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THE MEMPHIS DEPOT
TENNESSEE

ADMINISTRATIVE RECORD
COVER SHEET

AR File Number 127

Generic Quality Assurance Project Plan

for

Defense Distribution Depot Memphis

Prepared for

Huntsville Division Corps of Engineers
Huntsville, Alabama

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Introduction

In October 1992, the Defense Depot Memphis, Tennessee (DDMT), was placed on the National Priorities List (NPL) by the U.S. Environmental Protection Agency (EPA). Therefore, DDMT must fulfill requirements under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and National Contingency Plan. A remedial investigation/feasibility study (RI/FS) must be prepared to determine the nature and extent of contamination, to evaluate the risk to human health and the environment, and to screen potential cleanup actions. The *Generic RI/FS Work Plan* was prepared to show how the investigation and study would be accomplished. This *Quality Assurance Project Plan* (QAPP) was prepared as a supplement to the *Generic RI/FS Work Plan* to describe the general sampling, laboratory, monitoring well installation, soil boring installation, and quality assurance/quality control (QA/QC) procedures that will be used during the RI/FS at DDMT.

Site Background and Location

DDMT covers 642 acres of land in Memphis, Shelby County, Tennessee, in the extreme southwestern portion of the state. The installation contains approximately 110 buildings, 26 miles of railroad track, and 28 miles of paved streets. Approximately 5.5 million square feet of storage space is open. Stored items include food, clothing, electronic equipment, petroleum products, construction materials, and industrial, medical, and general supplies.

Description of Operable Units (OUs)

DDMT is divided into four OUs for evaluation purposes. Dunn Field is designated OU-1. The Main Installation is divided into three areas: the southwestern quadrant, OU-2; the southeastern lakes and golf course area, OU-3; and the north-central area, OU-4. Substances found in OU-1 probably resulted from use of the area for landfill operations, mineral stockpiles, pistol range use, and pesticides storage. Potential contamination of OU-2 could have resulted from spills or releases from the hazardous material storage and repouring area, sandblasting and painting activities, or both. Storage of polychlorinated biphenyls (PCBs) and the use of pesticides and herbicides are potential sources of contamination for OU-3. Principal contamination in OU-4 probably resulted from a wood treatment operation and hazardous material storage.

Description of QAPP

This QAPP was prepared as a supplement to the *Generic RI/FS Work Plan* to provide quality assurance and quality control requirements for sampling activities, and other types of field analyses and tests that generate data as part of the activities performed during the RI/FS process at DDMT. The goal of this plan is to provide data of known quality to the project team to support the project decision-making process. The requirements of this plan apply to the primary contractor, as well as to subcontractors.

This plan addresses the following:

- QA/QC objectives for the project
- Discussion of the QC levels and applicability of each
- Specific QA/QC procedures that will be implemented to achieve these objectives
- Project team organization and responsibility

The contractor's internal QA programs will control other project aspects, such as engineering analysis and report preparation. Laboratory activities (either onsite or fixed-base analytical laboratories) will be covered by the Laboratory Comprehensive Quality Assurance Manual.

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Acronyms

ASTM	American Society for Testing and Materials
bgs	Below ground surface
BRA	Baseline risk assessment
CEHND	Corps of Engineers, Huntsville Division
CEMRD	Corps of Engineers Missouri River Division
CEWES	Corps of Engineers Waterways Experiment Station
CFR	*Code of Federal Regulations*
CLP	Contract Laboratory Program
COC	Chain-of-Custody
COE	Corps of Engineers
CompQAM	Comprehensive Quality Assurance Manual
CPR	Cardiopulmonary resuscitation
CSL	Close support laboratory
DDIS	Detailed Data Inventory Sheet
DDMT	Defense Depot Memphis, Tennessee
DE	Disposable equipment
DOT	Department of Transportation
DQE	Data quality evaluation
DQO	Data quality objective
DRMO	Defense Reutilization and Marketing Office
E-Data	Electronic data
EMIS	Environmental Management Information System
EPA	U.S. Environmental Protection Agency
FID	Flame ionizing detection
FSP	Field Sampling Plan
FTL	Field team leader
GC	Gas chromatograph
GC/MS	Gas chromatograph/mass spectrometer
HSA	Hollow stem auger
HASP	Health and Safety Plan
HW	Hazardous waste
ID	Inside diameter
IFF	Interchange File Format
MLGW	Memphis Light, Gas, and Water
MR	Mud rotary
MS/MSD	Matrix spike/matrix spike duplicate
MW	Monitoring well
NCP	National Contingency Plan
NIST	National Institute of Standards and Technology
NRC	Nuclear Regulatory Commission
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
OU	Operable unit

Acronyms (cont'd)

OVA/PID	Organic vapor analyzer/photoionization detector
PAH	Polycyclic aromatic hydrocarbon
PARCC	Precision, accuracy, representativeness, completeness, and comparability
PCB	Polychlorinated biphenyl
PCP	Pentachlorophenol
PM	Project Manager
PPE	Personal protective equipment
ppm	Parts per million
psi	Pounds per square inch
PVC	Polyvinyl chloride
QA/QC	Quality assurance/quality control
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RD	Rotasonic drilling
RFA	RCRA Facility Assessment
RI/FS	Remedial investigation/feasibility study
RPD	Relative percent difference
RTL	Review team leader
SDG	Sample delivery group
SOP	Standard operating procedure
SOW	Statement of Work
SSC	Site safety coordinator
STB	Stratigraphic test boring
STP	Sample Tracking Program
SVOC	Semivolatile organic compound
TAL	Target analyte list
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
TCL	Target compound list
TCLP	Toxicity characteristic leaching procedure
TDEC	Tennessee Department of Environment and Conservation
TIC	Tentatively identified compounds
VOC	Volatile organic compound
WR	Water rotary

TAB

1.0

1.0 Objectives of the Quality Assurance Project Plan

The purpose of this Defense Depot Memphis, Tennessee (DDMT) Generic Quality Assurance Project Plan (QAPP) is to describe the general sampling, laboratory, monitoring well installation, soil boring installation, and quality assurance/quality control (QA/QC) procedures that will be used during the Remedial Investigation/Feasibility Study (RI/FS) at DDMT. The procedures have been developed for the chemical data collection activities to provide data of sufficient quality and quantity to support the objectives of the RI/FS, and to provide careful planning of data collection and analysis activities to meet the stated data quality objectives that are consistent with the intended data uses.

The QAPP has been written in accordance with the current RI/FS guidance (ref. 21), the *Data Quality Objectives for Remedial Response Activities* (ref. 26), the *Guidelines and Specifications for Preparing Quality Assurance Plans* (ref. 27), and *EPA Region IV, Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual (ECBSOPQAM)* (ref. 31) to address aspects of the field investigations to be conducted as a part of the site characterization activities that are common to all operable units (OUs) at DDMT. References used for QAPP development are provided as Appendix A.

1.1 Project Objectives

The overall objectives of the RI/FS are to determine the nature and extent of the release of hazardous substances to the underlying aquifer system as a result of past disposal activities at DDMT, to identify the sources of release, and to evaluate the effectiveness of proposed remedies. The ultimate goal is to select cost-effective and implementable remedies that mitigate threats and provide protection for public health and the environment. During the RI, the data and data collection processes will be evaluated to monitor the support of the RI/FS objectives. That is, the data must be of sufficient quality and quantity that the distribution and migration of contaminants can be determined to satisfy the objectives of the RI. The data and conclusions drawn during the RI must support the screening and in-depth analyses of the remedial alternatives to be evaluated during the FS. To accomplish these tasks, confidence in field sampling procedures; data collection, analysis, management, and validation procedures; and QA activities are vitally important. Because these items are so important to the remedial decision-making process, a carefully considered approach to detailed QA procedures is necessary for success.

To characterize the sites and potential releases, DDMT will implement an extensive field sampling effort to identify and delineate the contaminants (in the groundwater, soil, surface water, and sediments) that may have resulted from past practices at sites where hazardous or toxic wastes were managed or disposed. A laboratory that has been validated by the Corps of Engineers' Missouri River Division (CEMRD) and that is a

participant in the U.S. Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) will be selected to perform the required chemical analyses. Split samples will be routinely provided to the CEMRD to comply with Corps of Engineers (COE) quality-control requirements and to the EPA- and Tennessee Department of Environment and Conservation (TDEC)-designated laboratories to meet EPA's requirements.

1.2 Objectives of Site Investigation Activities

The primary objective of this RI is to characterize the nature and extent of contaminants in soil, surface water, sediment, and groundwater. Additional data will be collected to supplement the previous RI/FS completed in 1990 by Law Environmental Inc., to evaluate the extent of groundwater contamination in the Fluvial Aquifer and to assess the potential for contaminant migration to the Memphis Sands Aquifer. This investigation will provide additional information for the baseline risk assessment (BRA) and the selection of appropriate remedial alternatives. Other general objectives of the RI include the following:

- Understand site geology and hydrogeology sufficiently to evaluate groundwater movement and to identify potentially affected aquifers.
- Collect a sufficient number of samples from areas surrounding the site unaffected by earlier activities to adequately evaluate background concentrations of target analytes.
- Collect samples that are representative of actual site conditions.
- Provide data of known quality by using approved sampling and analytical methods.

Specific site investigation details, along with sampling and analysis objectives, are discussed in the Field Sampling Plans (FSPs) for the OU in which the site is located.

1.3 Site Characterization Activities

Field investigations will be conducted under the guidance of this QAPP, the Health and Safety Plan (HASP), and the OU-specific FSPs, as well as any addendum that may be required for these plans. Proposed sample locations are identified in the FSPs and in site maps prepared for the particular OU to be investigated. Data management, field

sampling, and field and laboratory QA/QC activities will be conducted in accordance with the procedures outlined in the QAPP. The following field activities will be conducted:

- Install monitoring wells and soil borings.
- Collect and analyze soil, groundwater, surface water, sediment samples, and the appropriate QA/QC samples.

TAB

2.0

2.0 Project Organization and Responsibilities

2.1 Project Team Organization

The project team will be organized into contractor, COE, and offsite laboratory work groups. The contractor's group will consist of a project manager, a project hydrogeologist, a project environmental engineer, a project chemist, a review team leader, a database manager, and various support staff. The COE's group will consist of a project manager, a project engineer, a project geologist, a project industrial hygienist, a project environmental engineer, and a project chemist, who will develop work plans and scopes of work, oversee field performance, and review technical documents. The contractor group at the field site will consist of the field team leader (FTL), who will be onsite for all phases of the project; the field geologists; the safety officer and sampling team; and various support technicians. The laboratory work groups include the technical staff and QA/QC personnel at the laboratories. Additional project organization information will be provided upon selection of a contractor.

2.2 Key Personnel Qualifications and Responsibilities

2.2.1 Contractor Work Group

The personnel selected for the RI/FS will have the necessary qualifications to complete this complex project. Additional information will be provided later concerning specific qualifications.

In full compliance with the training requirements of Occupational Safety and Health Administration (OSHA) regulations (29 *Code of Federal Regulations* [CFR] 1910.120), all field personnel have received at least 40 hours of health and safety training, including first aid and cardiopulmonary resuscitation (CPR), and a minimum of 3 days actual field experience under the direct supervision of a trained experienced supervisor. The personnel positions and responsibilities listed below will be involved in the RI/FS.

Program Manager—The program manager is a senior level management person who coordinates all the project efforts for DDMT. As the direct contact between the COE and other program and project staff, the program manager will be responsible for negotiating and communicating contractual obligations, including program objectives, technical requirements, schedules, budgets, and deliverables. The program manager will coordinate all administrative and financial reporting, provide the COE with progress and financial reports, review all deliverables, and provide day-to-day coordinating with the COE.

Project manager (PM)—Responsible for overall activities for a specific project. The PM is responsible for cost and schedule control and for technical quality; in addition, he

or she will develop the work plan and monitor task order activities to ensure compliance with project objectives and scope. The PM also will communicate with the client and, as appropriate, other designated parties regarding project progress.

The PM has ultimate responsibility within CH2M HILL for producing deliverables that are technically adequate, satisfactory to the client, and cost-effective. To accomplish this, the PM assists the review team leader (RTL) in developing an internal project review schedule, provides written instructions and frequent guidance to the project team, and monitors budgets and schedules.

Review Team Leader—The RTL is generally a technical resource with experience in the various technical aspects involved in a complex project. The RTL coordinates internal QA/QC review for technical validity and adherence to both internal CH2M HILL policy and project-specific criteria. The RTL assists the PM in selecting an internal QA/QC review team and in coordinating review efforts, and works with the project team in addressing review comments and adjudicating technical disagreements.

Lead Hydrogeologist—This person is a technical specialist who is responsible for the technical aspects of the project concerning hydrogeology and who provides technical review and continuity of work between project tasks. His/her role includes selection of methodology, field procedures, and review of data analysis and reporting. He/she will be present at major meetings on decision points. The lead hydrogeologist will work closely with the lead engineer to develop and implement a field program that addresses the project objectives and provides technically sound data.

Lead Chemist—The lead chemist assists with the preparation of the project scoping documents, provides an interface between the laboratory and the project team, supervises the analytical data quality evaluation, and participates in preparing deliverables to the client. The lead chemist communicates regularly with the project team and the analytical laboratory during the field activities. The lead chemist also is responsible for monitoring project-specific laboratory activities (including checking laboratory invoices and reports) and may audit the laboratory at the PM's direction.

The lead chemist monitors so that specific QA and primary technical operations are coordinated effectively for the project. The lead chemist is responsible for the following:

- Performance and system audits of laboratory operations to evaluate compliance with the QAPP
- System audits of field operations to evaluate compliance with the QAPP
- Provision of guidance and coordination to rapidly resolve any QA/QC problems

- Independent review of QA/QC information to evaluate the quality of all deliverables or outputs from the project team

- Interaction and communication with COE QA personnel to resolve QA/QC problems specific to the project

Lead Risk Assessor—The lead risk assessor provides guidance and input into the RI/FS planning implementation stages, and directs the human health and ecological risk assessments for the project.

Remedial Design Engineer—The remedial design engineer will evaluate the data collected from the RI and direct sampling to be conducted for the FS activities. The remedial design engineer also will conduct a cost-benefit analyses and other FS activities to aid in evaluating remedial alternatives for the contaminated sites at the facility.

Lead Data Manager—Responsible for the structure, organization, format, implementation, and operation of the project database. The lead data manager supervises the data management team and provides direction to the database manager. The lead data manager, in conjunction with the PM, may decide to establish separate databases for each project task. The lead data manager is responsible for the following:

- Coordinating efforts between the project team and the database, including setting up the sample tracking program and providing instruction to field team members in its operation.

- Importing the analytical data into the project database.

- Doing a QC review of the data input into the database.

- Assisting project team members in using the database.

- Preparing the electronic deliverables to the client.

Database Manager—Works with the database on a daily basis and provides normal deliverables (for example, data summary tables) to the project team.

Field Team Leader (FTL)—Reports to the PM and will be responsible for the coordination of field efforts, provides for the availability and maintenance of sampling equipment and materials, and provides shipping and packing materials. The FTL will supervise completion of all chain-of-custody records, supervise the proper handling and shipping of samples, and be responsible for accurate completion of the field notebook. As the lead field representative, the FTL will be responsible for consistently implementing program QA/QC measures at the site and for performing field activities in accordance with approved work plans, policies, and field procedures.

Site Safety Coordinator (SSC)—The SSC oversees the administration of the project HASPs in the field. The SSC will assist in conducting site briefings and perform all final

safety checks. The SSC is responsible for stopping any investigation-related operation that threatens the health and safety of the field team or surrounding populace. Additional responsibilities are detailed in the HASP.

2.2.2 Laboratory Work Group

The selected laboratories will be responsible for screening and analysis of groundwater, soil, sediment, and surface water samples obtained during RI activities.

The chemical analysis supervisor serves as a liaison between field and laboratory operations and is responsible for the following:

- Receipt of sample custody from the field team members, verification of sample integrity, and transfer of sample fractions to the appropriate analytical departments
- Coordination of sample analyses to meet project objectives
- Preparation of analytical reports
- Review of laboratory data for compliance with method requirements
- Review of any QC deficiencies reported by the analytical department manager
- Coordination of any data changes resulting from review by the project QA supervisor or the PM
- Response to questions from the project team during the data quality evaluation process

2.3 Project Communication

One of the most critical elements in performing the RI/FS is to establish and maintain lines of communication among all project personnel. Some work groups will meet at least weekly to review the status of the project and to discuss technical and safety issues. When necessary, other meetings will be scheduled or the FTL will meet individually with field personnel or the subcontractors to resolve problems. The FTL will prepare a weekly report detailing project progress.

The FTL will be in regular telephone contact with the all work groups. When significant problems or decisions requiring additional authority occur, the FTL can immediately contact the PM or project hydrogeologist for assistance.

Daily and weekly reports, boring logs, QA reports, and other project information will be delivered by the field supervisor or other personnel on a daily basis or several times during the week.

All communications with DDMT will be channeled through the DDMT project manager, who will be informed of field activities being conducted on a daily basis.

All communications with the COE will be channeled through the Corps of Engineers, Huntsville Division (CEHND) project manager. The contractor will prepare monthly progress reports and submit telephone conversation records to the COE throughout the contract period.

TAB

3.0

3.0 Data Quality and Quality Assurance Objectives for Sampling

3.1 Introduction

This section presents the data quality objectives (DQOs) and QA objectives for the RI/FS sampling activities. DQOs are quantitative and qualitative statements that specify the quality of the data required to support decisions during the remedial response activities. They are based on the end uses of the data to be collected. The basis on which these objectives were established are discussed in the following sections. The criteria for evaluating data quality, precision, accuracy, representativeness, comparability, and completeness are presented in this section, along with the mechanisms that will be used to determine if they are met.

3.2 Establishing Data Quality Objectives

Objectives for data quality reflect the expected uses of the data, the expected levels of contamination, and the available analytical and sampling resources.

3.2.1 Data Uses

The primary uses of the data to be gathered during the DDMT RI sampling activities are as follows:

- Contaminant Characterization—Data will be used to describe the nature and extent of contaminants in the soil and groundwater at the site.
- Health and Safety—Air monitoring within the RI/FS work zones will be used to establish the level of protection needed for workers during the RI activities.
- Risk Assessment—Data will be used to evaluate the threat posed by the site to public health and the environment via the soil, groundwater, surface water, and air pathways.
- Evaluation of Alternatives—Soil chemistry and physical data will be collected and used to evaluate the feasibility of various remedial technologies.
- Engineering Design of Alternatives—Data such as preliminary volume estimates for contaminated soil and groundwater will be used for engineering design purposes and to determine the cost and performance of various remedial technologies.

3.2.2 Data Quality Levels

Data must be of sufficient quality to support the decision-making process. A tiered approach to sampling and analysis (including screening) will be used so that the field team can adjust the sampling effort to accommodate site-specific conditions. The tiered approach will be accomplished by screening a large number of samples for potential contamination using Level 2 data quality; then a selected number of samples will be submitted to an analytical laboratory for confirmation. Screening data will be used to provide sufficient sampling to evaluate the potential presence of target compounds at each site and to accomplish quantitation.

Four categories of data will be collected as part of this field effort, with each category having a different level of supporting QA/QC documentation. The four categories, or levels, correspond to QC levels 1, 2, 3, and 4. Level 1 includes field monitoring activities such as pH, temperature, conductivity, and total organic vapor monitoring. Level 2 screening activities and Level 3 analysis provide confirmation by an analytical laboratory. Level 4 analysis provides legally defensible data, if needed. For each QC level, the potential measures and methods to be used, as well as the applicable data package deliverables, are outlined below. For each site, the use and applicability for each of the available measures and methods will be evaluated and appropriate measures and methods selected. For example, the pH and conductivity of groundwater samples from all the screening sites will be measured; however, only soil samples from selected sites will be tested for VOCs.

3.2.2.1 Level 1—Field Surveys

Level 1 encompasses field monitoring activities and does not require formal data package deliverables. Level 1 activities are focused on easily measured bulk characteristics of a sample such as total organic vapors, or pH, temperature, and conductivity. Level 1 activities also include screening samples using immunoassay field methods for classes of compounds such as polycyclic aromatic hydrocarbons (PAHs) or polychlorinated biphenyl (PCBs) in soils.

CH2M HILL typically uses the data generated from field monitoring to make decisions about the execution of the investigation, such as approximating the relative degree and extent of contamination to assist the investigation activities, or providing a general sample screening before analysis by the analytical laboratory.

Immunoassay screening provides a yes/no approach to screening: either the target compound(s) is present at, or above, the reporting limit or it is not. These tests will be used to identify potential sources of contamination and may be used to estimate approximate areas for vertical and horizontal extent of contamination. Immunoassay screening kits use an antibody that is developed to have a high degree of sensitivity to the target compounds. This antibody's high specificity is coupled with a sensitive

colorimeteric reaction that provides a visual result. Immunoassay screening tests consist of four steps:

- **Sample Extraction**—An aliquot of soil is weighed and extracted with methanol.
- **Dilution of Sample and Standard**—The sample extract is diluted to the required detection level.
- **Immunoassay**—The sample and enzyme conjugate are introduced into antibody tubes and allowed to stand; then the tubes are washed, coloring agent is added, and the color is allowed to develop
- **Measurement and Interpretation**—The color of the sample is measured using the spectrophotometer and the sample results are compared to the standard results. This comparison provides an accurate semi-quantitative measurement of the specific contaminant of interest.

Immunoassay kits that will be used in the field for Level 1 screening include PCBs, PAHs, total petroleum fuel contamination, pentachlorophenol (PCP), and dioxins (2,3,7,8-Tetrachlorodibenzo-p-dioxin [TCDD]). Each of the immunoassay kits is described briefly below:

- **PCBs**—Recognizes all commercial Aroclors; the more highly chlorinated and most common (1260, 1254, and 1248) are detected at lower concentrations, as summarized in Table 3-1.

Table 3-1
Detection Limits for Aroclors in Soil
Defense Depot Memphis, Tennessee

Aroclor	mg/kg in soil
1260	0.4
1254	0.4
1248	1.0
1242	2.0
1232	4.0
1016	4.0

- **Total Petroleum Fuel Contamination**—This immunoassay responds to a selected subset of the chemical components in fuels, primarily aromatic and aliphatic compounds with fewer than 15 carbons. Because this test

responds to "petroleum products," it cannot be used to distinguish individual types or sources of fuel. Reporting limits for various fuels using this screening test are summarized in Table 3-2.

Table 3-2
Reporting Limits for Various Fuels Using the Total Petroleum Fuel Contamination Screening Test
Defense Depot Memphis, Tennessee

Fuel	Reporting limit in mg/kg
Gasoline	10
Diesel fuel, #2	15
Jet A fuel	15
Jet fuel, JP-4	15
Kerosene	15
Fuel oil, #2	15

- **PAHs**—This test is used to screen for 3- and 4-ring PAHs, which are indicative of petroleum contamination. The overall detection limit is 1 mg/kg.

- **PCP**—This test recognizes pentachlorophenol only and has a reporting limit of 0.5 mg/kg.

- **Dioxin**—This test is used to detect the presence of 2,3,7,8-TCDD only and has a reporting limit of 10 picograms/kg. The extraction for this screening test is more complex than the simple methanol extraction used for the other analyses; therefore, samples for dioxin screening will be sent to the analytical laboratory for extraction and screening.

Monitoring results, as well as pertinent data concerning the sampling event, are documented in a bound field book. Level 1 documentation will consist of the following:

- Instrument identification
- Calibration information (standards used and results)
- Date and time of calibration and sample measurement
- Sample results

The logbooks will be reviewed by the FTL daily for completeness and correctness. No additional documentation or data quality evaluation is required.

3.2.2.2 *Level 2—Screening Data*

Level 2 screening data will be used by the project team to make informed decisions in the field concerning implementation and execution of the work plan, as well as to evaluate whether a release has occurred and to estimate the extent of contamination. Level 2 data differ from Level 1 data in that Level 1 is used to measure "bulk" characteristics of a sample, while Level 2 analyses are used to estimate the concentrations of selected individual compounds.

Level 2 data quality will be used on this project to collect cost-effective (lower cost than Level 3) quality data for use in decision making and in the risk assessment. The level 2 data quality will be evaluated as outlined in Section 8 and the sample results will be confirmed using Level 3 data.

EPA-approved methods will be used to analyze Level 2 samples. Level 2 data quality samples will be analyzed using the same analytical techniques as Level 3 data. The difference between Level 2 and Level 3 will be the frequency and target acceptance windows for laboratory QA/QC samples. The same QA/QC samples will be analyzed for Level 2 as Level 3; however, the QA/QC samples may be analyzed less frequently with broader acceptance limits than with Level 3. For example, for VOCs or SVOCs by GC/MS, for Level 2 an instrument tune check sample will be analyzed once every 24 hours rather than once every 12 hours as required for Level C. A comparison of the Level 2 and Level 3 QA/QC requirements is provided as Appendix B.

Formal data package deliverables are not required for this level of data quality; however, all instrument calibration and sample analysis activities must be documented and this information retained by the laboratory. Data package deliverables may require summaries of laboratory performance information (such as calibration), but the laboratory must maintain all the corresponding documentation for at least 7 years. Data package deliverables will include instrument calibration, sample, method blank results, and matrix spike results. Example data packages will be included in the subcontractor documentation.

Confirmation is critical for samples that are determined by field screening to contain concentrations near the action levels. Approximately 10 percent of the samples will be submitted to an analytical laboratory for additional Level 3 confirmatory testing.

3.2.2.3 *Level 3—Laboratory Analyses*

The purpose of Level 3 data is to provide the basis for evaluating Level 2 data and for making decisions for further action, if needed, at each of the areas of investigation and to broaden the characterization of contaminants. The TCL has been designed to fully evaluate the potential for contamination from past site activities and to support a preliminary risk evaluation. Only EPA-approved methods from *SW-846, Test Methods for Evaluating Solid Waste* or EPA CLP methods will be used to analyze samples for

Levels 3 or 4. Level 3 data package deliverables include all the CLP-type QC summary forms, but none of the unreduced experimental data, (summarized in Table 7-1). Therefore, during the data quality evaluation process, it is possible to evaluate the effect of the overall analytical process on the usability of the data; however, it is not possible to recreate the details of the analytical process or sample calculations.

TCLs and reporting limits for Levels 2 and 3 data quality are included in Section 7.

Many of the OU-specific FSPs refer to Level 3 analyses as "TAL/TCL." This is a common usage way of referring to the CLP SOWs lists for organic and inorganic compounds. For this project, "TCL/TAL" refers to VOCs, SVOCs, pesticides, PCBs, metals, and cyanide, but does not refer to dioxins. For TCL/TAL analyses, the CLP target compound lists and reporting limits will be used.

3.2.2.4 Level 4—Laboratory Analyses

Level 4 analytical methods are the same as Level 3; the difference between the levels is in the data package deliverables. Level 3 deliverables include only the QC summary information (typically provided on the CLP QC summary forms or functional equivalents). Level 4 deliverables include the summary forms and all the unreduced, experimental data. Therefore, it is possible for Level 4 data to completely recreate the entire analytical process and recalculate all of the calibration and sample results. For Level 3, this information is summarized on the data sheets and used to evaluate laboratory performance and potential matrix interferences.

There is a potential for Level 4 data to be required in the future at this facility. Samples analyzed using Level 4 QC are analyzed using the same analytical methods as Level 3 samples, but different data package deliverables are provided, as discussed in this section. Confirmatory samples will be analyzed using Level 3 QC, and no Level 4 is proposed at this time. However, if in the future Level 4 information becomes necessary, this information will be requested from the analytical laboratory.

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4.0

4.0 Field Sampling Procedures

4.1 General Sampling Requirements

The following general sampling requirements will be maintained:

- Prior notification of facility to obtain entry permits for personnel.
- Field sampling teams will consist of a minimum of two individuals. One person will collect the sample as the other monitors adherence to sampling procedures, records any difficulty encountered, and documents other information pertinent to the investigation.
- To the extent feasible during sampling episodes, sampling activities in each medium will be conducted so that the sampling order will be from the area of least contamination to the area of most contamination.
- The preferred order of sample collection will be specified in the OU-specific FSP.
- Sample collection for chemical analysis will be performed with either disposable sampling devices or decontaminated, stainless steel or Teflon® devices. When composite samples are required, the sample will be homogenized in stainless steel bowls. All sampling equipment will be decontaminated in accordance with the procedures outlined later in this plan.
- Samples collected for VOC analysis will not be homogenized.
- Precleaned sample containers will be provided by the analytical laboratory except for the stainless steel sleeves used for soil sampling, which will be decontaminated onsite. All sample container records will be maintained by the analytical laboratory and will be available upon request.
- A sample that is representative of the matrix being sampled will be collected.
- Sample integrity will be maintained from the time of sample collection to receipt by the laboratory.

All field notes will be recorded in indelible ink on standard forms in bound notebooks. A daily field log will be completed by the FTL. This log will be signed and dated daily. Significant events occurring during the day will be recorded and reported to the PM. Daily communication is essential to evaluate whether timely corrective actions are

necessary. The field notebook(s) must provide a place for the field team members to sign and date the entries. The FTL must review all field notes.

4.2 Sample Blanks and Field Duplicates

The number of environmental and field QC samples to be collected are discussed in the OU-specific FSP. The three types of sample blanks—travel (trip) blanks, equipment (rinsate) blanks, and field blanks—along with field duplicates and split samples, are discussed below.

4.2.1 Trip Blanks

Trip blanks are to be analyzed for VOCs only, and consist of sample bottles filled in the laboratory with American Society for Testing and Materials (ASTM) Type II water; the sample bottles are then sent to the sampling location with sampling kits. The specified number of trip blanks are returned from the sampling location with every shipment of groundwater samples and analyzed for VOCs. One of these trip blanks will accompany split VOC samples to the COE QA laboratory.

4.2.2 Equipment Blanks

Rinsate blanks for the groundwater samples are processed by rinsing decontaminated sampling equipment with ASTM Type II water obtained from the laboratory. The rinse water is collected in sample bottles, preserved, and handled in the same manner as the samples. Split equipment blank samples of the rinsate will be sent to the COE QA laboratory. Equipment blanks will be collected once a day for the equipment used during sampling procedures.

4.2.3 Field Blanks

Field blanks are samples of source water used for decontamination and are used to monitor the potential for contamination from the source water. Field blanks will be collected once a week from each water source.

4.2.4 Field Duplicates

Field duplicate samples are collected to measure the precision of the sampling process. The FTL will choose at least 10 percent of the total number of sample locations previously known to contain moderate contamination, and will collect duplicate samples from these locations. The source information will be recorded in the field notes, but not on the chain-of-custody (COC) form prepared by the field team at the time of sample collection. The identity of the duplicates will not be given to the analysts. The source information will be forwarded to the QA reviewer to aid in the review and validation of

the data. The source of the field duplicate for the QA samples will be clearly identified on the COC form sent to the QA laboratory.

4.2.5 Split Samples

Split samples are used to calculate the precision of the sampling and analytical processes by providing a measure of comparability between laboratories. Split samples will be submitted to the contractor's laboratory as QC samples and to the COE and EPA/TDEC Laboratories as QA samples. Split samples will be collected from 5 percent of the samples collected at DDMT for the purpose of a quality control check by the Corps of Engineers' laboratory in Missouri. Also, TDEC reserves the right to collect split samples and to analyze these samples by the State of Tennessee laboratory. The contact person at the COE laboratory will be notified at least 2 weeks in advance of the sampling event at (402) 444-4304. The samples will be sent to the following address:

COE Laboratory
Missouri River Division
420 South 18th Street
Omaha, Nebraska 68102

4.2.6 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD samples will be collected and shipped to the laboratory for spike analyses. Five percent of the samples collected will be accompanied by spike samples. However, if a spike sample has not been collected in a 14-day time period, a spike sample will be collected and sent for analyses.

4.2.7 Other Sample Blanks

Samples of the bentonite, sand, and mud used in the drilling process will be collected and retained for future analysis, if necessary.

4.3 Field Documentation

Bound field log books will be maintained by the FTL and other team members to provide a daily record of significant events, observations, and measurements during sampling events. All entries will be signed and dated. All information pertinent to sampling will be recorded in bound log books. Entries in the log book must include at least the following:

- Name and title of author, date and time of entry, and weather/ environmental conditions during field activity
- Location of sampling activity

- Name and title of field crew
- Name and title of any site visitors
- Sample media (for example, groundwater)
- Sample collection method
- Number and volume of sample(s) taken
- Date and time of collection
- Sample identification number(s)
- Sample distribution (for example, laboratory)
- Water level measurement data
- Field observations
- Any field measurements made, such as pH, temperature, and conductivity
- All sample documents such as:
  - Bottle lot numbers
  - Dates and method of sample shipments
  - COC forms
- Sample handling (preservation)

All original data recorded in field log books, sample labels, and COC forms will be written with waterproof, black, indelible ink. None of these accountable, serialized documents are to be destroyed or thrown away, even if one is illegible or contains inaccuracies requiring document replacement. If an error is made on an accountable document assigned to one individual, that individual should make all corrections simply by crossing a line through the error, initialing and dating the correction, and entering the correct information. The erroneous information should not be obliterated. Any subsequent error discovered on an accountable document should be corrected by the person who made the entry. All subsequent corrections will be initialed and dated.

4.4 Sample Numbering and Containers

The FTL is responsible for proper sampling, labeling of samples, preservation, and shipment of samples to the laboratory to meet required holding times. Table 4-1

Table 4-1
Required Sample Containers, Preservation, and Holding Times
Defense Depot Memphis, Tennessee

Analyses	Sample Matrix*	Container†	Quantity	Preservative**	Holding Time
Volatile Organic Compounds (SW8240)	W	40-mL VOA vials††	3	Cool 4°C, HCl, pH <2	14 days
	S	4-oz Glass	1	Cool 4°C	14 days
Semivolatile Organic Compounds	W	1-L amber glass	2	Cool 4°C	7/40 days***
Pentachlorophenol (8151)	S	1-L amber glass	2	Cool 4°C	7/40 days
BNAs (8270/3520)	S	4-oz Glass	1	Cool 4°C	40 days
PAHs (8310/3520)	W	1-L amber glass	2	Cool 4°C	7/40 days***
Pesticides/PCBs (8080/3520)	W	1-L amber glass	2	Cool 4°C	7/40 days***
	S	4-oz Glass	1	Cool 4°C	40 days
Organopesticides (8150/3520)	W	1-L amber glass	2	Cool 4°C	7/40 days***
Thiodyglycol (U109)	W	40-mL vials††	2	Cool 4°C	40 days
(LL09)	S	8-oz Glass	1	Cool 4°C	7/40 days***
Metals (Total) (6010, 7000)	W	1-L polyethylene	1	Cool 4°C, HNO_3, pH <2	6 months
	S	8-oz Glass	1	Cool 4°C	6 months
Metals (Dissolved) (6010, 7000)	W	1-L polyethylene	1	Cool 4°C, HNO_3, pH <2	6 months
Mercury (7470)	W	1-L polyethylene	1	Cool 4°C, HNO_3, pH <2	28 days
	S	8-oz Glass	1	Cool 4°C	28 days
Chromium VI (7196)	W	1-L polyethylene	1	Cool 4°C, HNO_3, pH <2	24 hours
	S	4-oz Glass	1	Cool 4°C	24 hours
Total Dissolved Solids (160.1)	W	1-L polyethylene	1	Cool 4°C	7 days

*Sample matrix: S = Surface soil, subsurface soil, sediment;
W = Groundwater, surface water
†Glass containers will be sealed with Teflon®-lined screw caps.
**All samples will be stored promptly at 4°C in insulated chest.
††VOC vials will be sealed with Teflon®-septa secured screw caps.
***Extraction: 7 days for water, 40 days for analysis.

Source: RI Report, 1990

identifies the proper containers, preservation techniques, and maximum holding times according to EPA SW-846.

4.5 Sampling Numbering System

A sample numbering system will be used to identify each sample collected during the field investigation and for all blanks. The numbering system will provide a tracking procedure to allow retrieval of information about a particular location and to monitor that each sample is uniquely numbered. The FTL will maintain a list of sample numbers.

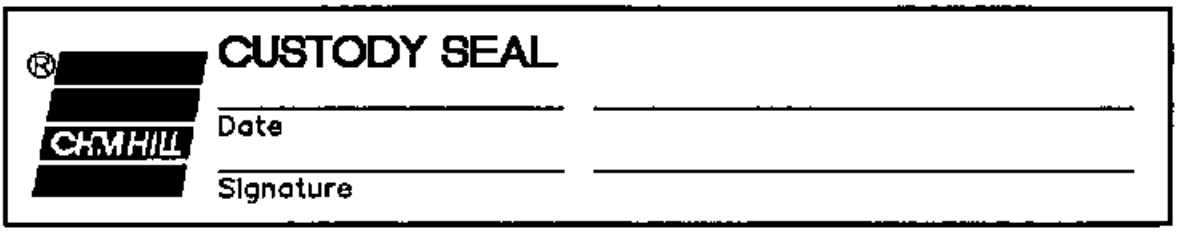
4.6 Sample Chain-of-Custody

Sample custody and documentation procedures described in this section will be followed throughout all sample collection at DDMT. Components of sample custody procedures include the use of field log books, sample labels, custody seals, and COC forms. Examples of these are present in Figures 4-1 and 4-2. Each person involved with sample handling will be trained in COC procedures before the implementation of the field program. The COC form will accompany the sample during shipment from the field to the laboratory. If samples are split and sent to different laboratories, a copy of the COC form will accompany each split sample.

The information provided on the COC form will include the following:

- The project name
- The sampling station number or sample number
- Date and time of collection
- Grab or sample designation
- A brief description of the type of sample and sampling location
- Signature of individuals involved in the sample transfer
- The time and date they receive the sample
- Sample matrix
- The analytical methods required

COC records initiated in the field will be placed in a plastic cover and taped to the inside of the shipping containers used for sample transport from the field to the laboratory. This record will be used to document sample custody transfer from the field sampler to the laboratory.



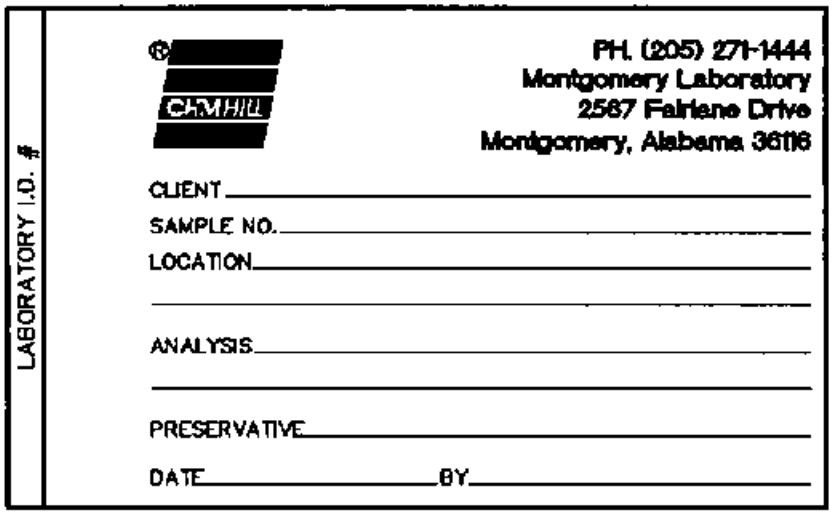


FIGURE 4-1
EXAMPLE CUSTODY SEAL AND SAMPLE CONTAINER LABEL
Defense Depot Memphis, Tennessee

QUALITY ANALYTICAL LABORATORIES — CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

PROJECT # | PURCHASE #

PROJECT NAME

COMPANY NAME/CH2M HILL OFFICE

PROJECT MANAGER AND PHONE # (Mr. [ ] Ms. [ ]) | REPORT COPY TO:

REQUESTED COMPLETION DATE

SAMPLING REQUIREMENTS: RCRA ☐ NPDES ☐ RCRA ☐ OTHER ___

SAMPLE DISPOSAL: DISPOSE ☐ RETURN ☐

SAMPLING DATE	SAMPLING TIME	TYPE: COMP	TYPE: GRAB	MATRIX: WATER	MATRIX: SOIL	CLIENT SAMPLE ID (1 CHARACTER)	# OF CONTAINERS

LAB TEST CODES

ANALYSES REQUESTED

SHADED AREA - FOR LAB USE ONLY

LAB #1 | LAB #2

QUOTE # | NT REQUEST #

PROJECT # | DATE/TIME

NO. OF SAMPLES | PAGE | OF

QOC REVIEW | LOGIN | LAB'S VOA | ACK SENT

REMARKS | LAB 1 ID | LAB 2 ID

SAMPLED BY & TITLE (Please sign and print name) | DATE/TIME

RELINQUISHED BY (Please sign and print name) | DATE/TIME

RECEIVED BY (Please sign and print name) | DATE/TIME

RELINQUISHED BY (Please sign and print name) | DATE/TIME

RECEIVED BY (Please sign and print name) | DATE/TIME

RELINQUISHED BY (Please sign and print name) | DATE/TIME

RECEIVED BY (Please sign and print name) | DATE/TIME

SHIPPED VIA: OPS | BUS | FED-EX | HAND | OTHER ___

SHIPPING #

WORK AUTHORIZED BY (Please sign and print name)

REMARKS

HAZWRAP/MESSA: Y | N

QC LEVEL: 1 2 3 OTHER: ___

COC SEAL | ICE

AMA SEAL | TEMP

CUST SEAL | PH

INSTRUCTIONS AND AGREEMENT PROVISIONS ON REVERSE SIDE

DISTRIBUTION: ORIGINAL - LAB, YELLOW - LAB, PINK - CLIENT

4-8

127 39

FIGURE 4-2
EXAMPLE CHAIN OF CUSTODY RECORD
Defense Depot Memphis, Tennessee

CH2MHILL

MOP-0006.0WG 02-21-95

4.6.1 Sample Custody

A sample is under custody under the following conditions:

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

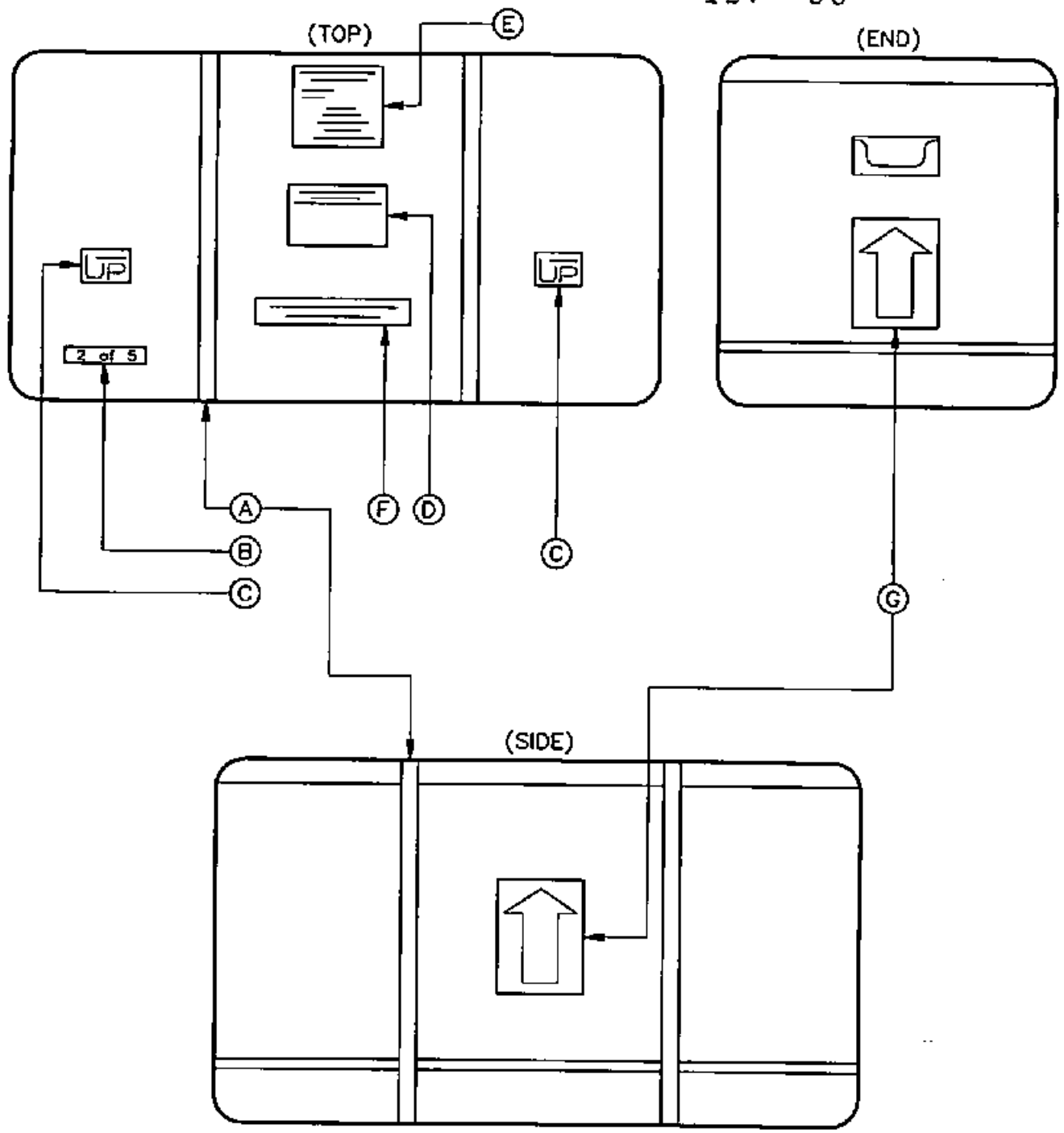
4.6.2 Sample Custody in the Field

The following procedures will be used to document, establish, and maintain custody of field samples:

- Sample labels will be completed for each sample, with waterproof ink, making sure that the labels are legible and affixed firmly on the sample container (see Figure 4-1).
- All sample-related information will be recorded in the project log book.
- The field sampler will retain custody of the samples until they are transferred or properly dispatched.
- During the course of and at the end of the field work, the field supervisor determines whether these procedures have been followed, and whether additional samples are required.

4.7 Sample Shipment

Samples will be delivered to the designated laboratory. During sampling and sample shipment work, the FTL (or a designee) will contact the appropriate laboratory daily to inform it of shipments. Hard plastic ice chests or coolers with similar durability will be used for shipping samples. The coolers must be able to withstand a 4-foot drop onto solid concrete in the position most likely to cause damage. Styrofoam or bubble wrap will be used as packing material to protect the samples from breakage during shipment. All water VOC vials will be shipped in the same cooler. After packing is complete, the cooler will then be taped shut with COC seals affixed across top and bottom joints. Each container will be clearly marked with "THIS END UP" arrows on all four sides and a sticker containing the originator's address. Figure 4-3 provides a schematic for proper labeling of the cooler.



Ⓐ FIBER TAPE SEAL
Ⓑ CHEST NUMBER
Ⓒ THIS SIDE UP
Ⓓ ADDRESS LABEL
Ⓔ DO NOT TAMPER
Ⓕ ENVIRONMENTAL LAB SAMPLES
Ⓖ UP ARROW

FIGURE 4-3
PROPER LABELING OF AN ICE CHEST
FOR LOW LEVEL SAMPLES
Defense Depot Memphis, Tennessee

CH2MHill

The following procedures will be used when transferring the samples for shipment:

- Samples are accompanied by a COC form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the field sampler to another person, or to the laboratory. Overnight carriers will be treated as a single entity and a single signature will be required when the samples are delivered to the laboratory.

- Samples will be properly packaged for a shipment and dispatched to the appropriate laboratory for analysis with a separate signed COC form enclosed in each sample box or cooler.

- Whenever samples are split with a government agency, a separate COC form will be prepared for those samples and marked to indicate with whom the samples are being split.

- All packages will be accompanied by a COC form showing identification of the contents. The original record will accompany the shipment, and a copy will be retained by the FTL.

4.8 Laboratory Sample Custody

The FTL will notify the laboratory of upcoming field sampling activities and the subsequent transfer of samples to the laboratory. This notification will include information concerning the number and type of samples to be shipped, as well as the expected date of arrival.

The following procedures will be used by the laboratory sample custodian in maintaining the COC once the samples have arrived at the laboratory:

- The laboratory will designate a sample custodian who is responsible for maintaining custody of the samples and for maintaining all associated records documenting that custody.

- Upon receipt of the samples, the custodian will check the original COC and request-for-analysis documents and compare them with the labeled contents of each sample container for corrections and traceability. The sample custodian signs the COC and records the date and time received. The sample custodian also will assign a unique laboratory sample number to each sample.

- Care is exercised to annotate any labeling or descriptive errors. In the event of discrepancies in the documentation, the laboratory will immediately contact the FTL as part of the corrective action process. A qualitative assessment of each sample container is performed to note any anomalies, such as broken or leaking bottles. This assessment is recorded as part of the incoming COC procedure.

- If all data and samples are correct, and there has been no tampering with the custody seals, the "received by laboratory" box is signed and dated.

- The samples are stored in a secured area and at a temperature of approximately 4°C, if necessary, until analyses are to begin.

- Samples are accompanied by a COC form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the field sampler to another person, or to the laboratory.

- A laboratory COC form accompanies the sample or sample fraction through final analysis for control.

- Copies of the COC and request-for-analysis forms will accompany the laboratory report and will become a permanent part of the project records.

4.9 Disposal of Derived Wastes

In the following sections, the disposal of derived wastes is discussed.

4.9.1 Purged/Development Water and Decontaminating Fluids

Development and purged water will be collected, stored, and analyzed (if required). The discharge will be conducted in accordance with the DDMT industrial discharge permit application (currently being applied for). The processed water will be collected in a storage tank for disposal to the City of Memphis sanitary sewer system (consistent with the permit). Solids will be allowed to settle out of the water before being transferred to the treatment system.

4.9.2 Storage, Analysis, Treatment, and Disposal of Investigation-derived Wastes

All monitoring well and soil boring cuttings will be collected and placed in DOT-approved drums. A label will be affixed to each drum clearly indicating the boring number and depth interval from which the cuttings originated. The site geologist will

maintain a log detailing the disposition of cuttings from each hole. The drums will be stored in the permitted Resource Conservation and Recovery Act (RCRA) storage area pending the results of the chemical analysis (toxicity characteristic leaching procedure [TCLP]), which will determine the disposition of the contents (if they are determined to be hazardous or nonhazardous by the toxicity characteristic).

4.9.2.1 Soil Waste

Analytical sample results from the investigation will be reviewed to evaluate whether any of the soil waste might exceed TCLP criteria. Upon completion of the data evaluation, a letter report will be submitted to DDMT detailing the drums that contain cuttings that are nonhazardous and may be disposed of onsite as fill. The sample from each drum will be collected using a stainless steel scoop and will be obtained immediately below the surface material in each drum. No attempt will be made to obtain depth-integrated samples from within the drums because of the homogenization expected during filling of the drums. Analysis of these samples will be at DQO analytical Level 3. Upon completion of laboratory analysis, a report will be submitted to DDMT detailing those drums containing cuttings that the should be considered hazardous waste (HW). The report will identify options for treatment and disposal of the HW in accordance with applicable federal and State of Tennessee regulations. The contents of the drums will be identified with a composite representative analytical sample. Of particular concern are cuttings with metals (primarily arsenic, chromium, and lead) contamination. The RI Report (ref. 7) reported widespread occurrence of metals concentrations in both surface and subsurface soils. A number of these samples were obtained from areas with no known source of metals contamination.

Soil and cuttings from the decontamination basin will be collected in drums. The site geologist will record the well number(s) from which decontamination sediments were added to the drum. Labeling and handling of the drums from decontamination will follow the same procedures as the drums of drill cuttings.

4.9.2.2 Classification and Disposal of Soil Waste

If the analysis of a soil sample indicates that organic compounds or metals exceed either federal or state TCLP limits (whichever is more stringent), then the drum(s) associated with that sample will be considered HW and will be disposed in accordance with federal and state requirements through the Defense Reutilization and Marketing Office (DRMO) at DDMT. Drums containing cuttings that were recommended to be considered nonhazardous will be disposed only upon specific written instructions from DDMT.

4.9.2.3 Personal Protective Equipment and Disposable Equipment Waste

All disposable personal protective equipment (PPE) waste (gloves, coveralls, decontamination supplies, protective coverings, respirator canisters, booties, and splash suits) and disposable equipment (DE) waste (plastic ground and equipment covers,

Teflon® tubing, conduit pipe, and aluminum foil) used during the study will be collected and double bagged. PPE and DE wastes are generally classified as nonhazardous wastes (ref. 31) and will be disposed in dumpsters at DDMT. This procedure is in accordance with Ref. 31.

TAB

5.0

5.0 Field Procedures 127 44

5.1 Groundwater

Groundwater sampling efforts will be conducted to identify and evaluate contaminants in the groundwater beneath and around DDMT. A summary of the quantity of samples to be collected and the parameters to be tested during chemical analysis is provided in the OU-specific FSP. Table 4-1 provides minimum laboratory QC sample requirements, including container type, container quantities, preservatives, holding times, SW-846 Methods, and extraction and preparation methods for each parameter.

5.1.1 Groundwater Sample Locations and Rationale

Groundwater samples will be collected for chemical analysis from both existing and newly constructed monitoring wells at DDMT. Collection and analysis of groundwater samples are planned for selected Memphis Light, Gas, and Water (MLGW) monitoring wells in the Allen Well Field. These samples will be collected if groundwater analysis from any of the optional wells (along Elvis Presley Boulevard) show that the contamination has migrated from Dunn Field to the wells on Elvis Presley Boulevard. In the event that recent groundwater data are not available from MLGW, efforts will be coordinated with MGLW to obtain the necessary approval to collect and chemically analyze groundwater samples from the Allen Well Field monitoring wells. Groundwater samples from the wells will be analyzed for several reasons: to characterize sites and to evaluate the nature of releases from disposal sites at DDMT; to evaluate the vertical and horizontal extent of a potential contaminant plume in the Fluvial Aquifer; to evaluate whether contaminants in the Fluvial Aquifer pose a threat to the Memphis Sand Aquifer; and to obtain background water quality data (offsite and upgradient wells) for comparative study. The specific rationale for collecting groundwater samples from each location will be provided in the OU-specific FSP. Additional samples to be analyzed will include equipment blanks, field duplicates, and samples of water from the wells. Split field duplicates and split equipment blanks will routinely be sent to the CEMRD.

5.1.2 Groundwater Sampling Procedures

Before groundwater sample collection, static water levels in the monitoring wells will be measured to calculate groundwater purge volumes. Water level measurements collected for this purpose will be obtained within 24 hours of purging the monitoring well.

Groundwater levels used to construct a groundwater potentiometric surface map will be collected within a 24-hour time frame, provided that barometric conditions remain essentially the same. This will be determined by using a barometer during water level measurements. The intent of this requirement is to obtain water levels during a short time frame during which no significant barometric variations occurred (all readings within 0.25-inch mercury), and not to obtain water levels within a 24-hour period when

significant barometric variations did occur (readings greater than 0.25-inch mercury). All water levels will be measured using a decontaminated, electronic water level indicator with an accuracy of plus or minus 0.1 foot. Monitoring well sampling will generally proceed from the potentially least contaminated well to the most contaminated well, according to existing data.

To prevent contamination of sampling equipment by surface soils when the wells are being purged or sampled, a plastic ground cloth will be placed beneath all sampling equipment. Purging will be accomplished through the use a decontaminated stainless steel submersible pump or Teflon® bailer. The discharged water will be monitored for pH, temperature, and specific conductivity. Purging will continue until three to five well volumes have been removed and the pH, temperature, and conductivity are stabilized (three successive measurements are within 5 percent of one another).

The amount of purged fluid will be measured by filling graduated buckets or by using a stopwatch and noting the flow rate of the pump versus elapsed times. All water purged from the wells will be permitted for discharge to the city sewer. Wells will be sampled immediately after purging, if possible, but no later than 6 hours after purging. Wells that recharge slowly will be purged dry and allowed to recharge to at least 80 percent of initial well volume before sampling. If excessive time (greater than 10 hours) is required for the slow recharging wells to recharge to 80 percent, it will be documented by the FTL in the field log. To monitor that data is consistent, all wells will be sampled within a 14-day time frame.

Clean disposable vinyl gloves will be used to handle all samples and equipment used for purging and sample collection. Each well will be sampled with a Teflon® bailer decontaminated according to procedures described previously. Precleaned bailers will be wrapped in aluminum foil for transportation to DDMT. A clean, braided nylon cord will be used to lower each bailer into the well and will be discarded after each use. Care will be taken to prevent contact between the bailer and line and the ground.

Samples will be collected in accordance with the guidelines furnished in the *Practical Guide for Ground Water Sampling* (ref. 1) and the *EPA Region IV ECBSOPQAM* (ref. 31). In accordance with EPA's Environmental Services Division guidelines, care will be taken to avoid aeration of the sample. The sample will be poured in a slow, steady stream from the bailer to the prepared sample containers. The process will be repeated as necessary to fill each container to the required volume. Field measurements of pH, specific conductance, and temperature will be conducted and recorded using instruments that have been calibrated daily and decontaminated before each use. Temperature will be measured immediately upon pouring the sample from the bailer into a glass beaker.

Samples to be analyzed for VOCs will be collected first, to minimize the effects of volatilization caused by disturbance of the water surface in the well. VOC sample containers will be filled completely to the top of the container, leaving no air space above the liquid. Before transport to the laboratory for analysis, samples will be preserved in

accordance with the guidelines in Table 4-1. Trip blanks will be included with each container holding samples to be analyzed for VOCs. Groundwater samples also will be collected by EPA and state regulators on a regular basis throughout the project.

5.2 Soil

5.2.1 Surface Soil

Surface soil samples will be collected and analyzed to identify and to delineate contaminants in the surface soils at sites and at some offsite locations (for background sampling). A summary of the quantity of samples to be collected and the parameters to be tested during chemical analysis is provided in the OU-specific FSP. Container type, container quantities, preservatives, holding times, SW-846 Methods, and extraction and preparation methods for each parameter are provided in Table 4-1. This section of the QAPP identifies the general requirements and purposes for collection of surface samples, including the field QA/QC methods.

5.2.2 Surface Soil Sampling Procedures

Surface soil samples will be collected using a clean stainless-steel hand auger or scoop to retrieve soil from zero to 12 inches below ground surface (bgs). Any VOC samples will be placed in the appropriate jars immediately upon collection. The remaining sample will be thoroughly mixed in a stainless-steel mixing bowl before being transferred to the appropriate sample containers. Surface cover (grass and weeds) and debris (such as broken glass and rocks) will be removed from the sample prior to placing in sample containers.

5.2.3 Subsurface Soils

Subsurface soil samples from soil borings will be collected for chemical analyses from both soil and monitoring well borings installed for this study. Samples will generally be selected on the basis of historical data results, field screening during sampling, or both. The overall purpose of this sampling effort will be to characterize the subsurface conditions by providing soil samples for chemical analysis to determine the nature and extent of releases of hazardous substances to the environment from waste disposal sites on DDMT, as well as the vertical and horizontal extent of such contamination in the subsurface soils; to evaluate soil lithology and subsurface stratigraphy; and to help characterize the potential hydraulic interconnection between the Fluvial Aquifer and the Memphis Sand Aquifer on the Main Installation. Soil samples also will be collected for geotechnical lab analyses. Locations and justifications for sample collection, including background samples and offsite locations, are provided in the OU-specific FSPs. Additional samples to be analyzed include equipment blanks and field duplicates (to fulfill QA/QC requirements) and samples from soil cuttings to determine disposal requirements. Split field duplicates and equipment blanks will routinely be sent to the CEMRD

laboratory. Trip blanks will be included with each container holding samples to be analyzed for VOCs.

5.2.4 Subsurface Soil Sampling Procedures

Three types of subsurface soil samples will be collected—vertical (shallow) soil borings, vertical (deep) soil borings. The specific number of samples for chemical analysis and depths of collection are discussed in the OU-specific FSPs. However, in general, one soil sample will be collected from the first 12 inches for all borings, from an intermediate depth based on field screening, and from the saturated zone of some vertical (deep) borings for geotechnical analyses. Soil samples will collected on the basis of visual or organic vapor analyzer/photoionization detector (OVA/PID) field screening. Soil samples will be stored in airtight containers and shipped daily to the laboratory for analysis. Geotechnical sample collection and analyses are discussed in Section 5.4. The general analyses include grain size, moisture content, and Atterberg limits. Grain size analysis will be performed on the aquifer material. Atterbergs will be performed on the fine silty to clay material. If the confining layer at the base of the Fluvial Aquifer is penetrated, Atterberg limits will be performed on the retrieved sample to evaluate the condition and character of the clay. The final decision to collect a sample from a certain zone will be at the discretion of the field geologist. This decision will be documented in the field log.

5.3 Surface Water and Sediment Samples

Surface water samples will be collected and analyzed to determine whether storm waters are contributing to the degradation of the Golf Course Pond and Lake Danielson and to determine if sites at DDMT are affecting the quality of storm water runoff waters leaving the installation. Specific location criteria and analysis will be identified in the appropriate OU FSP. Sediment samples will be collected from the same location as surface water samples to the extent possible. Collecting sediment and surface water samples from the same location will be easily accomplished at Lake Danielson and at the Golf Course Pond. However, it may not be possible for some of the storm water drainage channels. The samples will be taken from various locations around DDMT and will be used to further define sites previously identified in the RI Report (ref. 7) and the RFA (ref. 25) and to help characterize any possible sources for contaminants found in Lake Danielson, in the Golf Course Pond, and in storm water drainage channels.

5.3.1 Surface Water Sampling Procedures

After a rainstorm with at least 0.2 inches of precipitation, when quantities of surface water/runoff are sufficient for collection, samples will be collected for chemical analysis. Sampling locations are identified in the OU-specific FSPs, which are considered representative of surface water runoff from the installation. These samples will be used to determine whether storm waters are contributing to the degradation of the lakes and runoff waters leaving the installation. Samples may be collected from storm drainage

ditches will be a single grab sample taken at mid-depth from the center of the channel. Samples collected from Lake Danielson and from the Golf Course Pond. If so, they will be collected from the estimated deepest point of the lake or pond and, with the exception of the volatile sample, will consist of single vertical composite (depth integrated) samples. The vertical composite samples will be taken using a decontaminated stainless steel Kemmerer sampler or bailer. The physical water quality parameters of specific conductivity, temperature, pH, and dissolved oxygen will be measured at each sampling point. Specific conductivity, temperature, dissolved oxygen, and pH will be measured with an electronic meter. The first draw of sample will placed into the VOC containers immediately if a bailer or Kemmerer sampler is being used. An aliquot will be placed in each container from each subsequent draw until the bottles are filled.

Samples will be collected from the surface directly into the container where the column of water is less than 1 foot deep and when no preservatives are required in the sampling bottle. Samples requiring preservatives will be collected in a spare bottle that has been rinsed twice in the water to be sampled. The sample collected will then be transferred to the appropriate container. Sediment samples will be collected at the location of all surface water samples unless the sample is obtained from a concrete-lined drainage ditch with no accumulated sediment. If sediment samples are also to be collected, the surface water samples will be collected first. Care will be taken to prevent disturbance of the sediments in the stream, lake, or pond.

5.3.2 Sediment Sampling Procedures

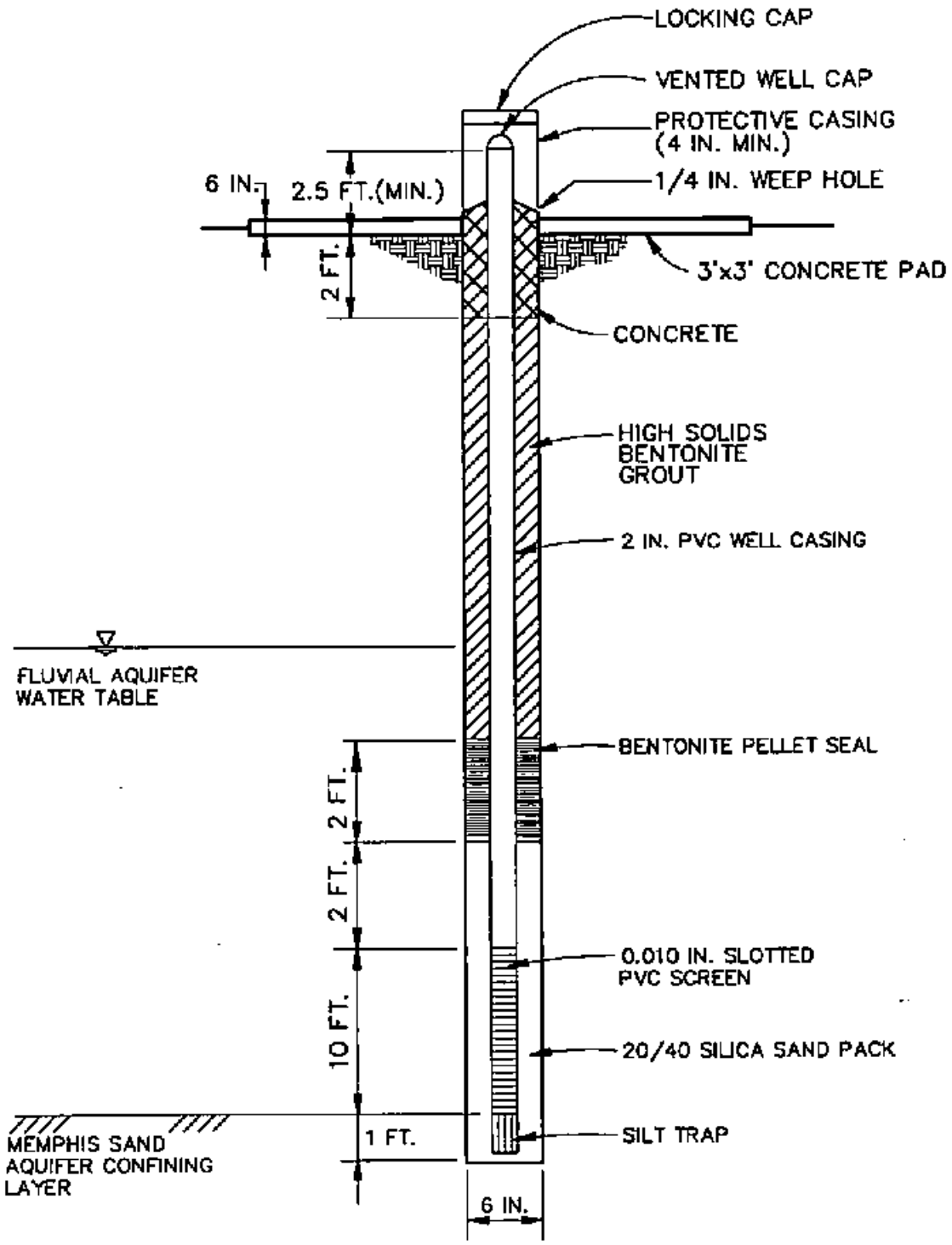
Samples of sediment from the drainage ditches will be collected using a stainless steel scoop. The samples will be collected when there is no flow in the ditch or when the flow allows wading to the sample location. Field judgment will be exercised when collecting sediment samples. The depth of sampling will be limited to zero to 12 inches for surface sediments. Smaller intervals may be used to limit sampling to sediments rather than native soil. The sampling interval will be documented in the field logbook. If there is flow in the stream, the sample location will be approached from downstream of the point facing into the current. All non-purgeable organic samples will be thoroughly mixed in a stainless steel mixing bowl before being transferred to the appropriate sample container. Sediment samples that are to be analyzed for VOCs will be immediately placed in the appropriate sample container and filled completely. No head space will remain in the sample container.

5.4 Soil Boring and Monitoring Well Drilling Procedures

5.4.1 Permitting and Design of Monitoring Wells

The design and construction of monitoring wells will follow (as closely as practical) the design criteria presented in the *Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells* (ref. 37) and *EPA Region IV ECBSOPQAM*

127 49



NOTE:
3-2" DIAMETER GUARD POSTS ARE REQUIRED (EQUAL SPACINGS) AROUND PROTECTIVE CASING. EXTEND POSTS 3'-6" ABOVE TOP OF PAD.

FIGURE 5-1
TYPICAL STICKUP MONITORING WELL
Defense Depot Memphis, Tennessee

CH2M HILL

127 50

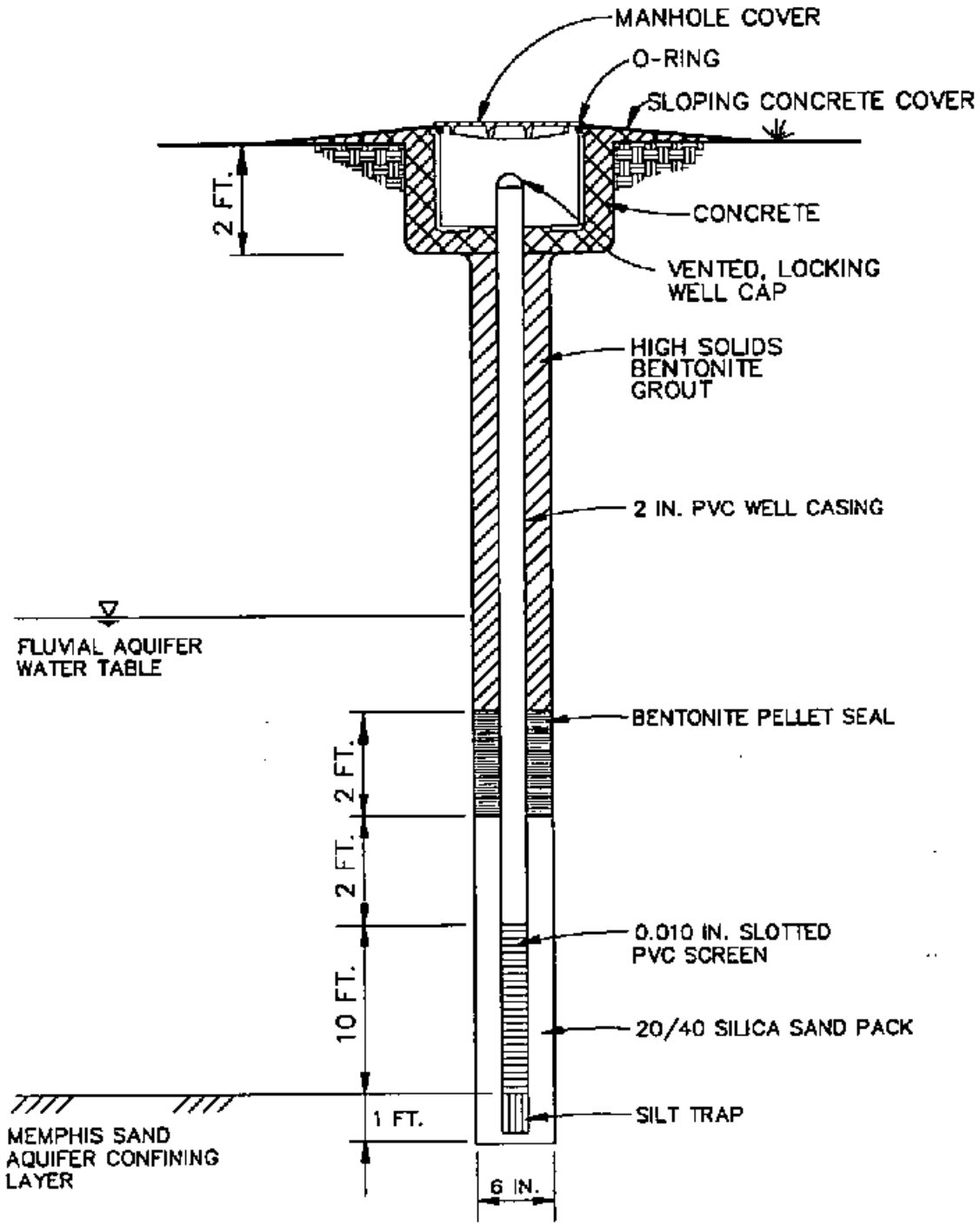


FIGURE 5-2
TYPICAL FLUSHMOUNT MONITORING WELL
Defense Depot Memphis, Tennessee

MOP-0001.DWG 9-8-95

(ref. 31). Diagrams of typical well construction details are shown in Figures 5-1 and 5-2. Drilling and field personnel will have all applicable state and local certification required for drilling. DDMT will be responsible for obtaining the required entry permits for offsite locations. Additionally, Figures 5-3 and 5-4 show the construction details of the proposed Memphis Sand Aquifer Monitoring Well (Section 4.6 of the OU-4 FSP).

5.4.2 Installation of Monitoring Wells and Soil Borings

The procedures described below will be followed for monitoring well installation and soil borings.

5.4.2.1 General Requirements

The drilling contractor will provide all drilling equipment, materials, and personnel required to install the monitoring wells and soil borings. A qualified geologist or geotechnical engineer will be onsite for all drilling, installation, development, and testing activities.

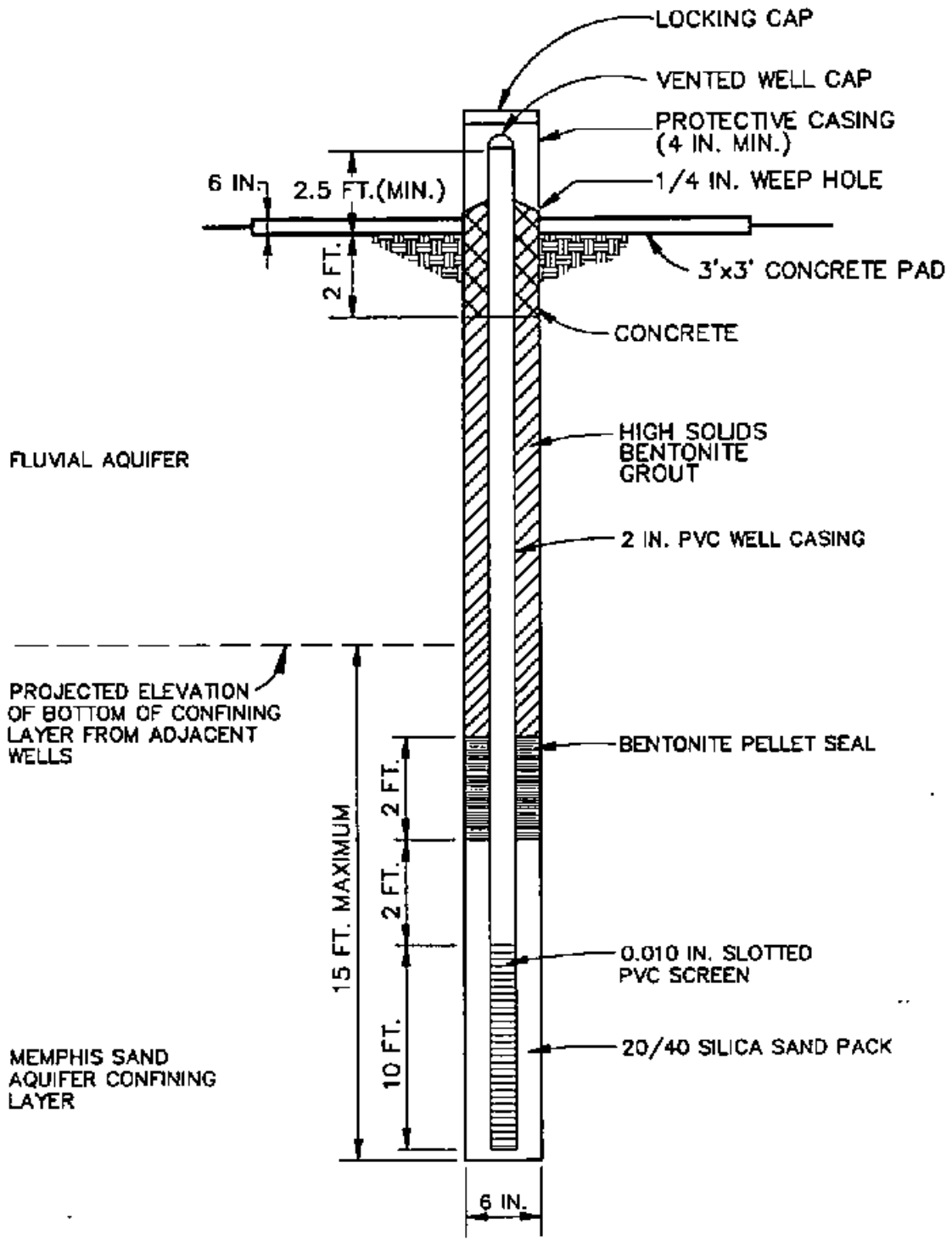
5.4.2.2 Protection of Water-yielding Zones

Water will be used during drilling only when absolutely necessary for successful installation of the well. During the drilling of wells at DDMT for the RI/FS, a zone of flowing sand was encountered in some boreholes. This zone made removal of the auger from the hole difficult, especially when it was left in overnight. In such an instance, water or an additive may be necessary to keep the hole open. If water is required during drilling or well installation, only non-chlorinated potable water will be used. If an additive is required, only pure bentonite will be used. Any proposed use of water or bentonite will be cleared through the CEHND Contracting Officer before use. Grease or oil on drill rod joints will not be permitted; neither will dispersing agents such as phosphates or acids. Toxic and contaminating substances will be prohibited during any part of the drilling, well installation, or well development activities. No attempt will be made to chemically disinfect the well.

All drilling activities and methods will be performed to prohibit the introduction of contaminants from one zone to another, particularly from the Fluvial Aquifer to the Memphis Sand Aquifer. Monitoring well borings intended to penetrate the Memphis Sand Aquifer will be completed with an isolation casing that will be pressure-grouted to approximately 3 ft into the confining layer. The grout will be allowed to set for a minimum of 24 hours before advancing the borehole and installing a monitoring well.

When material is removed from the confining unit for confirmation or laboratory testing from a soil boring, the base of the borehole will be backfilled using tremie pipe to pump pure bentonite containing at least 20 percent solids to the top of the confining unit.

127 52



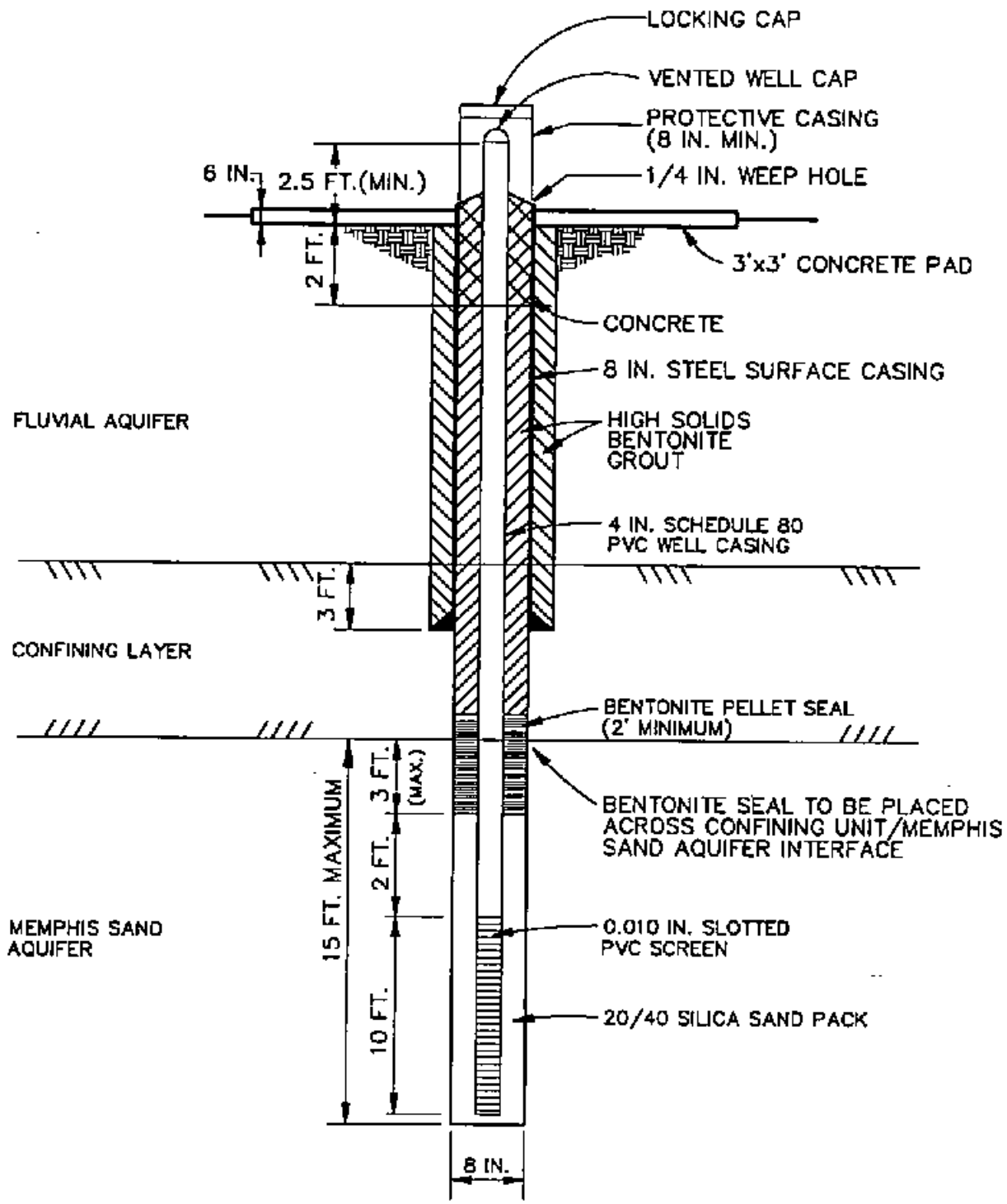
NOTE:
3-2" DIAMETER GUARD POSTS ARE REQUIRED (EQUAL SPACINGS) AROUND PROTECTIVE CASING. EXTEND POSTS 3'-6" ABOVE TOP OF PAD. SEE FIGURE 5-2 FOR FLUSHMOUNT INSTALLATION.

FIGURE 5-3
MEMPHIS SAND AQUIFER MONITORING WELL WITHOUT CONFINING UNIT
Defense Depot Memphis, Tennessee

CH2MHILL

MDP-0009.DWG 9-6-95

127 53



NOTE:
3-2" DIAMETER GUARD POSTS ARE REQUIRED (EQUAL SPACINGS) AROUND PROTECTIVE CASING. EXTEND POSTS 3'-6" ABOVE TOP OF PAD. SEE FIGURE 5-2 FOR FLUSHMOUNT INSTALLATION.

FIGURE 5-4
MEMPHIS SAND AQUIFER MONITORING WELL WITH CONFINING UNIT
Defense Depot Memphis, Tennessee

5.4.2.3 Drilling Techniques

Drilling techniques will be followed as described below.

Soil Borings. The DDMT soil borings and monitoring wells will be installed using hollow stem auger (HSA), mud rotary (MR), water rotary (WR), rotosonic, or another EPA-approved alternative drilling technique.

It is acknowledged that the HSA technique is preferable for installation of the monitoring wells and will be used whenever possible. As stated previously, a zone of flowing sand has been encountered during previous drilling operations at DDMT. If the auger becomes ineffective in the sands, a center plug will be used. If the center plug is ineffective, WR will be used. MR will be used only as a last resort. The drill rigs will install a minimum 7-inch-diameter borehole to facilitate installation of 2-inch inside diameter (ID) casing and screens for the Fluvial Aquifer monitoring wells. If soil borings and monitoring wells are to be installed in the Memphis Sand Aquifer, a larger diameter boring will be drilled for installation of the isolation casing. The drill rig will have the capability to collect split-spoon samples according to ASTM procedures. At a minimum, the rig will be equipped with a cathead-operated, 140-pound hammer with a 30-inch draw.

Hollow Stem Auger Technique. When a boring is advanced using HSA, the following protocol will be followed to install the well casing and screen in the shallow wells:

- Install the 2-inch screen and riser through the HSAs with enough riser pipe to extend the well casing about 2 ft above the ground surface.
- Install an artificial sand pack through the annular opening, using a tremie pipe. Water in small amounts may be used to prevent bridging of the sand in the annulus.
- Remove hollow stem augers in increments as the annulus space fills with sand.
- Continue installing sand pack until it reaches at least 2 ft above the top of the well screen.
- Install a minimum 2-foot pure bentonite seal of at least 20 percent solids using a tremie pipe.
- Remove HSAs from boring.
- Grout boring annulus to within 2 ft of ground surface using a tremie pipe and high solids pure bentonite grout. Install steel security cap and a 3-foot by 3-foot by 6-inch concrete pad with protective posts if the well is in a high-traffic

area. The grout will be allowed to set a minimum of 48 hours before developing the well.

Water Rotary Technique. When a boring is advanced using WR, the following protocol will be followed to install the well casing and screen the shallow wells:

- After termination of boring, all drilling rods will be removed.
- Install the 2-inch screen and riser, with enough riser pipe to extend about 2 ft above the ground surface. Centralizers may be necessary to center the pipe in the borehole.
- Install the sand pack with a tremie pipe from the bottom of the boring until at least 2 ft above the well screen.
- Install a minimum 2-foot pure bentonite seal with at least 20 percent solids.
- Grout boring annulus to within 2 ft of the ground surface using a tremie pipe and high solids, pure bentonite grout. Install steel security cap and a 3-foot by 3-foot by 6-inch concrete pad with protective posts if the well is in a high-traffic area. The grout will be allowed to set a minimum of 48 hours before developing the well.

Mud Rotary Technique. When a boring is advanced using MR, the protocol described below will be followed to install the well casing and screen in the shallow wells:

- After termination of boring, all drilling rods will be removed.
- Install the 2-inch screen and riser, with enough riser pipe to extend about 2 ft above the ground surface. Centralizers may be necessary to center the pipe in the borehole.
- Remove the mud cake from the boring well by pumping potable water through the well riser and screen.
- Install the sand pack with a tremie pipe from the bottom of the boring until at least 2 ft above the top of the well screen.
- Install minimum 2-foot bentonite seal.
- Grout boring annulus to within 2 ft of ground surface using a tremie pipe and high solids pure bentonite grout. Install steel security cap and a 3-foot by 3-foot by 6-inch concrete pad with protective posts. The grout will be allowed to set a minimum of 48 hours before developing the well.

Rotasonic Drilling (RD) Technique. When a boring is advanced using RD, the following protocol will be followed to install the well casing, screen, and cover for the shallow wells:

- At the termination depth of the boring, the inner drill pipe and core barrel containing the soil sample (typically up to 10 ft in length) are removed.
- Install the 2-inch monitoring well casing and screen through the outer drill pipe (usually 6- or 8-inch ID) using enough casing (riser) that the well extends about 2 feet above the ground surface.
- Install an artificial sand pack through the annular opening using a 1- or 1.5-inch tremie line. The drill pipe and well casing can be vibrated to minimize the potential for bridging of the sand in the annulus. Water in small amounts may also be used to minimize the potential for bridging.
- Remove the outer drill pipe in increments and allow the annular space to fill with sand. Repeat this process until the sand extends at least 2 feet above the top of the well screen.
- Install a minimum 2-foot bentonite slurry seal containing at least 20 percent solids into the annular space using a tremie pipe. Granular bentonite (pellets or chips) may be slowly poured into the annular space as an alternative to the bentonite slurry. If granular bentonite is used, the drill pipe and well casing can be vibrated to minimize the potential for bridging. Potable water should be used to hydrate the pellets or chips if the bentonite interval occurs above the water table. A minimum of 4 hours should be allowed for the bentonite to hydrate before grouting the remaining annular space.
- Grout annulus to within 2 feet of ground surface using a tremie pipe to pump a neat cement-bentonite sealant in the annular space. During the placement of the grout above the bentonite seal, the outer drill casing is incrementally removed, allowing this material to completely fill the annular space.
- Install a locking steel security cover within a 3-foot by 3-foot by 6-inch concrete pad. A minimum of three high-visibility steel protective posts will be installed around the concrete pad if the well is in a high-traffic area. The grout within the annular space of each monitoring well will be allowed to cure a minimum of 48 hours before beginning well development.

5.4.2.4 Borehole Abandonment Procedures

Upon completion of each borehole, or if for any reason a well must be abandoned during drilling, the abandonment will follow the procedure as outlined in Section E.8.1 of EPA's *ECBSOPQAM* (ref. 31).

5.4.2.5 Well Design

Well Riser and Screen. The OU-specific FSP will dictate the requirements for each specific proposed monitoring well. In general, the risers and screens used in well construction will be made of polyvinyl chloride (PVC) (meeting National Sanitation Foundation [NSF] Standard 14). PVC is preferred to stainless steel where possible because all of the existing monitoring wells at DDMT have PVC screens and risers. To have comparable results, wells that will be installed should be constructed with similar materials.

Additionally, previous analytical results from existing monitoring wells at DDMT indicate that contamination is not affecting well materials. There has been no indication of degradation of the well materials resulting in well failure or leaching of organics from the well materials. Thus, the sample and data quality will not be adversely affected by using PVC.

Continued use of PVC for well construction materials will provide water samples that will be consistent with samples from the existing monitoring wells without sacrificing data quality. This approach is consistent with technical information provided in Ref. 33, an EPA report concerning the selection well materials and contaminants, and Ref. 34, a COE report documenting surface changes in well casing pipes exposed to high concentrations of organic compounds. However, if DNAPL concentrations are detected during drilling operations or if contaminants are present in concentrations that degrade PVC well casing materials (ref. 41), then stainless steel will be used as the well construction material in the area of DNAPL concentration.

Riser. Wells installed in the Fluvial Aquifer will be constructed of new threaded, flush joint, PVC pipe with a nominal 2-inch diameter. Well risers will conform to the requirements of ASTM-D 1785 Schedule 40 pipe and NSF Standard 14 PVC, and will be clearly identified as such. Any Memphis Sand Aquifer wells will consist of new threaded, flush joint, Schedule 80 PVC pipe with a nominal 4-inch diameter and will conform to NSF Standard 14.

Screen. The well screens will be a minimum of 10 ft long and will be constructed of ink- and printing-free PVC material similar to the well riser. The screens will be non-contaminating, factory-constructed, continuous wrap or mill-slot design, with a slot size of 0.010 inch to minimize the volume of silt and sand entering the well. This slot size is compatible with the results of the sieve analysis of existing wells shown in Appendix C of the RI Report (ref. 8). The mean grain size for the samples from the Fluvial Aquifer ranged from 0.0075 to 0.11 inches, with most samples in the range of 0.012 to 0.032 inches. Most of the wells had a coefficient of uniformity less than 3 and a curvature of less than 2. The screens in the existing wells are also of the same slot size. The wells have functioned satisfactorily. A 20/40 filter pack will be used in the well installations. This screen and filter pack combination will minimize the sediment entering the well, while allowing adequate flow for rapid purging and sampling of the monitor wells. To

confirm the compatibility between the screen and the aquifer material, sieve analysis will be performed on at least one representative sample of the aquifer in which the screen is placed. The sieve analysis will be conducted in accordance with ASTM-C 117 and C 136. The results will be submitted in the field boring logs.

Screen Location. Wells will be constructed so that base of the screen is near the top of the confining unit between the Fluvial and Memphis Sand aquifers. The proposed screen length is 10 feet. The placement of well screens near the base of the Fluvial Aquifer is consistent with the nature of the contaminants of concern. Floating constituents have not been encountered and are not expected during this project. The potential contaminants of concern include solvents such as 1,1,2,2-Tetrachloroethane; 1,1,2-Trichloroethane; 1,1-Dichloroethene; carbon tetrachloride; and trichloroethene, as well as metals such as arsenic, barium, lead, chromium, and nickel. None of these substances occur or are expected to occur as a floating product or dense layers within the aquifer.

Joining Screen and Riser. Screen and riser sections will be joined by threaded, flush-joint couplings to form watertight unions that retain 100 percent of the strength of the screen. Solvent glue will not be used at any time in construction of the wells. The bottom of the deepest screen or casing section will be sealed with a threaded cap or plug of inert, non-corroding material similar in composition to the screen.

Well Plumbness and Alignment. All risers and screens will be set plumb and true to line. The monitoring well screen and riser pipe will be held in the center of the hole by the augers during the installation of the annular materials. Centralizers will be used where necessary to calculate plumbness and alignment of the wells (generally for wells that exceed 80 ft in depth). It can be assumed that centralizers will be used for wells in the Memphis Sand Aquifer. Centralizers will not be attached to the well screen. The lowest centralizer attachment will be a minimum of 10 ft above the top of the well screen.

Filter Pack. Silica sand will be used as the filter pack material. Only clean, inert silica sand of 20/40 or similar gradation will be used to construct a uniform and continuous filter pack. This filter pack is slightly finer than would be typically used in material with the reported grain size distribution of the Fluvial Aquifer. However, this difference will not alter the well efficiency and will provide an effective connection with the aquifer. The pack will be designed to prevent migration of fines into the screen. The existing wells are constructed of similar-sized material. The filter pack will be placed by tremie pipe from the base of the boring to approximately 2 ft above the well screen. If the boring penetrates the confining layer, bentonite will be used to backfill the portion of the confining layer penetrated by the auger.

Bentonite Seal and Grout. A minimum 2-foot bentonite pellet seal will be placed into the annular space between the riser and the boring wall at the top of the filter pack. The bentonite will be tremied in place to prevent "bridging." A pure bentonite grout, consisting of a coarse-grained solid (Baroid Benseal, American Colloid, Volclay, or equal), will be placed from the top of the bentonite seal to within 2 feet of ground

surface. The grout will contain a minimum of 20 percent solids and be mixed in the field with clear water in accordance with manufacturer's specifications. The upper 2 feet of the annulus will be filled with cement grout, as shown in Figures 5-1 and 5-2.

Soil Sampling for Geotechnical Analysis. During drilling, soil samples will be collected and geotechnical analysis will be performed as outlined below:

- Soil samples will be taken continuously for the first 10 ft, and then at 5-foot intervals thereafter.

- Sampling will be done with a split-spoon sampler (ASTM-D 1586-67) or thin wall sampler (ASTM-D 1587-74) using standard sampling techniques.

- Samples will be stored in labeled, air-tight plastic or glass containers until such time as they are needed for testing or the contract is complete.

- All soil samples will be visually classified by the Unified Soil Classification System. The field classification will be verified by laboratory analyses consisting of the following:

  - Shelby tube samples will be collected from specific wells and borings identified in the OU-specific FSPs. These samples will be collected and tested using Standard Triaxial Permeability methods developed by the COE (Engineering Manual 1110-2-1906, 1986) (ref. 39) to determine if the confining unit is capable of allowing contaminants to migrate to the lower aquifer:

    a. Grain-size distribution (ASTM-D 421 and 424)
    b. Atterberg limits (ASTM-D 423 and 424)
    c. Moisture content (ASTM-D 2216)
    d. Triaxial permeability (EM 1110-2-1906, 1986)

  - Specific depths for samples to be tested will be determined by the field geologist after reviewing the boring logs.

Protection of Well and Surface Completion. Precautions will be taken to prevent tampering with monitoring wells or the entrance of foreign material into the well. Upon the completion of each well, a vented cap will be installed to prevent material from entering the well. A protective steel casing will be placed around the well riser. The steel casing will be equipped with a cap and lock and will be between 24 inches and 36 inches above ground level. It will be taller than the enclosed well. Depending on the location (offsite versus onsite), wells may be set in a protective casing much closer to the ground (flush-mounted) to reduce the attraction for vandalism. At a minimum, a 3-foot-square, 4-inch-thick concrete pad will be constructed around the protective casing at

ground level and sloped away from the well. The portion of the pad around the well will be set a minimum of 3 inches in the ground. Three, 2-inch or larger diameter steel posts will be equally spaced around the protective casing and embedded in the concrete pad. There will be no openings in the protective casing wall below its top. The top of the well riser, as opposed to the well casings, will be notched on the north side, which will be the point where the elevation is established. The elevation will be to the closest 0.01 foot. All outside casing will be permanently identified with the well number. A survey marker will be permanently placed in each pad. Each survey marker will be stamped with the identifying number according to the directions of the survey section in this QAPP. Protective casings and steel posts will be primed and painted with two coats of traffic yellow paint.

Temporary Capping. Any well that is to be temporarily removed from service, or left incomplete because of delay in construction, will be capped with a watertight cap and equipped with a vandal-proof cover.

5.4.2.6 Field Logs

The field geologist or geotechnical engineer will maintain suitable field logs detailing drilling and well construction activities. One copy of each field log, including the required color slides, will be submitted to the Contracting Officer not longer than 10 calendar days after each well is completed. Information provided in the logs will include the following, as a minimum:

- Reference point for all depth measurements
- Depth of each change of stratum
- Thickness of each stratum
- Identification of the material of which each stratum is composed according to the Unified Soil Classification System, or standard nomenclature, as necessary
- Depth interval from which each formation sample was taken, and condition of sample (such as wet or dry)
- Depth at which hole diameter (bit sizes) change
- Depth at which groundwater is first encountered
- Depth to the static water level
- Total depth of completed well
- Depth or location of loss of drilling fluids (if used)

- Location of any fractures, joints, faults, cavities, or weathered zones
- Depth and thickness of grouting or sealing
- Nominal hole diameters
- Amount of cement used for grouting or sealing
- Depth and type of well casing
- Description (to include length, location, diameter, slot sizes, material, and manufacturer) of well screen(s)
- Any sealing-off of water-bearing strata
- Static water level upon completion of the well and after well development
- Drilling date or dates
- Construction details of monitoring well
- Well development notes

The original boring logs will be given to the Huntsville COE with the final version of the RI/FS reports.

Final Logs. Photocopies of the original field logs will be included in an Appendix of the final report. Additionally, the field logs will be edited (for spelling and grammar) and drafted for inclusion into the final report.

5.4.2.7 Well Development

After each well has been constructed, but no sooner than 48 hours after grouting is completed, the well will be developed by pumping or surging, without the use of acids, dispersing agents, or explosives. Development will continue for a minimum of 4 hours or until groundwater removed from the well is clear and free of sand and drilling fluids, and parameters (such as pH, temperature, and conductivity) are stabilized to less than 5 percent fluctuation between three successive readings. Other than formation water from the particular well, no other liquid will be introduced into the well. After final development of the well, approximately 1 liter of water will be collected (from the well) in a clear glass jar and photographed in front of a standard color chart with 35-mm color slide film. The jar will be shaken immediately before being photographed to display any suspended solids. The photograph will have enough close-up lighting to show the clarity or turbidity of the water. The slides will be submitted as part of the well log.

5.4.2.8 In-Situ Permeabilities

The hydraulic conductivity of the water-bearing zone in which each monitoring well is screened will be estimated using a rising head pneumatic slug test method. This slug test method will allow testing to be performed quickly, and nearly instantaneous removal of the pneumatic slug will eliminate much of the noise in the very-early-time data that is often present in manual slug test methods in transmissive aquifers.

5.4.2.9 Decontamination Procedures

A stringent decontamination and inspection program will be followed to prevent the introduction of any contaminants into the subsurface during drilling. A decontamination area for the cleaning of drilling equipment will be set up away from the drill site. After cleaning and decontaminating, all drilling equipment and sampling tools will remain off the ground on metal racks, metal sawhorses, or plastic sheeting until ready for use.

Drill Rig and Tools. All the drilling rigs and drilling equipment will be steam cleaned in the designated cleaning/decontamination area before entering the drill site. In addition, all downhole drilling, sampling, and associated equipment will be cleaned and decontaminated by the following procedure:

- Steam clean using a steam cleaner capable of generating a pressure of at least 2,500 pounds per square inch (psi) and producing a steam of at least 20°F. All equipment that is hollow or that has holes to transmit water or drilling fluids will be cleaned inside and outside.
- Rinse with potable tap water.
- Rinse with de-ionized water from a stainless steel container.
- Rinse with pesticide grade isopropanol from a stainless steel container.
- Air dry.
- Wrap with aluminum foil, if appropriate, to prevent contamination if equipment is going to be stored or transported.

All cleaning and decontamination will be conducted in a designated area lined with heavy-duty plastic. A catch basin will be used or constructed to contain all runoff until it can be placed into containers. The cleaning of drilling equipment (drill pipe, auger, and tools) will be conducted above the plastic sheeting on saw horses or other appropriate means.

All of the drilling equipment, including the drill rig, will be inspected before entering the site to monitor whether there are fluids leaking and whether all gaskets and seals are

intact. No oil or grease will be used to lubricate drill stem threads or any other drilling equipment being used over the borehole or in the borehole without prior approval.

Soil and Sediment Sampling Equipment Decontamination. All the soil and sediment sampling equipment not associated with the drill rig and drilling will be decontaminated by personnel wearing disposable latex gloves or vinyl gloves and using the following procedure:

- Wash with tap water and laboratory grade, non-phosphate detergent, using a brush if necessary to remove particulate matter and surface films.
- Rinse with tap water.
- Rinse with de-ionized water.
- Rinse twice with pesticide grade isopropanol.
- Rinse with organic-free water (not deionized or distilled water).
- Air dry.
- Wrap with aluminum foil, if appropriate, to prevent contamination if equipment is going to be stored or transported.
- Water used in decontamination operations will be disposed of as is purge water.

Surface Water Sampling Equipment Decontamination. All of the surface water sampling equipment will be decontaminated by personnel wearing disposable latex gloves or vinyl gloves and using the following procedure:

- Wash with tap water and laboratory grade, non-phosphate detergent, using a brush if necessary to remove particulate matter and surface films.
- Rinse with tap water.
- Rinse with de-ionized water.
- Rinse twice with pesticide grade isopropanol.
- Rinse with organic-free water (not deionized or distilled water).
- Air dry.
- Wrap with aluminum foil, if appropriate, to prevent contamination if equipment is going to be stored or transported.

- Water used in decontamination operations will be disposed of as is purge water.

Groundwater Sampling Equipment Decontamination. With the following exceptions, all groundwater sampling will be conducted with disposable sampling equipment (such as disposable bailers and disposable rope) that requires no decontamination.

Elevation tapes will be decontaminated using the following procedure:

- Wash with tap water and laboratory grade, non-phosphate detergent, using a brush if necessary to remove particulate matter and surface films.
- Rinse with tap water.
- Rinse with de-ionized water.
- Air dry.
- Wrap with aluminum foil or seal in a plastic bag.

Submersible pumps and hoses used to purge groundwater wells will be decontaminated using the following procedures:

- Flush the hose using laboratory grade, non-phosphate detergent, followed by scrubbing the exterior of the hose with a brush.
- Rinse the exterior of the hose with tap water followed by pumping tap water through the hose.
- Rinse the exterior of the hose and pump with de-ionized water.
- Place equipment in a polyethylene bag to prevent contamination.

5.5 Geophysical Survey and Logging

5.5.1 Natural Gamma Logs

Although MW-36 and MW-37 are double cased, there is a concern that they may represent a pathway for migration of potentially contaminated water. Either a dual density (gamma-gamma) or an acoustic velocity log will be conducted in the two wells currently screened in the Memphis Sand Aquifer (MW-36 and MW-37) to measure the density of the grout, to determine the location of the filter pack relative to the confining unit (the filter pack will have a lower density than the bentonite seal), and to determine if the grout is effectively sealing the upper aquifer from the lower aquifer.

Gamma-gamma and acoustic velocity are the only geophysical methods available to determine the soundness of the grout inside a small borehole with a 2-inch-diameter well casing. Because of the accuracy and the lack of a nuclear source, the acoustical method is the preferred method. However, because the probe used in the acoustical method has a diameter of 1 1/16 of an inch, the well casing must be perfectly round and free of any interior abnormalities (such as scaling or ridges). If interior abnormalities are encountered, the gamma-gamma method will have to be employed.

Geophysical logging service companies must maintain licenses from the Nuclear Regulatory Commission (NRC) to operate and transport a nuclear source. Part of their license requirements includes preparing a company health and safety plan. This plan includes safe handling training for their employees, quarterly testing of their equipment, and training regarding safe shipment of the sources. Part of the employee training includes provisions that do not allow untrained personnel to operate or be near a source when it is onsite. When implementing the health and safety plan, the area where the source is used is roped off and untrained personnel are not allowed within that exclusion zone. The service company's health and safety plan will be followed when that company is onsite, as described in Section 10 of DDMT's HASP.

In addition to the precautions that service companies take to maintain their license, they are subject to an audit from the NRC (or from the agreement state that implements the NRC rules) while they are onsite.

Natural gamma logging will be performed on six existing wells to help identify the depth to the Jackson/Claiborne confining unit. Because the existing monitoring wells are constructed with 2-inch-diameter PVC, natural gamma logging is the only applicable logging method. Other viable alternatives require a larger diameter casing. These logs will be prepared by lowering a natural gamma radiation detector into the well or borehole and recording the amount of naturally occurring gamma radiation present as a function of depth. Clay minerals commonly contain the isotope potassium-40, which is typically the source of gamma radiation. Natural gamma logs will be used in determining the proportion of clay present and the depth to formation interfaces.

The six existing wells to be logged are the two wells into the Memphis Sand Aquifer (MW-36 and 37) and four Fluvial Aquifer wells (MW-19, 34, 38, and 39) in the north-central area of DDMT in the vicinity of the depression into the confining unit (see the Generic RI/FS WP, ref. 38), for a discussion of this depression). The two Memphis Sand wells will provide a clear profile of the natural gamma characteristics of the confining unit. The four Fluvial Aquifer wells may provide added information on clay formations in the vicinity of the confining unit. New wells will be logged on a case-by-case basis. The logging of the well will be conducted by qualified personnel. All the necessary equipment, personnel, and safety procedures will be provided by the selected contractor. A copy of the log, along with a letter report indicating the findings, will be submitted as an appendix to the RI report.

5.5.2 Electromagnetic and Magnetic Surveys

Electromagnetic and magnetic surveys were performed in Dunn Field in the vicinity of known burial sites. The survey was performed in June 1993 by the Corps of Engineers Waterways Experiment Station (CEWES). The purpose was to confirm locations of buried pits and trenches that might be burial sites of hazardous and toxic waste that could be contributing to groundwater contamination in Dunn Field. The results of the investigation are being analyzed and will be included as an appendix to the RI/FS report. Magnetometers will be used before drilling to clear drill sites of any buried metal and utilities.

5.6 Surveying

5.6.1 Control Monuments

Control monuments, monitoring wells, and soil and stratigraphic borings will be surveyed for their locations and elevations by a State of Tennessee certified land surveyor. Permanent survey markers will be installed at each control monument and monitoring well. Documentation, tabulation, and mapping of the final coordinates and elevations will be submitted in the RI Report appendixes.

Three permanent control monuments with a 3½-inch-diameter domed, brass, bronze, or aluminum alloy cap will be set in accessible locations within or immediately adjacent to the project area. These monuments will be set no closer than 500 ft to each other. Coordinates (1:10,000) and elevations (1:5,000) to Third Order accuracies or better will be established to the closest 0.01 foot for each monument. The coordinates will be referenced to the State Plane Coordinate System, and the elevations will be referenced to the 1929 North American Vertical Datum. Each survey marker and monument will be stamped with the following data by using steel dies that are a minimum of 1/8 inch tall: *COE, Huntsville, Alabama Identification Number Month and Year Established.*

5.6.2 Location Surveys

Coordinates and elevations will be established for each of the following items: all new monitoring wells, stratigraphic test borings, and the corners of the geophysical survey area. The coordinates will be to the closest 1.0 foot and referenced to the State Plane Coordinate System. The elevation will be determined for both the top of the well casing (at the water-level measuring point) and the top of the survey marker. All elevations will be referenced to the North American Vertical Datum of 1929. A 3½-inch-diameter domed brass, bronze, or aluminum alloy cap will be permanently set in the concrete pad surrounding each well. The marker will be stamped as indicated above. In addition to the coordinates, the elevations to the closest 0.01 foot will be provided for the survey marker and top of casing for the pump test well, the piezometers, and all new monitoring wells.

5.6.3 Documentation

A tabulated list of the coordinates and elevations for the corners of the geophysical survey, stratigraphic test borings, monitoring wells, and control monuments will be prepared and submitted. The tabulation will consist of the designated name or number of the corner, boring, well, or monument; the X and Y coordinates; and all of the required elevations. Elevations will be determined for both the top of casing and the top of the survey monument at each monitoring well. This information will be used to generate a map plotted at a scale of 1 inch = 300 ft or larger showing the location, identification, coordinates, and elevations of the geophysical survey, soil borings, wells, and monuments. The tabulated list of coordinates and the map will be submitted, along with all field books and computation sheets, no later than when the Draft RI Report for this project is submitted.

TAB

6.0

6.0 Calibration Procedures

6.1 Field Instruments

Field instruments will be calibrated daily before beginning sampling activities. Standards used to calibrate the field survey instruments will be traceable to NIST Standards. The method and frequency of calibration for the instruments used for each field activity are described in this section.

6.1.1 HNu Calibration

The meter will be calibrated according to manufacturer's instructions. The manufacturer will be contacted regarding recommendations for the most appropriate calibration procedure to be used for the contaminants of interest. General instructions are included in the HASP. On a daily basis, the meter will be calibrated to isobutylene. The HNu will be zeroed to background levels each hour and at each new location. Calibration records will be kept in the field log book by field personnel.

6.1.2 Organic Vapor Analyzer Calibration

The primary calibration of the OVA is performed at the factory to 100 parts per million (ppm) methane gas. Secondary calibration will be performed according to manufacturer's specifications at the beginning of each sampling activity. Those specifications are included in the HASP. In addition, the manufacturer will be contacted regarding recommendations for the most appropriate calibration procedure to be used for the contaminants of interest. The meter will be zeroed to background levels on a daily basis by field personnel.

6.1.3 Soil Boring Drilling

While drilling either borings or wells, an OVA or an HNu will be used to screen the soil samples and to monitor the ambient air. The calibration procedures outlined in Section 6.1.1 will be followed during the soil boring activities.

6.1.4 Groundwater Sampling

Several instruments will be used during the collection of groundwater samples. Initial monitoring of the ambient air for volatile organic vapors around the wellhead will be performed using an HNu meter. The meter will be calibrated to isobutylene each day and will be zeroed to ambient air at each well location before opening the well. During well evacuation, pH and specific conductance will be measured. The meters will be calibrated in the field before use at each well, following manufacturer's specifications. The calibration procedures are described below and will be carried out by field personnel.

6.1.5 pH Meter Calibration

The pH meters will be calibrated against two sets of standard pH solutions, either 4.0 standard units (SU) and 7.0 SU or 7.0 SU and 10.0 SU, depending on whether previous pH measurements have been less than or greater than 7.0 SU, respectively. Both the Cole-Parmer and Beckman meters automatically recognize pH standards and adjust the span and offset readings accordingly. Both pH meters also measure and display temperatures and automatically compensate pH readings accordingly. At the end of calibration, the meter readings will be adjusted and the probe will be rinsed thoroughly with distilled water.

6.1.6 Specific Conductivity Meter Calibration

The specific conductivity meters will be standardized by immersing the decontaminated conductivity probe into a standard solution of conductivity buffer. The conductivity of the standard solution will be within the same order of magnitude as the water sample. The meter reading will be manually adjusted to the buffer solution value. The Markson conductivity meter is automatically temperature-compensated to 20°C, while the Hanna meter requires manual adjustment of a temperature compensation knob. After calibrating, the probe will be triple rinsed with distilled water.

The pH and conductivity meters will be decontaminated before use at each well. The probes will be rinsed three times with distilled water before storage each day. The meters will be checked for battery charge and physical damage each day. The meters, pH standard solutions, and conductivity buffers will be stored in a cool, dry environment. Standard solutions will be discarded on their expiration dates.

6.2 Laboratory Equipment

The contracted laboratory will provide the project chemist and QA supervisor with a copy of the appropriate Comprehensive Quality Assurance Manual (CompQAM) for review and approval. The Laboratory CompQAM will outline in detail procedures for instrument calibration control.

TAB

7.0

Section 7.0
Analytical Procedures

Samples will be analyzed using EPA-approved methods. Before the field effort begins, the analytical laboratory will provide the lead chemist with a copy of its CompQAM for review and approval.

7.1 Data Packages

Level 1 and 2 data package deliverables were detailed in Section 3.2.2. Level 3 data package deliverables are summarized in Table 7-1. Level 4 deliverables are the same as Level 3 with the addition of all the unreduced experimental data.

7.2 Reporting Limits

Method target compound lists and reporting limits are summarized in Table 7-2. Because of the use of similar analytical techniques for Levels 2 and 3, the target reporting limits presented in Table 7-2 are applicable for both data quality levels.

7.3 Special Analyses

The reporting limits are based on the Contract Laboratory Program Contract Required Detection Limits, which are equal to PQLs for this project.

Ten VOC compounds, three SVOC compounds, and one pesticide have MCLs lower than the standard reporting limits for the analytical methods chosen, as summarized in Table 7-3. Groundwater samples from areas not affected by site activities will initially be analyzed using the normal VOC and SVOC methods (CLP). However, sample locations that meet both of the following criteria may be resampled and reanalyzed using the low-level method presented below:

- None of the method target compounds can be present in concentrations greater than 25 μg/L (upper linear calibration range for the CLP).
- At least one of the target compounds was detected above its MCL but below the method reporting limit.

Also, for compounds where the CLP reporting limits do not meet the MCL or other preliminary remediation goal, the intent is to reanalyze the sample using a method with lower detection limits, if feasible. The decision to reanalyze samples using lower detection limits will be made on a case-by-case basis.

Table 7-1
Level 3 Data Package Deliverables
Defense Depot Memphis, Tennessee

CLP Form	Purpose
Organic Compounds by GC/MS	
1	Data summary form
2	Surrogate spike recovery
3	MS/MSD recovery
4	Method blank summary
5	Instrument performance check summary
6	Initial calibration data
7	Continuing calibration check
8	Internal standard area and retention time summary
Organic Compounds by GC (Pesticides, PCBs, Herbicides)	
1	Data summary form
2	Surrogate spike recovery
3	MS/MSD recovery
4	Method blank summary
6D	Initial calibration retention time summary
7E	Continuing calibration summary
8C	Analytical sequence—evaluation of retention time shift for the internal standard
10	Compound identification summary
Inorganic Compounds	
1	Data summary form
2	Initial and continuing calibration verification
3	Blanks
4	ICP Interference check samples

Table 7-1
Level 3 Data Package Deliverables
Defense Depot Memphis, Tennessee

CLP Form	Purpose
5A	Spike sample recovery
5B	Post-spike sample recovery
6	Duplicates
7	Laboratory control sample
8	Method of standard addition results
9	ICP serial dilution results
10	Instrument detection limit
11A & B	ICP inter-element correction factors (annually)
12	ICP linear ranges (quarterly)
13	Preparation logs
14	Analysis run logs

Table 7-2
Target Compound Lists and Reporting Limits
Defense Depot Memphis, Tennessee

Target Compound	Water (µg/L)	Soil (µg/kg)
Volatile Organic Compounds		
Chloromethane	10	10
Bromomethane	10	10
Vinyl chloride	10	10
Chloroethane	10	10
Methylene chloride	10	10
Acetone	10	10
Carbon disulfide	10	10
1,1-Dichloroethene	10	10
1,1-Dichloroethane	10	10
1,2-Dichloroethene (total)	10	10
Chloroform	10	10
1,2-Dichloroethane	10	10
2-Butanone	10	10
1,1,1-Trichloroethane	10	10
Carbon tetrachloride	10	10
Bromodichloromethane	10	10
1,2-Dichloropropane	10	10
cis-1,3-Dichloropropene	10	10
Trichloroethene	10	10
Dibromochloromethane	10	10
1,1,2-Trichloroethene	10	10
Benzene	10	10
trans-1,3-Dichloropropene	10	10
Bromoform	10	10
2-Hexanone	10	10
4-Methyl-2-pentanone	10	10

Table 7-2
Target Compound Lists and Reporting Limits
Defense Depot Memphis, Tennessee

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Target Compound	Water (µg/L)	Soil (µg/kg)
Tetrachloroethene	10	10
1,1,2,2-Tetrachloroethane	10	10
Toluene	10	10
Chlorobenzene	10	10
Ethyl benzene	10	10
Styrene	10	10
Xylenes (total)	10	10
Semivolatile Organic Compounds		
Phenol	10	330
bis(2-Chloroethyl)ether	10	330
2-Chlorophenol	10	330
1,3-Dichlorobenzene	10	330
1,4-Dichlorobenzene	10	330
1,2-Dichlorobenzene	10	330
2-Methylphenol	10	330
2,2'-oxybis(1-Chloropropane)	10	330
4-Methylphenol	10	330
N-Nitroso-di-n-propylamine	10	330
Hexachloroethane	10	330
Nitrobenzene	10	330
Isophorone	10	330
2-Nitrophenol	10	330
2,4-Dimethylphenol	10	330
bis(2-Chloroethyoxy)methane	10	330
2,4-Dichlorophenol	10	330
1,2,4-Trichlorobenzene	10	330

Table 7-2
Target Compound Lists and Reporting Limits
Defense Depot Memphis, Tennessee

Target Compound	Water (µg/L)	Soil (µg/kg)
Naphthalene	10	330
4-Chloroaniline	10	330
Hexachlorobutadiene	10	330
4-Chloro-3-methylphenol	10	330
2-Methylnaphthalene	10	330
Hexachlorocyclopentadiene	10	330
2,4,6-Trichlorophenol	10	330
2,4,5-Trichlorophenol	25	830
2-Chloronaphthalene	10	330
2-Nitroaniline	25	830
Dimethylphthalate	10	330
Acenaphthylene	10	330
2,6-Dinitrotoluene	10	330
3-Nitroaniline	25	830
Acenaphthene	10	330
2,4-Dinitrophenol	25	830
4-Nitrophenol	25	830
Dibenzofuran	10	330
2,4-Dinitrotoluene	10	330
Diethylphthalate	10	330
4-Chlorophenyl-phenylether	10	330
Fluorene	10	330
4-Nitroaniline	25	830
4,6-dinitro-2-methylphenol	25	830
N-Nitrosodiphenylamine	10	330
4-Bromophenyl-phenylether	10	330
Hexachlorobenzene	10	330

Table 7-2
Target Compound Lists and Reporting Limits
Defense Depot Memphis, Tennessee

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Target Compound	Water (µg/L)	Soil (µg/kg)
Pentachlorophenol	5	165
Phenanthrene	10	330
Anthracene	10	330
Carbazole	10	330
Di-n-butylphthalate	10	330
Fluoranthene	10	330
Pyrene	10	330
Butylbenzylphthalate	10	330
3,3'-dichlorobenzidine	10	330
Benzo(a)anthracene	10	330
Chrysene	10	330
bis(2-Ethylhexyl)phthalate	10	330
Di-n-octylphthalate	10	330
Benzo(b)fluoranthene	10	330
Benzo(k)fluoranthene	10	330
Benzo(a)pyrene	10	330
Indeno(1,2,3-cd)pyrene	10	330
Dibenz(a,h)anthracene	10	330
Benzo(g,h,i)perylene	10	330
Thiodyglycol	12.1	4200
2,4-Dinitrotoluene	10	330
Pesticides and PCBs		
alpha-BHC	0.050	1.7
beta-BHC	0.050	1.7
delta-BHC	0.050	1.7

Table 7-2
Target Compound Lists and Reporting Limits
Defense Depot Memphis, Tennessee

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Target Compound	Water (µg/L)	Soil (µg/kg)
gamma-BHC (Lindane)	0.050	1.7
Heptachlor	0.050	1.7
Aldrin	0.050	1.7
Heptachlor epoxide	0.050	1.7
Endosulfan I	0.050	1.7
Dieldrin	0.10	3.3
4,4'-DDE	0.10	3.3
Endrin	0.10	3.3
Endosulfan II	0.10	3.3
4,4'-DDD	0.10	3.3
Endosulfan sulfate	0.10	3.3
4,4'-DDT	0.10	3.3
Methoxychlor	0.50	17
Endrin ketone	0.10	3.3
Endrin aldehyde	0.10	3.3
Toxaphene	5.0	170
Aroclor-1016	1.0	33
Aroclor-1221	2.0	67
Aroclor-1232	1.0	33
Aroclor-1242	1.0	33
Aroclor-1248	1.0	33
Aroclor-1254	1.0	33
Aroclor-1260	1.0	33
alpha-Chlordane	0.05	1.7
gamma-Chlordane	0.05	1.7

Table 7-2
Target Compound Lists and Reporting Limits
Defense Depot Memphis, Tennessee

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Target Compound	Water (µg/L)	Soil (µg/kg)
Herbicides		
2,4-D	2.5	50
Silvex (2,4,5-TP)	0.5	10
2,4,5-T	0.5	10
Dinoseb	0.5	10
Dioxins and Furans		
Tetrachlorodibenzodioxins	0.005	0.005
Pentachlorodibenzodioxins	0.005	0.005
Hexachlorodibenzodioxins	0.005	0.005
Tetrachlorodibenzofurans	0.005	0.005
Pentachlorodibenzofurans	0.005	0.005
Hexachlorodibenzofurans	0.005	0.005
Metals		
Aluminum–ICP	200	40,000
Antimony-ICP	60	12
Arsenic-GFAA	10	2
Barium–ICP	200	40,000
Beryllium-ICP	5	1
Cadmium-ICP	5	1
Calcium–ICP	5,000	1,000,000
Chromium-ICP	10	2
Cobalt–ICP	50	10,000
Copper-ICP	25	5
Iron–ICP	100	20,000
Lead-GFAA	3	0.6
Magnesium–ICP	5,000	1,000,000
Manganese–ICP	15	3,000

Table 7-2
Target Compound Lists and Reporting Limits
Defense Depot Memphis, Tennessee

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Target Compound	Water (µg/L)	Soil (µg/kg)
Mercury-CVAA	0.2	0.1
Nickel-ICP	40	8
Potassium−ICP	5,000	1,000,000
Selenium-GFAA	5	1
Silver-ICP	10	2
Sodium−ICP	5,000	1,000,000
Thallium-GFAA	10	2
Vanadium−ICP	5,000	1,000,000
Zinc-ICP	20	4

Table 7-3
Comparison of Organic Compounds with MCLs and Method Reporting Limits
Defense Depot Memphis, Tennessee

Target Compound	Analysis	MCL (µg/L)	Normal CLP Method Reporting Limit (µg/L)	Special Method Reporting Limit (µg/L)
Vinyl chloride	VOC	2	10	1[a]
Methylene chloride	VOC	5	10	2[a]
1,1-Dichloroethene	VOC	7	10	1[a]
1,2-Dichloroethane	VOC	5	10	1[a]
Carbon tetrachloride	VOC	5	10	1[a]
1,2-Dichloropropane	VOC	5	10	1[a]
Trichloroethene	VOC	5	10	1[a]
1,1,2-Trichloroethene	VOC	5	10	1[a]
Benzene	VOC	5	10	1[a]
Tetrachloroethane	VOC	5	10	1[a]
Hexachlorobenzene	SVOC	1	10	0.2[b]
Pentachlorophenol	SVOC	1	50	0.5[c]
bis (2-ethylhexyl)phthalate	SVOC	6	10	5
Aldrin	Pesticide	–	0.05	0.02[b]

[a]Low Level Contract Laboratory Program
[b]Method 8080
[c]Method 8151

TAB

8.0

8.0 Data Quality Evaluation

8.1 Level 1—Field Survey Data

Field instruments used by CH2M HILL to collect temperature, pH, and conductivity are direct reading, thus making field calculations and subsequent data reduction unnecessary. All field data will be recorded in the site log books by appropriate trained field personnel. Field data will include the following:

- Instrument identification
- Calibration information (standards used and results)
- Date and time of calibration and sample measurement
- Sample results
- Supporting information (for example, temperature for pH reading)

If QC samples are used as part of the overall immunoassay tests, the results of these analyses also will be included in the field log. The FTL will provide a summary of the immunoassay results to the project chemist as well as to the FTL for review.

All data will be reviewed the FTL, who is responsible for the collection and verification of all field data while in the field. Data initially will be accepted or rejected by the FTL before leaving the sampling site. Extreme readings (readings that appear significantly different from other readings at the same site) will be accepted only after the instrument has been checked for malfunction and the readings verified by retesting. In addition, extreme or spurious readings will be recorded in the field log book, along with the rationale for accepting or rejecting the data.

Field documentation, sample data, instrument calibrations, and QC data will be reviewed by the PM (or a designee) before being included in the project files. QC checks will be reviewed by the project chemist, as well.

8.2 Level 2—Field Screening Data

The field screening laboratory will be required to provide a limited data package that includes instrument calibration, results for field samples, method blanks, and QC samples. This data package will be defined in detail in the subcontracting documents.

The project chemist will review the QC supporting information on a weekly basis and will provide a summary report to the PM at the end of the field effort. Areas of review will include the following:

- Instrument Calibration—Correct frequency for initial and continuing calibration, initial calibration linear range, and continuing calibration within the method target acceptance limits
- Sample Results—Results within the linear calibration range
- Laboratory Method Blanks—Potential for field sampling or laboratory contamination
- QC Sample Results—Replicate sample precision and spiked sample recovery (where applicable)
- Matrix Spike Results—Will be used to evaluate the effect of the sample matrix on the overall analytical results, as well as to provide an estimate for analytical accuracy and precision.

In addition to the methods outlined above, samples will be submitted to the fixed-base analytical laboratory for Level 2 screening. The laboratory will use the same analytical approach as outlined in the EPA-approved method; however, for Level 2 the frequency of QC will be decreased and no supporting QA/QC documentation will be included in the data package deliverables. There will not be any changes in the method target compound lists and reporting limits. For example, samples will still be analyzed for the same list of VOCs; however, for Level 2 samples, fewer MS/MSD samples will be analyzed and only sample results and method blank results will be submitted for the data package deliverables.

8.3 Level 3—Laboratory Analyses

Data quality evaluation will be performed by the CH2M HILL project chemists. The data quality evaluation process is used to assess the effect of the overall analytical process on the usability of the data. The two major categories of data evaluation are laboratory performance and matrix interferences. Evaluation of laboratory performance is a check for compliance with the method requirements and is a straight-forward examination; either the laboratory did, or did not, analyze the samples within the limits of the analytical method. Evaluation of the matrix interferences is more subtle and involves examination of several results including surrogate spike recoveries, matrix spike recoveries, and duplicate sample results.

Level 3 data package deliverables are summarized in Table 7-1 and will be detailed in the laboratory subcontractor documents. Before the analytical results were released by the

laboratory, both the sample and QC data were carefully reviewed to verify sample identity, instrument calibration, detection limits, dilution factors, numerical computations, accuracy of transcriptions, and chemical interpretations. Additionally, the QC data were reduced and spike recoveries were included in control charts, and the resulting data were reviewed to ascertain whether they were within the laboratory defined limits for accuracy and precision. Any non-conforming data were discussed in the data package cover letter and case narrative. The laboratory will retain all the analytical and QC documentation associated with each data package. Such retained documentation need not be hard (paper) copy, but can be available on other storage media such as magnetic tape. However, the laboratory must be able to produce a hard copy of all the retained information upon request.

The data package will be reviewed by the project chemists using the process outlined in the EPA guidance document, *Functional Guidelines for Evaluating Data Quality* (EPA, 1991) (ref. 40). This overall process is used regardless of whether the samples were analyzed using CLP methods or not. The data review and validation process is independent of the laboratory's checks. It focuses on the usability of the data to support the project data interpretation and decision-making process. Areas of review include data package completeness, holding time compliance, initial and continuing calibration, spiked sample results, method blank results, and duplicate sample results. A data review worksheet will be completed for each data package. Acceptance criteria for each area of review are specified in the analytical method. For example, acceptance criteria for initial and continuing calibration are specified in each analytical method; any non-conformances will be noted on the data review worksheets and the effect of the non-conformance on the overall usability of the data will be evaluated as part of the overall data quality evaluation.

Samples that do not meet the acceptance limit criteria will be indicated with a qualifying flag, which is a one or two-letter abbreviation that indicates a problem with the data. Flags used in the text may include the following:

- **U** Undetected. Analyte was analyzed for but not detected above the detection limit.
- **J** Estimated. The analyte was present, but the reported value may not be accurate or precise.
- **UJ** Reporting limit estimated. The analyte was not detected above the method detection limit, but the actual detection limit may be estimated.
- **R** Rejected. The data were rejected because the corresponding QC data were not within the method-specified limits.

It is important to note that laboratory qualifying flags are included on the data summary forms (Form I) which are submitted to the project by the laboratory. However, during

the data review and validation process, the laboratory qualifying flags are evaluated and replaced with validation flags.

Once each of the data packages has been reviewed, and the data review worksheets completed, then the entire data set will be evaluated for overall trends in data quality and usability. Information summarized as part of the data quality evaluation may include chemical compound frequencies of detection, dilution factors that might affect data usability, and patterns of target compound distribution. The data set will also be evaluated to identify potential data limitation or uncertainties in the laboratory. Additional areas of review are discussed below.

8.3.1 Field and Laboratory Blank Contamination

Review includes the appearance and concentration of target compounds in field and laboratory blanks as well as of environmental samples. Common field sampling and laboratory contaminants detected in blank include acetone, methylene chloride, and phthalates. Acetone and methylene chloride are used to extract samples in the laboratory and hence are common laboratory contaminants. Phthalates are used as plasticizers, the most common of which is bis(2-ethylhexyl)phthalate, and are often introduced during sample handling.

According to the EPA Functional Guidelines, concentrations of these common contaminants detected in samples at less than 10 times the maximum concentration in the blanks can be attributed to field sampling and laboratory contamination rather than to environmental contamination from site activities. As a note, concentrations of common contaminants such as acetone, methylene chloride, and phthalates detected in both the sample and the corresponding blanks use the 10X rule. Concentrations of less common contaminants are multiplied by five rather than 10, as required by the EPA Functional Guidelines.

8.3.2 Surrogate Spike Recoveries

Surrogate spike recoveries are compounds for each of the organic analytical methods. For gas chromatograph/mass spectrometer (GC/MS) analyses, surrogate spike compounds are the structural homologs of target compounds, often with deuterium substituted for hydrogen, and are therefore are expected to behave in a similar manner during analysis. For GC analyses, surrogate spike compounds, are structurally similar (but not identical) to target compounds and again, should behave in a similar manner during analysis. Surrogate spike recoveries are used to monitor both laboratory performance and matrix interferences. Surrogate spike recoveries from field and laboratory blanks are used to evaluate laboratory performance because these blanks represent an ideal sample matrix. Surrogate spike recoveries for field samples are used to evaluate the potential for matrix interferences. When surrogate spike recoveries for field samples fall outside the method target acceptance windows, the samples are re-analyzed. If the surrogate spike recovery

is still outside the acceptance window for the re-analyzed sample, then the sample results are qualified as affected by matrix interferences.

8.3.3 Matrix Spike Recoveries

For this QC measure, three aliquots of a single sample are analyzed—one native and two spiked with the same concentration of matrix spike compounds. Unlike the surrogate spike compounds, matrix spike compounds are found on the method target compound list. Spike recovery is used to evaluate potential matrix interferences as well as accuracy. The duplicate spike results are compared to evaluate precision.

8.3.4 Duplicate Sample Results

Typically, one duplicate field sample will be collected for every 10 field samples. Both the native and duplicate samples are analyzed for the same parameters. Target compounds that are detected in both the native and duplicate samples can be compared and precision for the sample results calculated.

8.4 Level 4—Laboratory Analyses

Data quality evaluation of Level 4 data will be executed using the same process described for Level 3 data; however, calculations for calibration, spike recovery, and sample results will be recreated using the raw data. These example calculations will be included with the data review worksheets.

8.5 Reconciliation with Data Quality Objectives

The final activity of the data quality evaluation is an assessment of whether the data meets the DQOs. The goal of this assessment is to demonstrate that a sufficient number of representative samples were collected and the resulting analytical data can be used to support the project decision-making process. The following precision, accuracy, representativeness, completeness, and comparability (PARCC) measures are used:

- **Precision**—is the agreement between duplicate results and can be estimated by comparing duplicate matrix spike recoveries and field duplicate sample results.

- **Accuracy**—is a measure of the agreement between an experimental determination and the true value of the parameter being measured. For organic analyses, each of the samples is spiked with a surrogate spike compound and for inorganic analyses, each sample was spiked with a known reference material before digestion. Each of these approaches provides a measure of the matrix effects on the analytical accuracy.

Accuracy can be estimated from the analytical data and cannot be measured directly.

- **Representativeness**—is a qualitative measure of the degree to which sample data accurately and precisely represent a characteristic environmental condition. Representativeness is a subjective parameter and is used to evaluate the efficacy of the sampling plan design. Representativeness is demonstrated by providing full descriptions of the sampling techniques and the rationale used for selecting sampling locations in the project scoping documents.

- **Completeness**—is defined as the percentage of measurements that are judged to be valid compared to the total number of measurements made. Typically, a goal of 95 percent usable data is desired.

- **Comparability**—is another qualitative measure designed to express the confidence with which one data set may be compared to another. The following factors affect comparability: sample collection and handling techniques, sample matrix type, and analytical method. Comparability is limited by the other PARCC parameters because data sets can be compared with confidence only when precision and accuracy are known. Data from one phase of an investigation to another can be compared when the same EPA-approved methods are used and data package deliverables are similar.

TAB

9.0

9.0 Performance and System Audits 127 91

Performance and systems will be audited to verify documentation and implementation of the project work plan, to identify any nonconformances, and to verify correction of identified deficiencies.

9.1 Assessments and Response Actions

Assessment activities may include surveillance, inspections, peer review, management system review, readiness review, technical systems audit, performance evaluation, and data quality assessment. The CH2M HILL project chemist or PM will be responsible for initiating audits, for selecting the audit team, and for overseeing audit implementation.

The project chemist or PM will evaluate the need for a performance audit independently, or by recommendation of the PM or the client. Performance audits are used to quantitatively assess the accuracy of analytical data through the use of performance evaluation and blind check samples. Laboratory performance will be audited by the PM, project chemist, or a designee.

The FTL is responsible for supervising and checking that samples are collected and handled in accordance with the approved project plans and that documentation of work is adequate and complete. The PM is responsible for seeing that project performance satisfies the QA/QC objectives. Reports and technical correspondence will be peer reviewed by an assigned qualified individual, otherwise external to the project, before being finalized.

9.2 Field Team Performance and System Audits

The FTL or a designated representative will conduct weekly informal audits of the field activities. The weekly audit for completeness will include the following items:

- Sample labels
- COC records
- Field notebooks
- Sampling operations
- Document control

The first three items above will be checked for completeness. Sampling operations will be reviewed to determine if they are performed as stated in the project-specific work plan, or as directed by the FTL. The informal document control audit will consist of checking each document for completeness, including such items as signatures, dates, and project numbers.

A systems audit of field operations may be required by the project-specific work plan and will be used to review the total data generation process, which includes onsite review of the field operational system, physical facilities for sampling, and equipment calibrations. A performance audit may be conducted by the PM and the FTL during the first week of sampling if it is deemed necessary by the PM, FTL, project chemist, or client. The audit may focus on verifying that proper procedures are followed so that subsequent sample data will be valid. Before the audit, a checklist will be prepared by the PM and the FTL, and will serve as a guide for the performance audit. The audit may verify the following:

- Collection of samples follows the available written procedures.
- COC procedures are followed for traceability of sample origin.
- Appropriate QC checks are being made in the field and documented in the field log book.
- Specified equipment is available, calibrated, and in proper working order.
- Sampling crews are adequately trained.
- Record-keeping procedures are being followed and appropriate documentation is maintained.
- Corrective action procedures are followed.

An audit report summarizing the results and corrections will be prepared and filed in the project files.

9.3 Laboratory Performance and Systems Audits

The analytical laboratory will conduct both internal and external QC checks. External QC checks include participation in EPA's certification and performance evaluation programs. The results of quarterly performance evaluation samples will be made available to the PM on request. Internal QC checks (duplicates, blanks, and spiked samples) will be performed in accordance with the approved methods.

Laboratory systems will be audited annually and as required by specific projects. Contracted laboratories are required to submit a laboratory QAPP and relevant SOPs before the field effort begins. If, during data evaluation and data use, any problems are noted, specific corrective actions will be implemented on a case-by-case basis. An additional systems audit may be requested by the CH2M HILL project chemist or PM, if warranted.

Depending on the project objectives, the laboratory may be required to perform the following:

- Monthly project review of 10 percent of all projects done by the QA department
- Audits performed by the laboratory QA manager at a frequency greater than specified in the lab CompQAM
- Special audits by the project chemist or corporate management when a problem is suspected

TAB

10.0

10.0 Preventive Maintenance

127 95

10.1 Field Instruments

All equipment used by CH2M HILL will be maintained in accordance with the manufacturer's instructions. Preventive maintenance activities for field equipment are listed in Table 10-1. Routine maintenance and all equipment repairs will be documented in the site log book. Whenever a piece of equipment fails to operate properly, the instrument either will be repaired in-house (if possible) or will be sent out for repairs and another instrument equivalent to the original substituted (if possible).

Table 10-1
Field Equipment Preventive Maintenance
Defense Depot Memphis, Tennessee

Instrument	Activity	Frequency
pH meter	Battery replacement or electrode cleaning	As needed (indicated by LCD display) or as specified in instrument manual
Conductivity Meter	Battery replacement or probe cleaning	As needed (indicated by LCD display) or as specified in instrument manual

10.2 Analytical Laboratory Instruments

Preventive maintenance for laboratory instruments is discussed in detail in the laboratory CompQAM.

TAB

11.0

11.0 Calculation of Data Quality Indicators

11.1 Quality Control Measures

The QC measures described below are incorporated into Levels 2, 3, and 4 analytical methods.

Method Blanks—A method blank is a sample of analyte-free water that is treated as a sample in that it undergoes the same analytical process as the corresponding field samples. Method blanks are used to monitor laboratory performance and contamination introduced during the analytical procedure. Typically, one method blank is required per 10 or 20 samples (depending on the analytical method) or one per batch, whichever is more frequent.

Matrix Spikes—For inorganic analyses, a single sample is split and one portion is spiked with a known amount of reference material. For organic analyses, three aliquots of a single sample are analyzed—one native and two spiked with matrix spike compounds. Unlike the surrogate spike compounds, matrix spike compounds are found on the method TCL. Spike recovery is used to evaluate potential matrix interferences as well as accuracy. The duplicate spike results are compared to evaluate precision. The matrix spike compounds and method target acceptance ranges are summarized for each analytical method. Typically, one matrix spike (inorganic) or matrix spike/matrix spike duplicate (MS/MSD) sample (organic) is analyzed for every 20 samples of the same matrix.

Surrogate Spikes Recoveries—This QC measure is applicable only to organic analyses. Surrogate compounds are the structural homologs of target compounds, often with deuterium substituted for hydrogen, and are therefore expected to behave in a similar manner during the analysis. Surrogate spike recoveries were used to monitor both laboratory performance and matrix interferences. Surrogate spike recoveries from field and laboratory blanks were used to evaluate laboratory performance because the field blanks represent an "ideal" sample matrix. Surrogate spike recoveries for field samples were used to evaluate the potential for matrix interferences. For field samples, when the surrogate spike recoveries fall outside the method target acceptance windows, the samples are re-analyzed. If the surrogate spike is still outside the acceptance window for the re-analysis, then the sample results are qualified as affected by matrix interferences.

11.2 Formulas for Calculating Accuracy, Precision, and Completeness

Precision is a measure of the agreement or repeatability of a set of replicate results obtained from duplicate analyses made under the same conditions. Precision will be estimated from analytical data and cannot be measured directly. The precision of a

duplicate determination can be expressed as the relative percent difference (RPD), as calculated from the equation:

$$RPD\ IX_1 - X_2 I / (X_1 + X_2)\ X\ 200$$

where X_1 and X_2 are the duplicate values.

Accuracy is a measure of the agreement between an experimental determination and the true value of the parameter being measured. Accuracy is estimated through the use of known reference materials or matrix spikes. Accuracy is calculated from analytical data and is not measured directly. Spiking of reference materials into an actual sample matrix is the preferred technique because it provides a measure of the matrix effects on the analytical accuracy. Accuracy, defined as percent recovery (P), is calculated by the following equation:

$$P = [(SSR - SR) / SA]\ x\ 100$$

where SSR is the spiked sample result, SR is the sample result (native), and SA is the spike added.

Completeness is defined as the percentage of measurements judged to be valid compared to the total number of measurements made. Completeness is calculated using the formula:

$$\text{Completeness} = \frac{\text{Valid Measurements}}{\text{Total Measurements}} \times 100$$

TAB

12.0

12.0 Corrective Actions

127 100

12.1 Field Activities Corrective Actions

The PM is responsible for initiating corrective actions. Corrective action steps include problem identification, investigation responsibility assignment, investigation, action to eliminate the problem, increased monitoring of the effectiveness of the corrective action, and verification that the problem has been eliminated.

Documentation of the problem is important to the overall management of the study. A corrective action request form for problems associated with sample collection is completed by the person discovering the QA problem. This form identifies the problem, establishes possible causes, and designates the person responsible for action. The responsible person will be either the project manager or the FTL.

The correction action request form (Figure 12-1) includes a description of the corrective action planned and has space for follow-up. The PM verifies that the initial action has been taken and appears to be effective and, at an appropriate later date, checks to see if the problem has been resolved fully. The PM receives a copy of all corrective action request forms and enters them into the corrective action log. This permanent record aids the PM in follow-up and assists in resolving the QA problems.

Examples of corrective action include, but are not limit to, correcting COC forms, analysis reruns (if holding time criteria permit), recalibration with fresh standards, replacement of sources of blank contamination, or additional training in sampling and analysis. Additional approaches may include the following:

- Resampling and re-analyzing.
- Evaluating and amending sampling and analytical procedures.
- Accepting the data and acknowledging the level of uncertainty or inaccuracy by flagging the validated data and providing an explanation for the qualification.

12.2 Laboratory Activities Corrective Actions

The laboratory department supervisors review the data generated to verify that all QC samples have been run as specified in the protocol. Laboratory personnel are alerted that corrective actions may be necessary under the following conditions:

- QC data are outside the warning or acceptable windows for precision and accuracy established for laboratory samples.

Originator: _____ Date: _____

Person responsible for replying: _____

Description of problem and when identified: _____

_____

Sequence of Corrective Action (CA): (Note, if no responsible person is identified, submit this form directly to the project manager)

State date, person, and action planned:

_____

_____

_____

_____

_____

CA initially approved by: _____ Date: _____

Follow-up date: _____

Final CA approval by: _____ Date: _____

Information copies to:

Responsible Person: _____

Field Team Leader: _____

Project Manager: _____

FIGURE 12-1
CORRECTIVE ACTION REQUEST FORM
Defense Depot Memphis, Tennessee

MOP-0005.DWG 21-Feb-1995

- Blanks contain contaminants at concentrations above the levels specified in the laboratory QAPP for any target compound.
- Undesirable trends are detected in matrix spike recoveries or RPD between matrix spike duplicates.
- There are unusual changes in detection limits.
- Deficiencies are detected by the laboratory QA director during internal or external audits, or from the results of performance evaluation samples.

If nonconformances appear in analytical methodologies, QC sample results are identified by the bench analyst, and corrective actions are implemented immediately. Corrective action procedures are handled initially at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors; and checks the instrument calibration, spike and calibration mixes, instrument sensitivity, and so forth. The analyst immediately notifies his/her supervisor of the problem that is identified and the investigation being made. If the problem persists or cannot be identified, the matter must be referred to the laboratory supervisor and QA/QC officer for further investigation. Once resolved, full documentation of the corrective action procedure must be filed with the laboratory supervisor, and the QA/QC officer must be provided with a corrective action memorandum for inclusion into the project file if data are affected.

Corrective actions may include, but are not limited to, the following:

- Re-analyzing suspect samples
- Resampling and analyzing new samples
- Evaluating and amending sampling and analytical procedures
- Accepting data with an acknowledged level of uncertainty
- Recalibrating analytical instruments
- Qualifying or rejecting the data

After the implementation of the required corrective action measures, data that is deemed unacceptable may not be accepted by the PM, and follow-up corrective actions may be explored. Details of laboratory corrective actions are provided in the laboratory CompQAM.

TAB

13.0

13.0 Quality Assurance Reports 127 104

The purpose of QA reports is to document implementation of the QAPP. These reports include periodic assessments of measurement data accuracy, precision, and completeness; the results of performance audits; the results of system audits; and identification of significant QA problems and recommended solutions.

The analytical laboratory will be responsible for submitting monthly progress reports to the client as requested.

The final QA report will be attached as an appendix to the project report and may include the following:

- Data quality assessment in terms of PARCC, and the method detection limits
- The degree to which DQOs were met
- Limitations of the measurement data; usability of the data
- Applicability of the data to site conditions
- Laboratory QC activities, including a summary of planned versus actual laboratory QC activities, explanations for deviations, and an evaluation of data quality for each analysis for each media
- Field QC activities, including a summary of planned versus actual field QC activities, explanations for deviations, and an evaluation of the data quality of field QC samples/activities and estimated effect on sample data
- Data presentation and evaluation, including an assessment of sampling and analysis techniques, data quality for each analysis and each media, and data usability

A final report will be submitted to the client after comments from the client and any regulatory agencies have been incorporated.

TAB

14.0

14.0 Sample and Database Management 127 106

14.1 General Information

The project database will be EDMS-A (environmental data management system in Access) and an environmental management information system (EMIS) deliverable will be submitted to the client. EMIS is similar to Interchange File Format (IFF) typically used by EPA, and the two formats are compared in Table 14-1. The few fields in IFF that do not correspond to an EMIS field include data that are not normally collected or are represented in EMIS in another field (LTHAN in Table 14-1 is represented in the flag qualifiers in EMIS).

The data management team consists of the PM, database manager, and data manager. The team will be responsible for the execution of the Data Management Plan. All documentation relating to the development and execution of the Data Management Plan will be kept in the project data management file, which will be stored in a central location accessible to all members of the data management team. The data manager will be responsible for maintenance of the data management file.

The data management file will consist of the following sections:

- Internal correspondence
- External correspondence
- Field correspondence
- Data management meeting notes
- Work plan information
- Project instructions
- Status reports
- E-Data documentation from lab
- Import description and exception reports
- Front-end QC description and exception reports
- Intermediate QC description and exception reports
- Back-End QC description and exception reports
- E-Data resubmittal requests
- Internal deliverable review comments
- External deliverable review comments
- Standard procedures

All electronic files associated with the project data management task will be kept on the network file server. Examples of these files are memos, plans, instructions, spreadsheets with station data, and the database itself. Backups of this data will be made according to that office's daily, system-wide backup routine.

Table 14-1
Parameters
Defense Depot Memphis, Tennessee

[illegible]	Format	Description	[illegible]	COMMENTS
LOCATION KEY	[A22]	(1-16 SiteID) (17-21 Solid Wst Mgt ID) (22 Program Status Indicator - VVL)	SAMP_LOC - LOC_ID	
			SAMP_LOC - SITE_ID	
SAMPLE KEY	[A15]	Unique field sample ID	SAMPLE_DATA - SAMPLE_NO	
PARAMETER KEY	[A15]	Unique lab sample ID	SAMPLE_PREP - LABSAMP_ID	
CASE NUMBER	[A5]	Batch identifier	SAMPLE_PREP - SDG	
PARAMID	[A12]	Parameter identifier	ANAL_RES - PARAM_LABEL	
REPLNUM	[XXXX]	Replicate number. Identifies results as which number replicate	None	
LABQUALIF	[A2]	Lab qualifier - VVL	ANAL_RES - LAB_QUAL	
REVIEWQUALIF	[A2]	Project qualifier - VVL	ANAL_RES - DATA_QUAL	
WHO_REVIEW	[A4]	Name and organization of reviewer	ANAL_RES - VALCOMP - VVL	
VALUE	[XXXXXXX.XXXX]	Analytical result of chemical	ANAL_RES - CONCENTRATION	
LTHAN	[A2]	[ND] for non detects or blank for detects	None	like lab and proj qualifiers
UNITS	[A6]	Units	ANAL_RES - UNIT_MEAS	
AMETHOD	[A40]	Analytical method used to find VALUE	ANAL_RES - ANAL_METH	
EMETHOD	[A40]	Extraction method used (SV, Pesticide/PCB etc.)	SAMPLE_PREP - EXTRACT_METH	
ADATE	[YYMMDD]	Analysis date	SAMPLE_PREP - ANALYSIS_DATE	
CDATE	[YYMMDD]	Collection date	SAMPLE_DATA - COLLECT_DATE	
RDATE	[YYMMDD]	Date recieved at lab	SAMPLE_PREP - RECEIVED	
EDATE	[YYMMDD]	Extraction date	SAMPLE_PREP - EXTRACT_DATE	
MATRIX	[A5]	Sample matrix (SOIL, WATER, AIR, OTHER)	SAMPLE_DATA - MATRIX	
DILUTION	[XXXXXXXX]	Dilution factor	ANAL_RES - DILUTE	

Table 14-1
Parameters
Defense Depot Memphis, Tennessee

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
REPLIMIT	[XXXXXXX.XXXX]	Lab reporting limit	ANAL_RES - DETECT_LIM	
DETECT_LIMIT	[XXXXXXX.XXXX]	Method detection limit	None	
PQL	[XXXXXXX.XXXX]	Practical quantification limit for the specified analysis	None	
LAB	[A40]	Name of lab performing analysis	SAMPLE_PREP - LAB_ID	
Comment	[A80]	Additional information	ANAL_RES - COMMENTS	

14.2 Hard Copy Data Management

Management of hard copy data packages is the responsibility of the data manager. As data packages are received, the data manager will enter the sample delivery group (SDG) number and date received in the database, and pass the data package to the data quality evaluation manager.

A cursory review of each hard copy data package will be performed by the data quality evaluation manager. Under the direction of the data quality evaluation manager, the data received will be compared to the COC to confirm that hard copies of all expected results are received. The SDG number for each analysis requested (for example, volatiles, semivolatiles, total metals, filtered metals, and dioxins) will be recorded in the Detailed Data Inventory Sheet (DDIS). Data packages will be prepared for data quality evaluation and filed in a central data storage area.

After all data packages are received, the DDIS will be reviewed for completeness by the data quality evaluation (DQE) team as part of the data quality evaluation process. The finalized DDIS will be included as part of the data quality evaluation technical memorandum delivered to the client.

14.3 Field Data Management

A sample tracking program (STP) will be used to manage data collected by the field team. STP is a subsystem of the EMIS implementation of the Microsoft Access-based Environmental Data Management System (EDMS/A-EMIS), developed to manage the flow of information from the field sampling team to the laboratory and to internal/external clients. STP is used for entry of field-originating information (such as station locations, lithologic descriptions, well completion information, sample collection dates/times, analyses requested, and field measurements), and to produce sample bottle labels, COC forms, electronic files containing COC information, and daily and weekly sampling summary reports.

STP will be updated by the database manager to include codes for EMIS-specific data reporting requirements (such as site location type, sample matrix, and analytical method) in accordance with the November 1994 EMIS Data Dictionary. Queries will be developed to aid the field team in calculating sample collection statistics and in verifying stations sampled and analyses requested against the work plan. All software modifications and support will be the responsibility of the database manager.

Before field mobilization, all STP modifications will be reviewed. All November 1994 EMIS Data Dictionary codes applicable to the project will be verified by data entry personnel. A data inventory table of all analytical methods to be requested and the corresponding analytes to be received from the laboratory will be verified by the data

manager and sent to the laboratory for verification. All sampling location information (such as well identification and site identification) will be verified against historically used location information by the data manager. If historical names are not available, location information will be provided by the client's data manager. A table of location information and the corresponding analyses to be requested will be sent to the client's data manager for independent verification.

Testing of STP modifications will consist of running STP through the normal daily routine performed in the field using an example data set that will be representative of planned field sampling activities. A daily sample summary report will be printed. Sample labels will be generated for all planned analytical combinations. Sample collection times will be entered and a COC will be printed. An electronic file containing COC information will be generated and sent via modem to the analytical laboratory for import into its data management system. Finally, an example weekly summary report will be produced and compared against the example data set.

The data manager will coordinate the implementation of STP during the field investigation during the mobilization period. Implementation will include the setup of all necessary computer hardware and software, setup of electronic communication systems, installation of the database, and STP usage training for the two-person sample management team. After the initial training, the data manager will provide support to the sample management team, as needed, for the duration of the field sampling event.

During the field sampling event, all station location, lithologic description, well completion, groundwater level, and sampling-related data will be entered by one field sample management team member and checked by the other team member against the original data forms (for example, purging forms, sampling forms, soil boring logs, and well completion logs) using the manual data entry verification procedure described below.

One of the sample management team members will be designated as the field data manager and will assume responsibility for setting up samples, generating labels, logging samples and generating COCs, generating electronic files containing COC information and transferring them via modem to the analytical laboratory, and entry of field-related information. The field data manager is also responsible for verifying that samples with QA Levels 3 and 4 collected on the same day will be shipped to the laboratory on separate COCs. The other sample management team member will be responsible for setting up sample coolers in the morning for the sampling teams to take out, checking in coolers after sample collection throughout the day, confirming that the sample preservation is adequate, shipping the sample coolers from the field to the laboratory, and verifying field-related information entered into the database against the hard copy. QA Level 2 (screening) samples and analyses will not be tracked by STP or reported in EMIS format.

The FTL will notify the data manager or database manager of any unusual occurrences relating to field sampling that affect the field or laboratory data that are to be processed by the data management team. Examples of unusual occurrences are assigned samples

that were not collected, omission of field-generated data from the database, or breaking of sample bottles during transport to or processing at the laboratory. This information will be documented as appropriate in the database and the data management file under "Field Correspondence."

After log-in of the SDG from the field, the laboratory will acknowledge receipt of the samples by faxing the following items to both the field data manager and the DQE team:

- COC
- Exception Report—noting any problems with the sample shipment
- Sample Receipt Summary Report—containing data entered into the laboratory's database for each sample (including SDG, sample identification, location identification, analysis requested, data collected, and date received by laboratory)

The field data manager will use this information to verify all field-related information (sample identification, location identification, analysis requested, and date collected) at the laboratory, using the manual data entry verification procedure described in this section. The date received by the laboratory and the SDG number assigned by the laboratory to each sample will be entered into STP by the field sample management team from the Detailed Laboratory Summary Report.

The field data manager will generate a weekly sample status report. This report will be delivered to the FTL for review and delivery to the client. The field data manager will fax a copy of the finalized weekly sample status report to the data manager, who will add it to the data management file under "Status Reports."

Data from STP will be transmitted via modem or disk from the field team to the data manager on a weekly basis. The time and method of transmittal will be coordinated by the field data manager and the data manager. The data manager will check the STP data for correctness, completeness, and consistency. The data manager will alert the FTL of any errors or omissions contained in the STP data.

STP data will be contained in the STP file EDMSDATA.MDB and will be "imported" into the data management team copy of EDMS/A-EMIS by renaming the existing file in the appropriate EDMS subdirectory to EDMSDATA.MXX (where XX is the two-digit number of the field effort's week) and copying the new EDMSDATA.MDB file into that same directory. The goal is to have one EDMSDATA.MDB file for every week of the field effort, each containing data up to that week, with the most current file using the .MDB extension.

14.4 Management of Laboratory Electronic Data Deliverables

Electronic data (E-Data) deliverables will be sent as compressed (PKZIP 2.04) files to the data manager. A copy of the E-Mail cover letter, which includes a list of the file(s) transmitted and the date and time of transmittal, will be printed and stored in the data management file under "E-Data Documentation from Lab."

E-Data will be imported into EDMS/A-EMIS, using an EMIS-specific import program. The import program reads the data into EDMS/A-EMIS and performs a series of QC and data validation checks, based on the requirements specified in the November 1994 EMIS Data Dictionary. The checks and the rules they are based on are documented in the data management file under "Import Description and Exception Reports."

If the import program encounters any exceptions to the QC checks described above, the exception will be listed in the Import Exceptions Report. The Import Exceptions Report will contain the information necessary to identify the import file and line, and an explanation of the exception. Exceptions serious enough to jeopardize the integrity of the database will be reported as "ERRORS," and the offending line will not be imported. Less critical exceptions will be reported as "WARNINGS," and the offending line will be imported.

The data manager will evaluate each item in the Import Exceptions Report and determine what action, if any, needs to be taken. If the appropriate action is a manual data change to the laboratory-provided E-Data files by the data management team, the change will be verified and the laboratory will be notified of the change via E-Mail. If the appropriate action is to request a resubmission of the electronic data from the laboratory, the resubmission will be requested.

Once the appropriate action to be taken is completed, the action taken for each item in the Import Exceptions Report will be noted, initialed, and dated. Once all items listed on the Import Exceptions Report are resolved, the report will be added to the data management file under "Import Exceptions Reports."

During the data management process, manual changes may be made to the EDMS/A-EMIS database that create discrepancies with data stored in files at the laboratory. The data manager will notify the laboratory of the discrepancies so that laboratory records can be updated.

14.5 Front-end Data Content Verification

After the import of laboratory electronic data into the EDMS/A-EMIS database and resolution of all Import Exceptions, a series of queries will be performed to verify the content of and relationships between data. Content queries will confirm that all specific data codes used are correct as defined by the November 1994 EMIS Data Dictionary. Relationship queries will verify that relationships between certain data elements are correct and logical. For example, queries will verify that for a single sample, the Collection Date is an earlier date than the Analysis Date. The front end QC queries will be reviewed and modified as needed to check for valid values specific to this project.

If a database record does not satisfy the conditions specified by the query, the exception will be listed in the Front-End Exceptions Report. The Front-End Exceptions Report will contain the name of the query, the information necessary to identify the database record, and an explanation of the exception. The data manager will evaluate each item in the Front-End Exceptions Report and determine what action, if any, needs to be taken. If the appropriate action is a manual data change, it will be verified. If the appropriate action is to request a resubmission of the electronic data from the laboratory, the resubmission will be requested. If the action taken affects information received from the laboratory in its deliverables, the laboratory will be notified of the changes made via E-Mail.

Some items in the Front-End Exceptions Report may be acceptable. For example, the Front-End Exceptions Report may identify a matrix spike that is reported with a Sample Location ID of "FIELDQC." The Location ID of "FIELDQC" is only appropriate for equipment blanks, field blanks, and trip blanks; matrix spikes normally are not taken from blanks. Evaluation of the database record reveals that the matrix spike was taken by the laboratory to satisfy its own internal QC procedures, and that the parent sample from which the matrix spike was taken was an equipment blank. Therefore, the Sample Location of "FIELDQC" is acceptable.

Once the appropriate action to be taken is completed, the query will be re-run to confirm that the exception has been corrected, and the item in the Front-End Exceptions Report will be initialed and dated. If the item is acceptable, it will be noted as such and explained as necessary on the Front-End Exceptions Report, initialed, and dated. Once all items listed on the Front-End Exceptions Report are resolved, the report will be added to the data management file under "Front-End QC Descriptions and Exceptions Reports."

14.6 Data Quality Evaluation Flag Entry

The data manager is responsible for the entry of the data quality evaluation flags into the database after the completion of data quality evaluation by the DQE team. The DQE team will notify the data manager when the data quality evaluation is completed. Using data entry forms in EDMS/A-EMIS, laboratory qualifiers and/or concentration values changed on the Form I by the DQE team will be entered into the database in the

validation flag and/or concentration fields. If the laboratory qualifier and/or concentration values were not changed by the DQE team, no entry will be made in the validation flag and/or concentration fields. After the completion of data entry, the data manager will update the validation flag field as appropriate with data from the laboratory qualifier field for validation flag values that were not changed during the data quality evaluation process. This update will occur for all non-surrogate parameters associated with normal environmental samples, field duplicates, dilutions, or re-extractions. This update will not occur for surrogate parameters or for parameters associated with equipment blanks, trip blanks, field blanks, matrix spike/spike duplicates, inorganic laboratory replicates, or laboratory blanks.

After completion of the process described above, Replicate Form Is will be generated from the database and printed. The Replicate Form Is will be verified against the original validated (marked-up) Form Is using the manual data entry verification procedure. If errors are discovered, the error will be corrected in the database, and a new Replicate Form Is will be generated, printed, and verified against the original marked-up Form I. This process is repeated until no errors remain. When the verification process is completed, the Replicate Form Is will be filed with the original validated (marked-up) Form Is according to SDG number. An entry will be made in the history data table to document that the data quality evaluation flag field values have been entered and verified.

14.7 Intermediate Data Completeness Verification

After entry of the data quality evaluation flags, a series of queries will be performed to verify the content of, correctness of, and relationships between the data. This intermediate data completeness verification will consist of the complete set of front-end data content validation queries (with results evaluated and documented), and additional intermediate queries that will further evaluate the database. The intermediate QC queries will be reviewed and modified as needed to meet the requirements of this project.

Content and relationship queries involving the data quality evaluation flag field will be evaluated. For example, queries will be performed confirming that all the data quality evaluation flags are valid and that all analytical result records with a QA level other than "N" have non-null values in the data quality evaluation flag field. In addition, queries will be performed confirming that the one-to-many relationships between Sample Data, Sample Preparation Data, and Analytical Results are intact and correct. Queries will confirm that all Analytical Results records have associated Sample Preparation Data records, and that all Sample Preparation Data records have associated Sample Data records. Conversely, queries will confirm that no Sample Data records exist without associated Sample Preparation Data records, and that no Sample Preparation Data records exist without associated Analytical Results records.

If a database record does not satisfy the conditions specified by the query, the exception will be listed in the Intermediate QC Exceptions Report. The Intermediate QC Exceptions Report will contain the name of the query, the information necessary to identify the database record, and an explanation of the exception. The data manager will evaluate each item in the Intermediate QC Exceptions Report and determine what action, if any, needs to be taken. If the appropriate action is a manual data change, it will be verified. If the appropriate action is to request a resubmission of the electronic data from the laboratory, the resubmission will be requested.

Once the appropriate action to be taken is completed, the query will be re-run to confirm that the exception has been corrected, and the item in the Intermediate QC Exceptions Report will be initialed and dated. If the item is acceptable, it will be noted as such and explained as necessary on the Intermediate Exceptions Report, initialed, and dated. Once all items listed on the Intermediate Exceptions Report are resolved, the report will be added to the data management file under "Intermediate QC Descriptions and Exceptions Reports." If the action taken affects data provided by the laboratory in its electronic deliverables, the laboratory will be notified via E-Mail of the changes made.

14.8 Generation of EMIS-like Access Tables

Two weeks before each deliverable deadline (draft/final), and provided that the necessary data are complete, the database manager will generate the EMIS-like Access tables. These tables follow the exact field name, count, type, length, and order of the EMIS tables deliverables. For the project, seven tables will be generated: SAMP_LOC, WELL_COMP, LITH_DES, SAMPLE_DATA, WATER_LEVEL, SAMPLE_PREP, and ANAL_RES. These tables are the source and final repository of the data for the draft and final deliverables.

The database manager will establish the structure of the tables manually in EDMS/A-EMIS, according to the EMIS November 1994 Data Dictionary specifications. The tables will be populated by running queries that pull the appropriate data from various EDMS/A-EMIS tables and place them in the corresponding fields in the EMIS-like Access tables. In addition to bringing in the data, the queries also format the data as necessary (for example, date as DD-MMM-YY, number of digits beyond the decimal point, and so forth).

Following the generation of the EMIS-like Access tables, a series of queries will be performed to verify the content of, correctness of, and relationships between the data. These queries, known as the back-end data content verification queries, will consist of appropriate front-end and intermediate data verification queries modified to analyze the EMIS template tables and their respective field names. The back-end QC queries will be reviewed and modified, if needed, to check for valid values specific to this project.

If a database record does not satisfy the conditions specified by a query, the discrepancy will be listed in the Back-End QC Exceptions Report. The Back-End QC Exceptions Report will contain the name of the query, the information necessary to identify the database record, and an explanation of the exception. The data manager will evaluate each item in the Back-End QC Exceptions Report and determine what action, if any, needs to be taken. If the appropriate action is a manual data change, it will be verified. If the appropriate action is to request a resubmission of the electronic data from the laboratory, the resubmission will be requested.

Once the appropriate action to be taken is completed, the query will be re-run to confirm that the exception has been corrected, and the item in the Back-End QC Exceptions Report will be initialed and dated.. If the item is acceptable, it will be noted as such and explained as necessary on the Back-End QC Exceptions Report, initialed, and dated. Once all items listed on the Back-End QC Exceptions Report are resolved, the report will be added to the data management file under "Back-End QC Descriptions and Exceptions Reports."

Depending on the action taken to resolve items in the Back-End QC Exceptions Report, the EMIS-like Access tables may have to be regenerated and the process described above repeated. When all issues are resolved, generation of draft/final deliverables will proceed.

14.9 Generation of Deliverables

After completion of the EMIS-like Access table generation, the EMIS deliverables will be generated by the data manager. The source for these deliverables will be the EMIS-like tables in EDMS/A-EMIS. Microsoft Excel (v.5.0) will be the primary tool used to manipulate and format the data contained in the EMIS-like tables. Using Excel macros, data will be extracted directly from the EMIS-like tables in EDMS/A-EMIS. The data will then be inserted into Excel worksheets modeled after the EMIS Lotus 123 (v.2.2) templates provided by the client's data manager. The filled Excel worksheets are then saved as Lotus 123 spreadsheets. Once completed and reviewed, these Lotus 123 spreadsheets serve as the final deliverables.

The EMIS Lotus 123 templates have three purposes. First, the templates specify the column (field) order in which the data is to be organized. Second, they specify the field type for each field. Third, they help the client's data manager view the data.

Hard copies of the SAMP_LOC, WELL_COMP and LITH_DESC EMIS files will be generated and given to the site geologist for review using guidelines that will include a checklist of project-specific, acceptable entries and the November 1994 EMIS Data Dictionary. The site geologist will fill out a Review Comments Form that will be returned to the data manager along with the marked-up hard copy.

Hard copies of the WATER_LEVEL and SAMPLE_DATA EMIS files will be generated and given to the FTL for review using guidelines that will include a checklist of project-specific, acceptable entries from the November 1994 EMIS Data Dictionary. The FTL will fill out a Review Comments Form that will be returned to the data manager along with the marked-up hard copy.

The draft submission of SAMPLE_DATA to the client will include normal environmental and field duplicate samples only. The final submission of SAMPLE_DATA will contain all sample types.

Hard copies of at least three sets of SAMPLE_PREP and ANAL_RES records for each SAMPLE_PREP fraction (volatiles, semivolatiles, pesticides, and so forth) will be generated and given to a representative of the DQE team for review using guidelines that will include a checklist of project-specific acceptable entries (previously agreed upon with the client data manager) and the November 1994 EMIS Data Dictionary. The reviewer will fill out a Review Comments Form that will be returned to the data manager along with the marked-up hard copy.

An electronic backup of the database will be made and stored as the current working version. After backup, the DQE team reviewer will be given access to the original electronic EDMS/A-EMIS database for electronic review of the EMIS template tables. The data management team will provide queries incorporating appropriate joins between the key fields of the EMIS template tables. Queries will be performed by the DQE reviewer using the guidelines described above. Comments will be noted on a Review Comments Form and returned to the data manager.

The data management team will determine what action, if any, is necessary to address the Review Comments for each EMIS deliverable. Actions taken will be noted on the Review Comments Form, initialed, and dated. The Review Comments Form and marked-up hard copies will be added to the data management file under "Internal Deliverable Review Comments." Depending on the nature of the comments and their resolution, the EMIS template tables may have to be regenerated and reviewed again.

If subsequent reviews are necessary, the data manager will return the marked-up hard copy, the Review Comments Form, and the corrected hard copy to the reviewer. The review process will continue until all exceptions identified in Review Comments Forms are resolved and verified.

After resolution of all internal review comments, the draft EMIS tables (Lotus 123 v.2.2 templates) will be placed on one or more 3.5-inch high density disk(s) (formatted using MS-DOS) with the files in a self-extracting compressed format (PKZIP 2.04). Each disk will be labeled with the following information:

- Name of Facility: DDMT
- Contractor Name:

A. Executable File Name:

- EMIS File Name(s): EMIS_SL, EMIS_WC, EMIS_LD, EMIS_SD, EMIS_WL, EMIS_SP, EMIS_AR1, EMIS_AR2...etc.
- Date of Submission:

A transmittal letter will accompany each data submission and will specify Contractor name, Contract number, Subcontractor point of contact, and a list of the files submitted. Additional explanation regarding the procedure for uncompression of the files will also be indicated. Unless directed otherwise, disk(s) containing draft and final EMIS files will be transmitted by the data manager via overnight delivery to the client's data manager.

The client's data manager should notify the PM immediately if any problems are encountered loading the draft EMIS electronic data deliverable into EMIS. This will allow the data management team to take any corrective actions needed and to include a corrected file(s) in the final EMIS electronic data deliverable.

The client's data manager will provide the PM with a hard copy of review comments. The data management team will determine what action, if any, is necessary to address the comments. Actions taken will be noted and explained to the extent necessary on the hard copy Comment Response Form, initialed, and dated. The client's data manager's Review Comments Form will be added to the data management file under "External Deliverable Review Comments." Depending on the nature of the comments and their resolution, the EMIS template tables may have to be regenerated and checked again.

After resolution of the client's data manager's comments, the final EMIS deliverables will be packaged and transmitted as described above for the draft deliverable. Copies of the final deliverables sent to the client will be archived by the data manager.

14.10 Postmortem

Any manual changes made to the electronic data by the client's data manager after the transmission of the final electronic deliverable will be documented as appropriate in the database and in the data management file to ensure that the data contained in the EDMS/A-EMIS database is identical to that in the client's database.

An archive of all the data on both file servers will be made to tape in a standard format (QIC-80, 8mm, etc) and stored with other project documentation, according to existing guidelines. The data will then be kept on both network file servers for 6 months. At the end of that period, a second archive will be made as described above and stored. At that time, unless the data is being actively used or modified, it will be removed from both network file servers.

If any subsequent changes need to be made to the data, it will be restored from the latest tape, modified, archived as indicated above, and removed from the network file servers. Unless problems occur with data restoration, the primary source for non-database and database files will be the archives. All laboratory deliverables (either hard copy or electronic) will be retained by the laboratory for a period of 7 years.

TAB

Appendix A

References

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TAB

Appendix B

DDMT ACRONYMS

Acronym	Meaning/Explanation 127 125
22-C	LMG designation for non-CLP Pesticide standard mixture of single component pesticides and surrogates (22 components)
BFB	Bromofluorobenzene
CCB	Continuing Calibration Blank
CCC	Calibration Check Compounds
CCV	Continuing Calibration Verification
CDA	Comma Delimited ASCII
CLP	USEPA Contract Laboratory Program
COC	Chain of Custody
CRDL	Contract Required Detection Limit - defined in CLP SOW for Inorganics
CRQL	Contract Required Quantitation Limit - defined in CLP SOW for Organics
CVAA	Cold-Vapor Atomic Absorption
% D	Percent Difference
DEM	Degradation Evaluation Mixture (LMG designation for 8080 work), measures Endrin and 4,4'-DDT degradation)
DFTPP	Decafluorotriphenylphosphine
EDL	Estimated Detection Limit
EMIS	Environmental Management Information System
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Specrometry
GFAA	Graphite Furnace Atomic Absoption
ICB	Initial Calibration Blank
ICP	Inductively Coupled Plasma
ICSA/ICSAB	Interference Check Samples (ICP)
ICV	Initial Calibration Verification
ICV	Initial Calibration Verfication
IDL	Instrument Detection Limit
IEC	Inter-Element Correction Factor (ICP)
INDA	Pesticide single component mixture A - compounds and concentration defined in CLP SOW. The 3 levels are named INDAL, INDAM, and INDAH (as specified in SOW).
INDB	Pesticide single component mixture B - compounds and concentration defined in CLP SOW. The 3 levels are named INDBL, INDBM, and INDBH (as specified in SOW).
IR	Infrared Spectrophotometer
IS	Internal standard
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LIMS	Laboratory Information Management System
LMG	QAL Montgomery Lab
MDL	Method Detection Limit
MS/MSD	Matrix Spike and Matrix Spike Duplicate
MSA	Method of Standard Addition
PCB	Polychlorinated biphenyl
PCB LOC	PCB Locator = mixture of aroclors 1221, 1248, and 1260 - which contain most PCB congener peaks. This standard is used to provide all necessary peaks to identify aroclors in samples.
PEM	Performance Evaluation Mixture - compounds, concentrations, and criteria (degradation and RF) defined in CLP SOW
PIBLK	Pesticide/PCB instrument blank - CLP nomenclature
% R	Percent Recovery
RESC	Resolution Check Mixture - compounds, concentration , and criteria defined in CLP SOW
RF	Response Factor
RL	Lab Reporting Limit

DDMT ACRONYMS

127 126

Acronym	Meaning/Explanation
RPD	Relative Percent Difference
RRF	Relative Response Factor
RRT	Relative Retention Time
RSD	Relative Standard Deviation
RT	Retention Time
RT window	Retention Time window
SOP	Standard Operating Procedures
SOW	CLP Statement of Work. We are currently following OLM01.9 for Organics and ILM02.1 for Inorganics.
TAL	Target Analyte List - as defined in Inorganic CLP SOW
TCL	Target Compound List - as defined in Organic CLP SOW
TEF	Toxicity Equivalent Factor
TIC	Tentatively Identified Compound

PROJECT: MEMPHIS DEFENSE DEPOT
GENERAL CHEMISTRY

	LEVEL 2	LEVEL 3
NO PROCEDURAL CHANGES IN SAMPLE PREPARATION		
Instrument Calibration	1/day	1/day
Method Blank	1/batch of 20 or less Target Analyte < Reporting Limit (RL)	1/batch of 20 or less Target Analyte < Reporting Limit (RL)
Initial Calibration/ICV	1/day EPA Methods: 90-100% CLP-Cyanide: 85-115%	1/day EPA Methods: 90-110% CLP-Cyanide: 85-115%
Continuing Calibration	Same as above	Same as above
MS/DUP	Recovery 80%-120% RPD <20% TSS DUP Only	Recovery 80%-120% RPD <20% TSS DUP Only
LCS	1/batch Recoveries Cyanide: 85-115% Roveries EPA Methods 90-110%	1/batch Recoveries Cyanide 85-115% Recoveries EPA Methods 90-110%
Reporting Levels	Water / Soil CN 10.0µg/L / 1.0 mg/Kg TSS 4.0 mg/L / -NA- F 0.10 mg/L / 1.0 mg/kg I 2.0 mg/L / 20 mg/Kg Br 2.0 mg/l / 20 mg/Kg I (IC) 0.1 mg/L / 1 mg/Kg Br (IC) 0.1 mg/L / 1 mg/Kg	Water / Soil CN CRDL 10 ug/L / 1.0 mg/kg TSS 4.0 mg/L / -NA- F 0.10 mg/L / 1.0 mg/kg I 2.0 mg/L / 20 mg/Kg Br 2.0 mg/L / 20 mg/Kg I (IC) 0.1 mg/L / 1 mg/Kg Br(IC) 0.1 mg/L / 1 mg/Kg
Dilutions	If Linear Range is Exceeded	If Linear Range is Exceeded
Report	LIMS Report	CLP Report
Review	Peer or Supervisor	Peer or Supervisor
Price		

pH (EPA 150.1)
Cyanide (CLP-SOW)
Total Suspended Solids (EPA 160.2)
Fluoride (EPA 340.2)
Iodide (EPA 345.1), Titrametric (Phospholine Iodide)
Iodine (EPA 300.0), Ion Chromatography (IC)
Bromide (EPA 320.1), Titrametric
Bromide (EPA 300.0), Ion Chromatography (IC)

PROJECT: MEMPHIS DEFENSE DEPOT
CATIONS

	LEVEL 2	LEVEL 3
NO CHANGE IN SAMPLE PREPARATION		
Instrument Tune	ICP Scan No GFAA Hg - by CVAA	CLP/SOW Criteria CLP ICP + GFAA+CVAA
Instrument Blank	Target Analytes <5xCRDL	Target < CRDL
Method Blank	1:20/Target Analytes <5xCRDL	1:20 CLP Criteria
Initial and Continuing Calibration	CCV/CCB 1:20 CCV 70 - 130% recoveries Calibration: ICP Blank + 1 standard Hg Blank + 3 standards	Calibration: CLP Criteria CLP ICV % Recovery 90-110% ICP, GFAA 80-120% Hg 85-115% CN CRA/CRI @ 1/run 2/run ICP
Interference Check	ICSA Beginning 1 ICSAB End 1 70-130%	ICSA/ICSAB 80-120% 1 set/ICP run
MS/DUP	Post Spike 1:20 MS/DUP 1:20 or as requested	1 MS 1:20 1 DUP 1:20 GFAA Post Spikes 85-115% (every sample)
LCS	1:20; Soil - EPA Criteria (0287) Recovery 70-130% H_2O	1:20; Soil - EPA Criteria (0287) % Recovery 80-120% H_2O
Reporting Levels	As 100 ICP & Hg Pb 50 Same as CRDL Se 60 Ti 60 (See Attachment)	CLP Criteria
Dilutions	Any sample response 10% above Linear Range	CLP Criteria
Report	LIMS Form I	CLP Criteria
Review	Analyst 100% Technical Review 10%	CLP Criteria
Price		

OC Pesticides and PCBs by GC/ECD

Quality Control	DOQ Level 2 Criteria (Screen)	DOQ Level 3 Criteria (CLP SOW OLM01.9)
Instrument blanks	As needed. Targets < 5 x RL	At CLP SOW specified frequency. Targets < 1/2 CRQL
Method blanks	Targets < 5 x CRQL	Targets < CRQL
MS/MSD	Frequency = 1 set / 20 samples Use lab generated limits as advisory. Recovery outside of limits will be investigated for possible explanation.	Frequency = 1 set / 20 samples Use CLP limits - CLP does not require corrective action.
Surrogate spikes	Use lab generated limits as advisory. Recovery outside of limits will be investigated for possible explanation.	Use CLP limits - CLP does not require corrective action.
LCS (a blank spike is prepped with every MS/MSD for internal QC & control charting)	No criteria	Not required by CLP SOW
Initial calibration	DEM - Endrin and 4,4'-DDT degradation must each be ≤30% 3 point of single-component pesticides (22-C mix) should produce correlation coefficient ≥ 0.95 or 25%RSD (linearity check) PCB LOC at RL (to be used for identification) Toxaphene/Chlordane at RL	Standard CLP requirements RESC - check resolution PEM - check degradation (Endrin and 4,4'-DDT each ≤ 20%, combined ≤ 30%) All multi-component targets at CRQL (single pt.) 3 levels of single-component pesticides to demonstrate instrument linearity (INDA/INDB)
Continuing calibration	Mid-level 22-C - should be ≤25%D from initial. Then recalibrate with this as single point. Frequency = after every 20 samples (approximately every 12 hours)	CLP specified standards and frequency. PIBLK/PEM and PIBLK/INDAM/INDBM alternating to bracket 12 hour blocks. RF < 25% from initial and degradation criteria same as initial.
	Mid-level multi-component standard of any hit in a sample - should be run within 48 hours of sample. This single point will be used to calculate.	Multi-component targets found in any samples will be run within 72 hours of sample (for identification). Calc. from initial single point.
Retention time windows	No defined RT windows. Analyst will compare RT and/or RRT to nearby applicable standards when targets are tentatively identified	CLP specified RT windows
Internal standards	Internal standard quantitation will be used. No quantitative criteria for IS response.	As specified in CLP SOW, only external standard quantitation will be used.
Cleanup (Sulfur removal with Hg for all Pesticides/PCBs)	Pest. and Pest/PCB will go through CLP approved lots of florisil. PCBs will be partitioned against sulfuric acid (which is a very effective cleanup)	Cleanups will be performed as specified in CLP SOW with CLP criteria. Florisil for all samples and GPC for all soils.
Second-column confirmation	Second column confirmation will be done as needed and will have same criteria as primary. But as long as criteria is met on one column, analysis will continue.	As required by SOW - dual column analysis with same criteria for both columns. CLP SOW does not designate primary and confirmation.
Reporting limits - may vary depending on chromatographic data	CLP SOW CRQLs	CLP SOW CRQLs
Dilutions	As needed to provide accurate quantitation. Single component pesticides will be within initial curve range. Multi-component targets are calculated from single point and will be diluted to be within approximately 20%-200% of standard. (this is the typical range of 5 point curve for 8080. CLP has no criteria for dilution of PCBs or Tox.)	Per CLP SOW
Report	Form 1s	CLP Forms
EData	CDA	

Herbicides by GC/ECD

Quality Control	DOQ Level 2 Criteria (Screen)	DOQ Level 3 Criteria (8150/8151)
Instrument blanks	Optional. As needed Targets < 5 x RL	Optional. Analyzed as needed. Targets < RL
Method blanks	Targets < 5 x RL	Targets < CRQL
MS/MSD	Frequency = 1 set / 20 samples Use lab generated limits as advisory. Recovery outside of limits will be investigated for possible explanation.	Frequency = 1 set / 20 samples Use lab generated limits
Surrogate spikes	Use lab generated limits as advisory. Recovery outside of limits will be investigated for possible explanation and corrective action.	Use lab generated limits
LCS (a blank spike is prepped with every MS/MSD for internal QC & control charting)	No criteria	Frequency = 1 per MS/MSD Use lab generated acceptance limits if MS/MSD does not meet criteria.
Initial calibration	3 point of all targets and surrogates. Curve should ≥ 0.95 correlation coefficient or 25%RSD	5 point of all targets and surrogates. Curve ≥ 0.995 correlation coefficient or 20% RSD Establish initial RT windows.
Continuing calibration	Mid-level injected after every 20 samples (approximately every 12 hours). Criteria: ≤25%D from initial. Then recalibrate with this as single point.	Mid -level injected after every 10 samples. Criteria: ≤ 15% D from initial RT windows can be updated once a day
Retention time windows	No defined RT windows. Analyst will compare RT and/or RRT to nearby applicable standards when targets are tentatively identified	RT windows are based upon actual retention time variation measured in accordance with Method 8000 published in SW-846, Test Methods for Evaluating Solid Waste, Third Edition, Nov. 1986 Can be updated once per day.
Internal standards	Internal standard quantitation will be used. No quantitative criteria for IS response.	Internal standard quantitation will be used. No quantitative criteria for IS response.
Cleanup	Cleanups will be performed as described in lab SOPs..	Cleanups will be performed as described in lab SOPs..
Second-column confirmation - will be done as needed.	Same criteria as primary. But as long as criteria is met on one column, analysis will continue.	Same criteria as primary. But as long as criteria is met on one column (and confirmation of any compound exceeding limits is not needed) analysis will continue.
Reporting limits - may vary depending on chromatographic data	Typical lab RL (attached)	Typical lab RL (attached)
Dilutions	As needed to provide accurate quantitation. Dilutions will be performed so that targets are within initial curve range.	As needed to prevent target compounds from exceeding instrument calibration range.
Report	Form Is	CLP-like forms
EData	CDA	

PNAs (Polynuclear Aromatic Hydrocarbons) by GC/FID		
Quality Control	**DOQ Level 2 Criteria (Screen)**	**DOQ Level 3 Criteria (8100)**
Instrument blanks	Optional. As needed Targets < 5 x RL	Optional. Analyzed as needed. Targets < RL
Method blanks	Targets < 5 x RL	Targets < CRQL
MS/MSD	Frequency = 1 set / 20 samples Use lab generated limits as advisory. Recovery outside of limits will be investigated for possible explanation.	Frequency = 1 set / 20 samples Use lab generated limits
Surrogate spikes	Use lab generated limits as advisory. Recovery outside of limits will be investigated for possible explanation and corrective action.	Use lab generated limits
LCS (a blank spike is prepped with every MS/MSD for internal QC & control charting)	No criteria	Frequency = 1 per MS/MSD Use lab generated acceptance limits if MS/MSD does not meet criteria.
Initial calibration	3 point of all targets and surrogates. Curve should ≥ 0.95 correlation coefficient or 25%RSD	5 point of all targets and surrogates. Curve ≥ 0.995 correlation coefficient or 20% RSD Establish initial RT windows.
Continuing calibration	Mid-level injected after every 20 samples (approximately every 12 hours). Criteria: ≤25%D from initial. Then recalibrate with this as single point.	Mid -level injected after every 10 samples. Criteria: ≤ 15% D from initial RT windows can be updated once a day
Retention time windows	No defined RT windows. Analyst will compare RT and/or RRT to nearby applicable standards when targets are tentatively identified	RT windows are based upon actual retention time variation measured in accordance with Method 8000 published in SW-846, Test Methods for Evaluating Solid Waste, Third Edition, Nov. 1986 Can be updated once per day.
Internal standards	Internal standard quantitation will be used. No quantitative criteria for IS response.	Internal standard quantitation will be used. No quantitative criteria for IS response.
Cleanup	Cleanup necessity and technique will depend on matrix.	Cleanups will be performed as described in lab SOPs..
Second-column confirmation - will be done as needed.	Same criteria as primary. But as long as criteria is met on one column, analysis will continue.	Same criteria as primary. But as long as criteria is met on one column (and confirmation of any compound exceeding limits is not needed) analysis will continue.
Reporting limits - may vary depending on chromatographic data	Typical lab RL (attached)	Typical lab RL (attached)
Dilutions	As needed to provide accurate quantitation. Dilutions will be performed so that targets are within initial curve range.	As needed to prevent target compounds from exceeding instrument calibration range.
Report	Base level (spreadsheet) or Level 1 Form Is	CLP-like forms
EData	CDA	

PROJECT: MEMPHIS DEFENSE DEPOT
GC/MS

	LEVEL 2	LEVEL 3
NO PROCEDURAL CHANGES IN SAMPLE PREPARATION		
Instrument Tune or Tune Verification	1/24 Hrs. Full Method Compliance	Every 12 Hours Full Method Compliance
Method Blank	1/day/instrument or 1/batch or as needed Target Analytes <5 x RL	1/20 or 1/Batch Common Contaminants - CLP Guidelines
Initial Calibration	3 Levels (VOA 10-200) (SVO 20-160) RSD ≤50%; Minimum RF - None Select List of Compounds (CCC)	5 Levels (VOA 10-200) (SVO-20-160) Method Criteria
Continuing Calibration	Mid Point: 1/day RPD ≤50% Select List (CCC + SPCC)	Method Criteria
MS/MSD	1 pair/20 samples or as requested Method Specified List %R within ± 20% D from Method Criteria	1/20 Per Matrix Method Specified List Method Criteria
Surrogates	All samples. Reanalyze if <10% - >200% of method specified recoveries 1 out each fraction VOA, B/N, A/E	All samples CLP Criteria
Internal Standards	Every injection +150%, -75% up to 2 out Analyst's discretion	Every injection Method Limits (+100%, -50%)
Second Vendor Standard	None	Analyze after each new stock calibration mix
Sample Screening	As needed	As needed
Sample Cleanup	If needed	CLP Guidelines
Reporting Levels	CLP/CRDL	CLP/CRDL
Dilutions	20% above the highest standard Analysts' discretion	CLP Guidelines
Report	Form I; E-Data - CDA	QAL Level 2
Review	Analyst 100% Tech Review 5%	Analyst 100% Forms 100% Tech Review 100%
Price		

TRIANGLE LABS
DIOXINS/FURANS
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	LEVEL 2	DLFM01.1 (CLP)
NO PROCEDURAL CHANGES IN SAMPLE PREPARATION		
Instrument Tune	Same	Verified prior to each sample: per method and instrument specifications.
Method Blank	1/20 or batch; target analytes <IDL	1/20 or batch : Target analytes < 2% of internal standard
Initial Calibration	Same	5 point RSD <15%
Continuing Calibration	Same	Midpoint 1/12 hours %D < 30%
MS/DUP	Same	1 Pair/20 Samples; method analyte, % recoveries 50-150% RPD < 50%
LCS/LCSD	Same	When MS/DUP not requested same analytes & criteria
Surrogates/Internal Standards	Same	All samples; % recoveries 25-150%; some out - analyst discretion
Recovery Standards	Same	All samples; signal to noise > 10:1; retention time within 10 sec of calibration
Sample Screening	If needed	If needed
Sample Cleanup	Same	As per method
Reporting Levels	Same	EDL's: Soil Water Tetra 1 ppb or 10 ppt Penta Hepta 2-5 ppb or 25 ppt Octa 5 ppb 50 ppt
Dilutions	On saturated peaks exceeding linear range.	On analytes greater than calibration range at client request (chargeable rerun).
Report	Formaster (Form I); Case Narrative; Sample Documentation	Full CLP package..
Review	Data Review; Peer Review/QC	Data Review; Peer Review/QC, Quality Assurance Review
Second Column Confirmation	No	If TEF> 7ppt (water) or 0.7 ppb (soil)

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ADMINISTRATIVE RECORD

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