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Work Plan
Treatability Study at the Incinerator Ash Landfill
Seneca Army Depot

Romulus, NY

Prepared for:

U.S ARMY CORPS OF ENGINEERS
Huntsville, Alabama

Prepared by:

HUNTER/ESE
Gainesville, Florida

Hunter/ESE No. 3902036

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LIST OF ACRONYMNS AND ABBREVIATIONS

AIHA	American Industrial Hygiene Association
ASTM	American Society for Testing and Materials
bag	treatment bag
BDL	below detection level
B/N/A	base/neutral/acid
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Delta	Delta Environmental, Inc.
DI	deionized
EPA	U.S. Environmental Protection Agency
EQC	engineering quality control
eV	electron volt
ft	foot
ft^2	square feet
ft^3	cubic feet
ft-bls	feet below land surface
ft/yr	feet per year
g/cc	grams per cubic centimeter

LIST OF ACRONYMNS AND ABBREVIATIONS
(Continued, Page 2 of 3)

gal	gallon
gal/yr	gallons per year
ID	inside diameter
IP	ionization potential
L	liter
lb	pound
lb/yr	pounds per year
mg	milligram
mm	millimeter
MRDL	Missouri River Division Laboratory
NIOSH	National Institute for Occupational Safety and Health
NYDEC	New York Department of Environmental Conservation
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit
ppm	parts per million
PVC	polyvinyl chloride
QA	quality assurance
QAPP	quality assurance project plan

LIST OF ACRONYMNS AND ABBREVIATIONS
(Continued, Page 3 of 3)

QA/QC	quality assurance/quality control
QC	quality control
RCRA	Resource Conservation and Recovery Act
S/AC	sand/activated carbon
SEAD	Seneca Army Depot
SHERP	Safety, Health, and Emergency Response Plan
SOW	Scope of Work
SR	State Route
TWA	time-weighted average
USACE	U.S. Army Corps of Engineers
USAEHA	U.S. Army Environmental Hygiene Agency
USCS	Unified Soil Classification System
USGS	U.S. Geological Survey
UV	ultraviolet
VOC	volatile organic contaminant
WP	Work Plan

1.0 INTRODUCTION

1.1 BACKGROUND

Under Contract No. DACA87-89-D0019, between Hunter/ESE and the U.S. Army Corps of Engineers (USACE), Huntsville Division, Hunter/ESE has prepared this work plan (WP) to design and perform a treatability study for the Seneca Army Depot (SEAD). SEAD is a U.S. Army facility located in Seneca County, New York and occupies approximately 10,600 acres. It is bounded on the west by State Route (SR) 96A and on the east by SR 96. The area surrounding the site is generally used as farmland.

A recently completed investigation of the site's abandoned ash landfill area documented the existence of a narrow plume of groundwater contamination that is believed to extend to, and possibly beyond, SEAD's western boundary. The contaminants of concern are chlorinated volatile organic compounds (VOCs). SEAD has requested the implementation of proposed interim remedial measures to control the plume migration while more detailed studies are being performed to delineate the full extent of contamination, its source(s), and possible methods of treatment.

1.2 OBJECTIVE

The objective of this WP is to design and perform a treatability study for the SEAD abandoned ash landfill area. After conducting the study, Hunter/ESE will determine the effectiveness of the study and make recommendations as to additional actions to be taken for permanent remediation.

2.0 PLANS AND MANAGEMENT

2.1 WORK PLAN

The purpose of this WP is to present the activities that will be performed during the development of the treatability study for the SEAD site. To minimize the potential for project delays, Hunter/ESE will incorporate USACE comments for the WP in the form of addenda. These addenda will consist of errata sheets for insertion into this WP document and will be distributed to all holders of the WP.

2.2 SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN (SHERP)

The health and safety of personnel, including Hunter/ESE field team members, subcontractor personnel, and the surrounding community, during the implementation of this project is a primary concern. Accordingly, a SHERP has been prepared to develop health and safety criteria and practices sufficient to protect onsite personnel, the public, and the environment from physical, chemical, and/or biological hazards particular to this site. The SHERP is included as Appendix A.

2.3 QUALITY ASSURANCE PROJECT PLAN (QAPP)

The proper management of the chemical data obtained during the fieldwork phase is an extremely important aspect of this project. To achieve the data quality goals of the fieldwork at the SEAD site, a QAPP was developed and is included as Appendix B.

2.4 PROJECT STAFFING AND RESPONSIBILITIES

This section contains a listing of project staff and describes the functional relationships of the organizational structure. In addition, key project team personnel are identified and their support functions are defined. Project organization is shown in Figure 2-1.

The project director, Gary R. Horwitch, P.E., is responsible for appointing the project manager and providing overall direction, coordination, and corporate support as needed during the treatability study.

The project manager, David M. Moccia, P.E., is responsible for the effective day-to-day management of the project staff; direct communication and liaison with the Huntsville Division, USACE; technical approach and review of deliverables; management of resources; schedules and budgets; and coordination between the general and design support functions. Mr. Moccia will be assisted by the project engineer, Mr. Rob Vicevich, P.E. Mr. Vicevich will be acting project manager in the absence of Mr. Moccia.

The engineering quality control (EQC) reviewer, Gary R. Horwitch, P.E., is responsible for senior technical review of all deliverables.

The general support functions include the quality assurance (QA) supervisor and the safety manager. The QA supervisor is responsible for preparation of the QAPP and monitoring and periodic auditing to assure that the quality control (QC) procedures as identified in the QAPP are followed by the chemical analysis personnel. The safety manager's responsibilities are to assist the

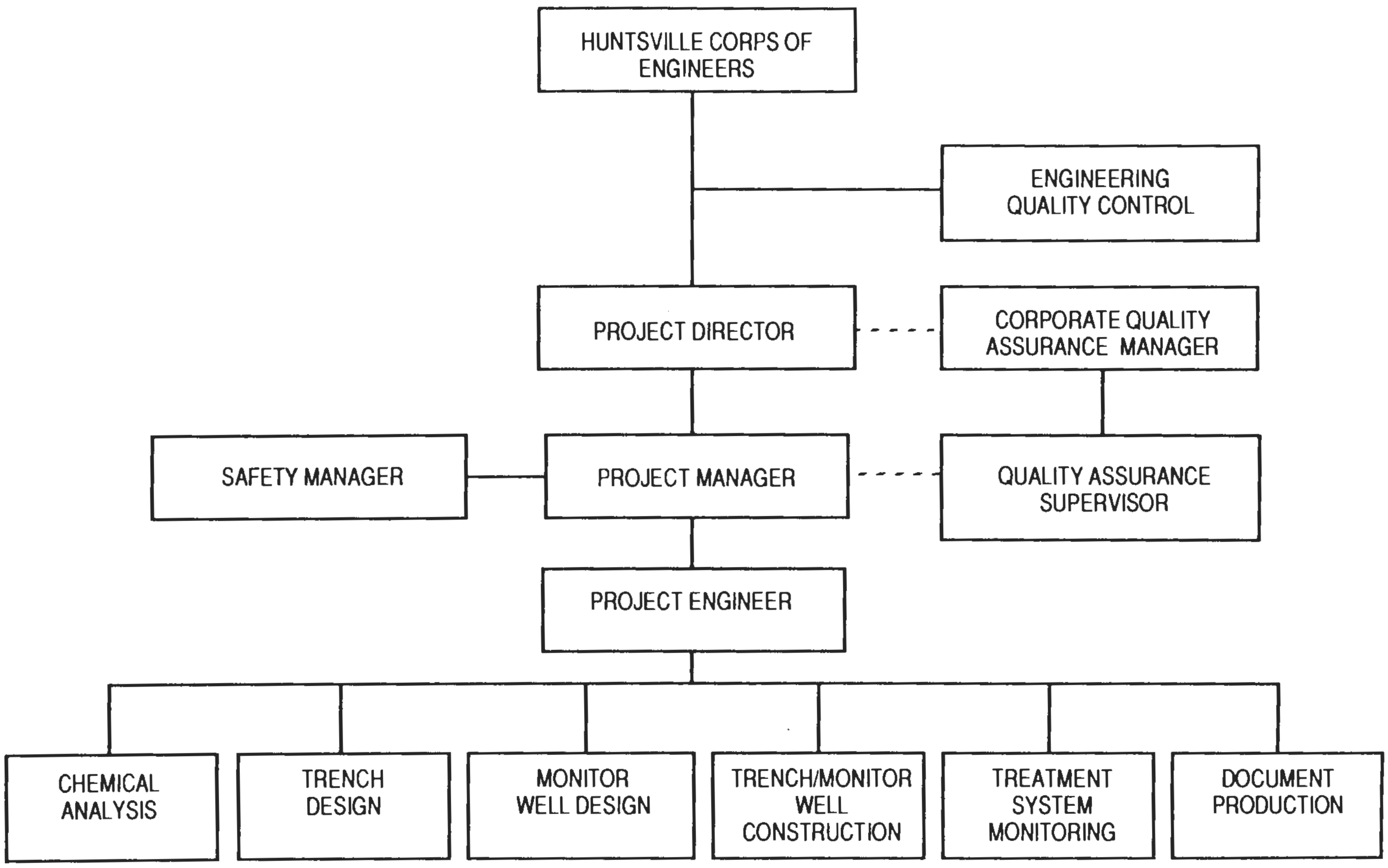


Figure 2-1
PROJECT ORGANIZATION

SOURCE: HUNTER/ESE, 1989.

project manager in preparation of the SHERP for site activities and to train project personnel in appropriate safety practices during field activities.

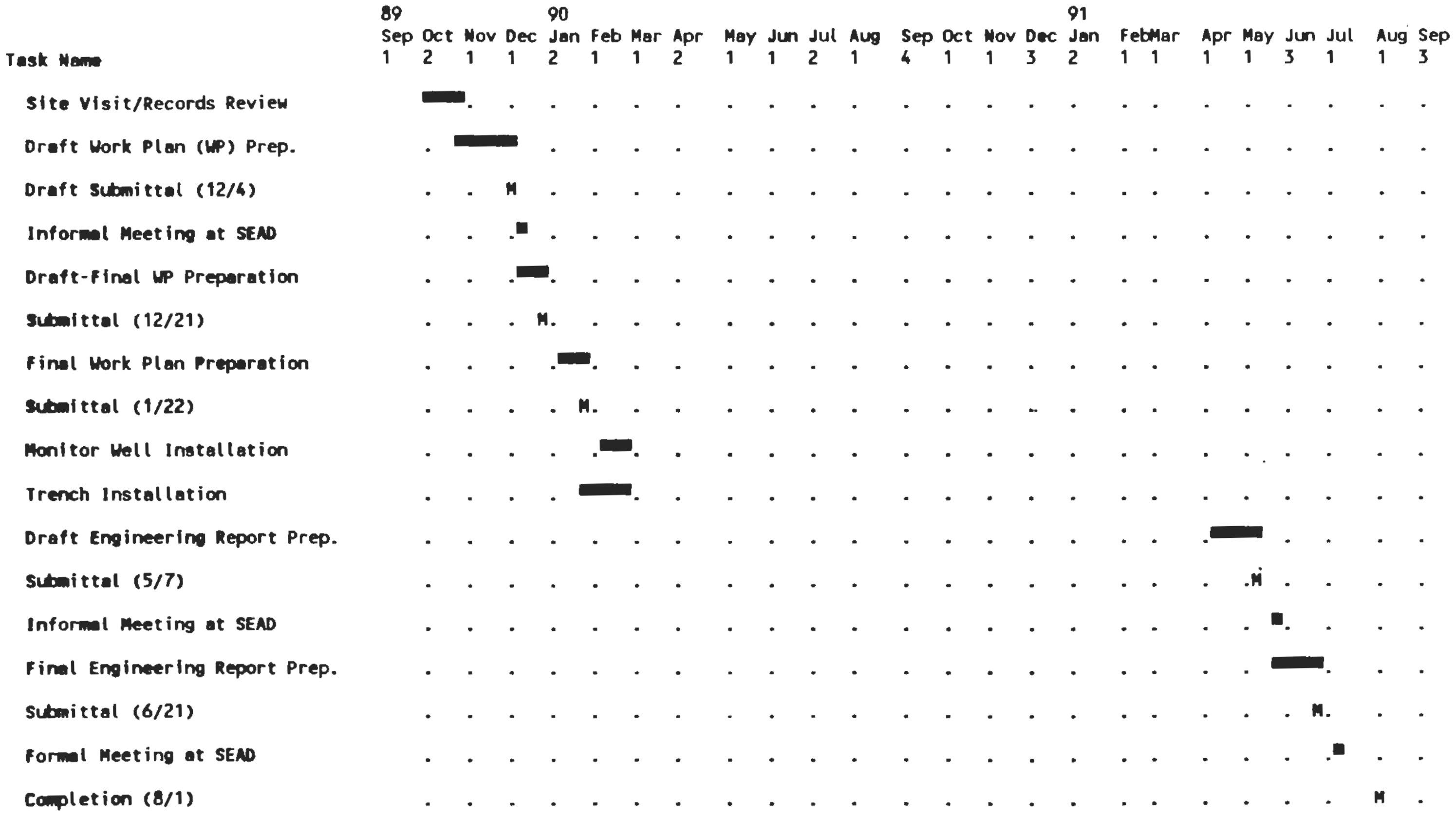
2.5 PROJECT SCHEDULE

The project schedule is presented in Figure 2-2. The completion date for the installation of the trench is estimated to be February 23, 1990. This date assumes that government comments on the draft-final WP will be received no later than January 8, 1990. If this January 8, 1990 date is missed, the schedule for mobilization and construction could slip, resulting in a slippage of the trench completion date. Additionally, full cooperation by all parties for short review periods and timely decisions will be required to meet both the overall and interim deadlines.

The open space on the project schedule following trench installation corresponds to the three 4-month periods of monitoring, which should be completed by April 1, 1991. Following the monitoring period, the draft and final engineering reports will be submitted by May 7, 1991 and June 21, 1991, respectively. Project completion is scheduled for August 1, 1991.

2.6 ENGINEERING QUALITY CONTROL (EQC)

EQC provides for senior technical review of all deliverables based on the reviewers' previous experience with similar projects. Technical review of design tasks will be conducted frequently during the design process. Before technical work plans are submitted to USACE, technical review comments will be incorporated into the deliverables.



igure 2-2
ROJECT SCHEDULE

URCE: HUNTER/ESE, 1989.

3.0 SCOPE OF WORK (SOW)

3.1 INTRODUCTION

The SOW for this project involves the design and implementation of a treatability study for the contaminated groundwater plume found in the abandoned ash landfill area of site. The performance of the work has been divided into separate tasks that are described briefly in the following sections. A detailed description of the requirements of each task can be found in the September 19, 1989 SOW included as Appendix C.

3.2 TASK G-1: VISUAL INSPECTION AND RECORDS REVIEW

Hunter/ESE will perform a visual inspection of the site and review records and reports made available by the government. This information will help Hunter/ESE personnel involved in this project to become familiar with basic site conditions.

3.3 TASK G-2: WP

Hunter/ESE shall prepare a WP that describes specific details involved in designing, installing, operating, and evaluating the permeable treatment bed system. All work will be performed in accordance with the approved plan.

3.4 TASK G-3: TREATMENT SYSTEM INSTALLATION

The installation of the treatment facilities and monitor wells will be completed in accordance to the approved WP (Task G-2) and in accordance with applicable federal and state regulations and permitting requirements.

3.5 TASK G-4: SOIL CHARACTERIZATION

Hunter/ESE will conduct two rounds of soil sampling for analysis during the excavation of the trench. The soil samples collected will be analyzed according to specified requirements. Results of the sampling and analysis will be used to determine if excavated soil must be managed as a Resource Conservation and Recovery Act (RCRA) hazardous waste. The results of the analyses will be included in the engineering report (Task G-8).

3.6 TASK G-5: DEWATERED GROUNDWATER CHARACTERIZATION

Hunter/ESE will conduct two rounds of dewatered groundwater sampling for chemical analysis during the excavation of the trench. The groundwater samples will be analyzed in accordance with specified requirements. Results of the sampling and analysis will be used to determine if the groundwater must be managed as a RCRA hazardous waste. Results of the analyses will be included in the engineering report.

3.7 TASK G-6: TREATMENT SYSTEM MONITORING

Hunter/ESE will monitor the effectiveness of the permeable treatment bed through periodic sampling and analysis of the monitor wells placed upgradient and downgradient of the trench. Monitor wells will be sampled initially upon installation and thereafter at 4-month intervals for a 1-year period. A total of four rounds of sampling will be conducted.

3.8 TASK G-7: TRIANNUAL REPORTS

Hunter/ESE will prepare triannual reports that fully document the results of sampling conducted during treatment system monitoring. The reports will be submitted within 14 days of completion of testing and completion of the chemical analysis.

3.9 TASK G-8: ENGINEERING REPORT

Hunter/ESE will prepare an engineering report that will fully document all work performed. The report will contain descriptions of the existing site conditions; fieldwork performed; the results of chemical analyses; and a discussion of the findings, results, and conclusions for each round of monitor well sampling.

3.10 TASK G-9: PRESENTATIONS AND MEETINGS

Hunter/ESE will conduct two informal presentations: one after submission of the draft WP and the other following submission of the draft engineering report. After submission of the final engineering report, Hunter/ESE will conduct a formal presentation. The proposed audience will consist of the SEAD Commander and other installation representatives, government personnel involved with the decision process, and regulatory agencies. Both the informal and formal meetings will be conducted at SEAD.

4.0 WORK PLAN

4.1 INTRODUCTION AND PURPOSE

This section addresses the requirements of Task G-2: Work Plan. The purpose of this section is to describe the specific details involved in designing, installing, and operating the treatment trench.

4.2 WP REQUIREMENTS

WP requirements include the following:

1. SHERP;
2. QAPP;
3. Monitor Well Installation Subplan;
4. Dewatering, Excavation, Transport, and Storage Subplan;
5. Treatment System Design Subplan;
6. Air Monitoring Subplan; and
7. Identification of applicable regulatory and permit requirements.

4.3 SHERP

The SHERP has been prepared and is included as Appendix A.

4.4 QAPP

The QAPP has been prepared and is included as Appendix B.

4.5 MONITOR WELL INSTALLATION SUBPLAN

4.5.1 INTRODUCTION

The Monitor Well Installation Subplan for SEAD addresses the construction of wells intended to monitor the performance of the permeable treatment bed.

This treatment bed has been proposed as an interim remedial measure to reduce the concentration of a plume of contaminated groundwater emanating from an abandoned ash landfill. The permeable treatment bed will be located downgradient of the ash landfill to intercept the plume. Groundwater flow through the bed will provide for in situ groundwater treatment for VOC removal.

4.5.2 WELL LOCATIONS AND DEPTHS

The proposed location for the permeable treatment bed and monitor wells is shown in Figure 4-6 (Section 4.7). A line of monitor wells will be placed along the upgradient and downgradient sides of the bed to characterize upgradient and downgradient groundwater quality. This data will allow for the evaluation of the treatment efficiency of the in situ treatment method.

The monitor wells will be spaced a distance of 5 feet (ft) from the bed. This distance is based on the groundwater flow velocity ranging from 7 to 16 feet per year (ft/yr). The groundwater flow velocity was calculated based on permeabilities of the aquifer obtained from analysis of slug test data from the existing monitor wells at the site (ICF, 1989). The existing groundwater quality data presented in the ICF report suggests preferential pathways of contaminant transport that occur at higher flow rates than those presented previously either through natural or man-made permeable zones (ICF, 1989). If an average flow for the site of 11.5 ft/yr is assumed based on the slug test data, the proposed well spacing should allow for upgradient sampling of untreated groundwater before it enters the treatment bed and downgradient sampling of the treated groundwater in the downgradient monitor wells after the treated groundwater has passed through the bed prior to the completion of this 1-year study.

In the area of the proposed location for the permeable treatment bed, the depth to hard bedrock was approximately 10 to 11 feet below land surface (ft-bls). Weathered bedrock was generally encountered above the hard bedrock at 2.5 to 5 ft-bls. The water table was present within the zone of weathered bedrock at approximately 6.5 ft-bls. The monitor well boreholes will be drilled approximately 1 ft into the hard bedrock to allow for the placement of a 1-ft sand-sump at the base of the 5-ft length of well screen. This positioning will provide for complete screening of the saturated portion of the shallow aquifer.

Prior to well installation, all well locations will be approved in writing by the SEAD facilities engineer to avoid placing wells where they will present an unnecessary obstruction and to ensure the drilling activity will not disturb underground utilities.

4.5.3 DRILLING EQUIPMENT

The proposed method of well installation is by hollow stem auger. This method should not require the use of water or other drilling fluids during the well installation. The inside diameter (ID) of the auger will minimally be 6-1/4 inches to allow for proper placement of annular materials around the well casing and screen. Split spoon samplers will be used to obtain continuous lithologic samples from depths of 0 to 10 ft, and at 5-ft intervals thereafter.

4.5.4 DRILLING PROCEDURES

Prior to well installation, the appropriate soil boring and/or well drilling permits will be obtained. The wells will be installed by hollow stem auguring. Split-spoon soil samples will be collected continuously over the first 10 ft of each borehole, and at 5-ft intervals thereafter. As the boreholes are anticipated to be approximately 10 ft deep, samples collected over 5-ft intervals may not be necessary. The soil samples will be stored at the Gainesville Hunter/ESE laboratory in labeled, air-tight, plastic bags in case they are needed for further testing. These samples will be discarded upon contract completion.

All soil samples will be visually classified at the time of collection by the site geologist according the Unified Soil Classification System (USCS). Field descriptions will be verified by the laboratory analyses consisting of the following:

Test Description	Number Required/Well
a. Grain-size distribution [American Society for Testing and Materials (ASTM)-D 421 & 422]	2
b. Atterburg limits (ASTM-D 423 & 424)	2
c. Moisture content (ASTM-D 2216)	2

The specific soil samples to be tested in the laboratory, along with the type of test, will be determined after review of the geologist's boring logs by a graduate geotechnical engineer.

In addition to soil sample descriptions, the site geologist will maintain a detailed drilling log documenting the well installation. The information provided in the logs shall include, but not be limited to, the following information:

1. Reference elevation for all depth measurements;
2. Depth of each change of stratum;
3. Thickness of each stratum;
4. Identification of the material of which each stratum is composed according to USCS or standard rock nomenclature, as necessary;
5. Depth interval from which each formation sample was taken;
6. Depth at which hole diameter (bit sizes) change;
7. Depth at which groundwater is first encountered;
8. Depth to the static water level and changes in static water level with well depth;
9. Total depth of completed well;
10. Depth or location of any loss of drill water circulation, loss of tools, or equipment;
11. Location of any fractures, joints, faults, cavities, or weathered zones;
12. Depth of any grouting or sealing;
13. Nominal hole diameters;
14. Amount of cement used for grouting or sealing;
15. Description (to include length, location, diameter, slot sizes, material, and manufacturer) of well screen(s);
16. Any sealing-off of water-bearing strata;
17. Static water level upon completion of the well and after development;
18. Drilling date or dates; and
19. Installation details of monitoring well.

This information will be recorded on Hunter/ESE standard soil sampling and well construction forms. Copies of these forms are provided in Figures 4-1, 4-2, and 4-3. The geologist's log will be included in the final report.

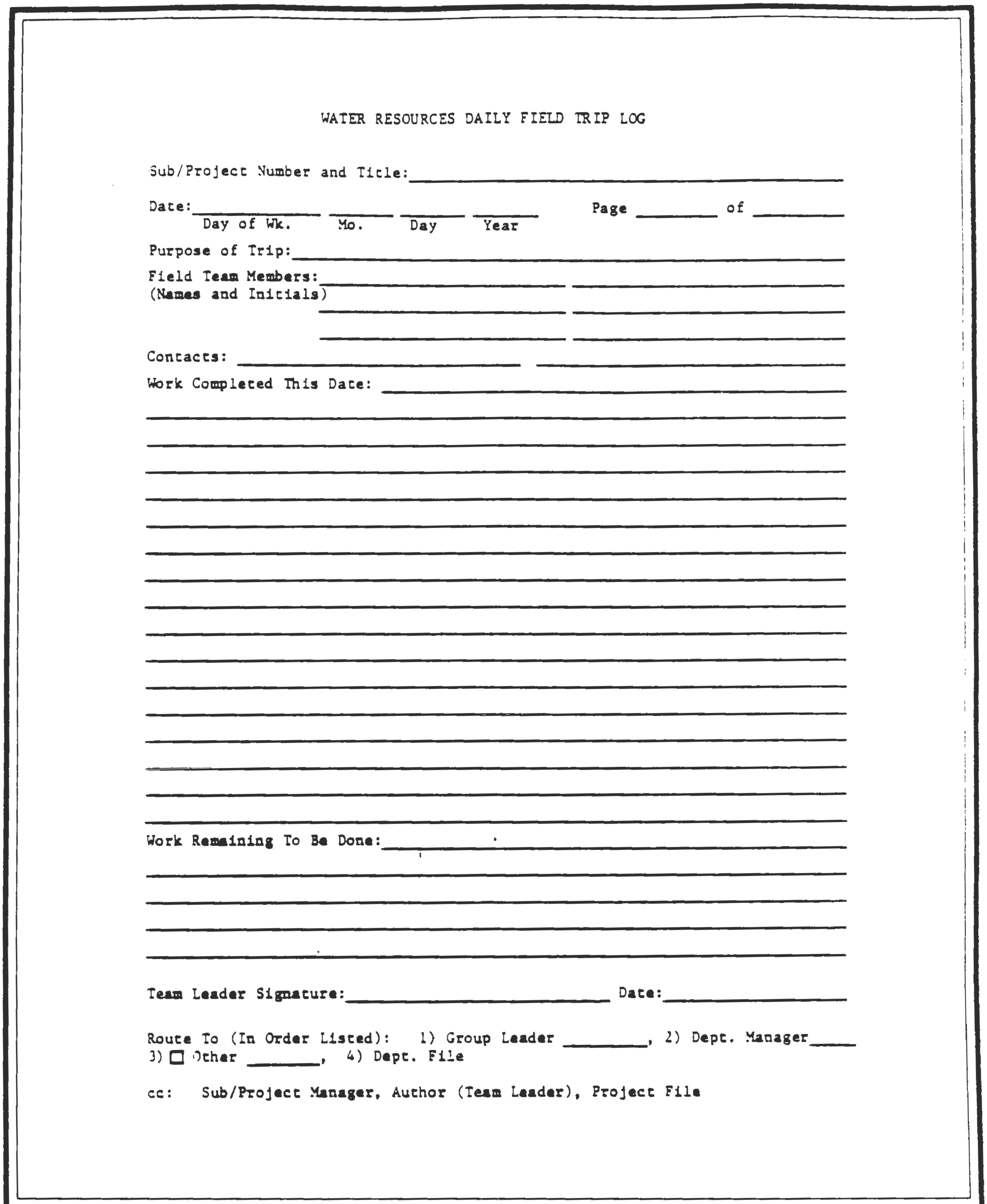
4.5.5 Contamination Prevention and Decontamination Procedures

The purpose of thorough decontamination is to prevent introducing contaminants into the aquifer from the drilling equipment, well construction materials, or well purging equipment. Prior to the drilling of a well or purging of the well for development, the procedures discussed in the following sections will be followed.

Drill Rig and Related Equipment

Each time the drill rig enters or leaves the site, including the initial decontamination and between monitor well locations, the equipment (i.e., auger flights, drilling rods, and drill head) will be decontaminated. Decontamination will include all well construction materials to be installed by the drilling crew. The specific procedure is as follows:

1. To remove any solids buildup on the back of the rig, auger flights, drill rods, drilling head, etc., the equipment may have to be scrubbed with a brush using tap water and a nonphosphate detergent (e.g., Alconox® or equivalent). This step may be preceded by steam cleaning. Any loose paint chips, paint flakes, and rust must also be removed.
2. Any portion of the drilling rig that is over the borehole (kelly or mast, drilling platform, hoist or chain pulldowns, head or cathead, etc.) must be steam cleaned and wire brushed before being brought



WATER RESOURCES DAILY FIELD TRIP LOG

Sub/Project Number and Title: ______________________

Date: __________ ______ ______ ______ Page ______ of ______
Day of Wk. Mo. Day Year

Purpose of Trip: ______________________

Field Team Members: ____________ ____________
(Names and Initials) ____________ ____________
____________ ____________

Contacts: ____________ ____________

Work Completed This Date: ______________________

Work Remaining To Be Done: ______________________

Team Leader Signature: ______________ Date: ______________

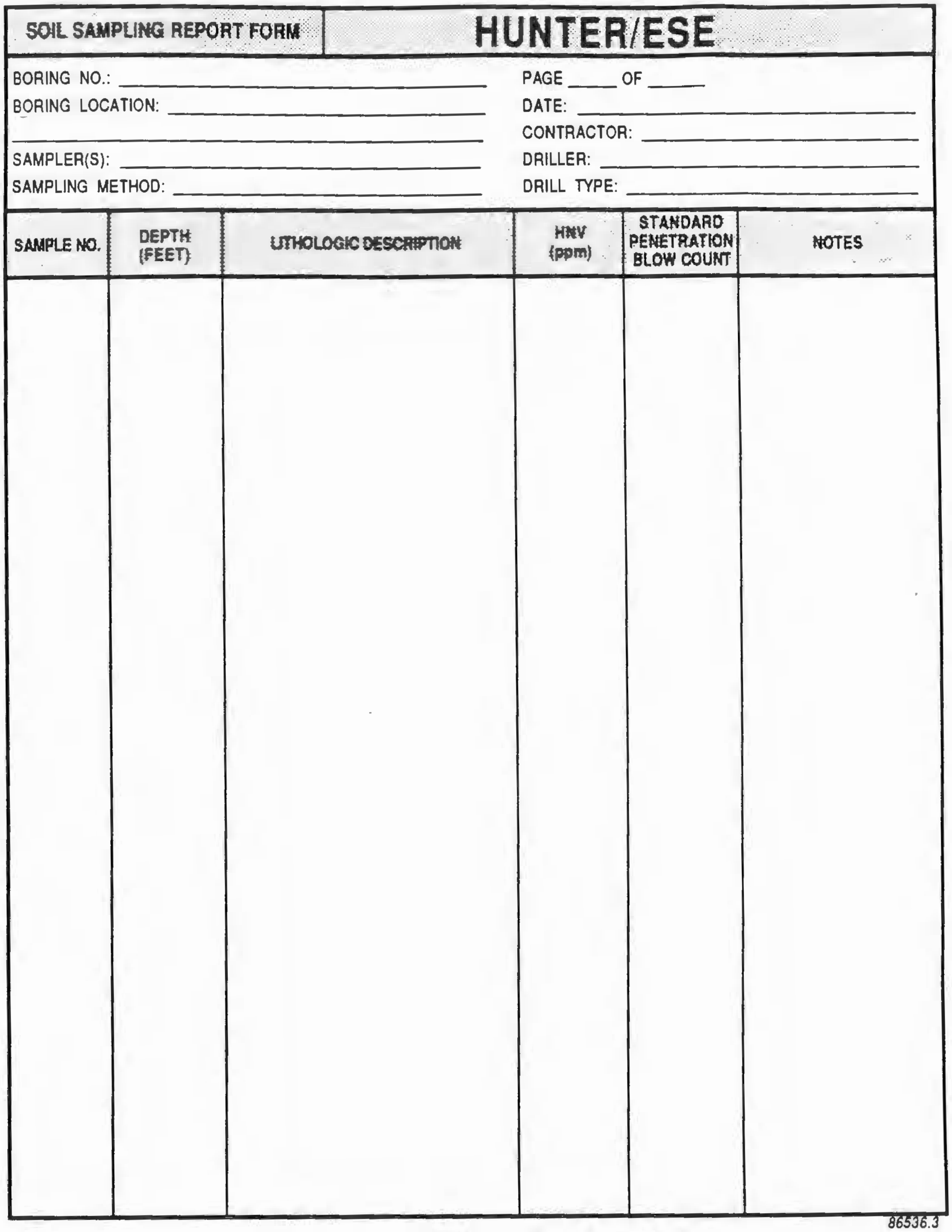
Route To (In Order Listed): 1) Group Leader ________, 2) Dept. Manager _____
3) ☐ Other ________, 4) Dept. File

cc: Sub/Project Manager, Author (Team Leader), Project File

Figure 4-1
DAILY LOG FORM

SOURCE: HUNTER/ESE, 1989.

HunTER/ESE



SOIL SAMPLING REPORT FORM **HUNTER/ESE**

BORING NO.: ____________________ PAGE _____ OF _____
BORING LOCATION: ____________________ DATE: ____________________
____________________ CONTRACTOR: ____________________
SAMPLER(S): ____________________ DRILLER: ____________________
SAMPLING METHOD: ____________________ DRILL TYPE: ____________________

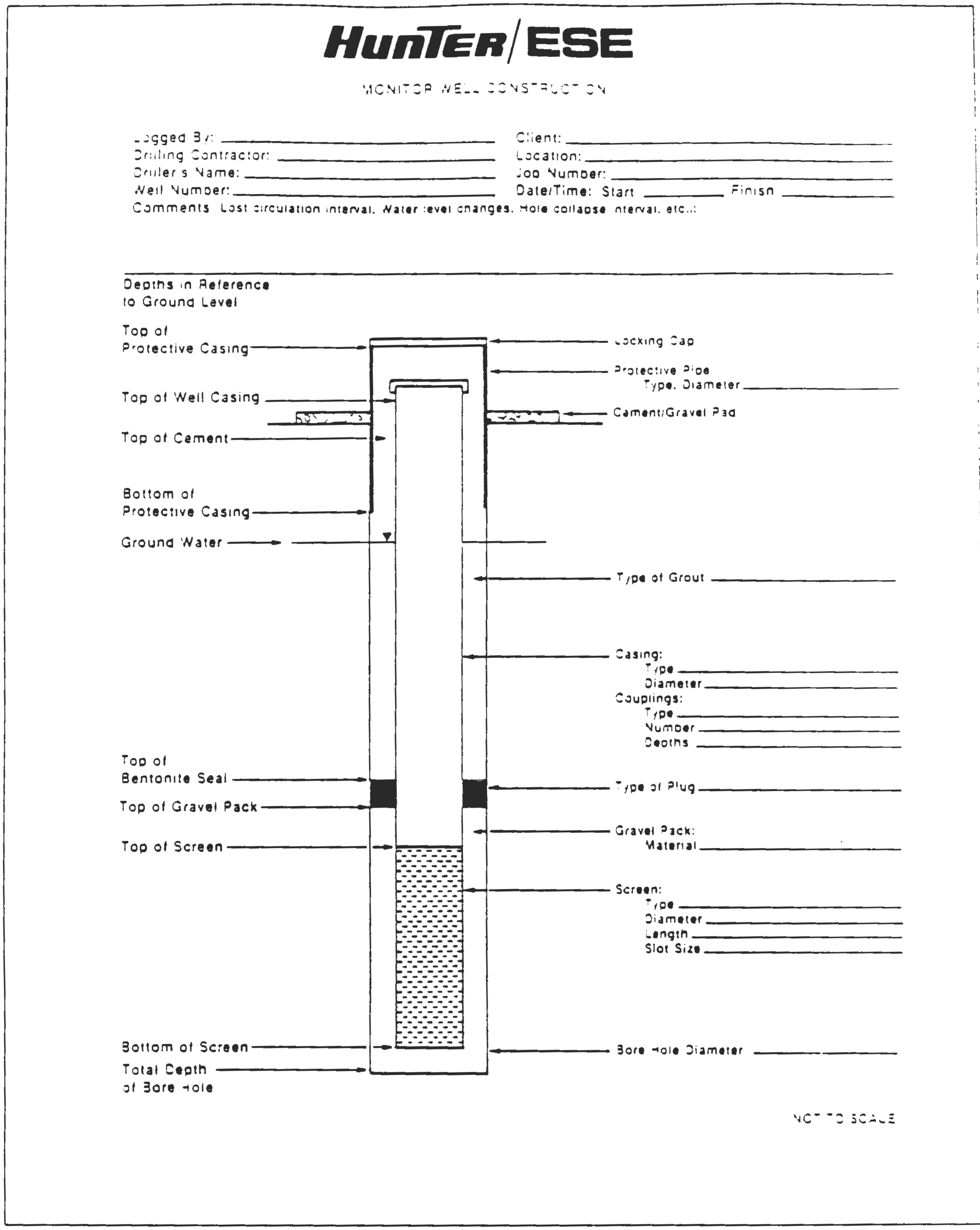
SAMPLE NO.	DEPTH (FEET)	LITHOLOGIC DESCRIPTION	HNV (ppm)	STANDARD PENETRATION BLOW COUNT	NOTES

86536.3

Figure 4-2
SOIL SAMPLING REPORT FORM

SOURCE: HUNTER/ ESE, 1989 .

HunTER/ESE



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MONITOR WELL CONSTRUCTION

Logged By: ____ Client: ____
Drilling Contractor: ____ Location: ____
Driller's Name: ____ Job Number: ____
Well Number: ____ Date/Time: Start ____ Finish ____
Comments (Lost circulation interval, Water level changes, Hole collapse interval, etc.):

Depths in Reference to Ground Level

Figure 4-3
MONITOR WELL CONSTRUCTION FORM

SOURCE: HUNTER/ESE, 1989.

HunTer/ESE

onsite to remove all rust, soil, and other material. The drilling rig should then be inspected to insure that all oil, grease, hydraulic fluid, etc. has been removed; all seals and gaskets are intact; and no fluids are leaking. Steam cleaning of the rig is then required prior to drilling each monitor well.

3. If the surfaces of downhole equipment (drilling rods, augers, bits, etc.) are painted, badly rusted, or coated with foreign materials, they must be sand blasted prior to being brought onsite.

All decontamination will take place at a specified area onsite. This site should be isolated from the sources of contamination. The drilling method of hollow-stem auguring should not require the addition of water to the borehole. However, water for the steam cleaner will be necessary for decontamination, as well as for decontamination rinses. The decontamination water source will be a nonchlorinated supply approved by the Contracting Officer prior to the commencement of the drilling operations.

Decontamination Procedure for Well Development Equipment

It is anticipated that centrifugal pumps with drop pipes will be used to develop wells after drilling. Drop pipes will be decontaminated in accordance with the following procedure:

1. If appropriate, scrub with a brush using tap water and a nonphosphate detergent for solids removal;
2. Rinse with tap water;
3. Rinse with deionized water;
4. Rinse with isopropanol;
5. Air dry;

6. Rinse with deionized (DI) water; and
7. Wrap completely in aluminum foil (shiny side out) for transport or storage.

After use in a well, the drop pipes will rinsed with tap water followed by a DI water rinse. The pipe will then be wrapped in aluminum foil, shiny side out, labeled with the appropriate well number, and stored in a trailer onsite for the next use in the well.

Spent decontamination solvents will be collected and allowed to evaporate.

If submersible pumps are used, they will be decontaminated by washing the outside of the pump housing, power cable, and discharge hose with a low phosphate soap solution and rinsing with tap water and DI water. Clean tap water will be pumped through the instrument to eliminate the possibility of cross contamination of wells.

Decontamination Procedure for Well Casings and Screens

Prior to installation, all well casings and screens must be decontaminated by steam cleaning. Any foreign material remaining after steam cleaning will be removed. Prior to decontamination, all paint on the casings must be removed. Special attention will be paid to threaded portions of the casing and screen.

4.5.6 Well Design and Installation

The intent of the well design and installation procedures is to produce a monitor well that will provide a representative sample of the groundwater in the shallow aquifer. Only with representative groundwater samples can an accurate evaluation of the effectiveness of the treatment bed be made. Adherence to the following procedures for well design and installation will result in such a well.

Boring Diameter

As discussed in Section 4.5.3, a hollow-stem auger with a minimum ID of 6-1/4 inches will be used to advance the borehole. The outside diameter of this auger is 9-1/2 inches and will result in a borehole with a nominal diameter of approximately 10 inches, which will allow adequate space for the proper placement of annular materials, including gravel pack, bentonite seal, and grout.

Well Riser and Screen

The casing string materials will consist of new threaded, flush-joint, 2-inch-diameter stainless steel pipe. No glue will be used in the well construction. Schedule 40 stainless steel will be used for both the riser and well screen, conforming to the requirements of ASTM D-1785. To assure the plumbness and alignment of the installed casing string in the borehole, one or more centralizers will be attached to the riser.

Five feet of well screen will be installed in each borehole. The screen will be factory constructed of continuous wrap or mill-slot design. The slot size to be used will be selected based on a sieve analysis of one or more representative samples of the aquifer material in which the monitor wells will be constructed. The selection of the screen slot size, as well as the filter pack gradation, will be based on the interpretation of the sieve analysis data. The results of the sieve analysis and screen and filter pack design will be included with the final engineering report.

Below the screen, a 1-ft length of solid-wall, stainless-steel pipe with a plug will be attached to function as a sand-sump. Based on the preliminary estimates of the depth to the water table and the depth to the top of the hard bedrock (Section 4.5.2), this sump will be placed approximately 1 ft into the hard bedrock. This positioning will result in the screened interval of the well within the saturated portion of the shallow aquifer. The bottom of the sand-sump will be fitted with a threaded stainless steel plug.

Filter Pack

The filter pack will consist of clean, inert, siliceous material with grain size based on the results of the sieve analysis of the aquifer material. The filter pack will be selected to prevent migration of fines into the screen and will be placed by tremie pipe from the bottom of the borehole to approximately 2 ft above the top of the well screen.

Bentonite Seal and Grout

A minimum 2-ft seal consisting of tamped bentonite pellets will be placed into the annular space between the riser and borehole above the filter pack. Nonshrinking cement grout will then be placed from the top of the bentonite seal to the ground surface. The cement grout will consist of a mixture of Portland® cement and water in the proportion of not more than 7 gallons (gal) of approved water per bag of Portland® cement. Additionally, 3 percent by weight of bentonite powder will be added, if permitted by state regulations.

Protection of Monitor Wells

Upon completion of the well, a vented stainless-steel cap will be installed to prevent extraneous material from entering the well. The well riser will be surrounded by a larger diameter steel casing set into a concrete pad. The larger steel casing will be placed 24 to 36 inches above ground level. The steel casing will be provided with a lock and cap. A minimum 3-ft-square, 4-inch-thick concrete pad, sloped away from the well, will be constructed around each well casing at the final ground level elevation. A survey marker will be permanently placed in each pad. Four 6-inch or larger diameter steel posts will be equally spaced around the well and embedded in the concrete pad. The ground immediately surrounding the top of the well will be graded to slope away from the well.

As the monitor wells are shallow depth installations, once a well is started, it will most likely be completed the same day. If a well casing is left incomplete due to a delay in installation, the well will be fitted with a watertight cap and equipped with a vandal-proof cover to satisfy applicable state or local regulations or recommendations.

4.5.7 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 and mechanical surging. Development will continue for a period of 4 hours (minimum), until groundwater removed from the well is clear and free of sand and drilling fluids. No water or other liquid will be introduced into the well other than formation water from that particular well. After final development of the well, approximately 1 quart of water from the well will be collected in a clear glass jar, labeled and photographed with a 35 millimeter (mm) camera using color slide film. The photograph will be a suitably back-lit close-up showing the clarity of the water. This slide will be developed and become part of the geologist's well log.

4.5.8 IN SITU PERMEABILITY

After monitor well development is complete, the permeability of the shallow aquifer will be evaluated. Single aquifer performance tests, or slug tests, will be performed on each new well. The slug test involves the introduction of a sealed, sand-filled, polyvinyl chloride (PVC) slug into the well, instantaneously raising the water level. When the water level stabilizes, the slug is quickly removed, instantaneously lowering the water level. The water level changes are recorded with a pressure sensitive probe attached to a computer data logger. The data logger allows for the collection of a multitude of pressure readings from the probe at intervals of 1 second or less during the slug test procedure. The resulting data will be analyzed by methods described by Bouwer and Rice (1976) to determine values for the hydraulic conductivity, or permeability, of the shallow aquifer. More recent work by Bouwer (1989) indicates the most reliable data is obtained from the slug-out portion of the test, the recovery of the water level following the removal of the slug from the well.

4.5.9 MANAGEMENT OF PURGE WATER

All purge water will be temporarily stored in the Frac-tank used to store groundwater removed during excavation of the permeable treatment bed trench. If the Frac-tank is no longer onsite, or is full to capacity, all purge water will be collected in approved Department of Transportation (DOT) 55-gal drums.

Drums will be labeled and manifested according to RCRA regulations. Actual disposal will be the responsibility of the government.

4.6 DEWATERING, EXCAVATION, TRANSPORT, AND STORAGE SUBPLAN

The objective of this subplan is to describe the materials, personnel, equipment, and procedures employed during the dewatering, excavation, transport, and storage activities involved in constructing the treatment trench. The trench will be constructed by Hunter/ESE's subcontractor, Delta Environmental, Inc., under the supervision, direction, and inspection of Hunter/ESE.

4.6.1 DEWATERING

Dewatering will be performed so the treatment trench can be constructed in relatively dry conditions. Dewatering will be preformed by sump-suction pumps. The specific types and numbers of pumps will be selected based on groundwater levels, permeability of soils, and quantities of water to be handled during construction of the treatment trench.

Groundwater removed through dewatering will be considered hazardous and will be handled accordingly. The groundwater will be pumped into a Frac-tank for temporary storage until it is determined by sampling and analysis (Section 3.6) to be a hazardous or nonhazardous waste. The Frac-tank will be in good condition, free of leaks, inspected every day, compatible with the contaminants of concern, and labeled in accordance with 49 Code of federal Regulations (CFR), Part 172.

Following the determination of whether the waste is hazardous or nonhazardous, final disposition will be the responsibility of the Army and will be accomplished in accordance with 40 CFR Parts 262, 263, 264 and 268; DOT shipment standards codified in 49 CFR Parts 172, 173, and 178; and any other applicable federal, state, or local regulations.

The pumps, pipes, valves, and fittings chosen for dewatering the treatment trench during excavation will be compatible with the contaminants of concern in the groundwater. The contaminants of concern are chlorinated VOCs: trans-1,2-dichloroethene; trichloroethene; and, to a lesser extent, 1,2-dichloroethane, vinyl chloride, and chloroform.

4.6.2 EXCAVATION

The trench will be excavated to install the treatment bag. The trench shall be 360 ft long, at least 2 ft wide, and approximately 7 to 12 ft deep.

According to the SEAD Burning Pit/Landfill Site Investigation Final Report (Draft), March 1989, the soils found in the vicinity of the trench are silty and clayey. The bedrock in the trench area consists of weathered and competent shale rock.

4.6.2.1 Personnel

Subcontractor personnel involved in the trench excavation will include a site foreman, backhoe equipment operator, front-end loader equipment operator, bulldozer equipment operator, dump truck driver, and four general laborers. This crew will be involved in all phases of the trench construction, including excavation, dewatering, transportation, and storage of the excavated material.

4.6.2.2 Equipment

The equipment used in the trench excavation will include a 2-cubic-yard (yd^3) hydraulic backhoe, 2.3-yd^3 front-end-loader, track-mounted bulldozer, 18 yd^3 dump truck, 21,000-gal wheel-mounted Frac-tank, and 2 crew general purpose pick-up trucks. Variations in this equipment list will be approved in writing by Hunter/ESE. This equipment will be involved in various phases of the trench construction, including excavation, dewatering, transportation, and storage of the excavated material.

4.6.2.3 Site Preparation

The site will be field verified prior to beginning excavation to identify all known underground and aboveground utilities. All underground utility locations will be staked and flagged. If utilities must be permanently or temporarily removed prior to the excavation of the trench, the corresponding utility company will be notified to remove or relocate the utility. The Army shall be responsible for the costs associated with the removal or relocation of any utilities. The lateral limits of the excavation will be carefully marked with stakes and flags before excavation begins.

4.6.2.4 Operational Layout

The site will be organized to provide a safe and environmentally sound working area. Exclusion, contamination reduction, and support zones will be established according to the SHERP. All excavation, transportation to storage, and storage activities will be conducted in the exclusion zone; personnel and equipment decontamination will be carried out in the contamination reduction zone; and any administrative and emergency medical care will be carried out in the support zone.

4.6.2.5 Environmental Controls

The subcontractor will conduct all excavation activities in accordance with the SHERP (Section 4.3). Air monitoring will be conducted during the excavation activity to determine the air concentration levels of the various contaminants of concern. All air monitoring will be conducted in accordance with the Air Monitoring Subplan, Section 4.8.

4.6.2.6 Excavation Procedures

Excavation activities will be performed with the equipment and personnel discussed in the previous paragraphs. Excavation, trenching, and shoring procedures will comply with Occupational Safety and Health Administration (OSHA) requirements as codified in 29 CFR, Parts 1926, Subpart P.

The trench will be excavated to a depth of approximately 1 ft below the surface of competent bedrock. Competent bedrock is defined as the same material identified as "hard shale" in the boring logs (USAEHA, 1987). Excavated soil will be immediately placed in a dump truck adjacent to the trench. The trench excavation will be sufficiently wide to allow safe personnel access and enable installation of the treatment bag. During all trench construction work, OSHA requirements will be met.

Stabilization of trench sides will be achieved with metal shoring trench boxes. No personnel will be allowed to enter the excavated trench until the trench walls have been stabilized.

Good communication between the excavation equipment operator and others will be practiced to prevent physical hazards and injury. Due to possible high noise levels from excavation equipment and dewatering pumps, hand and horn signals will be used during excavation. The excavation personnel and equipment operator will be thoroughly familiar with the communication signals.

4.6.3 TRANSPORT

As the subsoil is excavated it will be transferred directly into dump trucks and transported to the temporary storage area located within the exclusion zone. Dump trucks will follow the same route between the excavation and storage areas, always remaining within the exclusion zone. If the excavated soil is dry and windy conditions prevail, the excavated soil will be covered with a tarpaulin during transport. The dewatered groundwater will be pumped directly into a Frac-tank located near the trench.

4.6.4 STORAGE

Excavated soils will be stockpiled in a temporary waste storage area located within the exclusion zone, as shown in Figure 4-5. The storage area will be bermed on the sides and lined with a synthetic membrane to prevent runoff and leaching of contaminants into the ground. A layer of soil will be placed on the top of the synthetic membrane to prevent damage to the membrane.

The storage area will include a sump located downgradient to collect water that may accumulate within the bermed area due to rainfall or leachate seeping from the excavated soils. The site will have posted "Warning" and "No Smoking" signs to protect personnel working in the area.

4.6.4.1 Temporary Waste Pile

The waste storage area will be constructed in accordance with 40 CFR, Subpart L and will be identified as a temporary waste pile. It will be underlain with a synthetic liner installed to prevent migration of wastes out of the pile into the adjacent subsurface soil. The liner will be constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure due to pressure gradients, physical contact with waste to which it will be exposed, climatic conditions, installation stress, and the stress of daily operation. The liner will be placed on a base capable of providing support to the liner and resistance to pressure gradients above and below the liner to prevent failure of the liner due to settlement, compression, or uplift. It will be installed to cover all surrounding earth likely to be in contact with the waste. The design of the temporary waste storage area is described in Section 4.7.

4.6.4.2 Monitoring and Inspection

During construction of the waste pile, the liner system will be inspected for uniformity, damage, and imperfections. Immediately after installation, the liner system will be inspected to ensure tight seams and joints and the absence of tears, punctures, or blisters. While the waste pile is in operation, it will be inspected weekly and after storms to detect evidence of any deterioration, malfunctions, and leaching of waste. Following trench construction (i.e., after the last load of soil is transferred into the waste pile), monitoring and maintenance of the waste pile/liner will be the responsibility of the Army.

4.7 TREATMENT SYSTEM DESIGN SUBPLAN

Design calculations for the following are included in Appendix D.

4.7.1 MONITOR WELLS

To follow the progress of the groundwater remediation, monitor wells will be installed on each side of the treatment trench. Ten monitor wells will be installed; five wells will be placed hydraulically upgradient of the trench and five downgradient. Wells will be installed in accordance with the Monitor Well Installation Subplan presented in Section 4.5. The proposed monitor well locations are presented with the treatment trench configuration in Section 4.7.3 (see also Figure 4-6).

The proposed locations for the ten monitor wells are discussed in Section 4.5, Monitor Well Installation Subplan.

4.7.2 DEWATERING AND EXCAVATION

Dewatering

The factors considered in selecting the dewatering methodology were the types of soils encountered on site, probable groundwater levels during construction of the treatment trench, permeability of the soils in the area, and probable quantities of water to be handled.

The following design information was collected from the SEAD Burning Pit/Landfill Site Investigation Final Report (Draft), March 1989. The soils where the trench is to be located are predominantly clay and weathered shale. The hydraulic conductivity of the site soils averaged approximately 3×10^{-5} centimeters per second (cm/sec) (1×10^{-6} ft/sec) as determined by slug tests at selected monitor wells. Groundwater in the proposed trench area was encountered at approximately 5 ft below grade; weathered shale and competent shale bedrock were encountered at between approximately 3 and 4 ft and between approximately 8 and 11 ft, respectively. The effective porosity of the aquifer was estimated from typical values for silty clays and shale bedrock to be about 0.11.

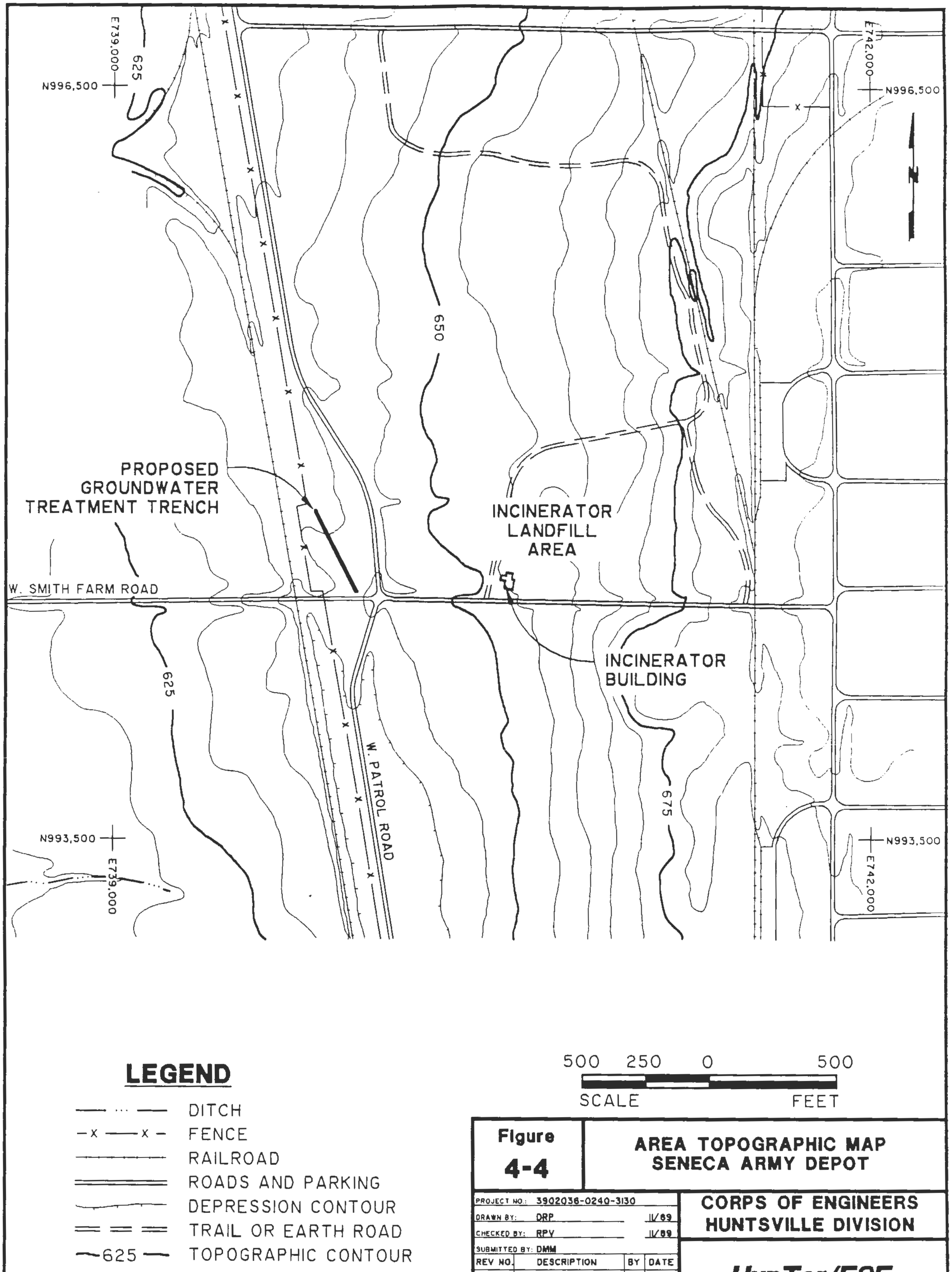
The dewatering method considered most suitable for the trench excavation will be the sump-suction pumping method because it is economical and most often used for silty, clayey soils with low permeabilities. The groundwater will be collected from the bottom of the excavated trench and pumped to a temporary storage tank.

Excavation

Trench excavation will be performed with a backhoe and will be continuous from one end to the other. Shoring of trench walls during excavation and treatment system construction will be performed by using trench boxes with movable internal crossbracing and a minimum internal width of 2 ft. Crossbraces will be moveable to facilitate installation and filling of the geotextile treatment bag (bag), and crossbrace ends will be padded to prevent damage to the geotextile. As the treatment bag is filled with the sand/activated carbon mix, the trench box will be moved to allow continued trench excavation.

4.7.3 TREATMENT TRENCH

A topographic map of the landfill and proposed treatment trench area is presented in Figure 4-4. This figure identifies the locations of the landfill, the incinerator building, and the proposed treatment trench. The trench location was selected, based upon conversations with USACE personnel, to intercept as



SOURCE: STV/LYON ASSOCIATES, INC., BALTIMORE, MARYLAND.

Figure 4-4

AREA TOPOGRAPHIC MAP SENECA ARMY DEPOT

PROJECT NO.: 3902036-0240-3130	
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CHECKED BY: RPV	11/89
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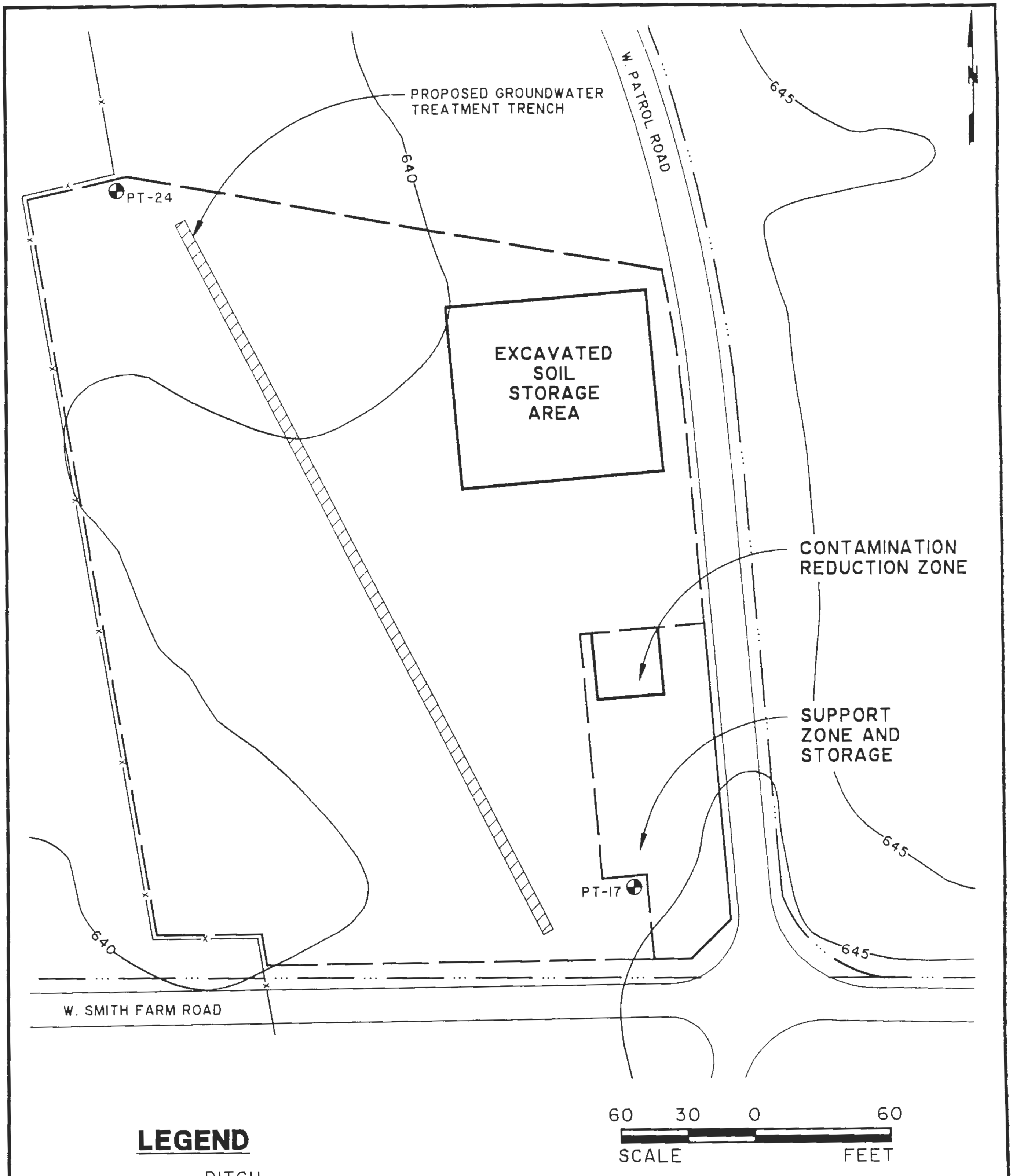
much of the plume as possible and to minimize interference with surrounding structures and utilities.

The treatment trench location is depicted in greater detail on the staging plan for the trench construction, which is presented in Figure 4-5. In addition to the treatment trench location, the staging plan identifies the locations of the excavated soil storage area, the contamination reduction zone, and the support and storage area. The staging plan and contamination control measures are discussed in greater detail in Section 4.7.7.

Figure 4-6 presents the proposed location of the treatment trench with respect to adjacent monitor wells and the approximate direction of groundwater flow. The treatment trench will be 360 ft in length and a minimum 2 ft in width. Since the trench box has a wall width of 8 inches, the total width of excavation will be approximately 3 ft 4 inches to insure a minimum treatment area width of 2 ft. Trenching will be done with a back hoe and will be continuous from one end to the other. The trench will be constructed to a depth of approximately 1 ft below the depth of competent bedrock. Competent bedrock is defined as material identified as "hard shale" on the boring logs prepared by USAEHA (1987). Trench depth is expected to range from approximately 7 to 12 ft.

4.7.4 TREATMENT BAG

The bag will consist of a mixture of activated carbon and sand enclosed within a geotextile fabric. A typical cross section of the bag is shown in Figure 4-7. The bag has been designed for the removal (via adsorption) of volatile chlorinated organic compounds within the groundwater. Design details for the



LEGEND

— ··· —	DITCH
–x ——x–	FENCE
═══	ROADS AND PARKING
═ ═ ═	TRAIL OR EARTH ROAD
—625—	TOPOGRAPHIC CONTOUR
—— ——	EXCLUSION ZONE

Figure 4-5

STAGING PLAN
SENECA ARMY DEPOT

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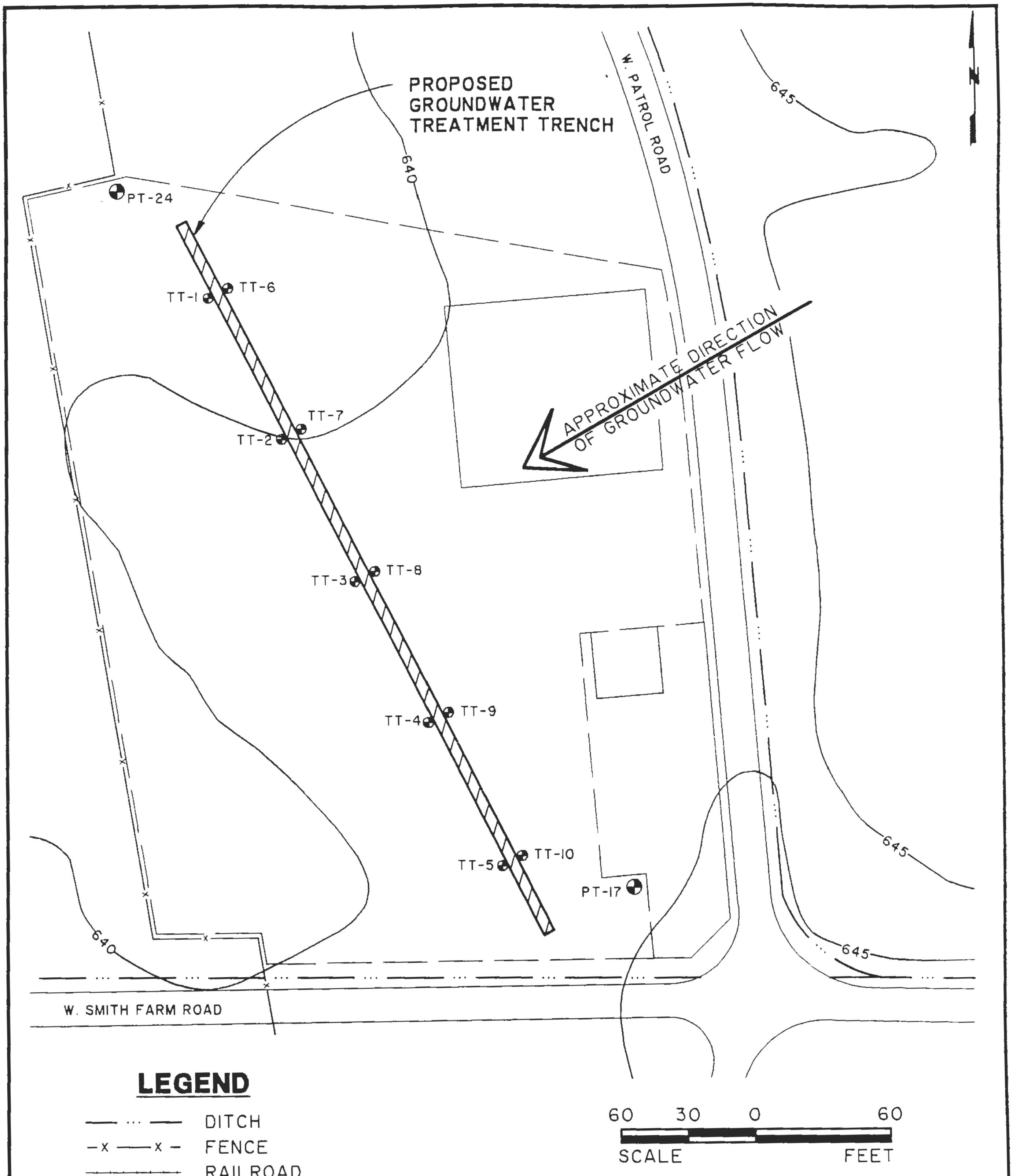

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— ··· — DITCH
–x —— x– FENCE
RAILROAD
ROADS AND PARKING
DEPRESSION CONTOUR
═ ═ ═ TRAIL OR EARTH ROAD
~625~ TOPOGRAPHIC CONTOUR
⊕ PT-17 MONITOR WELL LOCATION AND NUMBER (EXISTING)
⊕ TT-1 MONITOR WELL LOCATION AND NUMBER (PROPOSED)

Figure 4-6

PROPOSED TREATMENT TRENCH AND MONITOR WELL LOCATIONS SENECA ARMY DEPOT

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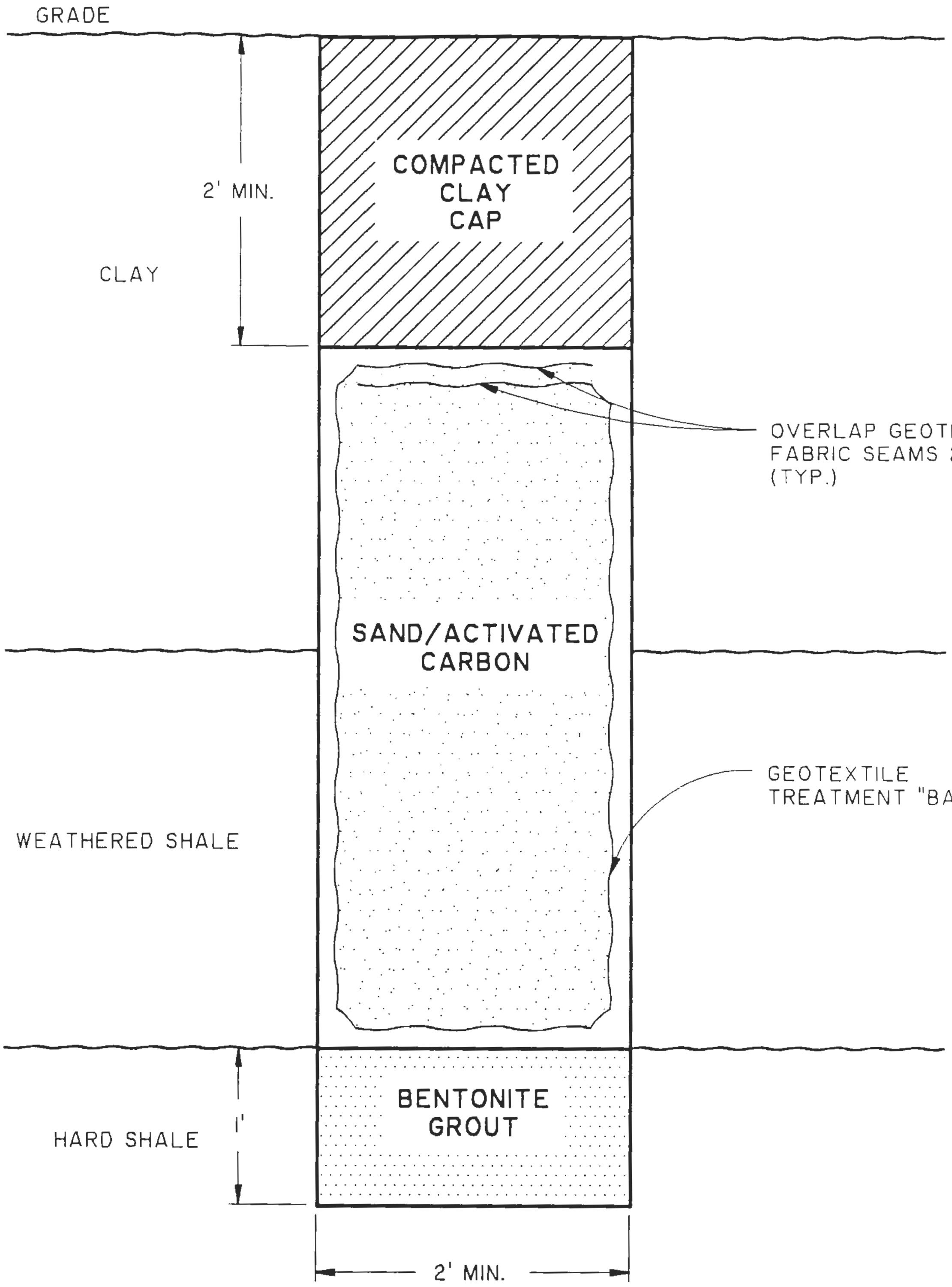

NOT TO SCALE

Figure 4-7

SECTION THROUGH GROUNDWATER TREATMENT TRENCH SENECA ARMY DEPOT

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selection and placement of the bag components, i.e., geotextile fabric, sand, carbon, and sand/carbon ratio, are described in the following paragraphs.

4.7.4.1 Geotextile Fabric

The purpose of the geotextile fabric is to prevent the migration of fines into the sand/activated carbon mixture. The fabric selected must be capable of retaining fines without becoming clogged due to the fines. Additionally, the fabric should be more permeable than the surrounding soil so that it does not restrict groundwater flow. Because this SOW did not allow for field investigations prior to design, the selection of the fabric was based on severely limited available data provided by SEAD (USAEHA, 1988). Two grain-size analyses completed from 0 to 2 ft and 2 to 4 ft on samples collected during the drilling of well PT-24 indicated 42.5 percent and 56.9 percent, respectively, passing Number 200 sieve size.

Geotextile Selection

The geotextile filter fabric chosen for lining the treatment trench must meet three general design criteria: soil retention ability, permeability, and clogging resistance.

Soil retention ability measures the ability of the fabric to prevent migration of soil particles through the fabric. In the case of the treatment trench, the fabric must prevent in situ fines from migrating into and clogging the treatment media, thus reducing its permeability. In general, any fabric that prevents the silt/clay size fines at the site from migrating into the treatment media will also prevent the treatment media from migrating beyond the confines of the bag. It normally is necessary to perform a grain-size analysis of the in situ soils to determine an appropriate effective opening size for the geotextile material that would prevent fines migration. Adequate grain-size information is not available presently. However, a nonwoven geotextile having an apparent opening size in the range of .1 to .2 mm generally would be considered appropriate for the silt/clay size soils present.

Fabric permeability and clogging resistance are related in that in the absence of reliable test data for clogging potential, manufacturers recommend choosing a geotextile with a permeability 1 or 2 orders of magnitude above that of the in situ soils. Slug testing of selected monitor wells onsite has shown the average permeability of these soils to be approximately 3.5×10^{-5} cm/sec. Therefore, a geotextile having a permeability greater than approximately 10^{-3} cm/s could satisfy the permeability and clogging criteria.

Since actual field testing of the geotextile is not a part of this SOW, a conservative selection is appropriate. Polyfelt TS650 nonwoven fabric or equivalent is selected for this application. Typical properties for this material are presented in Appendix D.

4.7.4.2 Sand

Sand Selection

Engineering criteria of concern for selection of the sand filler for the treatment system are permeability and chemical make-up. To prevent a buildup of hydraulic gradient behind the trench, the sand permeability should be an order of magnitude greater than the surrounding soils. The permeability of the surrounding soils as determined by slug testing of selected wells was previously determined to be approximately 3.5×10^{-5} cm/sec. Therefore a permeability of approximately 10^{-3} cm/sec or greater would be acceptable. The chemical make-up of the sand is only a concern in that it not interfere with the analytical testing performed during the treatment system evaluation study. The sand must therefore be free of organics or contamination.

Based upon permeability and chemical make-up concerns, a medium- to coarse-grained silica sand that is clean and free of organics is recommended for use within the treatment trench. Such a sand would be classified as SP or SW under USCS and would contain a percent fines or a percent passing the #200 sieve of less than 5.

4.7.4.3 Activated Carbon

Carbon Selection

The purpose of the activated carbon is to adsorb the major chlorinated organic contaminants that have been identified at the site: trans-1,2-dichloroethene, trichloroethene, and to a lesser extent, 1,2-dichloroethane, vinyl chloride, and chloroform. In the following paragraphs, the type and quantity and the corresponding rationales of carbon selected for the bag are discussed.

Bituminous-based carbon will be used because it is well proven in the removal of low molecular weight organics such as those referenced previously. However, it should be pointed out that the effectiveness of activated carbon for removal of vinyl chloride in an aqueous matrix is generally low, and if vinyl chloride is present in detectable concentrations, the bag may be prove ineffective in removing vinyl chloride. To be most compatible with the sand size, an 8 X 30 mesh carbon will be used.

Carbon Quantity

Selecting the quantity of activated carbon that should be added to the bag is not straightforward. The maximum (theoretical) carbon usage can be calculated based on the pounds of contaminants to be removed over a selected period of time. However, as soon as the carbon is mixed with sand, resulting in a matrix of sand and carbon, other factors come into play. Ample carbon may be available for removal of the contaminants, but, unless the contaminants come in contact with the activated carbon particles, removal will not occur. For example, if the contaminants are expected to come in contact with only 20 percent of the particles, then approximately 5 times the maximum calculated amount of carbon might be needed to provide effective removal. Therefore, following the calculation of the theoretical carbon usage, the spatial distribution of the carbon within the sand must be assumed and a model developed to estimate the extent of contact between the contaminants and carbon particles. Based on the results of this model, the amount of carbon that should be placed within the bag and the resulting ratio of sand to carbon can be determined.

The maximum carbon usage was calculated partly based on an assumed groundwater flow rate of 16 feet per year (ft/yr) and the following contaminant concentrations, all of which were taken from USACE (1989), <u>Remedial Investigations/Feasibility Studies, Seneca Army Depot Burning Pit/Landfill Site Investigation</u>.

Contaminants	Design Concentrations
trans-1,2-dichloroethene	0.085 mg/L
trichloroethene	0.226 mg/L
1,2-dichloroethane	below detection level (BDL)
vinyl chloride	BDL
chloroform	BDL

Concentrations were selected in the following manner. Page 4-8 of the referenced report (ICF, 1989) summarized the five contaminants listed previously for each well for several sample periods (March 1987 through November 1988). It was decided that only the latest sample results (November 1988) would be considered and then only results from wells close to the planned location of the treatment trench. These criteria consider that water in the vicinity of the other wells is not likely to reach the treatment trench within the time frame of this treatability study. Therefore, data from wells PT-12 and PT-18 were not considered. The closer of the two wells, PT-12, is at least 500 ft upgradient from the proposed location of the trench. At the assumed flow rate of 16 ft/yr, 30 years would be required for contaminants measured at that well to reach the trench. Following this described rationale resulted in the selection of the concentrations listed previously.

The groundwater flow rate was calculated based on permeabilities, gradients and porosities (ICF, 1989). Values of 7 ft/yr and 16 ft/yr were calculated, with the difference due to the permeability selected for each calculation. The 16 ft/yr groundwater flow rate was chosen rather than the 7 ft/yr rate to provide a conservative calculation, as it was apparent from reviewing ICF (1989) that the movement of groundwater could approach the higher value.

Using the assumed flow rate (16 ft/yr), an average height for the bag (7.5 ft), and the trench length (360 ft), the annual loading on the bag was calculated to be 323,000 gallons per year (gal/yr) of groundwater and 0.84 pound per year (lb/yr) of the combined contaminants listed previously. Based on the loading and literature-based carbon isotherms, theoretical carbon usage was calculated to be 4,070 lb/yr. It is important to reemphasize that this value represents the amount of carbon that would be used per year assuming complete contact between the contaminants and carbon particles. Less contact will require an increased quantity of carbon to increase contact. The calculations are in Appendix D.

Based on the carbon quantity determined previously, a simplified model was developed for estimating the contact between contaminants and carbon particles. The model was based on the following assumptions and conditions:

1. Given the quantity of carbon per unit volume of the bag, the total number of carbon particles within a unit volume can be estimated based on the mean particle diameter and density.
2. The particles within the unit volume can be assumed to be evenly distributed in all three directions of a three-coordinate system (X-Y-Z), such that the number of rows or columns along any axis is equal to the cube root of the total number of particles. It follows then, that the number of X-Y planes that contain a grid of particles will equal the cube root of the total number of particles and that each X-Y plane will contain the same number of particles.
3. The extent of contact between contaminants and carbon particles can be related to the probability that a water particle can pass through the unit volume without contacting a carbon particle.

4. Water flow lines through the unit volume will be straight, and channeling will not occur.
5. The probability that water will pass through a single X-Y plane without contacting a carbon particle is equal to the ratio of open area to total area. Open area equals total area [1 square foot (ft^2)] less occupied area. Occupied area equals the area occupied by the carbon particles and can be estimated based on the mean particle diameter and the calculated number of particles within the X-Y plane.
6. The probability that a water particle will pass through the entire unit volume without contacting carbon particles can be determined by the multiplicative law of probability.

The model was calculated for two carbon quantities and assumed mean particle density and diameter. The results of the model are as follows.

	Carbon Quantity	Mean Density	Mean Diameter
Case 1:	4,070 lb	1.35 grams per cubic centimeter (g/cc)	1.6 mm
Case 2:	6,100 lb	1.35 g/cc	1.6 mm

The model and calculations are in Appendix D.

The results of the modeling indicated the following probabilities for each case:

	Probability
Case 1:	99.5%
Case 2:	99.5%

Reviewing the probabalities for each case, it can be concluded that Case 1, with 4,070 lb of carbon should be adequate for this design. Considering the relationship between particle density and particle volume, the corresponding ratio of carbon to sand will be 1:57 (volume basis).

Contact Time

It is also important to estimate the contact time that might occur between the water and carbon particles. This is a difficult problem and also requires modeling. This model assumes that the contact time can be estimated based on the travel time of a water particle relative to the carbon particle size. It assumes straight flow past a particle of mean diameter (1.66 mm) at a rate of 16 ft/yr. The model and calculations are in Appendix D.

The results of the modeling calculations indicated that the contact time between water and carbon particles would average approximately 3 hours. Based on normal expectations, approximately 30 to 60 minutes contact time would be required to adsorb effectively the contaminants of concern. Therefore, the estimated contact time of approximately 3 hours should be adequate for this design.

4.7.4.4 Placement of Treatment Bag Components

Fabric Placement

The fabric will be placed as the trench is excavated. It will be positioned manually atop the bentonite grout seal with the sides lapping over the top of the excavation. With the bag in place, the sand and carbon mixture will be poured into the trench. As the bag is filled with the mixture, the trench box will be withdrawn, resulting in a spreading of the bag and contents. Following placement of the sand/carbon mixture, the sides of the bag will be overlapped 2 ft as shown in Figure 4-7.

Sand/Activated Carbon (S/AC) Placement

Prior to placement, the activated carbon will be mixed with clean sand in the volumetric ratio of 1 to 57. Mixing will be accomplished onsite in a cement mixer or other appropriate mixing device selected by the trench contractor. For each batch of S/AC mixture, the required quantities of sand and carbon will be combined and mixed for a specified time period. This time period will have been predetermined as the minimum time required to assure that the activated carbon particles are evenly distributed throughout the mixture. The time period will be determined in the following manner:

1. Appropriate quantities of sand and carbon, measured by volume, will be combined in the mixer, and the mixer will be started.
2. At intervals of 5, 10, 20, and 30 minutes, the mixer will be shut off and a single grab sample (one quart size) will be collected from the mixture.
3. The four grab samples and one grab sample of the clean sand will be submitted to the Hunter/ESE laboratory in Gainesville for total carbon analysis. Each sample will be analyzed in duplicate.

4. The results of the total carbon analyses, corrected for carbon content in the clean sand, will be evaluated to determine at what point in time, between 5 and 30 minutes, the sand and activated carbon were thoroughly mixed.
5. The value determined in Step 4 will be considered the minimum amount of time required to thoroughly mix the sand and carbon. To provide a safety factor, the number will be increased by 25 percent. This number will be selected as the record mix time for all subsequent S/AC batches.
6. Important: If the mixing device and/or operating conditions such as mixing speed are changed during the project, Steps 1 through 5 will be repeated to determine a new record mix time. The total carbon analyses, calculations, original record mix time and any subsequent revised mix times will be reported in the engineering report (Task G-8).

4.7.5 TRENCH CAP

Following installation of the treatment bag and removal of the trench box, the trench will be covered with a minimum 2-ft-thick layer of compacted clay as shown in Figures 4-7 and 4-8. The purpose of the clay cap is to minimize infiltration of surface water from precipitation/runoff into the treatment bag. Clay will be compacted in lifts not to exceed 6 inches compacted thickness using a mechanical hand-operated compactor. Clay will be compacted to a minimum 90 percent of standard Proctor density (ASTM D-698) at a moisture content greater than 2 percentage points above optimum moisture content.

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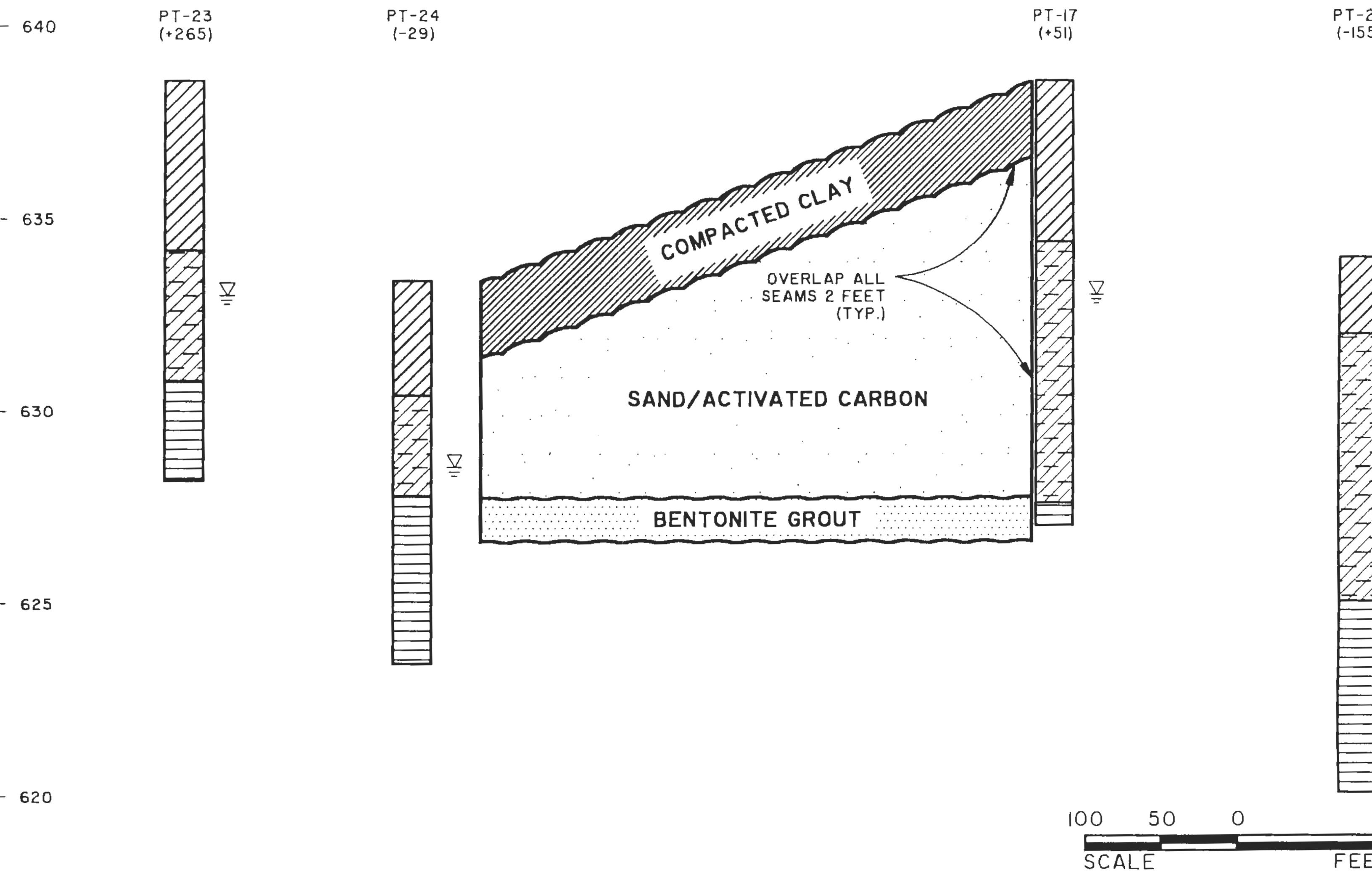

LEGEND

▨	CLAY	⊻	GROUNDWATER ELEVATION 10/24/88
▨	WEATHERED SHALE	PT-23 (+265)	MONITOR WELL NUMBER AND OFFSET FROM PROFILE LINE (FEET)
▤	HARD SHALE		

Figure
4-8

SUBSURFACE PROFILE
PROPOSED TRENCH
SENECA ARMY D

PROJECT NO. 3902036-0240-3130
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CHECKED BY: RPV 11/89
SUBMITTED BY: DMM

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4.7.6 STORAGE OF EXCAVATED MATERIAL

A temporary storage area for the excavated soils was designed to meet the RCRA standards for Owners and Operators of Hazardous Waste Piles, outlined in 40 CFR, Part 264, Subpart L. The design and operating requirements of 40 CFR, Part 264, Subpart L state that the waste pile will have a liner constructed and installed to prevent any migration of wastes out of the pile and a leachate collection and removal system constructed, maintained, and operated to collect and remove leachate from the pile.

The temporary storage area design was based on the assumption that all excavated soils and well drill cuttings will be considered hazardous waste. Therefore, the storage area will be located in the exclusion zone, as shown in Figure 4-5. The area will be enclosed within a berm and lined with a polyethylene synthetic liner, Gundle's Hyperplastic Very Low Density Polyethylene Liner or equivalent, that is resistant to the contaminants of concern. Hyperplastic was chosen for its resistance to halogenated hydrocarbons, flexibility at temperatures below freezing, and resistance to puncture and tearing. The liner will be placed over a 16 ounce (oz), nonwoven geotextile, Polyfelt's TS 800 or equivalent, to provide increased resistance to puncturing the liner. Prior to placement of excavated material, a 6-inch layer of clean sand will be placed by hand on top of the liner to prevent damage to the liner from the excavated soils and rocks and to provide a leachate drainage layer. Vehicles will not be permitted to drive over any portion of the liner until a minimum of 36 inches of soil is in place over the top of the synthetic liner. Waste soils will not be piled higher than 8 ft in height and side slopes will not exceed 2 horizontal to 1 vertical (2H:1V).

Figures 4-9 and 4-10 present plan and details respectively for the excavated soil storage area.

The berm surrounding the excavated soil storage area will consist of double rows of railroad ties that will be used to anchor the synthetic liner as depicted in Figure 4-10. The soil storage area will include a leachate collection sump consisting of a 1-ft-deep by 5-ft-wide trench along its west edge. The bottom of the area slopes at approximately 2 percent toward the proposed sump, which will slope at approximately 1 percent toward the northwest corner. The sump design capacity calculations were based upon the following considerations:

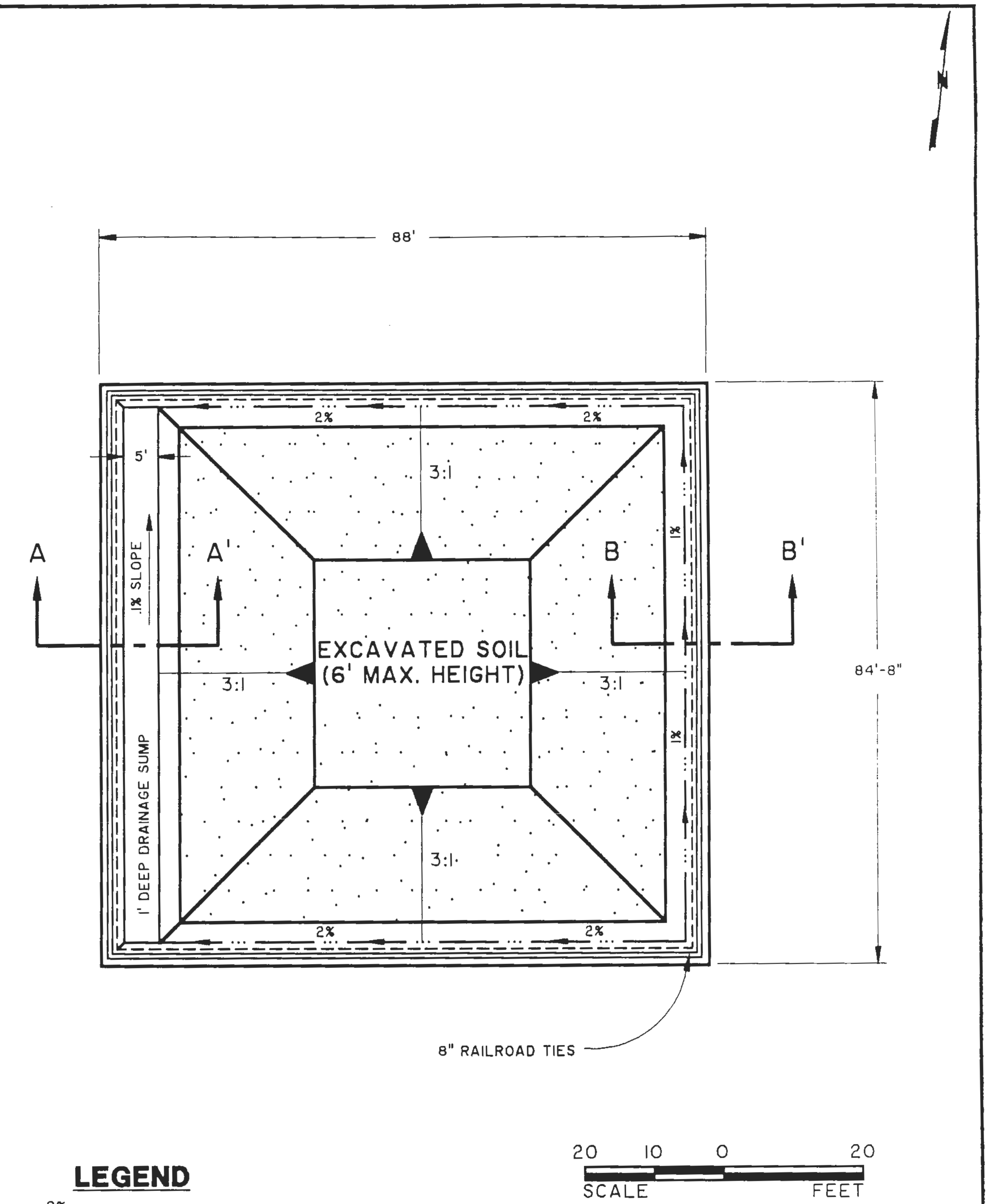
1. Temperatures are expected to remain below freezing, minimizing leachate production.
2. Precipitation is expected to be in the form of snow, which would melt slowly, reducing the rate of leachate formation.
3. The sump will be inspected daily and pumped as leachate accumulates. In the event of unusually warm weather and high precipitation, the sump would be pumped continuously, as necessary.

Pumped leachate will be combined with dewatered groundwater from the trench excavation in a 21,000-gal Frac-tank until it is determined to be hazardous or nonhazardous waste, and then the leachate will be disposed of accordingly by the Army. The Frac-tank will be kept in good condition and free from leaks.

4.7.7 CONTAMINATION CONTROL MEASURES

The treatment trench will be installed in a manner that will prevent release of contaminants to the surrounding surface area and atmosphere. The equipment,

SEAD-3130-01-A004BDSN



LEGEND

—— 2% ——◄ DRAINAGE CENTERLINE, FLOW DIRECTION AND SLOPE

Figure 4-9

EXCAVATED SOIL STORAGE AREA
SENECA ARMY DEPOT

PROJECT NO: 3902036-0240-3130
DRAWN BY: JAD 11/89
CHECKED BY: JM 11/89
SUBMITTED BY: DMM

REV NO.	DESCRIPTION	BY	DATE

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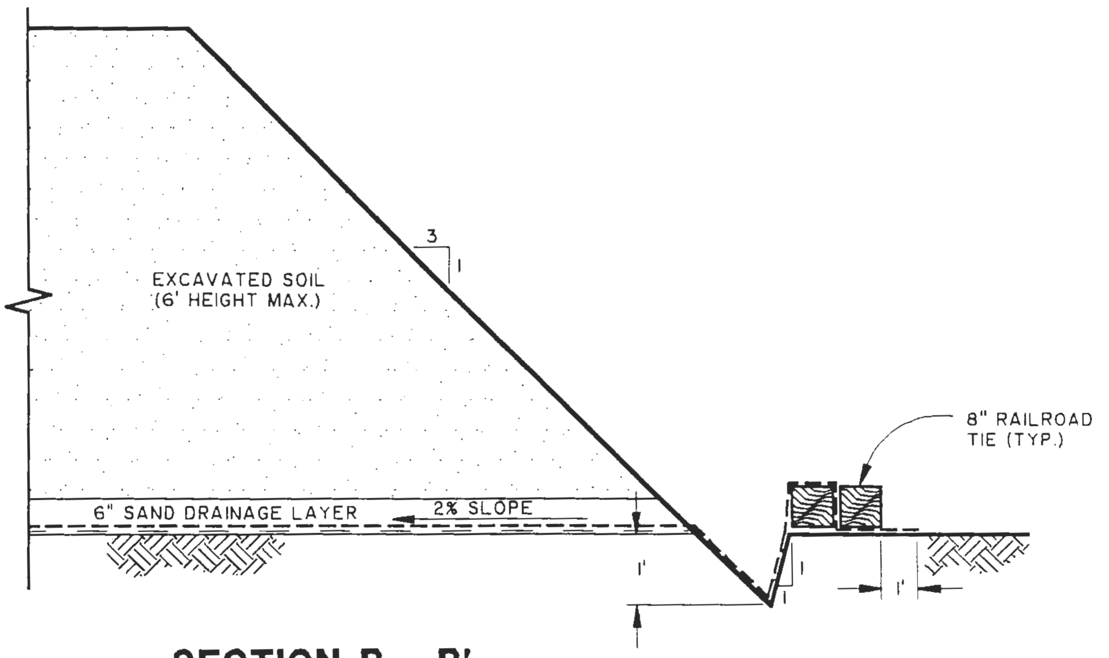
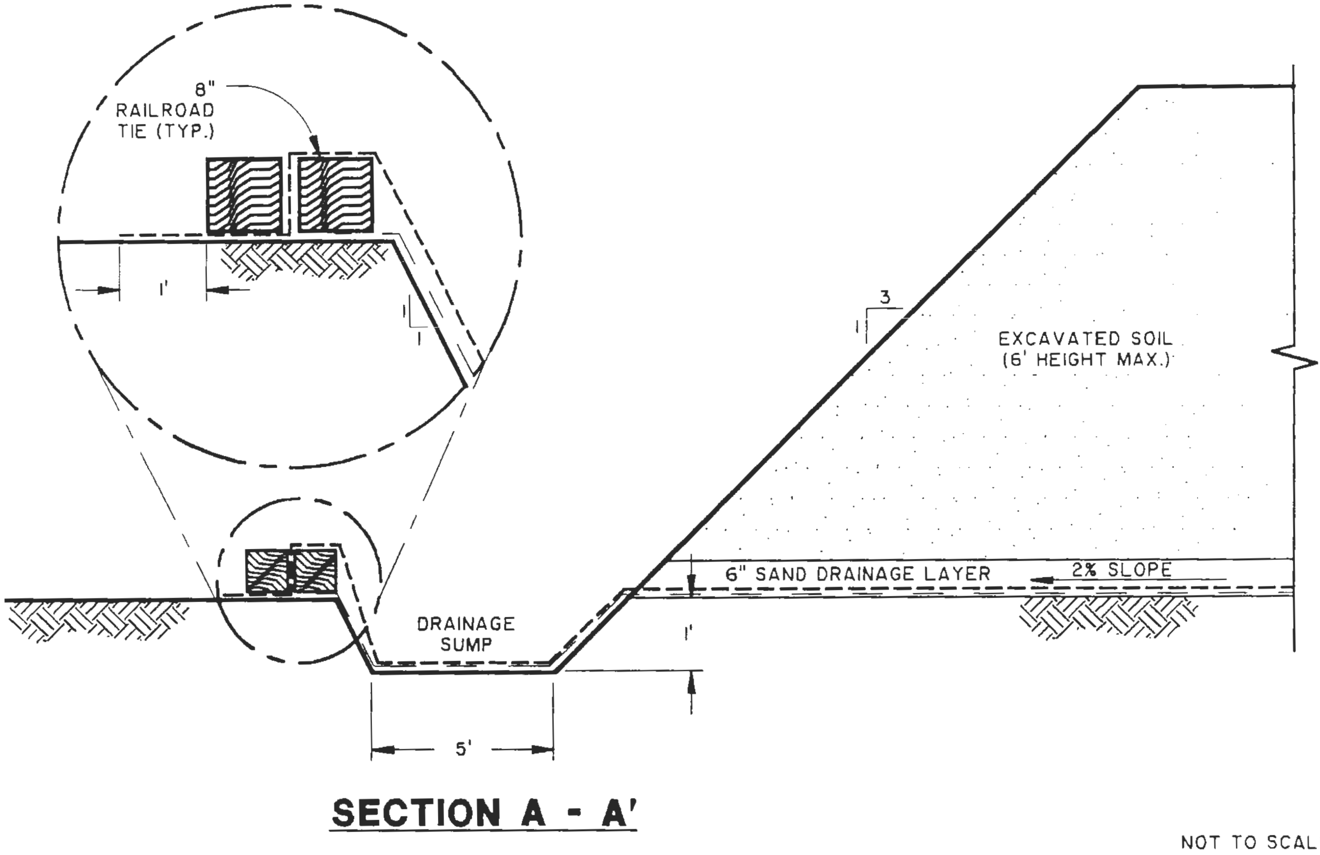


SECTION B - B'



SECTION A - A'

NOT TO SCALE

LEGEND

— — — —	30 MIL POLYETHYLENE LINER GUNDLE HYPERLASTIC OR EQUIV.
— — —	12 OZ. NONWOVEN GEOTEXTILE POLYFELT TS 800 OR EQUIV.

Figure 4-10

CROSS SECTIONS IN EXCAVATED SOIL STORAGE AREA SENECA ARMY DEPOT

PROJECT NO: 3902036-0240-3130
DRAWN BY: JAD 11/89
CHECKED BY: JM 11/89
SUBMITTED BY: DMM

REV NO.	DESCRIPTION	BY	DATE

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personnel, and operational layout have been chosen to allow safe and environmentally sound activities during construction.

The equipment generally will include a 2 yd^3 hydraulic backhoe, 2.3 yd^3 front-end loader, track-mounted bulldozer, 18 yd^3 dump truck, 21,000-gal wheel-mounted Frac-tank, and 2 crew general purpose pick-up trucks. The personnel generally will include a site foreman, backhoe equipment operator, front-end loader equipment operator, dozer equipment operator, dump truck driver, and four general laborers.

All dewatering, excavation, transportation, and storage activities will be conducted in the exclusion zone. Dewatered groundwater will be pumped directly into a Frac-tank located adjacent to the excavation for temporary storage. The Frac-tank will be inspected daily for leaks and possible damage. The dewatered groundwater will be sampled to determine if it is hazardous or nonhazardous and disposed of by the Army.

Before the dump truck is loaded, polyethylene sheeting will be laid on the ground from the edge of the trench to the truck to prevent excavated soil from contacting the surrounding ground during loading. The truck sides and tires will be covered with loading tarpaulins during loading and the truck will be under-filled to prevent contaminated soil from coming into contact with truck tires or outer surfaces. Dump trucks will never be filled over 80 percent of their capacity and will always follow the same route between the excavation and the excavated soil storage area. These procedures will also prevent contamination of the haul route between the trench and the excavated soil storage area. If windy conditions prevail, the excavated soil in the dump truck will be covered with a tarpaulin.

During dumping operations, polyethylene sheeting will be used to prevent dump truck tires from contacting potentially contaminated soil. Trucks will not be permitted to drive directly on potentially contaminated soil. The track-mounted bulldozer will be used to spread and compact excavated soil within the storage area once enough soil has been dumped to provide at least 2 ft of total soil thickness between the bulldozer tracks and the synthetic liner. If, for any reason, the bulldozer must leave the excavated soil storage area, it will be first scraped to remove bulk soil and then driven out of the area onto either polyethylene sheeting or a metal decontamination pan. Any soil in the exclusion zone that comes in contact with either potentially contaminated soil or vehicle tires/tracks that are potentially contaminated will be treated as contaminated soil and removed to the excavated soil storage area.

Workers' boots will be scraped and rinsed when workers leave the trench or the excavated soil disposal area to prevent contamination of the surrounding exclusion zone. All tools that come in contact with potentially contaminated soil will be stored on polyethylene sheeting prior to final decontamination in the contamination reduction zone. All final decontamination will be conducted in the contamination reduction zone (Figure 4-5). All equipment that has come in contact with contaminated soil will be steam cleaned in metal decontamination pans prior to leaving the contamination reduction zone. All wash water will be combined in the Frac-tank with dewatered trench water and leachate and treated as hazardous unless shown by chemical analysis to be nonhazardous. Disposal of all water will be the responsibility of the Army.

Soil and sludge recovered from the decontamination process will be placed in the excavated soil storage area. Any administrative and emergency medical care will be carried out in the support zone.

4.8 AIR MONITORING SUBPLAN

This air monitoring program describes the type of equipment, location, and frequency of measurements to be performed during the excavation phase of the trench and monitor well installation. The contaminants of concern during these field activities include 1,2-dichloroethane, trans-1,2-dichloroethene, trichloroethene, vinyl chloride, and chloroform. The proposed location and frequency of measurement is shown in Table 4-1.

Due to the ionization potential (IP) [expressed in electron volts (eV)], of the primary site contaminants of concern [1,2-dichloroethane (IP = 9.64eV), trans-1,2-dichloroethene (IP = 9.65eV), trichloroethene (IP = 9.47eV), vinyl chloride (IP = 9.99eV), and chloroform (IP = 11.42eV)], an HNU photoionizer equipped with an 11.7 eV lamp will be used for screening the air to determine the total concentration of organic vapors and gases with an IP of less than 11.7 eV in the air. This instrument cannot respond to methane or hydrogen cyanide, cannot be immersed in water, and can be used as a real-time screening device only.

The HNU analyzer functions upon the principle of photoionization for the detection of volatile compounds in air. The sensing device consists of a sealed ultraviolet (UV) light source that emits photons energetic enough to ionize many trace compounds (particularly organics). However, the sensing device does not ionize major components of air. When a positive potential is applied

Table 4-1. Air Monitoring Requirements Using the HNU Photoionizer

Location	Frequency*
A. Excavation Area	1. Continuously upon approach. 2. Continuously during excavation.
B. Trench	1. 5-minute periods in vicinity. 2. Beginning and end of each work day.
C. Backhoe Operation	1. Continuously with sreening of each bucket of soil. 2. Daily of excavated soil piles.
D. Monitor Well Installation	1. Continuously during the penetration and removal of coring tube. 2. Continuous during the cleaning of equipment. 3. 5-minute intervals when the borehole is open

*Measurements will be made within one foot of the source and in the breathing zone levels. Breathing zone refers to the area from the top of the shoulders to the top of the head. Consult the SHERP for personal protective equipment and health precautions.

Source: Hunter/ESE, 1989.

to one electrode in the chamber adjacent to the UV lamp, a field is created that drives any ions formed by absorption of the UV light to the collector electrode where the current (proportional to concentration) is measured. The useful range for sensitivity is 0.1 to 2000 parts per million (ppm).

After zeroing the instrument with clean or zero-grade air, an HNU calibration gas standard is connected and the span adjustment made according to standard specifications. Typical span settings for chlorinated hydrocarbons is between 5 and 9. Calibration checks will be performed at the start of each work period, at the end of the day, and if erratic readings occur.

If ambient levels exceed 50 ppm on the HNU analyzer, personal and perimeter air samples must be collected. This action level is based upon a protection factor of 100 (supplied air respirator) times the action level of the compound with the lowest permissible exposure limit (PEL), which is 1,2-dichloroethane (PEL = 1.0 ppm). Perimeter measurements will be at locations identified by the site safety officer. Methodology for the collection of halogenated hydrocarbons [National Institute for Occupational Safety and Health (NIOSH) Method 1003] utilizes a coconut shell charcoal tube [100 milligram (mg)/50 mg] for a maximum air volume of 15 liters (L) at a sampling rate of 0.03 liters per minute for an 8-hour time-weighted average (TWA) sample. The collection tubes will be submitted to an American Industrial Hygiene Association (AIHA)-accredited laboratory for analysis. The cost for these analyses is not included in the SOW for this project.

4.9 IDENTIFICATION OF APPLICABLE REGULATORY AND PERMIT REQUIREMENTS

All work detailed within this WP will be accomplished in accordance with all applicable local, state, and federal environmental, health, and safety regulations. The applicable regulations are referenced within the various stages of the treatment trench construction and installation.

The following agencies were contacted to determine the applicable regulatory requirements:

U.S. Environmental Protection Agency (EPA), Region II, New York, NY
Emergency and Remedial Response Division,
Kay Stone, 212/264-4595

EPA, Region II, New York, NY
Hazardous Waste Facilities Branch,
Maria John, 212/264-8690

New York Department of Environmental Conservation (NYDEC), Central Office
Albany, NY
Division of Hazardous Waste Remediation
Steve Scharf, 518/457-4343

RCRA/Comprehensive Environmental Response, Compensation, and Liability Act
(CERCLA)
HOTLINE
Renee La Valle, 1-800-424-9346

According to NYDEC, the construction of the treatment trench and storage of the excavated soil and dewatered groundwater does not require a state hazardous waste permit. However, the waste soil and groundwater should be handled in accordance with the RCRA waste pile regulations. NYDEC deferred federal regulation requirements concerning the construction of the treatment trench to EPA, Region II.

EPA Region II Emergency and Remedial Response Division stated that this project was governed under CERCLA guidelines. Any permits and regulations governing the excavated soil and dewatered groundwater were RCRA regulations and were deferred to the Hazardous Waste Facilities Branch for RCRA guidelines. The Hazardous Waste Facilities Branch stated that since the project was part of Superfund under CERCLA, no permit was required. The waste soil should be handled as a hazardous waste pile, covered by 40 CFR, Part 264, Subpart L; and the dewatered groundwater should be handled in accordance with 40 CFR, Part 264, Subpart J. The waste soil and dewatered groundwater should be handled in accordance with these regulations until it can be proven to be nonhazardous or it is transported offsite. If the waste soil and groundwater is sampled and determined to be hazardous waste, it must be transported offsite in accordance with 40 CFR, Parts 262, 263, and 268.

Other federal, state, and local regulations applicable in constructing the treatment trench are referenced within the WP. The WP should be reviewed by applicable federal, state, and local agencies for completeness.

5.0 TREATMENT SYSTEM INSTALLATION

Treatment system installation will consist of the installation of the monitor wells and the treatment trench. The monitor wells will be installed in accordance with the Monitor Well Installation Subplan and the Treatment System Design Subplan, both prepared as part of Task G-2, WP. The trench will be installed in accordance with the Dewatering, Excavation, Transport, and Storage Subplan and the Treatment System Design Subplan, both prepared as part of Task G-2, WP.

Installation of the wells will be performed by a well driller under subcontract to Hunter/ESE. A Hunter/ESE geologist will be onsite to log borings during the well drilling installation and well development activities.

Installation of the treatment trench will be performed by a remediation contractor under subcontract to Hunter/ESE. Delta Environmental, Inc. (Delta), an experienced remediation and emergency response contractor, has been identified as the subcontractor of choice. Representatives of Delta were involved in planning the trench installation method. A Hunter/ESE engineer or chief field technician will be onsite during the trench installation activities to assure that the trench is constructed in accordance with the Treatment System Design Subplan.

The SHERP will be followed during all onsite activities. Ambient air monitoring, in accordance with the Air Monitoring Subplan, will be performed while actual excavation activities are ongoing and until the trench is completed.

6.0 SAMPLING AND ANALYSIS PLANS

Three separate sampling and analysis plans are required to accommodate Tasks G-4, G-5, and G-6:

Task G-4: Soil Characterization
Task G-5: Dewatered Groundwater Characterization
Task G-6: Treatment System Monitoring

The soil and dewatered groundwater characterization tasks involve the sampling and analysis of soils and groundwater removed during the excavation of the treatment trench to determine if the media are hazardous waste as defined by federal (RCRA) regulations. Treatment system monitoring involves the periodic sampling and analysis of groundwater collected from the ten monitor wells installed around the trench to determine the effectiveness of the treatment trench in the removal of volatile chlorinated organics. Sampling locations, number and types of samples, sample collection methods, and analyses to be performed are described in the following sections.

6.1 SAMPLING LOCATIONS

6.1.1 SOILS

Excavated soils will be temporarily stored within the temporary waste storage area (Figure 4-5). One round of sampling will be performed to determine if the soils must be disposed as hazardous waste. In addition, a background soil sample will be collected from an uncontaminated area located away from the trench.

6.1.2 DEWATERED GROUNDWATER

Groundwater removed during trench construction will be temporarily stored in a 21,000-gal Frac-tank. At the completion of dewatering activities or the filling of the tank to capacity, whichever occurs first, the contents of the tank will be sampled. The SOW specifies that two rounds of sampling will be conducted. If the quantity of groundwater removed does not exceed the capacity of one Frac-tank, a second round of sampling will not be necessary. However, if the quantity does exceed the capacity, the second round of sampling will be required. Sampling beyond two rounds will be considered outside of the SOW and not covered under the existing contract.

6.1.3 MONITOR WELLS

Treatment system monitoring will consist of periodic sampling of 10 monitor wells located on both sides of the treatment trench. The locations of these wells are shown in Figure 4-6.

6.2 SAMPLES TO BE COLLECTED

6.2.1 SOILS

The number and types of samples to be collected are shown in Table 6-1. Sampling will consist of the collection of four separate samples, each of which represents a composite of two samples. The surface of the waste piles will be marked off or subdivided into 8 equal areas, to be designated as sections 1 through 8. From each section, a column of soil from 0 to 2 ft into the pile will be collected with a hand auger. Collected soils from two adjacent sections will be mixed together according to the following scheme to form 4 composite samples:

Table 6-1. Soil Characterization--Number of Samples to be Collected and Analyzed; Task G-4

		QA/QC Samples		
Type/Location	Field Samples	QA Split	QC Split	Totals
Waste pile	SSA1	SSA1Dup MRD	SSA1Dup	3
	SSA2	--	--	1
	SSA3	--	--	1
	SSA4	--	--	1
Background	SSBG1	--	--	1
Totals	5	1	1	7

Source: Hunter/ESE, 1989.

Section Samples		Composite Samples
1 plus 2	to form:	SSA1
3 plus 4		SSA2
5 plus 6		SSA3
7 plus 8		SSA4

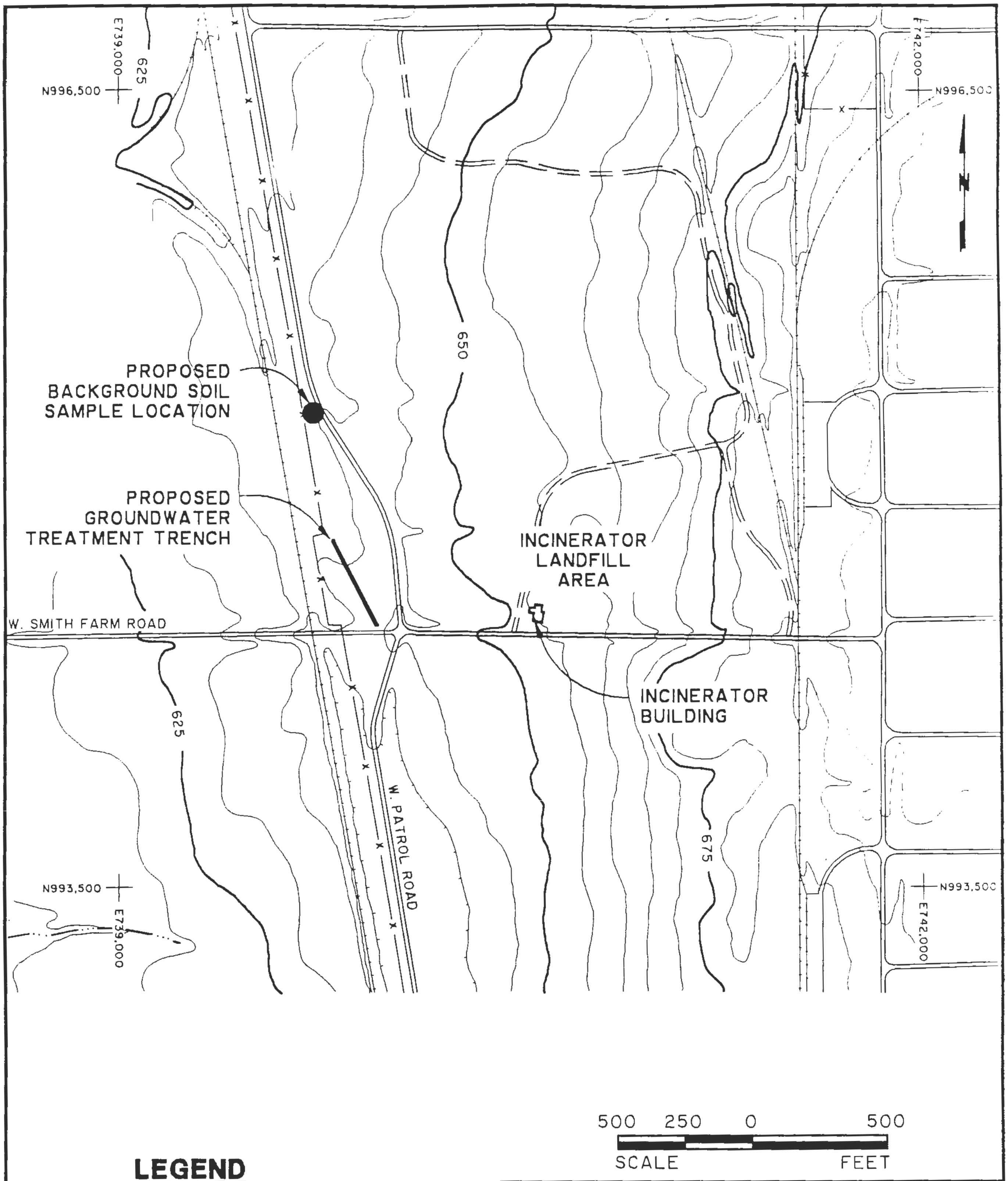
To satisfy quality assurance/quality control (QA/QC) requirements, Sample SSA1 will be split into three equal portions. One portion will serve as a field sample (SSA1), the second as a field duplicate (SSA1Dup) and the third as an interlaboratory duplicate (SSA1DupMRD) to be forwarded to the USACE Missouri River Division Laboratory (MRDL). Aliquots of samples SSA1 through SSA4 will be preserved and submitted for analysis.

In addition to sampling the pile, a background soil sample, SSBG1, will be collected from the area shown on Figure 6-1. This sample will be collected with a hand auger from 0 to 2 ft down. The collected column of soil will be well mixed and a portion preserved and submitted for analysis.

6.2.2 DEWATERED GROUNDWATER

The number and types of samples to be collected are shown in Table 6-2. As indicated previously, more than one round of sampling may be required, depending on the quantity of water removed during excavation. Nonetheless, the sampling scheme will be the same for each round, including QA/QC requirements.

A sampling round will consist of collecting a single grab sample from the Frac-tank. To meet QA/QC requirements, the sample will be divided into three



LEGEND

—— ··· ——	DITCH
–x —— x –	FENCE
┼┼┼┼┼┼	RAILROAD
═══	ROADS AND PARKING
————	DEPRESSION CONTOUR
═ ═ ═	TRAIL OR EARTH ROAD
~625 —	TOPOGRAPHIC CONTOUR

Figure 6-1

PROPOSED BACKGROUND SOIL SAMPLE LOCATION SENECA ARMY DEPOT

PROJECT NO.: 3902036-0240-3130
DRAWN BY: DRP 11/89
CHECKED BY: RPV 11/89
SUBMITTED BY: DMM

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Table 6-2. Dewatered Groundwater Characterization--Groundwater Samples to be Collected and Analyzed; Task G-5

		MRDL's QA Splits		Hunter/ ESE's QC Splits		
Type/ Location	Field Samples	Field Sample Split	Sample Blank Rinsate	Sample Blank Rinsate	Field Sample Split	Total Samples
Round 1	1	1	1	1	1	5
Round 2	1	1	1	1	1	5
Totals	2	2	2	2	2	10

Source: Hunter/ESE, 1989.

equal portions. One portion will serve as the field sample, the second as a field duplicate, and the third as an interlaboratory duplicate to be forwarded to the USACE MRD laboratory. In addition to the field and duplicate samples, a field rinsate blank will be prepared and split into two equal portions. One portion will be submitted along with the field and field duplicate samples to the Hunter/ESE laboratory, and the other portion will be submitted along with the interlaboratory field duplicate to the MRD laboratory.

6.2.3 MONITOR WELLS

The number and types of samples to be collected are shown in Table 6-3. Four rounds of sampling will be conducted: one immediately following the installation of the wells and the other three at 4, 8, and 12 months after well installation. The sampling scheme for each round will be identical.

A sampling round will consist of collecting one groundwater sample from each of 10 monitor wells located as shown on Figure 4-6. To satisfy QA/QC requirements, the sample collected from one of the wells (to be determined) will be split into three equal portions. The first portion will serve as the field sample, the second as the field duplicate, and the third as an interlaboratory field duplicate to be forwarded to the USACE MRDL. In addition to the field and duplicate samples, a field rinsate blank will be prepared and split into two equal portions. One portion will be submitted along with the field and field duplicate samples to the Hunter/ESE laboratory, and the other portion will be submitted along with the interlaboratory field duplicate to MRDL.

Table 6-3. Treatment System Monitoring--Monitor Well Groundwater Samples to be Collected and Analyzed; Task G-6

		MRDL's QA Splits		Hunter/ ESE's QC Splits		
Type/ Location	Field Samples	Field Sample Split	Sample Blank Rinsate	Sample Blank Rinsate	Field Sample Split	Total Samples
Round 1	10	1	1	1	1	14
Round 2	10	1	1	1	1	14
Round 3	10	1	1	1	1	14
Round 4	10	1	1	1	1	14
Totals	40	4	4	4	4	56

Source: Hunter/ESE, 1989.

6.2.4 SAMPLE COLLECTION METHODS AND EQUIPMENT

6.2.4.1 Waste Pile Sampling

The following methods will be used for collection of soil samples from the waste pile:

1. Debris, rocks, twigs, and vegetation will be removed from the sample area.
2. The surface of the pile will be subdivided into eight equal sections. From each section, four individual samples will be collected and composited to form one sample per section.
3. Each sample will be collected with a soil auger driven 2 ft into the pile. The four samples retrieved from each section will be combined into a stainless-steel bowl and well mixed to form a composite sample for that section. Each individual sample location will be marked with a stake. Sample size, location, and collection time will be recorded in the field log book and on a sample log sheet. A new or freshly decontaminated auger will be used for each section sampled.
4. The composite samples from each two adjacent sections will be combined into one bowl, as described in Section 6.2.1, to form a total of four composites.
5. A fraction of sample will be removed from each of the eight stainless-steel bowls and labeled in accordance with the sample and analytical requirements outlined in Tables 6-1 and 6-4.
6. Samples will be stored in ice and shipped for analysis in accordance with Tables 6-1 and 6-4.

Table 6-4. Soil Characterization--Required Analyses, Approved EPA Methods, and Estimated Quantities; Task G-4

Type/Location	Method Description	Method	Field Samples	QA/QC Samples*
Waste Pile	B/N/A	8270	4	1/1
	Volatile organics	8240	4	1/1
	Metals+	6010	2	1/1
	Arsenic	7060	2	1/1
	Selenium	7740	2	1/1
	Mercury	7470	2	1/1
Background	B/N/A	8270	1	0/0
	Volatile organics	8240	1	0/0
	Metals+	6010	1	0/0
	Arsenic	7060	1	0/0
	Selenium	7740	1	0/0
	Mercury	7470	1	0/0

Note: B/N/A = base/neutral/acid.

*QC samples to be analyzed by Hunter/ESE; QA samples by CEMRD.
+Barium, cadmium, chromium, lead, antimony, copper, nickel, thallium, zinc, and beryllium.

Source: Hunter/ESE, 1989.

6.2.4.2 Dewatered Groundwater Sampling

The following methods will be used for collection of samples from the Frac-tank:

1. Samples will be collected through a manhole opening on top of the Frac-tank.
2. Samples will be obtained using a decontaminated Teflon® bailer. Samples collected for volatiles analysis will be obtained in a manner that will minimize loss of volatiles.
3. Samples will be placed in laboratory-prepared sample containers, labeled, packed in ice, and shipped for analysis in accordance with the requirements outlined in Tables 6-2 and 6-5.
4. All sampling equipment will be decontaminated between samples, as specified in the QAPP.
5. Sampling logs will record sample date, location, and amount collected.

6.2.4.3 Monitor Wells

Monitor wells will be sampled in accordance with the following methods:

1. Prior to groundwater sample collection, water levels in all accessible monitor wells will be measured relative to the top of the well casing. Measurement will be by the USGS wetted-tape method using a decontaminated steel tape.
2. A plastic ground cloth will be placed beneath all sampling equipment during well purging and sampling to prevent contamination. Well purging will consist of pumping or bailing at least three to five submerged well volumes and will continue until the pH, temperature, and specific conductivity have stabilized. The pH, temperature, and

Table 6-5. Dewatered Groundwater Characterization--Required Analyses, Approved EPA Methods, Estimated Quantities; Task G-5

Type/Location	Method Description	Method	Field Samples	QA/QC Samples*
Round 1	B/N/A	8270	1	2/2
	Volatile organics	8240	1	2/2
	Metals+	6010	1	2/2
	Arsenic	7060	1	2/2
	Selenium	7740	1	2/2
	Mercury	7470	1	2/2
Round 2	B/N/A	8270	1	2/2
	Volatile organics	8240	1	2/2
	Metals+	6010	1	2/2
	Arsenic	7060	1	2/2
	Selenium	7740	1	2/2
	Mercury	7470	1	2/2

Note: B/N/A = base/neutral/acid.

*QC samples to be analyzed by Hunter/ESE; QA samples by MRDL.
+Barium, cadmium, chromium, lead, antimony, copper, nickel, thallium, zinc, and beryllium.

Source: Hunter/ESE, 1989.

specific conductivity will be measured with a Hydrolab model 4041 water quality surveyor, which will be calibrated onsite before and after each sampling day. If the well does not recharge fast enough to permit continuous pumping, the well will be pumped dry at least twice, allowing for 80-percent recharge between pumping, and allowed to recharge before sampling. If a well does not recharge sufficiently to allow for a second well volume to be purged after 2 hours have elapsed, the well will be allowed to recharge enough to permit sampling.

3. After purging the well, the sampling team will change disposable gloves for sample collection. Samples will be obtained using a decontaminated Teflon® bailer. Groundwater samples collected for volatile analyses will be obtained in a manner that will minimize the loss of volatile compounds. The samples will be placed in laboratory-prepared sample containers. All sample containers will be labeled with a preprinted label, packed with ice, and shipped to the laboratory for analysis in accordance with Tables 6-3 and 6-6.
4. All sampling and well purging equipment will be decontaminated between samples, as specified in the QAPP. Groundwater sampling logs will include onsite measurements of water quality (pH, specific conductance, and temperature), volume purged, method of purging, static water level, sample time and date, and fraction sampled. Chain-of-custody records will be maintained.
5. Purge water will be collected in properly labeled 55-gal drums and temporarily stored onsite for subsequent disposal by the Army in accordance with local, state, and federal (RCRA) regulations. (Note: For the first round of sampling, the purge water can be stored in the

Table 6-6. Treatment System Monitoring--Required Analyses Approved EPA Methods and Estimated Quantities

Type/Location	Method Description	Method	Field Samples	QA/QC Samples*
Round 1	B/N/A	8270	10	2/2
	Volatile organics	8240	10	2/2
	Metals+	6010	10	2/2
	Arsenic	7060	10	2/2
	Selenium	7740	10	2/2
	Mercury	7470	10	2/2
Round 2	B/N/A	8270	10	2/2
	Volatile organics	8240	10	2/2
Round 3	B/N/A	8270	10	2/2
	Volatile organics	8240	10	2/2
Round 4	B/N/A	8270	10	2/2
	Volatile organics	8240	10	2/2

Note: B/N/A = base/neutral/acid.

*QC samples to be analyzed by Hunter/ESE; QA samples by MRDL.
+Barium, cadmium, chromium, lead, antimony, copper, nickel, thallium, zinc, and beryllium.

Source: Hunter/ESE, 1989.

Frac-tank. However, the Frac-tank will not be onsite during sampling rounds 2, 3, and 4).

6.3 CHEMICAL ANALYSES

6.3.1 SOILS

The required analyses are shown in Table 6-4. Samples SSA1, SSA2, SSA3, SSA4; the field duplicate SSA1Dup; and SSBG1 will be analyzed for the base/neutral/acids (B/N/As), VOCs, and the metals barium, cadmium, chromium, lead, antimony, copper, nickel, thallium, zinc, beryllium, arsenic, selenium and mercury. All analyses will be completed in accordance with the approved methods indicated in the Table 6-4.

6.3.2 DEWATERED GROUNDWATER

The required analyses are shown in Table 6-5. For each round of sampling, each field sample, each rinsate blank and each field duplicate will be analyzed for B/N/As; VOCs; and the metals barium, cadmium, chromium, lead, antimony, copper, nickel, thallium, zinc, beryllium, arsenic, selenium and mercury. All analyses will be completed in accordance with the approved methods indicated in Table 6-5.

6.3.3 MONITOR WELLS

Required analyses are shown in Table 6-6. Round 1 samples, including the field samples, the rinsate blank, and the field duplicate, will be analyzed for BNAs; VOCs; and the metals barium, cadmium, chromium, lead, antimony, copper, nickel, thallium, zinc, beryllium, arsenic, selenium and mercury.

Rounds 2, 3, and 4 will be identical to Round 1, except that metals will not be analyzed.

All analyses will be completed in accordance with the approved methods indicated in the Table 6-6.

REFERENCES

Bouwer, H. 1989. Bouwer and Rice Slug Tests--An Update. Groundwater, 27(3), May-June 1989.

Bouwer, H. and Rice, R. 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers for Completely or Partially Penetrating Wells. Water Resources Research, 12(3):423-428.

ICF. 1989. Seneca Army Depot Landfill/Burning Pit Site Investigation. ICF Technology, Inc., Fairfax, VA.

United States Army Environmental Hygiene Agency (USAEHA). 1988. Geohydrologic Study No. 30-26-0313-88, Seneca Army Depot, Romulus, NY.

APPENDIX A--SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN

SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN
SENECA ARMY DEPOT
Romulus, New York

Prepared for:

U.S. ARMY CORPS OF ENGINEERS
Huntsville, Alabama

Prepared by:

HUNTER/ESE
Gainesville, Florida

Hunter/ESE No. 3902036

December 1989

SAFETY, HEALTH, AND ENVIRONMENTAL RESPONSE PLAN

FOREWORD

This plan has been prepared to provide site-specific safety information related to activities to be performed at Seneca Army Depot, Romulus, New York, for the U.S. Army Corps of Engineers. Any additional safety information developed during the project should be noted and used to revise the plan prior to future activities. The plan has been prepared, reviewed, and approved for this project by the personnel indicated below.

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John D. Bonds, Ph.D.
Corporate Health and Safety Officer

12/4/89
Date

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Project Safety Manager

12-4-89
Date

David M. Moccia
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National Program Manager

12/5/89
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LIST OF ACRONYMS AND ABBREVIATIONS

BP	boiling point
CFR	Code of Federal Regulations
CPR	cardiopulmonary resuscitation
CRZ	contamination reduction zone
CSP	Certified Safety Professional
EPA	U.S. Environmental Protection Agency
eV	electron volt
EZ	exclusion zone
°F	degrees Fahrenheit
ft	feet
IDLH	immediately dangerous to life and health
kV	kilovolts
LEL	lower explosive limit
mmHg	millimeters of mercury
mph	miles per hour
MSHA	Mine Safety and Health Administration
NIOSH	National Institute for Occupational Safety and Health
NPL	National Priority List
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit
PID	photoionization detector
ppm	parts per million
SCBA	self-contained breathing apparatus
SHERP	Safety, Health, and Emergency Response Plan
SWMU	solid waste management unit
T12DCE	trans-1,2-dichloroethene
TCE	trichloroethene

LIST OF ACRONYMS AND ABBREVIATIONS
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TOV	total organic vapor
TWA	time-weighted average
USACE	U.S. Army Corps of Engineers
USAMC	U.S. Army Materiel Command
USCG	U.S. Coast Guard
UXO	unexploded ordnance
VOC	volatile organic compound
VP	vapor pressure

1.0 GENERAL INFORMATION

Site:	Seneca Army Depot--Incinerator Ash Landfill Area
Location:	Seneca Army Depot, Romulus, New York
Prepared:	November 1989 by Christopher J. Campbell, Certified Safety Professional (CSP), Hunter/ESE, from information obtained from a previous site visit provided by project manager David Moccia.
Site objective:	Design, construct, and monitor for 1 year a permeable treatment trench to determine its effectiveness for passive treatment of groundwater containing chlorinated organic solvents.
Proposed dates of site activity:	January 1990 through February 1991
Site history:	A previous site investigation of solid waste management units (SWMUs) located at the abandoned incinerator ash landfill area confirmed the existence of a plume of groundwater contaminated with chlorinated volatile organic compounds (VOCs). The site has been proposed for inclusion on the Federal Facilities National Priority List (NPL).
Regulatory requirements:	Occupational Safety and Health Administration (OSHA) standards 29 Code of Federal Regulations (CFR) 1910 and 1926 apply to work performed under this Safety, Health, and Emergency Response Plan (SHERP). Specific sections of 29 CFR 1910 that apply include 1910.120, "Final Rule for Hazardous Waste Site Operations and Emergency Response"; 1910.134, "Respiratory Protection"; 1910.100, "Air Contaminants"; 1926.602, "Material Handling Equipment"; and 1926.652, "Specific Trenching Requirements." Additional U.S. Army requirements governing this work are included in the U.S. Army Corps of Engineers (USACE) Safety and Health Requirements Manual (EM 285-1-1) and the U.S. Army Materiel Command (USAMC) Safety Manual, AMC-R 385-100.

2.0 PERSONNEL

2.1 SAFETY AND HEALTH POLICY

The purpose of this SHERP is to protect workers and other onsite personnel, the public, and the environment from hazards associated with site activities and potential site contaminants. This SHERP includes preventive and protective measures against health, physical, fire, and explosion hazards that may exist or occur during field and laboratory activities.

It is the policy of Hunter/ESE management and also a contract requirement that all work be performed according to this SHERP. All Hunter/ESE personnel and subcontractors should be familiar with the SHERP and adhere to the SHERP at all times. Personnel associated with this project will sign the Declaration of Understanding (Attachment A) to document that this SHERP has been read and understood.

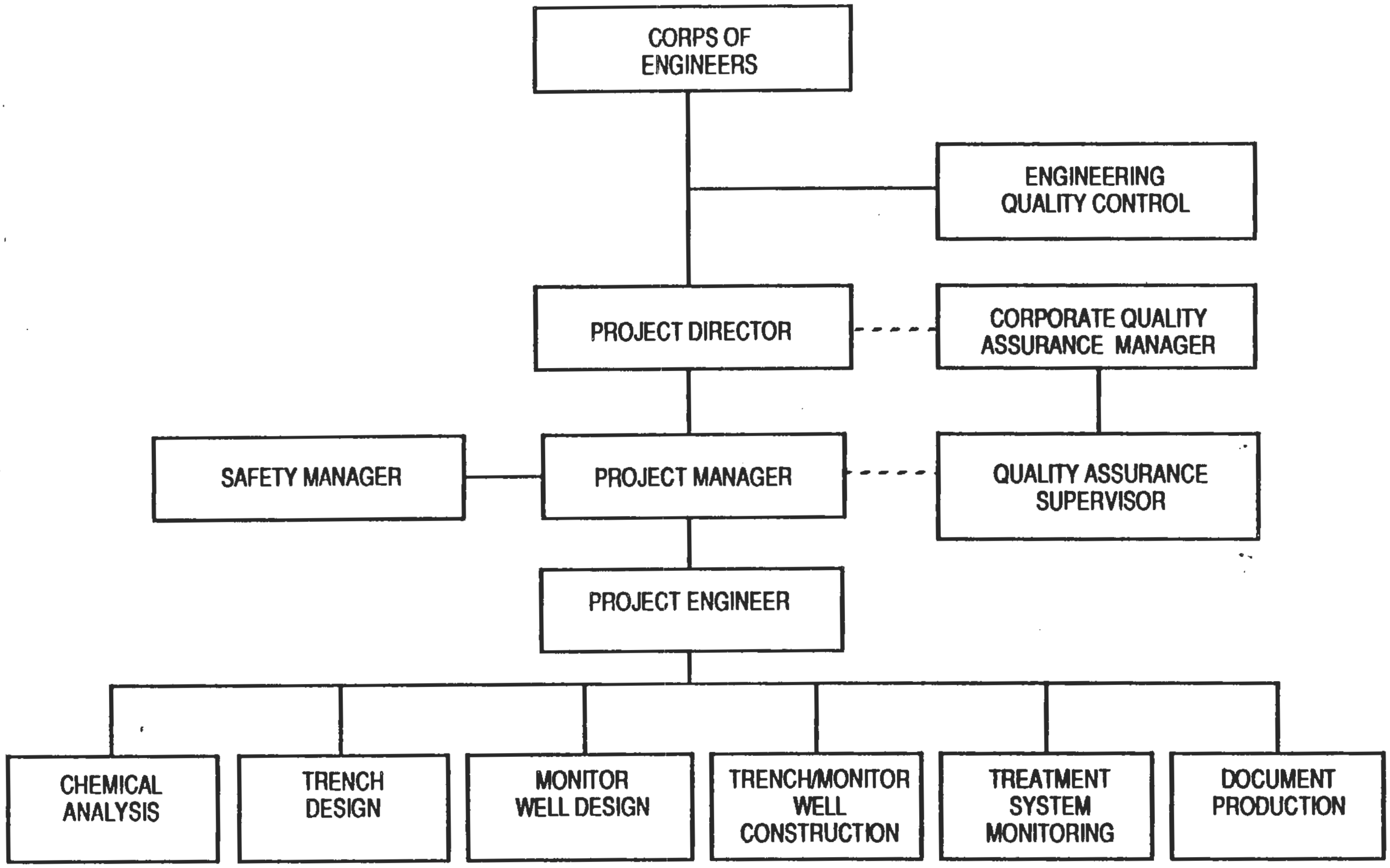
2.2 ORGANIZATION AND RESPONSIBILITIES

Overall project organization is shown in Figure 2-1. Responsibilities of the project manager, project safety manager, site safety officer, field team leader, and field team members will be in accordance with Hunter/ESE standard practices. Subcontractors for this project are subject to the same requirements and responsibilities as field team members.

2.2.1 PROJECT MANAGER--David M. Moccia

The ultimate responsibility for health and safety on a project lies with the project manager. The project manager's health and safety responsibilities include:

1. Ensuring that an effective and comprehensive SHERP be prepared for the project,
2. Ensuring that adequate and appropriate safety training and equipment are available for project personnel, and



ORGANIZATION

UNTER/ESE, 1989.

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3. Ensuring that project personnel are medically monitored and qualified for their involvement in the project.

2.2.2 PROJECT SAFETY MANAGER--Christopher J. Campbell, CSP

The project safety manager is responsible to the project manager for overall project safety. The responsibilities of the project safety manager include:

1. Preparing or reviewing the project SHERP, making necessary changes, and giving final approval only when the SHERP is satisfactory;
2. Categorizing and identifying the hazards and associated risks for the conditions and activities to be encountered onsite; and
3. Reviewing reports of incidents related to project activities.

2.2.3 SITE SAFETY OFFICER--To Be Determined

The site safety officer is responsible to the project manager for the health and safety of personnel during site activities. Responsibilities of the site safety officer include:

1. Implementing all safety procedures and operations onsite;
2. Updating equipment or procedures based upon new information gathered during the site inspection;
3. Upgrading or downgrading the levels of personal protection based upon site observations;
4. Determining and posting locations and routes to medical facilities (including poison control centers) and arranging emergency transportation to medical facilities (as required);
5. Notifying (as required) local public emergency officers (i.e., police and fire departments) of the nature of the team's operations and making emergency telephone numbers available to all team members;
6. Ensuring that at least one member of the field team is available to stay behind and notify emergency services if the site safety manager must enter an area of maximum hazard, or entering this area only after notifying emergency services (police department);

7. Observing work party members for symptoms of onsite exposure or stress; and
8. Arranging for the availability of onsite emergency medical care and first aid, as necessary.

The site safety officer has the ultimate responsibility to stop any operation that threatens the health or safety of the team or surrounding populace or causes significant adverse impact to the environment.

2.2.4 **FIELD TEAM LEADER**--Michael H. McKinney

The field team leader is responsible to the project manager for all operational activities onsite, as well as for all safety and health practices by site personnel. The responsibilities of the field team leader include:

1. Ensuring and enforcing compliance with the SHERP,
2. Controlling site entry of unauthorized personnel or coordinating with local law enforcement agencies or state authorities to limit site access,
3. Coordinating site activities such that they may be performed in an efficient and safe manner consistent with the SHERP,
4. Enforcing the buddy system onsite, and
5. Ensuring the ready access and availability of all safety equipment.

2.2.5 **FIELD TEAM MEMBERS**--Delta Environmental, Inc.

Hunter/ESE employees and subcontractors are responsible to the field team leader and the site safety officer for all activities onsite. The responsibilities of field team members include:

1. Complying with all aspects of the SHERP, including strict adherence to the buddy system;
2. Obeying the orders of the field team leader and the site safety officer; and
3. Notifying the field team leader or site safety officer of hazardous or potentially hazardous incidents or working situations.

2.2.6 SITE VISITORS

Visitors and client and governmental agency representatives are required to comply with all provisions of the SHERP and may be responsible to the field team leader or site safety officer. The responsibilities of site visitors include:

1. Complying with all aspects of the SHERP, including strict adherence to the buddy system; and
2. Obeying the orders of the field team leader and the site safety officer.

2.2.7 CLIENT CONTACT--Robert Nore [telephone (205) 722-1512]

The client contact is the individual serving as the primary liaison between the client and the Hunter/ESE project manager and field team leader. All Hunter/ESE project personnel and subcontractors are directly or indirectly responsible to the client. However, the client contact must comply with all applicable portions of the SHERP when in areas covered by its provisions.

2.3 TRAINING

In accordance with Hunter/ESE standard practices, all Hunter/ESE site personnel will have completed training required by 29 CFR 1910.120. Subcontractors will have had equivalent training. Attachment B lists onsite personnel and their training dates.

Site-specific training will be given by the field team leader or site safety officer to inform field team members of site-specific hazards and hazardous activities. Training will be provided prior to site entry, each morning before work begins, and after all project field activity has been completed. A record will be prepared by the site safety officer detailing each training session, including topics discussed, individuals present, date, and time of the training.

Visitors will be provided with safety training by the site safety officer prior to entry onsite. Prior to site entry, visitors must verify to the satisfaction of the site safety officer that they have met the formal training requirements for work on a hazardous waste site in accordance with 29 CFR 1910.120.

2.4 MEDICAL SURVEILLANCE

All Hunter/ESE site personnel will be subject to the Hunter/ESE medical surveillance program for hazardous waste site workers. This program was designed in accordance with the recommendations found in the National Institute for Occupational Safety and Health (NIOSH)/OSHA/U.S. Coast Guard (USCG)/U.S. Environmental Protection Agency (EPA) "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Operations," and meets the requirements of 29 CFR 1910.120. Attachment B lists onsite personnel and their medical surveillance dates. Medical records for onsite personnel will be reviewed by a board-certified occupational physician as required under this contract. Physician statements of findings are kept in employees' personnel files and will be available for review.

2.5 DOCUMENTATION

Personnel and environmental monitoring will be made part of the permanent project record. Monitoring records will be kept in accordance with 29 CFR 1910.20 and standard Hunter/ESE practices. Training and medical records for Hunter/ESE personnel are available for inspection as required. Subcontractors are required to have training and medical records available for inspection as required by Hunter/ESE and client representatives.

3.0 HAZARD EVALUATION AND CONTROL

3.1 CHEMICAL CONTAMINANTS

The chemical contaminants of concern are:

trans-1,2-dichloroethene,
trichloroethene,
1,2-dichloroethane,
vinyl chloride, and
chloroform.

3.1.1 TRANS-1,2-DICHLOROETHENE (T12DCE)

T12DCE is a colorless liquid with an ether-like and slightly acid odor. It has a boiling point (BP) of 113 to 140 degrees Fahrenheit (°F) and a vapor pressure (VP) of 180 to 265 millimeters of mercury (mmHg). Symptoms of exposure include eye and respiratory system irritation and central nervous system depression. Target organs include the respiratory system, eyes, and central nervous system. First-aid procedures include immediate irrigation of eyes and prompt soap-and-water wash for skin contact. Exposure limit for T12DCE is 200 parts per million (ppm). NIOSH has set an immediately dangerous to life and health (IDLH) level of 4,000 ppm.

3.1.2 TRICHLOROETHENE (TCE)

TCE is a colorless liquid with a sweet odor. It has a BP of 188°F and a VP of 58 mmHg. Symptoms of exposure include headache, vertigo, nausea, eye irritation, and dermatitis. First-aid procedures include flushing eyes immediately with water, using soap to wash the skin promptly, and seeking medical attention. Target organs include respiratory system, heart, liver, and kidneys. Exposure limit for TCE is 50 ppm.

3.1.3 1,2-DICHLOROETHANE

1,2-Dichloroethane is a volatile liquid which is harmful if swallowed or absorbed through the skin. Its vapors and mists are irritating to the skin, eyes, mucous membranes, and upper respiratory tract. Prolonged exposure can cause nausea, headache, vomiting, and damage to the liver, kidneys, and gastrointestinal system. Contact is to be minimized by wearing protective clothing and, when necessary, organic vapor cartridge or air supplied respirator. If skin contact occurs, the affected area should be flushed with copious amounts of water for 15 minutes while removing contaminated clothing. If inhaled, the victim should be moved to fresh air, with artificial respiration provided if not breathing or oxygen if breathing is difficult. 1,2-Dichloroethane is considered a carcinogen. OSHA exposure limit is 50 ppm for an 8-hour time-weighted average (TWA), with a ceiling limit of 100 ppm. 1,2-Dichloroethane is flammable with a flash point of 60°F. Since water may be ineffective for fire fighting, use extinguishing agents suitable for flammable liquids (Class B).

3.1.4 VINYL CHLORIDE

Vinyl chloride is a colorless liquid or gas (when inhibited) with a faintly sweet odor. Exposure to this chemical is usually through inhalation or through contact with skin or eyes. Symptoms of exposure include severe irritation of the skin, eyes, and mucous membranes. Target organs include the liver and central nervous system.

If eye contact occurs, flush the affected area immediately with water. If skin contact occurs, wash affected area with soap and water. If inhaled, move victim to fresh air and seek medical attention. Permissible exposure limit (PEL) is 1 ppm TWA. The compound is classified as flammable.

3.1.5 CHLOROFORM

Chloroform is a clear, colorless liquid with a characteristic odor. It is not flammable, but it does decompose in the presence of flame to form hydrochloric acid, phosgene, and chlorine. It is a suspect carcinogen. OSHA has set a PEL of 2 ppm. Chloroform can act as a potent anesthetic when inhaled in large concentrations. The primary route of entry of chloroform into the body is through inhalation. It may also be harmful to the skin, producing burns on prolonged contact. Preventive measures include using supplied air respirators and wearing protective clothing, eye and face protection, and gloves. If chloroform is inhaled, remove the individual to fresh air and seek medical attention. For skin contact, wash with soap and water; for eye contact, rinse eyes with clear water for 15 minutes and seek medical attention.

3.2 PHYSICAL AND MECHANICAL HAZARDS

Activities onsite will include:

1. Site visits,
2. Monitor well installation and sampling,
3. Trenching,
4. Installation of an in situ groundwater treatment system, and
5. Monitoring and sampling of soils, groundwater, and air.

Hazards associated with these activities are varied and include vehicle/pedestrian collisions; fire; adverse atmosphere during trench entry; contact or crushing injuries resulting from materials handling and equipment operations; abrasions, contusions, lacerations, etc. resulting from use of power tools; and elevated noise levels. The potential for such hazards necessitates that all onsite personnel wear personal protective clothing, including coveralls, gloves, eye and face protection, safety boots, and hard hats. Noise and trench air will also be monitored.

3.2.1 MOTOR VEHICLES AND MOTORIZED EQUIPMENT

All motor vehicles will be maintained in a safe operating condition and in accordance with local and state safety requirements. All vehicles and moving equipment will be operated on sites and en route to and from sites in accordance with state and local motor vehicle regulations for speed, lights and warnings, passenger carrying, and operation. If any equipment is left unattended at night adjacent to a highway in use, it will be provided with suitable barricading, lighting, reflectors, or other suitable visual warnings to identify its location.

Any mobile equipment, including drilling rigs, earth-moving machinery, or other similar types of equipment, will be operated in strict compliance with the manufacturer's instructions, specifications, and limitations, as well as any applicable regulations. The operator is responsible for inspecting the equipment daily to assure that it is functioning properly and safely. This inspection will include all parts subject to faster than normal wear and all lubrication points.

Hand and audible (horn) signals to equipment operators will be the commonly accepted industry standard signals for the type of equipment being used. All signals will be reviewed by the operator and signaller before work begins. Only one person will signal the equipment operator at any given time.

When equipment with moving booms, arms, or masts is operated near overhead hazards, the operator, with assistance from the designated signaling person, will assure that the moving parts of the equipment maintain safe vertical and horizontal clearances to the hazards. Moving booms, arms, or masts will be lowered and secured prior to moving from one location to another, even on the same site. Equipment will be kept away from energized electrical lines by at least 10 feet (ft) for lines rated up to 50 kilovolts (kV), and by 16 ft for lines rated over 50 and up to 750 kV.

Drill rigs and other equipment not specifically designed to move with the boom, mast, or arm elevated will be returned to traveling position and condition before being moved.

3.2.2 PORTABLE EQUIPMENT AND TOOLS

All equipment and tools will be inspected prior to each day's use and as often as necessary to ensure that they are in safe operating condition. Defective equipment and tools will be removed from service immediately. Examples of defective tools include: hooks and chains stretched beyond allowable deformations; cables and ropes with more than the allowable number of broken strands; missing grounding prongs on power tools; defective on/off switches; mushroomed heads of impact tools; sprung wrench jaws; missing or broken handles or guards; and wooden handles that are cracked, splintered, or loose. All equipment and tools will be used within their rated capacities and capabilities.

Whenever possible, equipment should not be driven into the ground, but should be placed into an augured hole. All onsite personnel will exercise due care when working with drilling equipment to not become entangled, crushed, or otherwise injured. No loose clothing or unconfined long hair will be permitted in the immediate area of any operating drilling tools or equipment. Probes and other pieces of equipment that are driven into the ground will be placed using a slide hammer to minimize potential for crushing injury.

3.2.3 TRENCHING

Trenching for this project will be performed using a box trench method. Soil will be removed using a backhoe, allowing the box trench to slip into the trench as soil is removed. The box provides shoring of the trench as required in 29 CFR 1926.652 "Specific Trenching Requirements." During trenching operations, no one will be permitted inside the box trench while soil is being removed.

Prior to personnel entry into the trench, all the following precautions must be taken:

1. The trench box must be stable, and its stability verified by the field team leader or site safety officer;
2. All earth-moving equipment and vehicles (except those necessary for supplying the in-trench worker with materials) must be moved and kept away from the trench area or must be parked with engines stopped;
3. The atmosphere of the trench must be monitored for combustible gas concentration at representative locations within the trench, including a minimum of three levels vertically each, at each end and a suitable number of

points between the ends of the trench. No one will be permitted to enter the trench if the presence of combustible gas exceeds 25 percent of the lower explosive limit (LEL);

4. An attendant will be appointed to monitor the activities and keep in visual contact with each in-trench worker at all times for the duration of in-trench work. One attendant also will continuously monitor atmospheric conditions as described in precaution number 3 during in-trench work. If the in-trench combustible gas concentration exceeds 25 percent of the LEL, all in-trench work will cease and in-trench personnel will leave the trench and allow 15 minutes for combustible gas to disperse. Levels will be monitored prior to reentry.

In-trench workers and personnel working near the trench must wear eye and face protection, safety boots, and hard hats at all times to minimize injury due to dropped objects, loose soil, and mechanical hazards of the trench box and its support system, as well as equipment used near the trench.

3.2.4 UNEXPLODED ORDNANCE (UXO)

The incinerator ash landfill was not used for the disposal of ammunition and/or explosive materials. It is not expected that UXO was disposed in the area. However, this does not preclude the possibility that some UXO may exist at this site. If explosive contamination or UXO is discovered at any time during site activities, the location will be marked, operations halted, and the CO notified. The government will make appropriate arrangements with the regional Explosive Ordnance Disposal Command Center for disposal of the explosive material.

3.3 PERSONAL PROTECTIVE EQUIPMENT

Trenching, in-trench work, drilling, and well development initially will be performed in Level B personal protective equipment. Level B protective equipment includes the following:

LEVEL B

1. Positive-pressure, self-contained breathing apparatus (SCBA) with full face mask;
2. Chemical protective Tyvek® coveralls;
3. Inner chemical resistant latex gloves;
4. Outer chemical resistant Solvex® gloves;
5. Chemical-protective Nitrile NBR, steel toe and shank, boots;
6. Chemical protective latex boot covers;
7. Hard hat; and
8. Sealed tape over joints between coveralls and boot covers or gloves.

Modifications

1. Air line respirator with escape SCBA may be used in lieu of SCBA.
2. Work gloves over chemical-resistant gloves must be used for specific activities that require such protection. Specific activities include drill rig operation, in-trench work, and other similar manual labor.

In the demonstrated absence of trichloroethene, 1,2-dichloroethane, vinyl chloride, and chloroform, Level C personal protective equipment will be permitted. Level C protective equipment includes the following:

LEVEL C

1. Air-purifying respirator with full face mask and organic vapor/high efficiency cartridges;
2. Chemical protective Tyvek® coveralls;
3. Inner chemical resistant latex gloves;
4. Outer chemical resistant Solvex® gloves;
5. Chemical-protective, steel toe and shank, Nitrile or NBR boots;
6. Chemical protective latex boot covers;

7. Hard hat; and
8. Sealed tape over joints between coveralls and boot covers or gloves.

Modification

1. Work gloves are to be worn over chemical-resistant gloves as necessary for the particular activity.

Other onsite work outside the Exclusion Zone (EZ) (described in section 3.4) where ionization detector measurements verify that total organic vapor (TOV) levels do not exceed background may be performed in Level D personal protective equipment. Level D protective equipment includes the following:

LEVEL D

1. Coveralls;
2. Chemical-resistant, steel toe and shank, Nitrile or NBR boots;
3. Eye and face protection;
4. Hard hat, and;
5. Work gloves.

Hunter/ESE will maintain two sets of Level C personal protective equipment onsite for official visitors and government personnel. Visitors will not be allowed in areas requiring Level B protection. The site safety officer will assure that all personal protective equipment, regardless of ownership, is in proper working order and is maintained in accordance with the manufacturer's instructions. All respiratory equipment will be used in accordance with its NIOSH/Mine Safety and Health Administration (MSHA) approval conditions, and with OSHA (29 CFR 1910.134) requirements.

3.4 SITE ACCESS, PERIMETER, AND WORK ZONES

The site is on an access-controlled military installation. Site access will be through public access points onto the installation. The field team leader will coordinate with the client contact for field personnel access.

As this site is on an access-controlled military installation, perimeters around the EZ and Contamination Reduction Zone (CRZ) may be established using barriers consisting of barrier tape and/or A-frame barricades for the duration of site work.

Site work zones will be established and suitably marked in accordance with site conditions and needs, using Attachment C for guidance. The extent of the EZs will be established in accordance with the proposed trench location. Separate EZs will be permitted for trenching and drilling operations as site conditions may indicate. Only personnel properly dressed in Level B equipment will be permitted within the EZ(s). The CRZ will be established and enlarged as necessary so that ionization detector measurements taken at multiple representative points along the upwind, downwind, and crosswind sides of the CRZ do not exceed background TOV levels.

3.5 PERSONNEL DECONTAMINATION

Personnel decontamination stations will be established and supplied in accordance with the procedures listed in Attachment D.

3.6 EQUIPMENT DECONTAMINATION

Equipment decontamination will be performed as necessary in accordance with procedures set forth in the Quality Assurance Subplan.

4.0 FIELD STANDARD OPERATING PROCEDURES

4.1 GENERAL SAFE WORK PRACTICES

In addition to the specific requirements of this project safety plan, common sense should prevail at all times. The following general safety rules and practices will be in effect at the site.

1. The site will be suitably marked or barricaded as necessary to prevent unauthorized visitors, but will not hinder emergency services if needed.
2. All open holes, trenches, and obstacles will be properly barricaded in accordance with local site needs. These needs will be determined by proximity to traffic ways, both pedestrian and vehicular, and site of the hole, trench, or obstacle. If holes are required to be left open during nonworking hours, they will be adequately decked over or barricaded and sufficiently lighted.
3. Prior to conducting any digging or boring operations, underground utility locations will be identified. The client contact will provide locations of underground utility lines and piping. All boring, excavation, and other site work will be planned and performed with consideration for underground lines.
4. Smoking and ignition sources in the vicinity of potentially flammable or contaminated material are prohibited.
5. Drilling, boring, trenching, excavation, and movement and use of earth-moving equipment, cranes and drilling rigs, erection of towers, movement of vehicles and equipment, and other activities will be planned and performed with consideration for the location, height, and relative position of aboveground utilities and fixtures, including signs, lights, canopies, buildings, and other structures and construction, and natural features such as trees, boulders, bodies of water, and terrain.
6. When working in areas where flammable vapors may be present, particular care must be exercised with tools and equipment that may be sources of

ignition. All tools and equipment so provided must be properly bonded and/or grounded.

7. Approved and appropriate safety equipment (as specified in this SHERP), such as eye protection, hard hats, foot protection, and respirators, must be worn in areas where required by the SHERP. In addition, eye protection must be worn when handling sampling soil or water that may be contaminated.
8. Beards that interfere with respirator fit are not allowed within the site boundaries because all site personnel may be called upon to use respirator protection in some situations, and beards do not allow for proper respirator fit.
9. No smoking, eating, or drinking will be allowed in the contaminated areas.
10. Tools and hands must be kept away from the face.
11. Personnel must shower at the end of the shift or as soon as possible after leaving the site.
12. Each sample must be treated and handled as though it were extremely toxic.
13. Persons with long hair and/or loose-fitting clothing that could become entangled in power equipment are not permitted in the work area.
14. Horseplay is prohibited in the work area.
15. Work while under the influence of intoxicants, narcotics, or controlled substances is prohibited.

4.2 AIR MONITORING

An air monitoring program is fundamental to the safety of onsite and offsite personnel. TOV levels associated with onsite activities will be monitored with a photoionization detection (PID) instrument (HNU PI-101) equipped with an 11.7 electron volt (eV) lamp. This instrument will provide information for upgrading or downgrading personal protection. Calibration and maintenance of monitoring equipment will be in accordance with manufacturer recommendations.

Hunter/ESE personnel will establish daily a background TOV prior to initiating onsite activities. Under most circumstances, this level can be determined by taking multiple readings at representative locations about the site before work has begun and averaging the results of sustained measurements. If, due to site conditions, it appears that perimeter readings will not yield a truly representative background level, the site safety officer or Hunter/ESE corporate health and safety officer will be consulted for guidance.

Hunter/ESE personnel will monitor TOV at the frequencies given in the Air Monitoring Subplan. Decisions to upgrade personal protection will be based on sustained breathing zone TOV that exceeds background levels. Breathing zone refers to the area from the top of the shoulders to the top of the head. Specific criteria for upgrading personal protection based on TOV is presented in Table 4-1. Attachment E contains a sample logsheet for recording TOV measurements. If TOV levels exceed background, gas chromatograph analysis may be made of the air in the breathing zone. In the absence of documented evidence that trichloroethene, 1,2-dichloroethane, vinyl chloride, and chloroform are not present in the breathing zone, work will be performed in Level B personal protective equipment. Further air monitoring information is given in the Air Monitoring Subplan.

4.3 WORK LIMITATIONS

Work will be limited to daylight hours and during normal weather conditions. If work is to be performed at times of reduced illumination, such as late evening hours, artificial flood lighting will be provided. Extremes in temperature and weather conditions (i.e., wind and lightning) will restrict working hours. All work onsite will be suspended when lightning is occurring in the vicinity.

4.3.1 HEAT STRESS

During warm weather, especially when personnel are wearing protective clothing, drinking water will be made available. Noncarbonated, noncaffeinated, and

Table 4-1. Organic Vapor Measurements and Corresponding Personal Protection Levels/Actions

Total Organic Vapor	Personal Protection Level or Action*
Background	D
In excess of background, <u>with</u> demonstrated absence of trichloroethene, 1,2-dichloroethane, vinyl chloride, and chloroform	C
In excess of background, <u>without</u> demonstrated absence of trichloroethene, 1,2-dichloroethane vinyl chloride, and chloroform	B
In excess of background + 50 ppm, <u>without</u> demonstrated absence of trichloroethene, 1,2-dichloroethane, vinyl chloride, and chloroform	Evacuate site and resample after 1 hour.

*See Section 3.3 for personal protective equipment level descriptions.

Source: Hunter/ESE, 1989.

nonalcoholic beverages are acceptable as a substitute to water. Drinks are to be located so that personnel are encouraged to frequently drink small quantities (i.e., 8 fluid ounces 3 to 4 times per hour). Drinks should be kept as close to the work area as practicable, and should be kept reasonably cool (50 to 60°F).

For monitoring the body's recuperative ability toward excess heat, the following techniques will be used as a screening mechanism. Monitoring of personnel wearing protective clothing will commence when the ambient temperature is 70°F or above. When temperatures exceed 85°F, workers will be monitored after every work period. Monitoring will include visual observations for signs of heat stress and measurement of radial pulse rate for 30 seconds at the beginning of each rest period. If the heart rate exceeds 110 beats per minute, the oral body temperature will be measured. If the body temperature is more than 98.6°F but less than 100.5°F, the next work period will be shortened by 10 minutes, with no reduction in rest period. If the pulse rate is 100 beats per minute at the beginning of the next rest period, the following work cycle will be shortened another 10 minutes.

If the body temperature exceeds 100.5°F, the worker will be monitored again at the end of the rest period and will not be allowed to return to work until the body temperature falls below 100.5°F. If 10 minutes after the second monitoring during a single rest period, the body temperature is still in excess of 100.5°F, the worker will be treated for heat stress, and medical attention will be sought for the worker.

4.3.2 COLD STRESS

The human body senses cold as a result of two factors, air temperature and wind velocity. Cooling of the flesh increases rapidly as wind velocity goes up. Frostbite can occur at relatively mild temperatures if wind penetrates the body insulation. For example, when the air temperature is 40°F and the wind velocity is 30 miles per hour (mph), the exposed skin would perceive an equivalent still air temperature of 13°F. Table 4-2 illustrates windchill indices and the associated hazards to exposed

Table 4-2. Windchill Index

Windspeed Miles per Hour	Actual Thermometer Reading (°F)									
	50	40	30	20	10	0	-10	-20	-30	-40
calm	50	40	30	20	10	0	-10	-20	-30	-40
5	48	37	27	16	6	-5	-15	-26	-36	-47
10	40	28	16	4	-9	-21	-33	-46	-58	-70
15	36	22	9	-5	-18	-36	-45	-58	-72	-85
20	32	18	4	-10	-25	-39	-53	-67	-82	-96
25	30	16	0	-15	-29	-44	-59	-74	-88	-104
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109
35	27	11	-4	-20	-35	-49	-67	-82	-98	-113
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116
Over 40	LITTLE DANGER (little added effect)			INCREASING DANGER (for properly clothed person)				GREAT DANGER (danger from freezing of exposed flesh)		

Source: National Safety Council, 1982.

flesh. Precautions will be taken to minimize exposed flesh, and layered clothing will be provided, as appropriate.

If a worker shows signs of cold stress, such as excessive shivering, the worker's oral body temperature will be monitored. If the temperature is less than 96.8°F, the worker will be allowed to warm up in a heated rest area. If, at the end of the scheduled rest period, the worker's temperature is still below 96.8°F, the worker will not be allowed to return to work until the body temperature rises to above 96.8°F. If, 10 minutes after the second monitoring during a single rest period, the body temperature is still below 96.8°F, the worker will be treated for cold stress, and medical attention will be sought for the worker.

Also, good hygienic standards must be maintained by frequent change of clothing and daily showering. Clothing should be permitted to dry during rest periods. If skin problems occur, medical personnel should be consulted.

4.4 LABORATORY SAFETY

Certain samples collected from the site and shipped to a Hunter/ESE laboratory for analysis may present a potential for exposure of laboratory personnel to dangerous levels of hazardous materials. The laboratory has implemented an effective safety plan for handling these materials.

The system designed for laboratory personnel protection prevents skin contact with hazardous chemicals and respiratory protection from dangerous levels of hazardous vapors. At a minimum, all laboratory personnel having direct contact with the hazardous samples will be equipped with the following equipment:

1. Safety glasses or face shield to protect from splashes,
2. Inner latex and outer Solvex® gloves, and
3. Rubberized apron or other chemical protective garment.

Respiratory protection in the form of organic vapor cartridge respirators may be required by the laboratory safety manager if exposure to hazardous vapors is likely. All operations conducted with the raw hazardous waste samples will be performed in an adequate fume hood. Once the samples have been extracted or processed and are present in sealed bottles and vials, respiratory protection may be discontinued; however, the following safety precautions should continue to be observed:

1. Use of safety glasses, and
2. Use of latex and/or rubber gloves.

4.5 ACCIDENT PREVENTION PLAN/ACCIDENT REPORTING

The purpose of the SHERP is to prevent accidents and minimize the impact of an accident if one should occur (i.e., the SHERP is the accident prevention plan).

4.5.1 ACCIDENT PREVENTION

The site safety officer will conduct periodic inspections of the work areas to ensure that safe working practices are being followed. These inspections will be made prior to the start of any new activity and during the performance of activities as necessary. The purpose of these inspections will be to determine if site conditions and operations are in accordance with this SHERP and safe working conditions and practices. Site personnel will, under the direction of the site safety officer, immediately correct any deficiencies, stopping all work if necessary to do so. The site safety officer will prepare a report for the project file indicating the date, time, and location of each inspection, detailing unsafe conditions and practices and remedial action taken.

4.5.2 ACCIDENT REPORTING

All accidents must be reported to the site safety officer immediately. Prompt reporting is essential to the prevention of future incidents in addition to the well-being of the affected individual or individuals. The site safety officer will notify the project manager and the client contact of any serious accidents. The site safety officer or other key members of the field team will be trained in first aid and cardiopulmonary resuscitation (CPR). First aid will be administered to affected personnel under the direction of the site safety officer. For serious accidents, the nearest ambulance service will be contacted for transport of injured personnel to the nearest medical facility (Section 5.0). The Site Safety Officer will have established contact and liaison with medical authorities (Section 5.0) whose personnel will be knowledgeable of the activities of the field team. Telephone numbers and addresses of ambulance and medical services will be posted onsite.

A formal report of all accidents and any OSHA-recordable accident will be filed with the Hunter Corporate Health and Safety Officer and with the client contact on ENG Form 3394 in accordance with Army requirements. All reports must be received within 2 working days.

5.0 EMERGENCY INFORMATION

5.1 CONTINGENCY PLANS

In the event of any site emergency, the site safety officer will notify the post environmental coordinator.

5.1.1 FIRE CONTROL

No smoking will be allowed during drilling or sampling activities. Fire extinguishers, suitable for Class A, B, and C fires (rated at least 1A, 10BC), will be available at sampling sites for use on small fires. It will be reiterated that all samples must be treated as flammable or explosive. The site safety officer will have available the telephone number of the nearest fire station and local law enforcement agencies in case of a major fire emergency.

5.1.2 SPILL CONTROL

In the event of a spill, the site safety officer will be notified immediately. The important factors are that no personnel are overexposed to vapors, gases, or mists and that the liquid does not ignite. Waste spillage must not be allowed to contaminate any local water source. Small dikes will be erected to contain spills, if necessary, until proper disposal can be completed. Subsequent to cleanup activities, the site safety officer will survey the area to ensure that no toxic or explosive vapors remain.

5.2 LOCAL RESOURCES

All emergency numbers and routes will be posted onsite.

Seneca Army Depot:	607/869-0448 (Police)	607/869-1436 (Ambulance)	607/869-1242 (Fire)
Hospitals:	Seneca Army Depot Clinic Romulus, New York		607/869-1243
	Geneva General Hospital 196-198 North Street Geneva, New York		315/798-4222

5.3 SITE RESOURCES

Support vehicle.

Safety and first-aid equipment accessible in the support vehicle:

1. One fire extinguisher, rated at least 1A, 10BC;
2. One Standard Industrial First Aid Kit, fully stocked; and
3. One Portable Emergency Eyewash Shower Unit, providing 0.4 gallons clean water per minute for 15 minutes.

5.4 EMERGENCY CONTACTS

1. Mr. Randy Battaglia, Environmental Contact, Seneca Army Depot, 607/869-1450.
2. Mr. David M. Moccia, Project Manager, Hunter/ESE 904/332-3318.
3. Dr. John D. Bonds, Corporate Health and Safety Officer, Hunter/ESE, 904/332-3318.
4. Christopher J. Campbell, CSP, Project Safety Manager, Hunter/ESE 904/332-3318.

5.5 HOSPITAL ROUTES

Seneca Army Depot Clinic
Located onpost near the south (main) gate (Figure 5-1).

Geneva General Hospital (Figure 5-2)
Exit the north gate from the depot onto State Road 96A. North on State Road 96A to Geneva. In Geneva turn right on State Roads 5 and 20 to North Street. Turn left on North Street to hospital.

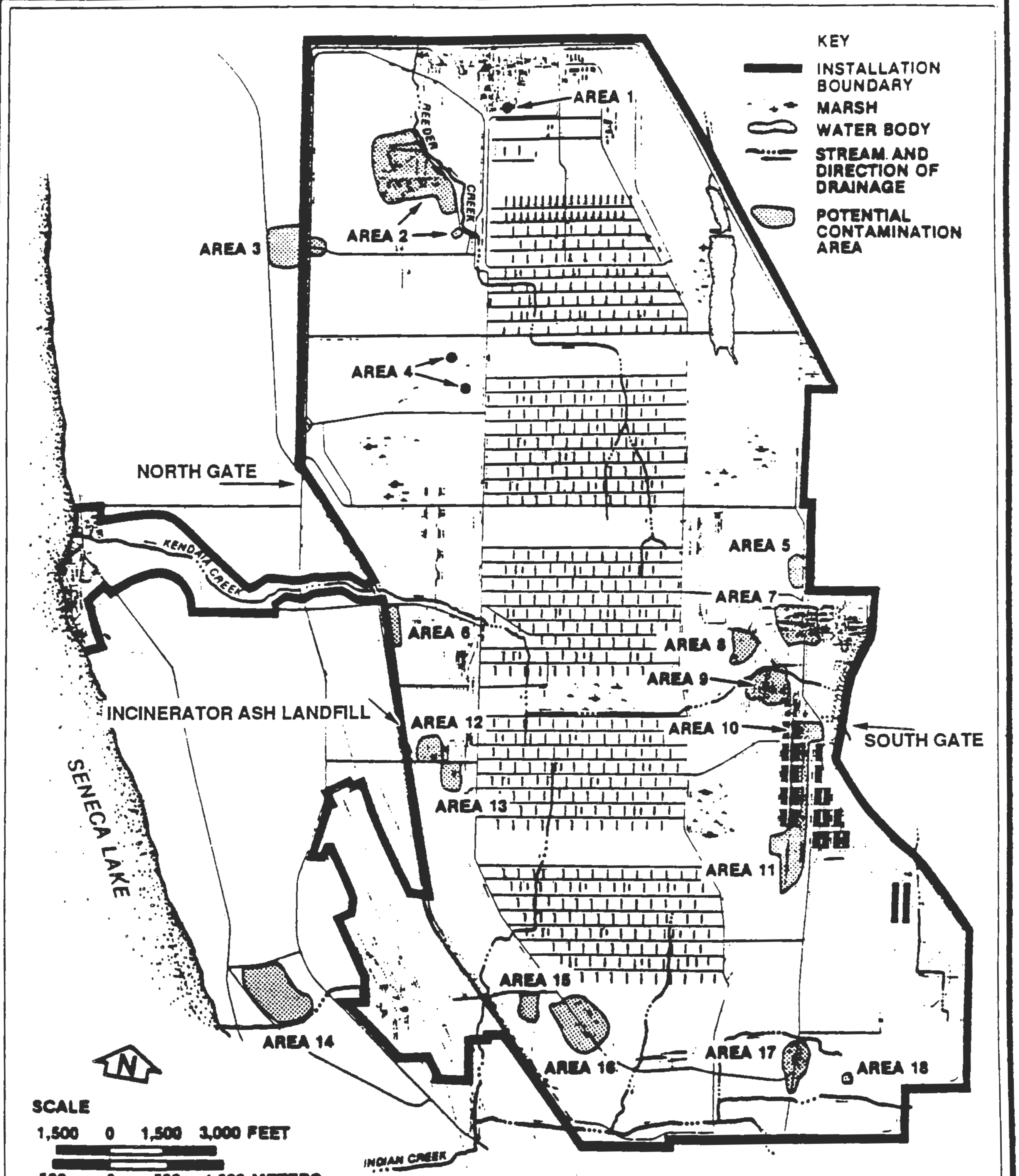

Figure 5-1
SITE MAP

HunTer/ESE

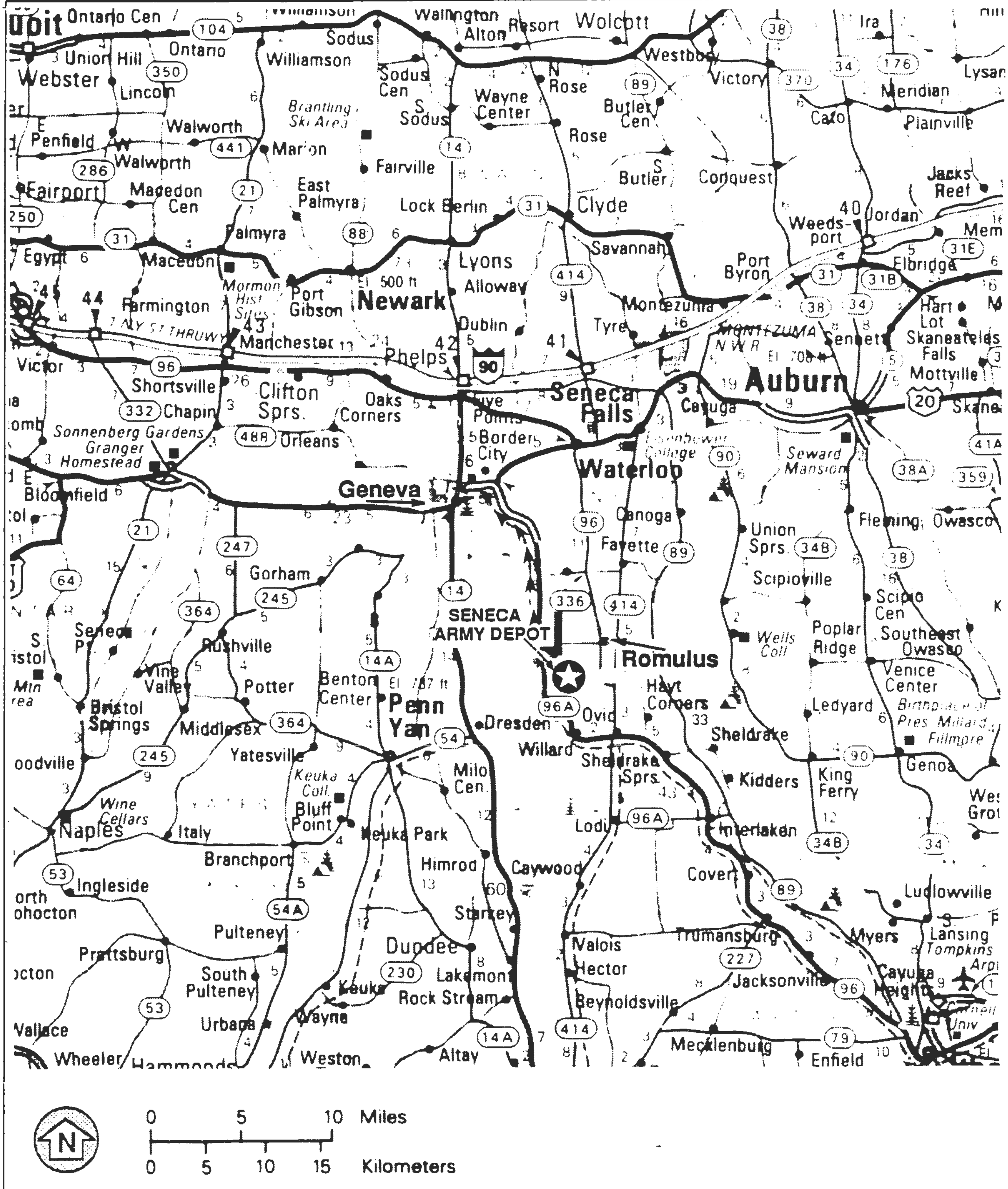

Figure 5-2
HOSPITAL ROUTE TO
GENEVA GENERAL HOSPITAL

SOURCE: HUNTER/ESE, 1989.

HunTer/ESE

ATTACHMENT A—DECLARATION OF UNDERSTANDING

HUNTER/ESE ENVIRONMENTAL SERVICES
PROJECT SPECIFIC HEALTH AND SAFETY PLAN

PROJECT NAME: ______________________________

PROJECT NUMBER: ______________________________

PROJECT MANAGER: ______________________________

CORPORATE SAFETY OFFICER: ______________________________

Check if Designee ☐

DECLARATION OF UNDERSTANDING

I have read and understand this Health and Safety Plan (HASP), and agree to abide by the procedures and limitations specified. I also certify that all medical monitoring and health and safety training requirements which may be applicable to my employment at this site are current and will not expire during onsite activities.

NAME	EMPLOYEE NO.	SS NO.	DATE

NOTE: All subcontractors to HUNTER/ESE must abide by the specifications and limitations contained in this HASP.

D12/PPG 6/89h

ATTACHMENT B--PERSONNEL TRAINING AND MEDICAL SURVEILLANCE

PERSONNEL TRAINING AND MEDICAL SURVEILLANCE

Project:______________________ Site:___________________________

The following personnel are expected to perform activities at this site. Training and medical surveillance, in accordance with 29 CFR 1910.120 and Hunter standard practices, has been provided on the dates indicated.

NAME	HAZARDOUS WASTE SITE	SITE SUPVSR	FIRST AID	CPR	MEDICAL EXAM

ATTACHMENT C--DIAGRAM OF SITE WORK ZONES

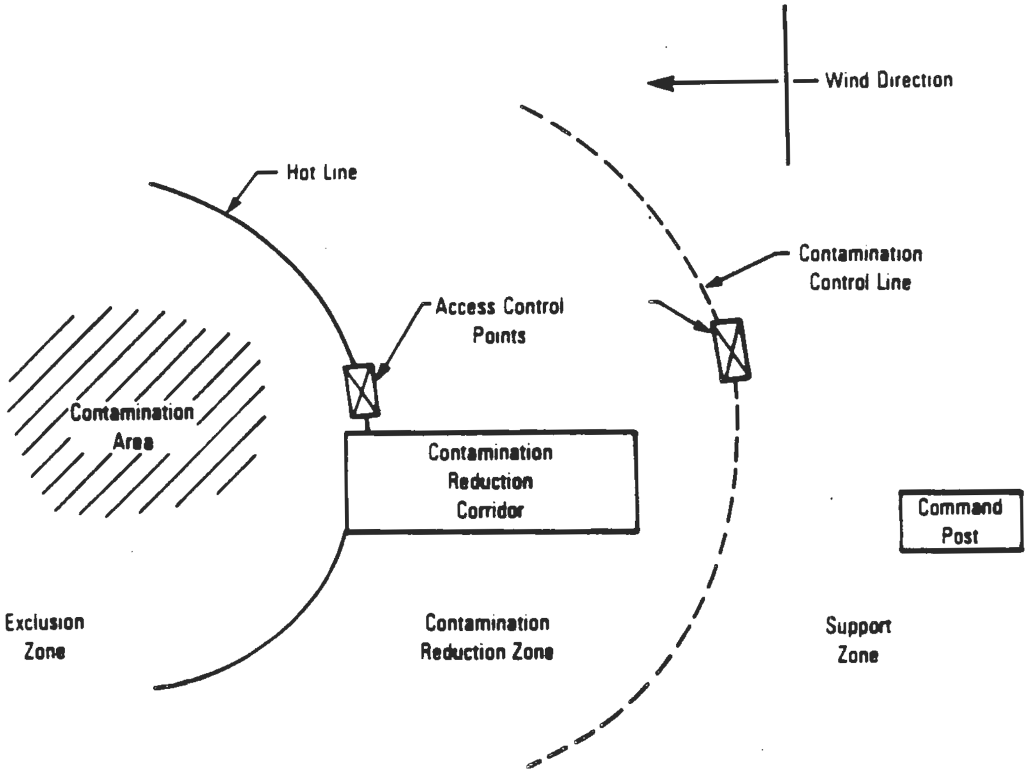

Figure C-1
DIAGRAM OF SITE WORK ZONES

SOURCES: NUS, 1983; HUNTER/ESE, 1989.

HUNTER/ESE

ATTACHMENT D--DECONTAMINATION PROCEDURES

Level B Decontamination

Equipment Worn

The full decontamination procedure outlined is for workers wearing Level B protection (with taped joints between gloves, boots, and suit). Such protection consists of:

1. One-piece, hooded, chemical-resistant splash suit
2. Self-contained breathing apparatus
3. Hard hat
4. Chemical-resistant boots with steel toe and shank
5. Boot covers
6. Inner and outer gloves

Procedure for Full Decontamination

Station 1: Segregated Equipment Drop

Deposit equipment used onsite (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths or in different containers with plastic liners. Each will be contaminated to a different degree. Segregation at the drop reduces the probability of cross-contamination.

Equipment necessary is:

1. Containers of various sizes
2. Plastic liners
3. Plastic drop cloths

Station 2: Boot Cover and Glove Wash

Scrub outer boot covers and gloves with decontamination solution or detergent/water solution.

Equipment necessary is:

1. Container (20 to 30 gallons)
2. Decontamination solution
   or
3. Detergent/water solution
4. Two or three long-handle, soft-bristle scrub brushes

Station 3: Boot Cover and Glove Rinse

Rinse off decontamination solution from Station 2 using copious amounts of water. Repeat as many times as necessary.

Equipment necessary is:

1. Container (30 to 50 gallons)
   or
2. High-pressure spray unit
3. Water
4. Two or three long-handle, soft-bristle scrub brushes

Figure D-1
LEVEL B DECONTAMINATION PROCEDURES
(PAGE 1 OF 5)

SOURCES: NUS, 1983; HUNTER/ESE, 1989.

HunTER/ESE

Station 4: Tape Removal

Remove tape around boots and gloves and deposit in container with plastic liner.

Equipment necessary is:

1. Container (20 to 30 gallons)
2. Plastic liners

Station 5: Boot Cover Removal

Remove boot covers and deposit in container with plastic liner.

Equipment necessary is:

1. Container (30 to 50 gallons)
2. Plastic liners
3. Bench or stool

Station 6: Outer Glove Removal

Remove outer gloves and deposit in container with plastic liner.

Equipment necessary is:

1. Container (20 to 30 gallons)
2. Plastic liners

Station 7: Suit/Safety Boot Wash

Thoroughly wash chemical-resistant splash suit, self-contained breathing apparatus, gloves, and safety boots. Scrub with long-handle, soft-bristle scrub brush and copious amounts of decontamination solution or detergent/water solution. Wrap self-contained breathing apparatus regulator (if belt-mounted type) with plastic to keep out water. Wash backpack assembly with sponges or cloths.

Equipment necessary is:

1. Container (30 to 50 gallons)
2. Decontamination solution
   or
3. Detergent/water solution
4. Two or three long-handle, soft-bristle scrub brushes
5. Small buckets
6. Sponges or cloths

Figure D-1
LEVEL B DECONTAMINATION PROCEDURES
(CONTINUED, PAGE 2 OF 5)

SOURCES: NUS, 1983; HUNTER/ESE, 1989.

HunTER/ESE

Station 8: Suit/Self-Contained Breathing Apparatus/Boot/Glove Rinse

Rinse off decontamination solution or detergent/water solution using copious amounts of water. Repeat as many times as necessary.

Equipment necessary is:

1. Container (30 to 50 gallons)
   or
2. High-pressure spray unit
3. Water
4. Small buckets
5. Two or three long-handle, soft-bristle scrub brushes
6. Sponges or cloths

Station 9: Tank Change

If worker leaves Exclusion Zone to change air tank, this is the last step in the decontamination procedure. Worker's air tank is exchanged; new outer glove and boot covers donned, and joints taped. Worker then returns to duty.

Equipment necessary is:

1. Air tanks
2. Tape
3. Boot covers
4. Gloves

Station 10: Safety Boot Removal

Remove safety boots and deposit in container with plastic liner.

Equipment necessary is:

1. Container (30 to 50 gallons)
2. Plastic liners
3. Bench or stool
4. Boot jack

Station 11: Self-Contained Breathing Apparatus Removal

While still wearing facepiece, remove backpack and place on table. Disconnect hose from regulator valve and proceed to next station.

Equipment necessary is:

1. Table

Figure D-1
LEVEL B DECONTAMINATION PROCEDURES
(CONTINUED, PAGE 3 OF 5)

SOURCES: NUS, 1983; HUNTER/ESE, 1989.

HunTER/ESE

Station 12: Splash Suit Removal

With assistance of helper, remove splash suit. Deposit in container with plastic liner.

Equipment necessary is:

1. Container (30 to 50 gallons)
2. Plastic liners
3. Bench or stool

Station 13: Inner Glove Wash

Wash with decontamination solution or detergent/water solution that will not harm skin. Repeat as many times as necessary.

Equipment necessary is:

1. Decontamination solution
   or
2. Detergent/water solution
3. Basin or bucket
4. Small table

Station 14: Inner Glove Rinse

Rinse with water. Repeat as many times as necessary.

Equipment necessary is:

1. Water
2. Basin or bucket
3. Small table

Station 15: Facepiece Removal

Remove facepiece. Deposit in container with plastic liner. Avoid touching face with fingers.

Equipment necessary is:

1. Container (30 to 50 gallons)
2. Plastic liners

Station 16: Inner Glove Removal

Remove inner gloves and deposit in container with plastic liner.

Equipment necessary is:

1. Container (20 to 30 gallons)
2. Plastic liners

Figure D-1
LEVEL B DECONTAMINATION PROCEDURES
(CONTINUED, PAGE 4 OF 5)

SOURCES: NUS, 1983; HUNTER/ESE, 1989.

HUNTER/ESE

Station 17: Inner Clothing Removal

Remove clothing soaked with perspiration. Place in container with plastic liner. Do not wear inner clothing offsite since there is a possibility that small amounts of contaminants might have been transferred in removing fully encapsulating suit.

Equipment necessary is:

1. Container (30 to 50 gallons)
2. Plastic liners

Station 18: Field Wash

Shower if highly toxic, skin-corrosive, or skin-absorbable materials are known or suspected to be present. Wash hands and face if shower is not available.

Equipment necessary is:

1. Water
2. Soap
3. Small table
4. Basin or bucket
5. Field showers

Station 19: Redress

Put on clean clothes. A dressing trailer is needed in inclement weather.

Equipment necessary is:

1. Tables
2. Chairs
3. Lockers
4. Clothes

Figure D-1
LEVEL B DECONTAMINATION PROCEDURES
(CONTINUED, PAGE 5 OF 5)

SOURCES: NUS, 1983; HUNTER/ESE, 1989.

HunTER/ESE

9A.3 Level C Decontamination

Equipment Worn

The full decontamination procedure outlined is for workers wearing Level C protection (with taped joints between gloves, boots, and suit). Such protection consists of

1. One-piece, hooded, chemical-resistant splash suit
2. Canister-equipped full-face mask
3. Hard hat
4. Chemical-resistant boots with steel toe and shank
5. Boot covers
6. Inner and outer gloves

Procedure for Full Decontamination

Station 1: Segregated Equipment Drop

Deposit equipment used on the site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths or in different containers with plastic liners. Each will be contaminated to a different degree. Segregation at the drop reduces the probability of cross-contamination.

Equipment necessary is

1. Containers of various sizes
2. Plastic liners
3. Plastic drop cloths

Station 2: Boot Cover and Glove Wash

Scrub outer boot covers and gloves with decon solution or detergent/water solution.

Equipment necessary is

1. Container (20 to 30 gal)
2. Decon solution
3. Detergent/water solution
4. Two or three long-handle, soft-bristle scrub brushes

Station 3: Boot Cover and Glove Rinse

Rinse off decon solution from Station 2 using copious amounts of water. Repeat as many times as necessary.

Figure D-2
LEVEL C DECONTAMINATION PROCEDURES
(PAGE 1 OF 5)

SOURCES: NUS, 1983; HUNTER/ESE, 1989.

HunTER/ESE

Equipment necessary is

1. Container (30 to 50 gal)
2. High-pressure spray unit
3. Water
4. Two or three long-handle, soft-bristle scrub brushes

Station 4: Tape Removal

Remove tape around boots and gloves and deposit in container with plastic liner.

Equipment necessary is

1. Container (20 to 30 gal)
2. Plastic liners

Station 5: Boot Cover Removal

Remove boot covers and deposit in container with plastic liner.

Equipment necessary is

1. Container (30 to 50 gal)
2. Plastic liners
3. Bench or stool

Station 6: Outer-Glove Removal

Remove outer gloves and deposit in container with plastic liner.

Equipment necessary is

1. Container (20 to 30 gal)
2. Plastic liners

Station 7: Suit/Safety Boot Wash

Thoroughly wash splash suit and safety boots. Scrub with long-handle, soft-bristle scrub brush and copious amounts of decon solution or detergent/water solution. Repeat as many times as necessary.

Equipment necessary is

1. Container (30 to 50 gal)
2. Decon solution
3. Detergent/water solution
4. Two or three long-handle, soft-bristle scrub brushes

Figure D-2
LEVEL C DECONTAMINATION PROCEDURES
(CONTINUED, PAGE 2 OF 5)

SOURCES: NUS, 1983; HUNTER/ESE, 1988.

HunTER/ESE

Station 8: Suit/Safety Boot Rinse

Rinse off decon solution or detergent/water solution using copious amounts of water. Repeat as many times as necessary.

Equipment necessary is

1. Container (30 to 50 gal)
2. High-pressure spray unit
3. Water
4. Two or three long-handle, soft-bristle scrub brushes

Station 9: Canister or Mask Change

If worker leaves Exclusion Zone to change canister (or mask), this is the last step in the decontamination procedure. Worker's canister is exchanged, new outer glove and boot covers donned, and joints taped. Worker returns to duty.

Equipment necessary is

1. Canister (or mask)
2. Tape
3. Boot covers
4. Gloves

Station 10: Safety Boot Removal

Remove safety boots and deposit in container with plastic liner.

Equipment necessary is

1. Container (30 to 50 gal)
2. Plastic liners
3. Bench or stool
4. Boot jack

Station 11: Splash Suit Removal

With assistance of helper, remove splash suit. Deposit in container with plastic liner.

Equipment necessary is

1. Container (30 to 50 gal)
2. Bench or stool
3. Plastic liner

Figure D-2
LEVEL C DECONTAMINATION PROCEDURES
(CONTINUED, PAGE 3 OF 5)
SOURCES: NUS, 1983; HUNTER/ESE, 1988.

HunTER/ESE

Station 12: Inner-Glove Wash

Wash inner gloves with decon solution or detergent/water solution that will not harm skin. Repeat as many times as necessary.

Equipment necessary is

1. Decon solution
2. Detergent/water solution
3. Basin or bucket

Station 13: Inner-Glove Rinse

Rinse inner gloves with water. Repeat as many times as necessary.

Equipment necessary is

1. Water
2. Basin or bucket
3. Small table

Station 14: Facepiece Removal

Remove facepiece. Avoid touching face with gloves. Deposit facepiece in container with plastic liner.

Equipment necessary is

1. Container (30 to 50 gal)
2. Plastic liners

Station 15: Inner-Glove Removal

Remove inner gloves and deposit in container with plastic liner.

Equipment necessary is

1. Container (20 to 30 gal)
2. Plastic liners

Station 16: Inner-Clothing Removal

Remove clothing soaked with perspiration. Place in container with plastic liner. Do not wear inner clothing off the site since there is a possibility small amounts of contaminants have been transferred in removing fully encapsulating suit.

Figure D-2
LEVEL C DECONTAMINATION PROCEDURES
(Continued, Page 4 of 5)

SOURCES: NUS, 1983; HUNTER/ESE, 1988.

HunTer/ESE

Equipment necessary is

1. Container (30 to 50 gal)
2. Plastic liners

Station 17: Field Wash

Shower if highly toxic, skin-corrosive, or skin-absorbable materials are known or suspected to be present. Wash hands and face if shower is not available.

Equipment necessary is

1. Water
2. Soap
3. Tables
4. Wash basins or buckets
5. Field showers

Station 18: Redress

Put on clean clothes. A dressing trailer is needed in inclement weather.

Equipment necessary is

1. Tables
2. Chairs
3. Lockers
4. Clothes

Full Decontamination (Situation 1) and Three Modifications

The preceding description outlines each station that is included in a complete worst-case decontamination protocol. It is obvious that different sites will present different hazard levels and thus that site-specific modifications of this protocol will be required. The following table illustrates the modifications that can be made in response to a variety of conditions.

STATION NUMBER

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X	X										
3	X						X	X		X	X				X	X	X		
4	X						X	X	X										

Figure D-2
LEVEL C DECONTAMINATION PROCEDURES
(Continued, Page 5 of 5)

SOURCES: NUS, 1983; HUNTER/ESE, 1988.

HunTER/ESE

ATTACHMENT E–SAMPLE LOGSHEET

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.

CALIBRATION DATA

Instrument Serial Number	DATE	Span Gas Concentration (For TIP or HNU Only)	CALIBRATION (ppm)		
			INITIAL	FINAL	

SED FOR ALL CALCULATIONS

FORM 86275a-A

APPENDIX B--QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN
SENECA ARMY DEPOT
Romulus, New York

Prepared for:

U.S. ARMY CORPS OF ENGINEERS
Huntsville, Alabama

Prepared by:

HUNTER/ESE
Gainesville, Florida

Hunter/ESE No. 3902036

December 1989

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LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

AAS	atomic absorption spectrophotometer
AIHA	American Industrial Hygiene Association
ASP	American Scientific Products
ASTM	American Society for Testing and Materials
BFB	bromofluorobenzene
B/N/A	base/neutral/acid
BOD	biological oxygen demand
°C	degrees Celsius
CETHAMA	Corps of Engineers Toxic and Hazardous Materials Agency
CLASS	Chemical Laboratory Analysis and Scheduling System
CLP	Contract Laboratory Program
CRDL	contract-required detection limit
DF	dilution factor
DFTPP	decafluorotriphenylphosphine
DI	deionized
DO	dissolved oxygen
DOD	U.S. Department of Defense
DOT	U.S. Department of Transportation
ECD	electron-capture detector

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued, Page 2 of 6)

EI/CI	electron ionization/chemical ionization
ELAP	Environmental Laboratory Approval Program
EPA	U.S. Environmental Protection Agency
EPA/NIST	U.S. Environmental Protection Agency/National Institute of Standards and Technology
ESE	Environmental Science and Engineering, Inc.
eV	electronvolt
FDER	Florida Department of Environmental Regulation
FE	fraction extract
FID	flame ionization detector
FPD	flame photometric detector
FRN	frame reference number
ft	foot
ft^2	square foot
ft-bls	feet below land surface
GAC	granular activated carbon
GC	gas chromatography
GC/MS	gas chromatography/mass spectrometry

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued, Page 3 of 6)

GC/MS/DS	gas chromatography/mass spectrometry/data systems
GSA	Government Services Administration
HECD	Hall electrolytic conductivity detector
HPLC	high-pressure liquid chromatography
HRS	Department of Health and Rehabilitative Services
IBM	International Business Machines
ICAP	inductively coupled argon plasma
ICP	inductively coupled plasma
ICS	interference check standard
ID	identification
IDL	instrument detection limit
IRDMS	Installation Restoration Data Management System
ITU	Individual Treatment Unit
KCl	potassium chloride
kg	kilogram
KOH	potassium hydroxide
LCS	laboratory control sample
LRCS	linear range check sample
MB	method blank

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued, Page 4 of 6)

MDL	method detection limit
mg	milligram
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL	milliliter
MRDL	Missouri River Division Laboratory
N	normal
ng	nanogram
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NPD	nitrogen-phosphorus detector
NVLAP	National Voluntary Laboratory Accreditation Program
PAT	Proficiency Analytical Testing
PBM	probability-based matching
PC	personal computer
PFS	prefield setup
PID	photoionization detector
PNA	polynuclear aromatics

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued, Page 5 of 6)

ppb	parts per billion
ppm	parts per million
psi	pounds per square inch
QA	quality assurance
QA/QC	quality assurance/quality control
QC	quality control
R	percent recovery
RCRA	Resource Conservation and Recovery Act
RF	response factor
RPD	relative percent difference
SD	serial dilution
SEAD	Seneca Army Depot
SHERP	Safety, Health, and Emergency Response Plan
SOP	standard operating procedure
STORET	storage and retrieval
TCD	thermal conductivity detector
TEU	U.S. Army Technical Escort Unit
TWA	time-weighted average
$\mu g/L$	micrograms per liter

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued, Page 6 of 6)

μL	microliter
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
μmho/cm	micromhos per centimeter
UV	ultraviolet
VOC	volatile organic compound
WP	work plan
YSI	Yellow Springs Instruments

1.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

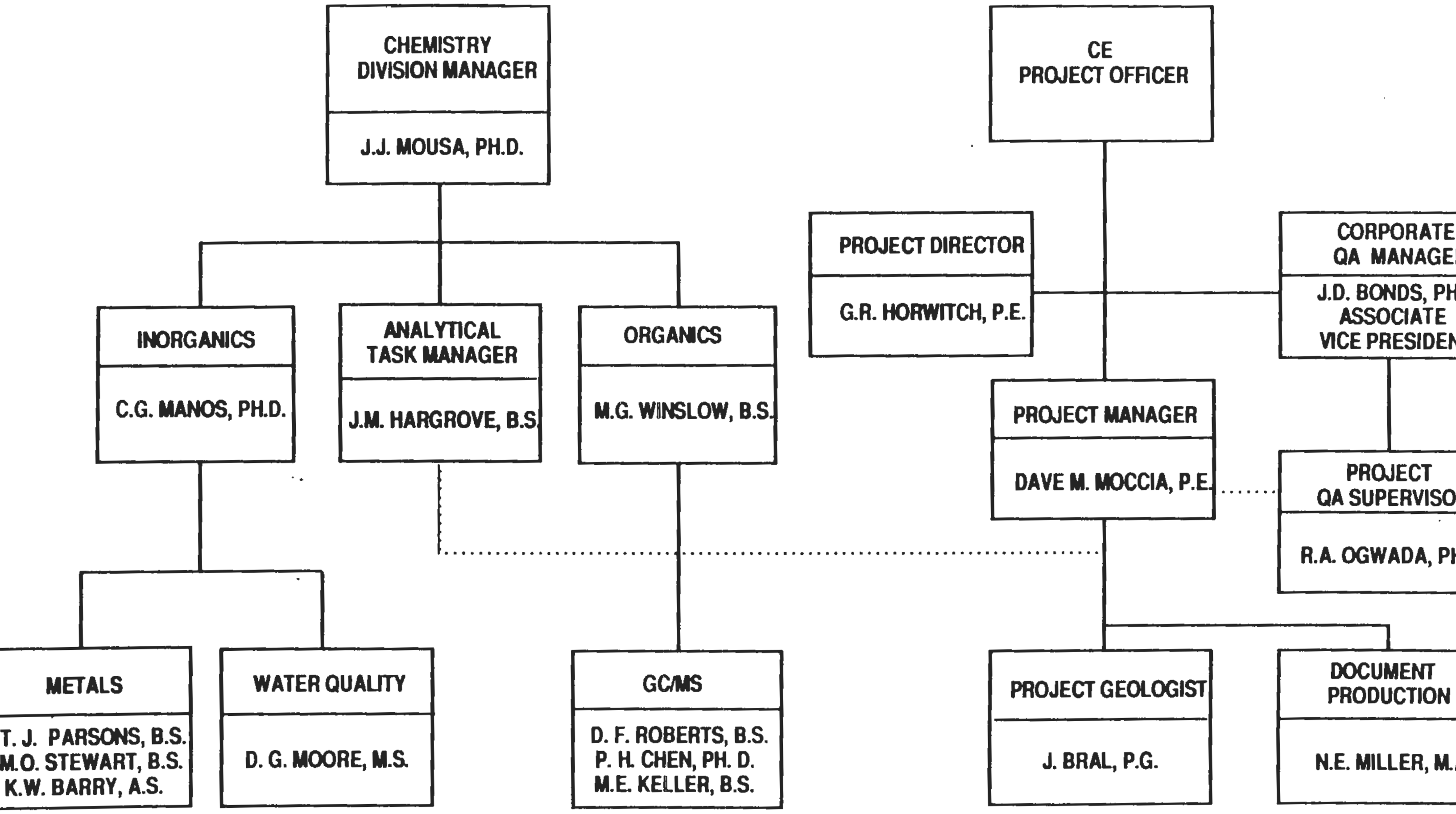
An organization chart showing the discipline leaders and analytical and field team personnel for this project is presented in Figure 1-1. Resumes of the leaders and analytical and field team personnel are included in Attachment A.

The Hunter/ESE program manager is responsible for appointing the principal engineer, supervising the engineer in performance of project duties, and providing corporate support as needed. The Hunter/ESE project manager is responsible for effective day-to-day management of the project staff as well as direct communication and liaison with the client. The project manager's responsibility to quality assurance (QA) is to assure that all project quality control (QC) procedures are followed in the performance of the project and to provide additional authority, when required, to support the project QA supervisor.

The Chemistry Division manager is responsible for the overall management of the analytical laboratory, including the appointment and supervision of departmental managers within the division. This manager is responsible for approving all analytical procedures and associated QC procedures.

The analytical task manager acts as liaison between field and laboratory operations and is responsible for the following:

1. Receipt of sample custody from field members, verification of sample integrity, and transfer of sample fractions to appropriate analytical departments;
2. Coordination of sample analyses to meet project objectives;



ure 1-1
OJECT ORGANIZATION

URCE: HUNTER/ESE, 1989.

HunTer/ESE

3. Preparation of analytical reports, including coordination with the project QA supervisor to assure that the data are validated prior to release outside of Hunter/ESE;
4. Review of laboratory data for compliance with precision, accuracy, and completeness objectives;
5. Review of any QC deficiencies reported by the Analytical Department manager; and
6. Coordination of any data changes resulting from review by the QA supervisor and/or project manager.

The project manager and analytical departmental managers are responsible for providing consistent and accurate field or laboratory data and technical reports produced by analysts, project scientists or engineers, and sampling personnel under their supervision. These individuals are responsible to the project manager for ensuring that all personnel under their direction are knowledgeable of the quality asssurance/quality control (QA/QC) requirements of the project and that all QC and technical review procedures are followed, and documentation is provided.

The Hunter/ESE QA manager, Dr. John Bonds, Associate Vice President, appoints the project QA supervisor and is responsible for supervision of the project QA supervisor in performance of project duties. Dr. Bonds maintains Hunter/ESE's overall corporate QA program and interacts with the corporate officers, division managers, and client QA/QC personnel to correct problem situations as necessary. He reviews all QA/QC reports to the principal engineer and the client.

The project QA supervisor ensures that specific QA and primary technical operations are coordinated efficiently for a specific project. The project QA supervisor is independent of the project team and is responsible for the following:

1. Approval of all QA/QC procedures used on the project;
2. Performance and/or system audits of laboratory, field, and engineering operations to ensure compliance with the project QA plan;
3. Introduction of performance evaluation samples into the analytical flow scheme, as needed;
4. Notification of the project manager of any QC deficiencies discovered during audits;
5. Provision of guidance and coordination to rapidly resolve any QA/QC problems;
6. Maintenance of all project QA records and assembly of project QA data for inspection by Hunter/ESE project management;
7. Independent review of QA/QC information to ensure the quality of all deliverables or outputs from the Hunter/ESE project team to the client; and
8. Interaction and communication with client QA personnel to resolve QA/QC problems specific to the project.

It is the responsibility of all project personnel, as well as the laboratory analysts, project scientists, and field team members, to perform and document the required QA/QC procedures.

It is the responsibility of laboratory analysts to perform preliminary QC checks to ensure that each batch of data being generated passes all required QC criteria. Field team members must bring any unusual observation or analytical problems to the immediate attention of the project manager.

1.1 ANALYTICAL CHEMISTRY FACILITIES

Hunter/ESE's analytical chemistry facilities provide state-of-the-art instrumentation for water quality, radiochemical, atmospheric, and industrial hygiene analysis. The management of Hunter/ESE is committed to keeping Hunter/ESE's laboratories up to date with the highest quality and most reliable equipment. Acquisition of equipment for specific projects and maintenance of the efficiency of high-level laboratories are the major justifications for increasing laboratory instrumentation capabilities. Table 1-1 details the major chemistry field/laboratory equipment to be used for this project.

Hunter/ESE's laboratory, which has more than 25,000 square feet (ft^2) of floor space, is sectioned into a wet chemical laboratory; organics extraction laboratories; instrument laboratories for Technicon® autoanalysis, Dionex® ion chromatography, atomic absorption and inductively coupled plasma (ICP) spectrophotometry, gas chromatography (GC), high-pressure liquid chromatography (HPLC), gas chromatography/mass spectrometry (GC/MS), and radiological analysis; a clean room for trace-level organics work; a humidity-controlled room housing the analytical balances; a toxic chemicals handling room; and ancillary support (e.g., glassware washing and sample receiving and identification) areas. A 10- by 10-foot (ft) cold room and a 16- by 24-ft cold room are used for storing samples at 4 degrees Celsius (°C). Large freezers are also available for sample storage. The laboratory is supplied with

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Table 1-1. Laboratory Equipment To Be Used

Item	Manufacturer	Model	Purchase Date	Maintenance Agreement
Gas Chromatograph/Mass Spectrometer/ Computer with Capillary	Hewlett-Packard	5988A	May 1985	Yes
	Finnigan	Incos 50	June 1987	Yes
Magnetic Tape Recording System (9-track)	Hewlett-Packard	7970B	May 1977	Yes
77K Compound Library	NIST/Wiley	- -	- -	- -
Disk Drives (180-Megabyte Storage)	Hewlett-Packard	7914	May 1985	Yes
Touchscreen Monitor	Hewlett-Packard	150	May 1986	Yes
Laboratory Data System	Hewlett-Packard	9871 9885	July 1977	Yes
Gas Chromatograph with Integrator	Hewlett-Packard	5880A	August 1981	Yes
Gas Chromatograph with Integrator	Hewlett-Packard	5890A 3393	January 1986	Yes
Inductively Coupled Argon Plasma Spectrophotometer	Jarrell-Ash	1103	February 1981	Yes
	Perkin-Elmer	PII	January 1987	Yes
Atomic Absorption Spectrophotometer	Perkin-Elmer	703	January 1979	Yes
Atomic Absorption Spectrophotometer	Perkin-Elmer	3030	July 1986	Yes
Atomic Absorption Spectrophotometer	Perkin-Elmer	5100	January 1987 January 1988	Yes Yes
Gas Chromatograph with Integrator	Tracor	540	February 1986	No

Table 1-1. Laboratory Equipment To Be Used (Continued, Page 2 of 2)

Item	Manufacturer	Model	Purchase Date	Maintenance Agreement
Analytical Balance (8) Various	Mettler	H80 (1)	- -	Yes
Various	Mettler	AE160 (5)	- -	Yes
Various	Mettler	PC200 (2)	- -	Yes

Note: -- = information not available.

Source: Hunter/ESE, 1989.

demineralized water at 30 pounds per square inch (psi) for glassware washing and other functions. Demineralized distilled water is available for reagent preparation, and a supply of organic-free water is maintained at all times for use in trace organics analysis.

The air in the laboratories is exchanged hourly. Each laboratory has at least one exhaust hood, with an average velocity of 100 linear feet per minute. There are eight exhaust hoods in Hunter/ESE's preparatory laboratories and nine hoods in the instrumentation laboratories.

Hunter/ESE has available 25 gas chromatographs with flame ionization detector (FID), nitrogen-phosphorus detector8 (NPD), flame photometric detector (FPD), thermal conductivity detector (TCD), photoionization detector (PID), Hall electrolytic conductivity detector (HECD), and electron-capture detector (ECD). Twenty-three autosamplers are used with these gas chromatographs for sample-handling efficiency. Data acquisition is accomplished by means of dedicated integrators and Nelson data acquisition stations. Six gas chromatographs are equipped with Tekmar® LSC purge- and-trap concentrators with automatic liquid samplers.

Eight HPLC units with ultraviolet (UV), fluorometric, electrochemical, or conductivity detectors are supported by data acquisition systems. Five autosamplers are available for use with these units to increase sample throughput. An LKB 2140 Photodiode array spectrometer interfaced to an International Business Machines (IBM) personal computer (PC)-XT is used for simultaneous multi-wavelength monitoring. One HPLC system is equipped with

Kratos post-column derivitization module and Shimadzu RF-535 fluorescence spectrometer.

The Hunter/ESE Gainesville laboratory has seven fully equipped GC/MS systems. These are Hewlett-Packard and Finnigan quadruple mass spectrometers, some of which are equipped with dual electron ionization/chemical ionization (EI/CI) sources. The mass spectral library is the combined Wiley/National Institute of Standards and Technology (NIST) library with 77,000 reference spectra and the U.S. Environmental Protection Agency/National Institute of Standards and Technology (EPA/NIST) library with 42,000 reference spectra. The reference libraries are both forward and reverse searchable using the probability-based matching (PBM) system. The system gas chromatographs have packed and capillary column capabilities. Three gas chromatography/mass spectrophotometry/data systems (GC/MS/DSs), dedicated to purgeable and volatile organics analyses, are fitted with Tekmar® LSC-2 purge-and-trap interfaces with automatic samplers. The other systems, dedicated to extractable organics analyses, have HP 7671A or HP 7673A automatic liquid samplers. The GC/MS laboratory also has two stand-alone gas chromatographs (an HP 5710 and an HP 5890) with automatic liquid samplers for sample screening, as well as an HP 5970A GC with a mass selective detector, which is equipped with a rotary valve switching device for thermal desorption/capillary GC/MS of ambient air traps. All of the equipment is covered by full service maintenance contracts which provide for rapid instrument repair.

Hunter/ESE has extensive equipment for inorganic metals analysis, a Jarrell Ash® inductively coupled argon plasma (ICAP) spectrometer and a Perkin-

Elmer® Plasma II ICAP. Four atomic absorption spectrophotometers (AASs) are also available with flame, graphite furnace, and cold vapor capabilities, as needed.

Two digital specific-ion meters provide detection and measurement of fluoride, sulfide, chloride, lead, ammonia, and pH.

Hunter/ESE uses a variety of instruments for determining the spectral characteristics of compounds. These instruments include a scanning infrared spectrophotometer, two UV-visible spectrophotometers, two fluorometers, a spectrofluorometer, and a visible spectrophotometer.

Two Dionex® ion chromatographs are used for the analysis of sulfur dioxide, nitrite, nitrate, phosphate, sulfate, nitrogen, silica, and other cations and anions. These instruments are used regularly for air/industrial hygiene studies and water quality studies.

The measurement of total organic halides is accomplished with a Dohrmann DX-20 total organic halide analyzer.

Hunter/ESE maintains a state-of-the-art radiation-counting laboratory and a wet laboratory reserved specifically for radiochemical analysis. In-house instrumentation includes a gamma-ray spectrometer consisting of a 3- by 3-inch sodium-iodide scintillation detector housed in a 4-inch steel shield and coupled to a 1,024-channel pulse-height analyzer; a Tennelec gas-flow-proportional, low-background alpha/beta counting system with a cosmic ray guard detector surrounded by a 4-inch shield of low-background lead bricks; a radon gas counting system consisting of a Ludlum radon flask photomultiplier tube coupled to an amplifier-scalertimer; a thermoluminescence dosimeter; and a Geiger counter. Other instrumentation, including a GeLi gamma spectrometer and a liquid scintillation counter, is also available.

Supporting equipment available in Hunter/ESE's laboratories include nine analytical balances, a microbalance, hoods, hot plates, ovens, centrifuges, shaking devices, and laboratory glassware necessary for all aspects of environmental analytical chemistry. Specific glassware includes 200 Kuderna-Danish evaporative concentrators, 10 vacuum rotary evaporators, 80 separatory funnels (Teflon®, glass), flasks, beakers, and graduated cylinders.

1.2 ANALYTICAL DATA SYSTEMS

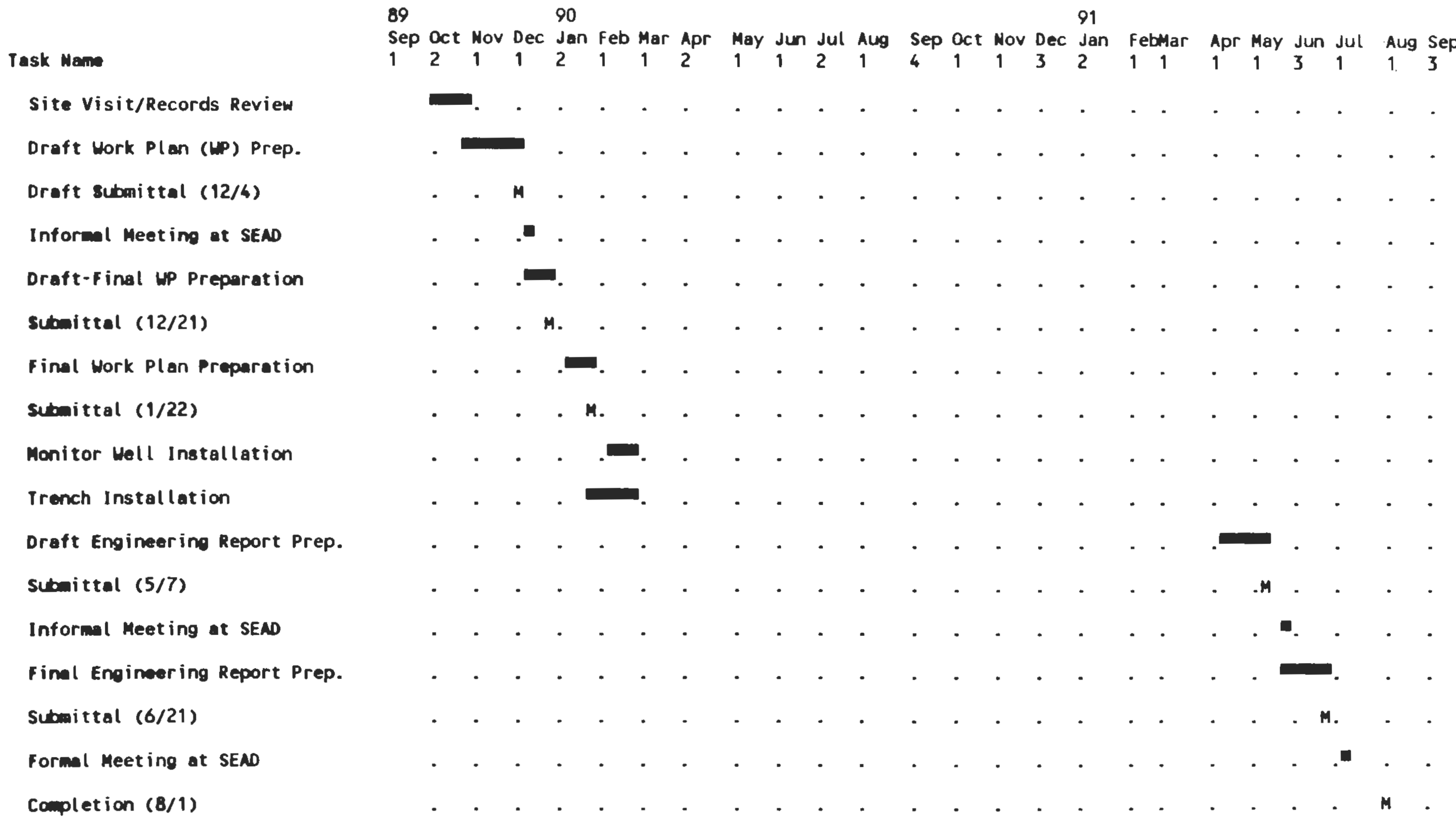
Due to the increasing volume and complexity of the analyses performed by Hunter/ESE, a data management system [Chemical Laboratory Analysis and Scheduling System (CLASS)] was developed for handling and reporting data obtained both onsite and in the laboratory for industrial plant surveys. Upon completion of sampling and analytical work, a computer printout is generated for each plant. A concise format is used to present analytical results, which greatly enhances the ability to work with the data and minimizes the potential for errors inherent in repetitive manual handling of large databases.

The Sample Control Center supervises the use of Hunter/ESE's central data system in the Chemistry Department. Members of this group interact with the Computer Services Group of Hunter/ESE, which serves all units of the organization by providing data processing support in the following areas: systems analysis, systems design, software development, data entry, and overall management of data processing functions. The Computer Services Group consists of a highly trained staff of computer professionals with expertise in FORTRAN, BASIC, PL/l, APL, COBOL, statistical packages, computer mapping programs, data communications, and database management systems.

Hunter/ESE has used its computerized data management systems to support environmental surveys performed for both Corps of Engineers Toxic and Hazardous Materials Agency (CETHAMA) and U.S. Army Corps of Engineers (USACE) Mobile District. During limnological surveys for USACE, Hunter/ESE was authorized to access the U.S. Environmental Protection Agency (EPA) storage and retrieval (STORET) system directly by means of the Hunter/ESE computer system to enter and retrieve chemical water and sediment quality data and in situ water quality measurements. Hunter/ESE has also developed programs and directly accessed the USATHAMA Installation Restoration Data Management System (IRDMS) to support environmental survey efforts at several Army installations. This effort involves computer linkage via acoustical hookup to transmit, recall, and validate chemical and physical files, station or site location files, and field drilling files.

1.3 PROJECT SCHEDULE

The project schedule is presented in Figure 1-2. The completion date for the installation of the trench is estimated to be February 23, 1990. This date assumes that government comments on the draft-final work plan (WP) will be received no later than January 8, 1990. If this date is missed, the schedule for mobilization and construction could slip, resulting in a slippage of the trench completion date. Additionally, full cooperation by all parties for short review periods and timely decisions will be required to meet both the overall and interim deadlines.



gure 1-2
ROJECT SCHEDULE

JRCE: HUNTER/ESE, 1989.

2.0 SAMPLING

The sampling procedures described in this plan are considered to be Hunter/ESE's field sampling standard operating procedures (SOPs). The procedures are based on the following sources:

1. EPA SOP and QA manual for Region IV (EPA, 1986),
2. Florida Department of Environmental Regulation (FDER) Supplement A to EPA's SOP and QA manual (FDER, 1981),
3. EPA's Manual of Ground Water Sampling Procedures (EPA, 1981),
4. EPA's Procedures for Handling and Chemical Analysis of Sediment and Water Samples (EPA, 1981),
5. USACE's "Sample Handling Protocol for Low, Medium, and High Concentration Samples of Hazardous Waste" (October 1986), and
6. Hunter/ESE division managers and regional office managers.

Critical objectives for each field team member are to:

1. Collect a sample that is representative of the matrix being sampled, and
2. Maintain sample integrity from the time of sample collection to receipt by the laboratory (see Section 2.5).

All field notes will be recorded in indelible ink on standard forms in bound notebooks. A sufficient supply of blank paper will also be added to record notes not included in the forms. A Daily Field Trip Log form (Figure 2-1) will be completed by the field team leader. This form is signed and dated on a daily basis. Significant events occurring during the day are reported to the

HUNTER ENVIRONMENTAL SERVICES, INC.

DAILY FIELD TRIP LOG

Sub/Project Number and Title: ____________________

Date: ________ ________ ________ ________ Page ______ of ______
Day of Wk. Mo. Day Year

Purpose of Trip: ____________________

Field Team Members: ____________ ____________
(Names and Initials) ____________ ____________
____________ ____________

Contacts: ____________ ____________

Work Completed This Date: ____________________

Work Remaining To Be Done: ____________________

Team Leader Signature: ____________ Date: ____________

Route To (In Order Listed): 1) Group Leader ________, 2) Dept. Manager ______
3) ☐ Other ________, 4) Dept. File

cc: Sub/Project Manager, Author (Team Leader), Project File

Figure 2-1
DAILY LOG FORM

SOURCE: HUNTER/ESE, 1988.

HunTER/ESE

project manager at the conclusion of each day's activities. Daily communication is essential to assure that timely corrective actions can be implemented, if necessary. Two calibration forms are standard for corporate use and must be employed by all divisions/regional offices (see Section 5.1). All forms must provide a place for the field team member to sign and date the entries. All field notes must be reviewed by the project manager. Approval of these notes must be documented by the project manager by either signing each field page or stating that the notes were reviewed.

Groundwater and soil sampling locations and analytical parameters were selected by USACE Huntsville District to address concerns regarding contamination in suspect areas. These sampling locations and parameters are identified in the following subsections.

2.1 SELECTION OF SAMPLING LOCATIONS

Three separate sampling and analysis plans are required to accommodate Tasks G-4, G-5, and G-6:

Task G-4: Soil Characterization,
Task G-5: Dewatered Groundwater Characterization, and
Task G-6: Treatment System Monitoring.

The soil and dewatered groundwater characterization tasks involve the sampling and analysis of soils and groundwater removed during the excavation of the treatment trench to determine if the media are hazardous waste as defined by federal [Resource Conservation and Recovery Act (RCRA)] regulations. Treatment system monitoring involves the periodic sampling and analysis of groundwater collected from the 10 monitor wells installed around the trench to determine the effectiveness of the treatment trench in the removal of volatile chlorinated organics. Sampling locations, number and types of samples, sample collection methods, and analyses to be performed are described in the following sections.

2.1.1 SOILS

Excavated soils will be stored within the temporary waste storage area (Figure 2-2). One round of sampling will be performed to determine if the soils must be disposed as hazardous waste. In addition, a background soil sample will be collected from an uncontaminated area, located away from the trench, as shown in Figure 2-3.

2.1.2 DEWATERED GROUNDWATER

Groundwater removed during trench construction will be temporarily stored in a 21,000-gallon Frac-tank. At the completion of dewatering activities or the filling of the tank to capacity, whichever occurs first, the contents of the tank will be sampled. The Statement of Work specifies that two rounds of sampling will be conducted. If the quantity of groundwater removed does not exceed the capacity of one Frac-tank, a second round of sampling will not be necessary. However, if the quantity does exceed the capacity, the second round of sampling will be required. Sampling beyond two rounds will be considered additional scope of work and not covered under the existing contract.

2.1.3 MONITOR WELLS

Treatment system monitoring will consist of the periodic sampling of 10 monitor wells located on both sides of the treatment trench. The locations of these wells are shown in Figure 2-4.

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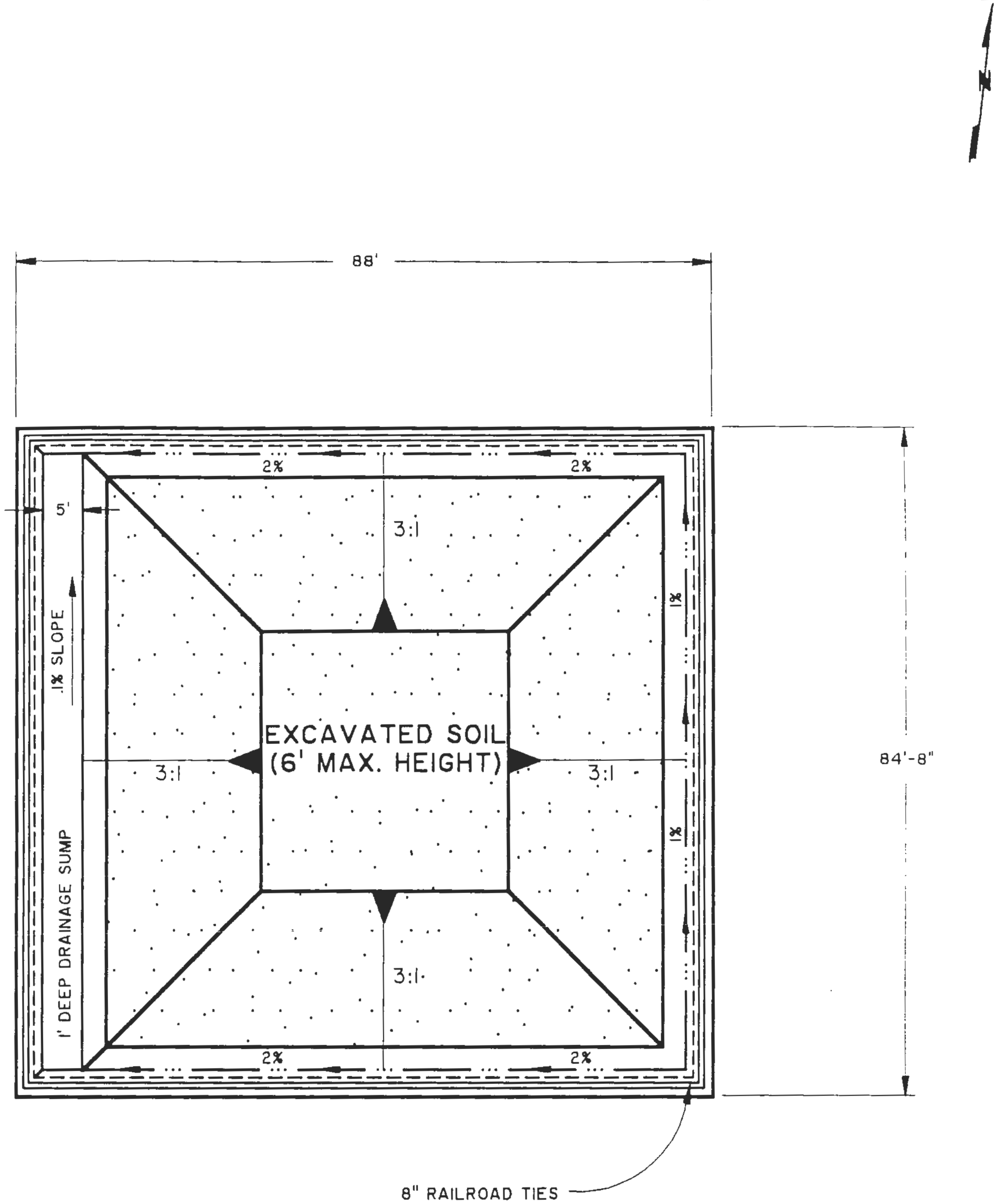
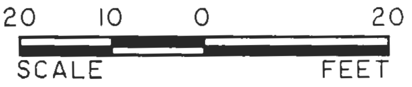




LEGEND

—— 2% ——◄ DRAINAGE CENTERLINE, FLOW DIRECTION AND SLOPE

Figure 2-2

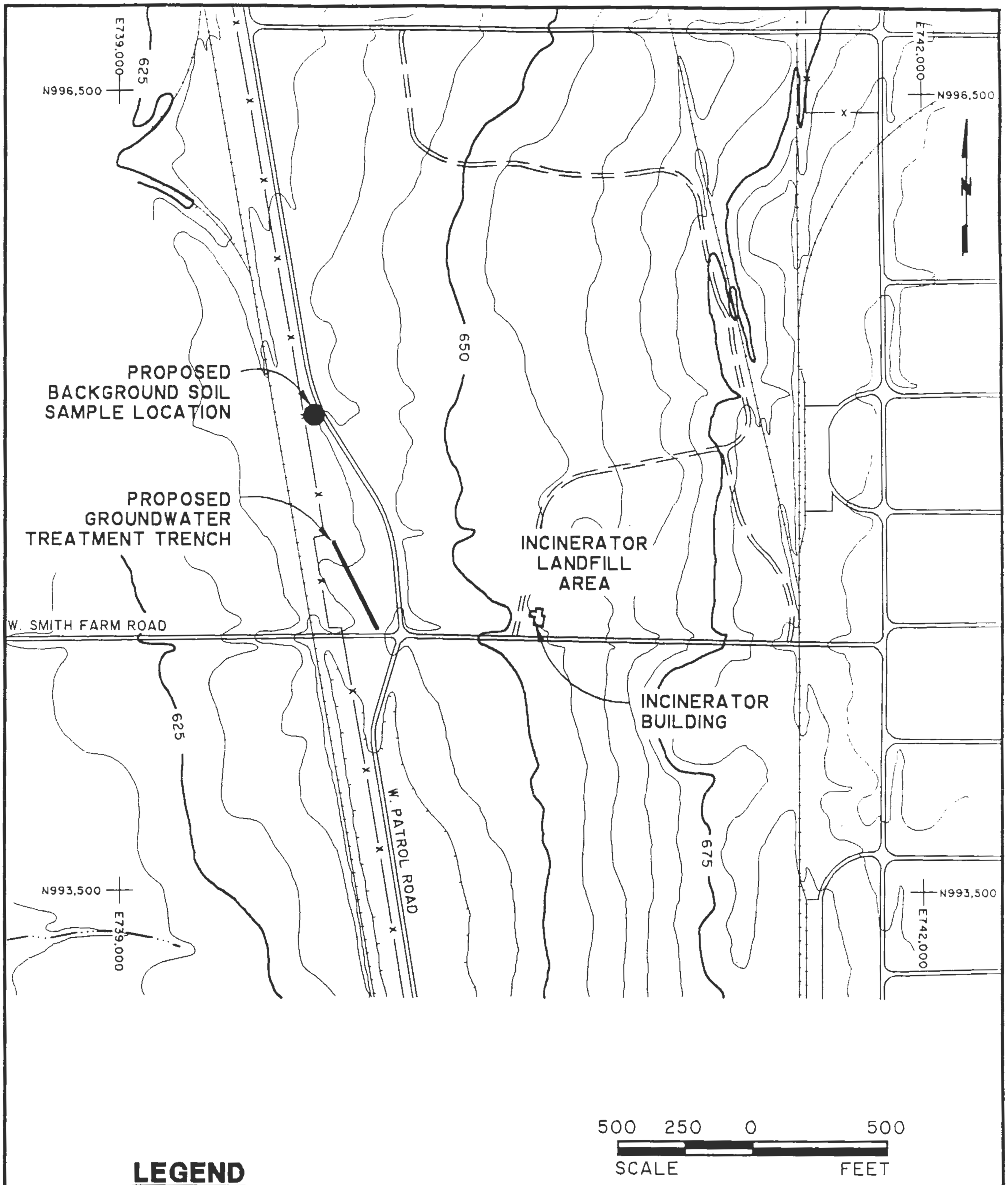
EXCAVATED SOIL STORAGE AREA
SENECA ARMY DEPOT

PROJECT NO: 3902036-0240-3130
DRAWN BY: JAD 11/89
CHECKED BY: JM 11/89
SUBMITTED BY: DMM

REV NO.	DESCRIPTION	BY	DATE

CORPS OF ENGINEERS
HUNTSVILLE DIVISION

HunTer/ESE



LEGEND

—— ··· ——	DITCH
–x ——x –	FENCE
┼┼┼┼┼	RAILROAD
═══	ROADS AND PARKING
┬┬┬┬	DEPRESSION CONTOUR
═ ═ ═	TRAIL OR EARTH ROAD
—625 —	TOPOGRAPHIC CONTOUR

Figure
2-3

PROPOSED BACKGROUND
SOIL SAMPLE LOCATION
SENECA ARMY DEPOT

PROJECT NO.: 3902036-0240-3130
DRAWN BY: DRP 11/89
CHECKED BY: RPV 11/89
SUBMITTED BY: DMM

REV NO.	DESCRIPTION	BY	DATE

CORPS OF ENGINEERS
HUNTSVILLE DIVISION

HunTer/ESE

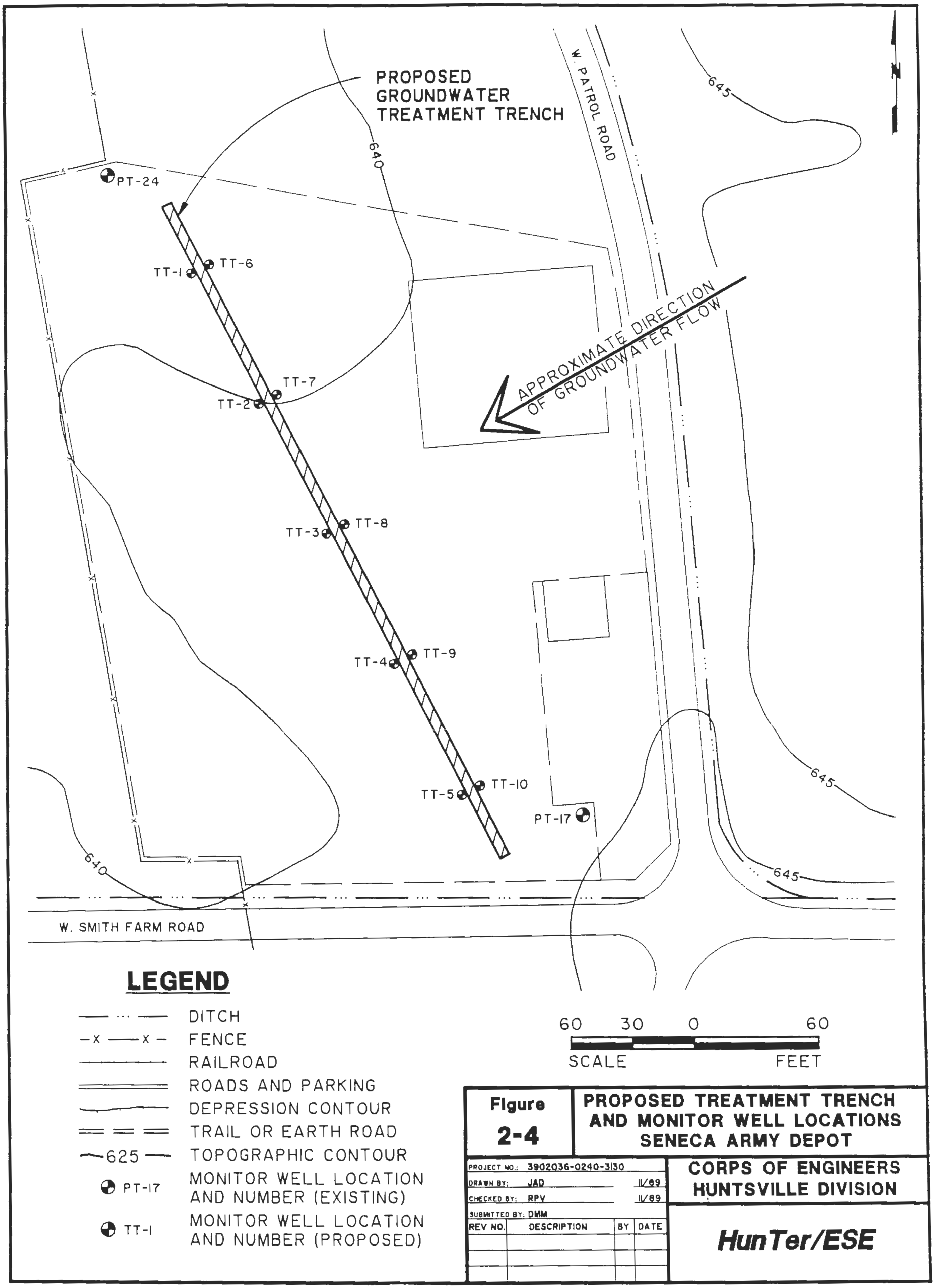


Figure 2-4

PROPOSED TREATMENT TRENCH AND MONITOR WELL LOCATIONS SENECA ARMY DEPOT

PROJECT NO.: 3902036-0240-3130
DRAWN BY: JAD 11/89
CHECKED BY: RPV 11/89
SUBMITTED BY: DMM

REV NO.	DESCRIPTION	BY	DATE

CORPS OF ENGINEERS HUNTSVILLE DIVISION

HunTer/ESE

2.2 SAMPLES TO BE COLLECTED

2.2.1 SOIL AND FIELD CONTROL SOIL SAMPLES

The number and types of samples to be collected are shown in Table 2-1. Sampling will consist of the collection of four separate samples, each of which represents a composite of two samples. The surface of the waste pile will be marked off or subdivided into eight equal areas, to be designated as Sections 1 through 8. From each section, a column of soil from 0 to 2 ft into the pile will be collected with a hand auger. Collected soils from two adjacent sections will be mixed together, according to the following scheme, to form four composite samples:

Section Samples		Composite Samples
1 plus 2	to form:	SSA1
3 plus 4		SSA2
5 plus 6		SSA3
7 plus 8		SSA4

To satisfy QA/QC requirements, Sample SSA1 will be split into three equal portions. One portion will serve as a field sample (SSA1), the second as a field duplicate (SSA1Dup), and the third as an interlaboratory duplicate (SSA1DupMRDL) to be forwarded to the USACE Missouri River Division Laboratory (MRDL). Aliquots of samples SSA1 through SSA4 will be preserved and submitted for analysis.

In addition to sampling the pile, a background soil sample, SSBG1, will be collected from the area shown on Figure 2-3. This sample will be collected

Table 2-1. Soil Characterization--Number of Samples To Be Collected and Analyzed, Task G-4

Type/Location	Field Samples	QA/QC Samples		Totals
		QA Split	QC Split	
Waste pile	SSA1	SSA1Dup MRDL	SSA1Dup	3
	SSA2	--	--	1
	SSA3	--	--	1
	SSA4	--	--	1
Background	SSBG1	--	--	1
TOTAL	5	1	1	7

Note: -- = no samples.

Source: Hunter/ESE, 1989.

with a hand auger from a depth of 0 to 2 ft. The collected column of soil will be well mixed and a portion preserved and submitted for analysis.

2.2.2 DEWATERED GROUNDWATER AND FIELD CONTROL SAMPLES

The number and types of samples to be collected are shown in Table 2-2. As indicated previously, more than one round of sampling may be required depending on the quantity of water removed during excavation. Nonetheless, the sampling scheme will be the same for each round, including QA/QC requirements.

A round of sampling will consist of collecting a single grab sample from the Frac-tank. To meet QA/QC requirements, the sample will be divided into three equal portions. One portion will serve as the field sample, the second as a field duplicate, and the third as an interlaboratory duplicate to be forwarded to USACE MRDL. In addition to the field and duplicate samples, a field rinsate blank will be prepared and split into two equal portions. One portion will be submitted along with the field and field duplicate samples to the Hunter/ESE laboratory while the other portion will be submitted along with the interlaboratory field duplicate to MRDL.

2.2.3 MONITOR WELLS AND FIELD CONTROL SAMPLES

The number and types of samples to be collected are shown in Table 2-3. Four rounds of sampling will be conducted: one immediately following the installation of the wells and the other three occurring at 4, 8, and 12 months later. The sampling scheme for each round will be identical.

Table 2-2. Dewatered Groundwater Characterization--Groundwater Samples To Be Collected and Analyzed, Task G-5

		Hunter/ESE's QC Splits		MDRL's QA Splits		
Type/Location	Field Samples	Sample Blank Rinsate	Field Sample Split	Field Sample Split	Sample Blank Rinsate	Total Samples
Round 1	1	1	1	1	1	5
Round 2	1	1	1	1	1	5
TOTAL	2	2	2	2	2	10

Source: Hunter/ESE, 1989.

Table 2-3. Treatment System Monitoring--Monitor Well Groundwater Samples To Be Collected and Analyzed, Task G-6

		Hunter/ESE's QC Splits		MRDL's QA Splits		
Type/Location	Field Samples	Sample Blank Rinsate	Field Sample Split	Field Sample Split	Sample Blank Rinsate	Total Samples
Round 1	10	1	1	1	1	14
Round 2	10	1	1	1	1	14
Round 3	10	1	1	1	1	14
Round 4	10	1	1	1	1	14
TOTAL	40	4	4	4	4	56

Source: Hunter/ESE, 1989.

A round of sampling will consist of collecting one groundwater sample from each of 10 monitor wells located as shown in Figure 2-4. To satisfy QA/QC requirements, the sample collected from one of the wells (to be determined) will be split into three equal portions. The first portion will serve as the field sample, the second as the field duplicate, and the third as an interlaboratory field duplicate to be forwarded to USACE MRDL. In addition to the field and duplicate samples, a field rinsate blank will be prepared and split into two equal portions. One portion will be submitted along with the field and field duplicate samples to the Hunter/ESE laboratory while the other portion will be submitted along with the interlaboratory field duplicate to MRDL.

2.3 SAMPLE COLLECTION METHODS AND EQUIPMENT

Prefield briefing meetings/conference calls will be held prior to any field investigations involving the collection of laboratory samples. These meetings are intended to assure that all necessary departments are aware of the field activity and can plan accordingly.

The project manager must schedule a meeting with at least the analytical task manager and project QA supervisor. A Field Trip Plan Approval form (Figure 2-5) is filled out, and approval is documented by the signatures of the personnel on the form.

Priority pollutant samples (or any trace contaminant samples) will be analyzed in the parts per billion (ppb) range for many compounds; therefore, extreme care must be exercised to prevent contamination of samples. When volatile organic compounds (VOCs) are included for analysis, field team members must

HUNTER ENVIRONMENTAL SERVICES, INC.

Project No. ____________

FIELD TRIP PLAN APPROVAL FORM

Project Name: ____
Field Trip Site: ____
Field Trip Responsibility(Subproj.or Proj.Mngr.) ______________________
Field Team Leader: ____
Laboratory Coordinator: ____
Field Team Members:

____________________ ____________________
____________________ ____________________
____________________ ____________________
____________________ ____________________

SCHEDULING INFORMATION:

Field Trip Briefing Mtg ______________ (Date) ______________ (Time)
Departure ESE ______________ (Date) ______________ (Time)
Site Arrival ______________ (Date) ______________ (Time)
Site Departure ______________ (Date) ______________ (Time)
Arrive ESE ______________ (Date) ______________ (Time)

PLANNING INFORMATION:

The following information must be attached (check to indicate):

__________ Sampling and Shipping Schedule; Lab/Field Contacts Established
__________ Sampling Location Layout
__________ Samples to be Collected and Fraction
__________ List of all Parameters to be Measured On-Site
__________ List of Field Equipment Requested

APPROVALS:

____________________ ____________________
Laboratory Coordinator (Date) Proj.or Subproj. Manager (Date)

____________________ ____________________
Field Team Leader (Date) QA Manager (Date)

REMARKS: ____
____
____
____
____

cc:Project Director / Project Manager

Signature ______________________ Date ______________________

Figure 2-5
FIELD TRIP APPROVAL FORM

SOURCE: HUNTER/ESE, 1989.

HunTER/ESE

use caution to assure that the samples are not exposed to the atmosphere unnecessarily.

The following precautions should be taken when sampling for all trace contaminants:

1. A clean pair of new, disposable gloves is worn for each new sampling station.
2. When possible, samples should be collected from stations that are the least contaminated (i.e., background) followed by stations of increasing order of contamination.

When VOCs are being sampled, the following additional precautions should be taken:

1. All sample bottles and equipment must be kept away from fuels and solvents. When possible, gasoline (used in generators) should be transported in a different vehicle from bailers, sample bottles, purging pumps, Kemmerers, etc. If possible, one person should be designated to handle samples, and another person should work generators and gas the truck. If this arrangement is not feasible, disposable gloves should be worn for each activity and then disposed of. Care must be taken not to spill any fuels on clothing.
2. All sampling equipment should be made of Teflon®, glass, or stainless steel which is decontaminated according to Section 2.3.1. Other materials such as plastic may contaminate samples with phthalate esters which interfere with many analyses.
3. Volatile water samples must be taken so that no air passes through the sample (to prevent volatiles from being stripped from the

samples); the bottles should be filled by slowly running the sample down the side of the bottle until there is a convex meniscus over the neck of the bottle; the Teflon® side of the septum (in cap) should be positioned against the meniscus, and the cap screwed on tightly; the sample should be inverted, and the bottle tapped lightly. The absence of an air bubble indicates a successful seal; if a bubble is evident, the cap should be removed, more sample added, and the bottle resealed.

4. Extra Teflon® seals should be available, because the seals are difficult to handle and might be dropped. Dropped seals should be considered contaminated and not reused. When replacing seals or if seals become flipped, care must be taken to assure that the Teflon® seal faces down.
5. Volatile soil samples should be collected with as little air space as possible (to prevent loss to the headspace).
6. Volatile compounds (including inorganics such as sulfide, chlorine, etc.) should not be composited, due to the potential for loss when homogenizing the sample.
7. Oil and grease fractions should not be composited, due to the possible loss of compounds on intermediate sample containers.

2.3.1 PREVENTION OF CROSS CONTAMINATION

2.3.1.1 Laboratory Cleaning Procedures

Hunter/ESE intends to use commercially cleaned sample containers whenever possible (except as noted). Table 2-4 summarizes the application of these cleaning procedures. Any containers prepared in-house (when necessary) will meet these or equivalent specifications. Sample-kit containers are stored in

Table 2-4. Sample Container Cleaning Procedures Within the Laboratory

Analysis/Parameter	Container Type	Matrix	Fraction Code*	Cleaning Protocol
Organic extractables include GC and GC/MS	Glass jar with Teflon®-lined cap	Water	MS, EC, HB, UP, NP, LC, W, Z	A
	Glass jar with Teflon®-lined cap	Soil/Sediment	SS	A
Organic purgeables including GC and GC/MS analyses	Glass septum vial with Teflon®-lined septum	Water	V, VP, ED, AL, XP	B
	Wide-mouth glass jar with Teflon®-lined cap	Soil	SV	B
Metals	Linear polyethylene cubitainer with polyethylene cap	Water	N	C
	Glass jar with Teflon®-lined cap (or new plastic)	Soil/ Sediment	SS	A

Note: GC = gas chromatography/high performance liquid chromatography.
GC/MS = gas chromatography/mass spectrography.
Glass = amber for all organic water analyses.

*Fraction codes are in the labeling of sample containers as an abbreviated notation of sample container preparation, preservation, and analyses that will be performed from that container.

Table 2-4. Sample Container Cleaning Procedures Within the Laboratory (Continued, Page 2 of 2)

Cleaning Protocol A	B	C	Specifications
X	X	X	Wash with hot tap water using laboratory-grade, nonphosphate detergent.
X	X	X	Rinse 3 times with tap water.
X		X	Rinse with 1:1 nitric acid (reagent-grade nitric acid diluted with ASTM Type 1 DI water).
X	X	X	Rinse 3 times with ASTM Type 1 DI water.
X			Rinse with pesticide-grade methylene chloride using 20 mL per 64-oz bottle, 10 mL per 32- or 16-oz bottle, or 5 mL per 8- or 4-oz bottle.
X	X		Oven-dry at 105° to 125°C for 1 hour.
		X	Invert and air-dry in contaminant-free environment.

Source: Hunter/ESE, 1989.

clean, dust-free areas segregated from the analytical laboratory and solvent/reagent storage areas. Occasional audits of containers to document freedom from contaminants will be performed to supplement the various blanks that are frequently and routinely analyzed to provide similar QC data. Deionized (DI) water is defined as Hunter/ESE well water that has been treated by passing through a softener, carbon resin column, reverse osmosis unit, ion-exchange resin, and DI mixed-bed tank. The water contains no detectable (Hunter/ESE's routine detection limits) heavy metals or inorganic compounds of analytical interest and is relatively free of organic compounds. The water is acceptable for the initial rinsing of laboratory glassware and field equipment. Ultrapure water, used for equipment blanks, is defined as Hunter/ESE well water that has been additionally treated through a Barnstead carbon treatment system and contains no organic compounds of analytical interest above Hunter/ESE's routine detection limits. Organic-free water, used for trip blanks, is prepared by purging American Society for Testing and Materials (ASTM) Type 2 water at 60°C for 24 hours with Grade 6 helium.

DI water other than Hunter/ESE-treated water may be used if it is of documented equivalent quality. Use of commercially deionized or distilled water is discouraged because it often contains phthalate esters.

2.3.1.2 Field Decontamination

A major concern in decontamination of field equipment is the choice of solvent. The standard Hunter/ESE decontamination solvent shall be pesticide-grade isopropanol. If a more polar solvent is required for a particular investigation, pesticide-grade methanol may be used if written safety procedures covering the handling and use of methanol have been approved by the safety officer and included in the work plan or project QA form. Use of other solvents, such as acetone, hexane, and petroleum ether, must be approved by the project QA supervisor. Use of acetone is generally discouraged because residues of acetone may be detected in samples that are being analyzed for acetone. Hexane and petroleum ether are not miscible with water, and, therefore, are effective only if the equipment is dry. The use of any solvent other than pesticide-grade isopropanol for field decontamination must be justified, and its use must be documented in the field notes. Disposal of solvent rinses must be performed in an approved manner (evaporated onsite or containerized for disposal through a disposal contract depending on the volume). The following decontamination procedures are for equipment that has contact with sample matrices:

1. Organic compounds and trace metal analyses:
    a. Clean with Liquinox® and tap water (a higher grade of water always may be substituted for tap water), using a brush, if necessary, to remove particulate matter and surface films;
    b. Rinse thoroughly with tap water;
    c. Rinse thoroughly with DI water;
    d. Rinse twice with pesticide-grade isopropanol;
    e. Allow to air-dry; and
    f. For overnight storage, wrap in new aluminum foil, if appropriate, to prevent contamination.
2. Groundwater purging and monitoring equipment:
    a. Rinse elevation tapes and slugs (slug testing) with tap water followed by DI water, and place in a polyethylene bag to prevent contamination during storage or transit;
    b. Rinse the downhole well tubing, hoses, and submersible pumps with copious amounts of tap water followed by DI water; and

   c. If the inside of the tubing/hoses cannot be rinsed adequately, tap water and DI water should be pumped through the tubing.

3. Drilling tools:
   a. All drilling equipment will be steam cleaned prior to shipment to a site; and
   b. Between borings, drilling tools will be steam cleaned using tap water to remove traces of soil, rock, or other contaminants. In addition, downhole tools will be rinsed with DI water followed by pesticide-grade isopropanol and air-dried.
4. Classic water quality parameters using ISCO® samplers, Kemmerers, dissolved oxygen samples, dredges, etc.:
   a. Rinse with DI water;
   b. Remove deposits of material/sediment with a brush, if necessary; and
   c. Rinse with water from the next sampling location.
5. Automatic samplers--Follow EPA's standard cleaning procedures for automatic sampling equipment.
6. Field filtration assembly for filtering samples in the field to determine the dissolved fraction of organic compounds and/or metal analyses:
   a. Wash filtration apparatus (filter holder and filtrate flask) with Liquinox® and tap water,
   b. Rinse thoroughly with DI water,
   c. Rinse with 0.5-percent nitric acid solution,
   d. Rinse thoroughly with tap water,
   e. Rinse thoroughly with DI water,
   f. Rinse twice with pesticide-grade isopropanol,

g. Allow to air-dry, and

h. Rinse with tap water immediately after filtering the sample.

2.3.2 SAMPLE COLLECTION PROCEDURES

2.3.2.1 Waste Pile Sampling

The following methods will be used for collection of soil samples from the waste pile:

1. Debris, rocks, twigs, and vegetation will be removed from the sample area.
2. The surface of the pile will be subdivided into eight equal sections. From each section, four individual samples will be collected and composited to form one sample per section.
3. Each sample will be collected with a soil auger driven 2 ft into the pile. The four samples retrieved from each section will be combined into a stainless steel bowl and well mixed to form a composite sample for that section. Each individual sample location will be marked with a stake. Sample size, location, and time of collection will be recorded in the field logbook and on a sample logsheet. A new or freshly decontaminated auger will be used for each section sampled.
4. The composite samples from each two adjacent sections will be combined into one bowl, as described in Section 2.2.1, to form a total of four composites.
5. A fraction of sample will be removed from each of the eight stainless steel bowls and labeled in accordance with the sample and analytical requirements outlined in Tables 2-1 and 2-5.

Table 2-5. Soil Characterization--Required Analyses, Approved EPA Methods, and Estimated Quantities, Task G-4

Type/Location	Method Description	Method	Field Samples	QA/QC Samples*
Waste Pile	B/N/A	8270	4	1/1
	Volatile organics	8240	4	1/1
	Metals+	6010	2	1/1
	Arsenic	7060	2	1/1
	Selenium	7740	2	1/1
	Mercury	7470	2	1/1
Background	B/N/A	8270	1	0/0
	Volatile organics	8240	1	0/0
	Metals+	6010	1	0/0
	Arsenic	7060	1	0/0
	Selenium	7740	1	0/0
	Mercury	7470	1	0/0

* QC samples to be analyzed by Hunter/ESE, QA samples by MRDL.

+ Barium, cadmium, chromium, lead, antimony, copper, nickel, thallium, zinc, and beryllium.

Source: Hunter/ESE, 1989.

6. Samples will be stored in ice and shipped for analysis in accordance with Tables 2-1 and 2-5.

2.3.2.2 Dewatered Groundwater Sampling

The following methods will be used for collection of samples from the Frac-tank:

1. Samples will be collected through a manhole opening on top of the Frac-tank.
2. Samples will be obtained using a decontaminated Teflon® bailer. Samples collected for volatiles analysis will be obtained in a manner that will minimize loss of volatiles.
3. Samples will be placed in laboratory-prepared sample containers, labeled, packed in ice, and shipped for analysis in accordance with the requirements outlined in Tables 2-2 and 2-6.
4. All sampling equipment will be decontaminated between samples, as specified in Section 2.3.1.
5. Sampling logs will record sample date, location, and amount collected.

2.3.2.3 Monitor Wells

Monitor wells will be sampled in accordance with the following methods:

1. Prior to groundwater sample collection, water levels in all accessible monitor wells will be measured relative to the top of the well casing. Measurement will be by the U.S. Geological Survey (USGS) wetted-tape method using a decontaminated steel tape.
2. A plastic ground cloth will be placed beneath all sampling equipment during well purging and sampling to prevent contamination. Well

Table 2-6. Dewatered Groundwater Characterization--Required Analyses, Approved EPA Methods, and Estimated Quantities, Task G-5

Type/Location	Method Description	Method	Field Samples	QA/QC Samples*
Round 1	B/N/A	8270	1	2/2
	Volatile organics	8240	1	2/2
	Metals+	6010	1	2/2
	Arsenic	7060	1	2/2
	Selenium	7740	1	2/2
	Mercury	7470	1	2/2
Round 2	B/N/A	8270	1	2/2
	Volatile organics	8240	1	2/2
	Metals+	6010	1	2/2
	Arsenic	7060	1	2/2
	Selenium	7740	1	2/2
	Mercury	7470	1	2/2

* QC samples to be analyzed by Hunter/ESE, QA samples by MRDL.
+Barium, cadmium, chromium, lead, antimony, copper, nickel, thallium, zinc, and beryllium.

Source: Hunter/ESE, 1989.

purging will consist of pumping or bailing at least 3 to 5 submerged well volumes and will continue until the pH, temperature, and specific conductivity have stabilized. The pH, temperature, and specific conductivity will be measured with a Hydrolab model 4041 water quality surveyor, which will be calibrated onsite before and after each sampling day. If the well does not recharge fast enough to permit continuous pumping, the well shall be pumped dry at least twice, allowing for 80-percent recharge between pumping, and allowed to recharge before sampling. If a well does not recharge sufficiently to allow for a second well volume to be purged after 2 hours have elapsed, the well will be allowed to recharge enough to permit sampling.

3. After purging the well, the sampling team will change disposable gloves for sample collection. Samples will be obtained using a decontaminated Teflon® bailer. Groundwater samples collected for volatile analyses will be obtained in a manner that will minimize the loss of volatile compounds. The samples will be placed in laboratory-prepared sample containers. All sample containers will be labeled with a preprinted label, packed with ice, and shipped to the laboratory for analysis in accordance with Tables 2-4 and 2-7.
4. All sampling and well purging equipment will be decontaminated between samples, as specified in Section 2.3.1. Groundwater sampling logs will include onsite measurements of water quality (pH, specific conductance, and temperature), volume purged, method of purging, static water level, sample time and date, and fraction sampled. Chain-of-custody records will be maintained.

Table 2-7. Treatment System Monitoring--Required Analyses, Approved EPA Methods, and Estimated Quantities

Type/Location	Method Description	Method	Field Samples	QA/QC Samples*
Round 1	B/N/A	8270	10	2/2
	Volatile organics	8240	10	2/2
	Metals+	6010	10	2/2
	Arsenic	7060	10	2/2
	Selenium	7740	10	2/2
	Mercury	7470	10	2/2
Round 2	B/N/A	8270	10	2/2
	Volatile organics	8240	10	2/2
Round 3	B/N/A	8270	10	2/2
	Volatile organics	8240	10	2/2
Round 4	B/N/A	8270	10	2/2
	Volatile organics	8240	10	2/2

* QC samples to be analyzed by Hunter/ESE, QA samples by MRDL.
+ Barium, cadmium, chromium, lead, antimony, copper, nickel, thallium, zinc, and beryllium.

Source: Hunter/ESE, 1989.

5. Purge water will be collected in properly labeled 55-gallon drums and temporarily stored onsite for subsequent disposal by the Army in accordance with local, state, and federal (RCRA) regulations.

2.3.2.4 Air Monitoring

This air monitoring program describes the type of equipment, frequency, and location of measurements to be performed during the excavation phase of a 15-ft deep trench.

Due to the ionization potential of the primary site contaminants of concern, an HNU photoionizer equipped with an 11.7 electronvolt (eV) lamp will be used for screening the air to determine the total concentration of organic and inorganic vapors and gases with an ionization potential of less than 11.7 eV in the air. The limitations of this instrument include: (1) it does not respond to methane or hydrogen cyanide; (2) it cannot be immersed in water; and (3) it can be used as a real-time screening device only.

The HNU analyzer functions upon the principle of photoionization for the detection of volatile compounds in the air. The sensing device consists of a sealed UV light source that emits photons that are energetic enough to ionize many trace compounds (particularly organics) but does not ionize major components of air. When a positive potential is applied to one electrode in the chamber adjacent to the UV lamp, a field created drives any ions formed by absorption of the UV light to the collector electrode where the current (proportional to concentration) is measured. The useful range for sensitivity is 0.1 parts per million (ppm) to 2,000 ppm.

After the instrument is zeroed with "clean" air or zero-grade air, an HNU calibration gas standard is connected and the span adjustment made according to standard specifications. Typical span settings for chlorinated hydrocarbons are between 5 and 9.

Calibration checks will be performed at the start of each work period, the end of the day, and any time erratic readings occur.

During the excavation phase of this project, measurements will be taken as follows: upon initial approach to the excavation area; continuously during excavation activities; in the vicinity of the trench; from each bucket of soil excavated from the trench; and through periodic monitoring of the excavated soil piles. The frequency of measurements for the trench will be at the beginning of each work period and at the end of the day. Monitoring during the excavation with the backhoe will take place continuously with a screening of each excavated bucket load. Daily measurements of the excavated soil piles will be made to evaluate fugitive organic emissions.

Measurements will be made within 1 ft of the source and in the breathing zone levels. Breathing zone refers to the area from the top of the shoulders to the top of the head. Consult the Safety, Health, and Emergency Response Plan (SHERP) for personal protective equipment and health precautions.

If ambient levels are greater than 50 ppm on the HNU analyzer, personal and perimeter air samples may become necessary. Monitoring of methodology for the collection of halogenated hydrocarbons uses a coconut shell charcoal tube [100 milligrams (mg)/50 mg] for a maximum air volume of 15 liters (L) at a sampling rate of 0.03 L per minute for an 8-hour time weighted average (TWA) sample [National Institute for Occupational Safety and Health (NIOSH) Method 1003]. The collection tubes will be submitted to an AIHA-accredited laboratory for analysis.

Air monitoring during the installation of groundwater monitor wells will consist of measurements taken: (1) at the borehole during penetration and removal of the coring tube; (2) during cleaning of the drilling equipment; and (3) at 10-minute intervals when the hole is open. Measurements will be made within 1 ft of the opening of the hole and in the breathing zone, using the HNU analyzer.

2.4 SAMPLE CONTAINERS AND PRESERVATION TECHNIQUES

The field team leader is responsible for proper sampling, labeling of samples, preservation, and shipment of samples to the laboratory to meet required holding times. Table 2-8 identifies the proper containers, preservation techniques, and maximum holding times established by EPA (SW-846, Third Edition, September 1986).

Trial preservation may be necessary for concentrated hazardous/industrial wastes to assure adequate preservation. If reactions of these wastes are suspected, the volume of preservation added should be recorded in the field notes. For example, acidification of some wastes may liberate toxic gases (e.g., cyanide gas) or result in foaming. In such cases, preservation should be omitted, samples should be shipped to the laboratory as soon as possible, and appropriate comments must be included on the sample logsheet.

Table 2-8. Containers, Preservation Techniques, and Holding Times

Measurement	Container[*]	Preservation Technique[+]	Maximum Holding Time[**]
<u>Waters</u>			
Metals	One 1-L polyethylene cubitainer	HNO_3 to pH <2	6 months (mercury 28 days)
Acid and base/neutral extractables	Two 1-L glass jar, Teflon®-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$[++]	7/40 days for waters[***] 14/40 days for soils
Purgeable compounds (including aromatics)	Four 40-mL amber-glass jar, Teflon®-lined septum cap (water)	Cool, 4°C, 0.008% $Na_2S_2O_3$[++] HCl to pH 2, no headspace	14 days
	One 2-oz amber-glass jar, Teflon®-lined cap (soil)	Cool, 4°C, no headspace	

Notes:
HCl = hydrochloric acid.
HNO_3 = nitric acid.
H_2SO_4 = sulfuric acid.
$Na_2S_2O_3$ = sodium thiosulfate.
L = liter.
mL = milliliter.

[*] Soil container for all measurements is an 8-ounce glass jar with Teflon®-lined lid.

[+] Sample preservation should be performed immediately upon sample collection. For composite samples, each aliquot should be preservec the time of collection. When use of an automatic sampler makes it impossible to preserve each aliquot, then samples may be preserved maintaining at 4°C until compositing and sample splitting are completed.

[**] Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held bef analysis and still considered valid. Samples may be held for longer periods only if the laboratory has data onfile to show that the speci types of samples under study are stable for the longer time.

[++] Used only in the presence of residual chlorine.

[***] 7/40 = 7 days from collection until completion of extraction; 40 days after extraction until completion of analysis.
14/40 = 14 days from collection until completion of extraction; 40 days after extraction until completion of analysis.

Source: Hunter/ESE, 1989.

With hazardous samples, it may be necessary to rinse the outer portion of sample containers with DI water prior to packaging for shipment. The latest U.S. Department of Transportation (DOT) procedures for shipment of environmental samples will be used in all cases. The quantity of acids or bases added as preservatives generally should not exceed 0.15 percent by weight, or the samples must be shipped as corrosives.

The quality of the preservation techniques and sampling containers is verified by running equipment blanks as described in Section 2.2.2.

2.5 SAMPLE IDENTIFICATION, TRANSPORTATION, AND CUSTODY

The primary objective of sample custody is to create an accurate, written, verified record that can be used to trace the possession and handling of the samples from the moment of collection until receipt by the laboratory. Adequate sample custody will be achieved by means of approved field and analytical documentation. A sign-in and sign-out sheet is provided at the laboratory.

A sample for this project is defined to be in someone's custody if:

1. It is in one's actual physical possession;
2. It is in one's view, after being in one's physical possession;
3. It is in one's physical possession and then locked or otherwise sealed so that tampering will be evident; or
4. It is kept in a secure area, restricted to authorized personnel only.

2.5.1 FIELD SAMPLE DOCUMENTATION

Field procedures will be designed to minimize sample handling and transfers. During sampling, the field crews will record the following information in field notebooks using indelible ink (Section 2.1):

1. The unique sample number as obtained from the sample label,
2. Source of sample (including name, location, and sample type),
3. Date and time of sample collection,
4. Preservatives used,
5. Name(s) of collector(s), and
6. Field data (pH, temperature, and specific conductance).

Each sample is identified by affixing the pressure-sensitive, gummed label produced by the laboratory data management prefield setup (PFS) program. Tags will be affixed to sample containers that will be sent to the USACE QA laboratory. The USACE QA laboratory will be notified of the arrival of samples at least 5 working days in advance. Each label has a unique combination of field group name and sequence number, a standardized sample preservation code (i.e., C for chilled, N for nitric acid), and the station identification (ID). Each label also has spaces for the field team to write in the date and time of sample collection, sampler's initials, and a new station ID if different from the original station ID. A new station ID may be necessary due to changes in field and/or sampling conditions that require substitution of sampling stations. All changes in station ID are clearly noted in permanent ink on the sample label and logsheet and must be approved by the project manager.

The sample container and the logsheets produced by the PFS program (see Figure 2-6) are placed in a transportation case and sealed with custody tape.

ENVIRONMENTAL SCIENCE & ENGINEERING *** FIELD LOGSHEET *** FIELD GROUP: FTA2W
PROJECT NUMBER PROJECT NAME: LAB COORD.

ESE #	SITE/STA	HAZ?	FTA2W FRACTIONS(CIRCLE)	DATE	TIME	PARAMETER LIST	H2O TEMP C	FIELD PH STD UNITS	SP COND UMHOS/CM
*1	CCFTA2-1		N O V V V VP VP VP VP W			CAPEW8			
*2	CCFTA2-2		N O V V V VP VP VP VP W			CAPEW8			
*3	CCFTA2-3		N O V V V VP VP VP VP W			CAPEW8			
*4	CCFTA2-4		N O V V V VP VP VP VP W			CAPEW8			
*5	CCFTA2-5		N O V V V VP VP VP VP W			CAPEW8			
*6	CCFTA2-6		N O V V V VP VP VP VP W			CAPEW8			
*7	CCFTA2-DUP		N O V V V VP VP VP VP W			CAPEW8			
*8	BLANK		N O V V V VP VP VP VP W			CAPEW8			

NOTE -CHANGE OR ENTER SITE ID AS NECESSARY; UP TO 9 ALPHANUMERIC CHARACTERS MAY BE USED
-CIRCLE FRACTIONS COLLECTED. ENTER DATE,TIME,FIELD DATA (IF REQUIRED), HAZARD CODE AND NOTES
-HAZARD CODES: I-IGNITABLE C-CORROSIVE R-REACTIVE T-TOXIC WASTE H-OTHER ACUTE HAZARD; IDENTIFY SPECIFICS IF KNOWN
-PLEASE RETURN LOGSHEETS WITH SAMPLES TO ESE

RELINQUISHED BY: (NAME/ORGANIZATION/DATE/TIME)	RECEIVED BY (NAME/ORGANIZATION/DATE/TI
1	
2	
3	

OTHER FIELD NOTES FOR FIELD GROUP FTA2W:

Figure 2-6
SAMPLE CHAIN -OF-CUSTODY FORM

SOURCE: HUNTER/ESE, 1989.

Each collected sample fraction contained in the transportation case is specified on the logsheet by circling the appropriate fraction code. Other field information, such as sample type, sample collection time and date, new station code (if different from tentative station ID), and field analysis results (e.g., pH, temperature, etc.), is also entered onto the logsheet. The method of shipment is entered on the bottom of the logsheet, and the sampler signs and dates the logsheet. The logsheet is placed in a waterproof container, taped to the inside of the lid of the transportation case, and sealed in the transportation case along with its samples. The transportation seal or lock will not be opened until the samples arrive in the analytical laboratory and are checked in by the analytical task manager or designate. The project manager will alert the analytical task manager to pertinent shipping information at the end of each sampling day.

2.5.2 LABORATORY SAMPLE DOCUMENTATION

Upon arrival in the laboratory, samples will be checked in by the analytical task manager or designate. All samples contained in the shipment will be compared to the logsheet(s) to assure that all samples designated on the logsheet have been received. Any changes in station ID from the originally established station ID are noted. The laboratory coordinator will note any special remarks concerning the shipment, indicate an analysis due date, and deliver the logsheet to the sample control center.

2.5.3 DOCUMENT CONTROL AND REVIEW

Document control includes the maintenance of project files. All project files will be maintained by the project manager. All documents will be kept in project files. Project personnel may keep their own files. However, all official and original documents will be placed in the official project file.

All laboratory records, including batch forms, logsheets, and computerized worksheets, are kept in a batch file in the sample control center. Field logs are maintained by the project manager in a project field file.

The project QA supervisor will independently maintain a QA file for this project. At the end of the project, the QA project file will be turned over to the project manager. The following documents will be placed in the QA project file:

1. QA records maintained throughout the investigation;
2. Documentation of QA system and performance audits;
3. Documentation of all unusual findings or observations;
4. Documentation of all QA corrective actions;
5. All official QA correspondence received or issued relating to the investigation, including records of telephone calls;
6. One copy of all QA deliverable review sheets; and
7. Any other QA documents related to the project or followup activities related to the investigation.

3.0 ANALYSES

Analyses performed for this project will use standard EPA or CETHAMA analytical procedures for analysis of water and soil/sediment. EPA or CETHAMA precision and accuracy data will be used as the basis for developing acceptance criteria for assessing the precision and accuracy of the generated data. Criteria to be used in this project are given in Tables 3-1 through 3-4. Precision and accuracy criteria are only given for selected analytes to be used in spiking for method control purposes. A minimum percent completeness (defined in Section 4.2.4) for each parameter is 90. The following is a brief explanation of the terms that appear in Tables 3-1 through 3-4. Items that are not applicable are denoted by "NA."

Method: refers to standard analytical methodology used for each procedure.

Precision: evaluated based on the relative percent difference (RPD) of duplicate spikes. Both precision and RPD are defined in Section 4.2.

Accuracy: evaluated based on the percent recovery of each spike (see Section 4.2 for definition).

Units: units in L [e.g., microgram per liter (μg/L)] indicate a water matrix; control spikes are added to organic-free laboratory water. Units in kilograms (kg) [e.g., milligram per kilogram (mg/kg)] indicate a soil/sediment matrix; control spikes are added to a standard Hunter/ESE/CETHAMA soil that has been chemically characterized.

Table 3-5 contains detection limits for aqueous samples for each analytical method that will be used for this project.

Table 3-1. Summary of Precision and Accuracy for Nonmetallic Inorganics

			Aqueous Matrix		Solid Matrix	
Method	Parameter	Spike Type	Precision (Max RPD)	Accuracy (% Recovery)	Precision (Max RPD)	Accuracy (% Recovery)
ASTM-D 2216	Percent moisture	NA	NA	NA	20	NA

Note: NA = not applicable.

Source: Hunter/ESE, 1989.

Table 3-2. Summary of Precision and Accuracy for Metals

			Aqueous Matrix		Solid Matrix	
Method	Parameter	Spike Type	Precision (Max RPD)	Accuracy (% Recovery)	Precision (Max RPD)	Accuracy (% Recovery)
SW6010	Barium	MSC/QCC	25	75-125	25	75-125
	Cadmium	MSC/QCC	25	75-125	25	75-125
	Chromium	MSC/QCC	25	75-125	25	75-125
	Lead	MSC/QCC	25	75-125	25	75-125
	Antimony	MSC/QCC	25	75-125	25	75-125
	Nickel	MSC/QCC	25	75-125	NCA	NCA
	Zinc	MSC/QCC	25	75-125	25	75-125
	Beryllium	MSC/QCC	25	75-125	25	75-125
	Silver	MSC/QCC	25	75-125	25	75-125
7060	Arsenic	MSC/QCC	25	75-125	25	75-125
7470/ 7471	Mercury	MSC/QCC	25	75-125	25	75-125
7740	Selenium	MSC/QCC	25	75-125	25	75-125

Note: MSC = matrix spike compound. This represents a spike into a sample matrix, in duplicate.
NCA = not a controlling analyte.
QCC = quality control check sample. This represents a spike into a standard matrix. It is a single standard matrix spike for the methods listed in this table.

Source: Hunter/ESE, 1989.

Table 3-3. Summary of Precision and Accuracy for Matrix Spike Compounds and Surrogates for Organic Analysis

			Aqueous Matrix		Solid Matrix	
Method*	Parameter	Spike Type	Precision (Max RPD)	Accuracy (% Recovery)	Precision (Max RPD)	Accuracy (% Recovery)
SW8240	1,1-Dichloroethene	MSC/QCC	14	61-145	22	59-172
	Trichloroethene	MSC/QCC	14	71-120	24	62-137
	Benzene	MSC/QCC	11	76-127	21	66-142
	Toluene	MSC/QCC	13	76-125	21	59-139
	Chlorobenzene	MSC/QCC	13	75-130	21	60-133
	Toluene-d_8	S/QCC	--	88-110	--	81-117
	4-Bromofluorobenzene	S/QCC	--	86-115	--	74-121
	1,2-Dichloroethane-d_4	S/QCC	--	76-114	--	70-121
SW8270	Phenol	MSC/QCC	42	12-89	35	26-90
	2-Chlorophenol	MSC/QCC	40	27-123	50	25-102
	1,4-Dichlorobenzene	MSC/QCC	28	36-97	27	28-104
	N-Nitroso-di-n-propylamine	MSC/QCC	38	41-116	38	41-126
	1,2,4-Trichlorobenzene	MSC/QCC	28	39-98	23	38-107
	4-Chloro-3-methylphenol	MSC/QCC	42	23-97	33	26-103
	Acenaphthene	MSC/QCC	31	46-118	19	31-137
	4-Nitrophenol	MSC/QCC	50	10-80	50	11-114
	2,4-Dinitrotoluene	MSC/QCC	38	24-96	47	28-89
	Pentachlorophenol	MSC/QCC	50	9-103	47	17-109
	Pyrene	MSC/QCC	31	26-127	36	35-142
	Nitrobenzene-d_5	S/QCC	--	35-114	--	23-120
	2-Fluorobiphenyl	S/QCC	--	43-116	--	30-115
	p-Terphenyl-d_{14}	S/QCC	--	33-141	--	18-137

Table 3-3. Summary of Precision and Accuracy for Matrix Spike Compounds and Surrogates for Organic Analysis (Continued, Page 2 of 2)

			Aqueous Matrix		Solid Matrix	
Method*	Parameter	Spike Type	Precision (Max RPD)	Accuracy (% Recovery)	Precision (Max RPD)	Accuracy (% Recovery)
SW8270	Phenol-d_5	S/QCC	--	10-94	--	24-113
	2-Fluorophenol	S/QCC	--	21-100	--	25-121
	2,4,6-Tribromophenol	S/QCC	--	10-123	--	19-122

Note: MSC = matrix spike compound. This compound represents a spike into a sample matrix and its duplicate.
S = surrogate.
QCC = quality control check sample. This represents a single spike into a standard matrix for the methods listed in this table. (Accuracy will be calculated and reported, but not precision.)
-- = not applicable.

*The methods cited are from Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition (EPA, 1986).

Source: Hunter/ESE, 1989.

Table 3-4. Summary of Equipment Calibration and Acceptance Criteria for Physical Analysis of Soils

Parameter	Laboratory Method	Equipment to be Calibrated	Calibration Frequency	Acceptance Criteria	Corrective Action
Particle Size	ASTM-D 421, 422	Drying Oven	Daily	110°C ±5°	Adjust temperature
		Thermometer	Annually	±2°	Replace thermometer
		Balance	Semi-annually	±0.01 g	Service balance
Moisture Content	ASTM-D 2216	Drying Oven	Daily	110°C ±5°	Adjust temperature
		Balance	Semi-annually	±0.01 g	Service balance
Atterberg Limits	ASTM-D 423, 424	Drying Oven	Daily	110°C ±5°	Adjust temperature
		Balance	Semi-annually	±0.01 g	Service balance
		Liquid Limit Device	Each use	Drop ht. = 10 mm.	Adjust height of cup

Source: Hunter/ESE, 1989.

Table 3-5. Typical Detection Limits for Analytical Methods To Be Used

Analyte	Detection Limit* (µg/L)
Metals	
Barium	1.1
Cadmium	4.0
Chromium	7.1
Lead	44.7
Antimony	45.1
Copper	3.6
Nickel	26.0
Thallium	160.5
Zinc	4.2
Beryllium	1.9
Arsenic	2.3
Selenium	1.8
Mercury	0.2
Volatile Organic Compounds	
Benzene	3
Bromodichloromethane	5
Bromoform	5
Bromomethane	10
2-Butanone (MEK)	50
Carbon disulfide	5
Carbon tetrachloride	3
Chlorobenzene	5
Chloroethane	10
2-Chloroethyl vinyl ether	10
Chloroform	5
Chloromethane	10
Dibromochloromethane	5
1,2-Dichlorobenzene	5
1,3-Dichlorobenzene	5
1,4-Dichlorobenzene	5
1,1-Dichloroethane	5
1,2-Dichloroethane	3
1,1-Dichloroethene	5
trans-1,2-Dichloroethene	5
1,2-Dichloropropane	5
cis-1,3-Dichloropropene	5
trans-1,3-Dichloropropene	5
Diethyl ether	10
Ethylbenzene	5
Methylene chloride	50
2-Methyl-2-pentanone (MIBK)	10
1,1,2,2-Tetrachloroethane	5
Tetrachloroethene	3
Toluene	5
1,1,1-Trichloroethane	5
1,1,2-Trichloroethane	5
Trichloroethene	3
Trichlorofluoromethane	10
Vinyl chloride	5
Xylenes (total, all isomers)	5
Acid and Base/Neutral Extractable Compounds	
Acenaphthene	10
Acenaphthylene	10
Anthracene	10
Benzo(a)anthracene	10
Benzo(b)fluoranthene	10
Benzo(k)fluoranthene	10
Benzo(a)pyrene	10
Benzo(g,h,i)perylene	10
Benzo butyl phthalate	10
4-Bromophenyl phenyl ether	10
bis(2-Chloroethoxy)methane	10

Table 3-5. Typical Detection Limits for Analytical Methods To Be Used (Continued, Page 2 of 2)

Analyte	Detection Limit* (μg/L)	Analyte	Detection Limit* (μg/L)
Acid and Base/Neutral Extractable Compounds (continued)		Hexachlorobenzene	10
		Hexachlorobutadiene	10
		Hexachloroethane	10
bis(2-Chloroethyl)ether	10	Indeno(1,2,3-c,d)pyrene	10
bis(2-Chloroisopropyl)-ether	10	Isophorone	10
		Naphthalene	10
2-Chloronaphthalene	10	Nitrobenzene	10
4-Chlorophenyl phenyl ether	10	n-Nitrosodi-n-propylamine	10
		Phenanthrene	10
Chrysene	10	Pyrene	10
Dibenzo(a,h)anthracene	10	1,2,4-Trichlorobenzene	10
Di-n-butylphthalate	10	4-Chloro-3-methylphenol	10
1,2-Dichlorobenzene	5	2-Chlorophenol	10
1,3-Dichlorobenzene	5	2,4-Dichlorophenol	10
1,4-Dichlorobenzene	5	2,4-Dimethylphenol	10
3,3'-Dichlorobenzidine	20	2,4-Dinitrophenol	50
Diethyl phthalate	20	2-Methyl-4,6-dinitrophenol	50
Dimethyl phthalate	10	2-Nitrophenol	10
2,4-Dinitrotoluene	10	4-Nitrophenol	10
2,6-Dinitrotoluene	10	Pentachlorophenol	10
Di-n-octyl phthalate	10	Phenol	10
bis(2-Ethylhexyl)-phthalate	10	2,4,5-Trichlorophenol	50
		2,4,6-Trichlorophenol	10
Fluoranthene	10		
Fluorene	10		

*The detection limits are typical detection limits and are dependent on dilutions, sample matrix interferences, and instrument conditions. Detection limits for solid samples would be calculated from the values given, taking into account sample volume, final extract volume, and moisture of the sample.

Source: Hunter/ESE, 1989.

4.0 DATA ANALYSIS AND REPORTING

Data transfer and reduction are essential functions in summarizing information to support conclusions. It is essential that these processes are performed accurately and, in the case of data reduction, accepted statistical techniques are used. Hunter/ESE's CLASS will be used for this project.

At a minimum, example calculations must be included with the summarized data to facilitate review. The entry of input data and calculations should be checked, and the signature/initials of the data technician and reviewer(s) should accompany all data transfers with and without reduction.

The data flow scheme for CLASS is presented in Figure 4-1. An example data output form is shown in Figure 4-2. Reporting will include standard curves, QC data, and sample data.

For routine analyses performed at the Hunter/ESE laboratory, sample response data information will be sent to the laboratory data assistant for computer entry. The laboratory data assistant will enter the information from the batch form into the computer, which will calculate:

1. Quadratic regression line for standards,
2. Relative percent difference for replicates,
3. Spike recoveries,
4. Reference sample concentrations, and
5. Sample concentrations.

D15/CLASS FLOWCHART
3.89h

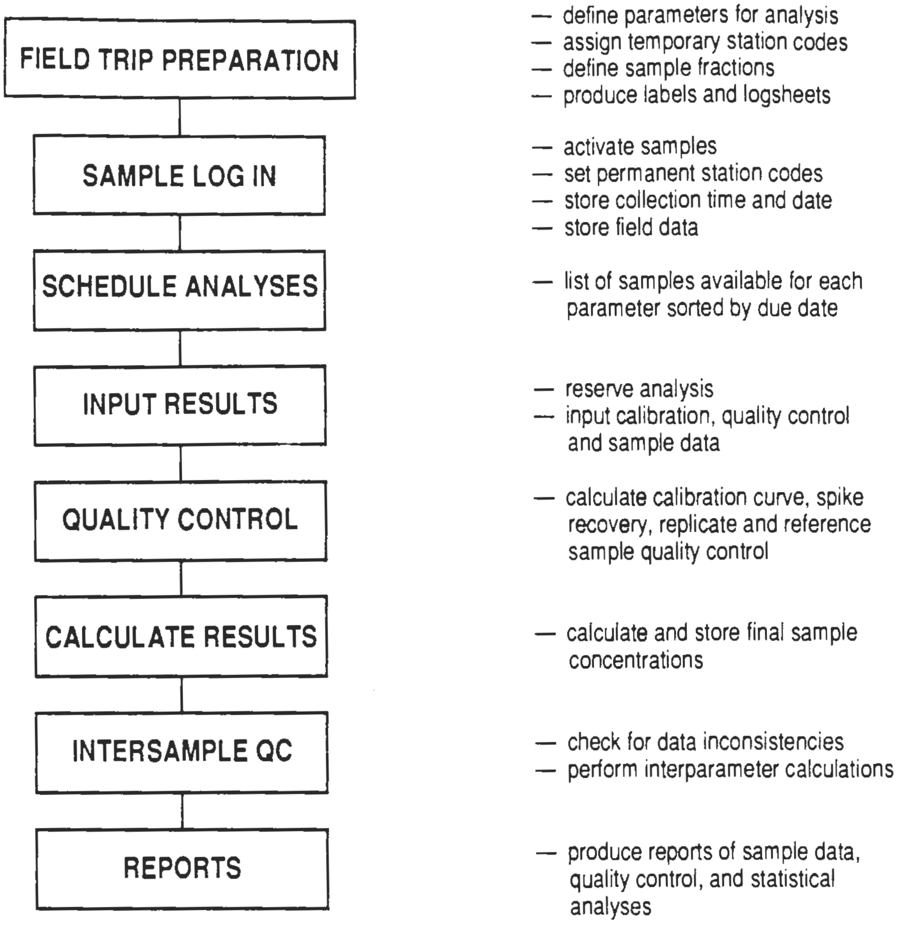
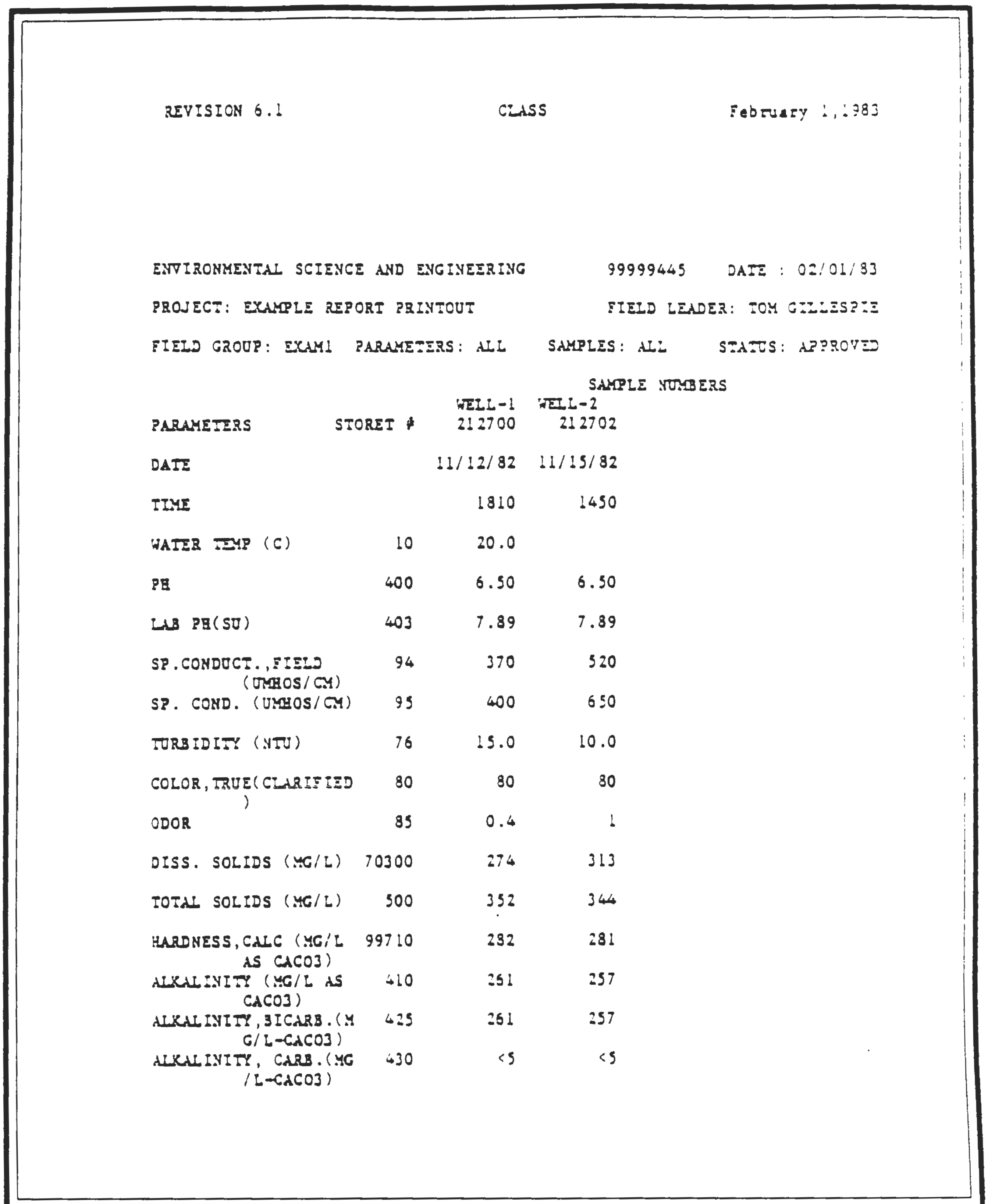


Figure 4-1
FLOWCHART OF THE CLASS PROGRAM

SOURCE: HUNTER/ESE, 1989.

HunTER/ESE



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REVISION 6.1                          CLASS                    February 1,1983




ENVIRONMENTAL SCIENCE AND ENGINEERING           99999445    DATE : 02/01/83

PROJECT: EXAMPLE REPORT PRINTOUT                FIELD LEADER: TOM GILLESPIE

FIELD GROUP: EXAM1  PARAMETERS: ALL    SAMPLES: ALL     STATUS: APPROVED

                                                SAMPLE NUMBERS
                                   WELL-1  WELL-2
PARAMETERS           STORET #      212700   212702

DATE                              11/12/82 11/15/82

TIME                                  1810     1450

WATER TEMP (C)              10        20.0

PH                         400        6.50     6.50

LAB PH(SU)                 403        7.89     7.89

SP.CONDUCT.,FIELD           94         370      520
          (UMHOS/CM)
SP. COND. (UMHOS/CM)        95         400      650

TURBIDITY (NTU)             76        15.0     10.0

COLOR,TRUE(CLARIFIED        80          80       80
          )
ODOR                        85         0.4        1

DISS. SOLIDS (MG/L)      70300         274      313

TOTAL SOLIDS (MG/L)        500         352      344

HARDNESS,CALC (MG/L      99710         282      281
          AS CACO3)
ALKALINITY (MG/L AS        410         261      257
          CACO3)
ALKALINITY,BICARB.(M       425         261      257
          G/L-CACO3)
ALKALINITY, CARB.(MG       430          <5       <5
          /L-CACO3)
```

Figure 4-2
FINAL RESULTS OUTPUT FROM THE DATA PROGRAM

SOURCE: HUNTER/ESE, 1989.

Linear or quadratic equations will be used to calculate final data for laboratory analyses requiring a calibration curve:

$$\text{Concentration} = \text{Intercept} + \text{M (Response)} + \text{M2 (Response)}^2$$

The equation used to calculate final data is dependent on the linearity of standard curve and method of analysis.

Purgeable organics by GC/MS are calculated as follows:

$$\text{Concentration } (\mu g/L) = \frac{(A_{sa})\ (Q_{is})}{(RF)\ (A_{is})\ (PV)}$$

where: A_{sa} = area from the extracted ion profile of the primary characteristics ion for the target analyte in the sample,

Q_{is} = quantity of the internal standard [nanogram (ng)],

RF = response factor (Section 5.1.2.2),

A_{is} = area from the extracted ion profile of the primary characteristic ion of the internal standard in the sample, and

PV = purge volume (mL).

Acid and base/neutral extractables are calculated as follows:

$$\text{Concentration } (\mu g/L) = \frac{(A_{sa})(Q_{is})}{(A_{is})\ (RF)} \times \frac{1}{FE} \times \frac{1}{\text{volume}} \times DF$$

where: A_{sa} = area from the extracted ion profile of the primary characteristic ion for the target analyte in the sample,

A_{is} = area from the extracted ion profile of the primary characteristic ion of the internal standard in the sample,

Q_{is} = quantity of the internal standard (ng),

RF = response factor (Section 5.1.2.2),

$$\text{FE} = \text{fraction extract analyzed} = \frac{\text{volume injected [microliter } (\mu\text{L})]}{\text{extract volume } (\mu\text{L})}$$

volume = sample volume (mL), and

$$\text{DF} = \text{dilution factor} = \frac{\text{diluted extract volume (mL)}}{\text{extract volume (mL)}}$$

QC acceptance criteria (Section 3.0) for the relative percent difference of replicate spike recoveries and for the range of acceptable recoveries will be stored in the computer data management files for each STORET number/method code combination. If the samples in a sample lot do not pass all the QC checks (Section 5.0), then the results reported in all samples processed in the same sample set should be considered as suspect, and the analyses may need to be repeated.

Completed batch forms will be stored in files arranged numerically by batch number. Strip charts, copies of parameter notebooks, and QC charts will be stored for each parameter.

When the data set is complete for each sampling effort, the computer can be used to organize the information in the field group in a variety of formats. The final reports will be reviewed by the analytical task manager and the project QA supervisor.

4.1 DOCUMENTATION OF RAW DATA

4.1.1 GC/MS

Prior to analysis, the extracting analyst must obtain a batch file folder and all applicable data sheets and logsheets.

Extraction Logsheet--Once a batch has been established, the sample extraction and analysis procedure begins. A GC/MS extraction logsheet, filled out by the analyst performing the sample extraction, will accompany the batch throughout analysis. This sheet will include, at least, the following data:

1. Project name and number,
2. Analyst's initials,
3. Type of sample matrix,
4. Field group name,
5. Sample numbers,
6. Date extracted,
7. Analyte group (i.e., acids, base/neutrals),
8. Initial volume or wet weight of sample extracted,
9. Initial/final pH,
10. Extract solvent,
11. Final volume/solvent,
12. Date of cleanup, and
13. Notes and comments affecting the extraction procedure.

After extraction, extraction logsheets will be filed in the batch file folder and accompany the extracted samples to the instrument analyst. The extract vial will be properly labeled. The label will contain the following information:

1. Project name,
2. Sample number,
3. Extraction concentration factor,
4. Date extracted,
5. Extractor's initials, and
6. Field group.

Sample Screening--Sample extracts will be screened by GC employing FID prior to GC/MS analysis to permit dilution of extracts (as required) to concentration levels compatible with the GC/MS instrument and column capabilities.

Spectral Data and GC/MS Computer Quantitation Report

The quantitative sample and standard data generated by the GC/MS data system and all mass spectral information will be labeled according to standard procedures and placed in the batch file folder. Manual data reduction sheets will also be placed in this folder.

Standards--Prior to analysis, stock standard solutions and working solutions covering the working range of the instrument are prepared. Procedures used in preparing the standards must be recorded in the preparer's laboratory notebook. The following information will be recorded:

1. Reference standard source,
2. Lot number,
3. Data of preparation,

After extraction, extraction logsheets will be filed in the batch file folder and accompany the extracted samples to the instrument analyst. The extract vial will be properly labeled. The label will contain the following information:

1. Project name,
2. Sample number,
3. Extraction concentration factor,
4. Date extracted,
5. Extractor's initials, and
6. Field group.

Sample Screening--Sample extracts will be screened by GC employing FID prior to GC/MS analysis to permit dilution of extracts (as required) to concentration levels compatible with the GC/MS instrument and column capabilities.

Spectral Data and GC/MS Computer Quantitation Report

The quantitative sample and standard data generated by the GC/MS data system and all mass spectral information will be labeled according to standard procedures and placed in the batch file folder. Manual data reduction sheets will also be placed in this folder.

Standards--Prior to analysis, stock standard solutions and working solutions covering the working range of the instrument are prepared. Procedures used in preparing the standards must be recorded in the preparer's laboratory notebook. The following information will be recorded:

1. Reference standard source,
2. Lot number,
3. Data of preparation,

4. Analyst's name or initials,
5. Actual weight (or volume) measured,
6. Volumetric flask volume,
7. Calculated concentration,
8. Solvent, and
9. Dilutions.

The analytical standard will be transferred immediately to a properly labeled amber-glass bottle or vial after preparation. Standards should be refrigerated when not in use.

GC/MS Instrument Logbooks--Whenever the GC/MS is used for sample analysis, the appropriate information will be recorded in an instrument logbook.

Compound Identification--Compound identification will be made in terms of the full-scan mass spectrum generally obtained in the electron impact mode at 70 eV. Compound identification will require the presence of all significant major ions at the appropriate relative abundance as obtained with an authentic compound or reference spectrum from a reputable literature source. The selection of significant ions is strongly compound-dependent. Because of this selection and other considerations, the identification of compounds will entail considerable professional judgment and experience.

The most convincing evidence for compound identification is comparison of spectrum with that of an authentic compound obtained under identical operation conditions. When this identification is not possible due to compound availability, computer identification or manual library search will be employed.

When no tentative matches are found in the library, identification will be based on application of known fragmentation patterns, empirical correlations, and isotope abundance data.

Compound Quantitation--The technique of extracted ion current profiles will be employed for the preliminary qualitative searching and for quantitation of individual compounds. Appropriate internal standards will be employed to permit quantitation of the relative response to these internal standards. Concentration calculations and data reduction procedures are given in Section 4.0.

Spiking with Internal Standards--All samples will be spiked with quantitation standards just prior to the GC/MS analysis. Appropriate internal standards will be selected for the remaining categories.

GC/MS Instrument Detection Limits--The instrument detection limit refers to the least quantity of material required to provide a total mass spectrum of sufficient quantity to permit compound identification. The mass spectrum must contain all major ions with the appropriate relative abundance within 35 percent of either an authentic compound analyzed under identical conditions or an appropriate reference spectrum from the literature.

Data Management--Output from the GC/MS/DS is variable, depending on the project. However, all raw data such as mass chromatograms will be stored on magnetic tape. The final results will be submitted to the data center by project, site description, and sample number. The raw calculation sheets will be kept in the GC/MS room by these same identifiers. From the calculation sheets, the frame reference number (FRN) is obtained. All magnetic tapes are kept in sequential order with respect to the FRN. By following this sequence, it is possible to obtain all raw data for a particular sample number. All raw data are stored in the GC/MS room, and all final numbers are kept in the data center.

4.1.2 TRACE METALS

At the time of analysis (for flame and flameless atomic absorption), the following information will be recorded on the strip chart:

1. Analyst's name, initials, or employee number;
2. Date of analysis;
3. Element of interest;
4. Instrument conditions;
5. Sample matrix; and
6. Comments.

During analysis, the analyst will indicate on the strip chart sample numbers, QC samples, blanks, and standards. After the data have been reduced and recorded in the analyst's notebook, the strip charts are filed in a central location by element.

The previous information is entered for each sample analyzed into the ICAP computer. The raw data batches generated by ICAP computer will be evaluated, transmitted to CLASS, and filed with the data batch in the central filing location.

Laboratory Notebooks--Each analyst will maintain his/her own laboratory notebook. After each analysis, the analyst will record in the prepaged, hardbound notebook the following information:

1. Problems encountered during the digestion/analysis,
2. Comments about the samples and/or analytical procedure,
3. Date of analysis,
4. Analyst(s),
5. Element,
6. Sample matrix,
7. Instrument conditions,
8. Sample numbers,
9. Quality control data,
10. Raw data, and
11. Blank subtracted responses.

Standards--Stock standard solutions are purchased from vendors. These stock solutions are certified by the vendor for purity and concentration.

Volumetric dilutions are made from the stock solution in order to obtain working solutions. Serial dilutions are then made from the working solutions to obtain working standards to be used to generate standard curves. Working standard solutions are stored in volumetric flasks and are properly labeled with the following information:

1. Preparer's name or initials,
2. Date of preparation,
3. Element(s), and
4. Concentration.

4.2 ANALYTICAL/STATISTICAL/CONTROL PARAMETERS

4.2.1 PRECISION

Precision is a measure of agreement among measurements performed using the same test procedure. Precision will be assessed for applicable parameters by calculating the RPD of two duplicate spike samples as follows:

$$RPD = \frac{R_1 - R_2}{(R_1 + R_2)/2} \times 100$$

where: Rl and R2 = concentration of Replicate Spikes 1 and 2, respectively.

This calculated RPD value is compared to the maximum value considered acceptable for this project (refer to Section 3.0). The values given in Section 3.0 are precision objectives for this project and are based on EPA criteria (for water samples) or historical Environmental Science and Engineering, Inc. (ESE) data from replicate measurements. These maximum values represent the upper control limit for the analysis. Since an absolute value is used for the difference between Rl and R2, there is no lower control limit.

4.2.2 ACCURACY

Accuracy is the degree of agreement between a sample's target value (known concentration) and the actual measured value. Accuracy for this project is measured by calculating the percent recovery (R) of known levels of spike compounds into appropriate sample matrices. Percent recovery is calculated as follows:

$$R = \frac{100\text{x}[(\text{Spike Sample Con.})(\text{Sample + Spike Vol.}) - (\text{Sample Vol.})(\text{Sample Conc.})]}{(\text{Spike Conc.})(\text{Spike Volume})}$$

The following equation is an example of how R would be calculated:

1 mL of spike with concentration of 100 ppb
10 mL of sample with concentration of 10 ppb
spiked sample concentration of 20 ppb

$$R = 100 \text{ x } \frac{(20)(11) - (10)(10)}{(1)(100)} = 100 \text{ x } \frac{120}{100} = 120 \text{ percent}$$

Each calculated R value is compared to the accuracy criteria listed in Section 3.0. The accuracy ranges provided in Section 3.0 are based on the mean accuracy measured or expected (based on EPA data) for each parameter plus or minus 3 standard deviations of the mean.

If RPD or R values do not meet acceptance criteria as specified in Section 3.0, results reported in all samples processed as part of the same set must be labeled as suspect, and the samples may need to be repeated. The project QA supervisor will be notified, and the necessary corrective action implemented.

4.2.3 DETECTION LIMITS

The detection limit of the method is the lowest sample concentration which can be reliably recovered and measured in the sample matrix with a low background level. To determine absolute method detection limits (MDL), statistically based procedures are available from EPA methods.

4.2.4 COMPLETENESS

Completeness is defined by EPA as "a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions" (EPA, 1980). A completeness of at least 90 percent for each parameter is the objective for this project. Following completion of the analytical testing, percent completeness will be calculated as follows:

$$\begin{array}{l}\text{Completeness (\%)}\\ \text{for parameter } y\end{array} = \frac{\text{\# of valid } y \text{ values reported}}{\text{\# of samples collected for analysis of } y} \times 100$$

If completeness is less than 90 percent for any parameter(s), the principal engineer will be notified immediately. The principal engineer is responsible for determining if resampling will be necessary to meet project objectives and will inform the QA supervisor and analytical task manager of the decision.

4.3 CORRECTIVE ACTIONS

Corrective action is necessary when any measurement system fails to follow this QA Plan. Items which may need corrective action range from a minor problem of a field team member failing to sign a field form to a major problem of an analyst using an improper analytical method. For this reason, corrective action protocols must be flexible.

In general, items needing corrective action fall into three "correction" categories: short-term, long-term, and QC; each requires different action.

4.3.1 SHORT-TERM CORRECTIVE ACTIONS

These actions consist of minor and major problems which can be corrected immediately. Examples include failure to date or sign a field form, incorrectly preserving samples, and errors in data entry. Corrective action is initiated by verbally calling attention to the problem; this is followed by a written notification.

4.3.2 LONG-TERM CORRECTIVE ACTIONS

Actions consist of minor and major problems which require a series of actions to resolve the problem. The actions to be taken are coordinated by the QA supervisor, and a QA corrective action and routing form (Figure 4-3) is used to track the action. An example of this type of corrective action is as follows:

> Problem--A field team member fails to calibrate an HNU meter in the field prior to use.
>
> Corrective Action--The problem is identified by the person originating the corrective action, responsibility is assigned to an appropriate person (may be someone other than person failing to calibrate the meter), an appropriate standard gas is selected, the gas is ordered, receipt of the shipment gas is verified that the order is filled properly, training of field members in the use of the gas is required, and the HNU is calibrated in the field during the next field trip. The QA supervisor audits this process to assure that it is completed in an expeditious manner.

4.3.3 QUALITY CONTROL CORRECTIVE ACTIONS

These actions consist of corrective action following a failure to meet QC criteria specified in this QA Plan and the analytical methods. Actions taken consist of

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QUALITY ASSURANCE CORRECTIVE ACTION REQUEST AND ROUTING FORM

1. IDENTIFICATION OF A PROBLEM:

CA# ____________________

Originator: ______________________________ Date: ____________________

Nature of Problem: ____

____

____

____

____

2. DETERMINATION OF REQUIRED ACTION:

Responsibility Assigned to: ____________________ Due Date: ____________________

Recommended Action: ____

____

____

____

____

3. IMPLEMENTATION OF REQUIRED ACTION:

Responsibility Assigned to: ____________________ Due Date: ____________________

4. ASSURING EFFECTIVENESS OF ACTION:

Responsibility Assigned to: ____________________ Due Date: ____________________

Procedure to Assure Effectiveness: ______________________________________

____

____

____

____

Figure 4-3
QUALITY ASSURANCE CORRECTIVE ACTION REQUEST AND ROUTING FORM
SOURCE: HUNTER/ESE, 1989.

HunTER/ESE

two types: (1) those resolved within each analytical department, and (2) those resolved outside the department. Examples outlining the differences between these two types of corrective action are as follows:

QC Failure	Department Action
WITHIN-DEPARTMENT ACTION	
Tuning results for GC/MS fail criteria in Methods 624 and 625	Analyst retunes instrument
Percent recoveries fail criteria (refer to Section 3.0) and sample holding times have not expired	Analyst investigates problem and reruns analyses
Standard curve correlation coefficient is less than 0.995	Analyst investigates problem and reruns curve and samples
Sample response falls outside calibration curve	Analyst dilutes sample into range of curve

QC Failure	Department Action
OUTSIDE-DEPARTMENT ACTION	
Holding times are exceeded	Notify principal engineer and QA supervisor; resampling may be necessary
Percent recoveries fail criteria (refer to Section 3.0) and sample holding times have expired	Notify principal engineer and QA supervisor; resampling may be necessary if a significant number of QC failures occur

Corrective actions may be initiated for each measurement system (individual disciplines) by subproject managers or other responsible individuals such as the department manager or division manager. The project QA supervisor, along with the project manager, will be responsible for approving the corrective action in the same fashion as if it had been initiated as a project QA function. The USACE Mobile District will be notified in writing within 48 hours of any significant QA/QC problem.

4.4 DATA VALIDATION

The following data review and validation procedures will be followed. The data validation will be initiated by the bench analyst upon conversion of raw data into reportable data. The bench analyst reviews preliminary data and assures that the holding times, precision, and accuracy checks are achieved or exceptions noted. If any of the method control parameters as outlined in Section 4.2 are not achieved, the analyst notifies the supervisor for review and discussion of the QC failures. Designated method control parameters that exceed criteria specified in Section 4.2 require an evaluation by the analyst's supervisor, and a decision is made as to whether corrective action is required. If a corrective action is required, it will be performed as described in Section 4.3. Review of the preliminary data also will be performed by the analyst's supervisor. When this supervisor has checked that the minimum QA/QC data are included in the data batch and is satisfied with the data, it is then signed. The laboratory coordinator reviews the final data reports for inconsistencies and completeness prior to releasing the report to the client. The project QA supervisor will perform quarterly data audits to check that the required quality control procedures are being followed. This procedure will entail random review of analytical batches to see that the QC that is designated for the analysis is being performed. A record of this audit is maintained by the project QA supervisor.

The minimum QA/QC data that should be included in the data batch are the following:

1. Sample data (matrix, date of extraction, and date of analysis);
2. Parameter, result, and test method identification;
3. Sample-specific detection limits for each parameter; and
4. Results of laboratory control data, method blanks, spikes, and replicates (if required).

4.5 REPORT DESIGN

QA activities are reported to project management and USACE in three ways:

1. Notification of significant QA deficiencies within 48 hours upon discovery of the problem,
2. Report of analytical data with QC sent twice weekly to USACE, and
3. Submittal of final QA report (written).

A final QA report will be prepared for the project. The following items will be addressed in the final report:

1. An assessment of the precision and accuracy data associated with sample data generated during the report period,
2. Results of any QA audits performed during the report period, and
3. Results of the QA data validation (refer to Section 4.4) performed during the report period.

The analytical results that will be sent to USACE will also include reports of internal QC data.

5.0 PROGRAM CONTROLS

5.1 EQUIPMENT CALIBRATION PROCEDURES AND FREQUENCY

5.1.1 FIELD INSTRUMENTS

All field geophysical and analytical equipment will be calibrated immediately prior to use in the field. The calibration procedures will follow standard manufacturers' instructions or routine Hunter/ESE procedures to assure that the equipment is functioning within tolerances established by the manufacturer and required by the project. A copy of all the instrument manuals will be placed in a 3-ring notebook and brought to the field by the field team leader. A record of the instrument calibration will be maintained by the project manager, and these records will be subject to audit by the QA supervisor.

5.1.1.1 pH Meter

Calibration is performed at the start of each sampling day using NIST-traceable standard buffer solutions which bracket the pH range expected in the samples. Calibration knobs are used to set the meter to read the value of the standard. The meter is then checked during the sampling period, using at least one standard, at a frequency which results in little or no calibration adjustment. If the reading varies more than one-tenth of a unit between calibration checks, the frequency of the checks must be increased.

5.1.1.2 Conductivity Meter

Calibration is performed at the start of each sampling day using potassium chloride (KCl) standard solutions made in the ESE laboratory prior to each field trip. The analyst preparing the solutions verifies the standard solution versus a laboratory conductivity bridge. The levels of the standards are selected to bracket the range of values expected in the samples. If the unit has a calibration adjustment (e.g., knobs, screws), the meter is calibrated in the same manner as the pH meter. Adjustments are generally not made on meters which lack a designated calibration knob. The meter must read within 10 percent of the standard to be considered in control and should read within 5 percent (7 percent is considered a warning level). If the calibration indicates the meter is out of control, a backup unit should be employed; if one is not available, the data will be flagged to note the percent difference between the meter and standard. Readings from conductivity meters which are lacking calibration adjustments are normally stable; thus, calibration checks are usually limited to checks at the beginning and end of the sampling day.

5.1.1.3 Temperature Meter

Temperature is measured using a thermistor built into the conductivity meter. The readings will be checked at least once per field trip using a quality-grade (preferably NIST-traceable) thermometer.

The calibration frequencies noted above are minimum. Additional checks should be performed if the unit experiences harsh conditions (e.g., shock, rain) or if readings become erratic.

5.1.1.4 Dissolved Oxygen (DO)

Within 1 week of entering the field, the DO meter must be calibrated versus the Winkler test. This calibration is accomplished as follows:

1. Fill a bucket or other suitable container with aerated water (below saturation).

2. Air calibrate the unit as would be done in the field; specifically, measure humid air above water in a closed container. Measure the temperature and calculate the theoretical DO. Immediately adjust the calibration knob to match the theoretical DO.
3. Without agitating the container so as not to lose or gain DO, siphon water from the container to a biological oxygen demand (BOD) bottle (fill 2 bottles for duplicate Winkler analysis). With the siphon tube extended to the bottom of the bottle, allow the water to displace a minimum of 10 volumes.
4. Using an air-calibrated DO meter with a probe containing a clean membrane free of air bubbles, immediately measure the DO in the container.
5. Stopper the bottles and immediately measure the DO in the bottles using the Winkler test.
6. Average the Winkler results and compare the reading to the meter reading. The meter reading should agree within 10 percent of the Winkler test, or the meter should not be employed.
7. Record all calibrations in a standard calibration notebook.

If DO data will be used in litigation or will be a major parameter in analysis of an environmental system, the meter should be calibrated daily in the field.

5.1.1.5 <u>HNU Photoionization Meter and Organic Vapor Analyzer Meter</u>

Calibration of the meter will be performed at the start of each day of use using a standard calibration gas. Additional calibrations will be made if the unit experiences abnormal perturbations or readings become erratic. Results of the calibrations will be recorded in a calibration log that accompanies each instrument.

All calibrations will be recorded in the field notebook on standard field calibration forms (Figures 5-1 and 5-2).

5.1.2 ANALYTICAL LABORATORY INSTRUMENTS

Calibration controls will be required for analytical operations of this project. Each instrument will be calibrated in a manner consistent with EPA calibration protocols and/or Hunter/ESE standard practice. Calibration will be documented in a parameter notebook or the analyst's notebook.

Specific calibration requirements for major classes of analytical procedures are described in Sections 5.1.2.1 through 5.1.2.4. Specific instruments used for this project are listed in Table 1-1.

5.1.2.1 GC/MS Tuning and Calibration

GC/MS Instrument Tuning--Daily instrument tuning will be practiced to assure that the instrument is calibrated and in proper working condition. The GC/MS will be tuned daily with decafluorotriphenylphosphine (DFTPP) (these outputs are contained in the instrument-tuning log) for nonvolatiles analysis and bromofluorobenzene (BFB) for volatiles analysis. The mass intensity specifications for BFB and DFTPP are contained in Table 5-1.

GC/MS Calibration--Relative response factors (RFs) for the individual compounds will be determined as:

Conductivity Meter Calibration Form

Project: ______________________ Date: ______________________

Meter: ______________________ Standards Temp.: ______________________

Is meter temperature compensated? ___ Yes ___ No

Manual Correction to 25°C

$$C_{25} = \frac{CK}{1 + .0191(t - 25)}$$ where,

C = meter reading (uncompensated)
t = solution temperature (°C)
K = Cell constant = 1 (most probes)

Time: ______________ Signature: ______________________

	Standard (umhos/cm)	Meter Reading	Meter Reading @ 25°C	% Error* $\frac{\text{Std-Meter @ 25°C}}{\text{Std}}$ (100)
1.)				
2.)				
3.)				

Time: ______________ Signature: ______________________

	Standard (umhos/cm)	Meter Reading	Meter Reading @ 25°C	% Error* $\frac{\text{Std-Meter @ 25°C}}{\text{Std}}$ (100)
1.)				
2.)				
3.)				

Time: ______________ Signature: ______________________

	Standard (umhos/cm)	Meter Reading	Meter Reading @ 25°C	% Error* $\frac{\text{Std-Meter @ 25°C}}{\text{Std}}$ (100)
1.)				
2.)				
3.)				

*Should be less than 10.

Signature: ______________________
Field Team Leader

Figure 5-1
CONDUCTIVITY METER CALIBRATION FORM

SOURCE: HUNTER/ESE, 1989.

HunTer/ESE

pH Meter Calibration Form

Project: ______________________ Date: ______________________

Meter: ______________________

			Buffer Solution					
	Time (24 hour system)	Meter Reading	7			Buffer Temp. °C	% Slope	Operator
Initial Calibration		Unadjusted						
		Adjusted						
Intermediate Calibration		Unadjusted						
		Adjusted						
		Unadjusted						
		Adjusted						
		Unadjusted						
		Adjusted						
		Unadjusted						
		Adjusted						
		Unadjusted						
		Adjusted						
		Unadjusted						
		Adjusted						
		Unadjusted						
		Adjusted						
Final Calibration		Unadjusted						
		Adjusted						

Intermediate checks may be made with one buffer (unadjusted reading), if readings are within one unit of the standard no calibration adjustment is made, if greater than 0.1 a complete calibration is necessary (adjusted readings), if greater than 0.2 increase frequency of intermediate checks.

Signature: ______________________

Field Team Leader

Figure 5-2
pH METER
CALIBRATION FORM
SOURCE: HUNTER/ESE, 1989.

HUNTER/ESE

Table 5-1. Mass Intensity Specifications for DFTPP and BFB

Key Ions	Ion Abundance Criteria
For DFTPP*	
51	30 to 60 percent of mass 198
68	Less than 2 percent of mass 69
70	Less than 2 percent of mass 69
127	40 to 60 percent of mass 198
197	Less than 1 percent of mass 198
198	Base peak, 100-percent relative abundance
199	5 to 9 percent of mass 198
275	10 to 30 percent of mass 198
365	Greater than 1 percent of mass 198
441	Present but less than mass 443
442	Greater than 40 percent of mass 198
443	17 to 23 percent of mass 442
For BFB*	
50	15 to 40 percent of mass 95
75	30 to 60 percent of mass 95
95	Base peak, 100-percent relative abundance
96	5 to 9 percent of mass 95
173	Less than 2 percent of mass 174
174	Greater than 50 percent of mass 95
175	5 to 9 percent of mass 174 (1 to 12 percent of mass 174)[+]
176	Greater than 95 percent but less than 101 percent of mass 174
177	5 to 9 percent of mass 176

*Reference: Test Methods for Evaluating Solid Waste, EPA-SW-846, 3rd Edition, November 1986.

[+] Variance of 1 to 12 percent of mass 174 for Hunter/ESE, Gainesville, FL, GC/MS Instrument D.

Source: Hunter/ESE, 1989.

$$RF = \frac{A_c/Q_c}{A_{is}/Q_s} = \frac{A_c\ Q_s}{A_{is}\ Q_c}$$

where: A = integrated area taken from the extracted ion current profile,

Q = quantity of material,

c = compound,

is = internal standard, and

s = standard.

A minimum of five levels of compound covering a significant portion of the linear range of the instrumental determination will be employed to determine the instrument sensitivity (i.e., response per unit quantity of compound). The resultant slope from the least square of the calibration data will be employed to calculate the relative response factor as:

$$RF = (\text{slope})/(A_s/Q_s)$$

A one-point calibration will be employed daily for all subsequent work to maintain the instrument response within 35 percent of the original calibration. Deterioration of instrument response for a significant number of internal standards or analyte compounds will require reanalysis of samples with a freshly prepared calibration standard.

5.1.2.2 Trace Metals Analysis Calibration

Stock Solutions--Stock solutions of 1,000 ppm are purchased from vendors. These stock solutions are certified by the vendor for purity and concentration.

AAS 10-ppm Intermediate Solutions--Volumetric dilutions will be made from the stock solutions in order to obtain intermediate solutions (10 ppm). These intermediate solutions may be used as working standard solutions for flame analyses. For more sensitive graphite furnace and hydride analyses, volumetric dilutions will be made from the 10-ppm intermediate solutions to produce working standard solutions.

AAS Working Standard Solutions--These solutions will be derived as described above. Dilutions of the working standard solutions will be made to produce the standard curve. The working standard solutions will be prepared daily.

ICAP 1-ppm Working Solution--A 1-ppm working solution is a multielement calibration standard used to calibrate the instrument prior to operation. This solution is obtained daily by volumetric dilution of the stock solution. The 1-ppm working solution will be verified weekly by an outside reference standard.

AAS Standard Curve Calibration--Working standard solutions will be prepared to cover the analytical working range of the method; these may be either composite standards of more than one metal or single-metal solutions. The standard concentrations will be adjusted to take into account the instrument and method, upper and lower limits of linearity, and the instrumental detection limit. A minimum of three standard concentrations covering the working range and a blank will be prepared and analyzed. The working standards and the blank will be analyzed at the beginning of the analytical run and at least one midlevel standard analyzed at the end of the run to check for constant instrument response.

The working curve will be produced by plotting the standard response for each standard versus the concentration of each standard from the initial calibration run. QC acceptance criteria for working curves are:

1. The working curve possesses a minimum of five points and a blank.
2. The correlation coefficient of the line exceeds 0.995.
3. The response for the midlevel standard analyzed at the end of the run is within 20 percent of response for the same standard at beginning of run.
4. The calibration curve brackets the response for all samples.

Failure to meet Criteria 1 and 2 will necessitate rerunning the standard curve, with new standards if necessary, and reanalysis of the analytical batch. Failure to meet Criterion 3 will require reanalysis of all samples with detectable levels of analytes.

The concentration of the sample is obtained by entering the response for the sample into the working curve equation and determining the sample concentration after all appropriate digestate and sample dilution factors have been applied.

ICAP Single Point Calibration--This procedure utilizes a single 1-ppm standard concentration to obtain an internal response factor from which daily sample concentrations are calculated.

A standard curve for each analyte must be run at least monthly to establish the working linear range of the ICAP. At least three standards (including a 1-ppm standard) which bracket the linear range of the ICAP must be analyzed. At least one standard must be at approximately 10 times the detection limit. Each standard concentration will be calculated based on the 1-ppm standard. Calculated concentrations must be within 10 percent of actual concentrations.

An independently prepared multielement check reference standard is analyzed with each run to verify the 1-ppm calibration standard. The check standard must be within 10 percent of the known concentration or within stated 95-percent confidence limits, or a new 1-ppm calibration standard must be prepared and the instrument recalibrated.

5.1.2.3 Gravimetric Methods Calibration

The analytical balances will be calibrated semiannually by the proper service personnel. The semiannual calibration will be documented by a tag on the instrument. A set of NIST-certified weights must be used to check the calibration daily. This check will be performed by the first analyst to use the balance during the day. Results will be recorded in the instrument notebook.

The project QA supervisor will check the instrument logbooks and/or parameter notebook to verify calibration. Analytical problems with the calibration procedure will result in corrective action recommended to the analytical task manager or field sampling team leader before final approval of the data (Section 4.3).

5.1.3 GENERAL SOILS LABORATORY EQUIPMENT

5.1.3.1 Drying Oven

For all routine laboratory testing, the Blue M drying oven is maintained at a constant temperature of 110°C. Calibration to maintain the acceptable range of oven temperature (plus or minus 5°C) is performed by performing a daily check with a calibrated thermometer (accurate to 1°C) and readjusting the oven temperature, if necessary.

5.1.3.2 Thermometers

All thermometers are calibrated annually against an NIST-certified thermometer. Results of the calibration are recorded in a laboratory notebook in the laboratory, and a temperature calibration curve is plotted for each thermometer. Thermometers are regularly inspected for signs of wear and are replaced as needed.

5.1.3.3 Analytical Balance

The American Scientific Products (ASP) Model Z 1800 electronic balance is inspected and calibrated semiannually by Mettler. Regular cleaning and preventative maintenance also is performed during the inspection. This electronic balance has a self-calibration feature that allows the instrument to be calibrated regularly between inspections.

5.1.4 EQUIPMENT FOR PARTICLE-SIZE ANALYSIS OF SOILS

The equipment required for quantitative determination of the distribution of particle sizes in soils is outlined in this section. The distribution of particle sizes larger than 75 micrometers (μm) (i.e., those particles retained on the No. 200 sieve) is determined by sieving, while the distribution of particle sizes smaller than 75 μm is determined by a sedimentation process using a hydrometer to secure the necessary data. In addition to the general laboratory equipment discussed in Section 5.1.3, this method uses the following special equipment: mechanical stirring apparatus with dispersion cup, ASTM-type 152H hydrometer, sedimentation cylinder (1,000-mL graduated cylinder), wire mesh standard size sieves, constant temperature water bath, beaker, and a timer accurate to 1 second. Although these items do not require regular calibration, they are inspected regularly for signs of damage or excess wear that would affect their performance. Additionally, all equipment used for the particle-size distribution test are specially manufactured items that conform to the specifications of ASTM D 422. When the constant temperature water bath is not used, the composite temperature correction that accounts for changes in density due to weight of dispersant and temperature is applied to the hydrometer readings, as described in ASTM D 422 Section 7.

5.1.5 EQUIPMENT FOR SOIL WATER (MOISTURE) CONTENT

The equipment required for determination of the moisture content by weight of soil, rock, or soil-aggregate mixtures is outlined in this section. The water content of a material is defined as the ratio, expressed as a percentage, of the mass of porewater in the material to the mass of the solid material particles. Moisture is determined by measuring the mass of water lost by drying the sample to a constant dry mass in an oven at 110 + 5°C. The equipment used for this test method includes the drying oven and the analytical balance. Calibration of these instruments was described in Section 5.1.3.

5.1.6 MEASUREMENT OF ATTERBERG LIMITS

The equipment required for determination of the liquid limit, plastic limit, and the plasticity index of soils is outlined in this section. The liquid limit and the plastic limit of soils are often referred to as the Atterberg limits, and they distinguish the boundaries (moisture contents) of the several consistency states of plastic soils. In addition to the general laboratory equipment discussed in Section 1.1, this method uses the following special equipment: liquid limit device and flat grooving tool. Section 9 of ASTM 4318 describes the calibration and inspection procedure for the liquid limit device and the grooving tool. The calibration procedures described are performed on a regular and frequent basis (typically with every use). Additionally, all equipment used for the Atterberg limits tests are specially manufactured items that conform to the specifications of ASTM D 4318.

5.2 GENERAL QC CHECKS

Analytical QC procedures are those steps taken by the laboratory in day-to-day activities to achieve the desired precision, accuracy, completeness, representativeness, and comparability. Each Analytical Chemistry Department manager and analyst is responsible for performing the analysis in accordance with the defined QC practices outlined in this plan.

Department managers are responsible for developing QC acceptance criteria for (1) the relative percent difference of duplicate spikes and (2) spike recovery ranges for each method performed by their department. These criteria must be approved by the division manager. EPA precision and accuracy data are used as a basis for developing acceptance criteria for assessing the precision and

For QC purposes the number of samples which are extracted and/or prepared for instrumental analysis as one group in one 24-hour period or during several days in a l-week period will constitute one analytical batch. The number and type of QC samples given in Table 5-2 will apply to this batch/lot of samples. For example, a group of samples which are extracted on the same day and (if required) undergo concentration and cleanup procedures on subsequent days would be considered one batch for QC purposes. Also, a set of samples that are extracted over several days in a l-week period may be considered one batch as long as the minimum number of QC samples is run. In this case, QC samples should be spread over several days.

A summary of the minimum QC procedures required for each analyte is presented in Tables 5-3 through 5-7. Calibration procedures, which play a major role in controlling quality, are discussed separately in Section 5.1. The following actions describe each QC item listed in the table.

Method Blanks--Method blanks consist of analyte-free water or soil, processed in the exact manner as the samples within a batch, using identical reagents and solvents. All analytes of interest should be less than the detection limit, except for the following volatiles, which should be less than 5 times the reported detection limit (quantitation limit):

1. Acetone,
2. Methylene chloride,
3. Toluene, and
4. Xylene.

Sample Matrix Spikes--For each batch, a sample is selected that represents the matrix in the batch and is spiked in duplicate with analytes specified for each method in Tables 3-2 and 3-3. Actions to be taken if recoveries and/or RPD

Table 5-2. Summary of Minimum QC Requirements for Each Type of Parameter

Parameter	Method Blank	Surrogate Spikes	Sample Matrix Spike	Sample Matrix Spike Duplicate	QC Check Sample	Laboratory Sample Duplicate	Interferent Check Sample
Soil moisture						X	
ICAP metals	X		X	X	X		X
AA metals	X		X	X	X		
Semivolatiles (GC/MS)	X	X	X	X	X		
Volatiles (GC/MS)	X	X	X	X	X		

Source: Hunter/ESE, 1989.

Table 5-3. Summary of Internal QC Procedures for Inductively Coupled Plasma Emission Spectrophotometry (SW6010)

Quality Control	Frequency	Acceptance Criteria	Corrective Action
Field Quality Control			
Field Duplicate	One per every 10 field samples but not to exceed the number specified in the Statement of Work.	Water Samples--RPD <30% Soil Samples--RPD <50% (RPD calculated only for detected analytes).	Use data to evaluate whether or not proper sample collection procedures have been followed.
Equipment Blank	One per every 10 field samples but not to exceed the number specified in the Statement of Work.	No more than 4 target analytes, each with a concentration exceeding 5 times the detection limit can be present.	If same analytes are found in field samples at comparable concentrations, notify the TPM for possible need to resample.
Laboratory Quality Control			
Calibration Verification Standards (ICV, CCV)	At the beginning and end of each analytical run and at a frequency of 10% during the run.	90 to 110% of True Value.	Terminate analyses, correct problem, recalibrate instrument.
Calibration Blank Solutions (ICB, CCB)	At the beginning and end of each analytical run, and at a frequency of 10% during the run.	Blank values must be less than or equal to the EPA contract-required detection limits (CRDLs). See Table 5-8.	Terminate analyses, correct problem, recalibrate instrument.
Interference Check Standard (ICS)	At the beginning and end of each analytical run.	80 to 120% of True Value.	Terminate analyses, correct problem, recalibrate instrument, reverify calibration, and reanalyze samples if applicable.

Table 5-3. Summary of Internal QC Procedures for Inductively Coupled Plasma Emission Spectrophotometry (SW6010) (Continued, Page 2 of 3)

Quality Control	Frequency	Acceptance Criteria	Corrective Action
<u>Laboratory Quality Control, continued</u>			
QC Check Sample	One per analytical batch for water matrices and monthly for solid matrices.	75 to 125% of True Value.	QC check sample is used to help evaluate whether the sample matrix is affecting matrix spike compound recoveries. If outside criteria, terminate analyses, correct problem, and reanalyze the affected samples.
Linear Range Check Sample (LRCS)	Quarterly	None: used to verify linear analysis range of instrument.	
Method Blank (MB)	One per analytical batch.	Values less than or equal to the EPA CRDLs. See Table 5-8.	All samples associated with the preparation blank and less than 10 times the preparation blank concentration must be reanalyzed.
ICP Serial Dilution Analysis (SD)	A minimum of one per analytical batch if applicable	If the analyte concentration is a factor of 10 or more above the instrument detection limit (IDL) after a 1+4 dilution, the diluted and undiluted analyte concentrations must agree within 10% after accounting for dilution.	Flag affected analytes for all samples analyzed with that particular ICP serial dilution analysis.

Table 5-3. Summary of Internal QC Procedures for Inductively Coupled Plasma Emission Spectrophotometry (SW6010) (Continued, Page 3 of 3)

Quality Control	Frequency	Acceptance Criteria	Corrective Action
<u>Laboratory Quality Control, continued</u>			
Matrix Spike	One per every 20 project samples.	See Table 3-2 for matrix spiking analytes, spike concentrations, and laboratory-established control limits for percent recovery.	Step 1: If QC check sample analyte are within control limits, qualify data. Step 2: If QC check sample outside controls limits, determine and correc problem, recalibrate, and reanalyze all samples run since last satisfactor QC check sample or document why data is acceptable. Step 3: Document corrective action.
Matrix Spike Duplicate	One per every 20 project samples.	See Table 3-2 for control limits for RPD.	Step 1: If QC check sample analyte are within control limits, qualify data. Step 2: If QC check sample outside controls limits, determine and correc problem, recalibrate, and reanalyze all samples run since last satisfactor QC check sample or document why data is acceptable. Step 3: Document corrective action.

Source: Hunter/ESE, 1989.

Table 5-4. Summary of Internal QC Procedures for Graphite Furnace Atomic Absorption Spectrophotometry (Arsenic SW7060, Selenium SW7740)

Quality Control	Frequency	Acceptance Criteria	Corrective Action
<u>Field Quality Control</u>			
Field Duplicate	One per every 10 field samples but not to exceed the number specified in the SOW.	Water samples--RPD <30% Soil samples--RPD <50% (RPD calculated only for detected analytes).	Use data to evaluate whether or not proper sample collection procedures have been followed.
Equipment blank	One per every 10 field samples but not to exceed the number specified in the SOW.	No analyte exceeding 5 times the method detection limit can be present.	If same analytes are found in field samples at comparable concentrations, notify the TPM for possible need to resample.
<u>Laboratory Quality Control</u>			
Calibration Verification Standards (ICV, CCV)	At the beginning and end of each analytical run and at a frequency of 10% during the run.	90 to 110% of True Value	Terminate analyses, correct problem, recalibrate instrument.
Calibration Blank Solutions (ICB, CCB)	At the beginning and end of each analytical run, and at a frequency of 10% during the run.	Blank values must be less than or equal to the EPA CRDLs. See Table 5-8.	Terminate analyses, correct problem, recalibrate instrument.

Table 5-4. Summary of Internal QC Procedures for Graphite Furnace Atomic Absorption Spectrophotometry (Arsenic SW7060, Selenium SW7740) (Continued, Page 2 of 3)

Quality Control	Frequency	Acceptance Criteria	Corrective Action
<u>Laboratory Quality Control, continued</u>			
QC Check Sample	One per analytical batch for water matrices and monthly for solid matrices.	75 to 125% of True Value.	QC check sample is used to help evaluate whether the sample matrix is affecting matrix spike recoveries. If outside criteria, terminate analyses, correct problem, and reanalyze the affected samples.
Method Blank (MB)	One per analytical batch.	Values less than or equal to the EPA CRDL, see Table 5-8.	All samples associated with the preparation blank and less than 10 times the preparation blank concentration must be reanalyzed.
Analytical Spike	10% of the samples	80 to 120% recovery of 2X CRDL spike.	Flag sample value.
Matrix Spike	One per every 20 project samples	See Table 3-2 for matrix spiking analytes, spike concentrations, and laboratory-established control limits for percent recovery.	Step 1: If QC check sample analytes are within control limits, qualify data. Step 2: If QC check sample outside controls limits, determine and correct problem, recalibrate, and reanalyze all samples run since last satisfactory QC check sample or document why data is acceptable. Step 3: Document corrective action.

Table 5-4. Summary of Internal QC Procedures for Graphite Furnace Atomic Absorption Spectrophotometry (Arsenic SW7060, Selenium SW7740) (Continued, Page 3 of 3)

Quality Control	Frequency	Acceptance Criteria	Corrective Action
<u>Laboratory Quality Control, continued</u>			
Matrix Spike Duplicate	One per every 20 project samples.	See Table 3-2 for control limits for RPD.	Step 1: If QC check sample analyte are within control limits, qualify data. Step 2: If QC check sample outside controls limits, determine and correc problem, recalibrate, and reanalyze all samples run since last satisfactory QC check sample or document why data is acceptable. Step 3: Document corrective action.

Source: Hunter/ESE, 1989.

Table 5-5. Summary of Internal QC Procedures for Mercury by Cold Vapor Atomic Absorption Spectrophotometry (SW7470/SW7471)

Quality Control	Frequency	Acceptance Criteria	Corrective Action
Field Quality Control			
Field Duplicate	One per every 10 field samples but not to exceed the number specified in the SOW.	Water samples--RPD <30% Soil samples--RPD <50%	Use data to evaluate whether or not proper sample collection procedures have been followed.
Equipment blank	One per every 10 field samples but not to exceed the number specified in the SOW.	No more than two times the method detection limit can be present.	If mercury is found in field samples at comparable concentrations, notify the TPM for possible need to resample.
Laboratory Quality Control			
Calibration Verification Standards (ICV, CCV)	At the beginning and end of each analytical run and at a frequency of 10% during the run.	80 to 120% of True Value	Terminate analyses, correct problem, recalibrate instrument.
Calibration Blank Solutions (ICB, CCB)	At the beginning and end of each analytical run, and at a frequency of 10% during the run.	Blank values must be less than or equal to the EPA CRDLs. See Table 5-8.	Terminate analyses, correct problem, recalibrate instrument.

Table 5-5. Summary of Internal QC Procedures for Mercury by Cold Vapor Atomic Absorption Spectrophotometry (SW7470/SW7471) (Continued, Page 2 of 3)

Quality Control	Frequency	Acceptance Criteria	Corrective Action
<u>Laboratory Quality Control, continued</u>			
QC Check Sample	One per analytical batch for water matrices and monthly for solid matrices.	75 to 125% of True Value.	QC check sample is used to help evaluate whether the sample matrix is affecting matrix spike recoveries. If outside criteria, terminate analyses, correct problem, and reanalyze the affected samples.
Method Blank (MB)	One per analytical batch.	Values less than or equal to two times the limit of detection.	All samples associated with the preparation blank and less than 10 times the preparation blank concentration must be reanalyzed.
Matrix Spike	One per every 20 project samples	See Table 3-2 for matrix spike concentrations and laboratory-established control limits for percent recovery.	Step 1: If QC check sample is within control limits, qualify data. Step 2: If QC check sample outside controls limits, determine and correct problem, recalibrate, and reanalyze all samples run since last satisfactory QC check sample or document why data is acceptable. Step 3: Document corrective action.

Table 5-5. Summary of Internal QC Procedures for Mercury by Cold Vapor Atomic Absorption Spectrophotometry (SW7470/SW7471) (Continued, Page 3 of 3)

Quality Control	Frequency	Acceptance Criteria	Corrective Action
<u>Laboratory Quality Control, continued</u>			
Matrix Spike Duplicate	One per every 20 project samples.	See Table 5-8 for control limits for RPD.	Step 1: If QC check sample is within control limits, qualify data. Step 2: If QC check sample outside controls limits, determine and correct problem, recalibrate, and reanalyze all samples run since last satisfactory QC check sample or document why data is acceptable. Step 3: Document corrective action.

Source: Hunter/ESE, 1989.

Table 5-6. Summary of Internal QC Procedures for GC/MS for Volatile Organics (SW8240)

Quality Control	Frequency	Acceptance Criteria	Corrective Action
<u>Field Quality Control</u>			
Trip Blank	One per each batch of samples shipped to laboratory but not to exceed the number specified in the SOW.	No more than 4 target compounds, each with a concentration exceeding 5 times the method detection limit can be present.	If same compounds are found in field samples at comparable concentrations, notify the TPM for possible need to resample.
Field Duplicate	One per every 10 field samples but not to exceed the number specified in the SOW.	Water Samples--RPD <30% Soil Samples--RPD <50% (RPD calculated only for detected compounds).	Use data to evaluate whether or not proper sample collection procedures have been followed.
Equipment Blank	One per every 10 field samples but not to exceed the number specified in the SOW.	No more than 4 target compounds, each with a concentration exceeding 5 times the method detection limit can be present.	If same compounds are found in field samples at comparable concentrations, notify the TPM for possible need to resample.
<u>Laboratory Quality Control</u>			
Reagent Blank	One per 12-hour day.	No greater than 5 times the MDL for methylene chloride, acetone, toluene, and xylene; all other target analytes must be below respective limit of detection.	Step 1: Reanalyze another reagent blank or document why data is acceptable. Step 2: If second reagent blank exceeds criteria, clean and recalibrate the analytical system. Step 3: Document the corrective action taken.

Table 5-6. Summary of Internal QC Procedures for GC/MS for Volatile Organics (SW8240) (Continued, Page 2 of 3)

Quality Control	Frequency	Acceptance Criteria	Corrective Action
Surrogate Spike	All blanks, standards, QC samples, and field samples.	See Table 3-3 for surrogate spiking compounds and laboratory control limits.	Step 1: Check recovery of surrogates in QC check sample. If surrogate in QC check samples are within criteria, then qualify the sample data. If surrogates in QC check sample are outside criteria, reanalyze all samples with surrogates outside criteria or document why data is acceptable.
QC Check Sample	One per analytical batch.	See Table 3-3 for QC check sample spiking compounds and laboratory control limits.	QC check sample is used to help evaluate whether the sample matrix is effecting surrogate or matrix spike compound recoveries.
Matrix Spike	One per every 20 project samples.	See Table 3-3 for matrix spiking compounds and laboratory-established control limts for percent recovery.	Step 1: If QC check sample compounds are within control limits, qualify data. Step 2: If QC check sample outside controls limits, determine and correct problem, recalibrate, and reanalyze all samples run since last satisfactory QC check sample or document why data is acceptable. Step 3: Document corrective action.

Table 5-6. Summary of Internal QC Procedures for GC/MS for Volatile Organics (SW8240) (Continued, Page 3 of 3)

Quality Control	Frequency	Acceptance Criteria	Corrective Action
Matrix Spike Duplicate	One per every 20 project samples	See Table 3-3 for control limits for RPD.	Step 1: If QC check sample compounds are within control limits, qualify data. Step 2: If QC check sample outside controls limits, determine and correct problem, recalibrate, and reanalyze all samples run since last satisfactory QC check sample or document why data is acceptable. Step 3: Document corrective action.

Source: Hunter/ESE, 1989.

Table 5-7. Summary of Internal QC Procedures for Semivolatile Organics (SW8270)

Quality Control	Frequency	Acceptance Criteria	Corrective Action
<u>Field Quality Control</u>			
Field Duplicate	One per every 10 field samples but not to exceed the number specified in the SOW.	Water Samples--RPD < 30% Soil Samples--RPD < 50% (RPD calculated only for detected compounds).	Use data to evaluate whether or not proper sample collection procedures have been followed.
Equipment Blank	One per every 10 field samples but not to exceed the number specified in the SOW.	No more than 4 target compounds, each with a concentration exceeding 5 times the method detection limit can be present.	If same compounds are found in field samples at comparable concentrations, notify the TPM for possible need to resample.
<u>Laboratory Quality Control</u>			
Method Blank (MB)	One per analytical batch.	All analytes of interest should be less than two times the limit of detection.	Step 1: Evaluate the impact of the presence of any target analytes in the method blank the presence of certain analytes in the method blank (i.e., low concentrations of phthalates may be acceptable). Step 2: If the presence of target analytes in the method blank are deemed unacceptable then the samples should be reextracted and reanalyzed or document why data is acceptable. Step 3: Document the corrective action taken.

Table 5-7. Summary of Internal QC Procedures for Semi-Volatile Organics (SW8270) (Continued, Page 2 of 3)

Quality Control	Frequency	Acceptance Criteria	Corrective Action
Surrogate Spike	All blanks, standards, QC samples, and field samples.	See Table 3-3 for surrogate spiking compounds, spike concentrations, and laboratory control limits.	Step 1: Check recovery of surrogates in QC check sample. If surrogate in QC check samples are within criteria, then qualify the sample data. If surrogates in QC check sample are outside criteria, reanalyze all samples with surrogates outside criteria or document why data is acceptable.
QC Check Sample	One per analytical batch.	See Table 3-3 for QC check sample spiking compounds, spike concentrations, and laboratory control limits.	QC check sample is used to help evaluate whether the sample matrix is effecting surrogate or matrix spike compound recoveries.
Standard Matrix/ Matrix Spike	One per every 20 project samples	See Table 3-3 for matrix spiking compounds, spike concentrations, and laboratory-established control limts for percent recovery.	Step 1: If QC check sample compounds are within control limits, qualify data. Step 2: If QC check sample outside controls limits, determine and correct problem, recalibrate, and reanalyze all samples run since last satisfactory QC check sample or document why data is acceptable. Step 3: Document corrective action.

Table 5-7. Summary of Internal QC Procedures for Semi-Volatile Organics (SW8270) (Continued, Page 3 of 3)

Quality Control	Frequency	Acceptance Criteria	Corrective Action
Standard Matrix/ Matrix Spike Duplicate	One per every 20 project samples	See Table 3-3 for control limits for RPD.	Step 1: If QC check sample compounds are within control limits qualify data. Step 2: If QC check sample outside controls limits, determine and correc problem, recalibrate, and reanalyze all samples run since last satisfactor QC check sample or document why data is acceptable. Step 3: Document corrective action.

Source: Hunter/ESE, 1989.

Table 5-8. EPA Contract-Required Detection Limits (CRDLs)

Element	CRDL (μg/L)
Arsenic	10
Barium	200
Cadmium	5
Calcium	5,000
Chromium	10
Iron	100
Lead (ICAP)	100*
Manganese	15
Mercury	0.2
Selenium	5
Silver	10
Sodium	5,000

Note: μg/L = micrograms per liter.

*The value is based on Hunter/ESE historical data and is used for lead analysis by ICAP.

Source: EPA Contract Laboratory Program Statement of Work 785.
EPA, 1985.
Hunter/ESE, 1989.

between duplicates are not met are discussed in Tables 5-3 through 5-7 and in Section 4.3.

Surrogate Spikes--Surrogate spikes are compounds that are added to every sample analyzed, including the standards, blanks, matrix spikes, and QC check samples, to assess the recovery of the method. A list of the surrogates that are spiked and associated acceptance criteria appears in Table 3-3. Actions to be taken if the recoveries do not meet acceptance criteria are discussed in Tables 5-6 and 5-7 and Section 4.3.

QC Check Sample--A QC check sample consists of either an EPA reference, NIST-traceable reference, or an in-laboratory prepared spike into a standard matrix (typically deionized water) using stocks made independently of the calibration standards. The QC check sample can serve one or two purposes, depending on the method:

1. Verify the standard calibration using an independent standard. This occurs when the method involves direct analysis of the sample.
2. Differentiate between sample matrix interference and analytical procedural error. Sample matrix spikes that fall outside of precision and/or accuracy acceptance criteria indicate either a matrix interference or a problem with the standard analytical procedure. An acceptable QC check sample provides strong evidence that a matrix interference is present.

Sample Duplicates--Certain analytes are not amenable to spike additions. In those cases, samples are run in duplicate without spike addition.

Interferent Check Sample--This solution contains both interfering and analyte elements of known concentrations and is used to verify background and interelement correction factors. The sample is run at the beginning and end of each batch for Method SW6010.

5.3 PREVENTIVE MAINTENANCE

To minimize the occurrence of instrument failure and other system malfunction, a preventive maintenance program for field and laboratory instruments was implemented. The preventive maintenance performed for each major piece of field and analytical equipment is listed in the following sections.

5.3.1 SALINITY/CONDUCTIVITY/TEMPERATURE METER AND PROBE

Preventive maintenance protocol for the Yellow Springs Instruments (YSI) meter and probe involves red-lining the meter to check the condition of the batteries. Probe preventive maintenance involves verification of temperature readings using a mercury thermometer and verifying that the probe does not need cleaning. A fouled probe is discovered by measuring a standard on the X100 and X10 ranges, then depressing the CELL TEST button. If the meter reading falls more than 2 percent, the probe is fouled and will be cleaned. Replacement membranes will be available.

5.3.2 pH METERS AND COMBINATION pH ELECTRODES

Preventive maintenance for the pH meter and electrodes primarily involves the proper care of the electrode. Electrodes are stored in a 1:1 solution of pH = 7 buffer and DI water. The hole to add the internal filling solution must be plugged at all times to prevent evaporation of the solution when the electrode is not in use. When the internal filling solution has dried out, the chamber will be rinsed with DI water before replacing the filling solution. This step prevents clogging of the probe and poor (<100 percent) slope adjustments when calibrating the electrode. Whenever slope readings are deteriorating or a low ionic strength sample gives erroneous readings, the electrode will be treated with 1 normal (N) potassium hydroxide (KOH) and 1 N HCl.

Spare parts such as a replacement probe and fresh buffer solutions will be available for the system at all times.

5.3.3 CONDUCTIVITY BRIDGE AND CELL

Preventive maintenance for the Beckman conductivity bridge involves keeping the rechargeable battery fully charged. Care for the conductivity cell involves storage in DI water. Replatinization of the conductivity cell is performed according to standard methods only when the cell response becomes erratic, a sharp endpoint cannot be obtained, or when inspection shows that any of the platinum back has flaked off.

5.3.4 DISSOLVED OXYGEN METER AND PROBE

Preventive maintenance procedures for the YSI meter involve verifying daily that the mechanical zero is properly set and ensuring that the batteries are fully charged to red-line the instrument. The meter is shipped to the manufacturer for repair if any other problems exist. The Model 5420 BOD probe and the Model 5418 and 5419 probes are kept ready by storing in a moist atmosphere. Probe temperature readings are verified by comparison to the readings on a mercury thermometer. The DO probe membrane is replaced prior to use of the instrument in the field. The replacement of the membrane must occur at least 24 hours before use to ensure stable readings during a large number of DO analyses. Probe replacement is necessary when the probe will not calibrate properly or there are air bubbles under the membrane. Spare parts will be available for the system components most likely to experience failure.

5.3.5 GC/MS

All routine preventive maintenance performed for gas chromatographs also will be performed for the GC/MS equipment. In addition, the ionizing source will be dismantled periodically, thoroughly cleaned, and reassembled to prevent serious sensitivity problems. Calibration with selected mass standards will be performed daily to ensure that instrument performance has not deteriorated. The failure to achieve calibration will require source cleaning. Spare parts and equipment will be available for the system components most likely to experience failure. Routine maintenance by the manufacturers' representatives will be performed annually.

5.3.6 ANALYTICAL BALANCE

Analytical balances will be cleaned and calibrated semiannually by manufacturers' representatives. The accuracy of analytical balances will be checked daily using standard weights. It is imperative that the balance logbooks be maintained daily.

5.3.7 ICAP

Routine maintenance on the ICAP system by the manufacturer's representatives is performed annually. In addition, a quarterly service contract is maintained on the minicomputer. Periodically, the analyst will dismantle, clean, and reassemble the torch and nebulizer to prevent serious sensitivity problems. Calibration with selected standards will be performed daily to ensure that the instrument performance has not deteriorated. Failure to achieve standardization could require cleaning, including changing the tubing of the sample delivery system. Spare parts are available for the system components most likely to experience failure.

5.3.8 ATOMIC ABSORPTION

Routine preventive maintenance on the atomic absorption systems primarily consists of keeping components clean (to prevent acid corrosion), replacement of expendables, and monitoring instrument response. Instrument response is compared to historical data and the manufacturers' performance specifications to verify instrument sensitivity. Sample cells (e.g., graphite furnace, hydride cell, and burner/spray chamber) are cleaned periodically to prevent serious contamination. Sufficient stock of spare parts and expendables is maintained at all times to ensure continuous operation. Manufacturers' service representatives inspect instrument optics and other components at least once per year.

5.3.9 ROUTINE MAINTENANCE OF SOIL MECHANICS LABORATORY EQUIPMENT

Routine maintenance of the ASP electronic balance is performed semiannually by a Mettler service technician and includes calibration, cleaning, and inspection/repair of mechanical parts. The routine maintenance of the Blue M oven consists of periodic cleaning and inspection of electrical connections, door seal, and controls. This is in addition to the daily checking of the oven temperature.

Other general soils laboratory equipment, such as vacuum pump, ultrasonic cleaner, sieves, and sieve shakers, are inspected and cleaned on a semiannual basis. Cleaning and preventive maintenance activities are conducted in accordance with equipment manufacturers' recommendations. Oil changes are performed at least quarterly on the Gast vacuum pump.

Routine maintenance of the Liquid Limit device used in the Atterberg limits test consists of quarterly inspection of the device for signs of excessive wear. The resilience of the rubber base is checked in accordance with ASTM D 4318. The cam, carriage, and grooving tool are also checked to see that they will perform according to the specifications of ASTM D 4318.

Routine maintenance of the permeability test system involves several components. The air compressor system is checked monthly for operational problems. This inspection includes checking the motor and belts and an oil change. In addition, the vapor trap, oil filter, and dessicator are inspected, cleaned, and refilled. Maintenance of the pressure control board consists of cleaning and/or deairing the pore pressure transducer, cleaning of burettes (if necessary), and cleaning/replacement of tubing and/or brass compression fittings. This maintenance program also covers the routine inspections and cleaning of the triaxial pressure cells. These are cleaned after every test and all replaceable parts (i.e., membranes, O rings, and filter stones) are inspected for wear and cleaned or replaced.

5.4 EXTERNAL CERTIFICATION AND SYSTEM AUDITS

Two types of audit procedures will be used to assess and document performance of project staff: system audits and performance audits. These are conducted at frequent intervals under the direction of the project QA supervisor. These audits form one of the bases for corrective action requirements and constitute a permanent record of the conformance of measurement systems to QA requirements.

System audits are inspections of training status, records, QC data, calibrations, and conformance to SOPs without the analysis of check samples. System audits will be performed periodically on laboratory, office, and field operations.

The system audit protocol is summarized as follows:

1. Field Operations--The project QA supervisor will periodically check:
    a. Field notebooks, logsheets, bench sheets, and tracking forms, and report any inconsistencies and/or omissions;
    b. Field sampling plans; and
    c. Sample site briefing package.
2. Laboratory Operations--The project QA supervisor will periodically check:
    a. Parameter and/or laboratory notebooks;
    b. Instrument logbooks;
    c. Sample log-in, dispensing, and labeling for analysis;
    d. Updating of QC criteria for spike recoveries.

    In addition, the project QA supervisor will monitor analyses to assure complete adherence to approved analytical methods.
3. Final Reports--The project QA supervisor will review all final reports and deliverables to the client.

Performance audits will include conductance of field audits and evaluation and analysis of check samples. Periodically, field audits will be performed on select projects to assure that sampling procedures are performed according to the QA plan.

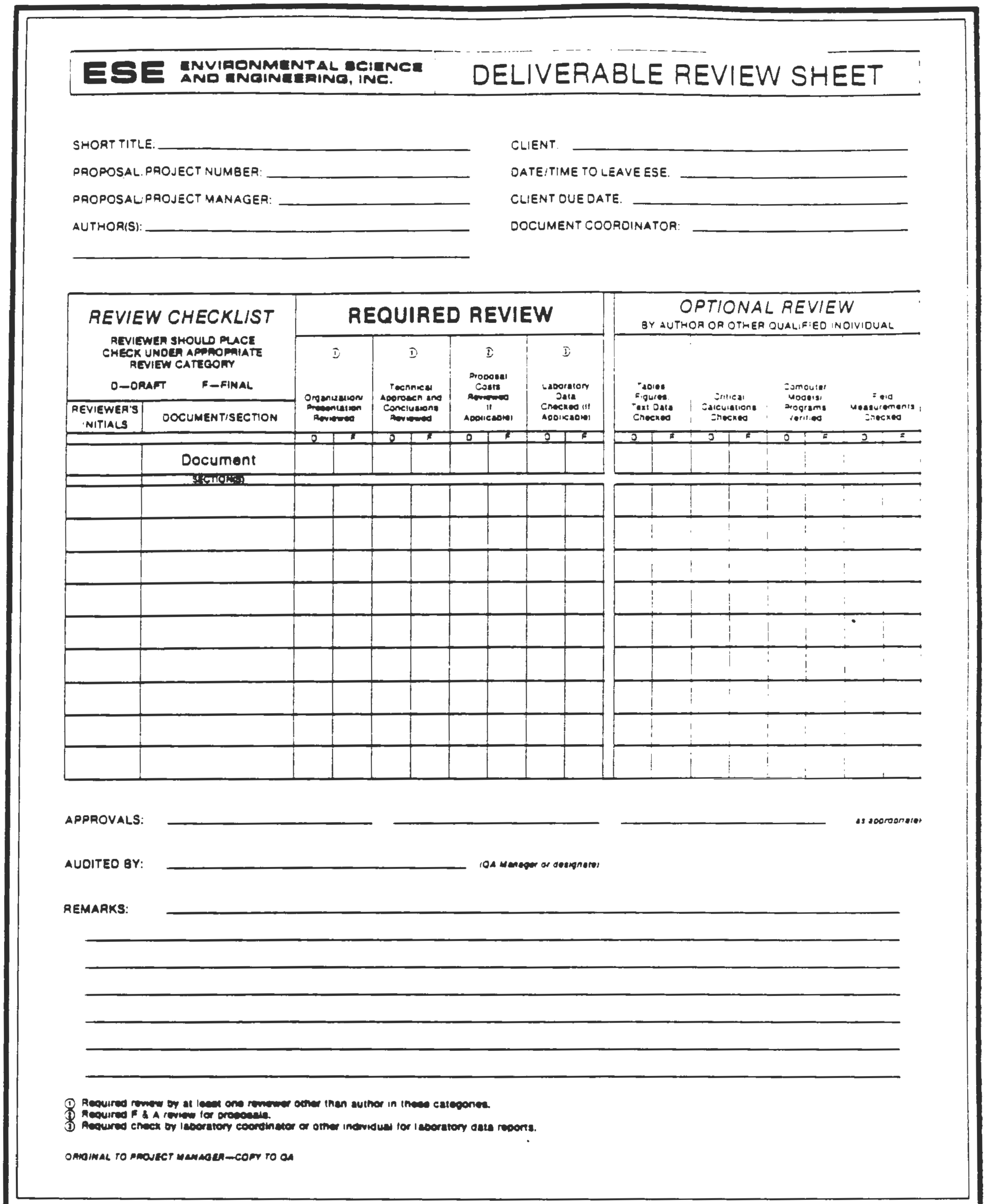
Peer review of all deliverable reports and data supporting this project will be performed by technically qualified individuals from each major discipline represented in the deliverable. Figure 5-3 is a sample Deliverable Review Sheet to be used in this project.

Hunter/ESE is participating in the following proficiency programs:

1. NIOSH, through its Proficiency Analytical Testing Program (PAT),
2. NIST proficiency testing program under the National Voluntary Laboratory Accreditation Program (NVLAP) for bulk asbestos,
3. EPA Water Pollution and Water Supply proficiency programs,
4. EPA Radiochemistry Intercomparison Study and Blind Performance Samples,
5. New York, through its Environmental Laboratory Approval Program (ELAP) for public drinking water and environmental samples categories,
6. California Department of Health, and
7. USACE.

The licenses and certifications held by the Gainesville analytical laboratory are the following:

1. AIHA,
2. NIOSH,
3. NIST for bulk asbestos,



ESE ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.

DELIVERABLE REVIEW SHEET

SHORT TITLE: ______________________

CLIENT: ______________________

PROPOSAL/PROJECT NUMBER: ______________________

DATE/TIME TO LEAVE ESE: ______________________

PROPOSAL/PROJECT MANAGER: ______________________

CLIENT DUE DATE: ______________________

AUTHOR(S): ______________________

DOCUMENT COORDINATOR: ______________________

REVIEW CHECKLIST REVIEWER SHOULD PLACE CHECK UNDER APPROPRIATE REVIEW CATEGORY D—DRAFT F—FINAL		REQUIRED REVIEW								*OPTIONAL REVIEW* BY AUTHOR OR OTHER QUALIFIED INDIVIDUAL							
REVIEWER'S INITIALS	DOCUMENT/SECTION	① Organization/ Presentation Reviewed		① Technical Approach and Conclusions Reviewed		② Proposal Costs Reviewed (If Applicable)		③ Laboratory Data Checked (If Applicable)		Tables Figures, Text Data Checked		Critical Calculations Checked		Computer Models/ Programs Verified		Field Measurements Checked	
		D	F	D	F	D	F	D	F	D	F	D	F	D	F	D	F
	Document																
	SECTION(S)																

APPROVALS: ______________ ______________ ______________ *as appropriate*

AUDITED BY: ______________________ *(QA Manager or designate)*

REMARKS: ______________________

① Required review by at least one reviewer other than author in these categories.
② Required F & A review for proposals.
③ Required check by laboratory coordinator or other individual for laboratory data reports.

ORIGINAL TO PROJECT MANAGER—COPY TO QA

Figure 5-3
DELIVERABLE REVIEW SHEET

SOURCE: HUNTER/ESE, 1989.

HunTER/ESE

4. Florida Department of Health and Rehabilitative Services (HRS) for environmental and drinking water analyses,
5. New York Department of Health,
6. New Jersey Department of Environmental Protection,
7. South Carolina Department of Health and Environmental Control,
8. EPA Contract Laboratory Program (CLP)--both organics and inorganics,
9. Florida HRS for Radiochemistry,
10. USACE,
11. U.S. Navy, and
12. California Department of Health.

The results of these interlaboratory studies will be evaluated periodically by the project QA supervisor during the project as part of the performance audits.

ATTACHMENT A

RESUMES OF KEY PERSONNEL

KATHERINE W. BARRY

Areas of Specialization

Atomic Spectroscopic Analysis in Water, Sediment, Industrial and Biological Materials, Project Coordination, Two and one-half years of CLP experience

Experience

Associate Scientist, Inorganic Chemistry Department, Chemistry Division, Hunter/ESE, Inc., 1986 to present.

Contamination Assessment, U.S. Army Armament R&D Command, Toxic and Hazardous Materials Agency, Multiple Sites, Project Analyst--Responsible for metals analyses by graphite furnace, hydride and flame, and mercury by cold vapor.

Acid Deposition Study, U.S. Environmental Protection Agency, Project Analyst--Project to study the atmospheric deposition of acidity, nutrients, and minerals in Florida. Implemented quality control/ quality assurance protocol in analysis of wet, dry, and bulk precipitation samples.

Confirmation Surveys, U.S. Air Force, Laboratory Analyst--Tasks have been assigned to be investigated at bases including Maxwell, Patrick, Panama City, and Tyndall Air Force Bases. Surface waters, ground waters, soil borings, and sediments are being sampled and analyzed for various screening parameters.

Contract Laboratory Program, U.S. Environmental Protection Agency, Project Analyst--Contract laboratory work for inorganic sample analysis.

Environmental Technician, CH2M Hill, 1984 to 1986.

Laboratory experience includes chemical analysis of water, soil, vegetation, and ambient air; environmental chemistry; bioassay; water/air sampling techniques; atomic absorption spectroscopy, gas chromatography; and quality control procedures.

Laboratory Technician/Supervisor, Breedlove Associates, Inc., 1981-1984.

Education

A.S.	1980	Environmental Science Technology	Santa Fe Community College

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02/05/89

Associations

Florida Society of Environmental Analysis

JOHN D. BONDS, Ph.D.
Associate Vice President/Principal Scientist

SPECIALIZATION

Quality Assurance/Quality Control, RI/FS, Atmospheric Chemistry, Water Chemistry, Industrial Hygiene, Quality Assurance, Hazardous Waste

RECENT EXPERIENCE

RI/FS at Seven U.S. Air Force Installations, Quality Assurance Manager--Prepared overall QA/QC plans, conducted QA/QC audits, monitored laboratory procedure. Sites have included Keesler AFB, MS; Dobbins AFB, Marietta, GA; Patrick AFB, FL; and Plant 78, Brigham City, UT.

RI/FS at 10 Sites for USATHAMA, Quality Assurance Director--Prepared QA/QC plans, conducted QA/QC audits, monitored laboratory practices for three multi-year contracts. Sites have included Rocky Mountain Arsenal, Letterkenny Army Depot, Sharpe Army Depot, West Virginia Ordnance Works, Louisiana Army Ammunition Plant, Tobyhanna Army Depot, Anniston Army Depot, and Jefferson Proving Grounds.

Development of Remedial Action Plan, USATHAMA, Project Manager--Remedial action alternatives were evaluated in a contract for USATHAMA to select the most cost-effective alternative for cleanup of a transformer/capacitor burial. Participated in public meeting to provide technical expertise on PCB contamination.

Initial Assessment for Hazardous Wastes at Army Installations, Team Leader--Comprehensive study at 48 Army installations to determine both past and present history with respect to the use of hazardous substances, quantities used, disposal methods, and disposal sites. Also included an assessment of safety practices and compliance with regulations. Provide technical expertise at public meetings.

Initial Assessment Studies for the United States Air Force, Team Leader--Comprehensive studies at two Air Force bases to determine both past and present history with regard to the use and disposal of toxic and hazardous materials. Conducted in accordance with the Department of Defense Installation Restoration Program policies.

EDUCATION

Ph.D.	1969	Analytical Chemistry	University of Alabama
B.S.	1963	Chemistry	University of Alabama

C-ESE1AF.5/JDB-RIFS.1
11/30/89

JANE M. BRAL, B.S., M.S.
Hydrogeologist

SPECIALIZATION
Geology, Hydrogeology

RECENT EXPERIENCE
Gas Station Assessment, Field Team Leader--Performed extensive sampling of shallow groundwater monitoring wells at gas stations throughout northern Florida. Sampling involved initial well observations concerning the condition and construction of the well, the presence of hydrocarbon odors or floating product, and measurement of water level, product thickness and total depth of the well. Wells were evacuated and a groundwater sample collected which was analyzed for selected organic and inorganic constituents.

Zirtech, Groundwater Monitoring Plan, Field Geologist--Revised a ground water monitoring plan for disposal site to meet FDER approval. Installed the proposed system and have used the resulting data to determine the extent of contamination.

Omni Vest Hazardous Waste Landfill, Field Team Geologist-- Assisted in sampling of monitoring wells and surface water. Performed slug tests of wells and analyzed resulting data for hydraulic parameters. Prepared report of hydrogeologic conditions used in a risk assessment of the site.

Fort George Island Consumptive Use Permit, Field Team Leader-Organized and coordinated field activities for drilling and testing of a 1,300-foot-deep water supply well on Fort George Island, Jacksonville, Florida. Responsibilities included preparation of lithologic log, analysis of pump test data, and assistance in preparation of a final report submitted to the governing water management district.

On Top of the World, Monitoring Plan, Author--Compiled background and site specific hydrogeologic information to develop a monitoring plan to adequately monitor effects of a waste disposal pond on the shallow aquifer.

Fort George Island Shallow Aquifer Pump Test, Field Team Leader--Responsible for conducting a 72-hour pump test of a shallow groundwater aquifer with subsequent data analysis for hydraulic parameters.

Fort George Island Consumptive Use Permit, Participant--Compiled piezometric, water quality, and geophysical data collected on Fort George Island, Jacksonville, Florida. The data was presented as contour maps and geologic cross-sections as required research for consumptive use permit.

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<u>American Agrivest, Monitoring Plan, Author</u>--Compiled background and site specific hydrogeologic information to develop a monitoring plan to adequately monitor effects of land application of industrial wastewater on the shallow and Floridan Aquifers.

<u>Energy Omega, Marietta, Ohio, Research Geologist</u>--Performed sample description, electric log interpretation, subsurface structure and isopach mapping, and lineament analysis to locate areas of oil and gas production in the Appalachian Basin. Prepared reports describing production history and new possibilities for production based on research findings.

<u>Independent Hydrogeologic Impact Assessment, Consultant</u>--Evaluated the hydrogeologic impact of the engineering plans for a proposed landfill site in Morristown, Ohio. Prepared full report for Gwinn and Wallace, Attorneys-At-Law, representing the Residents of Morristown.

<u>Water Quality Evaluation, Independent Consultant</u>--Evaluated surface water quality surrounding the Athens County Landfill, Athens County, Ohio. Study included a complete inorganic analysis of the water and collection of a sample analyzed commercially for the priority pollutants. Project was funded by a grant from Wayne National Forest Service, USDA.

<u>Soil Sampling, Independent Consultant</u>--Devised a method for examining soil samples from roadsides sprayed with brine. Results of an initial sampling of soil and ground water along a heavily sprayed road in Athens County, Ohio, were presented to the Athens County Engineer with a proposal for a further county-wide study.

EDUCATION

M.S.	1984	Hydrogeology	Ohio University
B.S.	1980	Geology	Ohio University

REGISTRATIONS AND CERTIFICATIONS

Certified, Employee Development Course in Hazardous Materials and Site Investigations

ASSOCIATIONS

National Water Well Association

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12/01/89

RUSI B. CHARNA, B.S., P.E.
Senior Engineer

SPECIALIZATION

Remedial Investigations/Feasibility Studies, Hazardous Waste Assessment, Risk Assessment, Clean-Up Design, Wastewater Treatability Studies

RECENT EXPERIENCE

RI/FS Studies at Letterkenny Army Depot for USATHAMA, Project Manager--Assessed extent of contamination and determined potential contamination sources. Project included evaluation of need for remedial measures to achieve regulatory compliance.

U.S. Army COE, Company-Wide Program Manager--Supervises day-to-day project management and performance for the company on all U.S. Army COE projects.

Remedial Investigation/Feasibility Study at the Former Webb AFB, Project Director--Supervised day-to-day project management and performance on this RI/FS for the Kansas City COE.

RI/FS, American Creosote Works, Florida, Project Manager--Work conducted at a former wood preserving plant at which creosote and penthchlorophenel were used as wood preservatives. As extensive ground water contamination was documented, the Feasibility Study focused on remediating the ground water contamination problem via pumping and treating.

RI/FS, Moyer Landfill Site, Project Manager--Project conducted at an inactive hazardous waste landfill that had accepted municipal and various industrial wastes and sludges. Remediation concentrated on the collection and treatment of leachate and seeps from the site, as these had been affecting a nearby creek and resulting in ground water contamination of private, residential drinking water supplies.

EDUCATION

B.S.	1967	Chemical Engineering	Lowell University
B.S.	1963	Chemistry	Bombay University, India

C-ESE1AF.5/RBC-RIFS.1
11/30/89

PAUL H. CHEN, Ph.D.
Staff Scientist

SPECIALIZATION

GC/MS and GC Analysis, Trace Organic Residue Analysis, Mass Spectral Interpretation, Non-Standard Techniques and Methods Development

RECENT EXPERIENCE

RI/FS at Multiple USAF Facilities in Accordance with CERCLA and SARA, GC/MS Chemist--These programs are being conducted at Keesler AFB, MS; Dobbins AFB, GA; Patrick AFB, FL; and Plant 78, UT.

Installation Restoration Phase II of Various USAF Installations, GC/MS Chemist--The Phase II studies for Dobbins AFB, GA; Lockheed Plant 6, GA; and Maxwell AFB, AL will include evaluation of hazardous waste disposal sites and analysis for metals, trace organics, and POL contamination.

RI/FS at Various Civilian and Military Installations Identified under DERA, through EPA or State programs for US Army COE, GC/MS Chemist--Sites include Webb AFB and Schilling AFB, KS.

Analysis of Semi-Volatile Organics in Water, Soil, Sediment, Sludge, and Tissues for a Wide Variety of Industrial and Governmental Clients--

- Analysis of toxic and hazardous substances in water for U.S. Army Toxic and Hazardous Material Agency.
- Analysis of base/neutral and acid extractables in water, soil, and sediment for U.S. Navy.
- Analysis of dioxins, furans, and PCBs in stack gases for Illinois Power Corporation to.establish the destruction efficiency of PCBs in the power plant incinerator.
- Analysis of semi-volatile hazardous substances for a three wood treatment facility.
- Analysis of polycyclic aromatic hydrocarbons and other toxic compounds for American Petroleum Institute.

Expert, National Institute of Environmental Health Sciences, Research Triangle Park, North Carolina, 1983 to 1985--

- Studied the effects of kepone, DDT, and permethrin on the rat brain concentrations of biogenic amine and amino acid neurotransmitters.
- Developed the method for the assessment of acetylchlorine turnover rate by the stable isotopic method.
- Supervised the determination of DDT, kepone, and lead in the rat brain and blood.

Visiting Professor, Indiana University, Bloomington, Indiana, 1982 to 1983--

- Studied the mechanism for the formation of perylene in sediments.
- Determined the concentration of PCBs and PCDFs in tissues.
- eveloped the method for the analysis of organics in fish by negative chemical ionization GC/MS.

Professor, National Yang Ming Medical College, Taipei, Taiwan, 1976 to 1982--

- Analysis of polycyclic aromatic hydrocarbons in air.
- Analysis of nitroamines in foods.
- Analysis of PCBs and PCDFs in the toxic oil and in the blood and tissues of PCB-poisoned patients.
- Studied the inhibition of aflatoxins production in peanut.

Research Scientist, Philip Morris, Inc., Richmond, Virginia, 1968 to 1976--

- Analytical services on mass spectral analysis and interpretation.
- Analysis of tobacco and cigarette smoke condensate for chemical carcinogens and tobacco flavors.

Postdoctoral Research Fellow, University of Pennsylvania, Philadelphia, Pennsylvania, 1967 to 1968--

- Studied the isotope effects in the mass spectra of deuteromethanes.

EDUCATION

Ph.D.	1967	Organic Chemistry	University of Tennessee
B.S.	1959	Chemical Engineering	Cheng Kung University

ASSOCIATIONS

American Chemical Society
American Society for Mass Spectrometry

JACKIE M. HARGROVE, B.S.
Associate Chemist/Project Coordinator

SPECIALIZATION

Water Quality, Inorganic Quantitative Analysis, Project Management and Coordination

RECENT EXPERIENCE

Contamination Assessment, Martin Marietta, Ocala, Florida, Task Manager--Coordinating laboratory analyses of surface water, ground water, soil, and sediment samples for a contamination assessment of metals and volatile organic compounds in ground water in order to develop the necessary remedial action alternatives. Project involves the collection of data to determine delineation of the extent of soil and ground water contamination, the characteristics of the Floridan aquifer, and the relationship between the Floridan Aquifer and Hawthorne Formation.

Hydrogeologic Assessment, Orange County Sanitary Landfill, Orlando. Florida, Task Manager--Coordinated laboratory analyses for surface water and ground water samples in support of a hydrogeological assessment of Orange County sanitary landfill. Project involved data collection to determine contamination assessment and to comply with permit monitoring requirements.

AMAX Chemical Corporation, Pine Level Mine, Hydrologic and Water Quality Monitoring, Task Manager--Coordinated laboratory analysis for monthly ground water and surface water monitoring program, involving Florida Department of Environmental Regulation 17-3 water quality standards. Project involved 1-year monitoring of the hydrology and water quality on the AMAX Pine Level site in order to provide baseline data in support of DRI preparation and discharge permit application.

Routine Chemical Analyses, Project Manager--Coordinated and supervised routine requests for chemical analyses to comply with state and federal regulations. Responsibilities include chain-of-custody procedures, tracking samples through the laboratory, generating final data reports that meet project specific QA/QC requirements, and communicating with clients and internal project managers.

Monitoring Program, W.R., Grace, Four Corners Mine, Project Manager--Coordinated laboratory analyses for monthly ground water and surface water monitoring program. Project involved accumulating data in order to establish baseline prior to mining, in compliance with the requirements of the Southwest Florida Water Management District and Florida Department of Environmental Regulation.

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Surface Water Monitoring, International Minerals and Chemicals Corporation, Kingsford Mine, Project Manager--Coordinated laboratory analysis for monthly surface water monitoring program. Project involved collecting data in order to establish background data in support of DRI preparation for Kingsford Mine.

Installation Assessments, Naval Energy and Environmental Support Activity, Initial Assessment Study, Project Chemist--Participated in two installation assessment studies of naval air stations. Responsibilities included assessment of present and past disposal practices, and an evaluation of the potential for migration of contaminants in the subsurface.

EDUCATION

B.S.	1982	Chemistry	University of Florida

ASSOCIATIONS

American Chemical Society
Florida Association for Water Quality Control

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GARY R. HORWITCH, M.S., P.E.
Chief Engineer

SPECIALIZATION

Remedial Investigation/Feasibility Studies, Remedial Design, Permit Applications for Solid and Industrial Waste Facilities, Solid and Hazardous Waste

RECENT EXPERIENCE

Remedial Investigation/Feasibility Study, Anniston Army Depot, Anniston, Alabama, USATHAMA, Project Manager--Conducted RI/FS to determine the extent and concentration of contaminants resulting from migration from onpost sources. TCE had been observed in Cold Water Springs, the municipal water supply for the area. The source of the TCE had been suspected to be the Anniston Depot, a tank rework facility. Conducted the offpost investigation and coordinated the feasibility study for control or treatment of contaminants originating from the depot.

Remedial Investigation/Feasibility Study, Gallaway Ponds, Gallaway, Tennessee, Tennessee Superfund Site, Project Manager--Directed successful project involving a solidification treatment process of pesticide contaminated sediments, design of a RCRA cap, construction oversite, and completion of a site closure plan and Operation and Maintenance Plan.

Remedial Investigation/Feasibility Study, Lockwood, Andrews and Newman and Texas Department of Water Resources, French Limited, Crosby, Texas, Project Manager--Performed ground water analyses for one phase of the remedial investigation at this Superfund site in Crosby, Texas. Hydrogeologic studies conducted to determine extent of contamination migration.

Remedial Investigation, City Chemical Company, Forsyth Road Site, Project Manager--Delineated the extent of onsite contamination in the soils and unconfined water table aquifer and evaluated the potential for migration to nearby private and public drinking water supplies.

Remedial Action, A.L. Taylor Site (Valley of the Drums), Bullitt County, Texas, Project Manager--Performed a remedial design (RD) to include a cap/cover over buried waste pits and removal of an onsite treatment plant. Performed a remedial investigation to determine the aerial extent of the buried wastes, open pits and holding ponds, and the chemical and physical characteristics of the materials within the onsite features.

EDUCATION

M.S.	1982	Civil Engineering	University of Houston
B.S.	1976	Civil Engineering	Wayne State University

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REGISTRATIONS AND CERTIFICATIONS
Registered Professional Engineer in Texas, Arkansas, Florida
EPA-Sponsored Hazardous Waste Training Course

ASSOCIATIONS
American Society of Civil Engineers
American Concrete Association

MICHAEL E. KELLER, B.S.

Areas of Specialization

Organic Analytical Chemistry, Gas Chromatography/Mass Spectrometry (GC/MS), Analysis of Volatiles, Quality Assurance

Experience

Environmental Science and Engineering, Inc. (ESE), Gainesville, Florida, August 1988 to present. GC/MS Chemist, Environmental Protection Systems, Pensacola, Florida, 1988 to August 1988.

Senior Associate Scientist--Analysis of environmental samples for volatiles and semivolatiles utilizing EPA 500, 600, and 8000 series methods on a Finnigan S100 GC/MS and a Finnigan 1020/OWA GC/MS with Incos/Superincos software.

Enviropact, Inc., Jacksonville, Florida, 1985 to 1987.

GC/MS Supervisor--Supervised operations of GC/MS/DS laboratories in Jacksonville and St. Louis consisting of Hewlett Packard Models 5996 and Mass Selective Detector (MSD) equipped with RTE and Aquarius software packages. Duties included analysis of environmental, hazardous waste, and industrial hygiene samples for trace toxic organic chemicals utilizing EPA 600 and 8000 series and NIOSH methods. Experience with EPA Contract Lab Program (CLP) requirements for both GC and GC/MS, purge and trap, packed, capillary, and megabore columns, and various autosamplers. Responsible for maintaining profitability, sample scheduling, instrument repair/maintenance, and ordering supplies.

Florida Department of Health, Jacksonville, Florida, 1982 to 1985.

Chemist III and Section Chief, GC/MS Section--Supervised operations of GC/MS/DS Laboratory consisting of a Finnigan Model 4000 and a Finnigan Model 4500 configured with Incos/Superincos software. Analyzed environmental and drinking water samples by EPA Methods 624 and 625, expert court witness involving blood alcohol analysis by GC-FID, technical advisor to statewide Implied Consent program (blood alcohol and breath testing), and supervision of laboratory's computerized sample receipt/reporting system.

Kenco Chemical and Manufacturing Corporation, Jacksonville, Florida, 1980 to 1981.

Quality Control Chemist--Developed and maintained quality assurance program with respect to product and packaging of pesticide

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formulations, government compliance, industrial hygiene, and product development.

Florida Department of Agriculture and Consumer Services, Ft. Lauderdale, Florida, 1979 to 1980.

Chemist I, Pesticide Residue Laboratory--Analyzed agricultural samples for pesticide residues by gas chromatography (EC, FID, RFD, TCD, NPD, and Hall detectors) and thin layer chromatography (TLC).

Education

M.B.A.	1982	Business	University of North Florida
B.S.	1979	Chemistry	Jacksonville University

Associations

American Chemical Society

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CHARLES G. MANOS, JR., PH.D.
Staff Scientist

SPECIALIZATION

Inorganic Analytical Chemistry, Soil Chemistry, Clay Mineral Chemistry, Quality Assurance, Mathematical Modeling, Surface Chemistry

RECENT EXPERIENCE

<u>Contract Laboratory Program, Environmental Protection Agency, Project Manager</u>--Responsible for laboratory methods, reporting requirements, and quality assurance.

<u>Gaseous Hydrocarbons in Soils, Environmental Protection Agency, Task Manager and Principal Investigator</u>--Project modeling diffusion, adsorption, and migration of volatile organic compounds in soils.

<u>Studying Deposition Mechanisms of Fuel-Bound Contaminants, U.S. Department of Energy, Research Chemist</u>--Principal Investigator studying deposition mechanisms of fuel-bound contaminants in coal-fired gas turbines. Responsible for design and implementation of experiments measuring effect of individual coal minerals and elements on deposition using laser-induced fluorescence and fiber optic atomic absorption.

<u>Environmental Protection Agency Contract Laboratory Program, Radian Corporation, Senior Scientist/Engineer</u>--Project Manager/Quality Assurance Officer for Radian's involvement in the U.S. EPA's Contract Laboratory Program. Project Manager and Task Leader for Radian contracts with the U.S. Department of Energy concerning development of new fuel forms from coal, and U.S. EPA project modeling diffusion, adsorption, and migration of volatile organic compounds in soils. Similar involvement with other projects that included work with clay liners, hazardous waste sites, and matrix-specific methods development for environmental analyses.

<u>Environmental Protection Agency Contract Laboratory Program, Toxicon Laboratories, Inc., Manager, Inorganic Chemistry Division, Project Manager and Quality Assurance Officer</u>--Supervised operation of all inorganic analyses including classical parameters, graphite furnace atomic absorption, and inductively coupled plasma emission spectrophotometers for Toxicon's involvement in the U.S. EPA's Contract Laboratory Program. Prepared and maintained budgets for laboratory and projects.

EDUCATION

Ph.D.	1982	Soil Chemistry/ Clay Mineralogy	Michigan State University
M.S.	1978	Mathematics	University of Florida
B.S.	1974	Chemistry	University of Florida

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NORMA E. MILLER, M.A.
Technical Editor/Document Coordinator

SPECIALIZATION

Technical Writing and Editing, Document Coordination, Preparation of Technical Reports.

EXPERIENCE

Endangerment Assessment, Confidential Client, Technical Editor/Document Coordinator--Responsible for editing and coordinating the overall production of draft and final reports. Also responsible for supervising word processing, graphics, printing, binding, and distribution.

Environmental Audit, Confidential Client, Technical Editor/Document Coordinator--Responsible for coordination and editing of draft and final reports for an environmental audit for a mining company. Also responsible for supervision of word processing; graphic production; and printing, binding, and distribution.

Master Quality Assurance Plan, Hunter/Environmental Science and Engineering, Inc., Technical Editor/Document Coordinator--Responsible for coordination and editing of revision of Master Quality Assurance Plan for the State of Florida. Also respnsible for superviison of word processing; graphic production; and printing, binding, and distribution.

Master Quality Assurance Plan Supplements, Technical Editor/Document Coordinator--Responsible for editing and coordination of draft and final reports. Responsible for supervising word processing, graphics, printing, binding, and distribution.

Public Involvement and Response Plans, for the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), Technical Editor/Document Coordinator--Responsible for editing and coordinating the overall production of draft and final reports, including formatting (according to USATHAMA specifications), word processing, graphics, printing/binding, and distribution.

Professional Papers, Hunter/Environmental Science and Engineering, Inc., Technical Editor/Document Coordinator--Responsible for coordinating and editing papers submitted to various journals, magazines, and newspapers. Responsible for formatting according to each outlet's specifications, word processing, graphics, printing, and distribution.

EDUCATION

M.A.	1984	Linguistics	University of Illinois

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ASSOCIATIONS
Society for Technical Communication

DAVID M. MOCCIA, B.S., P.E.
Senior Engineer

SPECIALIZATION

Wastewater Treatment, Remedial Investigations, Remedial Design, Remedial Action, and Alternatives Evaluation

RECENT EXPERIENCE

Remedial Action Master Plans, U.S. Environmental Protection Agency (EPA), Project Manager--Prepared Remedial Action Master Plans for several uncontrolled hazardous waste sites, including French Ltd., Sikes Disposal Site, Bayou Sorrell, and the Newport Dump. Existing information, data, and studies that had been completed at each site were evaluated to determine what, if any, additional information would be required to complete remedial investigation. The studies included recommended work plans for the additional site investigations deemed necessary to complete remedial investigations.

Installation Restoration Program, Record Searches, U.S. Air Force, Project Manager--Responsible for conducting record searches at ten U.S. Air Force Bases to determine and document where possible, the past and present hazardous waste management practices and to identify suspected or existing hazardous waste spill or disposal sites. Identified sites were ranked according to their suspected or known threat to the health and safety of the populace and threat to the environment. Based on the evaluations and the ranking of sites, recommendations were made for follow-on activities to better define and characterize the threat posed by the sites.

Industrial Wastewater Evaluation and Improvements Program, Hercules, Inc., Project Manager--Responsible for the evaluation of industrial wastewater collection and treatment programs at a south Georgia chemical manufacturing plant. Project required total identification and characterization of all industrial wastewater streams, evaluation of all existing wastewater processing units, evaluation of overall treatment efficiency, and recommendations for source reduction and design changes to improve treatment operations.

Metal Plating Wastewater Treatment, Stimpson Co., Project Manager--Responsible for comprehensive study of plating wastewater generation and treatment requirements. Project included complete characterization of wastewater, identification of generation sources, recommendations for source reduction, identification and evaluation of treatment and disposal alternatives, and design of treatment system.

EDUCATION

B.S.	1971	Chemical Engineering	University of Florida

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DANIEL G. MOORE, M.S.

SPECIALIZATION

Trace Metal Analysis Techniques for Sediment, Biota and Natural Waters Using Flame, Flameless (Graphite Furnace) and Hydride Atomic Adsorption Spectroscopy; Neutron Activation Analysis Techniques; IC, HPLE and GC Analysis Techniques; IF, UV and ICP Spectrophotometry Techniques; Volumetric and Gravimetric Analysis Techniques; Computer Skills Including Pascal, Fortran and Basic on the VAX, HP 85/87 and Macintosh; Radium Geochemistry and Trace Metal Geochemistry Within River/Ocean Mixing Regions; Uranium Series Nuclides in Groundwater and River Water, Concerning Both Authogenic and Anthropogenic Sources; Low Level Alpha Counting System Design

RECENT EXPERIENCE

Radiochemistry and Water Quality at Hunter/ESE, Department Manager--Supervises seven analysts and technicians. Responsible for measurements of a broad range of Radiochemical parameters including, but not limited to, gross alpha, gross beta, Radium-226, Radium-228, gross Uranium and photo emitters in a variety of environmental samples.

Department of Oceanography at Texas A&M University, Research Associate--Studies the behavior of Radium-226 in the river/ocean mixing zone of the Mississippi River. Performed trace analyses for the NOAA Status and Trends Project (Gulf of Mexico. Twenty-one days at sea participating in the T.T.O Ra/Rn Inter-calibration Cruise measuring Pu-239, U-234, RA-226, and Pb-210. Built and maintained a four channel alpha scintillation detector system for the analysis of Radon-222. Operated and maintained the alpha spectroscopy system used by the laboratory for the analysis of Pu, U, Th, and Pb in sediment and water samples.

Park Employee IV--Handled all aspects of park operations for the Texas Parks and Wildlife Department at Galveston Island State Park.

EDUCATION

M.S.	1986	Oceanography (Chemical)	Texas A&M University
B.S.	1981	Marine Biology	Texas A&M University

ASSOCIATIONS

American Geophysical Union
Sigma XI

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11/30/89

JOHN J. MOUSA, Ph.D.
Senior Chemist

SPECIALIZATION

Environmental Sampling and Analysis, Analytical Chemistry, Water Quality Assessment, Environmental Fate and Assessment Studies, Trace Organic Residue Analysis, Gas Chromatography and High-Pressure Liquid Chromatography

RECENT EXPERIENCE

Research and Development--Responsible for staffing, direction, review and technical quality of projects involving environmental/fate studies, trace organic residue analysis, environmental sampling and analysis, special instrumental techniques and analytical methods development.

Environmental Assessment and Transmission Corridor Studies for Two 600-MW, Coal-Fired Power Plants, Quality Assurance Manager--Study involved full baseline monitoring to support licensing application.

Effluent Guidelines BAT Review-Gum and Wood and Printing and Publishing Industries, Subproject Manager--Supervised and coordinated laboratory analyses for priority pollutants in industrial wastewaters.

Environmental Contamination Assessment of Army Munitions Manufacturing and Storage Facilities, Laboratory Manager/Subproject Manager--Managed laboratory analyses for four environmental assessment studies conducted for U.S. Army Toxic and Hazardous Materials Agency. Work involved methods development certification and trace organics analysis in water, soil, and sediment samples.

Sampling and Analysis of Boundary Monitoring Wells, Project Manager--Sampling and analysis of ground water for trace organics and inorganics at industrial explosives manufacturing facility. Supervised methods documentation and analysis.

Analytical Methods Development for Hazardous Compounds in Water and Soil, Project Manager--Development of analytical methods for seven organic compound at part-per-billion and part-per-million level in water and soil. Includes development of HPLC screening method for organics in water. Compounds include hazardous munitions and related degradation products.

EDUCATION

Ph.D.	1973	Analytical Chemistry	University of Florida
B.S.	1970	Chemistry	University of Houston (Summa Cum Laude)

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ASSOCIATIONS

American Chemical Society
Society of Environmental Toxicology and Chemistry (SETAC) American
Society for Testing and Materials (ASTM)
Phi Kappa Phi--Honor Society (1970)

RICHARD A. OGWADA, Ph.D.
Senior Associate Scientist

SPECIALIZATION

Quality Assurance for Environmental Testing, Soil Physical Chemistry and Environmental Chemistry

RECENT EXPERIENCE

Quality Assurance Audits for Environmental Testing--Responsible for preparation and implementation of project quality assurance plans, including laboratory system audits, data review and preparation of quality assurance reports

Technical Manuscripts Reviewer--Invitational reviewer of several manuscripts for Soil Science Society of America Journal and Soil Science.

Study Phosphorus Retention and Transport in Soils, Lake Okeechobee Watershed, Florida, University of Florida--Research aimed to protect Lake Okeechobee from phosphorus-loading from dairy and waste water application activities in the basin. Research focus was to provide phosphate-soil interactions information for overall modeling effort being undertaken to quantify the fate of phosphorus in the basin. Research included characterization of the soil profiles with phosphate sorption equilibrium parameters.

Study Retention and Transport of Selected Volatile Organic Constituents of Jet Fuels on Soils from Gas- and Solution-Phases, University of Florida, Department of Soil Science--Developed gas chromatographic and GC-headspace techniques to characterize sorption of volatile organic chemicals on soils and aquifer materials. Other duties included managing the day-to-day research activities of the project and writing monthly research progress reports and budgets. The project was sponsored by the U.S. Air Force (Tyndall Air Force Base).

Study Transport and Sorption of Potassium Fertilizer in Soils, University of Delaware--Developed kinetic methodologies to quantitate ion sorption thermodynamic parameters. Experience included atomic absorption spectrophotometry, X-ray diffraction, potentiometric and conductometric titration analyses, and kinetic analyses.

Field Studies Involving Corn Response to Native and Fertilizer Potassium Applications on Delaware Soils--Extensive field experience in field plot design, soil and tissue sampling and analyses.

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Teaching and Research Presentation--Assisted in the laboratory lecture of a General Soils course (Univ. of Florida) and Soil Physical Chemistry course (Univ. of Delaware). Seven technical papers to professional meetings and most of them received excellent responses.

Study of Selected Aquatic Plants to Remove Nutrients from Wastewaters of Lake Apopka Watershed, University of Florida--Organic soils of Lake Apopka basin are intensively used for vegetable production. The research was aimed to evaluate aquatic plants with high growth rates and potential to remove nutrients from organic soil flood-waters before pumping into the lake. Gained extensive experience in soil and water sampling techniques and the use of mass spectrometer for stable nitrogen isotope analysis.

EDUCATION

Ph.D.	1986	Soil Physical Chemistry	University of Delaware
M.Sc.	1983	Soil Science	University of Florida
B.Sc.	1980	Agriculture, Soil Science	University of Florida

ASSOCIATIONS

The National Dean's List 1979-1980
Member of American Society of Agronomy
Member of Soil Science Society of America

TIMOTHY J. PARSONS
Department Manager, Atomic Spectroscopy

SPECIALIZATION

Metals Analysis of Water, Wastewater, Soils, and Sediments. Utilizing ICP, Furnace, Cold-Vapor, and Flame Spectroscopy.

RECENT EXPERIENCE

EPA Contract Laboratory Program (CLP)--Currently coordinating laboratory analyses of water, soils, and sediments for the assessment of metals contamination. Project involves the collection and reporting of data within the guidelines of CLP protocol.

USATHAMA--Coordinating metals analysis of water, soils, and air using numerous USATHAMA methods.

Illinois EPA Contract Laboratory Program, Group Leader--Project involved getting documentation and analysis procedures within Illinois EPA guidelines and the analysis of performance evaluation samples. Once completed, the laboratory qualified for the Contract Laboratory Program and received samples for metals analysis on a routine basis.

Cilco Ground Water Analysis, Group Leader--Quarterly metals analysis of ground water in order to assess contamination that could result from area landfill leaching.

Central Illinois Light Company Groundwater Analysis, Group Leader--quarterly metals analysis of groundwater was performed to assess contamination that could result form area landfill leaching.

Moline Paint Company, Group Leader--Determination of lead and chromium in various paints and pigments. Initial investigation included the analysis of raw products used in paint manufacturing. The investigation ended with weekly monitoring of final products.

EDUCATION

B.S.	1983	Chemistry	Illinois State University

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12/01/89

DWIGHT F. ROBERTS, B.S.
Senior Associate Chemist

SPECIALIZATION

Gas Chromatography/Mass Spectrometry (GC/MS), High Performance Liquid Chromatography (HPLC), Analytical Organic Chemistry

RECENT EXPERIENCE

Management--Department Manager, GC/MS. Responsible for all departmental, technical, and administrative operations of 12 chemists and technicians performing GC/MS analysis of volatile and semi-volatile compounds in various environmental media. The department currently utilizes five Hewlett-Packard GC/MS units and two Finnigan Incos 50s.

Rocky Mountain Arsenal, Analysis Group Leader--Responsible for semi-volatiles analysis and extensive QA/QC for 900 environmental samples. Performed unknown searches for all chromatograms and provided mass-spectral identifications of non-target compounds.

Environmental Survey Analysis for Trace Organics in Groundwater, Soils, and Sediments from Various U.S. Army Installations, Task Manager--Environmental monitoring of previous U.S. Army munitions facilities for chemical characterization of representative sites, specifically explosives, and EPA non-volatile priority pollutants. Involved with sample preparation, screening of extracts by GC-FID, and analysis by capillary GC/MS.

Confirmation of Chlorinated Phenols and Chlorinated Dioxins--Project involved the selection ion monitoring of specific ions indicative of polychlorinated phenols and polychlorinated dioxins.

Quantitative Analysis of PCBs and Pesticides Residues--Project involved conducting analysis by GC-ECD according to EPA protocol for EPA Effluent Guidelines Division to establish guidelines for gum and wood industries.

Miscellaneous NPDES Permit Monitoring, Laboratory Coordinator--Various utility companies and industries need to monitor for many pollutants so that elimination and/or control can be instituted. Sample preparation and analysis by capillary GC/MS for non-volatile priority pollutants including PCBs and pesticides.

EPA Screen Sampling and Analysis for Organic Chemicals in Related Industries, Laboratory Coordinator--Documentation, organization, and implementation for quality control. Sample preparation and instrumental analysis for non-volatile organic priority pollutants by capillary GC/MS for establishment of industrial effluent guidelines.

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<u>Champion International Corporation Consultation, Laboratory Consultant</u>--Training and consultation for Champion analytical personnel for capillary GC/MS analysis of EPA priority pollutants, NPDES monitoring, and instrumental training and troubleshooting.

<u>Synthetic Organic Chemicals in Drinking Water for Various Residential Municipalities, Task Manager</u>--Monitoring of drinking water for trace levels of chemicals by capillary GC/MS per Safe Drinking Water Act.

<u>GC/MS Experience</u>--Ten years experience in GC/MS maintenance and operation. Supervisor of 10 chemists performing GC/MS analysis of environmental samples.

<u>HPLC Experience</u>--Method development and quantitative analysis of trianzines, PNAs, and various pesticides by HPLC using fixed UV, variable UV, fluorescence, refractive index, and electrochemical detectors in reverse and normal phase.

EDUCATION

B.S.	1973	Chemistry	University of Florida

ASSOCIATIONS

American Society for Mass Spectrometry
American Chemical Society

MARCUS O. STEWART

Areas of Specialization

Graphite Furnace Atomic Absorption and Inductively Coupled Argon Plasma Emission Spectroscopy on a Variety of Environmental Matrices

Experience

Laboratory Analyst, Group Leader, ICP Group, Atomic Spectroscopy Department, Chemistry Division, Environmental Science and Engineering, Inc. (ESE), October 1985 to present.

Contamination Assessment U.S. Army Armament R&D command, Toxic and Hazardous Materials Agency, Multiple Sites, Project Analyst--Responsible for metals analyses by graphite furnace, hydride and flame, mercury by cold vapor, and inductively coupled plasma.

Acid Deposition Study, U.S. Environmental Protection Agency, Project Analyst--Project to study the atmospheric deposition of acidity, nutrients, and minerals in Florida. Implemented quality control/ quality assurance protocol in analysis of wet, dry, and bulk precipitation samples.

Confirmation Surveys, U.S. Air Force, Laboratory Analyst--Tasks have been assigned to be investigated at bases including Maxwell, Patrick, Panama City, and Tyndall Air Force Bases. Surface waters, groundwaters, soil borings, and sediments are being sampled and analyzed for various screening parameters.

Contract Laboratory Program, U.S. Environmental Protection Agency, Project Analyst--Contract laboratory work for inorganic sample analysis. Two years of CLP experience.

Hexavalent Chromium Study, Anniston Army Depot, Anniston, AL, Project Chemist--Responsible for onsite setup and operation of Perkin-Elmer 552 Spectrophotometer and sample analysis.

Laboratory Setup--Participated in setting up Jarrell-Ash 1100 MKIII ICP instrument laboratory.

Perkin-Elmer Training Institute, Chicago, IL--Attended course on advanced concepts in ICP in September 1987.

Analyst Training--Responsible for training and supervision of ICP analysts.

Education

B.S.	1985	Applied Mathematics	University of Florida

MICHAEL G. WINSLOW, M.A.

SPECIALIZATION

Operation of Field Analytical Organic Laboratories, Gas Chromatography, Pesticide Residue Analysis, Trace Organic Methods Development, Specific Detectors in Gas Chromatography

RECENT EXPERIENCE

USATHAMA Methods Development, Supervisor--Supervised the development validation of numerous gas chromatographic methods for the analysis in soils and waters of organochlorine pesticides, PCBs, purgeable halocarbons, purgeable aromatics, organosulfur, and organophosphorous compounds in response to the contamination assessment of Rocky Mountain Arsenal.

USATHAMA Groundwater Aeration and Ion, Laboratory Coordinator--Analytical support for pilot study of a treatment system for contaminated groundwater.

Management--Section Manager, Organic Analytical Chemistry. Responsible for all administrative, technical, and marketing operations of four departments currently comprising 40 chemists and technicians: GC/MS, GC volatiles, GC non-volatiles, GC-HPLC.

Wastewater Treatment, Laboratory Coordinator--Analytical support for the optimization of granular activated carbon treatment of pesticidesmanufacturing wastewaters.

Mobile Field Laboratory Operation, Laboratory Supervisor--Managed and operated mobile laboratories at more than ten sites including industrial process plants, hazardous waste treatment facilities, spill response areas, and pilot plant support.

Pesticide/PCB Residue Analysis, Project Chemist--Work included complex-clean-up and gas chromatography and interpretation. Responsibilities included hazardous waste sampling, analysis, data handling, and reporting of pesticide/PCB values for all types of environmental media. Extensive involvement in the extraction and analysis of trihalomethanes, volatiles, phenols, nitrosamines,. and other priority pollutants in soils, wastewaters, and biota.

EDUCATION

M.A.	1977	German	University of Florida
B.S.	1967	Chemistry	University of Florida

APPENDIX C--SCOPE OF WORK

19 September 1989 ANNEX G

TREATABILITY STUDY
AT THE
INCINERATOR ASH LANDFILL
SENECA ARMY DEPOT, ROMULUS, NEW YORK

1.0 GENERAL STATEMENT OF SERVICES

1.1 Background. As part of its continuing program of evaluating and upgrading its hazardous waste management facilities, the Army is performing hazardous waste investigations at Solid Waste Management Units (SWMU's) at Seneca Army Depot (SEAD). A recently completed site investigation of the abandoned ash landfill area (SWMU Designations SEAD-3, SEAD-6, SEAD-14 and SEAD-15) has documented the existence of a narrow plume of groundwater contamination which is believed to extend to, and possibly beyond, the Depot's western boundary. The contaminants of concern are chlorinated volatile organic compounds (VOC's); trans-1,2-dichloroethene, trichloroethene and, to a lesser extent, 1,2-dichloroethane, vinyl chloride and chloroform. SEAD has requested the implementation of proposed interim remedial measures to control the plume migration while more detailed studies are being performed to delineate the full extent of the contamination, its source(s) and possible methods of remediation. The US Army Corps of Engineers, Huntsville Division, on behalf of SEAD, is contracting for the required work.

1.2 Location. Seneca Army Depot is a US Army facility located in Seneca County, New York. SEAD occupies approximately 10,600 acres. It is bounded on the west by State Route 96A and on the east by State Route 96. The cities of Geneva and Rochester are located to the northwest (14 and 50 miles, respectively); Syracuse is 53 miles to the northeast and Ithaca is 31 miles to the south. The surrounding area is generally used for farming.

1.3 Regulatory Status. The Incinerator Ash Landfill area of Seneca Army Depot was proposed for inclusion on the Federal Facilities National Priorities List on 13 July 1989. Consequently, all work to be performed under this contract shall be performed according to CERCLA guidance as put forth in the draft "Guidance for Conducting Remedial Investigations/Feasibility Studies under CERCLA", dated March 1988 (Reference 11.21).

1.4 Previous Investigations. Previous investigations have been performed at various SEAD units. An Installation Assessment and Update (USATHAMA Reports No. 157 (1980) and 157(U) (1987), respectively) were conducted by the U.S. Army Toxic and Hazardous Materials Agency. The purpose of the Assessments was to identify potentially contaminated areas at the Depot. The U.S. Army Environmental Hygiene Agency's Groundwater Contamination Survey No. 38-26-0868-88, "Evaluation of Solid Waste Management Units, Seneca Army Depot" identifies and describes all solid waste management units (SWMU's) at SEAD. In addition, a confirmation study has been performed and closure plans are being developed for the burning pads (SEAD-23). A complete list of previous investigations is presented as References in Section 11.0.

1.5 Security Requirements. Compliance with SEAD security requirements is mandated. These requirements are presented in Section 9.0.

2.0 OBJECTIVE

The objective of this project is to perform a treatability study designed and implemented by the AE. After conducting the study, the AE shall evaluate the effectiveness of the treatment study and make recommendations as to additional actions to be taken for permanent remediation. All work shall be performed under the general supervision of a Professional Engineer registered in the State of New York.

3.0 DETAILED DESCRIPTION OF SERVICES

The AE shall be responsible for performance of the work described in the Tasks below.

3.1 (Task G-1) Visual Inspection and Records Review. The AE shall perform a visual inspection of the site, and review records and reports provided by the Government or available to the AE as published data. The purpose of this Task is to permit the AE's personnel responsible for immediate supervision and implemention of the contract sufficient time to familiarize themselves with basic site conditions. It is not intended that this be a "discovery" process where new information concerning the site is developed.

3.2 (Task G-2) Work Plan. The AE shall prepare and provide a Work Plan describing the specific details of work involved in designing, installing, operating, and evaluating a permeable bed treatment system. No field work, with the exception of the initial site visit, may be performed until the plan is reviewed and approved by the Contracting Officer. All work shall be performed according to the approved plan. The Work Plan shall include, as a minimum, the following sub-plans.

3.2.1 Safety, Health, and Emergency Response Plan (SHERP). See Section 5.0 for details.

3.2.2 Quality Assurance Project Plan (QAPP). See Section 6.0 for details.

3.2.3 Monitoring Well Installation Sub-Plan. The AE shall prepare and provide as part of the Work Plan, a Monitoring Well Installation Sub-Plan. This sub-plan shall describe the materials, personnel, equipment and procedures to be used during installation of the monitoring wells. See Section 7.0 for details.

3.2.4 Dewatering, Excavation, Transport, and Storage Sub-Plan. The AE shall prepare and provide as part of the Work Plan, a Dewatering, Excavation, Transport, and Storage Sub-Plan. This sub-plan shall describe the materials, personnel, equipment and procedures to be used during the various phases of the treatment trench installation.

3.2.5 Treatment System Design Sub-Plan. As part of the Work Plan, the AE shall design a permeable treatment bed for the removal of chlorinated VOC's from the groundwater at the incinerator ash landfill area. A trench shall be excavated, sealed to competent bedrock with bentonite grout and lined with a seamless or sealed-seam permeable geotextile. The trench will then be filled with activated carbon or a sand-carbon mixture, sealed at the top, and capped with clay to minimize infiltration. Naturally flowing groundwater will be intercepted by the trench, treated and released to the downgradient side. Monitoring wells, installed prior to the bed installation, will be used to provide baseline data and to monitor the effectiveness of the treatment bed following installation. The AE shall prepare and submit a Design Sub-plan as part of the Work Plan including narrative and drawings, outlining the design specifics of each system to the Contracting Officer for review and approval prior to trench installation. The drawings shall be conceptual (single-line) type and the narrative shall follow the requirements of Section 4.1. The Design Sub-Plan shall include the following work as a minimum:

3.2.5.1 Monitoring Wells. The AE shall propose the locations, depth and specific installation of 10 monitoring wells to be placed upgradient and downgradient of the treatment trench. For estimating purposes, the AE shall assume an average well depth of 15 feet deep. General criteria for the installation of wells are presented in Section 7.0.

3.2.5.2 Dewatering and Excavation. The AE shall design a dewatering system to remove groundwater prior to excavation. In addition, the AE shall design the trench excavation. Both dewatering and excavation designs shall be proposed based on a need to minimize the amounts of contaminated groundwater and soil to be removed. Methods of bracing the excavation, as required, shall be discussed along with methods proposed for providing positive cutoff at the trench/bedrock tie-in.

3.2.5.3 Treatment Trench. The AE shall propose the location, dimensions and configuration of the treatment trench. The trench shall be 360 feet long by 2 feet wide (minimum dimensions). The trench shall be installed to a depth of one (1) foot below competent bedrock. For estimating purposes, the AE shall assume an average trench depth of 15 feet deep.

3.2.5.4 Treatment "Bag". The AE shall design the treatment bag and the composition of its contents. Geotextile type, size and placement, in addition to the mixture percentages of sand/carbon and gradations required, shall be specified. All design assumptions (carbon efficiencies, etc.) shall be presented.

3.2.5.5 Trench Cap. The AE shall design a trench cap for control of infiltration during operation.

3.2.5.6 Storage of Excavated Material. The AE shall propose the design of temporary storage facilities for excavated soil, dewatered groundwater, well drill cuttings, and well development water. Actual treatment/disposal of material is not part of this delivery order. Storage facilities shall contain materials while preventing contaminant release to the surrounding surface area and atmosphere.

3.2.5.7 Contamination Control Measures. The AE shall discuss in the Design Sub-Plan measures to prevent the release of contaminants during the installation phase of the treatment system. Methods of excavation and equipment to be used shall be chosen based on the need to prevent releases of contaminated soil and groundwater to the surrounding ground area.

3.2.6 Air Monitoring Sub-Plan. The AE shall prepare and submit an Air Monitoring Sub-Plan as part of the Work Plan. The AE shall provide in the Sub-Plan a description of the equipment and procedures to be used for the monitoring of air quality during the installation phase. Air quality monitoring will be required, at a minimum, of the ambient air during the excavation phase using portable air monitoring instrumentation. This emissions monitoring shall be conducted on a real time basis using an organic vapor detection unit. The AE shall identify in the Sub-Plan specific air sampling locations and frequencies.

3.2.7 Identification of Applicable Regulatory and Permit Requirements. As part of the Work Plan, the AE shall identify all applicable local, State and Federal environmental regulations which govern the design, installation and operation of the proposed treatment system. It shall be the responsibility of the AE to obtain all permits required for the installation and operation of the treatment system.

3.3 (Task G-3) Treatment System Installation. The minimum requirements for installation of the treatment facilities are outlined in the following. All work shall be completed according to the approved Work Plans and in accordance with applicable Federal and State regulations and permitting requirements.

3.3.1 Monitoring Wells. The AE shall install monitoring wells according to the criteria presented in Section 7.0 and as designed in the approved Work Plans.

3.3.2 Excavating, Stockpiling, and Storing. The AE shall provide necessary labor and equipment and be responsible for all grubbing, excavating, dewatering, stockpiling, and storing. The AE shall utilize excavating methods and procedures that were approved in the Work Plan. The excavation locations as approved in the Work Plan shall not be deviated from by the AE. The AE shall assume that all excavated soil, dewatered groundwater, well drill cuttings, and well development water is to be considered hazardous and shall be handled accordingly. Stockpiling and storage facilities shall be sufficient to preclude movement of contaminants outside stockpile and storage areas. The AE shall containerize the dewatered groundwater and well development water in an area adjacent to the trench. The AE shall sample the excavated soil and dewatered groundwater to determine if they are in fact hazardous. If the analytical testing indicates they are hazardous, the Government will be responsible for disposal. If they are non-hazardous, the soil and groundwater will remain on site. The AE shall be responsible for compliance with all Resource Conservation and Recovery Act (RCRA) requirements for removal of hazardous wastes. The AE shall be responsible for acquiring all permits necessary for installation and operation of the trench. Methods for accomplishing the objectives shall be discussed in the Work Plans.

3.4 (Task G-4) Soil Characterization. The AE shall conduct two rounds of soil sampling for chemical analysis. Both rounds shall be taken during the excavation of the trench. Sampling locations shall be proposed in the Work Plans. The soil samples collected under this task shall be analyzed according to the requirements of Tables 1 and 2. In addition, Quality Control/Quality Assurance (QC/QA) samples shall be taken and analyzed according to the requirements of Tables 1 and 2. A total of 12 soil samples shall be analyzed. Soil sampling and analysis shall conform to the requirements of the approved Work Plan. Results of sampling and analysis shall be presented in the Engineering Report.

TABLE 1

Number of Samples to be Collected and Analyzed (Task G-4)
(Soil, Leachate and Control Samples.)

Type/Location of Samples To Be Collected and Analyzed.	Field Samples	QC/QA Samples		Total Samples Collected
		AE's QC Samples Splits	CEMRD QA Samples Splits	
Round 1	3	1	1	5
Round 2	3	1	1	5
Leachate	3	1	1	5
Totals (Basic)	9	3	3	15

* CEMRD (QA) samples shall be collected by the AE and sent to the government laboratory for analysis that will be conducted by the Government.

** 15 is the total to be collected by the AE; however, laboratory analysis shall be limited to only field and QC samples (total 12).

Field samples must include at least one "background" soil sample.

TABLE 2

Required Analyses, Approved EPA Methods and Estimated Quantities

Task G-4

Rounds	Method Description	Method	Field Samps	Number of QA/QC Samps**
One	B/N/A	8270	3	1
	Volatile Organics	8240	3	1
	Metals*	6010	3	1
	Arsenic	7060	3	1
	Selenium	7740	3	1
	Mercury	7470	3	1
Two	B/N/A	8270	3	1
	Volatile Organics	8240	3	1
Leachate	B/N/A	8270	3	1
	Volatile Organics	8240	3	1

* Metals Analysis: Method 6010 shall include Barium, cadmium, chromium, lead, antimony, copper, nickel, thallium, zinc and beryllium.

** The numbers presented are the samples to be analyzed by the AE's laboratory. QA samples as stated in Table 1 shall be collected by the AE and sent to the CEMRD laboratory for analysis.

3.5 (Task G-5) Dewatered Groundwater Characterization. The AE shall conduct two rounds of dewatered groundwater sampling for chemical analysis. Both rounds shall be taken during the excavation of the trench. The groundwater samples collected under this task shall be analyzed according to the requirements of Tables 3 and 4. In addition, Quality Control/Quality Assurance (QC/QA) samples shall be taken and analyzed according to the requirements of Tables 3 and 4. A total of 12 groundwater samples shall be analyzed. Groundwater sampling and analysis shall conform to the requirements of the approved Work Plan. Results of sampling and analysis shall be presented in the Engineering Report.

3.6 (Task G-6) Treatment System Monitoring. The AE shall monitor the effectiveness of the treatment system through periodic sampling of the wells placed upgradient and downgradient. Monitoring wells shall be sampled immediately prior to and following system installation and thereafter at four-month intervals for 1 year. Five rounds of monitoring well sampling shall be conducted as shown in Table 3. In addition, Quality Control/Quality Assurance (QC/QA) samples shall be taken and analyzed according to the requirements of Tables 3 and 4.

TABLE 3

Number of Samples to be Collected and Analyzed

(Monitoring Wells, Dewatered Groundwater, and Control Samples.)

Samples To Be Collected and Analyzed	Field Samples	QC/QA Samples				Total Samples
		Sample Blank, Rinsate	AE's QC Samples Split	CEMRD QA Samples Split	Sample Blank, Rinsate	
MONITORING WELLS:						
Round 1 (Prior to installation)	10	1	1	1	1	14
Round 2 (Following installation)	10	1	1	1	1	14
Round 3 (After 4 months)	10	1	1	1	1	14
Round 4 (After 8 months)	10	1	1	1	1	14
Round 5 (After 1 year)	10	1	1	1	1	14
DEWATERED GROUNDWATER:						
Round 1	2	1	1	1	1	6
Round 2	2	1	1	1	1	6
Totals	54	7	7	7	7	84

* CEMRD (QA) samples shall be collected by the AE and sent to the Government laboratory in Omaha, Nebraska for analysis that will be conducted by the Government.

** 84 is the total to be collected by the AE; however, laboratory analysis shall be limited to only field and QC samples (total 77).

TABLE 4

Required Analyses, Approved EPA Methods and Estimated Quantities

Rounds	Method Description	Method	Field Samps	# QA/QC Samps
MONITORING WELLS:				
One	B/N/A	8270	10	4
(Prior to	Volatile Organics	8240	10	4
installation)	Metals*	6010	10	4
	Arsenic	7060	10	4
	Selenium	7740	10	4
	Mercury	7470	10	4
Two	B/N/A	8270	10	4
(Following installation)	Volatile Organics	8240	10	4
Three	B/N/A	8270	10	4
(After 4 mo.)	Volatile Organics	8240	10	4
Four	B/N/A	8270	10	4
(After 8 mo.)	Volatile Organics	8240	10	4
Five	B/N/A	8270	10	4
(After 12 mo.)	Volatile Organics	8240	10	4
DEWATERED GROUNDWATER:				
One	B/N/A	8270	4	2
	Volatile Organics	8240	4	2
	Metals*	6010	4	2
	Arsenic	7060	4	2
	Selenium	7740	4	2
	Mercury	7470	4	2
Two	B/N/A	8270	4	2
	Volatile Organics	8240	4	2

* Metals Analysis: Method 6010 shall include Barium, cadmium, chromium, lead, antimony, copper, nickel, thallium, zinc and beryllium.

3.7 <u>(Task G-7)</u> <u>Tri-annual Reports.</u> The AE shall prepare tri-annual reports fully documenting the results of sampling accomplished in Task G-6. These reports shall be submitted within 14 days of completion of the testing. Specifically, each report shall present the following information:

o A summary of all analytical results that have become available during the previous four months.

o Supporting QC/QA documentation.

o All groundwater level data collected during the four-month sampling event.

o Groundwater flow maps based on the most recent four-months of groundwater level data.

o Isopleth maps for the applicable contaminants.

o Well maintenance activities planned or performed.

o Summary of well installation activities performed in the last four months, including well logs, installation details, field data collected and surveyed well locations. Existing reports may be referenced.

o Any problems or planned activities.

o An evaluation of the progress of the study based on the information provided in the items above.

3.8 <u>(Task G-8)</u> <u>Engineering Report.</u> The AE shall prepare an engineering report which fully documents all work performed. The report shall present descriptions of the existing site conditions, field work performed and the results of chemical analyses. More specifically, the report shall include discussions of the following.

3.8.1 Findings/Results/Conclusions from Round 1 Monitoring Well and Dewatered Groundwater Sampling

3.8.2 Findings/Results/Conclusions from Round 2 Monitoring Well and Dewatered Groundwater Sampling

3.8.3 Findings/Results/Conclusions from Round 3 Monitoring Well Sampling

3.8.4 Findings/Results/Conclusions from Round 4 Monitoring Well Sampling

3.8.5 Findings/Results/Conclusions from Round 5 Monitoring Well Sampling

3.8.6 Findings/Results/Conclusions from Round 1 Excavated Soil Sampling

3.8.7 Findings/Results/Conclusions from Round 2 Excavated Soil Sampling

3.8.8 Detailed Evaluation of Treatment Results

3.8.9 Discussion of Problem Areas and Operational Constraints

3.8.10 Recommendations for Further Actions

3.9 (Task G-9) Presentations and Meetings.

3.9.1 Informal Presentation. The AE shall conduct two informal presentations. One will be conducted after the draft work plan and the other after the draft engineering report. A meeting will follow each informal presentation. Presentations will be conducted at SEAD. Comments generated as a result of Government review and comments at the informal presentations shall be incorporated into the submittals by the AE. The AE shall assume that the two informal presentation/meeting will last one day each, and that two AE personnel will attend (one project manager and one technical person).

3.9.2 Formal Presentation. After the final submittal, the AE shall conduct a formal presentation of the Engineering Report and the conclusions that were reached. The formal presentation will follow a meeting in which only Government personnel and the AE will be involved. This meeting will occur in the morning session and the formal presentation in the afternoon. The AE shall assume that both the informal meeting and the formal presentation will be conducted at SEAD. During the formal presentation, the AE shall utilize handouts, vugraphs, charts and maps, as required, to illustrate the conclusions of the Engineering report. The proposed audience consists of the SEAD Commander and other installation representatives, Government personnel involved with the decision process, and regulatory agencies. All comments made shall be addressed and incorporated into the Engineering Report by the AE. The AE may assume that the meeting/formal presentation will last one day, and that one technical person and one project manager shall attend.

4.0 SUBMITTALS AND PRESENTATIONS

4.1 Format and Content of Engineering and Design Reports. The Engineering and Design Reports presenting all data, analyses, and recommendations shall be prepared in the AE's standard format for engineering and design reports. All drawings shall be of engineering quality in drafted form with sufficient detail to show interrelations of major features on the installation site map. When drawings are required, data may be combined to reduce the number of drawings. The report shall consist of 8-1/2" x 11" pages with drawings folded, if necessary, to this size. A decimal paragraphing system shall be used. The report covers shall consist of vinyl three-ring binders and shall hold pages firmly while allowing easy removal, addition, or replacement of pages. A report title page shall identify the AE, the Corps of Engineers, Huntsville Division, and the date. The AE identification shall not dominate the title page. This Statement of Work shall be incorporated in the draft report only. Submittals shall include incorporation of all previous review comments accepted by the AE as well as a section describing the disposition of each comment. Disposition of comments submitted with the final report shall be separate from the report document. All final submittals shall be sealed by the registered Professional Engineer-In-Charge.

4.2 Conference Notes. The AE will be responsible for taking notes and preparing the reports of all conferences, presentations, and review meetings. Conference notes will be prepared in typed form and the original furnished to the Contracting Officer (within five (5) working days after date of conference) for concurrence and distribution to all attendees. This report shall include the following items as a minimum:

a. The date and place the conference was held with a list of attendees. The roster of attendees shall include name, organization, and telephone number.

b. Written comments presented by attendees shall be attached to each report with the conference action noted. Conference action as determined by the Government's Project Manager shall be "A" for an approved comment, "D" for a disapproved comment, "W" for a comment that has been withdrawn, and "E" for a comment that has an exception noted.

c. Comments made during the conference and decisions affecting criteria changes, must be recorded in the basic conference notes. Any augmentation of written comments should be documented by the conference notes.

4.3 Confirmation Notices. The AE will be required to provide a record of all discussions, verbal directions, telephone conversations, etc., participated in by the AE and/or representatives on matters relative to this contract and the work. These records, entitled "Confirmation Notices", will be numbered sequentially and shall fully identify participating personnel, subject discussed, and any conclusions reached. The AE shall forward to the Contracting Officer as soon as possible (not more than five (5) work days), a reproducible copy of said confirmation notices. Distribution of said confirmation notices will be made by the Government.

4.4 Progress Reports and Charts. The AE shall submit progress reports to the Contracting Officer with each request for payment. The progress reports shall indicate work performed, and problems incurred during the payment period. Upon award of contract, the AE shall, within 15 days, prepare a progress chart to show the proposed schedule for completion of the project. The progress chart shall be prepared in reproducible form and submitted for approval. The actual progress shall be updated and submitted by the 15th of each month and may be included with the request for payment.

4.5 Completion Dates.

Site Visit/Record Review	13 Oct 89
Draft Work Plans	28 Nov 89 Dec 4
Informal Meeting/Presentation at SEAD	5 Dec 89
Draft-Final Work Plans	19 Dec 89
Gov't Comments Provided	8 Jan 90
Final Work Plans	22 Jan 90
Completion of Monitoring Well Installation	9 Feb 90
Completion of Trench Installation	23 Feb 90 ✓
Draft Engineering Report	7 May 91
Informal Meeting/Presentation at SEAD	22 May 91
Final Engineering Report	21 Jun 91
Formal Meeting/Presentation at SEAD	9 Jul 91 ✓

The overall completion date for this delivery order shall be 1 Aug 1991.

4.6 Submittals.

4.6.1 General Submittal Requirements.

4.6.1.1 Distribution. The AE is responsible for reproduction and distribution of all documents. The AE shall furnish copies of submittals to each addressee listed in paragraph 4.6.3 in the quantities listed in the document submittal list. Submittals are due at each of the addressees not later than the close of business on the dates shown in paragraph 4.5.

4.6.1.2 Partial Submittals. Partial submittals will not be accepted unless prior approval is given by the Contracting Officer.

4.6.1.3 Cover Letters. A cover letter shall accompany each document and indicate the project, project phase, the date comments are due, to whom comments are submitted, the date and location of the review conference, etc., as appropriate. (Note that, depending on the recipient, not all letters will contain the same information.) The contents of the cover letters should be coordinated with CEHND-ED-PM prior to the submittal date. The cover letter shall not be bound into the document.

4.6.1.4 Supporting Data and Calculations. The tabulation of criteria, data, calculations, and etc., which are performed but not included in detail in the report shall be assembled as appendices. Criteria information provided by CEHND need not be reiterated, although it should be referenced as appropriate. Persons performing and checking calculations are required to put their full names on the first sheet of all supporting calculations, and etc., and initial the following sheets. These may not be the same individual. Each sheet should be dated. A copy of the final scope of services shall be included as appendix A in the report.

4.6.1.5 Reproducibles. One camera-ready, unbound copy of each submittal shall be provided to the Contracting Officer in addition to the submittals required in the document and submittal list. All final submittals shall also be provided to the Contracting Officer on floppy disks compatible with the Intel 310/80286 computer with XENIX release 3.0 update 2 operating system in ASCII format and Wordstar 2000 Release 2 format.

4.6.2 Specific Submittal Requirements.

a. Work Plans (Task G-2) (Draft, Draft-Final and Final).

b. Tri-Annual Reports (Task G-7).

c. Engineering Report (Task G-8) (Draft and Final).

4.6.3 Addressees.

Commander
U.S. Army Corps of Engineers
Huntsville Division
ATTN: CEHND-ED-PM (Mr. Walt Perro)
PO Box 1600
Huntsville, AL 35807-4301

Commander
U.S. Army Environmental
Hygiene Agency (USAEHA)
ATTN: HSHB-ES-G
Building 1677
Aberdeen Proving Ground, MD 21010-5422

Commander
U.S. Army Material Command (USAMC)
ATTN: AMCEN-A (Mr. Bob King)
5001 Eisenhower Ave.
Alexandria, VA 22333-0001

Commander
U.S. Army Corps of Engineers
Toxic and Hazardous Materials Agency
ATTN: CETHA-IR-D (Katherine Gibson)
Aberdeen Proving Ground, MD 21010-5401

Commander
US Army Corps of Engineers,
North Atlantic Division,
ATTN: CENAD-CO-EP
90 Church Street
New York, NY 10007-9998

Commander
U.S. Army Depot Systems
Command (DESCOM)
ATTN: AMSDS-EN-FD
(Mr. Tim Toplisek)
Chambersburg, PA 17201

Commander
US Army Corps of Engineers
Missouri River Division
ATTN: CEMRD-ED-EA (Mr. Doug Plack)
PO Box 103, Downtown Station
Omaha, NE 68101-0103

Commander
US Army Corps of Engineers
Missouri River Division
ATTN: CEMRD-ED-GL
PO Box 103, Downtown Station
Omaha, NE 68101-0103

Commander
Seneca Army Depot
ATTN: SDSSE-HE (Randy Battaglia)
Romulus, NY 14541

Commander
HQUSACE
ATTN: CEMP-RI
20 Massachusettes Ave., NW
Room 2209
Washington, D.C. 20314-1000

4.6.4 Document and Submittal List.

	Work Plans			Engr. Rpt.		Tri-Annual Reports
	Draft	Draft-Final	Final	Draft	Final	
CEHND-ED-PM	6	6	6	6	6	6
USAMC	1	1	1	1	1	1
DESCOM	2	2	2	2	2	2
CETHA-IR-D	2	2	2	2	2	2
CEMRD-ED-EA	3	3	3	3	3	3
CEMRD-EA-GL	1	1	1	1	1	1
SDSSE-HE	10	10	10	10	10	10
CENAD-CO-EP	0	0	1	1	1	1
USAEHA	7	0	7	1	1	1
CEMP-RI	1	0	1	0	1	0
TOTAL	33	25	34	27	28	27x3=81

5.0 SAFETY REQUIREMENTS.

Site activities in conjunction with this project may pose unique safety, chemical, and/or biological exposure hazards which require specialized expertise to effectively address and eliminate. The AE shall prepare and submit a Safety, Health and Emergency Response Plan (SHERP) to the Contracting Officer (CO) which shall address accident prevention, personal protection against chemical exposures, and emergency response procedures. The SHERP shall establish in detail the protocols necessary for protecting workers and on-site personnel, the public, and the environment from any hazards associated with well installation, soil borings, water sampling, and sediment sampling equipment and procedures; and from hazards associated with potential exposures from chemicals, agents, or situations suspected or known to be on the site. A Draft SHERP shall be submitted as a separately bound document to the CO for approval prior to the commencement of any on-site activity which, with revisions, will stand as the Final SHERP for this site. All work shall be performed according to the approved SHERP. The SHERP shall be prepared in accordance with the requirements specified in this section. The SHERP must be prepared and administered by a Certified Industrial Hygienist (CIH).

Qualifications for the CIH shall consist of training and experience commensurate with the hazards to be encountered for the project. The SHERP shall comply with all federal, state, and local health and safety requirements, e.g., the Occupational Safety and Health Administration (OSHA) requirements (29 CFR 1910 and 1926), the U.S. Environmental Protection Agency (USEPA) hazardous waste requirements (40 CFR 260-270), the U.S. Army Corps of Engineers Safety and Health Requirements Manual (EM 385-1-1), and the U.S. Army Materiel Command Safety Manual, AMC-R 385-100. The SHERP shall include but not limited to:

5.1 Organization/Administration. The AE shall assign responsibilities for safety activities and procedures. A Certified Safety Professional (CSP) shall be designated to implement the SHERP for all onsite activities. A person certified in first aid/CPR by the Red Cross or equivalent, shall be continuously present on-site during operations.

5.2 Standard Operating Procedures (SOPs). The AE shall outline standard operating procedures (SOPs) for preventing accidents, and protecting personnel from injury and occupational illness for all operations having a significant accident potential. Approved SOPs will be made available to prime and subcontractor personnel for personnel information guidance and compliance.

5.3 Identification of Hazards. The AE shall review existing records and data to identify potential hazards associated with the designated drilling and sampling sites and to evaluate their impact on field operations. The AE shall develop action levels for controlling worker exposure to the identified hazards in accordance with appropriate requirements.

5.4 Personal Protective Equipment. The AE shall provide appropriate personal protective equipment (PPE) to ensure workers, official visitors and government employees are protected from exposure to recognized physical hazards and protected from exposure to hazardous chemical concentrations above the action level (Levels A, B, C, D, and modifications) for each operation stated for each work zone. The level of protection shall be specified in the SOP for each operation. The AE shall provide and maintain all PPE.

5.5 Safety and Health Training. The AE shall, as a minimum provide training to his employees complying with the requirements of 29 CFR 1910.120. The program shall inform employees, official visitors and government employees of the special hazards and procedures (including PPE, its use and inspection) to control these hazards during field operations. Employees shall be trained in emergency procedures, areas of restricted access, methods of decontamination, and general safety. All prime and subcontractor personnel shall complete this program prior to beginning on-site work. The AE shall keep individual training records on all workers associated with the project and submit a copy of these records in the draft SOP.

5.6 Monitoring. The AE shall provide continuous monitoring of the identified hazards associated with the designated drilling sites for controlling worker exposure during field operation. When applicable, National Institute for Occupational Safety and Health (NIOSH) approved sampling and analytical methods must be used.

5.7 Emergency Procedures. The AE shall establish procedures to take emergency action in the event of immediate hazards, i.e.,a chemical agent leak or spill, fire, or personal injury. The AE designated CSP shall serve as the emergency coordinator. Personnel and facilities providing support in emergency procedures shall be identified. Specify the emergency equipment to be present on-site and the Emergency Response Plan procedures, as required by 29 CFR 1910.120 (1) (1) (ii).

5.8 Medical Surveillance. Prime and subcontractor personnel shall have medical examinations prior to commencement of work. The medical examination results shall be evaluated by a board-certified or board-eligible licensed physician practicing occupational medicine to determine if the individual is physically fit for the work to be performed and that no physical condition or disease would be aggravated by exposure to the identified hazards. Medical records shall be available for review by the CO upon request. Specify exam content and frequency.

5.9 First Aid. The AE shall provide appropriate emergency first aid equipment suitable for treatment of exposure to identified hazards, including chemical agents. A vehicle shall be made available to transport injured workers to medical facilities identified in the SHERP.

5.10 Accident Prevention, Recording and Recordkeeping. An accident prevention plan and description of work phase safety plans shall be addressed, as discussed in Paragraphs 01.A.03 thru 01.A.06 and Appendix Y of COE EM 385-1-1 for those topics not specifically addressed by this listing. The AE shall immediately notify the CO of any accident/incident. Within two working days of any reportable accident the AE shall complete and submit to the CO an Accident Report on ENG Form 3394 in accordance with AR 385-40 and OCE supplement 1 to that regulation.

5.11 Safety Inspection. The AE shall conduct regular safety inspections to determine if operations are being conducted in accordance with established SOPs.

5.12 Site Layout and Control. Include a site map, work zone delineation, on/off-site communications, site access controls, and security (physical and procedural). The AE will determine three areas; exclusion, contamination reduction and support, for each work site. No person shall be allowed entry into the exclusion and contamination reduction areas unless in compliance with Sections 5.4, 5.5, and 5.8.

5.13 Air Monitoring Program. Specify the types and frequency of air monitoring/sampling to be performed. Include real-time (direct-reading) monitoring and integrated (TWA) sampling for specific contaminants of concer, as appropriate. Discuss instrumentation and calibration to be performed.

5.14 Health and Safety Work Precautions. Buddy system, eating and drinking precautions, smoking and ignition sources, potentially hazardous noise, explosive atmosphere, illumination, heat or cold stress, confined space entry precautions, eye wash stations, fire extinguishers, sanitation, and routine safety inspections shall be discussed.

5.15 Personnel and Equipment Decontamination. Specify decon facilities and procedures for personnel protective equipment, sampling equipment, and heavy equipment.

5.16 Logs, Reports, and Recordkeeping. Safety inspection reports, accident/incident reports, medical certifications, training logs, monitoring results, etc. All exposure and medical monitoring records to be maintained according to OSHA standard 29 CFR 1910.20.

5.17 Unexploded Ordnance. The facility is a military installation and has been used for storage, evaluation and disposal of ordnance and/or explosive materials as well as for military training. If explosive contamination or unexploded ordnance is discovered at any time during operations at the site the AE shall mark the location, immediately stop operations in the affected area, and notify the CO. The Government will make appropriate arrangements for evaluation and proper disposal of the device. It is anticipated that in the unlikely event that such conditions arise, they will be overcome with only slight delays to the AE. It is the express intention of the Government that the AE is not to drill, excavate, or otherwise disturb the subsurface in areas where ordnance or explosives may reasonably be suspected unless specific, detailed plans to do so are prepared and approved.

5.18 Suggested SHERP Format.

STAFF ORGANIZATION
- Principal Engineer
- Program Manager
- Certified Industrial Hygienist
- Certified Safety Professional
- First Aid/CPR Personnel
- Field Personnel
- Subcontractor Personnel

HAZARD COMMUNICATION AND TRAINING
- Comprehensive Health and Safety Indoctrination
- Specialized Training
- Visitor Training
- Pre-Investigation Health and Safety Briefing
- Post-Investigation Health and Safety Briefing
- Morning Safety Meetings

MEDICAL SURVEILLANCE
- Medical Surveillance
- Licensed Occupational Physician
- Medical Examinations

EXPOSURE MONITORING

- Environmental and Personnel Monitoring
- Meteorological Monitoring
- Sampling and Analytical Methods
- Heat/Cold Stress Monitoring

HEALTH AND SAFETY EQUIPMENT

- Personal Protective Equipment
- Environmental Monitoring Equipment
- Decontamination Equipment
- Emergency Equipment
- Emergency-Use Respirators
- Spill Control Equipment
- Fire Extinguishers
- First Aid Equipment and Supplies
- Emergency Eye Wash/Shower (ANSI Z358.1)
- Personnel Hygiene
- Personnel Decontamination
- Communications

STANDARD OPERATING PROCEDURES

- Health and Safety Site Plan
- Site Description
- Site Inspection
- Site Security
- Site Entry Procedures
- Responsibilities
- Work Zones
- Hazard Evaluation
- Activity Hazard Analysis
- Accident Prevention
- Accident Reporting
- Safe Work Practices
- Confined Space Entry Procedures
- Material Handling Procedures
- Levels of Protection
- Decontamination Procedures
- Emergency Information
- Emergency Response Plan
- Illumination
- Sanitation
- Well Installation/Logging
- Sampling
- Land Survey
- Laboratory Analysis
- Logs, Reports, and Recordkeeping

6.0 QUALITY ASSURANCE PROJECT PLAN REQUIREMENTS

The AE shall prepare and submit the Quality Assurance Project Plan (QAPP) according to the requirements of this section, ER 1110-1-263, and the definitions given in Paragraph 6.9. The site specific field and laboratory QC/QA plan shall be included. The AE shall propose only methods and procedures in the work plans acceptable to EPA and the State of New York.

6.1 Approval. The work plan must be approved by the CO prior to performing any field work. In the event corrections or comments are made by the CO on the draft work plan, any necessary changes shall be implemented by the AE before final approval.

6.2 AE Responsibility for Chemical Analyses. It is the responsibility of the AE to properly collect, transport, analyze and present the data pertaining to chemical analysis. If the AE or his subcontractor does not follow the specified criteria and approved work plans and thereby jeopardizes the samples, the Contracting Officer will disapprove the samples and direct the AE to resample, analyze, and present the data at no additional cost to the Government. If directed to do so by the Contracting Officer, the AE shall collect and send representative "split" samples to the US Army Corps of Engineers, Missouri River Division Laboratory (CEMRD-ED-GC, 402-221-7324). The AE will not be responsible for the analysis of the "split" samples or subsequent reporting results. The AE, however, is required to defend his results if there is disagreement between the samples analyzed by the AE and the samples analyzed by the CEMRD laboratory.

6.3 Content and Format. The plan shall address each of the topics in Paragraphs 6.4 through 6.8.2. The following outline shall be used as applicable.

SECTION 1.0 PROJECT ORGANIZATION AND RESPONSIBILITY
SECTION 2.0 SAMPLING
    2.1 Selection of Sampling Locations
    2.2 Samples to be Collected
        2.1.1 Soil/Leachate Samples
        2.1.2 Groundwater Samples
        2.1.3 QC/QA Samples

2.3 Sample Collection Methods and Equipment
2.4 Sample Containers
2.5 Sample Preservation
2.6 Identification
2.7 Transportation and Custody
SECTION 3.0 ANALYSES
3.1 Parameters
3.2 Analytical Methods and Detection Limits
3.3 Laboratory QC/QA
SECTION 4.0 DATA ANALYSIS AND REPORTING
SECTION 5.0 PROGRAM CONTROLS
SECTION 6.0 AIR MONITORING

6.4 Project Organization and Responsibility. The project organization for the prime contractor and any subcontractors shall be clearly defined with a discussion of quality control responsibilities. The AE's Quality Control (QC) Officer shall report to a responsible senior officer of the company, that is, QC management shall be separate from project management. A list of key individuals shall be provided, including those with QC responsibilities. The project-related qualifications of the AE's analytical laboratory shall be addressed in terms of equipment, facilities, and personnel. Names of laboratory supervisors, chemists, technicians and QC officers shall be given with brief resumes chronologically listing education and experience. The project schedule and list of responsible persons shall be stated.

6.5 Sampling. Unless otherwise specified in this SOW and contract, all sampling and sample custody procedures shall be consistent with EPA and State of New York guidelines.

6.5.1 Selection of Sampling Locations. For sampling sites to be chosen in the field, the plan shall describe the rationale that will govern their selection. The plan shall provide the location of each known sampling point on a site map. The plan shall discuss geological and hydrological influences on sample location, and provisions to insure that samples are representative of the site through the use of appropriate field control samples.

6.5.2 Samples to be Collected. The plan shall list or tabulate the samples to be collected, showing the number of samples, locations and analytes. The list shall include field controls. Samples collected and prepared in the field shall include: soil samples, groundwater samples, and field control samples.

6.5.2.1 Soil Samples. The plan shall list or tabulate samples to be collected from the soil borings and test pits for chemical analysis, indicating number, location, depth and analyses required.

6.5.2.2 Groundwater Samples. Each of the groundwater monitoring wells shall be sampled once, by the procedure specified in Paragraph 6.5.3.2. All sampling of wells installed under this delivery order shall be accomplished within a period not exceeding five consecutive days. All samples to be analyzed for metals shall be filtered at the time of collection through filter membranes with a nominal pore size of 0.45 microns.

6.5.2.3 Field Control Samples. A minimum of 10% of all groundwater samples collected shall be QC/QA (5% QC, 5% QA). At least two sampling blanks (1 QC, 1 QA) and two duplicates (1 QC, 1 QA) shall be collected. If samples are to be tested for volatiles, at least two travel blanks shall be included (1 QC, 1 QA).

6.5.2.4 Summary. The types and numbers of samples required are summarized in "Number of Samples to be Collected and Analyizted", Tables 1 and 3.

6.5.3 Sample Collection Methods and Equipment. The plan shall include specific sampling procedures and equipment to be used to collect the various samples. Appropriate references or descriptions shall be given as needed including sample sizes, containers, equipment, etc. Collection and preservation methods shall be consistent with the specified analytical methods and other standards.

6.5.3.1 Prevention of Cross-Contamination. The plan will describe cleaning of equipment and precautions for preventing contamination of samples during collection.

6.5.3.2 Groundwater Sampling. Before a sample is collected from a well, the depth to water from the surveyed reference point shall be measured and recorded. Then the well shall be pumped or bailed with clean equipment to remove a quantity of water equal to at least five times the submerged volume of the casing. If the well does not recharge fast enough to permit removing five casing volumes, the well shall be pumped or bailed dry, and allowed to recharge for four hours. If the well has recharged to greater than 50 percent of the static water level, then two to three well volumes shall be removed. If the well does not recover to 50 percent of the static water level in four hours, then the well shall be pumped dry a second time and sampled as soon as sufficient recharge has occurred. The sample taken from the well for chemical analyses shall be collected from the screened portion of the well and not from the overlying riser section or the underlying sand-sump section of the well. The plan shall describe details of the sample collection procedure.

6.5.3.3 Collection of Soil Samples. The plan shall include complete details of the proposed procedure for collecting soil samples.

6.5.4 Sample Containers. List the composition and volume of containers to be used according to sample type and analyte. Describe cleaning and other preparation of containers.

6.5.5 Sample Preservation. List or tabulate the required preservation methods and maximum holding times, by sample type and analyte.

6.5.6 Identification. Describe the proposed system for identifying, labeling and tracking samples. Include recording of field data in permanently bound notebooks, and the system for relating field data to the proper samples.

6.5.7 Transportation and Custody. Describe packing, shipping or other transportation and custody documentation, in accordance with "Sample Handling Procedures," HND Guideline, September, 1986.

6.6 Analyses.

6.6.1 Parameters. The plan shall tabulate the samples to be collected, each analyte to be investigated, analyses to be performed, and associated predicted detection limit for each analyte. Analysis as listed in the SOW shall be performed on each field sample as well as on field controls sent to the AE's laboratory or subcontract laboratory. Laboratory controls (internal QC samples) are not listed, but shall be included in the approved QAPP. Alternate methods and variation in procedures to those in this SOW may be used if approved by the CO and described in the approved plan.

6.6.2 Analytical Methods. Each proposed method must be specified exactly and in detail by one of the following: (1) Reference to an accepted published method, e.g., an EPA, SM, or ASTM method, if the published procedure is followed exactly, or (2) reference to an accepted published method with a description of any deviations from the published procedure, or (3) complete description of the procedure, e.g., copies of laboratory instructions. Descriptions of any pre-treatment or preparation of the sample required before the actual analysis shall be included. Include the required concentration ranges, and data on the sensitivity (detection limits), precision and accuracy, by analyte and sample matrix in the descriptions of methods. Detection limits shall correspond to the Contract Laboratory Program of the USEPA. Indicate how pre-existing data on sensitivity, precision and accuracy were determined, and procedures to be used to validate the methods for the matrices in question.

6.7 Data Analysis and Reporting. For each analytical method and major measurement parameter, the following information shall be provided:

6.7.1. The data analysis scheme including units and equations required to calculate concentrations or the value of the measured parameter.

6.7.2. Plans for treating results that appear unusual or questionable. Describe the feedback systems used to identify problems by means of the results obtained from control samples. Limits of data acceptability shall be included with the corrective action to be taken when these limits are exceeded. Personnel responsible for initiating and carrying out corrective action shall be indicated. Describe how re-establishment of control is demonstrated. Unacceptable contamination levels in blanks, and the maximum acceptable disagreement between replicate samples and analyses shall be stated in the QAPP. These limits shall correspond to those required by the Contract Laboratory Program of the USEPA. Corrective action to be taken when these limits are exceeded shall be described, and the circumstances that require collection of new samples at no additional cost to the Government shall be specified.

6.7.3. Description of the data management systems, including the collection of raw data, data storage and data quality assurance documentation.

6.7.4. Identification of individuals to be involved in the reporting sequence.

6.7.5. Description or illustration of the proposed data reporting format. Only quantified concentrations of analytes shall be reported.

6.7.6. Procedures to assess the precision, accuracy and completeness of all measurement parameters. The AE shall report precision based on standards and known additions. If statistical procedures are used for data review before reporting, include descriptions.

6.8 Program Controls

6.8.1 Calibration Procedures and Frequency. List field and laboratory instrumentation, specifying manufacturers, models, accessories, etc., with procedures used for calibration and frequency of checks. The instrumentation and calibration should be consistent with the requirements of the contract and the analytical method requirements.

6.8.2 Internal Quality Control Checks. Internal quality control checks are necessary to evaluate performance reliability for each measurement parameter. The numbers and types of internal QC checks and samples proposed (e.g. blanks, duplicates, splits, "spiked" samples and reference standards, as applicable) shall be defined clearly in the work plan and summarized by methods and analytes. The laboratory's established practice for including control samples among the samples tested, and any additional controls required by the present project, shall be described.

6.8.3 Preventive Maintenance. A system for preventive maintenance for facilities and instrumentation shall be described. Preventive maintenance shall be performed by qualified personnel. Records shall be maintained and shall be available for inspection by the CO on request and subsequent repairs, adjustments and calibrations shall be recorded.

6.8.4 External Certification. Prior to any sampling activities under this SOW, the AE's analytical laboratory must be validated by the US Army Corps of Engineers, Missouri River Division (CEMRD-ED-GC, 402-221-7324) or its representative for the contaminants of concern. It is the responsibility of the AE's laboratory to achieve validation from CEMRD independent of CEHND and this delivery order. The AE should start the validation process as soon as this delivery order is awarded since the process takes approximately six (6) to eight (8) weeks.

6.8.5 Laboratory QC. Laboratory QC results shall be submitted to the QA laboratory as soon as it becomes available.

6.9 Definitions. The following terms and meanings are given as they are applied here, since usage and terminology in this field are not yet standardized.

6.9.1 Field Blank Sample is a trip blank, rinsate sample, field background soil blank sample submitted with the field samples for QC/QA purposes.

6.9.2 Field Control Samples are field splits, duplicates/replicates and Field Blank Samples submitted with the field samples for QC/QA purposes.

6.9.3 Trip or Travel Blanks are Type II Reagent Grade organic-free deionized water in 2 x 40 mL VOA vials that accompany the sample containers to the field and back to the laboratory. Trip blanks are used only for coolers containing aqueous samples for volatile organic analysis. These blanks, as well as all other samples being submitted for volatile organic analysis, are to contain no headspace.

6.9.4 Rinsate Blanks are collected rinse water (Type II Reagent Grade) from the final rinses of the sampling equipment. Rinsate blanks are to be used in conjunction with volatile, semi-volatile and in-organic analysis of water samples. Sample preservation and containers shall be appropriate for the analytes of interest.

6.9.5 Laboratory Blank. A sample prepared at the laboratory from pure materials containing none of the analyte. Laboratory blanks include method blanks, reagent blanks and others.

6.9.6 Splits are two or more subsamples of one large sample. These are taken after compositing a large soil sample (after samples for volatile analyses have been removed). Splits are used for both QA and QC purposes for soil samples for all analytes excluding volatiles. It is acceptable to split soil samples into three portions after compositing (field sample, split for QA, and split for QC).

6.9.7 Duplicates or Triplicates are separate samples collected at the same location and time as the original sample. Duplicates or triplicates are preferred over splits for volatile organic analyses of soil samples because compositing leads to loss of volatile components. Water samples for QA/QC checking are also duplicate or triplicate samples.

6.9.8 Check/Calibration Standards are used to calibrate field instruments such as the VOA meter and are used to establish control limits for analytical parameters.

6.9.9 Quality Assurance Samples are collected by the sampling team for use by the government's QA laboratory. The purpose of the sample in to assure the government that the data generated by the AE's analytical laboratory are of suitable quality.

6.9.10 Quality Control Samples are collected by the sampling team for use by the AE's laboratory. The identity of these samples is held blind to the analysts and laboratory personnel until data are in deliverable form. The purpose of the sample is to provide site specific field originated checks that the data generated by the AE's analytical laboratory are of suitable quality.

6.9.11 Internal QC Sample or Laboratory Control. A reference standard, standard addition, replicate sample, blank or other sample are samples in which the analyte concentration is known or can be calculated, which is placed among the samples to be analyzed in order to evaluate or demonstrate validity of the analytical results.

6.9.12 Reference Standard. A sample prepared from pure reagents to contain one or more analytes at known concentrations.

6.9.13 Standard Addition or "Spiked" Sample. A field sample to which known concentrations of one or more analytes have been added.

6.9.14 Laboratory Replicate Samples. Subsamples of a single field sample which are divided at the laboratory and analyzed as separate samples.

6.9.15 Replicate Analyses. Multiple analyses performed on the same sample.

6.9.16 Soil Blanks (Background) are used to establish background levels of metals and other analytes in soils. These are normally collected from visually clean soil near the site. The field background soil blank sample is usually counted along with the field samples. It is collected in duplicate and submitted to the AE's laboratory and the QA laboratory along with the field samples.

6.10 Site Specific Sampling and Analyses Requirements. The following specific requirements shall be addressed in the appropriate sections of the QAPP and followed in the sampling and analysis activities.

6.10.1 Groundwater Samples. Representative groundwater samples shall be collected and analyzed from the six rounds identified in the SOW. The AE shall select sampling points that will reflect the effectiveness of the trench in treating the plume. Representative groundwater samples shall be obtained using techniques and equipment as described in the QAPP. The various procedures shall insure that samples are handled properly, equipment is clean, and sample integrity is maintained. The sampling device shall not bias sample parameter concentrations. The sample volume must be sufficient for the analyses required.

6.10.1.1 Field Control Samples, Groundwater. For each sampling period, sufficient groundwater shall be collected for three samples to form a field split. The soil shall be collected then divided among sample containers and properly preserved. Two of the three samples shall be separately identified and sent to the AE's laboratory: one as a field sample, the second as a QC sample and the third is to be sent to CEMRD for government analysis. The required number of field splits are indicated in Table 1. A rinsate sample from sampling equipment, shall also be collected. This rinsate sample shall be split, with one portion going to the AE's lab and the other going to the CEMRD lab.

6.10.2 Organic Vapor Detection (OVD) Unit. The AE shall provide an OVD capable of monitoring the trench construction emissions. The OVD shall be available for all testing operations at the trench. The AE shall describe quality control procedures, equipment utilized and operating personnel. The AE shall discuss the analytes (in relation to the site) that the OVD unit will detect and detection limits. The sampling locations and frequencies shall be identified in the Work Plan.

6.10.3 Sample Containment, Preservation, and Holding Times. The AE shall provide information on sample containment preservation and maximum holding times for groundwater samples. When arranging the schedule for sample collection, the AE shall coordinate with the laboratory to assure that samples arrive and are analyzed within the maximum holding times specified by applicable EPA regulations and method guidelines. The AE shall be responsible for the coordination with CEMRD and for the collection and transportation of the stated number of QA samples to the government laboratory for analyses that will be conducted by the Government.

6.11 Reporting. Chemical results shall be included in the Engineering Report. Compounds identified in the samples shall be listed or tabulated, with the best estimates of concentrations that can be made from the methods and techniques employed. Concentrations reported shall be accompanied by confidence limits or other comparable indications of the associated uncertainty. The concentrations of contaminants encountered shall be compared to appropriate state or federal concentration limits for such contaminants. Data from field quality control samples and from relevant laboratory quality control samples shall also be included. The AE shall attach raw data and reports generated by field and laboratory operations to the Engineering Report as appendices.

7.0 MONITORING WELL REQUIREMENTS.

The following requirements shall be incorporated into the AE's Monitoring Well Installation Sub-Plan and followed in the field. The plan shall be prepared using the following outline as applicable:

SECTION 1.0	INTRODUCTION AND BACKGROUND
SECTION 2.0	WELL LOCATIONS AND DEPTHS
SECTION 3.0	DRILLING EQUIPMENT
SECTION 4.0	DRILLING PROCEDURES
SECTION 5.0	CONTAMINATION PREVENTION AND DECONTAMINATION PROCEDURES
SECTION 6.0	WELL DESIGN AND INSTALLATION
SECTION 7.0	WELL DEVELOPMENT
SECTION 8.0	IN-SITU PERMEABILITY
SECTION 9.0	PROJECT ASSIGNMENTS & PERSONNEL QUALIFICATIONS

7.1. Location. Monitoring well locations shall be proposed by the AE as part of the sub-plan prior to commencement of drilling activities. The AE shall obtain written approval from the facility engineer to drill at each site to avoid disturbing buried utilities.

7.2. Design of Monitoring Wells. The design and installation of all monitoring wells shall follow as closely as practical the design for properly installed, low-yield domestic water supply wells. Recommended practices for such wells are set out in "Manual of Water Well Construction Practices", U.S. EPA Publ. EPA 570/9-75-001 (Reference 11.2). Additional design recommendations are given in "Procedures Manual for Groundwater Monitoring at Solid Waste Disposal Facilities", USEPA Publ. No. EPA 530/SW-611 (Reference 11.1). State and local certification requirements for drillers shall be met. State and local design and installation requirements shall be met. The AE shall be responsible for obtaining any soil boring or well drilling permits required by state or local authorities and for complying with state or local regulations concerning submission of well logs and samples.

7.3. Installation of Monitoring Wells.

7.3.1 General Requirements. The AE shall provide all drilling equipment, materials and personnel required to install the wells, as well as a qualified geologist or geotechnical engineer who shall be on-site for all drilling, installation, development and testing operations. The AE shall submit proposed drilling methods in the System Design, Installation and Monitoring Sub-Plan. Any changes to the approved drilling methods must be submitted to the Contracting Officer for prior approval.

7.3.2. Protection of Water Yielding Zones. The use of any liquid, including water, is to be avoided during drilling and will only be permitted by the Contracting Officer in cases where he determines that it is absolutely necessary for successful installation of the well. If water is required during drilling or well installation, only non-chlorinated potable water will be permitted. Any proposed use and source of water must be approved by the Contracting Officer beforehand. Grease or oil on drill rod joints will not be permitted. Dispersing agents (such as phosphates) or acids shall not be used. There shall be no attempt made to chemically disinfect the well. The rigs, drill tools, and associated equipment shall be cleaned with steam and washed and rinsed with a decontaminating liquid prior to commencement of drilling at each well. It is expressly required that toxic and/or contaminating substances shall not be used during any part of the drilling, well installation or well development processes. All drilling activities and methods shall be sufficient to positively prohibit the introduction of contaminants from one water bearing stratum to another via the well bore or completed well.

7.3.3 Well Design.

7.3.3.1 Boring Diameter. The boring shall be of sufficient diameter to permit at least two (2) inches of annular space between the boring wall and all sides of the centered riser and screen.

7.3.3.2 Well Riser and Screen.

7.3.3.2.1 Riser. Well riser shall consist of new threaded, flush joint, Stainless Steel pipe with a nominal diameter of two (2) inches. Well risers shall, as a minimum, conform to the requirements of ASTM D-1785 Schedule 40 pipe and shall is clearly identified as the material which is specified.

7.3.3.2.2 Screen. The well screen shall be five (5) feet in length and shall be constructed of material similar to the well riser. The screen shall be noncontaminating, factory constructed and of "continuous wrap" or "mill-slot" design. Field slotted or cut screen is not permitted. The slot size shall be determined by the AE and designed to be compatible with aquifer and filter pack material. The AE shall provide a sieve analysis of one or more representative samples of the aquifer material in which the screen is placed and which demonstrates that the screen is compatible with the aquifer material. The sieve analysis shall be conducted in accordance with ASTM C-117 and C-136 and results shall be submitted to the Contracting Officer with the field boring logs.

7.3.3.2.3 Screen Location. The AE shall have the responsibility of placing the well screen in the appropriate location in the bore hole so that the completed monitoring well functions satisfactorily.

7.3.3.2.4 Sand-Sump. There shall be a 1-foot "sand-sump" placed below the base of the screen. The sand-sump shall be a blank section of riser conforming to the requirements of riser as described above. The sand-sump will be installed only if the screen can be placed at the appropriate interval without the sand-sump penetrating any underlying aquitards.

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

7.3.3.2.6 Well Plumbness and Alignment. All risers and screens shall be set round, plumb, and true to line. Centralizers shall be used to assure plumbness and alignment of the wells. Centralizers shall not be installed on the well screen.

7.3.3.3 Filter Pack. The AE shall select and use clean, inert, siliceous materials to construct a uniform and continuous filter pack designed to prevent migration of fines into the screen. Carbonate or crushed stone material shall not be used. The filter pack shall be placed by tremie pipe from the bottom of the boring to approximately two (2) feet above the top of the well screen.

7.3.3.4 Bentonite Seal and Grout. A minimum two (2) foot seal, consisting of tamped bentonite pellets or bentonite slurry shall be placed into the annular space between the riser and boring wall at the top of the filter pack. Non-shrinking cement grout shall then be placed from the top of the bentonite seal to the ground surface. The cement grout shall consist of a mixture of portland cement (ASTM C-150), and water in the proportion of not more than seven (7) gallons of clean water per bag of cement (One cubic foot or 94 pounds). Additionally, 3% by weight of bentonite powder shall be added if permitted by State regulations.

7.3.4 Soil Sampling for Geotechnical Analysis. During drilling of monitoring wells, soil samples shall be collected and geotechnical analysis shall be performed as outlined below.

7.3.4.1 Dry, hollow stem or solid auger methods of drilling shall be used wherever subsurface conditions allow.

7.3.4.2 Soil samples shall be taken continuously for the first 10 feet and at 5-foot intervals thereafter.

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

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

7.3.4.5 All soil samples shall be visually classified by the Unified Soil Classification System. The AE shall verify the classification by laboratory analyses consisting of the following:

Test Description	# Required/ Well
a. Grain-size distribution (ASTM-D 421 & 422)	2
b. Atterburg limits (ASTM-D 423 & 424)	2
c. Moisture content (ASTM-D 2216)	2

Specific soil samples to be tested, along with type of test, will be determined by the AE after reviewing the boring logs. Laboratory analyses shall use equipment and methods described in EM-1110-2-1906 or ASTM manuals.

7.3.5 Protection of Well. At all times during the progress of the work, precautions shall be used to prevent tampering with the well or the entrance of foreign material into it. Upon completion of the well, a suitable vented cap shall be installed to prevent material from entering the well. The well riser shall be surrounded by a larger diameter steel casing set into a concrete pad and rising 24" to 36" above ground level. The steel casing shall be provided with lock and cap. A minimum three foot square, four inch thick concrete pad, sloped away from the well shall be constructed around the well casing at the final ground level elevation. A survey marker shall be permanently placed in each pad as detailed in Section 8.0. Four, two-inch or larger diameter steel posts shall be equally spaced around the well and embedded in the concrete pad. The ground immediately surrounding the top of the well shall be sloped away from the well. There shall be no openings in the protective casing wall below its top.

7.3.6 Temporary Capping. Any well that is to be temporarily removed from service, or left incomplete due to delay in installation, shall be capped with a watertight cap and equipped with a "vandal proof" cover satisfying applicable state or local regulations or recommendations.

7.3.7 Field Logs. The field geologist or geotechnical engineer shall maintain suitable logs detailing drilling and well installation practices. One copy of each field log including the required color slides, shall be submitted to the Contracting Officer not later than 10 calendar days after each well is completed. The well will not be accepted by the Contracting Officer until the logs are received and approved. Information provided in the logs shall include but not be limited to the following:

7.3.7.1 Reference elevation for all depth measurements.

7.3.7.2 Depth of each change of stratum.

7.3.7.3 Thickness of each stratum.

7.3.7.4 Identification of the material of which each stratum is composed according to the Unified Soil Classification System, or standard rock nomenclature, as necessary.

7.3.7.5 Depth interval from which each formation sample was taken.

7.3.7.6 Depth at which hole diameter (bit sizes) change.

7.3.7.7 Depth at which groundwater is first encountered.

7.3.7.8 Depth to the static water level and changes in static water level with well depth.

7.3.7.9 Total depth of completed well.

7.3.7.10 Depth or location of any loss of drill water circulation, loss of tools or equipment.

7.3.7.11 Location of any fractures, joints, faults, cavities or weathered zones.

7.3.7.12 Depth of any grouting or sealing.

7.3.7.13 Nominal hole diameters.

7.3.7.14 Amount of cement used for grouting or sealing.

7.3.7.15 Depth and type of well casing.

7.3.7.16 Description (to include length, location, diameter, slot sizes, material, and manufacturer) of well screen(s).

7.3.7.17 Any sealing-off of water-bearing strata.

7.3.7.18 Static water level upon completion of the well and after development.

7.3.7.19 Drilling date or dates.

7.3.7.20 Installation details of monitoring well.

7.3.8 Final Logs. The field logs shall be edited and drafted for inclusion into the final report.

7.4. Well Development. After each well has been constructed, but no sooner than 48 hours after grouting is completed, the AE shall direct a program for the development of the well by pumping and/or surging, without the use of acids, dispersing agents or explosives. Development shall continue for a period of 4 hours (minimum), and until groundwater removed from the well is clear and free of sand and drilling fluids. No water or other liquid may be introduced into the well other than formation water from that well. After final development of the well, the AE shall collect approximately 1 liter of water from the well in a clear glass jar, label and photograph it with a 35mm color slide, and submit the slide as part of the well log. The photograph shall be a suitably back-lit close up which shows the clarity of the water.

7.5. In-Situ Permeabilities. After development of monitoring wells, the AE shall calculate for each, the in-situ permeability of the screened stratum in accordance with "Methods of Determining Permeability, Transmissibility and Drawdown," (Reference 11.3) or other equivalent methods. However, no water or other liquid may be introduced into the well other than formation water from that well.

7.6. AE Responsibility for Monitoring Wells.

7.6.1 It is the responsibility of the AE to properly plan, design, install, develop, and test monitoring wells so that they are suitable to produce groundwater samples representative in quantity and quality of subsurface conditions. The AE shall ensure that the requirements of this scope of work and best installation practices are carried out.

7.6.2 If the AE, due to his inadequate design or installation, installs monitoring wells that are not functional or not in accordance with specifications, the Contracting Officer will disapprove the well and direct the AE to repair or replace it at the Contacting Officer's discretion. This work shall be done at no additional cost to the Government.

7.6.3 If a monitoring well is disapproved by the Contracting Officer, or is abandoned by the AE for any reason, the hole shall be backfilled with neat cement grout from top to bottom by the AE at no additional cost to the Government.

7.7 Containerization of Purge Water. The AE shall contain all purge water in DOT approved 55 gallon drums when the storage facility is no longer available for use. The AE shall lable and manifest, according to RCRA regulations, each drum of material which is to be handled as hazardous waste. Actual disposal will be the responsibility of the Government.

8.0 SURVEY REQUIREMENTS.

8.1 Control Points. Plastic or wooden hubs shall be used for all basic control points. A minimum of three (3) concrete monuments with 3.25-inch domed brass or aluminum alloy survey markers (caps) and witness posts shall be established at the site. The concrete monuments shall be located within the project limits, be set 50 feet from the edge of any existing roads in the interior of the project limits and be a minimum of 1,000 feet apart. The placement of all monuments, hubs etc., shall be coordinated with SEAD to prevent destruction due to regular landscaping activities. Horizontal control (1:10000) and vertical control (1:5000) of third order or better shall be established for the network required for all the monuments. The caps for the new monuments shall be stamped in a consecutively numbered sequence as follows:

SEAD-1-1989	SEAD-2-1989	SEAD-3-1989
USAED-HUNTSVILLE	USAED-HUNTSVILLE	USAED-HUNTSVILLE

The dies for stamping the numbers and letters into these caps shall be of 3/16-inch in size. All coordinates are to be referenced to the State Plane Coordinate System and all elevations are to be referenced to the 1929 North American Vertical Datum.

8.2 <u>Location Surveys.</u> A 3.25-inch diameter domed survey marker (cap) composed of brass, bronze or aluminum alloy shall be permanently set in the concrete pad surrounding each well. Coordinates and elevations shall be established for each monitoring well and the trench. The coordinates shall be to the closest 1.0-foot and referenced to the State Plane Coordinate System. Elevations to the closest 0.01-foot shall be provided for the survey marker and for top of the casing at each well. These elevations shall be referenced to the National Geodetic Vertical Datum of 1929.

8.3 The location, identification, coordinates and elevations of all the control points recovered and/or established at the site, all of the wells, and the location of the trench, shall be plotted on a planimetric map (at a scale of 1"=50 feet) to show their location with respect to surface features within the project area. A tabulated list of the monuments and the monitoring wells, including their coordinates and elevations, a "Description Card" for each monument established or used for this project and all field books and computations shall be prepared and submitted to the Huntsville Division (CEHND), ATTN: CEHND-ED-CS. The tabulation shall consist of the designated number of the well or monument, the X- and Y-coordinates and all the required elevations. The Description Card shall show a sketch of each monument; its location with relative to reference marks, buildings, roads, towers, etc.; a written description telling how to locate the monument from a known point; the monument name or number and the adjusted coordinates and elevations. These items shall be submitted to CEHND no later than the Draft Report Submission.

9.0 SECURITY REQUIREMENTS

9.1 The following requirements must be followed by the AE at Seneca Army Depot to facilitate entry and exit of AE employees and to maintain security.

9.1.1 Personnel Registration:

9.1.1.1 A list of all AE employees, sub-contractors and suppliers indicating firm name and address will be furnished through the SEAD Environmental Office to the Counterintelligence Division, Building 710, 72 hours prior to commencement of work.

9.1.1.2 A confirmation of employment SDSSE-SC Form 268 will be executed by the AE concerning each employee, to include all sub-contractors and their personnel. No forms will be transferred to another file if the AE has other ongoing contracts at SEAD. The AE will provide a list of personnel who are authorized to sign Form 268 for the firm. A sample of each signature is required. Counterintelligence Division must be notified, in writing, of any changes to this list. All completed forms will be provided through the SEAD Environmental Office to the Counterintelligence Division 72 hours prior to commencement of work. Failure to complete Form 268 correctly will result in employee's denial of access to Seneca. The Counterintelligence Division must be notified, in writing through the SEAD Environmental Office to Counterintellignece, at least 72 hours prior to requesting any action. The chain of command for all AE actions will be through the SEAD Environmental Office to Counterintelligence Division. There will be no exceptions.

9.1.1.3 Camera permits require written notice from the SEAD Environmental Office prior to access. Open camera permits will not be issued. The following information is required:

(a) Camera make, model and serial number.

(b) Contract name and name of individual responsible for the camera.

(c) Dates camera will be used.

(d) Where it will be used.

(e) What will be photographed and why.

9.1.1.4 If a rental, leased or privately owned vehicle is required in place of a company vehicle, the following information is needed.

(a) Name of individual driving.

(b) Year, make, model, color and license plate of the vehicle.

(c) Typed letter on company letterhead indicating that the company assumes responsibility for rental, leased or privately owned vehicles.

9.1.1.5 All access media will be destroyed upon expiration date of contract. If an extension is required a list of employee names and new expiration date must be furnished to the Counterintelligence Division. Contract extensions must be made prior to the contract expiration date or new Form 268s will be required for each individual that requires an extension.

9.1.2 Traffic Regulations:

9.1.2.1 Traffic Laws, State of New York, apply with emphasis on the following regulations.

9.1.2.2 Speed Limit: Controlled Area - as posted
Ammo Area - 50 mph
Limited/Exclusion Area - 25 mph

9.1.2.3 All of the above are subject to change with road conditions or as otherwise posted.

9.1.3 Parking: AE vehicles (trucks, rigs, etc.) will be parked in areas designated by the Director of Law Enforcement and Security. Usually parking will be permitted within close proximity to the work site. Do not park within 30 feet of a depot fence, as these are clear zones.

9.1.4 Gates:

9.1.4.1 Post 1, Main Gate - NY Highway 96, Romulus, New York is open for personnel entrance and exit 24 hours daily, 7 days a week.

9.1.4.2 Post 3, entrance to North Depot Troop Area, located at end of access road from Route 96-A is open 24 hours daily, 7 days a week for personnel and vehicle entrance and exit.

9.1.5 Security Regulations:

9.1.5.1 Prohibited Property:

9.1.5.1.1 Cameras, binoculars, weapons and intoxicating beverages will not be introduced to the installation, except by written permission of the Director/Deputy Director of Law Enforcement and Security.

9.1.5.1.2 Matches or other spark producing devices will not be introduced into the Limited/Exclusion or Ammo Area's except when the processor of such items is covered by a properly validated match or flame producing device permit.

9.1.5.1.3 All vehicles and personal parcels, lunch pails, etc. are subject to routine security inspections at any time while on depot property.

9.1.5.1.4 All building materials, equipment and machinery must be cleared by the Director of Engineering and Housing who will issue a property pass for outgoing equipment and materials.

9.1.6 AE Employee Circulation:

9.1.6.1 AE employees are cleared for entrance to the location of contract work only. Sight-seeing tours or wandering from work site is NOT AUTHORIZED.

9.1.6.2 Written notification will be provided to the Counterintelligence Division (Ext. 30202) at least 72 hours prior to overtime work or prior to working on non-operating days.

9.1.6.3 Security Police (Ext. 30448/30366) will be notified at least two hours in advance of any installation or movement of slow moving heavy equipment that may interfere with normal flow of traffic, parking or security.

9.1.7 Unions: Representatives will be referred to the Depot Industrial Labor Relations Officer (Ext. 41317).

9.1.8 Offenses: (Violations of law or regulations)

9.1.8.1 Minor: Offenses committed by AE personnel which are minor in nature will be reported by the Director of Law Enforcement and Security to the Contracting Officer who in turn will report such incidents to the AE for appropriate disciplinary action.

9.1.8.2 Major: Serious offenses committed while on the installation will be reported to the FBI. Violators may be subject to trial in Federal Court.

9.1.9 Explosive Laden Vehicles:

9.1.9.1 Vehicles such as vans, cargo trucks, etc. carrying explosives will display placards or signs stating "EXPLOSIVES".

9.1.9.2 Explosive ladened vehicles will not be passed.

9.1.9.3 When an explosive laden vehicle is approaching, pull over to the side and stop.

9.1.9.4 When catching up with an explosive laden vehicle, slow down and allow that vehicle to remain at least 100 feet ahead.

9.1.9.5 When approaching an intersection where an explosive laden vehicle is crossing - STOP - do not enter the intersection until such time as the explosive carrier has passed thru, and cleared the intersection.

9.1.9.6 When passing a vehicle that is parked, and displaying "Explosive" signs, slow down to 10 miles per hour, and take every precaution to allow more than ample clearance.

9.1.10 Clearing Post: All AE employees are required to return all identification badges, and passes on the last day of employment on the depot. The AE is responsible for the completion of all turn-ins by his employees, and informing the Counterintelligence Division and the depot organization administering the contract, for termination of any employee's access to the depot.

10.0 PUBLIC AFFAIRS

The AE shall not publicly disclose any data generated or reviewed under this contract. The AE shall refer all requests for information to the SEAD Environmental Office. Reports and data generated under this contract shall become the property of the Department of Defense and distribution to any other source by the AE, unless authorized by the Contracting Officer, is prohibited.

11.0 REFERENCES

11.1 "Procedures Manual for Groundwater Monitoring at Solid Waste Disposal Facilities," USEPA Publ. No. EPA/530/SW-611.

11.2 "Manual of Water Well Construction Practices, " USEPA Publ. NO. EPA/570/9-75-001.

11.3 "Methods of Determining Permeability, Transmissibility, and Drawdown," U.S. Geological Survey Water Supply Paper No. 1536-1, 1963.

11.4 "U.S. Corps of Engineers Safety and Health Requirements Manual," U.S. Army Engineering Manual No. EM-385-1-1, April 1981.

11.5 "Code of Federal Regulations, "Volume 40, Parts 260 through 265 plus 270, July 1986.

11.6 "American Society for Testing and Materials, " ASTM D-421, D-422, D-423, D-424, D-2216, and D-2436.

11.7 "Code of Federal Regulation," Volume 40, Part 300, July 1987.

11.8 "Methods for Chemical Analysis of Water and Wastes," U.S. Environmental Protection Agency, Publ. No. EPA/625/6-7-003a.

11.9 "Test Methods for Evaluating Solid Wastes," USEPA Publ. No. SW- 846, July 1982.

11.10 "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act," 40 CFR 136, Federal Register, Oct 26, 1984.

11.11 "RCRA Groundwater Monitoring Technical Enforcement Guidance Document" (Draft) Office of Waste Programs Enforcement, USEPA, August 1985.

11.12 "Handbook for Analytical Quality Control in Water and Wastewater Laboratories," EPA Manual 600/4-79-019, March 1979.

11.13 "Safety and Occupational Health Document Requirements for Hazardous Waste Site Remedial Actions," U.S. Army Engineering Regulation (ER) 385-1-192.

11.14 "Engineer Guidance Design Manual for Architect-Engineer," US Army Corps of Engineer. HNDM-1110-1-1. Rev. 1986.

11.15 RCRA Corrective Action Plan, OSWER Directive 9902.3, November, 1986.

11.16 U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), Initial Installation Assessment of Seneca Army Depot, N.Y. Report no. AMXTH-IR-A-157, 1980.

11.17 U.S. Army Environmental Hygiene Agency (USAEHA), Final Report, Army Pollution Abatement Program Study No. D-1031-W, Landfill Leachate Study, Seneca Army Depot, 1981.

11.18 U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), Update of the Initial Installation Assessment of Seneca Army Depot, N.Y. Report no. AMXTH-IR-A-157(U), 1988.

11.19 "Evaluation of Solid Waste Management Units, Seneca Army Depot", Interim Final Report, Groundwater Contamination Survey No.38-26-0868-88, U.S. Army Environmental Hygiene Agency.

11.20 "Remedial Investigations/Feasibility Studies, Seneca Army Depot Burning Pit/Landfill, Site Investigation", Draft Final Report, ICF Technology Inc., March 1989.

11.21 Draft, "Guidance For Conducting Remedial Investigations/Feasibility Studies Under CERCLA",U.S. EPA, Office of Solid Waste and Emergency Response, March 1988.

11.22 "Engineering and Design, Chemical Quality Management, Toxic and Hazardous Wastee," ER 1110-1-263, 30 Dec 1985.

APPENDIX D--DESIGN ANALYSIS CALCULATIONS

Estimated Activated Carbon Usage

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Estimated Carbon Requirement :

Purpose : To estimate the amount of Carbon required

Assumptions : 1. Groundwater flow rate = 16 ft/year *

2. Contaminant Concentrations** :

trans. 1-2-dichloroethene	85.1 µg/L
trichloro-ethene	226.0 µg/L
1-2 dichloroethane	µg BDL[a] µg/L
Vinyl chloride	µg BDL µg/L
Chloroform	µg BDL µg/L

3. Literature based isotherms are applicable ***

* Source : Remedial Investigations - Seneca Army Depot Burning Pit/Landfill Site Investigations, March 1988 P. 4-4

** Source : ~~ditto~~ ditto P. 4-8

*** Source : Carbon Adsorption Isotherms for Toxic Organics' An EPA's Manual # 600/8-80-023, April 1980

a BDL = Below Detectable Level

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Solution:

1. Estimate the flow rate of groundwater
2. Calculate the concentration vol of pollutants collected in the trench/day
3. Make Adsorption Isotherm Calculations for the amount of AC required
4. Calculate the of volume of AC in the treatment bed.

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SOLUTION :

1) Trench dimensions :

length : 360 ft

depth of the saturated zone : 7.5 ft

width : 3.3 ft

volumetric flow rate of water in the trench

$$= 360\,(ft) \times 7.5\,(ft) \times 16\left(\frac{ft}{yr}\right)\frac{1}{365}\left(\frac{yr}{day}\right)$$

$$= 118.36\ ft^3/day$$

total concentration of the pollutants in the groundwater

$$= (85.1) + (226.0) = 311.1\ \mu g/l$$

$$= 8.81\ mg/ft^3$$

2) Total concentration of pollutants collected in the trench/day

$$= 118.36\left(\frac{ft^3}{day}\right) \times 8.81\left(\frac{mg}{ft^3}\right) = 1042.8\ \frac{mg}{day}$$

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$= 2.3 \times 10^{-3}$ lb / day

Therefore, treatment would be necessary for $(2.3 \times 365 \times 10^{-3}) = 0.84$ lbs of VOC's collected in the trench / year.

3) Adsorption Isotherm Calculations:

a. trans 1-2 dichloroethene

$K = 3.05$; $1/n = 0.51$

Assume, $C_f = 1.0\ \mu g/l = 1.0 \times 10^{-3}$ mg/l

$\therefore x = 85.1 - 1 = 84.1\ \mu g/l = 84.1 \times 10^{-3}$ mg/l

Freundlich equation:

$$\log \frac{x}{M} = \log K + 1/n \log C_f$$

$$= 0.484 + (-1.53) = -1.046$$

x in mg/l
C_f in mg/l
M in g/l

$$\frac{x}{M} = 0.09 \Rightarrow M = 0.93\ g/l$$

$\therefore$ Carbon requirement $= \underline{0.93}$ g/l

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b. Trichloroethene :

$K = 28.0 \quad , \quad 1/n = 0.62$

Assume, $C_f = 1.0\ \mu g/l$

$\therefore x = 226 - 1 = 225\ \mu g = 0.225\ mg/l$

$C_f = 1 \times 10^{-3}\ mg/l$

use $\log\left(\frac{x}{M}\right) = \log K + 1/n \log C_f$

$= 1.447 - 1.86 = -0.413$

$\frac{x}{M} = 0.386 \implies M = 0.58\ g/l$

Carbon requirement $= \underline{0.58}\ g/l$

c. ~~Chloroform :~~

~~$K = 2.6 \ ; \ 1/n = 0.73$~~

~~Assume, $C_f = 1.0\ \mu g/l = 1.0 \times 10^{-3}\ mg/l$~~

~~$\therefore x = 456 - 1 = 455\ \mu g/l = 0.455\ mg/l$~~

~~$\log\left(\frac{x}{M}\right) = \log K + 1/n \log C_f$~~

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$= 0.415 - 2.19 = -1.775$

$\left(\frac{x}{M}\right) = 0.0168 \Rightarrow M = 27.08$ g/l

∴ Carbon Requirement = $\underline{27.08}$ g/l.

Total AC required/unit/vol. = $(0.93) + (0.58)$ NR

= 1.51 g/l

= 0.094 lbs/ft^3

Therefore, AC required/day

$= 118.36 \left(\frac{ft^3}{day}\right) \overset{NR}{0.094} \left(\frac{lbs}{ft^3}\right)$

= NR $\underline{11.15}$ lbs/day

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4) % volume Requirement of AC : *

Particle density of AC = 1.35 gm/cc *(84 lbs/ft³)
bulk density of AC = 26 lb/ft³

$$\text{volume of AC/day} = \frac{11.15}{26} = \underset{158}{0.429} \text{ ft}^3/\text{day}$$

$$\text{volume of AC/year} = (\underset{158}{0.429})(365)$$

$$= 156.5 \text{ ft}^3/\text{year}$$

volume of the treatment trench bed

= 360 (ft) × 7.5 (ft) × 3.3 (ft)

= 8910 ft³

$$(\text{particle density}) / (\text{bulk density}) = \frac{84}{26} = 3.23$$

∴ Real % volume of AC in the treatment trench

$$\text{bed} = \left(\frac{1}{3.23}\right)\left(\frac{156.5}{8910}\right) \times 100 = 0.54\%$$

~~* Source : '[illegible] Engineer's Hand Book' by Perry~~

* SOURCE: "Activated carbon Adsorption for Wastewater treatment" – Jerry R. Perrich, P 19.

EXHIBIT 4-5
COMPARISON OF CURRENT AND PRIOR MONITORING WELL RESULTS

WELL NO.	DATE	t-1,2-DICHLOROETHENE	TRICHLOROETHENE	1,2-DICHLOROETHANE	VINYL CHLORIDE
PT-10	MAR 87	BDL	BDL	BDL	BDL
	SEP 87	BDL	BDL	BDL	BDL
	OCT 87	BDL	BDL	BDL	BDL
	NOV 88	BCRL	BCRL	BCRL	BCRL
PT-12	MAR 87	570	540		11
	SEP 87	95	94		BDL
	OCT 87	92	94	BDL	BDL
	NOV 88	2730	1530	BCRL	
PT-15	MAR 87	BDL	BDL	BDL	BDL
	SEP 87	BDL	BDL	BDL	BDL
	OCT 87	BDL	BDL	BDL	BDL
	NOV 88	BCRL	BCRL	BCRL	
(PT-14)	MAR 87	100	160		BDL
(PT-14)	SEP 87	172	192		79
PT-17	OCT 87	172	192	BDL	BDL
	NOV 88	56.8	226	BCRL	
PT-18	OCT 87	160	8800	BDL	BDL
	NOV 88	436	9460	BCRL	
PT-20	OCT 87	39	14	BDL	BDL
	NOV 88	52.6	41.8	BCRL	
PT-21	OCT 87	6	BDL	BDL	BDL
	NOV 88	BCRL	BCRL	BCRL	
PT-22	OCT 87	220	110	9	BDL
	NOV 88	85.1	41.8	BCRL	
PT-24	OCT 87	66	BDL	BDL	BDL
	NOV 88	71.1	BCRL	BCRL	
PT-25	OCT 87	BDL	BDL	BDL	BDL
	NOV 88	BCRL	BCRL	BCRL	

Probability of Contact Between Groundwater and Activated Carbon Particles as Groundwater Moves Through the Bed

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PROBLEM: To estimate the percentage of water passing through the treatment bed that will contact Activated Carbon

METHOD: (1) Determine number of Activated Carbon Particles in unit volume of trench (based on assumed % by volume of carbon)

a. Select mean particle diameter, particle density based on literature values.

b. calculate mean particle volume ($4/3 \pi r^3$).

c. calculate # of particles in 1 ft^3 unit volume

(2) Determine percent of cross sectional area ($1 ft^2$) that will be occupied by Activated carbon Particles

a. Assuming even distribution of A.C Particles throught the unit volume, calculate the # of Particles in a cross section, assuming all cross sections through a unit volume will contain the same number of particles and will equal the # of particles on the face of a 1 ft^3 unit volume

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b. calculate the cross sectional area of a single A.C. Particle

c. calculate the total area occupied

d. total area occupied / 1 ft^2 = fraction of area occupied → ×100 = %

(3) calculate Probability that a 'Particle' of water can pass through successive cross sections (layers) without contacting an A.C. particle

a. calculate Prob. for one layer

b. Determine number of layers

c. calculate Prob. through all layers combined

(4) Determine Probability that water 'Particle' will contact A.C. Particles

a. will equal 1 minus Prob determined in 3c above ✓

(5) value determined in (4) will be taken as the percentage of water that will come in contact with A.C. through a one (1) foot wide trench.

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Solution:

(1) Amount of AC / year :

A) 4,070 lbs

B) 6,105 lbs

bulk density = 26 lb/ft^3 * ✓

bulk volume of AC :

A) $\frac{4,070}{26}$ = 156.5 ft^3 ✓

B) $\frac{6,105}{26}$ = 234.8 ft^3 ✓

2. Mean particle diameter = 1.6 mm* ✓

Particle density = 1.35 gm/cc* (84 lb/ft^3) ✓

~~A)~~ bulk density / particle density :

~~A)~~ = 26/84 = 0.31 ✓

Actual volume to be occupied by AC :

A) (0.31) (156.5) = 48.52 ft^3 ✓

B) (0.31) (234.8) = 72.79 ft^3 ✓

* SOURCE: "Activated Carbon Adsorption for Wastewater Treatment" by Jerry R. Perrich p 19.

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% volume of Ac in the trench :

A) $\frac{48.52}{8910} \frac{(ft^3)}{(ft^3)} \times 100 = 0.545\%$ ✓

Trench Volume :
= 360' x 3.3' wide x 7.5' deep average bag depth
= 8910 ft³

B) $\frac{72.79}{8910} \frac{(ft^3)}{(ft^3)} \times 100 = 0.816\%$ ✓

b. ~~Average~~ particle ~~diameter~~ volume $= \frac{4}{3} \pi r^3$

$= \frac{4}{3} \pi \left(\frac{1.6}{2}\right)^3$

$= 2.144 \text{ mm}^3$

$= 75.7 \times 10^{-9} \text{ ft}^3$ ✓

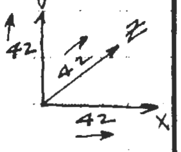
c. No. of particles :

A) 0.00545 ft³ total vol. / 75.7×10^{-9} ft³/particle
$= 7.2 \times 10^4$ ✓

B) 0.00816 ft³ total vol. / 75.7×10^{-9} ft³/particle
$= 10.78 \times 10^4$ ✓

(2) Distribution of particles throught 1 ft³ volume

A) $(7.2 \times 10^4)^{1/3} = 41.6 \Rightarrow 42$ ✓



B) $(10.78 \times 10^4)^{1/3} = 47.6 \Rightarrow 48$ ✓

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CALCULATED BY Prasad K DATE 12/4/89
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SCALE

Percentage of cross sectional area occupied by Ac Particles:

cross section = 1 ft^2

A) # of Particles = 42 x 42 = 1,764 ✓

Area / particle = $\pi r^2 = \pi \left(\frac{1.6}{2}\right)^2 = 2.01$ mm^2 ✓

Total particle area = 1,764 x 2.01 = 3545.6 mm^2
= 0.038 ft^2 ✓

B) # of Particles = 48 x 48 = 2,304

Total particle area = 2,304 x 2.01 = 4631 mm^2
= 0.05 ft^2 ✓

Percentage of cross sectional area occupied by A.C. Particles

A) 0.038 ft^2 / 1 ft^2 = 0.038 = 3.8 % ✓

B) 0.05 ft^2 / 1 ft^2 = 0.05 = 5.0 % ✓

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(3) & (4):

Probability that a 'particle' of water can pass through each layer (successive cross sections) without contacting an A.C. particle:

A) $\left(\frac{100 - 3.8}{100}\right) = \frac{96.2}{100} = 0.962$

= probability that water will pass a layer without contacting A.C. particle

In case A, 42 successive layers exist –

total probability $= (0.962)^n = (0.962)^{42} = 0.196$

$\therefore$ Probability that water will contact A.C. particle $= 1.0 - 0.196 = 0.804$ or 80.4%

B) In case B, 48 successive layers exist.

$\frac{100 - 5}{100} = \frac{95}{100} = 0.95$

Total probability $= (0.95)^{48} = 0.085$

$\therefore$ Probability that water will contact A.C. particle

$= 1.0 - 0.085 = 0.915$ or 91.5%

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Case 1:

For a 2' thickness, the corresponding probabilities will be

A) $(0.962)^{2(42)} = 0.039$

B) $(0.950)^{2(48)} = 0.007$

Probability that water will contact with A.C particle:

A) 0.961 or 96.10 %

B) 0.993 or 99.30 %

Case 2:

For a 3.3' thickness, the corresponding probabilities will be:

A) $(0.962)^{3.3(42)} = 0.00465$

B) $(0.950)^{3.3(48)} = 0.0003$

Probability that water will contact with A.C. particle:

A) 0.995 or 99.5 %

B) 0.999 or 99.9 %

Theoretical Contact Time Between Groundwater and Activated Carbon Particles

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JOB 390 2036
SHEET NO. 1 OF 1
CALCULATED BY Prasad K DATE 12.5.89
CHECKED BY DM DATE 12-5-89
SCALE

PURPOSE : To Estimate Contact Time between water and Activated carbon Particles

ASSUMPTIONS : 1. Mean particle diameter = 1.6 mm ✓
2. Groundwater velocity = 16 ft/year ✓
$= 0.556 \frac{mm}{hr}$ ✓
3. Straight flow past activated carbon particles

SOLUTION :

$$\text{Contact time} = \frac{\text{mean particle diameter}}{\text{groundwater velocity}}$$

$$= \frac{1.6 \ (mm)}{0.556 \ (mm/hr)}$$ ✓

$$= 2.88 \text{ hrs.}$$ ✓

Therefore, Contact time of an individual A. C. particles with water flowing past the particle = $\underline{\underline{2.88 \text{ hrs}}}$ ✓

Sand/Carbon Ratio

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JOB 3902036
SHEET NO. 1 OF 2
CALCULATED BY Prasad DATE 12-6-89
CHECKED BY Dm DATE 12-6-89
SCALE

PURPOSE: To Estimate the mix ratio of Activated carbon to Sand

ASSUMPTIONS:

1. 4070 lbs A.C. at 26 lb/ft^3 (bulk ρ)
2. 6105 lbs A.C. at 26 lb/ft^3 (bulk ρ)
3. Total Volume Sand + A.C.

$$= 360' \times 3.3' \times 7.5' \text{ (Average)} = 8910\ ft^3$$

SOLUTION:

Case A: 4,070 lbs A.C. in trench

$$\text{bulk volume} = \frac{4070\ lbs}{26\ lb/ft^3} = 156\ ft^3$$

volume when mixed with sand

$$= 156\ ft^3 \times \frac{\text{bulk density}}{\text{Particle density}}$$

$$= 156\ ft^3 \times \frac{26\ lb/ft^3}{84\ lb/ft^3}$$

$$= 48.3\ ft^3$$

volume of sand = Total volume $- 48.3\ ft^3$

$$= 8910 - 48.3 = 8862\ ft^3$$

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JOB 3902036
SHEET NO. 2 OF 2
CALCULATED BY Prasad K DATE 12-6-89
CHECKED BY DATE 12-6-89
SCALE

Mix Ratio :

$$\text{A.C. to Sand} = \frac{156\ \text{ft}^3}{8862\ \text{ft}^3} = 0.018$$

$$\text{Sand to A.C.} = \frac{1}{0.018} = 56.8$$

Case B : 6,105 lbs A.C. in trench

$$\text{bulk volume} = \frac{6,105\ \text{lbs}}{26\ \text{lb/ft}^3} = 234.8\ \text{ft}^3$$

volume when mixed with sand

$$= 234.8\ \text{ft}^3 \times \frac{\text{bulk density}}{\text{particle density}}$$

$$= 234.8\ \text{ft}^3 \times \frac{26}{84} = 72.7\ \text{ft}^3$$

$$\text{volume of sand} = \text{Total volume} - 72.7\ \text{ft}^3$$

$$= 8,910 - 72.7$$

$$= 8837\ \text{ft}^3$$

Mix Ratio :

$$\text{A.C. to Sand} = \frac{234.8\ \text{ft}^3}{8837\ \text{ft}^3} = 0.027$$

$$\text{Sand to A.C.} = \frac{1}{0.027} = 37.6$$

Excavated Soil Storage Area

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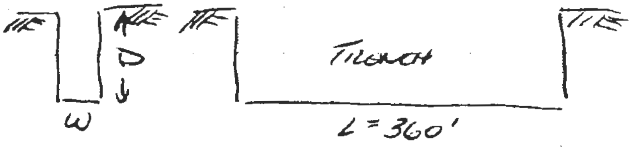
JOB 3902036
SHEET NO. 1 OF 4
CALCULATED BY JM DATE 5 DEC 89
CHECKED BY RV DATE 12/5/89
SCALE

SENECA WASTE PILE CALCULATIONS

PURPOSE: CALCULATE WASTE PILE DIMENSIONS USING EXCAVATED SOIL VOLUME

ASSUMPTIONS: (1) TRENCH LENGTH = $L = 360'$
WIDTH = w = 2' + TRENCH BOX WIDTH = $2' + \frac{2(8'')}{12} = 3.33'$
$\cong 3.5'$
AVERAGE DEPTH = $D = 10'$ (CONSERVATION)
(2) ALL SOILS HAZARDOUS
(3) 3:1 SIDE SLOPE
(4) 6 ft MAXIMUM HEIGHT (h)
(5) WASTE STORED IN PRISMATOID $V = \frac{1}{6}(A_1 + 4A_m + A_2)h$

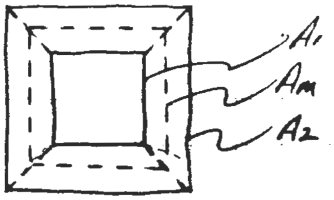
CALCULATIONS:

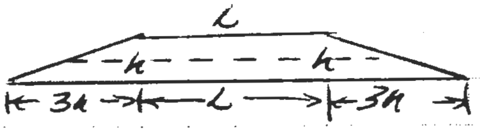


VOLUME = LWD
= 360(3.5)10
= 12,600 ft³
= 467 yd³

ADD 20% (SWELL/CONTINGENCY) ⇒ 12,600(1.20) ≅ 15,000 ft³

PRISMOID





$A_1 = L^2$ $A_2 = (L+6h)^2$ $A_m = (L+3h)^2$

$$\text{VOLUME} = 15{,}000\text{ ft}^3 = \tfrac{1}{6}(A_1 + A_2 + 4A_m)h$$
$$= \tfrac{1}{6}(L^2 + L^2 + 12Lh + 36h^2 + 4L^2 + 24Lh + 36h^2)h$$
$$90{,}000 = L^2h + L^2h + 12Lh^2 + 36h^3 + 4L^2h + 24Lh^2 + 36h^3$$

at $h = 6$, $L = ?$

$$90{,}000 = 6L^2 + 6L^2 + 432L + 7776 + 24L^2 + 864L + 7776$$

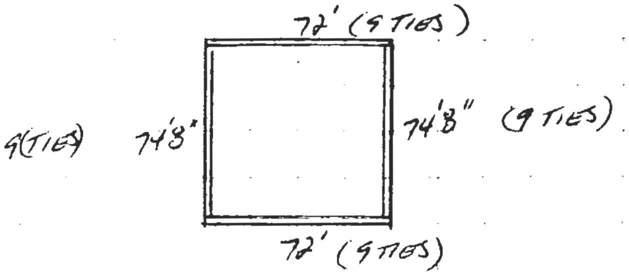
$$\Rightarrow \underset{a}{36}L^2 + \overset{b}{1296}L - \overset{c}{74{,}448} = 0 \qquad L = \frac{-1296 \pm \sqrt{(1296)^2 - 4(36)(-74{,}448)}}{2(36)}$$

$L \cong 31'$

THEREFORE THE AREA MUST BE $L + 3h + 3h = 31 + 3(6) + 3(6) = 67'$
AT LEAST 67' × 67' ⇐ ✓

JOB 3902036
SHEET NO. 2 OF 4
CALCULATED BY JM DATE 5 Dec 89
CHECKED BY RV DATE 12/5/89
SCALE

IF THE SIDES WILL BE BERMED WITH 8"×8"×8' RAILROAD TIES, THE STORAGE AREA MUST BE AT LEAST



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JOB 3902036
SHEET NO. 3 OF 3
CALCULATED BY JM DATE 7 DEC 89
CHECKED BY R. THOMPSON DATE 12-7-89
SCALE

SENECA WASTE PILE CALCULATIONS

PURPOSE: CALCULATE SUMP DIMENSIONS FOR STORAGE AREA.

ASSUMPTIONS / DATA (1) MAX PRECI. = 2 INCHES APPROX., 2 YEAR, 24-HOUR RAINFALL (INTENSITY IS CONSTANT FOR DURATION) HERSHFIELD D.M, 1961, TP 40

(2) LINER AREA FOR SOIL STORAGE APPRO. 83 × 80
EXC. SOIL ON 70 × 70' AREA 2% SLOPE TO SUMP

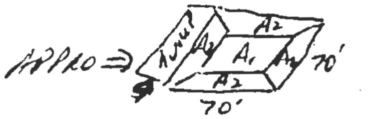
(3) POROSITY OF SAND = .35

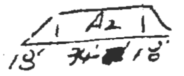
(4) RATIONAL FORMULA APPLIES FOR RUNOFF PRECIPITATION

(5) DESIGN FOR MAX STORAGE

(6) SUMP IS RELATIVELY FLAT (.1 SLOPE)

CALCULATIONS: PRECIPITATION RUNOFF $Q = CIA$

APPRO ⇒ 



$A_1 = (34)(35) = 1190\ ft^2$
$\cong 0.027$ acres

$A_2 = [(70)^2 - (36)^2] = 3604\ ft^2$
$\cong 0.0827$

$I = 2$ INCHES, FOR 24 HRS STORM $= 0.083$ in/hr

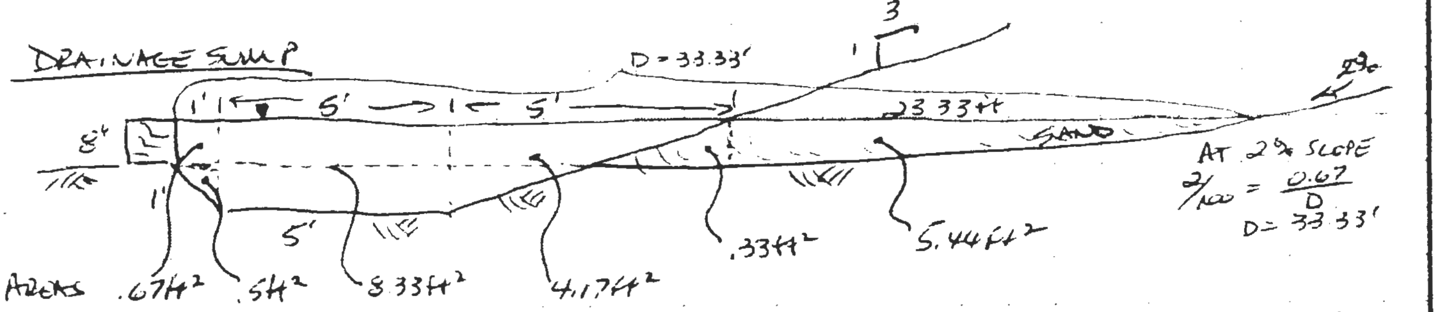
FOR CLAYS { C_1 = COEFFICIENT OF RUNOFF FOR 2% SLOPE $\cong .90$
C_2 = " " FOR STEEP SLOPES $\cong .95$

$C_{sump} = 1.0$ AREA SUMP $= 9 \times 70 = 630\ ft^2 = 0.014$ acres

$$Q_T = I(A_1C_1 + A_2C_2) + \text{SUMP AREA } C_{sump}\, I$$
$$= 0.083(.027(.90) + .083(.95)) + (0.014)(1.0)(0.083)$$
$$= 9.7 \times 10^{-3}\ ft^3/sec \cong 4.4\ gpm$$

THEREFORE, FOR A 24-HR PERIOD THE STORM WILL PRODUCE
4.4 gal/min × 60 min × 24 hrs $\cong$ 6300 gals IN 24 HRS

DRAINAGE SUMP



TOTAL AREAS USABLE $= .67 + .5 + 8.33 + 4.17 + .33(.35) + 5.44(.35) = 15.7\ ft^2$
(USING .35 POROSITY)

TOTAL VOLUME AVAILABLE $= 70' \times 15.7\ ft^2 = 1099 \cong$ 8220 gals

CK

Synthetic Liner and Geotextile Fabric Information

Gundle Lining Systems Inc

Gundle®

"Hyperlastic" VLDPE Lining System.

Now, there's a proven, cost-effective solution to flexibility requirements in many of your liner applications... Gundle's "Hyperlastic" Very Low Density Polyethylene (VLDPE) Liner. As its name suggests, this high-performance polyolefin (also known as "FLEXOMER") has exceptional elastic properties. So, in applications such as landfill caps, tunnel lining, and potable water containment, where flexibility and elongation are more important than thickness, Hyperlastic is ideal over PVC. Hyperlastic also offers many of the traditional advantages of Gundline® HD liner such as UV light stability; low temperature resistance; microorganism, insect, and rodent resistance; 22.5-foot seamless widths and effective heat-seaming techniques.

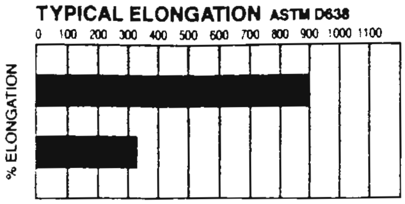
The Alternate Choice for Landfill Caps and Closures.

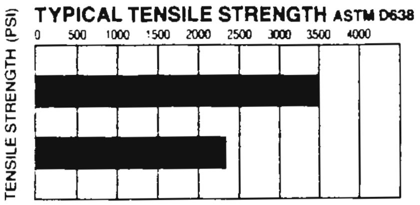
Landfill cap design usually presents unique problems, especially potential differential settlement of the landfill. Hyperlastic, with its excellent elongation, offers tremendous insurance against problems due to settling. Clay liners, on the other hand, are known to lose much of their barrier properties due to the absence of elasticity, difficulties of proper compaction, weathering and root growth.

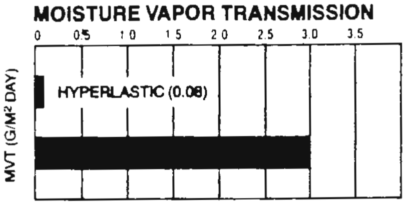
Not only does the liner have excellent elasticity, but Hyperlastic also offers excellent barrier properties to rainwater from outside the landfill while acting as a collector of gas from inside the landfill. Because of its flexibility, Hyperlastic conforms very well to non-uniform surfaces. It "hugs" these surfaces tightly, providing good slope stability and puncture resistance over the closures.

A Hyperlastic cap also promotes good vegetative growth in the topsoil cover of the closure by blocking the seepage of landfill gas through the vegetation. This enhances slope stability even further and provides better erosion control for the final closure.

Hyperlastic Liner Compared to PVC.







While Polyvinyl Chloride (PVC) has been used in applications where flexibility is more important than chemical resistance, the material achieves its flexibility from the addition of plasticizers. Present in PVC liners at 30% weight or more, plasticizers are low molecular-weight compounds such as oils.

These lower molecular-weight plasticizers can leach out because of heat, soil chemicals, and stresses in the liner, causing the liner to become brittle later on. Plasticizers are also food for rodents and microorganisms.

A Flexomer, Hyperlastic VLDPE, on the other hand, contains no plasticizers. It achieves all of its flexibility and elongation from its inherent polymer structure. Hyperlastic can also be made in one color or in a layer of colors. So go with Gundle's Hyperlastic and stay with the leader.

GUNDLE HYPERLASTIC VLDPE SPECIFICATIONS

Gundle Hyperlastic is a special formulation of very low density polyethylene containing approximately 97.5% polymer and 2.5% carbon black, anti-oxidants and heat stabilizers.

TYPICAL PROPERTIES*	TEST METHOD	GAUGE (NOMINAL)		
		20 mil (0.5 mm)	30 mil (0.75 mm)	40 mil (1.0 mm)
Tensile Properties. (Typical)				
1. Tensile Strength at Break (Pounds/inch-width)	ASTM D638 Type IV Dumb-bell at 2 ipm	63	94	126
2. Elongation at Break (Percent)		900	900	900
Puncture Resistance. Pounds. (Typical)	FTMS 101 Method 2065	38	51	64
Tear Resistance Initiation. Pounds. (Typical)	ASTM D1004 Die C	10	12	18
Dimensional Stability. % Change. Each Direction. (Max.)	ASTM D1204 212° F 1 hr.	±2	±2	±2
Low Temperature Brittleness. °F (Typical)	ASTM D746M Procedure B	−112	−112	−112
Resistance to Soil Burial. Percent change in original value. (Typical)	ASTM D3083 Type IV Dumb-bell at 2 ipm			
Tensile Strength at Break.		±10	±10	±10
Environmental Stress Crack. Hours. (Min.)	ASTM D1693 10% Igepal, 50°C	1500	1500	1500

*Note: All values, except when specified as minimum or maximum, are typical test results.

SUPPLY SPECIFICATIONS

The following describes typical roll dimensions for Hyperlastic VLDPE

THICKNESS		WIDTH		LENGTH		AREA		ROLL WEIGHT	
mil	mm	ft	m	ft	m	ft²	m²	lb	kg
20	0.5	22.5	6.86	1250	381	28,125	2613	2800	1272
30	0.75	22.5	6.86	840	256	18,900	1756	2800	1272
40	1.0	22.5	6.86	650	198	14,625	1359	2800	1272

HYPERLASTIC is rolled on 6″ I.D. hollow cores. Each roll is provided with 2 slings to aid handling on site. Dimensions and weights are approximate. Custom lengths available on request.

Gundle Lining Systems Inc

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Houston, Texas 77073 U.S.A.
Phone: (713) 443-8564
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These specifications are offered as a guide for consideration to assist engineers with their specifications; however, Gundle assumes no liability in connection with the use of this information. The specifications on this data sheet are subject to change without notice.

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polyfelt

Geotextiles

The tough component in the watertight system

D-30

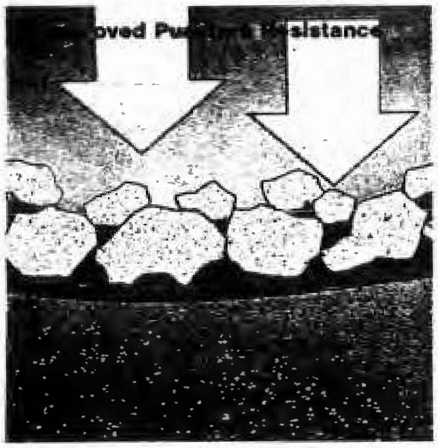
polyfelt

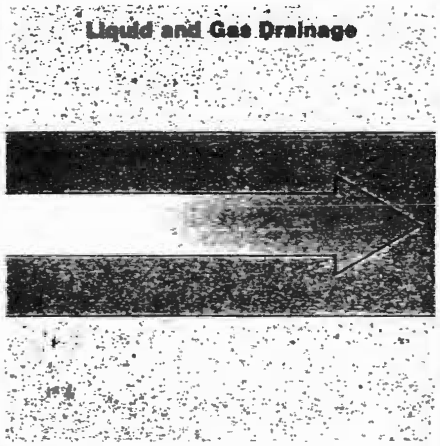
A Leader in its Field

Polyfelt, Incorporated, a division of the Petrochemie Danubia Group, is a major worldwide producer of nonwoven geotextiles and the recognized leader in the research and development of application and manufacturing technology for geotextiles. Unlike other geotextile firms whose position within the geotextile market is secondary to their core business, Polyfelt has exclusively developed and committed its manufacturing technology and marketing efforts to the geotextile industry. This focus combined with its worldwide experience and success allows Polyfelt to uniquely meet the design and specification needs for successful geomembrane installations through the use of geotextiles.

Polyfelt's newest manufacturing facility, located in Evergreen, Alabama, represents the largest single investment in the geotextile industry in many years. This modern plant produces through a patented and fully computer controlled process nonwoven, continuous filament, needlepunched geotextiles of the highest quality. This quality is ensured through the use of statistical process control techniques and computerized monitoring, thereby providing Polyfelt the highest quality products available anywhere.

This manufacturing excellence together with the world's highest ranked Application Engineering and extensive Marketing and Distribution network, makes Polyfelt unequalled in product, quality, cost, and service.





1. Improved Puncture Resistance

The three-dimensional fiber structure and high elongation characteristics under load ensure absorption of impact stress and improved geomembrane creep puncture resistance.

Abrasion from rough subgrade during and after installation is eliminated. Provides a protective cushion against the cyclic abrasive effects of wind or water acting against the geomembrane.

2. Provides Liquid and Gas Drainage

The three-dimensional fiber structure and high percentage of air voids (approximately 90% in uncompressed state) allows rapid radial freeflow of liquids and gases in the plane of the fabric.

3. Improved Installation Surface

Polyfelt provides a clean dust-free surface that is smooth and continuous and facilitates improved geomembrane panel positioning and seaming.

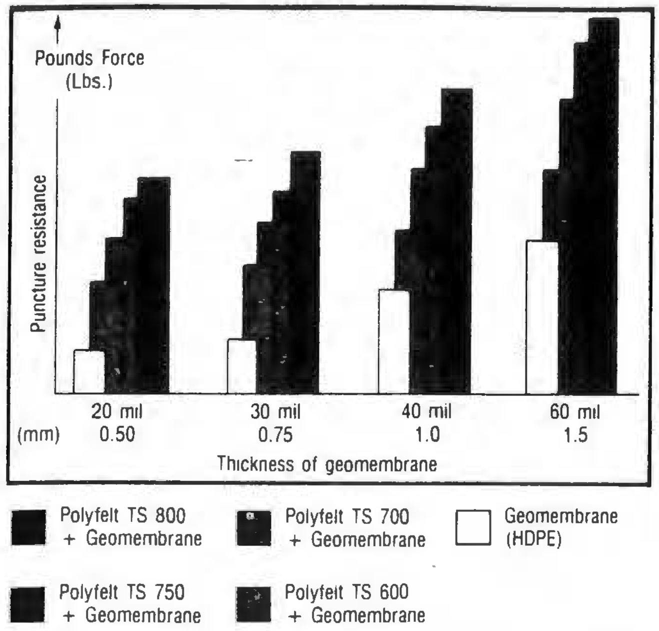


Table: Typical increase in puncture resistance of geomembranes with Polyfelt geotextile protection

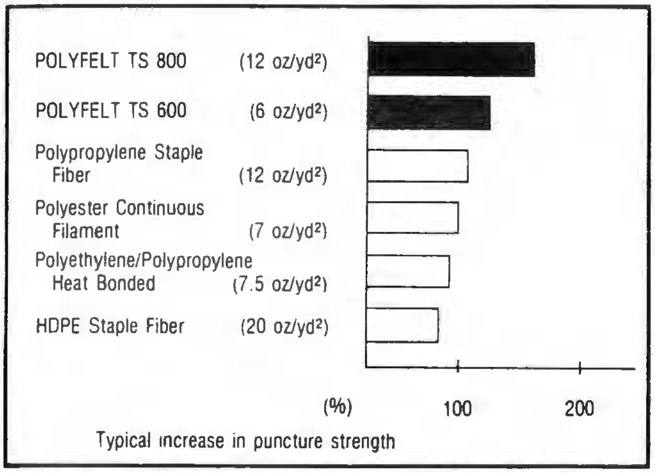
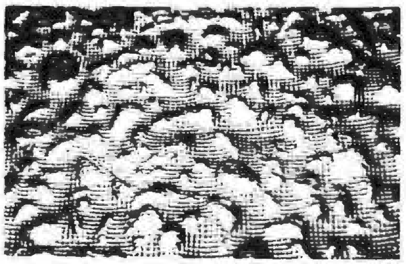


Table: Increase in puncture strength of different geotextiles on typical geomembrane types



Failure of an unprotected geomembrane placed over coarse aggregate and subjected to pressure equivalent to 33 ft. head of water.

Polyfelt: Puncture Protection for Geomembranes

Experience has shown Polyfelt geotextiles can play an important role in successful geomembrane installations and long term performance. Polyfelt protects the geomembrane by acting as a cushion to prevent puncture damage to the geomembrane. As proper geomembrane selection is critical in successful projects, proper geotextile selection is also an important step. Few applications require such a critical review in geotextile selection as is necessary when geotextiles are used to protect geomembranes.

Polyfelt is a 100% polypropylene continuous filament geotextile. It has a highly porous three dimensional fiber structure, manufactured by needlepunching the fibers to form a homogeneous sheet. It has been proven internationally to be one of the best geotextiles for improved geomembrane performance.

Secure Sophisticated Composite Design Capability

Design and specification of geotextile and geomembrane systems can be undertaken in two ways:

- **Evaluation and specification of the geotextile and geomembrane as individual components**
- **Evaluation of properties and specification of minimum requirements of the geotextile and geomembrane as a composite installation of two materials.**

Specification of minimum requirements of the geotextile and geomembrane as a composite installation is the recommended method of obtaining optimum minimum installed performance of both the geotextile and geomembrane.

In each instance evaluation of individual properties relative to the requirements of the project is necessary.

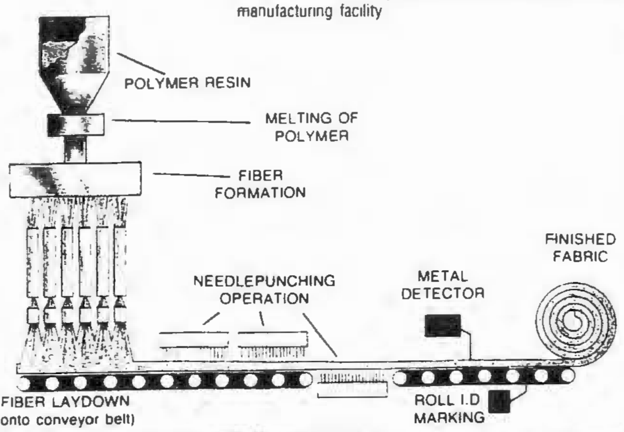
Simple Design Procedure

1. Determine precise site conditions and project performance requirements.
2. Compare project and site information with the physical and mechanical properties of the geomembrane liner and Polyfelt geotextiles.
3. Contact Polyfelt, Inc. for the puncture resistance values of the geomembrane and Polyfelt tested in composite.
4. Determine optimum requirements plus required factor of safety.
5. Specify minimum physical and mechanical requirements of both geomembrane and geotextile and minimum required composite performance.

Polyfelt geotextiles are compatible with all geomembrane types and contact with reputable geomembrane manufacturers and installers is maintained to guarantee that a high level of professional expertise and personal service is provided.

Precise design information and advice based on laboratory testing and over 15 years international experience is available on request.

polyfelt



Simplified view of Polyfelt's patented continuous filament manufacturing facility

Technically proven by test and performance

Polyfelt geotextiles are produced by the only nonwoven process specifically engineered to meet geotechnical design and installation requirements. Our application and manufacturing experience during the seventies led to the development and installation of a next generation manufacturing technology in 1982 which produces products offering the following unique features:

- **Randomly laid, continuous filament fiber extrusion provides excellent strength and fabric uniformity.**
- **Extensive needlepunching entangles fibers thereby forming excellent mechanical properties and thickness for hydraulic drainage.**
- **A controlled fabric forming process develops biaxial and isotropic mechanical properties and product elongation. These features form the basis for installation survivability.**
- **Fully traceable, high quality virgin polypropylene resin provides a nonbiodegradable fabric resistant to acid and alkaline soil conditions and chemical attack.**
- **An ultraviolet inhibitor within the resin provides the highest resistance to U.V. degradation of any nonwoven geotextile.**
- **Available certified needle-free products for installation with geomembranes.**
- **Roll, lot, and product identification indelibly printed on every roll allows traceability to certified test results.**

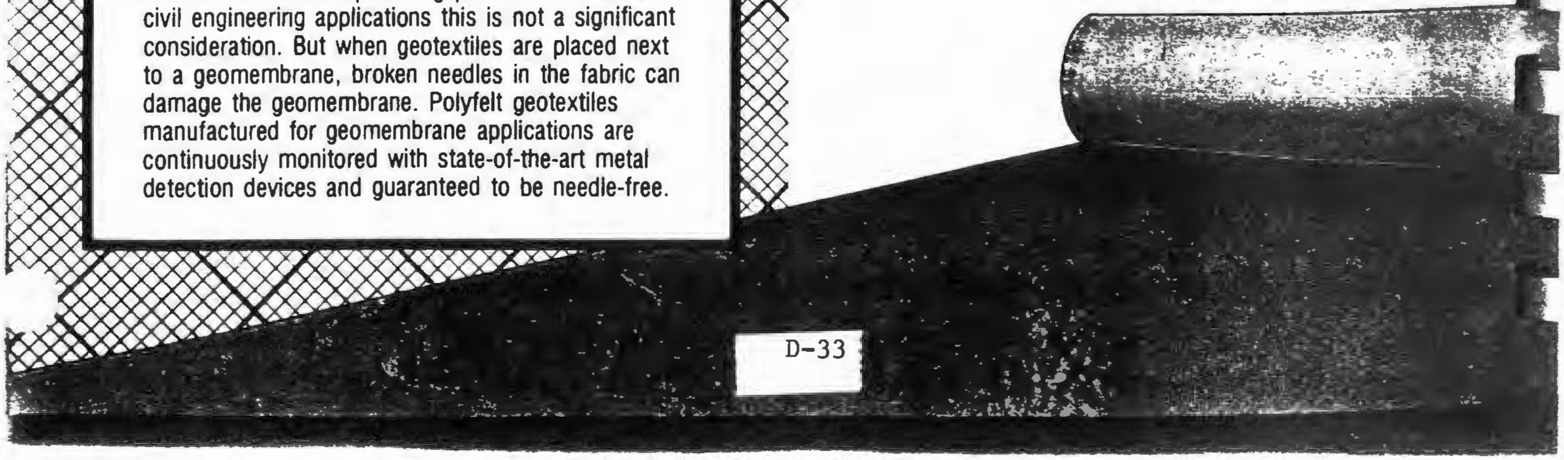
The characteristics of nonwoven fabric forming, combined with Polyfelt's advanced manufacturing process, places Polyfelt's products steps ahead in geotechnical performance.

Specify Needle-Free

Needle breakage is not common in Polyfelt's manufacturing process, however, this is a possibility inherent in all needlepunching processes. In most civil engineering applications this is not a significant consideration. But when geotextiles are placed next to a geomembrane, broken needles in the fabric can damage the geomembrane. Polyfelt geotextiles manufactured for geomembrane applications are continuously monitored with state-of-the-art metal detection devices and guaranteed to be needle-free.

Clearly marked for on-site quality assurance

Each roll of Polyfelt is continuously marked along the edge with the product grade and a quality control batch number for ease of on-site inspection and quality assurance.



Chemically and Biologically Inert

(pH range 2-13)

- **Does not deteriorate in soils due to microbial attack.**
- **Resistant to the effects of long term exposure to acid and alkali solutions in the pH range 2-13.**
- **Polyfelt is certified resistant to municipal and industrial waste.**

Chemical Resistance of Typical Geotextile Polymers

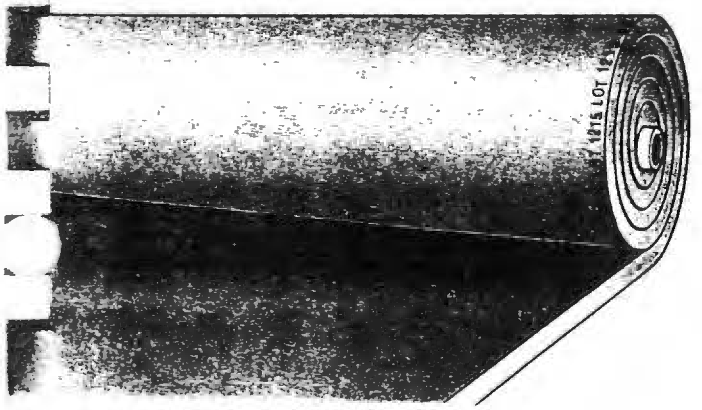
POLYMERS PROPERTIES	Polypropylene* (PP)	Polyethylene* (PE)	Polyester (PET)
Acids, diluted	□	□	■
Acids, concentrated	■	■	■
Alkali, diluted	□	▨	■
Alkali, concentrated	■	■	■
Microorganisms	□	□	□
Hydrolysis (humidity and high temperature)	□	□	■
Sunlight	■	□	■

*U.V. stabilized

□ excellent	■ requires assessment
□ very good	■ not achieved
■ good	■ not advised

Clearly defined product properties

Careful determination of all mechanical, hydraulic and chemical properties for each grade allows precise design and performance assessment.



• High UV-Resistance

The polypropylene polymer used in Polyfelt is highly UV-stabilized to ensure no strength loss occurs when exposed to sunlight during installation.

Polyfelt has been field and laboratory tested in extreme UV-environments worldwide and proven to have one of the best levels of resistance of all geotextiles tested.

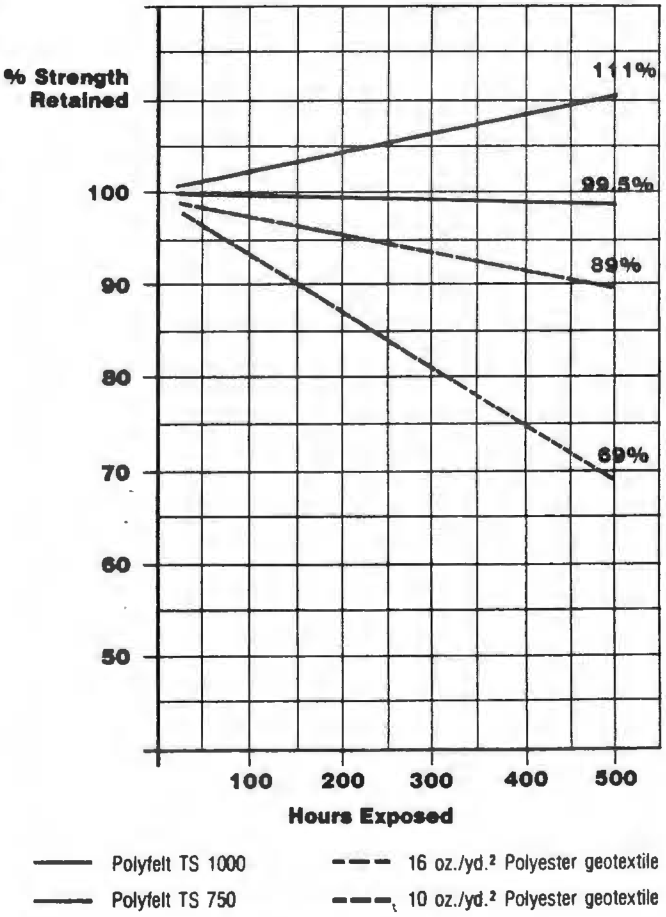
• Resistant to effects of heat and humidity

Polyfelt does not hydrolyze when installed in tropical climatic conditions, or when placed in contact with damp cementitious surfaces.

• Laboratory Test

(South Florida Test Service, 1987)

Polyfelt TS and a polyester nonwoven continuous fiber geotextile were exposed to a xenon arc lamp for 500 hours (ASTM D4355). The Polyfelt sample showed the highest strength retention. This is due to Polyfelt's unique U.V. stabilizer added prior to fiber formation.



ASTM D4355 — Xenon Arc Accelerated Exposure Testing (South Florida Test Service, 1987)