, EPA-600/4-79-019
2. "Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants," April 1978, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, 45268.
3. Budde, W. L., and Eichelberger, J.W., U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, 45268.
4. Eichelberger, J. W., Harris, L.E., and Budde, W. L., Anal. Chem. 47, 995 (1975).
5. "Standard Methods for the Examination of Water and Wastewater," 15th Edd., American Public Health Association, Washington, D.C. (1980).
6. "Wastewater Sampling for Process and Quality Control." Manual of Practice No. OM-1. Water Pollution Control Federation, Washington, D.C. (1980).

APPENDIX D

GUIDELINES FOR GROUNDWATER MONITORING WELL INSTALLATION

SOUTHERN DIVISION NAVAL FACILITIES
ENGINEERING COMMAND

GUIDELINES FOR GROUNDWATER MONITORING
WELL INSTALLATION

PART 1: GENERAL

1.1 Introduction

Groundwater monitoring wells shall be located at sites approved by the Southern Division Engineer-In-Charge (EIC) and the Activity Environmental Coordinator (EC). All applicable local, state and federal regulations concerning well installations or soil borings shall be followed.

1.2 Applicable Publications

The publications listed below form a part of this guideline to the extent referenced. The publications are referred to in this text by designation only. The latest revision of the specifications shall be followed.

1.2.1 American Association of State Highway and Transportation Officials (AASHTO)

<u>Document No.</u>	<u>Title</u>
M 220	Epoxy Coatings Specifications

1.2.2 American Society of Testing and Materials (ASTM)

<u>Document No.</u>	<u>Title</u>
A 120	Pipe, Steel, Black and Hot-dipped, Zinc coated, welded and seamless
A 312	Seamless and Welded Austenitic Stainless Steel Pipe
B 209	Aluminum and Aluminum-alloy Sheet and Plate
C 150	Portland Cement
C 778	Standard Sand
D 1457	Polytetrafluoroethylene (PTFE) Molding and Extrusion Materials

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<u>Document No.</u>	<u>Title</u>
D 1785	Standard Specification of Polyvinyl Chloride Pipe (PVC Pipe, Schedules 40, 80, 120)
D 1586	Method for Penetration Test and Split Barrel Sampling of Soils
D 1587	Practice for Thin Wall Tube Sampling of Soils.
D 2113	Diamond Core Drilling for Site Investigation
F 480	Thermoplastic Water Well Casing, Pipe and Couplings Made in Standard Dimension Ratios
F 883	Padlocks

1.2.3 American Petroleum Institute (API)

<u>Document No.</u>	<u>Title</u>
13-A	Oil Well Drilling Fluid Specifications

1.3 Submittals

1.3.1 A completed "Southern Division Naval Facilities Engineering Command Groundwater Monitoring Well Installation Report" will be submitted for each well installation.

1.3.2 Certificates of Conformance: A certificate of conformance shall be provided to the EIC for any of the items below that are used in a well installation. The certificate shall describe in detail how the material meets or exceeds the required specifications for the following, as appropriate:

- | | |
|-------------------|---------------------------------|
| a) Casing | i) Well Protective Cover |
| b) Screen | j) Flush Mount Protective Cover |
| c) Grout | k) Padlock |
| d) Drilling Mud | l) Protective Post |
| e) Gravel Pack | m) Well Designation Sign |
| f) Caps and Plugs | o) Epoxy Paint |
| g) Centralizers | |
| h) Surface Casing | |

1.4 Delivery and Storage

All materials shall be delivered in undamaged condition, stored in accordance with manufacturer's recommendations (off the ground) and protected from the weather in an area designated by the EC. All defective or damaged material will be replaced with new material at no cost to the government.

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PART 2: PRODUCTS

2.1 All materials shall conform to the respective specifications and other requirements as specified herein.

2.1.1 Well Casing

Material type will be approved by the EIC. The material provided will have adequate strength to resist external forces both during and after installation. The casing threads shall be compatible with the screen listed in 2.2.2. Markings, writing or paint strips are not allowable on any of the materials. The casing shall conform to the specifications listed below.

- a. PVC, flush threaded joints (schedule 40) ASTM F480 and ASTM D1785

All PVC flush threaded joints will meet or exceed the water pressure ratings (at 73 degrees Fahrenheit) for the size and schedule of PVC pipe used in the project, as listed in ASTM D1785: Table XI.2.

- b. Polytetrafluoroethylene (PT-E), flush threaded joints, ASTM D1457

Virgin materials shall be used to meet the ASTM specification. Certification of compliance and joint evaluation are required. Shall be shipped in sealed containers that are capable of preventing contact with any foreign substances. PTEF "O" rings are required to seal all joints.

- c. 316 stainless steel, flush threaded joints, ASTM A312
- d. 304 stainless steel, flush threaded joints, ASTM A312

End fittings shall be double entry flush screw threads. The casing shall be cleaned prior to delivery in the following manner: 5-minute immersion in static bath of dilute acid, pressure wash with detergent and cool water, rinse with warm water and allow to air dry.

2.1.2 Well Screen

Material type will be approved by the EIC. The material provided will have adequate strength to resist external forces both during and after installation. Water velocity through the screen openings shall not exceed 0.1 feet/sec. The opening size will be determined from an analysis of the material in geologic formation to be screened and/or the size of the filter pack material. Markings, writing or paint strips are not allowable on any of the materials. The screens shall conform to the specifications listed below.

- a. PVC, flush threaded joints (schedule 40), slotted, ASTM F480 and ASTM D1785

Two inch I.D. screens will have 3 rows of slots with a spacing of 1/8 inch between slots. Four inch I.D. screens will have six rows of slots with a spacing of 1/8 inch between slots. All PVC flush threaded joints will meet or exceed the

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water pressure ratings (at 73 degrees Fahrenheit) for the size and schedule of PVC pipe as listed in ASTM D1785, Table XI.2.

- b. Polytetrafluoroethylene (PTFE), flush threaded joints, slotted, ASTM D1457

Virgin materials shall be used to meet the ASTM specification. Certification of compliance and joint evaluation are required. Shall be shipped in sealed containers. PTFE "O" rings will be used to seal all joints.

- c. 316 stainless steel, wire wrapped, flush threaded joints, ASTM A312
- d. 304 stainless steel, wire wrapped, flush threaded joints, ASTM A312

The well screen shall be of a continuous slot, wire wound design. It shall be fabricated by circumferentially wrapping a triangularly shaped wire around a circular array of internal rods. The configuration must produce sharp outer edges, widening inward. PTFE "O" rings will be used to seal all joints. End fittings will be welded to the screen body.

2.1.3 End Plugs

The end plug shall be flush threaded and shall be constructed of the same type of material selected for the screen or casing above. All ASTM specifications that apply to the screen and casing materials shall apply to the end plugs. Markings, writing or paint strips are not allowable on any of the above materials.

2.1.4 Well Caps

The well cap shall be flush threaded and be constructed of the same type of material selected for the casing above. All ASTM specifications that apply to the casing materials shall apply to the well caps. Markings, writing or paint strips are not allowable on any of the above materials.

2.1.5 Adjustable Centralizers

The centralizer shall be capable of maintaining the casing and screen straight and plumb in the borehole during well installation. The material type shall be the same type of material selected for the casing/screen above. No solvents or glues will be used.

2.1.6 Annular Space Fill Materials

- a. Filter pack shall be 98% pure silica, cleaned with potable water, have a uniformity coefficient of 1-3, and a specific gravity of 2.6 - 2.7. The filter pack shall meet ASTM C 775 standard sand specifications.
- b. 1/4-inch bentonite pellets shall be 90% montmorillonite clay, with a bulk dry density 80 lbs/cu ft, a specific gravity 1.2, and a pH of 8.5-10.5.

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- c. Granular bentonite shall conform to API std 13-A for bentonite. -
- d. Portland Cement shall conform to ASTM C 150 Type I.

2.1.7 **Surface Casing:** shall be constructed of steel meeting ASTM A 120 and shall have a wall thickness as specified below.

- a. 24 inch diameter 0.25 inch wall thickness
- b. 20 inch diameter 0.25 inch wall thickness
- c. 16 inch diameter 0.25 inch wall thickness
- d. 10.75 inch diameter 0.25 inch wall thickness
- e. 24 inch diameter 0.50 inch wall thickness
- f. 20 inch diameter 0.50 inch wall thickness
- g. 16 inch diameter 0.50 inch wall thickness
- h. 10.75 inch diameter 0.365 inch wall thickness

2.1.8 **Surface Completion:** all materials provided for a well surface completion shall conform to the specifications listed below.

- a. Locking 16-gauge steel protective well cover, round or square and 5-ft in length
- b. Flush mount 22-gauge steel, water resistant welded box with 3/8-inch steel lid, locking device and padlock guard
- c. Concrete pad at ground surface (3' X 4' X 6") ASTM C 150
- d. Padlock (brass, corrosion resistant, keyed alike) ASTM F 883
- e. Steel protective post (4-inch diameter, 6-ft length, 1/4-inch thickness, concrete filled) ASTM A 120.
- f. Well designation sign, sheet aluminum, ASTM B 209, 1/8 inch by 18 inch by 6 inch, anchors and fasteners compatible with sign, designation to be provided by EIC, the designation shall be stamped into the plate with 4-inch letters and numbers.
- g. High visibility yellow epoxy paint AASHTO M220.

PART 3: EXECUTION

3.1 Drilling Method

The proposed drilling method must be approved by the EIC. Hollow-stem auger methods will be given first preference, rotary methods second and any other methods will require detailed evaluation by the EIC and written approval.

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3.2 Well Installation

Well depths, length of screen and sump will be determined on a site specific basis with approval of the EIC. Screen lengths will be limited to 10 feet unless longer lengths are specifically approved in writing by the EIC. Two inch well diameters will be specified for shallow well installations. Deeper well installations or wells that will be converted to recovery wells may require four inch wells. Recovery well specifications will be approved by the EIC.

Well installation shall follow commonly accepted professional drilling procedures. The borehole will be logged by a qualified geologist/hydrogeologist as drilling proceeds. The minimum qualifications are those describing a "Geologist-in-Training", as described in Article 1, Chapter 23, Title 1, Code of Laws of South Carolina: Rules of the South Carolina State Board of Registration for Geologists. Soil samples shall be collected according to one of the following methods: ASTM D 1586-Method for Penetration Test and Split Barrel Sampling of Soils or ASTM D 1587-Practice for Thin Wall Tube Sampling of Soils. Consolidated Rock will be sampled according to ASTM D2113 Diamond Core Drilling for Site Investigation.

Gravel pack, seals, and grout will be installed using tremie methods. Bentonite seals shall be allowed to hydrate the time period specified by the manufacturer. Accurate measurements shall be made to the top of the gravel pack and seals with a weighted steel tape and adjusted to reflect the top of casing.

If water is used in the drilling process, a sample shall be collected from the source and analyzed for the parameters specified in the investigation. Results will be included in the investigation report.

3.3 Well Development

Well development shall commence no sooner than 24 hours after placement of the grout. The development method shall be approved by the EIC. The selected method shall be capable of removing all drilling fluids and cuttings from inside the well, within the gravel pack and from within the formation. The development method shall not introduce any type of contamination into the aquifer. Introduction of outside water to the well shall be minimized. Any water introduced into the well shall be recovered to the maximum extent possible. A written report will be required describing the reasons why any introduced water could not be recovered.

The development process should result in wells that are sediment free. A well that produces turbid water (as defined by the Safe Drinking Water Act PL 93-523) may be rejected by the EIC.

3.4 Material Disposal

All borehole cuttings and development water will be contained in - DOT 17-C Open-top 55-gallon drums, permanently labeled by well number and stored in a location designated by the EC. The material will be handled as hazardous waste until laboratory results are reviewed and certification of the waste is submitted to

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the Navy. This requirement may be waived if approval is given in writing by the EIC. The material may then be disposed of as normal solid waste if it does not exceed any state or federal regulatory limits for the type of waste in question. The Navy will be responsible for disposal of all waste unless other direction is given by the EIC.

3.5 Decontamination

All down-hole drilling equipment (the drill rig, tools, etc.) will be decontaminated according to the approved Quality Control Plan prior to beginning work, between each well location and after the last well is completed. The drill rig will be placed on 10-mil polyethylene sheeting at each drilling site to contain any spillage or leaking of hydraulic fluid or fuel. All of the decontamination waste will be handled according to section 3.4 above.

3.6 Well Protection

A steel, hinged, locking protective casing will be installed within a 3-ft by 4-ft by 6-inch thick concrete pad. The pad will be set level and 4-inches below grade. The pad shall be installed so that surface runoff does not pond around the well casing and protective cover. The concrete mix shall obtain a minimum 28-day compressive strength of 3000 pounds per square inch.

If designated by the EIC, four steel protective posts will be installed 0.5 ft from the corners of the pad but not set within the pad. The post will be 6-ft in length, 4-inch in diameter and have a wall thickness of 0.25-inch. The post will be filled with concrete and set three feet below grade in a 10-inch diameter hole with concrete backfill (as above).

The protective casing and any protective post installed shall be cleaned, primed and then painted with two coats of high visibility yellow epoxy paint that meets the specifications of AASHTO M 200. The protective casing will be locked with a Type Pol (Key Operated), Option E (Corrosion Resistant) padlock that conforms to ASTM F 883. When multiple wells are installed, the padlocks for each well at an activity shall be keyed alike. The original and two copies of all keys shall be delivered to the EIC and two copies shall be delivered to the EC. All keys shall be tested to ensure performance prior to delivery.

3.7 Well Designation

A permanent well designation sign will be attached to the protective casing. The sign shall be a 18-inch by 6-inch by 1/8-inch thick sheet aluminum plate, bolted to 1/4-inch studs welded to the casing. The sign shall be stamped with 4-inch letters and numbers in accordance with the numbering system in section 4.0 of this specification.

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PART 4. INSTALLATION RESTORATION PROGRAM WELL NUMBERING SYSTEM

The purpose of this well numbering system is to locate a particular well by activity, key it to the Initial Assessment Study (IAS) and sequentially number each well at each site. The EIC will provide designations for sites not included in the IAS.

Example: CEF-1-1 Cecil Field, Site 1, Well number 1
 KYW-5-8 Key West, Site 5, Well Number 8

FLORIDA

Cecil Field	CEF
Ft. Lauderdale	FLD
Key West	KYW
NavHosp Key West	KWH
Homestead	HST
Jacksonville	JAX
Mayport	MPT
Panama City	PCY
Whiting Field	WHF
Andros Island	AIS
Pensacola	PEN
Saufley	SFY
Correy Station	CRY
Orlando	OLD

GEORGIA

Albany	ALB
Atlanta	ATL
Kings Bay	KBA
Athens	ATH

SOUTH CAROLINA

Parris Island	PAI
Beaufort	BFT
NavHosp Beaufort	BFH
NWS Charleston	NWS
NS Charleston	CSY

LOUISIANA

NAS New Orleans	NOA
NSA New Orleans	NOS

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MISSISSIPPI

Gulfport	GPT
NavHome Gulfport	GPH
Meridian	MRD

TENNESSEE

Memphis	MPH
Bristol	BRT

TEXAS

Corpus Christi	CCT
Chase Field	CAF
Kingsville	KVE
NAS Dallas	DNA
NWIRP Dallas	DWP
McGregor	MGR