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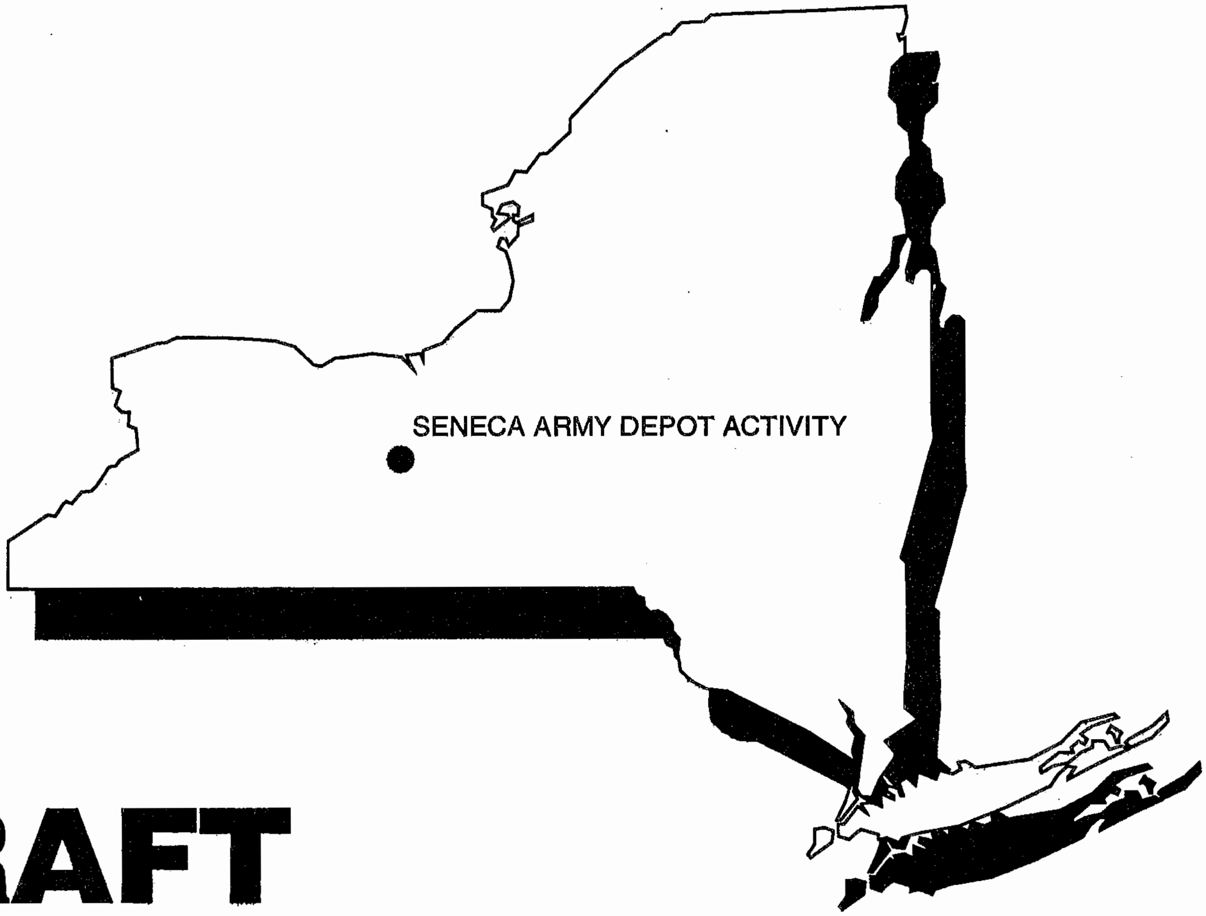
U.S. ARMY ENGINEER DIVISION
HUNTSVILLE, ALABAMA



DRAFT

SEAD-52 AND SEAD-60
PROJECT SCOPING PLAN FOR PERFORMING A CERCLA REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS) AT THE AMMUNITION BREAKDOWN AREA (SEAD-52) AND THE OIL DISCHARGE AREA ADJACENT TO BUILDING 609 (SEAD-60), SENECA ARMY DEPOT ACTIVITY

JANUARY 1996

PARSONS ENGINEERING SCIENCE, INC.

Prudential Center • Boston, Massachusetts 02199-7697 • (617) 859-2000 • Fax: (617) 859-2043

January 19, 1996

Ms. Dorothy Richards
CEHND-PM-E
U.S. Army Corps of Engineers
Huntsville Division
Huntsville, Alabama 35807-4301

SUBJECT: **Submittal of a Draft Project Scoping Plan for Performing a CERCLA Remedial Investigation Feasibility Study (RI/FS) at the Ammunition Breakdown Area (SEAD-52) and the Oil Discharge Area Adjacent to Building 609 (SEAD-60)**

Dear Ms. Richards:

Parsons Engineering Science, Inc. (Parsons ES) is pleased to submit the Draft Project Scoping Plan for performing a Comprehensive Environmental Responsibility, Compensation and Liability Act (CERCLA) Remedial Investigation/Feasibility Study (RI/FS) at the Ammunition Breakdown Area (SEAD-52) and the Oil Discharge Area Adjacent to Building 609 (SEAD-60) at the Seneca Army Depot Activity (SEDA) located in Romulus, New York. This work was performed in accordance with the Scope of Work (SOW) for Delivery Order 0041 to the Parsons ES Contract DACA87-92-D-0022.

The Project Scoping Plan contains specific information about this site for conducting an RI/FS. Additional information that is not specific to any particular site at SEDA is contained in the Generic Installation RI/FS Workplan that serves as a foundation for this RI/FS Project Scoping Plan. The Draft Final Generic Installation RI/FS Workplan was submitted to you on June 23. We have incorporated comments from the Army, USEPA and NYSDEC into the Draft Final Generic Installation RI/FS Workplan. The Workplan and its associated Scoping Plans provide a mechanism for investigating Areas of Concern at SEDA as part of the United States Army Corps of Engineers (USACE) remedial response activities under CERCLA.

Parsons ES appreciates the opportunity to work with the USACE on this important project and looks forward to a continued relationship on this and other projects. Please feel free to call me at 617-859-2492.

Sincerely,

PARSONS ENGINEERING SCIENCE, INC.

Michael Duchesneau

Michael Duchesneau, P.E.
Project Manager

MD/cmf/Sead52&60

cc: Mr. S. Absolom, SEDA
Mr. R. Battaglia, CENAN-PP-E
Mr. K. Hoddinott, USACHPPM (Prov.)
Mr. H. Krierler, USAEC
Mr. D. Williams, USACE-MRD
Mr. Lau, CENAN
Mr. Pickett, CENAD
Mr. P. Cunanan, USAMC
Mr. S. Chaki, CENAB
Ms. C. Struble, USEPA Region II
Mr. K. Gupta, NYSDEC

PROJECT SCOPING PLAN
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
AT SEAD-52 and SEAD-60
SENECA ARMY DEPOT ACTIVITY
ROMULUS, NEW YORK

Prepared For:

Seneca Army Depot Activity
Romulus, New York

Prepared By:

Parsons Engineering Science, Inc.
Prudential Center
Boston, Massachusetts

727651

January 1996

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LIST OF ACRONYMS

1,2-DCA	1,2-Dichloroethane
1,2-DCE	1,2-Dichloroethylene (total)
AA	Atomic absorption
AMC	U.S. Army Material Command
AN	Army-Navy
AOC	Areas of Concern
APCS	Air Pollution Control System
AQCR	Genesee-Finger Air Quality Control Region
ARAR	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
BOD	Biological Oxygen Demand
CEC	Cation exchange capacity
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CLP	Contract Laboratory Program
cm	Centimeters
cm/sec	Centimeters per second
COD	Chemical Oxygen Demand
Cr	Chromium
$CaCO_3$	Calcium Carbonate
CRT	Cathode ray tube
DARCOM	Development and Readiness Command
DERA	Defense Environmental Restoration Account
DO	Dissolved oxygen
DOT	Department of Transportation
DQO	Data Quality Objective
DRMO	Defense, Revitalization and Marketing Office
EM-31	Electromagnetic
EPA	Environmental Protection Agency
ESI	Expanded Site Inspections
FS	Feasibility Study
ft	Feet
ft/ft	Feet per foot

LIST OF ACRONYMS
(CONT.)

ft/sec	Feet per second
ft/yr	Feet per year
GA	Classification: The best usage of Class GA waters is as a source of potable water supply. Class GA waters are fresh groundwaters .
GC	Gas chromatograph
gpm	Gallons per minute
GPR	Ground penetrating radar
GRI	Gas Research Institute
GSSI	Geophysical Survey Systems, Inc.
HSWA	Hazardous and Solid Waste Amendments
IAG	Interagency Agreement
Koc	Organic carbon coefficient
lb	pound
L/min	Liters per minute
MCL	Maximum Contaminant Level
mg/l	Milligram per liter
mg/kg	Milligrams per kilogram
MHz	Megahertz
Miniram	Minature Real-Time Aerosol Meter
mL	Milliliter
mmhos/m	Millimhos per meter
MSL	Mean sea level
MW	Monitoring Well
NA	Not analyzed or not available
NBS	National Bureau of Standards
NGVD	National Geologic Vertical Datum
NO_2/N	Nitrite-Nitrogen
NO_3/N	Nitrate-Nitrogen
NPL	National Priority List
NTU	Nephelometric turbidity units
NYSDEC	New York State Department of Environmental Conservation
OVM	Organic Vapor Meter
Pb	Lead

LIST OF ACRONYMS
(CONT.)

PAH	Polynuclear Aromatic Hydrocarbon
Parsons ES	Parsons Engineering Science, Inc.
PCB	Polychlorinated biphenyls
PID	Photoionization detector
ppm	parts per million
ppmv	parts per million per volume
PSCR	Preliminary Site Characterization Report
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
RAGS	EPA Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RF	Response factor
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RQD	Rock Quality Designation
SB	Soil boring
SCS	Soil Conservation Service
SD	Sediment sample
SEAD	Seneca Army Depot (old name)
SEDA	Seneca Army Depot Activity
sec	Seconds
SOW	Statement of Work
SS	Soil sample
SVO	Semivolatile Organic Compounds
SW	Surface water sample
SWMU	Solid Waste Management Unit
TAGM	Technical and Administrative Guidance Memorandum
TAL	Target analyte list
TCL	Target compound list
TDS	Total dissolved solids
TKN	Total Kjeldah Nitrogen

LIST OF ACRONYMS
(CONT.)

TOC	Total Organic Carbon
TOX	Total Organic Halogens
TRPH	Total Recovered Petroleum Hydrocarbons
TP	Test Pit
UCL	Upper Confidence Level
ug/g	Micrograms per gram
ug/kg	Micrograms per kilogram
ug/mg	Micrograms per milligram
ug/L	Micrograms per liter
USACE	United States Army Corps of Engineers
USAEHA	United States Army Environmental Hygiene Agency
USATHAMA	United States Army Toxic and Hazardous Materials Agency
USCS	Unified Soil Classification System
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
Vs	Volt Second

1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

The purpose of this Project Scoping Plan is to outline the work proposed for a Remedial Investigation/Feasibility Study (RI/FS) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) at SEAD-52 and SEAD-60 at the Seneca Army Depot Activity (SEDA) in Romulus, New York. This Plan is based on the results and recommendations for SEAD-52 presented in final SWMU Classification Report (Parsons ES, September 1994) and for SEAD-60 presented in the draft Expanded Site Inspection (ESI) Report for the Seven Low Priority SWMUs (Parsons ES, April 1995). The purpose of the RI/FS is to determine the nature and extent of environmental impacts, and to evaluate and select appropriate remedial actions. These actions will comply with applicable or relevant and appropriate requirements (ARARs) and take into account the risks to human health and the environment. The sites are called SWMUs because the Army elected in the Federal Facilities Agreement to combine RCRA and CERCLA obligations and the Army uses RCRA terms to describe the units.

This work will be performed as part of the United States Army Corps of Engineers (USACOE) remedial response activities under CERCLA. It will follow the requirements of the New York State Department of Environmental Conservation (NYSDEC), the U.S. Environmental Protection Agency, Region II (EPA), and the Interagency Agreement (IAG).

This Project Scoping Plan provides site specific information for the RI/FS projects at SEAD-52 and SEAD-60. The Generic Installation RI/FS Workplan (Parsons ES, June 1995) is designed to serve as a foundation for this document and provides generic information that is applicable to all site activities at SEDA.

1.2 REPORT ORGANIZATION

The remaining sections of this report are organized to describe the overall site conditions, provide a scoping of the RI/FS, and to provide task plans for the RI and FS. Section 2.0 presents a description of regional geologic and hydrogeologic site conditions. Section 3.0 discusses scoping of the RI/FS including the conceptual site model, the results of previous investigations, identification of potential receptors and exposure scenarios, scoping of potential remedial action technologies, preliminary identification of ARARs, data quality objectives, and data gaps and needs. The task plans for the RI and FS are discussed in Sections 4.0 and 5.0, respectively.

Section 6.0 discusses scheduling and staffing. Appendices A through G provide additional supplemental information to the topics discussed in this report.

1.3 BACKGROUND

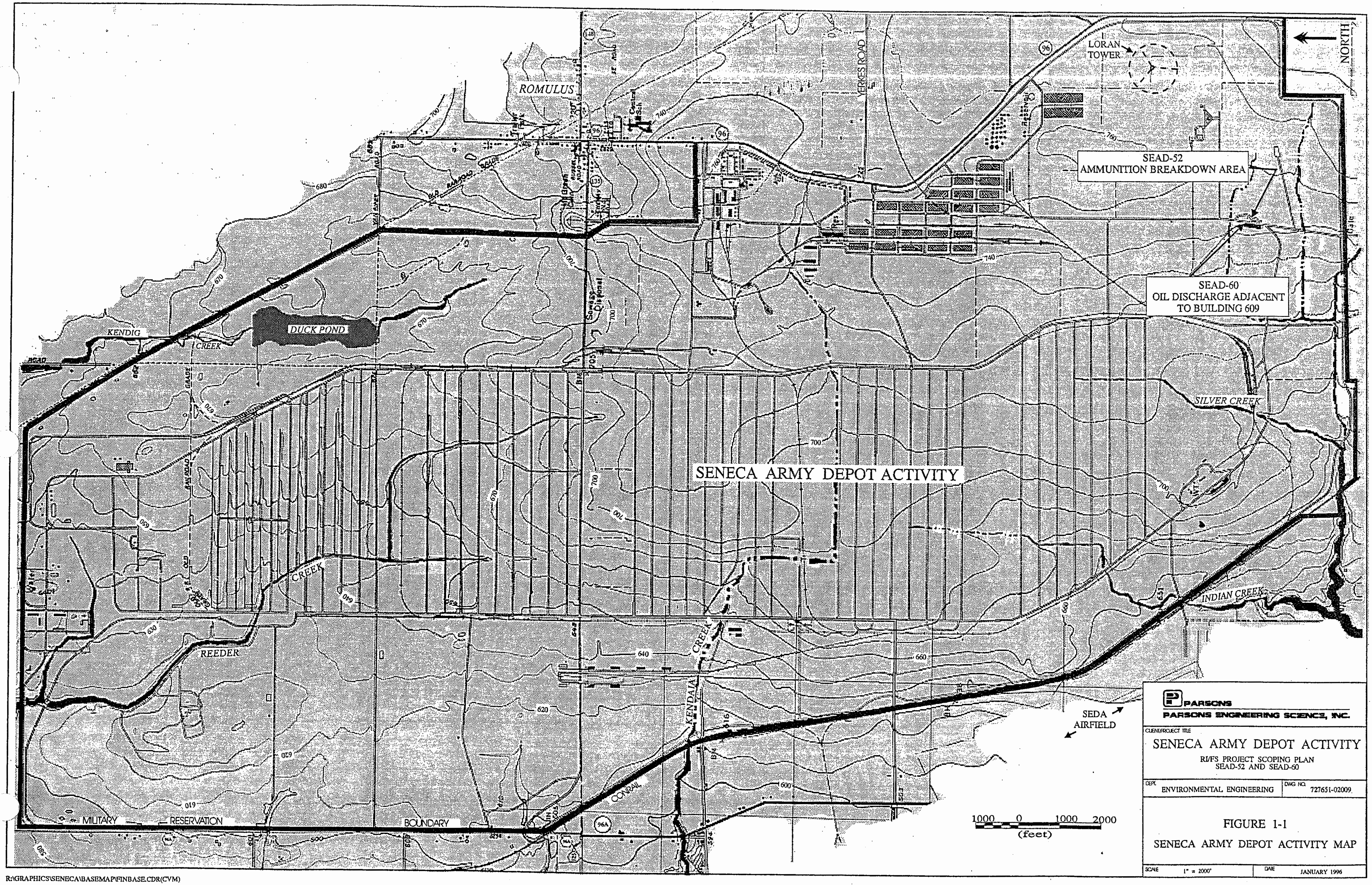
SEAD-52 is the Ammunition Breakdown Area located in the southeastern portion of SEDA as shown in Figure 1-1. SEAD-52 is comprised of Buildings 608, 610, 611 and 612,which have been used for the breakdown and maintenance of ammunitions. The materials handled at the Ammunitions Breakdown Area are not considered wastes. The materials are either reused or stored for later use. If the materials become obsolete, they are taken to the demolition grounds. Once received at the demolition grounds, the materials are considered wastes and appropriate actions are taken to dispose of them. A detailed site plan is shown on Figure 1-2.

In January 1980, this Solid Waste Management Unit (SWMU) was identified as a location of known or suspected waste materials by the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) in their report, "Installation Assessment of Seneca Army Depot". In 1987, the facility was deleted from the SWMU submission list by the U.S. Army Environmental Hygiene Agency (Groundwater Contamination Survey No. 38-26-0868-88). The reason for deleting the unit was due to the fact that there was no handling of waste at the SWMU. The facility was again added to the SWMU list in August, 1988 by the New York State Department of Environmental Conservation (RCRA Facility Assessment Report, draft August 1988). SWMU Classification Report (SCR) Resolution Meeting Minutes of September 25, 1992 indicated that limited sampling should be conducted at the site. Limited sampling was performed in December 1993 as part of the SWMU Classification Study update. The purpose of this sampling program was to collect additional data which would be used to determine whether or not this SWMU could be classified as a No-Action SWMU or if a Site Investigation (SI) was required. Based on the results of the limited sampling program presented in the final SWMU Classification Report (Parsons ES, September 1994), NYSDEC determined that a threat may exist at SEAD-52 due to the presence of explosive compounds in the surface soils. NYSDEC recommended that further investigations be performed at SEAD-52.

SEAD-60 is a former fuel oil spill area at SEDA in Romulus, NY and is referred to as the Oil Discharge area adjacent to Building 609. SEAD-60 is located in the southeastern portion of SEDA. The site is shown in Figure 1-1. The site is located immediately west of Brady Road. Building 612, which is not part of SEAD-60, is located approximately 120 feet south of Building 609. A detailed site plan is shown in Figure 1-3.

In accordance with the decision process outlined in the Interagency Agreement (IAG) between the USACOE, EPA, and NYSDEC, an Expanded Site Inspection (ESI) was performed at SEAD-60 in 1994. This investigation included sampling of surface soils, subsurface soils, groundwater, surface water and sediment to identify hazardous constituents or wastes that may have been released to the environment. The sampling data were compared to state and federal guidelines and standards to determine whether this AOC posed a potential threat or risk to human health and the environment. The draft ESI report (Parsons ES, April 1995) indicated that impacts to soils, groundwater, and sediment exceeding state and federal standard and guidelines had occurred at SEAD-60. As part of the ESI report a CERCLA RI/FS was recommended for SEAD-60.

This RI/FS Project Scoping Plan along with the Generic Installation RI/FS Workplan outline the recommended approach and methodologies for completion of an RI/FS at SEAD-52 and SEAD-60 in accordance with EPA CERCLA guidelines.



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CLIENT/PROJECT TITLE
SENECA ARMY DEPOT ACTIVITY
RI/FS PROJECT SCOPING PLAN
SEAD-52 AND SEAD-60

DEPT.	DWG NO.
ENVIRONMENTAL ENGINEERING	727651-02009

FIGURE 1-1
SENECA ARMY DEPOT ACTIVITY MAP

SCALE	DATE
1" = 2000'	JANUARY 1996

R:\GRAPHICS\SENECA\BASEMAP\FINBASE.CDR(CVM)

LEGEND

MINOR WATERWAY
MAJOR WATERWAY
FENCE
UNPAVED ROAD
BRUSH LINE
LANDFILL EXTENT
RAILROAD
760 GROUND SURFACE ELEVATION CONTOUR
ROAD SIGN
DECIDUOUS TREE
GUIDE POST
FIRE HYDRANT
MANHOLE
COORDINATE GRID (250' GRID)
POLE
UTILITY BOX
MAILBOX/RR SIGNAL
OVERHEAD UTILITY POLE
☒ SURVEY MONUMENT

← SURFACE WATER FLOW DIRECTION

100 0 100 200
(feet)

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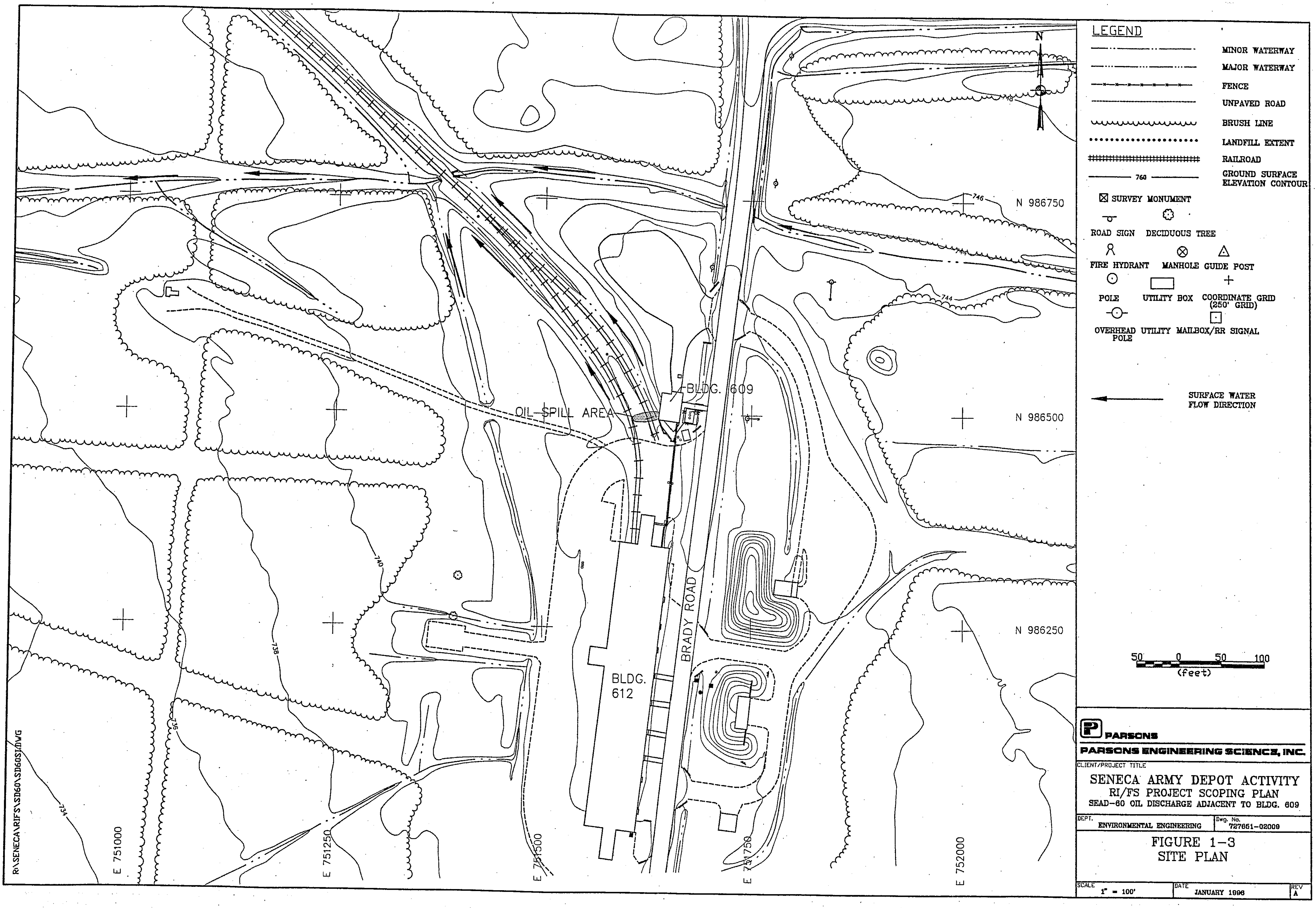
CLIENT/PROJECT TITLE

SENECA ARMY DEPOT ACTIVITY
RI/FS PROJECT SCOPING PLAN
SEAD-52 AMMUNITION BREAKDOWN AREA

DEPT. ENVIRONMENTAL ENGINEERING	Dwg. No.

FIGURE 1-2
SITE PLAN

SCALE 1" = 200'	DATE JULY 1995	REV A



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CLIENT/PROJECT TITLE

SENECA ARMY DEPOT ACTIVITY
RI/FS PROJECT SCOPING PLAN
SEAD-60 OIL DISCHARGE ADJACENT TO BLDG. 609

DEPT.	Dwg. No.
ENVIRONMENTAL ENGINEERING	727651-02009

FIGURE 1-3
SITE PLAN

SCALE	DATE	REV
1" = 100'	JANUARY 1996	A

2.0 SITE CONDITIONS

2.1 PHYSICAL SETTING

The physical setting of SEDA is described in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan.

2.2 REGIONAL GEOLOGICAL SETTING

The regional geological setting of SEDA is described in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan.

2.3 REGIONAL HYDROGEOLOGICAL SETTING

The regional hydrogeological setting of SEDA is described in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan.

3.0 SCOPING OF THE REMEDIAL INVESTIGATION/FEASIBILITY STUDY RI/FS

This section describes the current understanding of SEAD-52 based upon the results of the Limited Sampling Program presented in the Solid Waste Management Unit Classification Study Report (Parsons ES, September 1994) and of SEAD-60 based upon the results of the draft ESI Report (Parsons ES, April 1995). This includes the development of a conceptual model for each site describing all known contaminant sources and receptor pathways based upon actual sampling data. These conceptual models will be used to develop and implement additional studies which may be required to fully assess risks to human health and the environment. Other considerations which are discussed in this section are data quality objectives (DQOs) and potential remedial actions for SEAD-52 and SEAD-60. These considerations will also be integrated into the scoping process to ensure that adequate data is collected to complete the RI/FS process for this area of concern (AOC).

3.1 CONCEPTUAL SITE MODEL

The conceptual site models for SEAD-52 and SEAD-60 take into account site conditions and accepted pollutant behavior to formulate an understanding of the site. These models will serve as a basis for determining necessary additional studies for the RI. These models were developed by evaluating the following aspects:

- Historical usage and waste disposal practices.
- Physical site characteristics: This considers the physical aspects of environmental conditions and the effect these conditions may have on potential pollutant migration. These include soil characteristics, topography, subsurface geology, groundwater characteristics and local terrain.
- Environmental fate of constituents: This considers the fate and transport of residual materials in the environment based upon known chemical and physical properties.

3.1.1 SEAD-52

3.1.1.1 Site History

The Ammunition Breakdown Area (SEAD-52) has been an active site from the 1940s to the present time. The site consists of four buildings of concern which include Buildings 608, 610, 611 and Building 612. Building 612 has been used for the breakdown and maintenance of ammunitions; Building 608 has been used for the storage of ammunition magazines although no ammunition magazines are currently stored in the building; Building 610 has been used for ammunition powder collection; and Building 611 has been used for storage of equipment, paints, and solvents.

Cleaning procedures of Buildings 610 and 612 included hosing the floors with a water hose and releasing the water to the ground surface outside through the doors.

3.1.1.2 Physical Site Characterization

3.1.1.2.1 Physical Site Setting

SEAD-52 is located in the southeastern portion of SEDA as shown in Figure 1-1. The site is characterized by developed and undeveloped land as shown in Figure 1-2. East and west of the site are grassy fields with some sparse brush. Brady Road bisects the site running from north to south. The developed areas consist of Building 612, which is immediately west of Brady Road, and Buildings 608, 610 and 611, which are located east of Brady Road. Building 609, which is not part of SEAD-52, is located approximately 200 feet north of Building 612 on Brady Road and is a boiler house for Building 612. SEDA railroad tracks enter the site from the northwest and divide into two spurs which provide access to the northern side of Building 612 and the western side of Building 609. There are paved access routes on all sides of Building 612 and paved access routes to Buildings 608, 610, and 611.

Building 612 is a concrete block structure which is approximately 60 feet wide, 300 feet long, and 15 feet high. Covered platforms are located on the north and south ends of the building. Building 608 is also a concrete block structure which is approximately 20 feet wide by 20 feet long and 12 feet high. A concrete ramp extends from the front of the building to north of the building. No additional information is available for Buildings 610 and 611.

A mounded area with approximately 14 feet of relief is located west and south of Building 608. Another mounded area with approximately 8 feet of relief is located on the north, west, and south sides of Building 610.

The topography of SEAD-52 is relatively flat with the area to the west of Brady Road sloping gently to the west from a topographic high at Building 612. Several drainage ditches are located to the west, north, and south of Building 612 as shown on Figure 1-2. Approximately four ditches are located west of the building. One ditch flows north intersecting an east-west trending drainage ditch. One ditch flows southwest and two ditches flow west. Another ditch is located south of Building 612 and flows south paralleling Brady Road.

The area to the east of Brady Road also slopes gently to the west. A north-south trending drainage ditch is located east of Buildings 608, 610, and 611. Another drainage ditch parallels the east side of Brady Road and flows south.

3.1.1.2.2 Local Hydrology

Surface water flow in the area to the west of Brady Road is likely to be captured by the network of drainage ditches located to the north, west, and south of Building 612 as shown in Figure 1-2. Drainage ditches flowing north intersect an east-west trending drainage ditch located approximately 250 feet north of Building 612.

Surface water runoff from Building 608 is to the north and east and is likely to be captured by a north-south trending drainage ditch which flows north and by the north-south trending drainage ditch located to the east of Buildings 608, 610, and 611. This ditch flows south and intersects a drainage ditch which parallels Brady Road. Surface water runoff from Building 610 is to the east into the eastern drainage ditch. The mounded areas located adjacent to Buildings 608 and 610 prevent flow from the building areas to the west.

Surface water runoff from Building 611 is to the west and south into the drainage ditch paralleling Brady Road.

3.1.1.2.3 Chemical Analysis Results

A Limited Sampling Program was performed at SEAD-52 in December 1993. A total of eighteen (18) surface soil samples were collected from a depth of 0 to 2" below ground surface and chemically analyzed for explosives by EPA Method 8330. The samples were collected from locations around Buildings 608, 611 and 612 as shown in Figure 3-1. A description of the program is presented below.

Bldg. 608 -	Four surface soil samples, at 0-2" depth, were collected; one from each corner of the building.
Bldg. 611 -	Four surface soil samples, at 0-2" depth, were collected; one from each corner of the building.
Bldg. 612 -	Ten surface soil samples, at 0-2" depth, were collected; one from each corner of the building, two from the long sides of the building, approximately 100 feet apart, and one from the middle of each of the shorter sides.

The results of the analyses are presented in Table 3-1. The results of the limited sampling indicate that the three explosive compounds, tetryl, 2,4,6-trinitrotoluene, and 2,4-dinitrotoluene, were detected in 10 surface soil samples. Surface soil samples SS52-1 through SS52-8, which were collected from the buildings on the east side of Brady Road, were generally free of explosive compounds, with the exception of SS52-1 and SS52-6, which contained 110 and 280 ug/kg, respectively, of the compound 2,4-dinitrotoluene.

All of the surface soil samples, except two samples, that were collected around Building 612 contained explosive compounds. 2,4-dinitrotoluene was the most frequently detected compound and ranged in concentration from 91 to 2100 ug/kg. The compound 2,4,6-trinitrotoluene was detected in only two samples and tetryl in only one sample. SS52-15 and SS52-16 , the two samples in which explosive compounds were not detected, were located on the southwest side of Building 612. No NYSDEC TAGM criteria are available for the explosive compounds detected.

3.1.1.3 Data Summary and Conclusions

The Limited Sampling Program at SEAD-52 consisted of surface soil sampling and chemical analyses for explosive compounds. No previous sampling data were available for SEAD-52 prior to this sampling program. The results of the Limited Sampling Program at SEAD-52 were presented in the SWMU Classification Report (Parsons ES, September 1994).

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CLIENT/PROJECT TITLE

SENECA ARMY DEPOT ACTIVITY
RI/FS PROJECT SCOPING PLAN
SEAD-52 AMMUNITION BREAKDOWN AREA

DEPT.	Dwg. No.
ENVIRONMENTAL ENGINEERING	

FIGURE 3-1
LOCATION OF SAMPLE POINTS
FROM THE LIMITED SAMPLING PROGRAM

SCALE	DATE	REV
1" = 200'	JULY 1995	A

R:\SENECA\RIFS\SD52\SD52SP.DWG

TABLE 3-1

SOIL ANALYSIS RESULTS
SENECA ARMY DEPOT
SEAD-52 LIMITED SAMPLING PROGRAM

COMPOUND	MATRIX LOCATION DEPTH (FEET) SAMPLE DATE ES ID LAB ID UNITS	MAXIMUM	FREQUENCY OF DETECTION	TAGM	NUMBER ABOVE TAGM	SOIL SEAD-52 0-0.2 12/16/93 SS-52-1 207145	SOIL SEAD-52 0-0.2 12/16/93 SS-52-2 207146	SOIL SEAD-52 0-0.2 12/16/93 SS-52-3 207147	SOIL SEAD-52 0-0.2 12/16/93 SS-52-4 207148	SOIL SEAD-52 0-0.2 12/16/93 SS-52-5 207149	SOIL SEAD-52 0-0.2 12/16/93 SS-52-6 207150	SOIL SEAD-52 0-0.2 12/16/93 SS-52-7 207151	SOIL SEAD-52 0-0.2 12/16/93 SS-52-8 207152	SOIL SEAD-52 0-0.2 10/20/93 SS-52-9 207153
NITROAROMATICS														
Tetryl	ug/kg	150	5.0%	NA	NA	130 UJ	130 UJ	130 UJ	130 UJ	130 UJ	130 UJ	130 UJ	130 UJ	130 UJ
2,4,6-Trinitrotoluene	ug/kg	410	11.0%	NA	NA	130 UJ	130 UJ	130 UJ	130 UJ	130 UJ	130 UJ	130 UJ	130 UJ	130 UJ
2,4-Dinitrotoluene	ug/kg	2100	53.0%	NA	NA	110 J	130 UJ	130 UJ	130 UJ	130 UJ	280 J	130 UJ	130 UJ	490 J
OTHER ANALYSES														
Total Solids	%W/W					77.3	65.8	69.2	66.5	74.8	89.8	73.8	76.2	87.3

NOTES:

a) J = The reported value is an estimated concentration.
b) UJ = The compound may have been present above this concentration, but was not detected due to problems with the analysis.

TABLE 3-1

SOIL ANALYSIS RESULTS
SENECA ARMY DEPOT
SEAD-52 LIMITED SAMPLING PROGRAM

COMPOUND	MATRIX LOCATION DEPTH (FEET) SAMPLE DATE ES ID LAB ID UNITS	MAXIMUM	FREQUENCY OF DETECTION	TAGM	NUMBER ABOVE TAGM	SOIL SEAD-52 0-0.2 12/16/93 SS-52-10 207154	SOIL SEAD-52 0-0.2 12/16/93 SS-52-11 207155	SOIL SEAD-52 0-0.2 12/16/93 SS-52-12 207156	SOIL SEAD-52 0-0.2 10/20/93 SS-52-13 207157	SOIL SEAD-52 0-0.2 12/16/93 SS-52-14 207158	SOIL SEAD-52 0-0.2 12/16/93 SS-52-15 207159	SOIL SEAD-52 0-0.2 12/16/93 SS-52-16 207160	SOIL SEAD-52 0-0.2 12/16/93 SS-52-17 207161	SOIL SEAD-52 0-0.2 12/16/93 SS-52-18 207162	SOIL SEAD-52 0-0.2 12/16/93 SS-52-19 207163 SS-52-1DUP
NITROAROMATICS															
Tetryl	ug/kg	150	5.0%	NA	NA	130 UJ	150 J	130 UJ	130 UJ	130 UJ	130 UJ	130 UJ	130 UJ	130 UJ	130 UJ
2,4,6-Trinitrotoluene	ug/kg	410	11.0%	NA	NA	130 UJ	130 UJ	130 UJ	130 UJ	160 J	130 UJ	130 UJ	410 J	130 UJ	130 UJ
2,4-Dinitrotoluene	ug/kg	2100	53.0%	NA	NA	99 J	130 UJ	91 J	200 J	1500 J	130 UJ	130 UJ	1800 J	2100 J	120 J
OTHER ANALYSES															
Total Solids	%W/W					89	92.5	88	88.1	93.8	84.3	81	74.2	89.6	78.2

This section will summarize the data collected to date and draw conclusions as to the likely environmental impacts those constituents have made to the site.

Sampling at SEAD-52 focused upon surface soil (0-2") impacts in the immediate vicinity of Buildings 608, 611 and 612. This was based upon the premise that the principle source of the impacts in this area would be the soil in the areas where ammunition breakdown and maintenance were suspected to have been conducted. The results of the chemical analyses indicate impacts to surface soil from explosives, principally 2,4-dinitrotoluene, 2,4,6-trinitrotoluene and tetryl.

Based upon the results of the investigation conducted at SEAD-52, a threat to human health and the environment may exist due to the presence of explosives in the surface soil. No information exists concerning the potential for volatilization of contaminants from soil to air or for infiltration of contaminants from soil to groundwater. Additional data is required to further evaluate these pathways in the overall evaluation of risks.

3.1.2 SEAD-60

3.1.2.1 Site History

Most of the historical information for SEAD-60 is related to a release of oil on the site. Building 609 has historically been a boiler house for Building 612, which is located south of Building 609. It is believed that overflow from an aboveground storage tank located in Building 609 was discharged from a pipe in the wall of Building 609 resulting in a spill adjacent to the southwest corner of the building. According to SEDA personnel, the aboveground storage tank contains No. 2 fuel oil. No information is available on the date of the spill or the volume of oil released.

3.1.2.2 Physical Site Characterization

3.1.2.2.1 Physical Site Setting

SEAD-60 is located in the southeastern portion of SEDA and represents an area of oil stained soil adjacent to the southwest corner of Building 609. SEAD-52 is adjacent to the southern boundary of the SWMU area, and SEAD-62 is located to the east. The site is located within the ammunition storage area and access to the site is restricted. The site plan is shown in Figure 1-2.

The surrounding areas are characterized by developed and undeveloped land. The developed areas consist of Building 609, which is located immediately west of Brady Road, and two SEDA railroad spurs. One railroad track enters the site from the northwest and divides into two spurs approximately 300 feet northwest of Building 609. The two spurs transect the site to the west of Building 609. The eastern railroad spur passes within a few feet of Building 609 and ends just south of Building 609. The western spur ends at the northern side of Building 612.

The undevoloped areas are located north, west and east of SEAD-60, and consist of grassy fields with sparse brush. A grassy mounded area is also located north-northwest of the site.

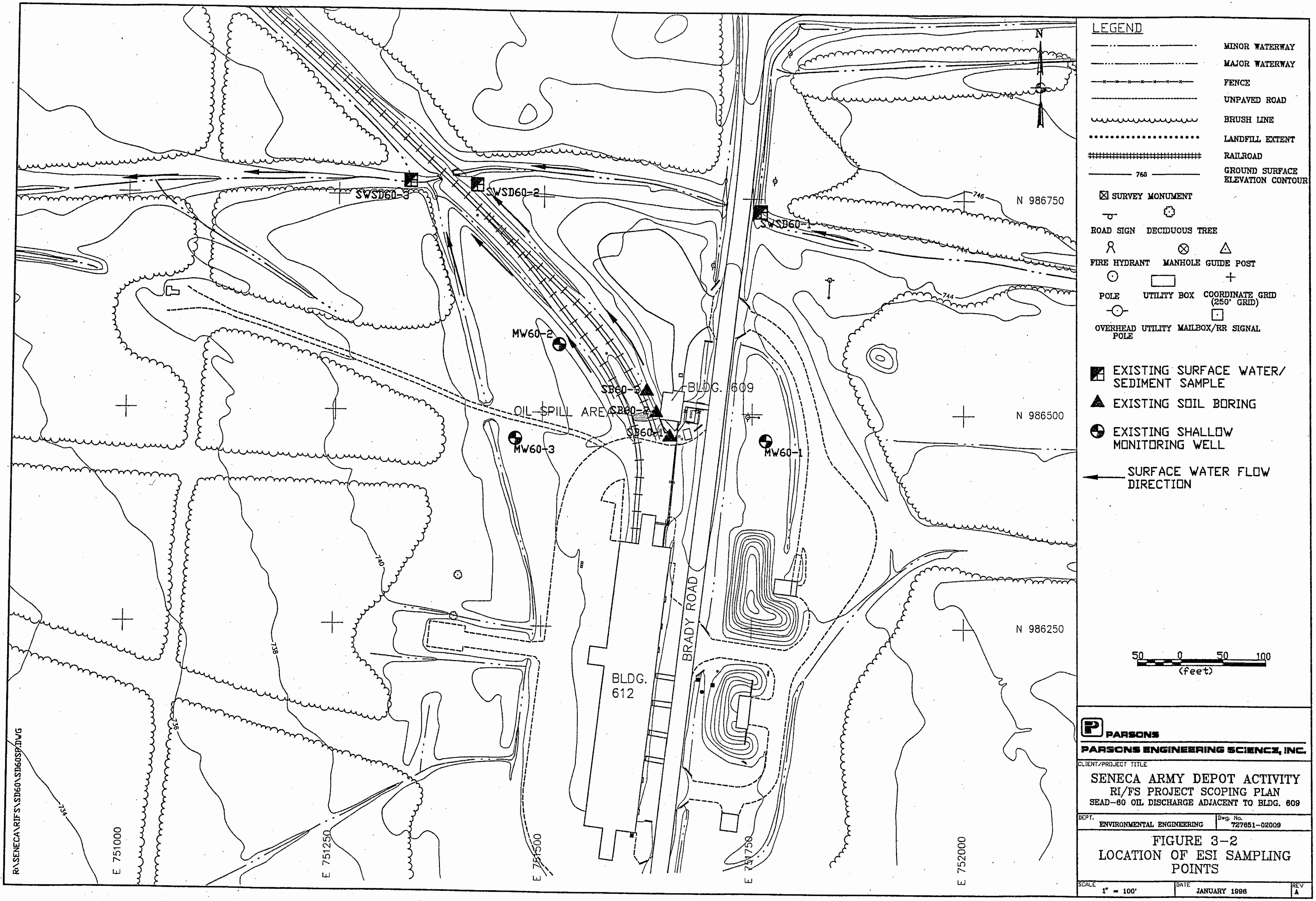
Building 612, which is part of SEAD-52, is located approximately 120 feet south of the site. Building 609 is a boiler house for Building 612. Elevated pipes, which include steampipes, run parallel to Brady Road and connect Buildings 609 and 612. A tall emissions stack protrudes from the southeastern corner of Building 609. A paved driveway is located immediately south of Building 609 and provides vehicular access to the western portion of the site from Brady Road. There are also paved access routes on the eastern and northern sides of the building.

The spill area, which is evidenced by visibly stained soils, approximately 6 feet by 30 feet in area, extends west of the easternmost railroad spur. No vegetation is present in the visibly stained soil area.

The topography in the immediate vicinity of the Building 609 is variable but the most notable feature is a low-lying area defined by the western wall of Building 609 and the easement of the easternmost railroad spur. The local topography within an approximately 50-foot radius slopes toward this area while the regional topography slopes to the west. In the northern portion of the site, the topography slopes toward an east-west trending intermittent stream that flows to the west. Drainage swales, which parallel each side of the railroad spurs, flow north intersecting the intermittent stream approximately 300 feet northwest of Building 609.

3.1.2.2.2 Site Geology

Determination of the site geology was based on the drilling program conducted for the ESI at SEAD-60. This program included 3 soil borings and 3 monitoring wells which were drilled to a maximum depth of 24.5 feet below ground surface. The locations of the soil borings and monitoring wells are shown in Figure 3-2. Soil boring logs are included in Appendix G.



PARSONS

PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT ACTIVITY
RI/FS PROJECT SCOPING PLAN
SEAD-60 OIL DISCHARGE ADJACENT TO BLDG. 609

DEPT. ENVIRONMENTAL ENGINEERING
Dwg. No. 727651-02009

FIGURE 3-2
LOCATION OF ESI SAMPLING POINTS

SCALE 1" = 100'
DATE JANUARY 1996
REV A

Based on the results of the drilling program, till and calcareous shale are the two major geologic units present on-site. A very thin soil horizon was present within 1.0 foot of the ground surface. The depths to the bottom of the till, thickness of weathered shale, and depth to bedrock at SEAD-60 are presented in the table below.

Boring Location	Depth to Bottom of Till (feet)	Thickness of Weathered Shale (feet)	Depth to Bedrock (feet)
SB60-1	18.4	1.6	20
SB60-2	10.0	ND	ND
SB60-3	9.0	ND	ND
MW60-1	15.3	3.0	18.3
MW60-2	16.0	3.0	19.0
MW60-3	19.3	2.7	22.0

ND = Not Determined

The till was characterized as grey brown in color and consisted of silt, with little clay, little very fine sand, and little dark grey-black shale fragments (up to 0.75 inch in diameter). Larger shale fragments (rip-up clasts) were observed at some locations near the till-weathered shale contact. Areas of oxidized till were observed in the upper portion of the till strata.

One of the soil borings, SB60-2, was advanced in the visibly stained oil spill area. The top 0.3 foot of the soil consisted of dark grey-black silt, with some very fine sand, trace organic material, and trace amounts of shale fragments (up to 1-inch in diameter). The stained soil contained a strong petroleum odor and an oily sheen. Elevated Organic Vapor Meter (OVM) readings were recorded at SB60-2 as follows:

0.0 to 0.3 foot below ground surface - 65 ppm
0.3 to 0.65 foot below ground surface - 4.3 ppm
0.65 to 1.0 foot below ground surface - 1.3 ppm
1.0 to 1.15 feet below ground surface - 0.6 ppm

No other borings conducted at SEAD-60 exhibited signs of stained soils or elevated OVM readings.

Competent, calcareous dark grey to black shale was encountered at depths between approximately 18 and 22 feet below the ground surface. Due to the extensive weathering of the shale (minimum of 1.6 feet) as determined through split spoon sampling and augering, competent shale was not observed in all of the soil borings.

3.1.2.2.3 Site Hydrology and Hydrogeology

Surface water flow from precipitation events at SEAD-60 is controlled by the local topography, as shown in Figure 1-2. Surface water flows primarily westward following the regional topographic slope in this area. There are no sustained surface water bodies present at SEAD-60, although intermittent drainage ditches are present to the north, northwest and west of the site. The two drainage ditches, which flow to the northwest along the railroad spurs, originate near the oil spill area.

As part of the ESI program, three monitoring wells were installed at SEAD-60. Groundwater elevations were measured in the three monitoring wells and the results are presented in Table 3-2. Figure 3-3 shows the groundwater elevations. Based on these data, the groundwater flow direction is primarily west across SEAD-60.

3.1.2.2.4 Chemical Analysis Results

Soil, surface water, sediment and groundwater were sampled as part of the ESI conducted at SEAD-60 in 1994. Sampling and analyses were based upon historical information of an oil release on site. The results of this investigation were detailed in the draft ESI report (Parsons ES, April 1995).

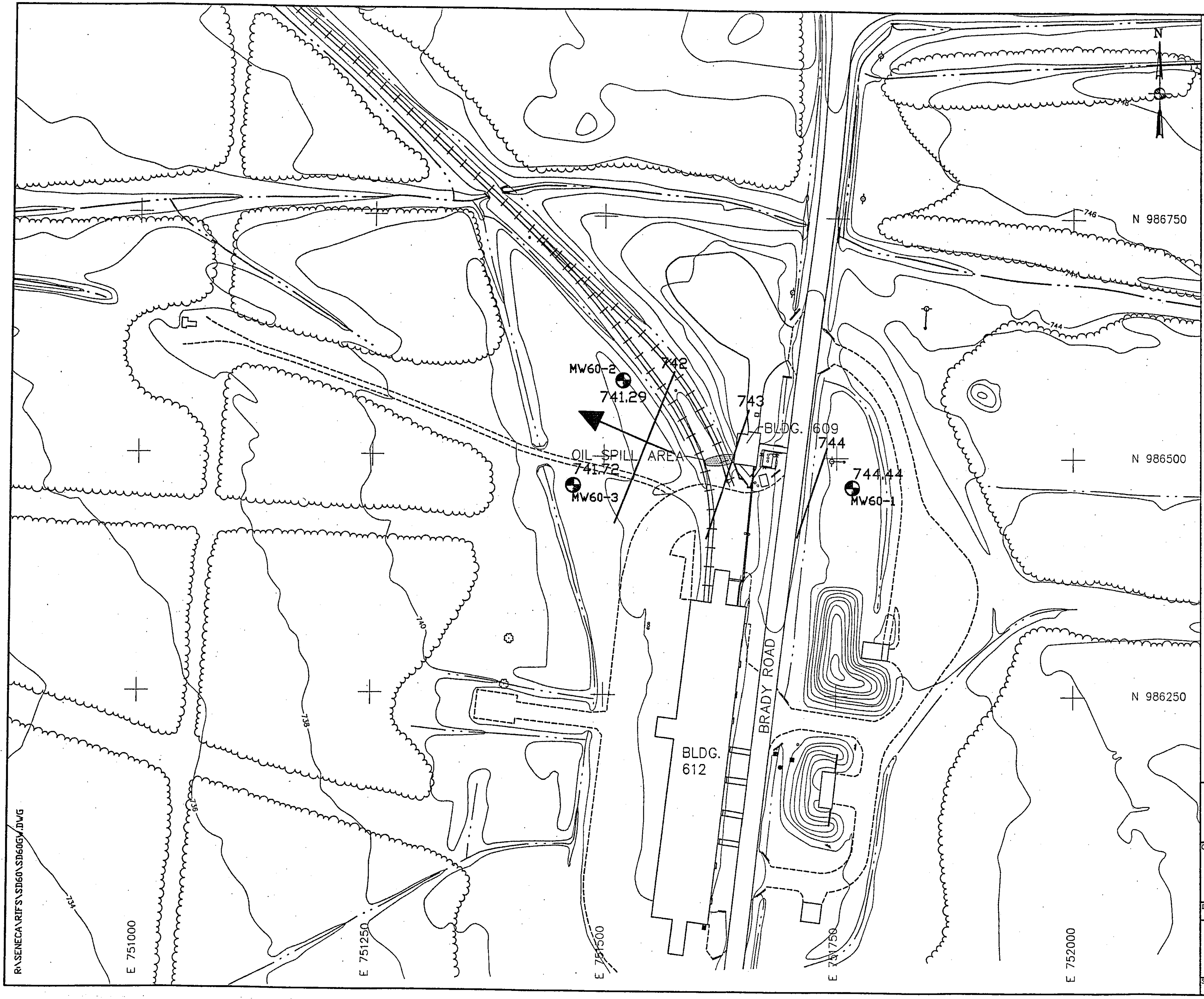
A total of 3 surface and 6 subsurface soil samples were collected at SEAD-60 in the immediate vicinity of the oil-stained soil. To assess the potential impact from surface water runoff, 3 surface water and sediment samples were collected in drainage ditches north of the site that are suspected to receive surface water runoff from the site; one of these three sample locations (SWSD60-1) is an upstream sample. Three monitoring wells were also sampled as part of this investigation. The following sections describe the nature and extent of contamination identified at SEAD-60. The sample locations are shown in Figure 3-2.

TABLE 3-2

SENECA ARMY DEPOT ACTIVITY
SEAD-60 RI/FS SCOPING PLAN
MONITORING WELL WATER LEVEL SUMMARY

MONITORING WELL NUMBER	TOP OF PVC CASING ELEVATION (MSL)	WELL DEVELOPMENT			SAMPLING			WATER LEVEL MEASUREMENTS		
		DATE	DEPTH TO GROUNDWATER TOC (FT)	GROUNDWATER ELEVATION (MSL)	DATE	DEPTH TO GROUNDWATER TOC (FT)	GROUNDWATER ELEVATION (MSL)	DATE	DEPTH TO GROUNDWATER TOC (FT)	GROUNDWATER ELEVATION (MSL)
MW60-1	747.86	3/31/94	2.88	744.98	7/7/94	3.63	744.23	7/6/94	3.42	744.44
								7/25/94	4.5	743.36
MW60-2	745.53	3/30/94	3.51	742.02	7/7/94	4.42	741.11	7/6/94	4.24	741.29
								7/25/94	5.29	740.24
MW60-3	744.42	3/5/94	2.48	741.94	3/29/94	1.75	742.67	7/6/94	2.7	741.72
								7/25/94	3.94	740.48

H:\ENG\SENECA\scoping\sead5260\tbl3-2.WK



LEGEND

- MINOR WATERWAY
- MAJOR WATERWAY
- FENCE
- UNPAVED ROAD
- BRUSH LINE
- LANDFILL EXTENT
- RAILROAD
- 760 GROUND SURFACE ELEVATION CONTOUR
- ☒ SURVEY MONUMENT
- ROAD SIGN
- DECIDUOUS TREE
- FIRE HYDRANT
- ⊗ MANHOLE
- △ GUIDE POST
- ⊙ POLE
- ▭ UTILITY BOX
- + COORDINATE GRID (250' GRID)
- OVERHEAD UTILITY POLE
- ☐ MAILBOX/RR SIGNAL
- MW60-1 744.44 MONITORING WELL WITH WATER TABLE ELEVATION
- 744 GROUNDWATER ELEVATION CONTOUR (ARROW INDICATES DIRECTION OF FLOW)

GROUNDWATER LEVEL MEASUREMENTS MADE ON 7/6/94

50 0 50 100
(feet)

PARSONS
PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT ACTIVITY
RI/FS PROJECT SCOPING PLAN
SEAD-60 OIL DISCHARGE ADJACENT TO BLDG. 609

DEPT.	Dwg. No.
ENVIRONMENTAL ENGINEERING	727651-02009

FIGURE 3-3
GROUNDWATER ELEVATION MAP

SCALE	DATE	REV
1" = 100'	JANUARY 1996	A

SOIL SAMPLING SUMMARY

The analytical results for the 3 surface and 6 subsurface soil samples collected as part of the investigation of SEAD-60 are presented in Table 3-3. The following sections describe the nature and extent of contamination in SEAD-60 soils.

Volatile Organic Compounds

Nine volatile organic compounds were detected in the 9 soil samples collected. All were found at concentrations well below the associated TAGM values. The maximum detected concentration was 170 μg/kg of acetone in the surface soil sample SB60-2-00. The volatile organic compounds toluene, ethylbenzene, and tetrachloroethane can be found in fuel oils. While the surface soil sample from boring SB60-2-00 clearly contained the greatest number of volatile organic compounds, low concentrations of toluene and tetrachloroethane (up to 3 μg/kg) were also detected in deeper samples from this boring.

The volatile organic compound, carbon disulfide, was found in only two samples at concentrations of up to 2 μg/kg. The TAGM value for carbon disulfide is 2,700 μg/kg.

Some of the volatile organic compounds detected in the soil are common laboratory contaminants. These are acetone, which was found in one sample; methylene chloride, which was found in 5 samples; 2-butanone, which was found in one sample; and toluene, which was found in 3 samples. These compounds can be potentially attributed to the laboratory and not site conditions.

Semivolatile Organic Compounds

A total of 20 semivolatile organic compounds, most of which were PAH compounds, were found at varying concentrations in the soil samples collected at SEAD-60. Most compounds were detected in only the surface soils (0 to 0.2 feet) at each of the three boring locations. The highest concentrations were found in the surface sample from soil boring SB60-2-00, located at the visibly oil stained area near the southwest corner of Building 609. Values of up to an estimated concentration of 17,000J μg/kg were measured for several individual compounds at this location. Concentrations of up to an estimated concentration of 2,000J μg/kg were measured in surface soil samples from the other two borings, however, all three surface soil samples contained compounds in concentrations exceeding the associated TAGM

TABLE 3-3

SENECA ARMY DEPOT ACTIVITY
SEAD-60 RI/FS SCOPING PLAN
SOIL ANALYSIS RESULTS FROM THE ESI

COMPOUND	MATRIX LOCATION DEPTH (FEET) SAMPLE DATE ES ID LAB ID SDG NUMBER UNITS	MAXIMUM	FREQUENCY OF DETECTION	TAGM	NUMBER ABOVE TAGM	SOIL SEAD-60 0-0.2 05/27/94 SB60-1-00 222473 44410	SOIL SEAD-60 0-2 02/28/94 SB60-1.01 212883 42510	SOIL SEAD-60 2-4 02/28/94 SB60-1.02 212884 42510	SOIL SEAD-60 0-0.2 06/07/94 SB60-2-00 223339 44410	SOIL SEAD-60 2-4 06/08/94 SB60-2-02 223513 44694
VOLATILE ORGANICS										
Methylene Chloride	ug/Kg	54	56%	100	0	12 U	11 U	11 U	27 J	11 U
Acetone	ug/Kg	170	11%	200	0	12 U	11 U	11 U	170 J	11 U
Carbon Disulfide	ug/Kg	2	22%	2700	0	12 U	11 U	11 U	1 J	11 U
2-Butanone	ug/Kg	26	11%	300	0	12 U	11 U	11 U	26 J	11 U
2-Hexanone	ug/Kg	1	11%	NA	NA	12 U	11 U	1 J	11 UJ	11 U
Tetrachloroethene	ug/Kg	3	11%	1400	0	12 U	11 U	11 U	11 UJ	11 U
Toluene	ug/Kg	13	33%	1500	0	12 U	11 U	11 U	13 J	2 J
Ethylbenzene	ug/Kg	4	11%	5500	0	12 U	11 U	11 U	4 J	11 U
Xylene (total)	ug/Kg	9	11%	1200	0	12 U	11 U	11 U	9 J	11 U
SEMIVOLATILE ORGANICS										
Naphthalene	ug/Kg	38	11%	13000	0	38 J	370 U	370 U	18000 U	360 U
2-Methylnaphthalene	ug/Kg	1100	11%	36400	0	390 U	370 U	370 U	1100 J	360 U
Acenaphthene	ug/Kg	1400	33%	50000*	0	59 J	370 U	370 U	1400 J	360 U
Dibenzofuran	ug/Kg	29	11%	6200	0	29 J	370 U	370 U	18000 U	360 U
Fluorene	ug/Kg	1300	22%	50000*	0	48 J	370 U	370 U	1300 J	360 U
Phenanthrene	ug/Kg	8900	44%	50000*	0	570 J	25 J	370 U	8900 J	360 U
Anthracene	ug/Kg	2000	22%	50000*	0	98 J	370 U	370 U	2000 J	360 U
Carbazole	ug/Kg	79	11%	50000*	0	79 J	370 U	370 U	18000 U	360 U
Di-n-butylphthalate	ug/Kg	1500	33%	8100	0	390 U	370 U	370 U	1500 J	360 U
Fluoranthene	ug/Kg	14000	67%	50000*	0	1100 J	33 J	370 U	14000 J	27 J
Pyrene	ug/Kg	27000	78%	50000*	0	700 J	31 J	37 J	27000 J	27 J
Benzo(a)anthracene	ug/Kg	340	11%	220	1	340 J	370 U	370 U	18000 U	360 U
Chrysene	ug/Kg	17000	44%	400	2	400	370 U	370 U	17000 J	18 J
bis(2-Ethylhexyl)phthalate	ug/Kg	380	44%	50000*	0	54 J	370 U	380 J	18000 U	360 U
Benzo(b)fluoranthene	ug/Kg	16000	33%	1100	2	730 J	370 U	370 U	16000 J	360 U
Benzo(k)fluoranthene	ug/Kg	190	11%	1100	0	190 J	370 U	370 U	18000 U	360 U
Benzo(a)pyrene	ug/Kg	350	11%	61	1	350 J	370 U	370 U	18000 U	360 U
Indeno(1,2,3-cd)pyrene	ug/Kg	1100	33%	3200	0	220 J	370 U	370 U	18000 U	360 U
Dibenz(a,h)anthracene	ug/Kg	1100	33%	14	3	110 J	370 U	370 U	18000 U	360 U
Benzo(g,h,i)perylene	ug/Kg	1600	33%	50000*	0	220 J	370 U	370 U	18000 U	360 U

TABLE 3-3

SENECA ARMY DEPOT ACTIVITY
SEAD-60 RI/FS SCOPING PLAN
SOIL ANALYSIS RESULTS FROM THE ESI

COMPOUND	MATRIX	MAXIMUM	FREQUENCY OF DETECTION	TAGM	NUMBER ABOVE TAGM	SOIL	SOIL	SOIL	SOIL	SOIL
	LOCATION					SEAD-60	SEAD-60	SEAD-60	SEAD-60	SEAD-60
	DEPTH (FEET)					0-0.2	0-2	2-4	0-0.2	2-4
	SAMPLE DATE					05/27/94	02/28/94	02/28/94	06/07/94	06/08/94
	ES ID					SB60-1-00	SB60-1.01	SB60-1.02	SB60-2-00	SB60-2-02
	LAB ID					222473	212883	212884	223339	223513
	SDG NUMBER					44410	42510	42510	44410	44694
	UNITS									
PESTICIDES/PCB										
alpha-BHC	ug/Kg	5	11%	110	0	4 UJ	1.9 U	1.9 U	5 J	1.8 U
Aldrin	ug/Kg	16	11%	41	0	4 UJ	1.9 U	1.9 U	16 J	1.8 U
Endosulfan I	ug/Kg	34	33%	900	0	3.2 J	1.9 U	1.9 U	34 J	1.8 U
4,4'-DDE	ug/Kg	110	44%	2100	0	110 J	2.7 J	3.7 U	31 J	3.6 U
4,4'-DDD	ug/Kg	100	22%	2900	0	7.8 UJ	3.7 U	3.7 U	55 J	3.6 U
4,4'-DDT	ug/Kg	130	22%	2100	0	84 J	3.7 U	3.7 U	130 J	3.6 U
Endrin ketone	ug/Kg	14	11%	NA	NA	7.8 UJ	3.7 U	3.7 U	14 J	3.6 U
alpha-Chlordane	ug/Kg	27	22%	540	0	4 UJ	1.9 U	1.9 U	27 J	1.8 U
gamma-Chlordane	ug/Kg	10	11%	540	0	4 UJ	1.9 U	1.9 U	10 J	1.8 U
Aroclor-1242	ug/Kg	970	11%	1000/10000(a)	0	78 UJ	37 U	37 U	970 J	36 U
Aroclor-1248	ug/Kg	2100	11%	1000/10000(a)	1	78 UJ	37 U	37 U	2100 J	36 U
Aroclor-1260	ug/Kg	4400	22%	1000/10000(a)	1	78 UJ	37 U	37 U	4400 J	36 U
METALS										
Aluminum	mg/Kg	14100	100%	14593	0	10800	8440	13300	9420	6850 J
Antimony	mg/Kg	1.8	78%	3.59	0	0.28 J	0.43 J	0.36 J	1.8 J	0.29 J
Arsenic	mg/Kg	8.1	100%	7.5	1	5.3	4.1 J	6.2 J	8.1	4.6
Barium	mg/Kg	679	100%	300	2	77.6	98.3	85.8	679	71.7 J
Beryllium	mg/Kg	0.67	100%	1	0	0.47 J	0.43 J	0.67 J	0.42 J	0.26 J
Cadmium	mg/Kg	2	100%	1	2	0.58 J	0.36 J	0.27 J	2	0.32 J
Calcium	mg/Kg	102000	100%	101904	1	65800	75100	64000	56200	90900 J
Chromium	mg/Kg	23.3	100%	22	2	18.3	14.2	19.4	18.8	12 J
Cobalt	mg/Kg	13.1	100%	30	0	9.6	8.3 J	10.8	9.5 J	8.1 J
Copper	mg/Kg	190	100%	25	3	24.9	21.3	21.7	190	16.6 J
Iron	mg/Kg	32100	100%	26627	1	22800	18900	23900	22800	15600 J
Lead	mg/Kg	66.7	100%	30	3	17.1	47.5 J	12.6 J	66.7	7.2
Magnesium	mg/Kg	25400	100%	12222	5	13300	11300	17200	12200	25400 J
Manganese	mg/Kg	536	100%	669	0	422	333	431	317	536 J
Mercury	mg/Kg	0.08	89%	0.1	0	0.06 J	0.08 J	0.03 J	0.03 J	0.03 J
Nickel	mg/Kg	44.3	100%	34	1	30.9	23.5	29.1	29.5	23.5 J
Potassium	mg/Kg	1920	100%	1762	7	1920 J	1470	1820	1870 J	1860
Selenium	mg/Kg	1.5	33%	2	0	0.43 U	0.32 U	0.31 U	1.5 J	0.54 U
Sodium	mg/Kg	140	100%	104	8	105 J	75 J	129 J	127 J	119 J
Vanadium	mg/Kg	26.2	100%	150	0	18.6	14.8	21.9	21.2	13.7 J
Zinc	mg/Kg	569	100%	83	5	85	58.6	101	569	43.7 J
OTHER ANALYSES										
Total Petroleum Hydrocarbons	mg/Kg	218000	89%	NA	NA	87 J	29 U	87 J	218000	283
Total Solids	%W/W					85.4	88.4	87.7	90.1	91.8

TABLE 3-3

SENECA ARMY DEPOT ACTIVITY
SEAD-60 RI/FS SCOPING PLAN
SOIL ANALYSIS RESULTS FROM THE ESI

COMPOUND	MATRIX LOCATION DEPTH (FEET) SAMPLE DATE ES ID LAB ID SDG NUMBER UNITS	MAXIMUM	FREQUENCY OF DETECTION	TAGM	NUMBER ABOVE TAGM	SOIL SEAD-60 6-8 06/07/94 SB60-2-04 223340 44665	SOIL SEAD-60 0-0.2 06/08/94 SB60-3.00 223499 44665	SOIL SEAD-60 4-6 06/08/94 SB60-3.03 223500 44665	SOIL SEAD-60 6-8 06/08/94 SB60-3.04 223501 44665
VOLATILE ORGANICS									
Methylene Chloride	ug/Kg	54	56%	100	0	3 J	21	54	1 J
Acetone	ug/Kg	170	11%	200	0	11 U R	14 U	11 U	11 U
Carbon Disulfide	ug/Kg	2	22%	2700	0	11 U R	14 U	11 U	2 J
2-Butanone	ug/Kg	26	11%	300	0	11 U R	14 U	11 U	11 U
2-Hexanone	ug/Kg	1	11%	NA	NA	11 U R	14 U	11 U	11 U
Tetrachloroethene	ug/Kg	3	11%	1400	0	3 J	14 U	11 U	11 U
Toluene	ug/Kg	13	33%	1500	0	2 J	14 U	11 U	11 U
Ethylbenzene	ug/Kg	4	11%	5500	0	11 U R	14 U	11 U	11 U
Xylene (total)	ug/Kg	9	11%	1200	0	11 U R	14 U	11 U	11 U
SEMIVOLATILE ORGANICS									
Naphthalene	ug/Kg	38	11%	13000	0	350 U	2200 U	350 U	350 U
2-Methylnaphthalene	ug/Kg	1100	11%	36400	0	350 U	2200 U	350 U	350 U
Acenaphthene	ug/Kg	1400	33%	50000*	0	32 J	2200 U	350 U	350 U
Dibenzofuran	ug/Kg	29	11%	6200	0	350 U	2200 U	350 U	350 U
Fluorene	ug/Kg	1300	22%	50000*	0	350 U	2200 U	350 U	350 U
Phenanthrene	ug/Kg	8900	44%	50000*	0	350 U	680 J	350 U	350 U
Anthracene	ug/Kg	2000	22%	50000*	0	350 U	2200 U	350 U	350 U
Carbazole	ug/Kg	79	11%	50000*	0	350 U	2200 U	350 U	350 U
Di-n-butylphthalate	ug/Kg	1500	33%	8100	0	350 U	2200 U	81 J	94 J
Fluoranthene	ug/Kg	14000	67%	50000*	0	29 J	1300 J	350 U	350 U
Pyrene	ug/Kg	27000	78%	50000*	0	62 J	2000 J	350 U	350 U
Benzo(a)anthracene	ug/Kg	340	11%	220	1	350 U	2200 U	350 U	350 U
Chrysene	ug/Kg	17000	44%	400	2	350 U	1100 J	350 U	350 U
bis(2-Ethylhexyl)phthalate	ug/Kg	380	44%	50000*	0	43 J	2200 U	350 U	160 J
Benzo(b)fluoranthene	ug/Kg	16000	33%	1100	2	350 U	1500 J	350 U	350 U
Benzo(k)fluoranthene	ug/Kg	190	11%	1100	0	350 U	2200 UJ	350 U	350 U
Benzo(a)pyrene	ug/Kg	350	11%	61	1	350 U	2200 U	350 U	350 U
Indeno(1,2,3-cd)pyrene	ug/Kg	1100	33%	3200	0	46 J	1100 J	350 U	350 U
Dibenz(a,h)anthracene	ug/Kg	1100	33%	14	3	27 J	1100 J	350 U	350 U
Benzo(g,h,i)perylene	ug/Kg	1600	33%	50000*	0	43 J	1600 J	350 U	350 U

TABLE 3-3

SENECA ARMY DEPOT ACTIVITY
SEAD-60 RI/FS SCOPING PLAN
SOIL ANALYSIS RESULTS FROM THE ESI

COMPOUND		MAXIMUM	FREQUENCY OF DETECTION	TAGM	NUMBER ABOVE TAGM				
	MATRIX					SOIL	SOIL	SOIL	SOIL
	LOCATION					SEAD-60	SEAD-60	SEAD-60	SEAD-60
	DEPTH (FEET)					6-8	0-0.2	4-6	6-8
	SAMPLE DATE					06/07/94	06/08/94	06/08/94	06/08/94
	ES ID					SB60-2-04	SB60-3.00	SB60-3.03	SB60-3.04
	LAB ID					223340	223499	223500	223501
	SDG NUMBER					44665	44665	44665	44665
	UNITS								
PESTICIDES/PCB									
alpha-BHC	ug/Kg	5	11%	110	0	1.8 U	2.9 UJ	1.8 U	1.8 U
Aldrin	ug/Kg	16	11%	41	0	1.8 U	2.9 UJ	1.8 U	1.8 U
Endosulfan I	ug/Kg	34	33%	900	0	1.8 U	6.3 J	1.8 U	1.8 U
4,4'-DDE	ug/Kg	110	44%	2100	0	3.5 U	28 J	3.5 U	3.5 U
4,4'-DDD	ug/Kg	100	22%	2900	0	3.5 U	100 J	3.5 U	3.5 U
4,4'-DDT	ug/Kg	130	22%	2100	0	3.5 U	5.6 UJ	3.5 U	3.5 U
Endrin ketone	ug/Kg	14	11%	NA	NA	3.5 U	5.6 UJ	3.5 U	3.5 U
alpha-Chlordane	ug/Kg	27	22%	540	0	1.8 U	3 J	1.8 U	1.8 U
gamma-Chlordane	ug/Kg	10	11%	540	0	1.8 U	2.9 UJ	1.8 U	1.8 U
Aroclor-1242	ug/Kg	970	11%	1000/10000(a)	0	35 U	56 UJ	35 U	35 U
Aroclor-1248	ug/Kg	2100	11%	1000/10000(a)	1	35 U	56 UJ	35 U	35 U
Aroclor-1260	ug/Kg	4400	22%	1000/10000(a)	1	35 U	220 J	35 U	35 U
METALS									
Aluminum	mg/Kg	14100	100%	14593	0	8320	14100	6980	13200
Antimony	mg/Kg	1.8	78%	3.59	0	0.22 UJ	0.49 J	0.26 J	0.18 UJ
Arsenic	mg/Kg	8.1	100%	7.5	1	3.8	7	4	5.6
Barium	mg/Kg	679	100%	300	2	90.1	416	64	50.1
Beryllium	mg/Kg	0.67	100%	1	0	0.38 J	0.66 J	0.35 J	0.63 J
Cadmium	mg/Kg	2	100%	1	2	0.33 J	1.5 J	0.35 J	0.72
Calcium	mg/Kg	102000	100%	101904	1	72300 J	23700 J	102000 J	50600 J
Chromium	mg/Kg	23.3	100%	22	2	14.1	23.3	12	22.7
Cobalt	mg/Kg	13.1	100%	30	0	7.9 J	13.1 J	8.2	12.7
Copper	mg/Kg	190	100%	25	3	20.5	74.1	19.8	30.6
Iron	mg/Kg	32100	100%	26627	1	17700	25700	15500	32100
Lead	mg/Kg	66.7	100%	30	3	9.5	50.6	8.2	15.3
Magnesium	mg/Kg	25400	100%	12222	5	19000	8570	18000	11400
Manganese	mg/Kg	536	100%	669	0	368	443	417	378
Mercury	mg/Kg	0.08	89%	0.1	0	0.07 J	0.02 U	0.02 J	0.01 J
Nickel	mg/Kg	44.3	100%	34	1	23.6	31.3	22.9	44.3
Potassium	mg/Kg	1920	100%	1762	7	1820 J	1820 J	1690 J	1920 J
Selenium	mg/Kg	1.5	33%	2	0	0.47 U	1.2 J	0.43 U	0.65 J
Sodium	mg/Kg	140	100%	104	8	119 J	118 J	113 J	140 J
Vanadium	mg/Kg	26.2	100%	150	0	14.5	26.2	12.9	19.3
Zinc	mg/Kg	569	100%	83	5	64.4	314	56.3	266
OTHER ANALYSES									
Total Petroleum Hydrocarbons	mg/Kg	218000	89%	NA	NA	332	50900	57	34
Total Solids	%W/W					94.2	59.1	93.1	93.8

NOTES:

a) The TAGM value for PCBs is 1000ug/Kg for surface soils and 10,000 ug/Kg for subsurface soils.
b) * = As per proposed TAGM, total VOCs < 10 ppm, total SVOs < 500 ppm, and individual SVOs < 50 ppm.
c) NA = Not Available.
d) U = The compound was not detected below this concentration.
e) J = The reported value is an estimated concentration.
f) UJ = The compound may have been present above this concentration, but was not detected due to problems with t
g) R = The data was rejected during the data validation process.

values. TAGM values were exceeded for benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene, and dibenz(a,h)anthracene. Dibenz(a,h)anthracene was detected at an estimated concentration of 27J μg/kg in sample SB60-2-04 collected at 6 to 8 feet in the boring and was the only compound detected in the subsurface soil samples exceeding the associated TAGM value. Generally, SB60-2-00 was impacted by the highest concentrations and the greatest number of semivolatile organic compounds, followed by SB60-3, the topographically downgradient boring. The total PAH concentrations in the surface soils and sediments are shown in Figure 3-3.

Two semivolatile organic compounds, di-n-butylphthalate and bis(2-ethylhexyl)phthalate, were detected in three and four samples, respectively. These compounds are common laboratory contaminants and can be potentially attributed to the laboratory and not site conditions.

Pesticides and PCBs

Twelve pesticide and PCB compounds were detected in the 9 soil samples collected. The distribution of pesticides and PCBs was similar to that found for the semivolatile organic compounds. The surface soil samples contained the highest concentrations and the greatest number of individual compounds. TAGM values were exceeded for only two PCBs (Aroclor 1248 and Aroclor 1260) in surface soil sample SB60-2-00. This sample was the most significantly impacted and contained every pesticide and PCB compound that was detected on- site. Subsurface soil samples were generally free of pesticides and PCBs, with only one soil sample, SB60-1.01, containing an estimated concentration of 2.7J μg/kg for 4,4'-DDE.

Metals

A total of 21 metals were detected in the 9 soil samples collected at SEAD-60. Thirteen metals were found in one or more samples at concentrations which exceeded the TAGM values. The largest number of TAGM value exceedances occurred in surface soil samples SB60-2 (located in the oil-stained area) and SB60-3 (located 30 feet topographically downgradient of the oil-stained area). Several of the metals were found at concentrations just slightly above the associated TAGM values which may reflect natural variations in site soils. The exceptions to this were the metals barium, cadmium, copper, magnesium, manganese and zinc, which were reported at concentrations at least 2 times the criteria in the soil samples.

Total Petroleum Hydrocarbons

Total petroleum hydrocarbons (TPH) were detected in nearly all of the soil samples. The highest concentrations, 218,000 mg/kg and 50,900 mg/kg were detected in surface soil samples from SB60-2 and SB60-3, respectively. The remaining soil samples contained TPH concentrations that were considerably lower (a maximum of 332 mg/kg). As with the SVOC results, the highest concentration was found in the surface soil sample from SB60-2. The downgradient drainage ditch sample, SB60-3 contained the next highest concentration. The TPH concentrations in surface soils are shown in Figure 3-4.

GROUNDWATER SAMPLING SUMMARY

Three monitoring wells were installed and sampled as part of the ESI conducted at SEAD-60. The locations of the wells are shown in Figure 3-2. The summary of the chemical analyses are presented in Table 3-4. The following sections describe the nature and extent of groundwater contamination identified at SEAD-60. Concentrations of constituents were compared to the NY AWQS Class GA groundwater criteria and the Federal Primary and Secondary Drinking Water Maximum Contaminant Levels (MCLs).

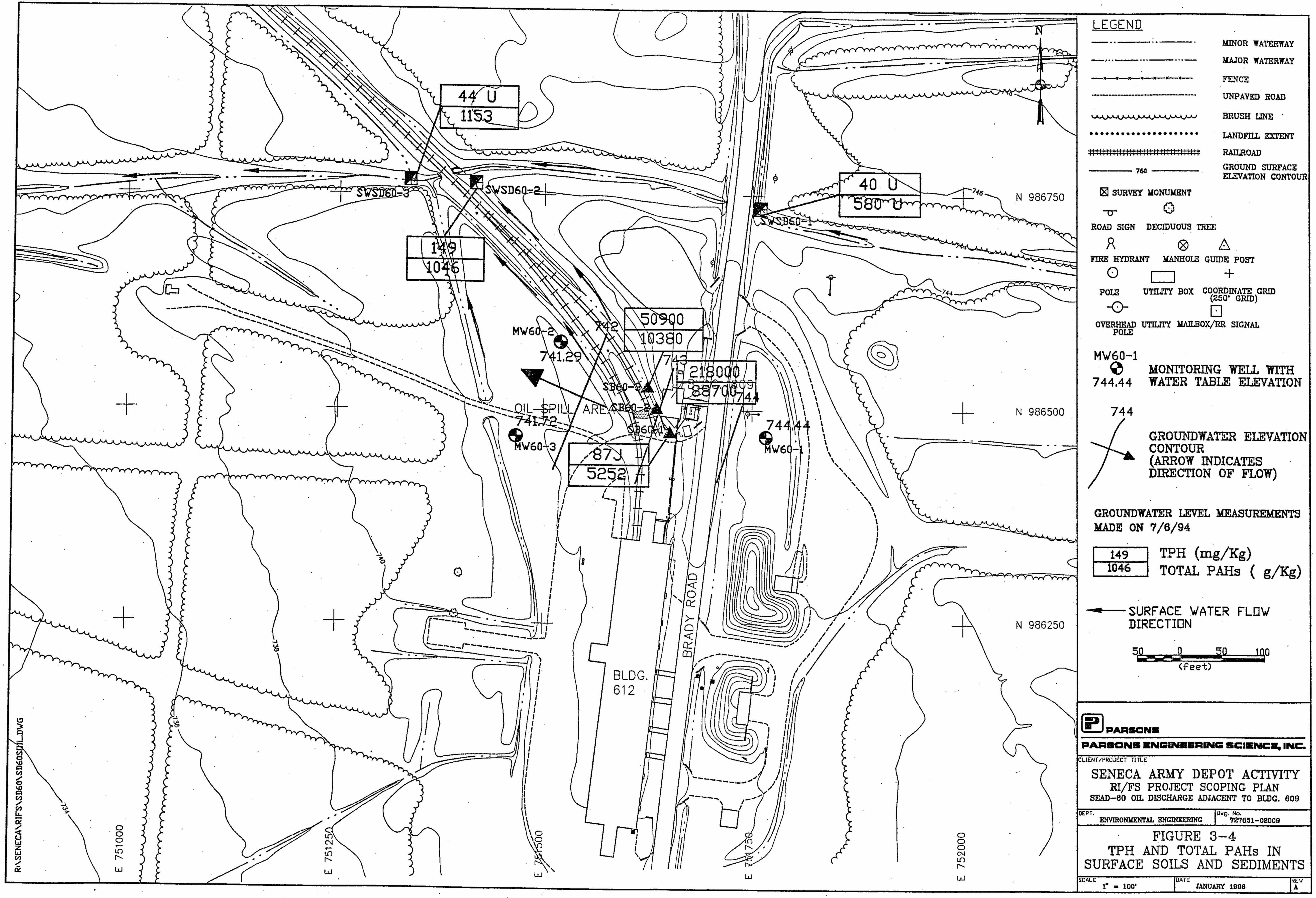
Volatile Organic Compounds

Two volatile organic compounds, acetone and benzene, were detected in two of the groundwater samples collected at SEAD-60. Monitoring well MW60-1, the background well, contained 48 μg/L of acetone and an estimated concentration of 1J μg/L of benzene. The concentration of benzene detected in MW60-1 exceeded the state criteria value of 0.7 μg/L but did not exceed the federal criteria of 5 μg/L. Benzene was detected only in the background well, MW60-1. Only acetone (77J μg/L) was detected in MW60-2.

Acetone is a common laboratory contaminant and can be potentially attributed to the laboratory and not site conditions.

Pesticides and PCBs

One pesticide, beta-BHC, was detected at an estimated concentration of 0.049 μg/L, which is below the method detection limit, in the groundwater sample collected from MW60-3. The state groundwater criteria for beta-BHC is 5 μg/L. No PCBs were detected in the three monitoring wells sampled for this investigation.



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CLIENT/PROJECT TITLE

SENECA ARMY DEPOT ACTIVITY
RI/FS PROJECT SCOPING PLAN
SEAD-60 OIL DISCHARGE ADJACENT TO BLDG. 609

DEPT. ENVIRONMENTAL ENGINEERING
Dwg. No. 727651-02009

FIGURE 3-4
TPH AND TOTAL PAHs IN
SURFACE SOILS AND SEDIMENTS

SCALE 1" = 100'
DATE JANUARY 1996
REV A

TABLE 3-4

SENECA ARMY DEPOT ACTIVITY
SEAD-60 RI/FS SCOPING PLAN
GROUNDWATER ANALYSIS RESULTS FROM THE ESI

COMPOUND		MAXIMUM	FREQUENCY OF DETECTION	FEDERAL DRINKING WATER MCL (h)	NY AWQS CLASS GA (a)	NUMBER ABOVE LOWEST CRITERIA			
	MATRIX						WATER	WATER	WATER
	LOCATION						SEAD-60	SEAD-60	SEAD-60
	SAMPLE DATE						07/07/94	07/07/94	03/29/94
	ES ID						MW60-1	MW60-2	MW60-3
	LAB ID						226301	226302	215838
	SDG NUMBER						45257	45257	43179
	UNITS								
VOLATILE ORGANICS									
Acetone	ug/L	77	67%	NA	NA	NA	48	77 J	10 U
Benzene	ug/L	1	33%	5	0.7	1	1 J	10 U	10 U
PESTICIDES/PCB									
beta-BHC	ug/L	0.049	33%	NA	5	0	0.051 U	0.051 U	0.049 J
METALS									
Aluminum	ug/L	376	100%	50-100*	NA	3	348	58 J	376
Barium	ug/L	88.7	100%	2000	1000	0	88.7 J	45 J	34 J
Calcium	ug/L	113000	100%	NA	NA	NA	95100	112000	113000
Chromium	ug/L	0.56	67%	100	50	0	0.56 J	0.4 U	0.51 J
Cobalt	ug/L	0.72	33%	NA	NA	NA	0.5 U	0.5 U	0.72 J
Copper	ug/L	0.99	33%	1000*	200	0	0.5 U	0.5 U	0.99 J
Iron	ug/L	1440	100%	300	300	3	1290	1340	1440
Magnesium	ug/L	55100	100%	NA	NA	NA	31100	55100	52600
Manganese	ug/L	377	100%	50*	300	3	377	125	166
Mercury	ug/L	0.05	67%	2	2	0	0.05 J	0.05 J	0.03 U
Nickel	ug/L	1.6	33%	100	NA	NA	0.7 U	0.7 U	1.6 J
Potassium	ug/L	8760	100%	NA	NA	NA	8760	4530 J	4510 J
Sodium	ug/L	59400	100%	NA	20000	1	59400	12300	11400
Thallium	ug/L	1.8	33%	2	NA	0	1.9 U	1.9 U	1.8 J
Vanadium	ug/L	1.5	67%	NA	NA	NA	1 J	0.5 U	1.5 J
Zinc	ug/L	6.9	100%	5000*	300	0	6.9 J	3.2 J	4.8 J
OTHER ANALYSES									
Total Petroleum Hydrocarbons	mg/L	2.2	66%		NA	NA	2.2	1.22	0.4 U
pH	Standard Units						7.4	7.3	7.6
Conductivity	umhos/cm						1010	700	615
Temperature	°C						11.7	11.5	8.2
Turbidity	NTU						104	8.6	5.8

NOTES:

a) NY State Class GA Groundwater Regulations
b) NA = Not Available
d) U = The compound was not detected below this concentration.
e) J = The reported value is an estimated concentration.
f) UJ = The compound may have been present above this concentration, but was not detected due to problems with the analysis.
g) R = The data was rejected during the data validation process.
h) Federal Primary and Secondary (*) Drinking Water Maximum Contaminant Levels (40 CRF 141.61-62 and 40 CRF 143.3)

Metals

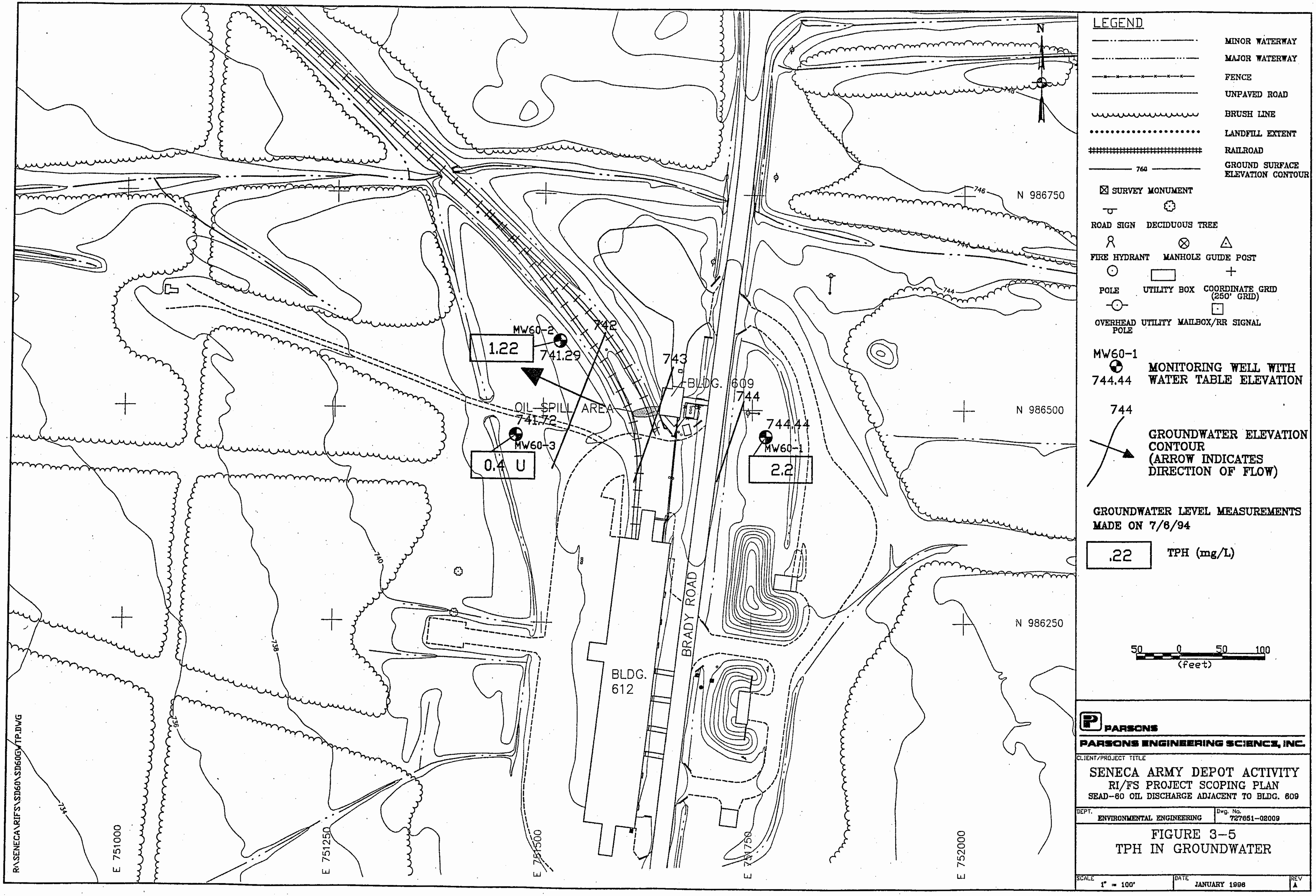
The four metals, aluminum, iron, manganese, and sodium were found in the groundwater samples at concentrations above the lowest associated federal or state criteria. One sample from MW60-2 contained aluminum at an estimated concentration of 58J μg/L which was within the criteria range of 50-100 μg/L. The two samples from MW60-1 (348 μg/L) and MW60-3 (376 μg/L) exceeded the criteria range for aluminum. Iron was found in groundwater from all of the monitoring wells at concentrations above the criteria value of 300 μg/L. The concentrations of iron were between 1,290 μg/L and 1,440 μg/L. Manganese results in groundwater ranged from 125 μg/L to 377 μg/L in three wells at SEAD-60. The federal Secondary Drinking Water MCL of 50 μg/L for manganese was exceeded in all three groundwater samples. Sodium was detected in MW60-1 at a concentration of 59,400 μg/L, almost three times the NYSDEC Class GA criteria of 20,000 μg/L. The sample from MW60-1 was over an order of magnitude more turbid than samples from MW60-2 and MW60-3. The high concentrations of metals in the groundwater sample from MW60-1, the background well, may be due to silt in the groundwater sample as evidenced by the turbidity reading of 104 NTUs.

Total Petroleum Hydrocarbons

Two of the groundwater samples had detectable concentrations of total petroleum hydrocarbons. Monitoring well MW60-1, the background well, contained the highest TPH concentration (2.2 mg/L) and monitoring well, MW60-2, contained approximately one half of this amount (1.22 mg/L). There is no NYSDEC Class GA nor federal criteria value for TPH. Furthermore, the TPH analysis may also detect high molecular compounds of natural origin other than fuels. The TPH concentrations in groundwater are shown in Figure 3-5.

SURFACE WATER SAMPLING SUMMARY

Three surface water samples were collected as part of the ESI at SEAD-60. The summary of results of the chemical analyses are presented in Table 3-5. No volatile organic compounds, semi-volatile organic compounds, pesticides, PCBs, or TPHs were detected in the surface water samples collected at SEAD-60.



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RI/FS PROJECT SCOPING PLAN
SEAD-60 OIL DISCHARGE ADJACENT TO BLDG. 609

DEPT. ENVIRONMENTAL ENGINEERING
Dwg. No. 727651-02009

FIGURE 3-5
TPH IN GROUNDWATER

SCALE 1" = 100'
DATE JANUARY 1996
REV A

01/03/96

TABLE 3-5

SENECA ARMY DEPOT ACTIVITY
SEAD-60 RI/FS SCOPING PLAN
SURFACE WATER ANALYSIS RESULTS FROM THE ESI

COMPOUND	MATRIX	MAXIMUM	FREQUENCY OF DETECTION	NYS GUIDELINES CLASS D (a,c)	NUMBER ABOVE CRITERIA	WATER	WATER	WATER
	LOCATION					SEAD-60	SEAD-60	SEAD-60
	SAMPLE DATE					04/27/94	04/20/94	04/20/94
	ES ID					SW60-1	SW60-2	SW60-3
	LAB ID					219531	218496	218497
	SDG NUMBER					43626	43626	43626
	UNITS							
METALS								
Aluminum	ug/L	259	100%	NA	NA	35.7 J	259	93.5 J
Arsenic	ug/L	1.6	33%	360	0	1.5 U	1.6 J	1.5 U
Barium	ug/L	49.4	100%	NA	NA	28.7 J	49.4 J	22.4 J
Calcium	ug/L	89000	100%	360	NA	42300	89000	42200
Chromium	ug/L	0.68	67%	3275	0	0.56 J	0.68 J	0.4 U
Copper	ug/L	2	100%	36.8	0	1.7 J	2 J	1.1 J
Iron	ug/L	453	100%	300	1	78 J	453	121
Magnesium	ug/L	22000	100%	NA	NA	8260	22000	8390
Manganese	ug/L	28.5	100%	NA	NA	12.5 J	28.5	4.5 J
Nickel	ug/L	1.8	100%	50562	0	0.98 J	1.8 J	0.83 J
Potassium	ug/L	1430	100%	NA	NA	1060 J	1430 J	649 J
Sodium	ug/L	53800	100%	NA	NA	2030 J	53800	2340 J
Vanadium	ug/L	0.85	33%	190	0	0.7 U	0.85 J	0.69 U
Zinc	ug/L	9.6	100%	611	0	3 J	3.4 J	9.6 J
OTHER ANALYSES								
pH	Standard Units					8.4	8.7	9.1
Conductivity	umhos/cm					232	675	180
Temperature	°C					23.3	16	10
Turbidity	NTU					2.2	5.7	2.4

NOTES:

a) The New York State Ambient Water Quality standards and guidelines for Class D surface water.
b) Hardness dependent values assume a hardness of 217 mg/L.
c) NA = Not Available
d) U = The compound was not detected below this concentration.
e) J = The reported value is an estimated concentration.
f) UJ = The compound may have been present above this concentration, but was not detected due to problems with the analysis.

Metals

One metal, iron, was detected at a concentration above the criteria value of 300 μg/L. Iron was detected in surface water sample SW60-2 at a concentration of 453 μg/L.

SEDIMENT SAMPLING SUMMARY

A total of three sediment samples were collected as part of the ESI at SEAD-60. The summary of results of the chemical analyses are presented in Table 3-6. The sediment samples were collected in the same locations as the surface water samples discussed above. The following sections describe the nature and extent of sediment contamination identified at SEAD-60.

Volatile Organic Compounds

Only one volatile organic compound was detected in the sediment samples. Chloroform was detected at an estimated concentration of 3J μg/kg in sample SD60-2.

Semivolatile Organic Compounds

A total of eleven SVOCs were identified in the three sediment samples collected at SEAD-60. The SVOCs detected were all PAHs, six of which were found at concentrations above their respective NYSDEC criteria values. Concentrations of PAHs, in samples SD60-2 and SD60-3 were above the associated criteria.

One SVOC, bis(2-ethylhexyl)phthalate, which was found in three samples, is a common laboratory contaminant and can be potentially attributed to the laboratory and not site conditions.

Pesticides and PCBs

Four pesticide compounds were detected in the downgradient sediment sample SD60-3. Three of the four compounds were detected in concentrations exceeding their respective NYSDEC criteria values. The three pesticides, endosulfan I, 4,4'-DDE, and alpha chlordane, were found at estimated concentrations of 2.1J μg/kg, 5.4J μg/kg and 1.9J μg/kg, respectively.

TABLE 3-6

SENECA ARMY DEPOT
SEAD-60 RI/FS SCOPING PLAN
SEDIMENT ANALYSIS RESULTS FROM THE ESI

COMPOUND	MATRIX LOCATION DEPTH (FEET) SAMPLE DATE ES ID LAB ID SDG NUMBER UNITS	MAXIMUM	FREQUENCY OF DETECTION	NYSDEC SEDIMENT CRITERIA FOR AQUATIC LIFE (a)	NYSDEC SEDIMENT CRITERIA FOR HUMAN HEALTH (a)	NYSDEC SEDIMENT CRITERIA FOR WILDLIFE (a)	LOT (b)	NUMBER ABOVE CRITERIA	SOIL SEAD-60 0-0.2 04/27/94 SD60-1 219550 43663	SOIL SEAD-60 0-0.2 04/20/94 SD60-2 218490 43663	SOIL SEAD-60 0-0.2 04/20/94 SD60-3 218491 43663
VOLATILE ORGANICS											
Chloroform	ug/Kg	3	33%	NA	NA	NA	NA	NA	16 U	3 J	16 U
SEMIVOLATILE ORGANICS											
Phenanthrene	ug/Kg	70	67%	1390	NA	NA	NA	0	580 U	63 J	70 J
Fluoranthene	ug/Kg	200	67%	NA	NA	NA	NA	NA	580 U	160 J	200 J
Pyrene	ug/Kg	250	67%	NA	NA	NA	NA	NA	580 U	190 J	250 J
Benzo(a)anthracene	ug/Kg	68	67%	NA	13	NA	NA	2	580 U	56 J	68 J
Chrysene	ug/Kg	160	67%	NA	13	NA	NA	2	580 U	130 J	160 J
bis(2-Ethylhexyl)phthalate	ug/Kg	1100	100%	1197 (c)	NA	NA	NA	0	110 J	1100	75 J
Benzo(b)fluoranthene	ug/Kg	120	67%	NA	13	NA	NA	2	580 U	120 J	120 J
Benzo(k)fluoranthene	ug/Kg	97	67%	NA	13	NA	NA	2	580 U	87 J	97 J
Benzo(a)pyrene	ug/Kg	79	67%	NA	13	NA	NA	2	580 U	79 J	64 J
Indeno(1,2,3-cd)pyrene	ug/Kg	68	67%	NA	13	NA	NA	2	580 U	68 J	57 J
Benzo(g,h,i)perylene	ug/Kg	93	67%	NA	NA	NA	NA	NA	580 U	93 J	67 J
PESTICIDES/PCB											
Endosulfan I	ug/Kg	2.1	33%	0.3	NA	NA	NA	1	3 U	3.3 U	2.1 J
4,4'-DDE	ug/Kg	5.4	33%	500	0.1	10	NA	1	5.8 U	6.5 U	5.4 J
4,4'-DDT	ug/Kg	3.4	33%	NA	NA	10	NA	0	5.8 U	6.5 U	3.4 J
alpha-Chlordane	ug/Kg	1.9	33%	0.06	0.01	0.06	NA	1	3 U	3.3 U	1.9 J
METALS											
Aluminum	mg/Kg	12700	100%	NA	NA	NA	NA	NA	12700	10700	5470
Arsenic	mg/Kg	4.8	100%	5	NA	NA	33	0	4.8	3.6	3.7
Barium	mg/Kg	97.6	100%	NA	NA	NA	NA	NA	97.6	80.3	46.5 J
Beryllium	mg/Kg	0.62	100%	NA	NA	NA	NA	NA	0.62 J	0.54 J	0.35 J
Cadmium	mg/Kg	0.44	100%	0.8	NA	NA	10	0	0.34 J	0.44 J	0.25 J
Calcium	mg/Kg	227000	100%	NA	NA	NA	NA	NA	3760	21300	227000
Chromium	mg/Kg	19.5	100%	26	NA	NA	111	0	19.5	17.5	9
Cobalt	mg/Kg	9.6	100%	NA	NA	NA	NA	NA	9.6 J	8.2 J	6.7 J
Copper	mg/Kg	21.1	100%	19	NA	NA	114	1	14.2	21.1	12.5
Iron	mg/Kg	25000	100%	24000	NA	NA	40000	1	25000	22000	12700
Lead	mg/Kg	24.6	100%	27	NA	NA	250	0	13.9	24.6	9.1
Magnesium	mg/Kg	8380	100%	NA	NA	NA	NA	NA	4370	7490	8380
Manganese	mg/Kg	509	100%	428	NA	NA	1100	2	467 J	282 J	509 J
Mercury	mg/Kg	0.03	33%	0.11	NA	NA	2	0	0.05 J R	0.04 J R	0.03 J
Nickel	mg/Kg	27.2	100%	22	NA	NA	90	2	27.2	26.7	16.2
Potassium	mg/Kg	1610	100%	NA	NA	NA	NA	NA	1610	1190 J	988 J
Sodium	mg/Kg	134	67%	NA	NA	NA	NA	NA	45 U	134 J	91 J
Thallium	mg/Kg	0.55	33%	NA	NA	NA	NA	NA	0.45 U	0.55 J	0.46 U
Vanadium	mg/Kg	23.9	100%	NA	NA	NA	NA	NA	23.9	19.2	11.1 J
Zinc	mg/Kg	101	100%	85	NA	NA	800	3	93.5	88.1	101
Cyanide	mg/Kg	3.3	33%	NA	NA	NA	NA	NA	0.83 U	0.94 U	3.3
OTHER ANALYSES											
Total Petroleum Hydrocarbons	mg/Kg	149	33%						40 U	149	44 U
Total Solids	%W/W								56.8	50.7	60.5

NOTES:
a) NYSDEC Sediment Criteria - 1989
b) LOT = Limit of Tolerance: Represents point at which significant effects on benthic species occur.
c) NYSDEC 1969 guideline for phthalates.
d) NA = Not Available.
e) U = The compound was not detected below this concentration.
f) J = The reported value is an estimated concentration.
g) UJ = The compound may have been present above this concentration, but was not detected due to problems with the analysis.
h) R = The data was rejected during the data validation process.

Metals

A number of metals were detected in the three sediment samples collected at SEAD-60. Of these, copper, iron, manganese, nickel, and zinc were found at concentrations in excess of the NYSDEC sediment criteria. All three sediment samples contained metals above the criteria values. Copper (21.1 mg/kg) and iron (25,000 mg/kg) were detected at concentrations exceeding their criteria values only in samples SD60-2 and SD60-1, respectively. Manganese (a maximum of 509 mg/kg) was detected above the criteria value in samples SD60-1 and SD60-3. Nickel (a maximum of 27.2 mg/kg) exceeded its criteria value in samples SD60-1 and SD60-2. Zinc was detected in concentrations above the criteria value in all three samples with a maximum concentration of 101 mg/kg in SD60-3.

Total Petroleum Hydrocarbons

Total petroleum hydrocarbons were detected in only one sample, SD60-2, at a concentration of 149 mg/kg. This sample was collected in a drainage ditch approximately 340 feet downgradient of the oil spill area in a location receiving direct run-off from the site.

3.1.2.3 Data Summary and Conclusions

The impacts to the SEAD-60 site media (soil, groundwater, surface water, and sediment) are summarized below.

Soils

Soils at the site have been impacted primarily by TPH, semivolatile organic compounds (mostly PAHs) and metals. Other constituents that were detected include volatile organic compounds, pesticides and PCBs. These latter constituents are present at low concentrations and/or only a small number of samples exceed their respective TAGM values.

At the location of the release of oil, surface soils (0 to 2 inches) are the most significantly impacted media, with TPH concentrations of 218,000 mg/kg and 50,900 mg/kg. Significant concentrations of PAHs (up to an estimated concentration of 17,000J μg/kg) correlated spatially with the elevated TPH concentrations in surface soils, and TAGM value exceedances for PAHs were more numerous for surface soils. At depth, the concentrations of these constituents in soil was reduced; only one subsurface sample contained a TAGM value exceedance for an individual PAH compound. Heavy metals concentrations above the TAGM value were present in all the soil samples. While the surface soil samples from the two borings located near the release of oil generally contained the most TAGM exceedances for metals, no consistent pattern was evident.

Groundwater

Groundwater at the site appears to have been impacted by volatile organic compounds and metals. Volatile organic compounds and metals were considered to pose an unlikely risk to receptors because they were either present at low concentrations and/or only a small number of samples contained concentrations of compounds exceeding their respective TAGM values.

Surface Water

Surface water at the site has not been significantly impacted by any of the constituents that were analyzed for during the ESI. Constituents that were detected include metals. The metals were considered to pose little risk to receptors because they were either present at low concentrations and/or only a small number of samples contained concentrations which exceeded their respective TAGM values.

Sediment

Sediment at the site has been impacted primarily by semivolatile organic compounds (mostly PAHs) and TPH. Generally, the types and concentrations of PAHs in samples SD60-2 and SD60-3 were similar. However, sample SD60-2, which was located nearest the spill area, contained a concentration of TPH (149 mg/kg) and sample SD60-3 contained no TPH. Other constituents that were detected in sediment but are considered to pose little risk include volatile organic compounds, pesticides and metals. These latter constituents are either present at low concentrations and/or only a small number of samples exceed their respective criteria values.

The results of the ESI conducted at SEAD-60 have identified a release of PAHs and TPH compounds from the Oil Discharge Area adjacent to Building 609. These results suggest that the affected media at SEAD-60 have the potential to impact the potential receptors.

3.1.3 Environmental Fate of Constituents

The constituents of concern at SEAD-52 are explosives, heavy metals, and SVOCs. The potential contaminants of concern at SEAD-60 are volatile organic compounds, SVOCs, pesticides and PCBs, metals, and TPHs. Their environmental fate is discussed below. The discussion is meant to present general information on the fate of the selected constituents of concern, and where possible, site-specific characteristics are presented. A summary of fate and transport characteristics for the constituents of concern is presented in Table 3-7.

3.1.3.1 Volatile Organic Compounds

Volatile organic compounds tend to have a low residence time in surface soil environments. These chemicals can be persistent in groundwater. However, there is evidence that non-chlorinated volatile organic compounds may degrade rapidly in the vadose zone aboveground water plumes. (Gas Research Institute, Management of Manufactured Gas Plant Sites, Volume III, Risk Assessment, May 1988, GRI-87/0260.3).

Major exposure routes of interest include the ingestion of groundwater and the inhalation of the gases. The latter can be important in situations involving the excavation of pits or the entrainment of soil gas into buildings. There is little potential for these chemicals to accumulate in aquatic or terrestrial biota.

Because it is not the intent of this section to discuss the persistence of all volatile organic compounds, only selected volatile organics that are commonly found or are suspected to have been released to the environment at SEAD-60 are discussed below.

This section addresses the contaminant persistence (fate and transport) and focuses on volatile organic compounds of concern at SEAD-60. The volatile organic chlorinated (aliphatic) compound associated with SEAD-60 is primarily benzene which is associated with petroleum hydrocarbons, including gasoline.

The chemical/physical properties of benzene and the potentially impacted media groundwater, are necessary to fully evaluate the fate and transport. Meaningful chemical-specific properties are solubility, volatility, degradability, and adsorptivity. These properties are discussed below. Table 3-6 summarizes the chemical specific properties of BTEX compounds. Media specific properties include organic carbon content, porosity, moisture content, bulk density, groundwater velocity, and dispersivity.

<u>Aromatic Volatile Organics</u>

The following information on aromatic volatile organics was obtained from the document, "Installation Restoration Program Toxicology Guide", Volume 1, October 1985, AD-A171095.

TABLE 3-7

SENECA ARMY DEPOT ACTIVITY

SUMMARY OF FATE AND TRANSPORT PARAMETERS FOR SELECTED ORGANIC COMPOUNDS

COMPOUND	SOLUBILITY (mg/l)	VAPOR PRESSURE (mmHg)	HENRY'S LAW CONSTANT (atm-m³/mol)	Koc (ml/g)	Kow	HALF - LIFE (days)	BCF
Volatile Organic Compounds							
Methylene Chloride	20000	438	2.03E-03	8.80E+00	2.00E+01	1-3	0.8
Acetone	infinite	288	2.06E-05	2.80E-01	5.75E-01		0.03
1,2-Dichloroethene (total)	6300	5.3	6.60E-03	5.90E+01	1.23E+02		4.5
Carbon Disulfide	2940	366	1.32E-02	5.40E+01	1.00E+02		7.9
Chloroform	8200	208	2.87E-03	4.70E+01	9.33E+01		4.5-6
2-Butanone	353000	70.6	4.35E-05	9.40E-01	1.95E+00		0.09-1.86
1,2-Dichloroethane	8520	80	9.78E-04	1.40E+01	3.02E+01	2-18	1.4-2
Trichloroethene	1100	75	9.10E-03	1.26E+02	2.40E+02	3-300	13-39
Vinyl chloride	2670	2300	8.19E-02	5.70E+01	2.40E+01		
1,1-Dichlroethene	2250	500	3.40E-02	6.50E+01	5.30E+01		
Tetrachloroethene	150	19	2.59E-02	3.64E+02	3.98E+02	1-13	49-66
Toluene	535	30	6.37E-03	3.00E+02	5.37E+02	3-39	2.6-27.1
Chlorobenzene	490	8.8	3.46E-03	3.33E+02	6.92E+02		10-33
Xylene (total)	0.3	9	6.91E-03	6.91E+02	1.45E+03		70
Semivolatile Organic Compounds							
Phenol	93000	0.341	4.54E-07	1.42E+01	2.88E+01	3-5	1.4-2
2-Methylphenol	25000	0.24	1.50E-06	2.74E+02	8.91E+01	1-3	
4-Methylphenol		0.11	4.43E-07	2.67E+02	8.51E+01	1-3	
2,4-Dimethylphenol	4200	0.0573	2.38E-06	2.22E+02	2.63E+02	1-3	9.5-150
Benzoic Acid	2700			2.48E+02	7.41E+01		
Naphthalene	31.7	0.23	1.15E-03	1.30E+03	2.76E+03	1-110	44-95
2-Methylnaphthalene	25.4	0.0083	5.80E-05	8.50E+03	1.30E+04	1-3	
2-Chloronaphthalene	6.74	0.017	4.27E-04	4.16E+03	1.32E+04		
2,6-Dinitrotoluene	1320	0.018	3.27E-06	9.20E+01	1.00E+02	4	4.6
Acenaphthene	3.42	0.00155	9.20E-05	4.60E+03	1.00E+04		
Dibenzofuran				4.16E+03	1.32E+04		
2,4-Dinitrotoluene	240	0.0051	5.09E-06	4.50E+01	1.00E+02	5	
Diethylphthalate	896	0.0035	1.14E-06	1.42E+02	3.16E+02	1-3	14-117

TABLE 3-7

SENECA ARMY DEPOT ACTIVITY

SUMMARY OF FATE AND TRANSPORT PARAMETERS FOR SELECTED ORGANIC COMPOUNDS

COMPOUND	SOLUBILITY (mg/l)	VAPOR PRESSURE (mmHg)	HENRY'S LAW CONSTANT (atm-m³/mol)	Koc (ml/g)	Kow	HALF - LIFE (days)	BCF
Fluorene	1.69	0.00071	6.42E-05	7.30E+03	1.58E+04		
N-Nitrosodiphenylamine	113		1.40E-06	6.50E+02	1.35E+03	4	65-217
Hexachlorobenzene	0.006	0.000019	6.81E-04	3.90E+03	1.70E+05		
Phenanthrene	1	0.00021	1.59E-04	1.40E+04	2.88E+04	1-200	
Anthracene	0.045	0.000195	1.02E-03	1.40E+04	2.82E+04		
Di-n-butylphthalate	13	0.00001	2.82E-07	1.70E+05	3.98E+05	1-3	89-1800
Fluoranthene	0.206	0.0177	6.46E-06	3.80E+04	7.94E+04	140-440	
Pyrene	0.132	2.50E-06	5.04E-06	3.80E+04	7.59E+04	9-1900	
Butylbenzylphthalate	2.9	8.60E-06	1.20E-06	2.84E+04	5.89E+04		663
Benzo(a)anthracene	0.0057	1.50E-07	1.16E-06	1.38E+06	3.98E+05	240-680	
Chrysene	0.0018	6.30E-09	1.05E-06	2.00E+05	4.07E+05	160-1900	
Bis(2-Ethylhexyl)phthalate	0.285	2.00E-07	3.61E-07	5.90E+03	9.50E+03	Neg. Deg.	
Di-ni-octylphthalate	3			2.40E+06	1.58E+09		
Benzo(b)fluoranthene	0.014	5.00E-07	1.19E-05	5.50E+05	1.15E+06	360-610	
Benzo(k)fluoranthene	0.0043	5.10E-07	3.94E-05	5.50E+05	1.15E+06	910-1400	
Benzo(a)pyrene	0.0012	0.000568	1.55E-06	5.50E+06	1.15E+06	220-530	
Indeno(1,2,3-cd)pyrene	0.00053	1.00E-10	6.86E-08	1.60E+06	3.16E+06	600-730	
Dibenz(a,h)anthracene	0.0005	5.20E-11	7.33E-08	3.30E+06	6.31E+06	750-940	
Benzo(g,h,i)perylene	0.0007	1.03E-10	5.34E-08	1.60E+06	3.24E+06	590-650	
Explosives							
HMX	66	3.90E-09		5.08E+02	1.30E-01		
RDX	50	4.10E-09	2.00E-05	5.38E+02	7.80E-01		
1,3,5-Trinitrobenzene	35	2.20E-04	1.30E+00	5.20E+02			
1,3-Dinitrobenzene	470			1.50E+02	4.17E+01		
Tetryl							
2,4,6-Trinitrotoluene	130	0.0001	1.37E-06	5.34E+02	1.90E+00		
4-amino-2,6-Dinitrotoluene							
2-amino-4,6-Dinitrotoluene							
2,6-Dinitrotoluene	182	0.018	3.27E-06	2.49E+02	1.00E+02	4	4.6
2,4-Dinitrotoluene	270	0.0051	5.09E-06	2.01E+02	1.00E+02	5	

Notes:
Koc = organic carbon partition coefficient
Kow = octanol-water partition coefficient
BCF = bioconcentration factor
Neg. Deg. = Negligible Biodegradation
Parameters are presented at standard temperature (25 degrees C).

References:
1. IRP Toxicology Guide
2. Basics of Pump-and-Treat Ground-Water Remediation Technology (EPA, 1990).
3. Handbook of Environmental Fate and Exposure Data (Howard, 1989).
4. Soil Chemistry of Hazardous Materials (Dragun, 1988)
5. Hazardous Waste Treatment, Storage, and Disposal Facilities, Air Emissions Models (EPA, 1989).
6. USATHAMA, 1985
7. Values for Koc not found were estimated by: logKoc = 0.544logKow + 1.377 (Dragun, 1988).

Benzene, toluene, ethylbenzene, and xylenes (BTEX) compounds may move through the soil/groundwater system when present at low concentrations (dissolved in water and sorbed on soil) or as a separate organic phase (resulting from a spill of significant quantities of the chemical). In general, transport pathways of low soil concentrations can be assessed by equilibrium partitioning. These calculations predict the partitioning of BTEX compounds among soil particles, soil water and soil air. The portions of BTEX compounds associated with the water and air phases of the soil are more mobile than the adsorbed portions.

Partitioning in the Environment

Benzene: The estimate for an unsaturated topsoil model indicate that most of the benzene (88%) is expected to be sorbed to the soil. A much smaller (yet significant) amount (7%) will be present in the soil water phase and can thus migrate by bulk transport (e.g., the downward movement of infiltrating water), dispersion and diffusion. For the portion of benzene in the gaseous phase of the soil (5%), diffusion through the soil-air pores up to the ground surface, and subsequent removal by wind, will be a significant loss pathway.

In saturated, deep soils (containing no soil air and negligible soil organic carbon), a much higher fraction of the benzene (79%) is likely to be present in the soil water phase and transported with flowing groundwater.

Toluene: The estimates for an unsaturated topsoil model indicate that nearly all of the toluene (97%) is sorbed to the soil. A much smaller amount (2%) will be present in the soil water phase and thus migrate by bulk transport (e.g., the downward movement of infiltrating water). For the portion of toluene in the gaseous phase of the soil (1.6%), diffusion through the soil pore spaces up to the ground surface, and subsequent removal by wind, will be significant loss pathway. there is no significant difference in the partitioning calculated for 25°C and 10°C.

In saturated, deep soils (containing no soil air and negligible soil organic carbon), a much higher fraction of the toluene (48%) is likely to be present in the soil water phase and transported with flowing groundwater.

Ethyl benzene: The estimates from an unsaturated topsoil model indicate that nearly all of the ethyl benzene (98%) is sorbed to the soil. A much smaller amount (0.75%) is expected to be present in the soil-water phase and can thus migrate by bulk transport (e.g., the downward movement of infiltrating water, dispersion and diffusion. For the portion of ethyl benzene in the gaseous phase of the soil (0.7%), diffusion through the soil air pores up to the ground surface, and subsequent removal by wind, will be a significant loss pathway.

In saturated, deep soils (containing no soil air and negligible soil organic carbon), a much higher fraction of the ethyl benzene (26%) is likely to be present in the soil water phase and transported with flowing groundwater.

Xylene: The estimates from an unsaturated topsoil model indicate that nearly all of the xylene (98.8%) is expected to be sorbed to the soil. A much smaller amount (0.7%) is expected to be present in the soil water phase and thus available to migrate by bulk transport (e.g., the downward movement of infiltrating water), dispersion and diffusion. For the portion of xylene in the gaseous phase of the soil (0.5%), diffusion through the soil-air pores up to the ground surface, and subsequent removal by wind, will be a significant loss pathway.

In saturated, deep soils (containing no soil air and negligible soil organic carbon), a much higher fraction of the xylene (26%) is likely to be present in the soil water phase and transported with flowing groundwater.

Sorption of BTEX on Soils

The mobility of BTEX compounds in the soil/groundwater system (and their eventual migration into aquifers) is strongly affected by the extent of their sorption on soil particles. In general, sorption on soils is expected to:

- increase with increasing soil organic matter content;
- increase slightly with decreasing temperature;
- increase moderately with increasing salinity of the soil water; and
- decrease moderately with increasing dissolved organic matter content of the soil water.

Based upon octanol-water partition coefficients, for the BTEX compounds (135, 537, 1410, and 1450, respectively) the soil sorption coefficients (K_{oc})s are estimated to be 65, 259, 681, and 691, respectively.

Volatilization of BTEX from Soils

Transport of BTEX vapors through the air-filled pores of unsaturated soils is an important transport mechanism for near-surface soils. In general, important soil and environmental properties influencing the rate of volatilization include soil porosity, temperature, convection currents and barometric pressure changes; important physio-chemical properties include the Henry's law constant, the vapor-soil sorption coefficient, and, to a lesser extent, the vapor phase diffusion coefficient.

There are no data from laboratory or field tests showing actual soil volatilization rates. Sorption of the benzene vapors on the soil may slow the vapor phase transport.
The Henry's law constant (H), which provides an indication of a chemical's tendency to volatilize from solution . increases significantly with increasing temperature. Moderate increases in H are also observed with increasing salinity due to a decrease in solubility of benzene, toluene and ethyl benzene.

Transformation Processes of BTEX in Soil/Groundwater Systems

The persistence of BTEX compounds in soil/groundwater systems is not well documented. In most cases, it should be assumed that the chemical will persist for months to years (or more). Benzene, toluene and ethyl benzene that have been released into the air will eventually undergo photochemical oxidation; tropospheric lifetime on the order of a few hours to a few days have been estimated for benzene and 15 hours for toluene and ethyl benzene.

BTEX compounds under normal environmental conditions are not expected to undergo hydrolysis. Further, benzene and toluene are not expected to be susceptible to oxidation or reduction reactions in the soil/groundwater environment.

Available data on the biodegradability of benzene are somewhat contradictory. Certain pure and mixed cultures can apparently degrade benzene under environmental conditions, but the chemical must be considered fairly resistant to biodegradation. Available data indicate that toluene and ethyl benzene are biodegradable in the soil/groundwater environment. No information on the biodegradability of xylene in the soil/groundwater environment is available. However, based upon data for other structurally similar chemicals (e.g., toluene, ethyl benzene), it is expected that xylene would be biodegradable. In most soil/groundwater systems aerobic degradation would be of minimal importance because of the low concentration of microorganisms (at depth) and the low dissolved oxygen (anaerobic) conditions. No data are available on the possibility of anaerobic biodegradation.

Primary Routes of Exposure From Soil/Groundwater Systems

The above discussion of fate pathways suggests that benzene is highly volatile, weakly adsorbed by soil and has a limited potential for bioaccumulation. Additionally, toluene is highly volatile from aqueous solutions, moderately sorbed to soil and has a low potential for bioaccumulation. Ethyl benzene and xylene are highly volatile from aqueous solutions, may be moderately adsorbed by soil and have a moderate potential for bioaccumulation. BTEX compounds may volatilize from soil surfaces, but that portion not subject to volatilization is likely to be mobile in groundwater. These fate characteristics suggest several potential exposure pathways.

Volatilization of BTEX compounds from a disposal site, particularly during drilling or restoration activities, could result in inhalation exposures. The potential for groundwater contamination is high, particularly in sandy soils.

The results of a USEPA Groundwater Supply Survey indicate that BTEX compounds have the potential for movement in soil/groundwater systems. The compounds may eventually reach surface waters by this mechanism, suggesting several other exposure pathways:

- Surface waters may be used as drinking water supplies, resulting in direct ingestion exposure;
- Aquatic organisms residing in these waters may be consumed, also resulting in ingestion exposure through bioaccumulation;
- Recreational use of these waters may result in dermal exposure; and
- Domestic animals may consume or be dermally exposed to contaminated ground or surface waters; the consumption of meats and poultry could then result in ingestion exposures.

In general, exposures associated with surface water contamination can be expected to be lower than exposures from drinking contaminated groundwater for two reasons. First, the Henry's law constants for BTEX compounds indicate that they will volatilize upon reaching surface waters. Secondly, the bioconcentration factors for benzene and toluene are expected to be low, suggesting limited bioaccumulation in aquatic organisms or domestic animals. For ethylbenzene, the bioconcentration factor suggests moderate bioaccumulation in aquatic organisms and domestic animals. The bioaccumulation factor for xylene is not high enough to suggest consumption of aquatic organisms or domestic animals as a significant source of exposure compared to drinking water.

Although BTEX compounds are readily photo-oxidized in the atmosphere, its volatility suggests that it may be found in air as well.

3.1.3.2 Semi-Volatile Organic Compounds

PAH Compounds

The following information was obtained from the document, "Management of Manufactured Gas Plant Sites, Volume III, Risk Assessment," GRI, May 1988, GRI-87/0260.3.

PAH compounds have a high affinity for organic matter and low water solubility. Water solubility tends to decrease and affinity for organic material tends to increase with increasing molecular weight. Therefore, naphthalene is much more soluble in water than is benzo(a)pyrene. When present in soil or sediments, PAHs tend to remain bound to the soil particles and dissolve only slowly into groundwater or the overlying water column. Because of the high affinity for organic matter, the physical fate of the chemicals is usually controlled by the transport of particulates. Thus, soil, sediment and suspended particulate matter (in air) represent important media for the transport of the chemicals.

Because of their high affinity for organic matter, PAH compounds are readily taken up (bioaccumulated) by living organisms. However, organisms have the potential to metabolize the chemicals and to excrete the polar metabolites. The ability to do this varies among organisms. Fish appear to have well-developed systems for metabolizing the chemicals. The metabolites are excreted. Shellfish (bi-valves) appear to be less able to metabolize the compounds. As a result, while PAH compounds are seldom high in fish tissues, they can be high in shellfish tissues.

Several factors can degrade PAH compounds in the environment. Biodegradation on soil microorganisms is an important process affecting the concentrations of the chemicals in soils, sediment and water. Volatilization may also occur. This mechanism is effective for the lighter molecular weight compounds. However, the volatilization of higher molecular weight PAH compounds occurs slowly.

3.1.3.3 Pesticides and PCBs

This section discusses only selected pesticides and PCBs that are suspected to be applicable to SEAD-60. It is not meant to present a complete summary of all possible pesticides and PCBs that could be found at SEAD-60.

Chlordane

The following information was obtained from "Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Vol. III, Pesticides (ed. Philip H. Howard, Lewis Publishers, 1991).

Chlordane has been released in the past into the environment primarily from its application as an insecticide. Technical grade chlordane is a mixture of at least 50 compounds. If released to soil, chlordane may persist for long periods of time. Under field conditions, the mean degradation rate has been observed to range from 4.05-28.33%/yrwith a mean half-life of 3.3 years. Chlordane is expected to be generally immobile or only slightly mobile in soil based on field tests, soil column leaching tests and estimated K_{oc} estimation; however, its detection in various ground waters in NJ and elsewhere indicates that movement to ground water can occur. Adsorption to sediment is expected to be a major fate process based on soil adsorption data, estimated Koc values (24,600-15,500), and extensive sediment monitoring data. The presence of chlordane in sediment core samples suggests that chlordane may be very persistent in the adsorbed state in the aquatic environment. If released to water, chlordane is not expected to undergo significant hydrolysis, oxidation or direct photolysis. Sensitized photolysis in the water column may be possible, however. The observation that 85% of the chlordane originally present in a sealed glass jar under sunlight and artificial light in a river die-away test remained at the end of two weeks and persisted at that level through week 8 of the experiment; this indicates that chlordane will be very persistent in aquatic environments.

Although sufficient biodegradation data are not available, it has been suggested that chlordane is very slowly biotransformed in the environment which is consistent with the long persistence periods observed under field conditions. Bioconcentration is expected to be important based on experimental BCF values which are generally above 3,200.

If released to the atmosphere, it will be expected to be predominantly in the vapor phase. Chlordane will react in the vapor-phase with photochemically produced hydroxyl radicals at an estimated half-life rate of 6.2 hr suggesting that this reaction is the dominant chemical removal process. Soil volatility tests have found that chlordane can volatilize significantly from soil surfaces on which it has been sprayed, particularly moist soil surfaces; however, shallow incorporation into soil will greatly restrict volatile losses.

The detection of chlordane in remote atmospheres (Pacific and Atlantic Oceans; the Arctic) indicates that long range transport occurs. It has been estimated that 96% of the airborne reservoir of chlordane exists in the sorbed state which may explain why its long range transport is possible without chemical transformation. The detection of chlordane in rainwater and its observed dry deposition at various rural locations indicates that physical removal via wet and dry deposition occurs in the environment.

Endosulfan

The following information was obtained from "Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Vol. III, Pesticides (ed. Philip H. Howard, Lewis Publishers, 1991).

Endosulfan is used as an insecticide against a variety of insects on a variety of crops. Technical endosulfan is composed of α-endosulfan and β-endosulfan. Release of endosulfan isomers to soil will most likely result in biodegradation and in hydrolysis, especially under alkaline conditions. Endosulfan isomers on the soil surface may photolyze. Volatilization and leaching are not expected to be significant due to the high estimated soil-sorption coefficients of the isomers. When release to water, endosulfan isomers are expected to hydrolyze readily under alkaline conditions, and more slowly at neutral and acidic pH values (α half-lives=35.4 and 150.6 days for pH 7 and 5.5, respectively; β half-lives=37.5 and 187.3 days for pH 7 and 5.5, respectively). Volatilization and biodegradation are also expected to be significant. Endosulfan released to the atmosphere will react with photochemically generated hydroxyl radicals with an estimated half-life of 1.23 hr. Bioconcentration of endosulfan is expected to be significant. Isomers of endosulfan are contaminants in air, water, sediment, soil, fish and other aquatic organisms, and food. Human exposure results primarily from food, and by occupational exposure.

DDT

The following information was obtained from "The Installation Restoration Program Toxicology Guide," Vol. III, Arthur D. Little, Inc. June 1987.

From 1946 to 1972, DDT was one of the most widely used agricultural insecticides in the world. During this time, DDT played an important role in many phases of agriculture and in the eradication of malaria, typhus and plague. As of January 1, 1973, all uses of DDT in the United States were cancelled with the exception of emergency public health however, it is still used extensively in some tropical countries.

DDT is expected to be highly immobile in the soil/groundwater environment when present at low dissolved concentrations. Bulk quantities of DDT dissolved in an organic solvent could be transported through the unsaturated zone as the result of a spill or improper disposal of excess formulations. However, the extremely low solubility of DDT and its strong tendency to sorb to soils results in a very slow transport rate in soils.

In general transport pathways can be assessed by using an equilibrium-partitioning models. These calculations predict the partitioning of low soil concentrations of DDT among soil particles, soil water, and soil air. Due to its strong tendency to sorb to soil, virtually all of the DDT partitions to the soil particles of unsaturated top soil, with negligible amounts associated with the soil water or air. Even in saturated deep soil, which is assumed to contain no soil air and a smaller organic carbon fraction, almost all of the DDT is retained on the soil.

DDT is characterized by a strong tendency to sorb to organic carbon. Kadeg et. al. report an arithmetic mean K_{oc} of 670,200 for 17 reported values; the corresponding geometric mean was log $K_{oc} = 5.48$. As with all neutral organic chemicals, the extent of sorption is proportional to the soil organic carbon content. In soils with little organic carbon (e.g., clays) the extent of sorption may also depend upon soil properties such as surface area, cation exchange capacity and degree of hydration.

The apparent sorption of DDT to soils and sediments is lessened, and thus its mobility is enhanced by the presence of dissolved organic matter in solution. Caron et. al. found the sorption of DDT to a natural freshwater sediment to be reduced by 75% in the presence of 6.95 mg/L of dissolved organic carbon (in the form of humic acid extracted from another sediment). Using p,p'-DDT, Chiou et al. observed the apparent water solubility to be significantly enhanced (roughly 2-5 times) in the presence of 100 mg/L of humic and fulvic acids. (Sorption will decrease with increasing water solubility). The partitioning of p,p'-DDT between soil-derived humic acid and water was approximately 4 times greater than with soil fulvic acids and 5-7 times greater than with aquatic (freshwater) humic and fulvic acids. These findings indicated that the mobility of DDT in natural waters may be several times greater than predicted (though probably still small) when the effect of dissolved organic matter is present. In waters containing large concentrations of dissolved organic material, such as swamps and bogs, this may be especially important.

The vapor pressure of DDT at 25°C has been given as 2.6×10^{-10} atm with estimates of its Henry's law constant at 25°C ranging from 2.8×10^{-5} to 2.0×10^{-6} $\text{atm} \cdot \text{m}^3/\text{mol}$. Volatilization is expected to be an important loss process in aquatic environments with the half-life for DDT on the order of several hours to several days. The presence of sediment particles, which would adsorb DDT from solution, would significantly reduce volatilization losses.

In soils, volatilization is much slower. Jury et al. using soil of 1.25% organic carbon to which DDT was applied uniformly to a depth of 1 cm at the rate of 1 kg/hectare, calculated volatilization half-lives of 497 and 432 days when water evaporation rates were 0.0 and 5.0 mm/day, respectively. The corresponding figures when the same quantity of DDT was mixed to a depth of 10 cm were 2300 and 2069 days.

Similar results were obtained by Lichtenstein et al. who studied the persistence of technical DDT (84% p,p', 15% o,p') in agricultural loam soil with crops over a 15 year period. Calculated half-lives for both isomers fell between 4.0 and 4.7 years for DDT applied at 10 pounds/acre; somewhat longer half-lives were measured for applications of 100 pounds/acre. These half-lives should be taken as upper limits of the volatilization rate since other processes such as leaching and degradation contribute to the DDT loss.

In tropical soils, the loss of DDT has been found to be much more rapid. El Zorgani found a half-life of less than three weeks for DDT applied at an initial concentration of 6.65 ppm to the soil surface beneath a cotton crop in the Sudan. The loss of the o,p' isomer was several times greater than for the p,p' isomer; and insignificant fraction of the loss could be accounted for by conversion to p,p'-DDE. A half-life 110 days has been reported for DDT in Kenya where it was found to sublime directly into the atmosphere without conversion to DDE.

The rate at which DDT degrades in the soil/groundwater environment is dependent on the conditions under which it is present. The pH strongly affects the rate of aqueous hydrolysis.

Over the pH range typical of natural waters (pH 5-9), Wolfe et al. found the pseudo-first-order rate constant (k_{obs}) at 27°C could be expressed as:

$$k_{obs} = 1.9 \times 10^{-9} + 9.9 \times 10^{-3} \cdot [OH^-]$$

where k_{obs} is in s^{-1} and $[OH^-]$, the concentration of the hydroxide ion, is in moles/liter. Hydrolysis half-lives of roughly 81 days, 8 years and 12 years at pH 9, 7, and 5, respectively, result from the rate constant obtained from this equation. The hydrolysis product of p,p'-DDT is p,p'-DDE.

A photolysis half-life of 5 days was measured for DDT when it was present in natural water exposed to summer sunlight, although no photolysis was observed when the chemical was present in pure water. Again, p,p'-DDE is a degradation product. Chen et al. observed a similar half-life of 8 days for p,p'-DDT applied as a thin film (0.67 $\mu g/cm^2$) to glass plates and exposed to light of environmentally important wavelengths (maximum intensity at 300 nm). The degradation of DDT by ultraviolet light was found to be more effective when the DDT was present in humus-free soil than in soil containing humus.

DDT has been found to undergo abiotic, reductive dehalogenation to DDD in the presence of Fe(II) porphyrin. It has been suggested that the Fe(III) porphyrin, which results from the oxidation of the Fe(II) porphyrin in this process, is reconverted to the Fe(II) porphyrin in the presence of reduced organic material. Dehydrochlorination of DDT to DDE (removal of a hydrogen and chlorine atom to form a double bond) has also been observed in model systems containing reduced porphyrins and in the natural environment.

Gambrell et al. found the degradation of DDT to be little affected by pH but greatly affected by redox conditions. Under strongly reducing conditions (Eh = 150 mV), over 90% of the DDT was degraded within a few days. The authors note that this is an unusually rapid rate.

The half-life for the decomposition of DDT in aerobic soils has been reported to be in the range of 10-14 years compared to half-lives of 28-33 days in moist soils incubated under anaerobic conditions. DDE is the major degradation product in aerobic soil, and it is believed to be produced predominantly by chemical processes. Under anaerobic conditions DDD is the major metabolite.

The bacterial and fungal cometabolism of DDT has been observed in the laboratory and has been suggested to be potentially important in the field as well. In these reactions, bacteria which are not able to use DDT as their sole carbon source grow on non-chlorinated analogues of DDT, but degrade DDT in the process.

Information on the fate and transport parameters of DDT (i.e., solubility, vapor pressure, Henry's Law Constant, K_{oc}, K_{ow}, half-life and BCF) are provided in Table 3-1.

DDD

The following information was obtained from "The Installation Restoration Program Toxicology Guide," Vol. III, Arthur D. Little, Inc. June 1987.

DDD, no longer manufactured commercially, is still found as an impurity in the pesticide DDT and the miticide dicofol. It is also the major breakdown product of DDT under anaerobic conditions. The p,p' isomer of DDD is the third largest component of the technical DDT product after the two DDT isomers accounting for >4% of the mixture. It is present in somewhat lower concentrations in dicofol. In one study of several dicofol products, DDD was present in amounts ranging from 0.1 to 2.5% of the amount of dicofol.

Like DDT, DDD is expected to be highly immobile in the soil/groundwater environment when present at low dissolved concentrations. Bulk quantities of DDD dissolved in an organic solvent could be transported through the unsaturated zone as a result of a spill or the improper disposal of excess formulations. However, the extremely low solubility of DDD and its strong tendency to sorb to soil organic carbon results in a very slow transport rate in soils.

In general, transport pathways can be assessed by using an equilibrium partitioning models. These calculations predict the partitioning of low soil concentrations of DDD among soil particles, soil water, and soil air. Due to its strong sorption to soil, virtually all of the DDD partitions to the soil particles of unsaturated top soil and negligible amounts to the soil air or water. Even in saturated deep soil, which is assumed to contain no soil air, and a smaller organic carbon fraction, almost all of the DDD is retained on the soil.

DDD, like DDT, is characterized by a strong tendency to sorb to soil organic carbon. While only one measured K_{oc} value for DDD was found ($\log K_{oc} = 5.38$) it is consistent with the value obtained for DDT, as would be expected based on the similarity of their structures and their octanol water partition coefficients (DDD $\log K_{ow} = 5.56$). As with all neutral organic chemicals, the extent of DDD sorption is proportional to the soil organic carbon content. In soils with little organic carbon (e.g., clays) the extent of sorption may also depend upon such soil properties as surface area, cation exchange capacity, and degree of hydration.

The sorption of DDD to soils is lessened and thus its mobility is enhanced by the presence of dissolved organic matter in solution. The apparent solubility of DDT was increased several times in solutions containing humic and fulvic acids. Because the sorption behavior of DDD is expected to be much like that of DDT, its mobility in natural waters may be several times greater than predicted (though probably still small) if dissolved organic matter is present. In waters containing large concentrations of dissolved organic matter, such as swamps and bogs, this may be especially important.

The vapor pressures of the p,p' and o,p' - isomers of DDD at 30°C have been measured as 1.3×10^{-9} and 2.5×10^{-9} atm, respectively. The Henry's law constant estimated by use of the average vapor pressure of the two isomers and an aqueous solubility of 20 ppb is $3.1 \times 10^{-5} \cdot \text{atm m}^3/\text{mol}$. This value is almost identical to that for DDT and roughly an order of magnitude less than that for DDE.

Experimental evidence indicates that DDT volatilization from water occurs at about one-third the rate for DDT, which may seem at odds with the similar estimates for the Henry's law constants for these two compounds. Given the uncertainties involved in measuring both the aqueous solubilities and the vapor pressures of these compounds, from which H is estimated, the findings cannot be considered inconsistent. Using a factor of one-third for the difference in the rate of volatilization of DDD and DDT, a volatilization half-life for DDD ranging from a day to less than a month has been estimated.

Volatilization of DDD from soils can be expected to be much slower than from water because of the strong tendency of DDD to sorb to soil. Using wet river bed quartz sand in 15 mm deep petri dishes, Ware et at. measured volatilization losses of p,p'-DDD (present initially at 10 ppm) that corresponded to a volatilization half-life of roughly 170 days, slightly more than twice that for p,p'-DDT under the same conditions. Because these experiments were conducted with a relatively thin layer of soil with a small organic carbon fraction, the actual volatilization rate of DDD in the field would be expected to be lower. If the relative volatilization rates of DDD and DDT in the field were the same as those observed by Ware et al., the volatilization half-life of DDD from soil could be assumed to be double the value of one to several years for DDT.

Hydrolysis of DDD can be expected to be extremely slow under environmental conditions. Over the pH range typical of natural waters (pH 5-9), Wolfe et al. found the pseudo-first-order rate constant (k_{obs}) at 27°C could be expressed as:

$$k_{obs} = 1.1 \times 10^{-10} + 1.4 \times 10^{-3} \cdot [OH^-]$$

where k_{obs} is in s^{-1} and $[OH^-]$, the concentration of the hydroxide ion, in moles/liter. Hydrolysis half-lives of roughly 1.6, 88, and 190 years at pH 9, 7, and 5, respectively, correspond to the rate constant estimated from this equation. These estimates are consistent with the observations of Eichelberger and Lichtenberg that no DDD, initially present in river water at 20 ppb, degraded over an eight week period (within 2.5%).

No information was found on the photolysis of DDD in natural waters. Direct photolysis of DDD (i.e., in pure water) is believed to be slower than that for DDT which is estimated to have a half-life of over 150 years. However, DDT in natural water has been estimated to have a photolysis half-life of 5 days when exposed to sunlight in mid-June; DDD might be expected to have a similar half-life based on the similar structure of the two chemicals.

Data on the biodegradation of DDD are limited. In aquatic systems, biotransformation is believed to be slow, although a model ecosystem study has shown DDD to be more biodegradable than either DDT or DDE. The ketone analogue of DDD (i.e., p,p'-dichlorobenzophenone) has been suggested as the end product of the biodegradation of DDD in the environment. DDD undergoes dehydrochlorination to 2,2-bis-(p-chlorophenyl)-1-chloroethylene, reduction to 2,2-bis-(p-chlorophenyl)-1-chlorethane, dehydrochlorination to 2,2-bis-(p-chlorophenyl)-ethylene, reduction to 1,1-bis-(p-chlorophenyl)-ethane and eventual oxidation to bis-(p-chlorophenyl)-acetic acid (DDA), the ultimate excretory product of higher animals. DDD has also been observed to degrade in anaerobic sewage sludge.

The above discussion of fate pathways suggests that DDD is moderately volatile, very strongly sorbed to soil, and has a high potential for bioaccumulation. Information on the fate and transport parameters (i.e., solubility, vapor pressure, Henry's Law Constant, K_{oc}, K_{ow}, half-life and BCF) are provided in Table 3-1.

DDE

The following information was obtained from "The Installation Restoration Program Toxicology Guide," Vol. III, Arthur D. Little, Inc. June 1987.

The presence of DDE in the environment is primarily the result of the use of the insecticide DDT and the miticide dicofol. DDE is the principal degradation product of DDT under aerobic conditions, and it has been found to equal roughly 1-3% of the weight of dicofol in the technical mixture. Like DDT, DDE exists as both an o,p' and a p,p' isomer, with the o,p' and the p,p' isomers of DDT degrading to the respective DDE isomer. Because technical DDT consists of 65-80% p,p' - DDT and 15-21% o,p' - DDT, the p,p' - DDE isomer might be expected to predominate in the environment. In dicofol, however, the o,p' isomer typically makes up 80-90% of the DDE present. The two isomers of DDE are considered individually below where data are available.

Like DDT, DDE is expected to be highly immobile in the soil/groundwater environment when present at low dissolved concentrations. Bulk quantities of DDE dissolved in an organic solvent (e.g., as a contaminant in dicofol) could be transported through the unsaturated zone as a result of a spill or improper disposal of excess formulations. However, the extremely low solubility of DDE and its strong tendency to sorb to soils would result in a very slow transport rate in soils.

In general, transport pathways can be assessed by using an equilibrium partitioning model. These calculations predict the partitioning of low soil concentrations of DDE among soil particles, soil water and soil air. Due to its strong tendency to sorb to soil, virtually all of the DDE partitions to the soil particles of unsaturated topsoil, with negligible amounts associated with the soil water or air. Even in saturated deep soil, which is assumed to contain no soil air and a smaller organic carbon fraction, almost all of the DDE is retained on the soil.

DDE is characterized by a strong tendency to sorb to organic matter in soils and in sediments. Only one value, log K_{oc} = 5.17 was found in the literature for the soil organic carbon partition coefficient. A log K_{oc} value of roughly 5 has been suggested based on log K_{ow} measurements of 5.69 for the p,p' isomer and 5.78 for the o,p' isomer. Using the geometric mean of these K_{ow} values and a regression equation, a log K_{oc} value of 5.41 is estimated. As with all neutral organic chemicals, the extent of sorption is proportional to the soil organic carbon content. In soils with little organic carbon (e.g., clays), the extent of sorption may also depend upon soil properties such as surface area, cation exchange capacity, and degree of hydration.

The apparent sorption of DDE to soils and sediments (like that of DDT), is lessened, and thus its mobility is enhanced by the presence of dissolved organic matter. DDT concentrations were found to be higher in aqueous solutions containing humic and fulvic acids. Because the sorption behavior of DDE is expected to be much like that of DDT, its mobility in natural waters may be several times greater than predicted (though probably still small) if dissolved organic matter is present. In waters containing large concentrations of dissolved organic matter such as swamps and bogs, this may be especially important.

The vapor pressure of p,p'- isomer of DDE at 20°C has been given as 8.7×10^{-9} atm and that of the o,p' isomer as 8.2×10^{-9} atm. A somewhat lower value of roughly eight times the vapor pressure of DDT has been suggested. Using the average vapor pressures for the two isomers to estimate the Henry's law constant, a value of 1.9×10^{-4} $\mathrm{atm \cdot m^3/mol}$ is obtained.

This estimate is roughly an order of magnitude larger than the Henry's law constant for DDT. Because volatilization losses for DDT are expected to be important, the same is also true for DDE. DDE has been found to volatilize from distilled and natural waters five times faster than DDT. Since the volatilization half-life for DDT has been reported to range from several hours to several days (see Section 57.2.1.3) proportionately shorter half-lives would be expected for DDE.

In soils, volatilization of DDE is much slower. Using wet river bed, quartz sand in 15 mm deep petri dishes, Ware et al. measured volatilization losses of p,p'-DDE (present initially at 10 ppm) that corresponded to a half-life of roughly 40 days. This value may be more indicative of an upper limit of the volatilization rate because soils of higher organic matter content would tend to sorb more of the DDE, and the rate of volatilization would be expected to be lower from thicker layers of soil. In the same study and under the same conditions, the o,p' isomer of DDT took 50% longer to reach half its initial concentration; p,p'-DDT took twice as long. This suggests that the volatilization of DDE in the field may occur at a rate somewhat greater than that for DDT, which has been found to have a volatilization half-life of one to several years. The observation that the volatilization rate of DDE from soil is not several times the rate for DDT, given that it has an order of magnitude larger Henry's law constant, may be explained by its strong sorption to soil, which tends to impede volatilization.

DDE is the hydrolysis product of DDT and is quite resistant to further hydrolysis. A hydrolysis half-life of over 120 years at pH 5 and 27°C has been given. Thus, hydrolysis is not expected to be an environmentally significant process.

Several studies have examined the aqueous photolysis of DDE. Zepp and Schlotzhauer found that DDE in the aqueous phase of sediment suspensions exposed to ultraviolet light of wavelength > 300 nm had a half-life of roughly 13 to 17 hours. Under the same conditions, DDE equilibrated with sediment for 60 days (i.e., sorbed to the sediment) photodegraded much more slowly. To reach 25% of its initial concentration, roughly seven half-lives were needed instead of the expected two, and little further degradation occurred. The authors suggested that over time, part of the DDE diffused into the sediment particles and became unavailable for photolysis. Chen et al. found the thin film photodegradation rate of p,p'-DDE to be about 90% of that for p,p'-DDT, and the half-life of DDE in aquatic systems at 40°N latitude has been estimated to range from one day in summer to six days in winter. These findings suggest that photolysis of DDE may be an important loss process, as it is for DDT. However, for photolysis to occur, the chemical must be exposed to sunlight, which often is not the case for a large fraction of the amount sorbed to soils or deep sediments.

The biological degradation of DDE in aquatic environments is believed to occur very slowly if at all. In modeling the fate of DDE in a quarry, Di Toro and Paquin considered biodegradation to be insignificant compared to loss by photolysis and volatilization. The half-life for biodegradation in sediments has also been found to be extremely slow. Using radiolabeled p,p'-DDE mixed with river sediment, Lee and Ryan measured a half-life of 1100 days based on the evolution of CO_2. In short, photolysis appears to be the only degradation process that affects DDE significantly under environmental conditions.

Information on the fate and transport parameters (i.e., solubility, vapor pressure, Henry's Law Constant, K_{oc}, K_{ow}, half-life and BCF) are provided in Table 3-1.

Aroclor® PCBs 1016, 1242, 1254, 1260

The following information was obtained from "The Installation Restoration Program Toxicology Guide", Vol. II, Arthur D. Little, Inc., June 1987.

This section encompasses a general review of the environmental fate of polychlorinated biphenyl (PCBs) mixtures marketed in the U.S. under the name Aroclor® (Aroclor® 1016, 1242, 1254, and 1260).

Aroclor® compounds are very inert, thermally and chemically stable compounds with dielectric properties. They have been used in nominally closed systems as heat transfer liquids, hydraulic fluids and lubricants, and in open-ended systems in which they came in direct contact with the environment as plasticizers, surface coatings, inks, adhesives, pesticide extenders and for microencapsulation of dyes for carbonless duplicating paper. In 1974, use of PCBs in the United States was limited to closed systems, i.e., approximately 70% of PCBs produced were used in capacitors while the remaining 30% were utilized in transformers (1457).

The environmental behavior of the Aroclor® mixtures is a direct function of their relative composition with respect to the individual chlorinated biphenyl species. It is important to remember that Aroclor® formulations are mixtures and the physical properties and chemical behavior of mixtures cannot be precisely defined. The individual PCBs in a pure state are generally solids at room temperature; however, due to melting point depression, Aroclor® mixtures are oily to resinous liquids at ambient temperatures.

Individual PCBs vary widely in their physical and chemical properties according to the degree of chlorination and position of the chlorines on the biphenyl structure. In general, as chlorine content increases, adsorption increases while transport and transformation processes decrease. Except for Aroclor® 1016, the last two digits in the Aroclor® number identification denote the approximate chlorine content by weight percent. The specific PCB distribution measured in environmental samples may be distorted and may not correspond to the specific Aroclor® mixture responsible for the contamination. For this reason, most of the fate and transport discussion will focus on the chlorinated biphenyl species rather than the Aroclor® mixtures.

In general, transport pathways can be assessed by using an equilibrium partitioning model. These calculations predict the partitioning of low soil concentrations of the PCB mixtures among soil particles, soil water and soil air; portions associated with the water and air phases of the soil have higher mobility than the adsorbed portion. Estimates for the unsaturated topsoil model indicate that almost all (>99.99%) of the Aroclor® formulations are expected to be associated with the stationary phase. Much less than 1% is expected to partition to the soil-water phase; therefore, only a small portion would be available to migrate by bulk transport (e.g., the downward movement of infiltrating water), dispersion and diffusion. An insignificant portion of the Aroclor® formulations is expected in the gaseous phase of the soil; diffusion of vapors through the soil-air pores up to the ground surface is not expected to be important. In saturated, deep soils (containing no soil air and negligible soil organic carbon), sorption is still expected to be the most significant fate process. Overall, groundwater underlying PCB-contaminated soils is not expected to be vulnerable to contamination.

Adsorption to soils and sediments is the major fate process affecting PCBs in the environment. PCB sorption has been studied and reviewed in a number of reports. In general, the rate of adsorption by soil materials was found to be rapid and conformed to the Freundich adsorption equation; adsorption capacity was highly correlated with organic content, surface area, and clay content of the soil materials; PCBs were reported to be unable to penetrate into the inner surfaces of clay materials. Desorption of sorbed PCB is not expected to be rapid.

Distribution coefficients for PCBs on suspended solids in Saginaw Bay have been reported to range from 4×10^4 to 9×10^4. In general, higher chlorinated isomers are more strongly sorbed; however, preferential adsorption is also dependent on ring position of the substituted chlorine; values for K_{oc} range from approximately 10^5 for dichlorobiphenyl to 10^9 for octachlorobiphenyl.

Experimental studies on the mobility of Aroclor® 1242 and 1254 in soil materials indicate that these PCBs were adsorbed strongly and remained immobile when leached with water or aqueous leachate from a waste disposal site. However, they were found to be highly mobile when leached with carbon tetrachloride. The mobilities of the PCBs were highly correlated with their solubilities in the leaching solvent and the organic content of the soil material. It should be noted that even with carbon tetrachloride, a high percentage of the PCBs were retained on the soil while some moved with the solvent front.

Additional studies were performed using different solvents and varying amounts of water. Relatively small amounts of water (9%) in methanol were shown to significantly reduce the mobility of PCBs compared to the mobility in the pure solvent.

In summary, the available data indicate that sorption of PCBs, particularly the higher chlorinated biphenyls onto soil materials, will be rapid and strong. In the absence of organic solvents, leaching is not expected to be important, and PCBs are expected to be immobile in the soil/groundwater system; PCBs will be much more mobile in the presence of organic solvents. In the case of large spills of PCB/solvent mixtures, the soil and aqueous phases may become saturated resulting in a separate oily phase which may be more mobile.

Transport of PCB vapors through the air-filled pores of unsaturated soils is not expected to be a rapid transport pathway. Modeling results indicate that a very small fraction of PCB loading will be present in the soil-air phase. On the other hand, volatilization (mostly from aqueous systems) and atmospheric transport are thought to account for the widespread, almost ubiquitous, distribution of PCBs in the environment. Several studies have shown that vapor phase transport can be a significant process for loss of PCBs from water bodies. Adsorption to organic matter, however, has been shown to compete strongly with volatilization. Adsorption onto suspended sediment has been presented as an explanation for the lower rates of volatilization exhibited for natural water bodies compared to estimated rates. Volatilization from soil was reported to be slow compared to volatilization from sand or PCB solution.

Calculated half-lives for the volatilization of Aroclor® 1242, 1248, 1254, and 1260 from 1 mm water column have been reported to range from 9.5 hours to 12.1 hours; other authors have reported half-lives on the order of 3-4 hours for di- and tetrachlorobiphenyls. Volatilization of Aroclor® 1260 from river water was reported to be only 67% after 12 weeks; after addition of sediment, the loss dropped to 34% after 12 weeks. The Henry's law constants and volatilization half-lives do not vary widely with degree of chlorination of the PCBs.

The available data indicate that due to low water solubility, volatilization of water-borne PCBs not sorbed to sediment or suspended solids may be significant; when sorbed to soils/sediments, volatilization will be drastically reduced. However, since other fate and transport processes in the soil environment are relatively slow, volatilization of PCBs sorbed on surface soils may occur. Elevated airborne concentrations of PCBs have been measured near PCB disposal area.

PCBs have been reported to be strongly resistant to chemical degradation by oxidation or hydrolysis. However, they have been shown to be susceptible to photolytic and biological degradation. Baxter and Sutherland have shown that successive biochemical and photochemical processes contribute to the degradation of PCBs in the environment. Experimental results indicate that the highly chlorinated PCBs can be photolytically degraded, resulting in the formation of lower chlorinated species and substituted products, as well as potential formation of biphenylenes and chlorinated dibenzofurans; the presence of oxygen retards the photolytic degradation of PCBs.

There is some doubt as to the applicability of these photolysis experiments to environmental conditions, since they were generally carried out in organic solvents, often in the presence of other additives. However, since the rate of photolytic dechlorination is greatest for the highly chlorinated species (i.e., those species that are most resistant to biodegradation), photolytic degradation, although slow, may be a significant transformation process for these molecules. Furthermore, since they are rapidly adsorbed to soils, these highly chlorinated PCBs may be concentrated in the surface layers and their actual photolysis rates may be higher than expected.

Microbial degradation has been reported to be an important transformation process for PCBs. In general, the lower chlorinated PCBs were more easily degraded than the higher chlorinated species. Position of chlorine substitution on the biphenyl molecule also affected the rate of PCB degradation. Biodegradability of PCBs has been reported to be a function of the number of carbon-hydrogen bonds available for hydroxylation by microbial oxidation; adjacent unchlorinated carbons have been shown to facilitate metabolism through formation of arene oxide intermediates. Both aerobic oxidative biodegradation and anaerobic dechlorination have been identified as PCB transformation processes in Hudson River sediments. Composting studies indicate that aerobic systems exhibited greater PCB reductions than anaerobic systems (42 to 48% vs. 18 to 28% reduction after two weeks).

The biodegradation of Aroclor® 1016, 1242, 1254, and 1260 is a function of their relative content of the lower chlorinated biphenyls. Aroclor® 1016 and 1242 are largely comprised of di-, tri- and tetra-chloro biphenyls, which have been shown to be biodegraded in microbial cultures, aquatic systems, and soils at fairly rapid rates. Aroclor 1254 and 1260 are largely comprised of higher chlorinated species and are expected to be resistant to biodegradation. In fact, Liu reported that an increase of chlorination from monochlorobiphenyls to predominantly trichlorobiphenyls (Aroclor® 1016 and 1242) and pentachlorobiphenyls (Aroclor® 1254) resulted in a corresponding decrease in degradation from 100% to 29% and 19%, respectively; similar results were reported by other authors. In an experiment with reservoir sediment, Aroclor® 1254 was degraded approximately 50% in six weeks. Using an acclimated semi-continuous activated sludge experiment with 48-hour exposure, degradation rates of 33%, 26% and 19% were determined for Aroclor® 1016, 1242, and 1254, respectively.

A study of the fate of Aroclor® 1254 in soil and groundwater after an accidental spill showed essentially no reduction in Aroclor® 1254 concentration due to biodegradation after two years. On the other hand, other authors reported moderate biodegradation of Aroclor® 1254 in soils (40% degraded in 112 days) and no degradation of Aroclor® 1260 (primarily hexa- and hepta-chlorobiphenyls). The presence of the lower chlorinated biphenyls has been shown to actually increase the rate of biodegradation of the higher PCBs through co-metabolism.

In summary, most studies have reported substantial PCB degradation in aqueous solutions; biodegradation rates are greatest for the lower chlorinated species. While adsorption of PCBs by soil and competition by native soil organisms may alter the degradation rate, several authors have reported substantial PCB degradation in soil systems. Mixed cultures of PCB-degrading microbes have been isolated from PCB-contaminated soils, suggesting that PCBs will be degraded to some extent in the environment.

3.1.3.4 Heavy Metals and Cyanide

Metals and cyanides tend to be persistent and relatively insoluble. There may be some slow rate of photolysis of the complex cyanides. The chemicals are expected to be closely bound to particulate matter and bioavailability is expected to be limited (GRI, May 1987, GRI-87/0260.3).

Heavy Metals

In general, metals tend to be persistent and relatively insoluble in the environment. For example, volatilization of metals from soil is not considered a realistic mechanism for contaminant migration and is not considered here. However, leaching and sorption will be considered.

Leaching of heavy metals from soil is controlled by numerous factors. The most important consideration for leaching of heavy metals is the chemical form (base metal or cation) present in the soil. The leaching of metals from soils is substantial if the metal exists as a soluble salt. Metallic salts have been identified as a component of such items as tracer ammunition, ignitor compositions, incendiary ammunition, flares, colored smoke and primer explosive compositions. In particular, barium nitrate, lead stearate, lead carbonate, and mercury fulminate are potential heavy metal salts or complexes which are components of ammunition that may have been tested or disposed of at SEDA. During the burning of these materials, a portion of these salts oxidize to their metallic oxide forms. In general, metal oxides are considered less likely to leach metallic ions than metallic salts. Upon contact with surface water or precipitation, the heavy metals salts may be dissolved, increasing their mobility and increasing the potential for leaching to the groundwater.

Heavy metals may also exist in the base metallic form as a component of the projectiles tested or disposed of at SEDA. Bullets are composed mainly of lead, which may contain trace amounts of cadmium and selenium. Metals which exist in metallic form, i.e., as bullets or projectiles, will tend to dissolve more slowly than the metallic salts.

Oxidation and reduction involves the change of the valence state of the metals and has a large influence on the other fate mechanisms. A good example of the variation in contamination fate due to oxidation and reduction changes is iron. Iron (Fe) normally exists in one of two valence states, +2 and +3 [Fe(II) and Fe(III)]. Fe(II) is far more soluble than Fe(III) and therefore has a greater mobility.

Soil pH is often correlated with potential metal migration. If the soil pH is greater than 6.5, most metals, especially those normally present as cations, are fairly immobile. At higher pH values, metals form insoluble carbonate and hydroxide complexes. Metals would be most mobile in highly acidic soils, i.e. those with a pH of less than 5.

The surface soil at SEDA has pH values ranging from 5 to 8.4 (SCS, 1972). Subsurface soil has even higher pH values, with the data indicating values ranging from 7 to 9. Therefore, metals at the SEDA grounds would be expected to be present primarily in insoluble forms. A detailed evaluation of select metals (barium, copper, lead and zinc) is given below.

Barium is a highly reactive metal that occurs naturally only in the combined state. Most barium released to the environment from industrial sources is in forms that do not become widely dispersed. Barium in soil may be taken up to a small extent either by vegetation, or transported through soil with infiltration of precipitation. Barium is not very mobile in most soil systems. The higher the level of organic matter, the greater the adsorption. The presence of calcium carbonate will also limit mobility, since barium will form $BaCO_3$, an insoluble carbonate. In aquatic media, barium is likely to precipitate out of solution as an insoluble salt, or adsorb to suspended particulate matter. Sedimentation of suspended solids removes a large portion of the barium from surface waters. Barium in sediment is found largely in the form of barium sulfate. Bioconcentration in freshwater aquatic organisms is minimal.

Copper is considered to be among the more mobile of the heavy metals in surface environments. Seasonal fluctuations have been observed in surface water copper concentrations, with higher levels in fall and winter, and lower levels in the spring and summer. Copper is not expected to volatilize from water. Since copper is an essential nutrient, it is strongly accumulated by all plants and animals, but is probably not biomagnified. The degree of persistence of copper in soil depends on the soil characteristics and the forms of copper present. For example, in soil of low organic content, soluble copper compounds may move into groundwater at a significant rate. On the other hand, the presence of organic complexing agents may restrict movement in soil, and copper may be immobilized in the form of various inorganic complexes. Copper is not expected to volatilize from soil. Several processes determine the fate of copper in aquatic environments, these being: formation of complexes, especially with humic substances; sorption to hydrous metal oxides, clays, and organic materials; and bioaccumulation. Organic complexes of copper are more easily adsorbed on clay and other surfaces than the free form. The aquatic fate of copper is highly dependent on factors such as pH, oxidation-reduction potential, concentration of organic matter, and the presence of other metals. With regard to the latter, it has been demonstrated that co-precipitation of copper with hydrous oxides of iron effectively scavenges copper from solution, although in most surface waters organic materials prevail over inorganic ions in complexing copper.

Lead is extremely persistent in both water and soil. Environmental fate processes may transform one lead compound to another; however, lead is generally present in the +2 oxidation state, and will form lead oxides. It is largely associated with suspended solids and sediment in aquatic systems, and it occurs in relatively immobile forms in soil. Lead which has been released to soil may become airborne as a result of fugitive dust generation.

Elemental mercury is insoluble in water and binds tightly to soil particles giving it a relatively low mobility. Bacterial and fungal organisms in sediment are capable of methylating mercury. Methyl mercury, which is soluble in water, is a mobile substance and can then be ingested or absorbed. Until altered by biological processes, the primary transport method for mercury is the erosion and transportation of soil and sediment. Mercury most likely exists at SEDA in the elemental state as a result of the testing or demolition of munitions containing mercury fuzes. Although a mercury salt, mercury fulminate, was used in the past as a priming explosive, it has not been commonly used since 1925 (Dunstan and Bell, 1972), and its environmental fate will not be considered at the site.

Zinc is stable in dry air, but upon exposure to moist air will form a white coating composed of basic carbonate. Zinc loses electrons (oxidizes) in aqueous environments. In the environment, zinc is found primarily in the +2 oxidation state. Elemental zinc is insoluble; most zinc compounds show negligible solubility as well, with the exception of elements (other than fluoride) from Group VII of the Periodic Table compounded with zinc (i.e., $ZnCl_2$, ZnI_2) showing a general 4:1 compound to water solubility level. In contaminated waters, zinc often complexes with a variety of organic and inorganic ligands. Therefore, the overall mobility of zinc in an aqueous environment, or through moist-to-wet soil, may be accelerated by compounding/complexing reactions.

Zinc has a tendency to adsorb to soil, sediment and suspended solids in water. Adsorption to sediments and suspended solids is the primary fate for zinc in aqueous environments, and will greatly limit the amount of solubilized zinc. Zinc is an essential element and, therefore, is accumulated by all organisms. Zinc concentrations in air are relatively low except near industrial sources. Volatilization is not an important process from soil or water.

3.1.3.5 Fuel Oils

The following discussion of fuel oils was obtained from the "Installation Restoration Program Toxicity Guide", Volume III, July, 1987.

Fuel oils have various uses for which they are specifically formulated. Fuel oil number 1 is used almost exclusively for domestic heating. Fuel oil number 2 is used as a general purpose domestic or commercial fuel in atomizing type burners. Number 4 oil is used in commercial or industrial burner installations not equipped with preheating facilities. Numbers 5 and 6 are used in furnaces and boilers of utility power plants, ships, locomotives, metallurgical operations and industrial power plants.

Diesel fuel is available in different grades. Number 1-D is used for engines in service requiring frequent speed and load changes. Number 2-D is used for engines in industrial and heavy mobile service while number 4-D is used in low and medium speed engines.

Composition

The discussion of fuel oil in this chapter largely focuses on diesel fuel. Limited information on residual fuel oils, which are generally defined as the product remaining after the removal of the appreciable quantities of the more volatile components is included but environmental fate data are not specifically addressed. Residual fuel oils are expected to be extremely complex in composition, with higher concentrations of the many high molecular weight asphaltic compounds and impurities present in the original crude oils. Available data suggest sulfur values ranging from 0.18 to 4.36% by weight; trace element data indicate that concentrations of many elements vary by one or more orders of magnitude. The environmental transport and transformation of the high molecular weight organics is expected to be minimal and is not addressed in detail.

Diesel fuel is usually that fraction of petroleum that distill after kerosene in the 200°C to 400°C range. Several commercial grades of diesel fuels are obtained by blending various feedstocks to achieve established specifications. Due to differences in feed stocks, refining methods, and blending practices, the composition of diesel fuel samples is expected to be highly variable. Sulfur content has been reported to vary by several orders of magnitude (0-0.57% by weight): similar variations have been documented for a number of trace elements.

Diesel fuel is predominantly a mixture of C_{10} through C_{19} hydrocarbons. Composition by chemical class has been reported to be approximately 64% aliphatic hydrocarbons (straight chain alkanes and cycloalkanes), 1-2% olefinic hydrocarbons and 35% aromatic hydrocarbons, including alkylbenzenes and 2-3 ring aromatics. Petroleum distillates may contain many non-hydrocarbon components in varying concentrations.

Fuel oils also contain a number of additives used as ignition improvers, combustion catalysts, antioxidants, flow improvers, metal deactivators, detergents and emulsifiers. Many compounds added to fuel oils are similar to those added to gasoline.

Environmental Fate and Exposure Pathways

A discussion of the environmental behavior of fuel oil is limited by the lack of data defining its major components. The environmental behavior of hydrocarbons selected from the major classes will be addressed; however, trace elements and the many diverse additives will not be specifically addressed.

In general, soil/groundwater transport pathways for low concentration of pollutants in soil can be assessed by using an equilibrium partioning model. For the purposes of assessing the environmental transport of diesel fuel, a group of specific hydrocarbons was selected from the dominant hydrocarbon classes, i.e., alkanes, cycloalkanes, and aromatics; there were no available data to confirm the presence of the selected compounds in a typical diesel fuel sample. The hydrocarbon portions associated with water and air phases of the soil are expected to have higher mobility that the adsorbed portion.

Estimates for the unsaturated topsoil indicate that sorption is expected to be an important process for all the dominant hydrocarbon categories. Partioning to the soil-vapor phase is much less important than for other petroleum distillates since many of the lower molecular weight aliphatic hydrocarbons (C_4-C_8) characterized by high vapor pressure and low water solubility are not expected to be major components of diesel fuel. The aromatics have slightly higher water solubilities and transport with infiltrating water may be more important for these compounds; volatilization, on the other hand, is not expected to be important. In saturated, deep soils (containing no soil air and negligible soil organic carbon), a significant percent of the aromatic hydrocarbons is predicted to be present in the soil-water phase and available for transport with flowing groundwater. Partitioning to the air and water phases is expected to be even less important for the organic components of residual fuel oils compared to components of diesel oil; sorption to soil particles is expected to be significant.

In interpreting these results, it must be remembered that this model is valid only for low soil concentrations (below aqueous solubility) of the components. Large releases of diesel fuel (spills, leading underground storage tanks) may exceed the sorptive capacity of the soil, thereby filling the pore spaces of the soil with the fuel. In this situation, the hydrocarbon mixture would move as a bulk fluid and the equilibrium partitioning model would not be applicable.

Transport and Transformation Processes

Transport and transformation of individual fuel oil constituents will depend on the physiochemical (and biological) properties of the constituents. Some constituents will dissolve more quickly in the percolating groundwaters, be sorbed less strongly on the soils thus being transported more rapidly, and may be more or less susceptible to degradation by chemical or biological action. Thus, the relative concentrations of the constituents of the fuel will vary with time and distance form the site of contamination. This effect is called "weathering". (This term is also used to describe the changes to oil following spills into surface waters where film spreading and breakup, and differential volatilization dissolution and degradation are all involved).

Transport processes have been shown to be more significant than transformation processes in determining the initial fate of lower molecular weight petroleum hydrocarbons released to soil/ground-water systems. However, due to the lower water solubilities and lower vapor pressures of the higher molecular weight hydrocarbons environmental transformation processes may be increasingly significant for hydrocarbons in the C_{10}-C_{19} range characteristic of diesel fuel and in the $> C_{19}$ range expected in residual fuel oils.

Under conditions of limited volatilization (low temperatures, subsurface release or concentrated spill) other transport processes including downward migration into the soil, sorption to soils, and transport to groundwater may be important. It has been reported that oil substances released in significant quantities to soils result in a separate organic phase which moves downward through the unsaturated zone to the less permeable layer, the soil/groundwater boundary, where they tend to accumulated and spread horizontally.

The organic layer floating on the groundwater is carried in the general direction of groundwater flow. At the oil-water interface, some hydrocarbons are leached according to their aqueous solubility. The pollution caused by the hydrocarbon phase is much less extensive than pollution caused by hydrocarbons dissolved in ground water. Furthermore, the pattern of migration of the hydrocarbon phase may be very different from that of the groundwater. Due to fluctuations in groundwater elevation over time, the organic layer on top of the aquifer may be transported into several zones where the components occur in the gaseous phase (able to diffuse in all directions, including upward), liquid phase (adsorbed onto rock particles or sealed under water), or dissolved/emulsified in water.

Migration through soils may be retarded by sorption. Sorption is expected to be significant for higher molecular weight aliphatics, particularly $> C_{20}$. Migration is expected to be fastest through previously contaminated soils where the sorptive sites may be unavailable; on the other hand, soil-water content increases sorption and slows migration of hydrocarbons. In fissured rock, the migration of hydrocarbons is much less uniform than in porous soils. Preferential spreading through crevices, sometimes changing the direction of flow, may occur. Determination of the potential groundwater contamination in fissured rock is thus very difficult.

The water-soluble portion of No. 2 fuel oil (a higher temperature distilling fraction than diesel oil) was shown to be almost entirely aromatic (99%) even though the product itself was 48% aliphatic; the aliphatic fuel oil hydrocarbons have very low water solubility compared with the aromatics. The largest percentage (40%) of the water-soluble fraction of fuel oil was represented by C_{11} - aromatics. In deep, saturated soils with no soil air, the aromatics represent the greatest threat of contamination to groundwater supplies. Solubility in aqueous solution of polar, non-hydrocarbon components of some higher boiling petroleum fractions such as diesel oil and other fuel oils has also been reported.

In summary, the physical distribution of fuel oil contamination affects its impact on, and removal from, the soil environment. Lateral spreading along the surface increases the initial contaminated area while facilitating evaporative removal or sorption of different hydrocarbons. Subsurface release or vertical penetration mediated by gravitation and capillary forces decreases evaporation, reduces the importance of some transformation pathways (see below), and may lead to groundwater contamination.

Photo-oxidation has been reported to play a significant role in the chemical degradation of petroleum hydrocarbons in the sunlit environment. Alkanes, benzenes, and mono-substituted venzens have been shown to be relatively resistant to photolysis in aqueous systems; xylenes photolyzed slowly while trisubstituted benzenes and naphthalenes photolyzed at rates competitive with volatilization. Anthracene and other polycyclic aromatic hydrocarbons (PAH) in the carbon range of diesel fuel are subject to photochemical oxidation; benzo(a)pyrene is the most susceptible of the PAH compounds, suggesting that the residual fuel oils may be even more affected by photodegradation than diesel oil. Penetration of oil below the soil surface limits exposure to solar radiation while extensive lateral spreading of oil over impermeable or rocky surfaces may promote substantial photo-oxidative degradation.

The oxygenated products of photo-oxidation are generally more water-soluble than the parent hydrocarbons and are thus more likely to be leached from soil.

Natural ecosystems have considerable exposure to petroleum hydrocarbons from natural emissions, accidental contamination through oil spills and storage tank leaks, and deliberate application to land in waste disposal activities such as land-farming; therefore, their biodegradation of petroleum hydrocarbons, and several extensive reviews and reports are available. An extensive and diverse group of petroleum hydrocarbon degrading bacteria and fungi are widely distributed in the environment. Although the microbiota of most non-contaminated soils include many naturally occurring hydrocarbon-degrading populations, the addition of petroleum selectively enriches that sector able to adapt and utilize the new substrate. Other environmental factors shown to have a major effect in biodegradability are availability of oxygen and moderate temperatures.

The qualitative hydrocarbon content of petroleum mixtures largely determines their degradability. In general, microorganisms exhibit decreasing ability to degrade aliphatic hydrocarbons with increasing chain length; aromatics are generally more rapidly biodegraded than alkanes. The composition of diesel oil suggests that some of the aromatic species will be biodegradable; biodegradation of the high molecular weight aromatics expected to be present in residual oils will be slower.

In summary, biodegradation of the petroleum hydrocarbons comprising diesel and fuel oils may occur under conditions favorable for microbial activity and when fuel components are freely available to the microorganisms. Degradation may be limited and/or slow in environments with few degrading organisms, low pH, low temperature, and high salinity. It should be mentioned that even under optimum conditions, total and complete biodegradation is not expected to occur except possibly over an extremely long time period.

Primary Routes of Exposure from Soil/Groundwater Systems

The above discussion of fate pathways suggests that pure fuel oils have low vapor pressure but that their components vary in their volatility from water. The components are strongly or very strongly sorbed to soil. The polycyclic aromatic hydrocarbons in fuel oils have a moderate or high potential for bioaccumulation, while the longer-chain aliphatic compounds have low potential for bioaccumulation. These fate characteristics suggest that the various components may have somewhat different potential exposure pathways.

Volatilization of fuel oils from a disposal site or spill would not be expected to result in significant inhalation exposures to workers or residents in the area. Gravity would tend to carry bulk quantities of the oil down towards the water table leaving only a relatively small fraction on the soil surface to volatize. Volatilization of the remaining oil would occur very slowly because of its low vapor pressure, especially for the heavier weight fuel oils, and because of strong sorption to soil.

Groundwater contamination may result from large spills that reach the water table. There, the more soluble components will dissolve in the groundwater or form emulsions with it. The soluble fraction is mainly aromatic and lower molecular weight aliphatic compounds. In one study using No. 2 fuel oil, 40% of the water soluble fraction was made up of aromatic compounds composed of 11 carbon atoms and 25% each of compounds containing 10 and 12 carbon atoms. The hydrocarbons dissolved in the groundwater may move hundreds to thousands of meters. By comparison, the undissolved fraction, which floats on the surface of the water table as a separate phase, would be expected to move only tens of meters, unless cracks or fissures were present.

The movement of fuel oil components in groundwater may contaminate drinking water supplies, resulting in ingestion exposures. Groundwater discharges to surface water or the movement of contaminated soil particles to surface water drinking water supplies may also result in ingestion exposures and in dermal exposures from the recreational use of these waters. The potential also exists for the uptake of polynuclear aromatic compounds in fuel oil (e.g., naphthalene, methylnaphthalene and higher weight PAHs) by fish and domestic animals, which may also result in human exposures. Exposures to high concentrations of fuel oil components in drinking water and food are expected to be rare because tainting becomes apparent at relatively low concentrations.

Volatilization of fuel oil hydrocarbons in soil is another potential source of human exposure. Despite their relatively low vapor pressure, the more volatile components of fuel oil in soil evaporate, saturating the air in the soil pores, and diffusing in all directions including upward to the surface. The vapors may diffuse into basements of homes or other structures in the area, resulting in inhalation exposures to the building's occupants. Exposures may be more intensive when the soil is contaminated from leaking underground storage tanks and pipes, rather than from surface spills, because the more volatile components do not have an opportunity to evaporate before penetrating the soil. Even then, this exposure pathway is expected to be much less important for fuel oils than for more volatile petroleum products like gasoline.

3.1.3.6 Explosive Compounds

Table 3-7 presents the information which will serve as a basis for understanding the likely environmental fate of explosives at SEDA. The chemical class of the compounds identified in Table 3-7 is considered to be semivolatile. This is based upon the high molecular weights of these compounds and their low vapor pressures, typical of most semivolatile compounds. The most volatile of the five explosives considered at this site is 2,6-dinitrotoluene (2,6 DNT), with a vapor pressure of 0.018 millimeters mercury (mm Hg). Compared to benzene, a volatile compound which has a vapor pressure of 95.2 mm Hg, it is apparent that volatilization of this compound is expected to be low, especially in soil which have a high clay content. Soil with a high clay content generally has a high, i.e. >50%, ratio of water filled to air filled porosity, therefore, there is a small amount of air space through which vapor can migrate. Compounds such as RDX and HMX have extremely low vapor pressures and would not volatilize through the soil. Consequently, volatilization of RDX and HMX are not expected to represent a significant environmental pathway.

The potential for explosives to leach to the groundwater is a complicated consideration and influenced by many factors such as solubility, cation exchange capacity, clay content and percolation rate. For this evaluation, solubility has been considered as the most representative parameter for leaching potential. Of the six explosives considered, the most soluble of the explosives are the di- and trinitrotoluenes. Their solubilities range from approximately 130 mg/l to 270 mg/l. These are similar to the solubilities of organic hydrocarbons such as toluene, (500 mg/l), or the xylenes, (150 mg/l). This range of solubilities is considered to represent a moderate degree of leaching potential. Compounds which would represent a high degree of leachibility, i.e., high solubility, would be methylene chloride, (20,000 mg/l), benzene (1780 mg/l) and TCE, (1100 mg/l). The solubilities of HMX and RDX are approximately four times less than that for the di- and trinitrotoluenes and therefore represent a smaller potential for leaching.

A review of the melting points of these compounds indicates that explosives are solids at room temperature and therefore would not migrate through soil as separate liquid phases. Instead, as precipitation interacts with these solid residues a small portion would dissolve or erode away. Complete leaching would require a long interaction period.

Field studies have confirmed the long-term potential for leaching of explosives into the groundwater. An evaluation of the critical parameters affecting the migration of explosives through soil indicated that at a former propellant manufacturing facility, 2,4-DNT leached from soil contaminated with smokeless powder for over 35 years after cessation of operations (USATHAMA, 1985). At another facility, leaching of 2,4-DNT into groundwater from former burning grounds has been documented to occur for as long as 10 years after operations had been discontinued.

Another factor to examine is the tendency of explosives compounds to adsorb to the soil. The compounds considered in this evaluation show K_{oc} values which range from approximately 100 to 500 mL/g. The SEDA site soil has been shown to possess a high percentage of fines including clay, thereby increasing the sorption potential of these compounds to the soil. As shown in Table 3-2, for the range of K_{oc} exhibited by explosives, i.e., 100-500 mL/g, these compounds would be considered intermediately mobile.

Environmental degradation of these parent organic compounds has been shown to occur by various investigators. The information available on this subject is substantial and a detailed discussion is beyond the scope of this document. However, a review of the available information indicates that nitroaromatics and nitroamines are susceptible to environmental transformations. Since some of the byproducts of these transformations may be environmentally persistent, there is a potential for concern.

Much of the available research has been conducted on the environmental transformation of TNT. A summary of the identified breakdown products resulting from environmental degradation of TNT and 2,4-DNT is presented in the Generic Installation RI/FS Workplan. The environmental fate of RDX is less defined than that of the other two compounds previously mentioned. An overview of the expected degradation pathways and the byproducts produced as a result of the environmental degradation of RDX is also presented in the Generic Installation RI/FS Workplan. Clearly, the breakdown byproducts which have been identified are diverse. Analytical methods have only recently been developed which are capable of accurately detecting these compounds. The widespread application of these analytical techniques are greatly limited by the availability of standards which are essential for the analyses. Responding to the need for accurate analytical procedures and recognizing that standards for every breakdown product are not available, USATHAMA has developed Method 8330. This method is intended for the analysis of explosive residues in water, soil and sediment.

3.2 PRELIMINARY IDENTIFICATION OF POTENTIAL RECEPTORS AND EXPOSURE SCENARIOS

This section will identify the source areas, release mechanisms, potential exposure pathways and the likely human and environmental receptors at SEAD-52 and SEAD-60 based upon the results of their conceptual site models, which were described in the previous section.

This section discusses the current understanding of site risks for each site based upon the data gathered from the Limited Sampling Program conducted at SEAD-52 and the ESI conducted at SEAD-60. This information is used to assess whether sources of contamination, release mechanisms, exposure routes and receptor pathways developed in the conceptual site model for each site are valid or if they may be eliminated from further consideration prior to conducting a risk assessment. Additionally, this information will determine what data are necessary to develop a better conceptual understanding of each site, in order that risk to human health and the environment can be determined, Applicable or Relevant and Appropriate Requirements (ARARs) can be defined and appropriate remedial actions can be developed.

This is a generic discussion. The future use scenario and the required degrees of cleanup will be proposed on a site-by-site basis as part of each feasibility study. The future plans for each site will be taken into account at that time.

As of early July 1995, the Base Realignment and Closure Act (BRAC) Commission voted to recommend closure of SEDA. The President and Congress have approved the recommendations, which became public law on October 1, 1995. According to BRAC regulations, future use of the sites will be determined by the Army and the Army will perform any additional investigations and remedial actions to assure that any change in intended land use is protective of human health and the environment.

At this time, the specific details for closure procedures, projected timetables of closure, discussion of the Army's future intention for the sites, and detailed account of notification methods to prospective purchasers are unavailable for inclusion in this Workplan.

3.2.1 SEAD-52

3.2.1.1 Potential Source Areas and Release Mechanisms

Based upon historical knowledge, the primary contaminant source area for SEAD-52 would be soil impacted by explosives resulting from handling of the ammunition powder and cleaning process during the ammunition breakdown.

Potential release mechanisms from these source areas are runoff and erosion to surface water and sediment and infiltration to groundwater. Wind may also release the impacted soil as fugitive dust, but because the area is paved and vegetated, this is not expected to be a significant release mechanism.

3.2.1.2 Potential Exposure Pathways and Receptors - Current Uses

The potential exposure pathways from sources to receptors based upon current and future use scenarios are shown in Figure 3-6. The potential for human exposure is directly affected by the accessibility to the site. Since SEAD-52 is within the Ammunition Breakdown Area, access is restricted.

There are two primary receptor populations for potential releases of contaminants from the Ammunition Breakdown Area near Buildings 608, 610, 611, and 612 at SEAD-52:

1. Current site workers and visitors to the site; and
2. Terrestrial biota on or near the Ammunition Breakdown area.

Ingestion and Dermal Exposure Due to Surface Water and Sediment

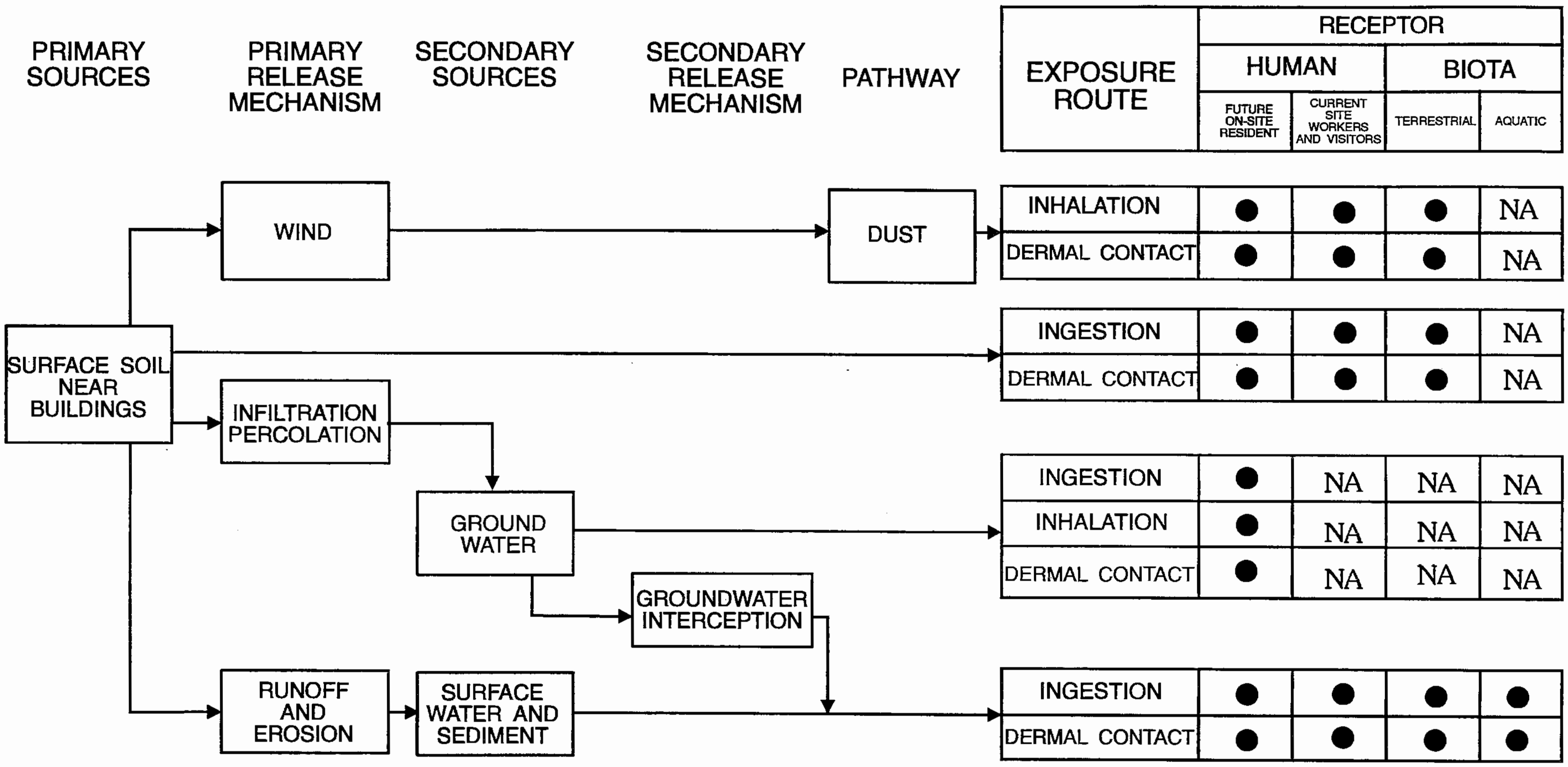
Current site workers and visitors could be exposed by way of ingestion or dermal contact to surface water or sediment in the drainage ditches. Terrestrial biota that ingest or come in contact with surface water or sediment in the drainage ditches may be exposed. Aquatic biota in the drainage ditches may also be exposed.

Incidental Soil Ingestion and Dermal Contact

Incidental ingestion of, and dermal contact with, impacted soil is a potential exposure pathway for current site workers, visitors, and terrestrial biota.

Groundwater Ingestion, Inhalation, and Dermal Contact

The groundwater at SEAD-52 is not used as a drinking water source. It is not anticipated that there will be direct exposure to the groundwater from the site under current uses to current site workers, visitors, or terrestrial biota.



EXPOSURE ROUTE	RECEPTOR			
	HUMAN		BIOTA	
	FUTURE ON-SITE RESIDENT	CURRENT SITE WORKERS AND VISITORS	TERRESTRIAL	AQUATIC
INHALATION	●	●	●	NA
DERMAL CONTACT	●	●	●	NA
INGESTION	●	●	●	NA
DERMAL CONTACT	●	●	●	NA
INGESTION	●	NA	NA	NA
INHALATION	●	NA	NA	NA
DERMAL CONTACT	●	NA	NA	NA
INGESTION	●	●	●	●
DERMAL CONTACT	●	●	●	●

●	PATHWAY CONSIDERED TO POSE POTENTIAL RISK
NA	NOT APPLICABLE RECEPTOR

PARSONS

PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT ACTIVITY
RI/FS PROJECT SCOPING PLAN
SEAD-52 AMMUNITION BREAKDOWN AREA

DEPT. ENVIRONMENTAL ENGINEERING

DWG NO. 726510-02001

FIGURE 3-6

EXPOSURE PATHWAY SUMMARY

SCALE NA

DATE JULY 1995

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Dust Inhalation and Dermal Contact

Contaminated fugitive dust may be released from SEAD-52 due to high winds, vehicle traffic through the area, or disturbance of the soil during site use. The receptors of fugitive dust releases by way of inhalation and dermal contact are current site workers, visitors, and terrestrial biota. Because the site is vegetated and paved, the amount of fugitive dust is not expected to be significant.

3.2.1.3 Potential Exposure Pathways and Receptors - Future Uses

Under current site conditions, access to the site is limited. While strict land use control cannot be assured in future uses, limitations may be imposed through zoning restrictions or deed restrictions. Potential future uses of the site include light industrial and unrestricted residential or other private development.

For future uses of SEAD-52, the receptor population that would differ from the above-mentioned receptors would be on-site residents. For the ingestion of soil, surface water, and sediment, and dermal contact with surface water and sediment, the receptors would be primarily children. Dermal contact with soil; ingestion of, inhalation of, and dermal contact with groundwater; and inhalation of and dermal contact with fugitive dust are potential exposure pathways for any future on-site residents.

The numerical assumptions that will be used in the risk assessment for the future use exposure scenario are listed in Table 4-1 of the Generic Installation RI/FS Workplan.

3.2.2 SEAD-60

3.2.2.1 Potential Source Areas and Release Mechanisms

SEAD-60 is the location of oil-stained soil near the southwestern corner of Building 609. The primary release mechanisms from the oil-stained soil are surface water runoff and infiltration of precipitation. Wind is also a primary release mechanism from the oil-stained soil. Groundwater, surface water, and sediment are secondary sources. Groundwater interception of surface water is a secondary release mechanism.

3.2.2.2 Potential Exposure Pathways and Receptors - Current Uses

The complete potential exposure pathways from sources to receptors based upon current and future use scenarios, are shown in Figure 3-7. The potential for human exposures, with the exception of fugitive dust, is directly affected by the accessibility to the site. Human and vehicular access to the site is restricted since SEAD-60 is located within the confines of the ammunition storage area.

There are three primary receptor populations that could be affected by potential releases of contaminants from SEAD-60:

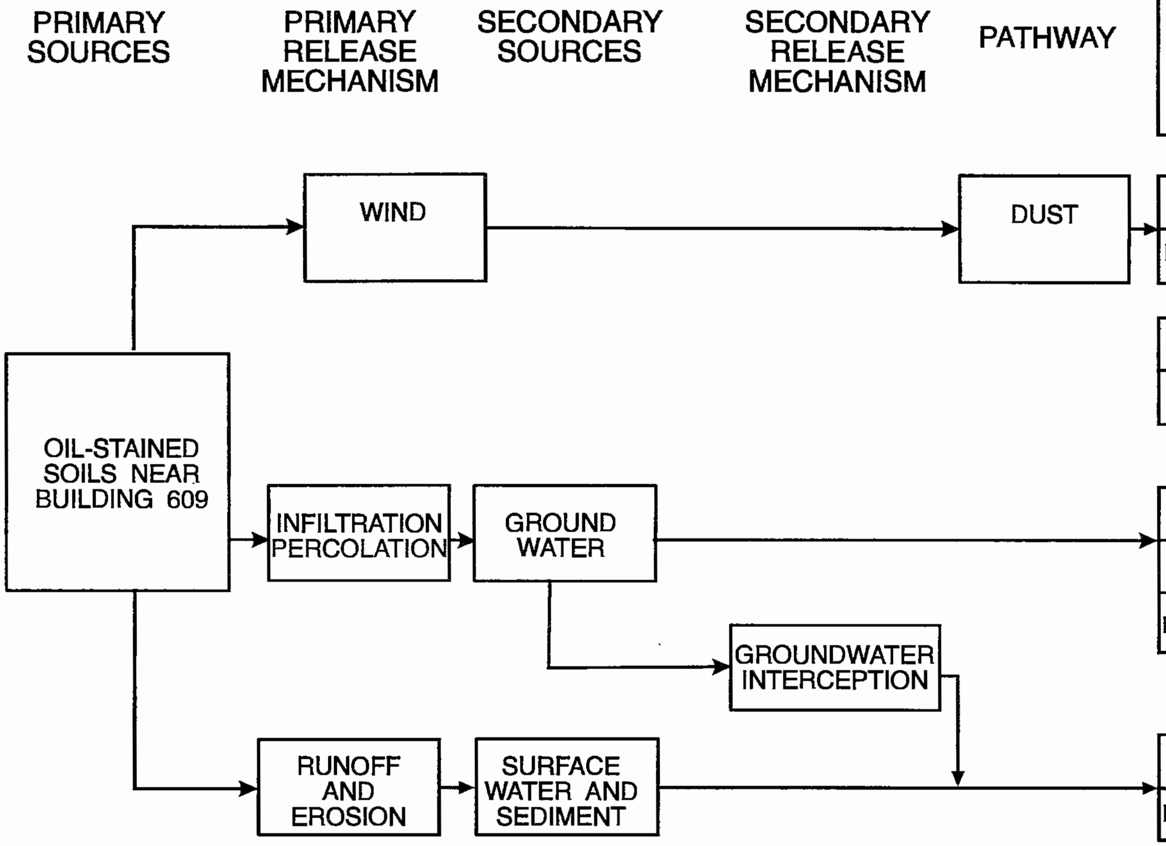
- Future on-site residents
- Current site workers
- Terrestrial biota on or near the oil stained area.

The exposure pathways and media of exposure are described below as they may affect the various receptors.

The numerical assumptions that will be used in the risk assessment for the current uses exposure scenario are listed in Table 4-1 of the Generic Installation RI/FS Workplan.

Ingestion and Dermal Exposure Due to Surface Water Runoff and Erosion

The oil-spill area is located at the upgradient end of a drainage ditch that parallels a set of SEDA railroad tracks and leads to a somewhat larger, east-west trending drainage ditch located approximately 300 feet from Building 609. Based on topographic expression, the oil-spill area would be expected to receive surface water runoff via overland flow from areas to the east, south and west. This water is funneled into the elongated drainage ditch that eventually leads to a larger drainage ditch north of the site. Thus, there is a potential for surface waters and sediment to be impacted by the oil and transported away from the site. These two ditches are ephemeral, and any transport of oil-impacted surface water and sediment to the ditches would likely occur during precipitation or spring snow melt events via overland flow. Due to these events, the ditches may fill with water for extended periods of time.



EXPOSURE ROUTE	RECEPTOR			
	HUMAN		BIOTA	
	FUTURE ON-SITE RESIDENT	CURRENT SITE WORKERS	TERRESTRIAL	AQUATIC
INHALATION	●	●	●	NA
DERMAL CONTACT	●	●	●	NA
INGESTION	●	●	●	NA
DERMAL CONTACT	●	●	●	NA
INGESTION	●	NA	NA	NA
INHALATION	●	NA	NA	NA
DERMAL CONTACT	●	NA	NA	NA
INGESTION	●	●	●	NA
DERMAL CONTACT	●	●	●	NA

● PATHWAY CONSIDERED TO POSE POTENTIAL RISK

NA NOT APPLICABLE RECEPTOR

PARSONS
PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE
SENECA ARMY DEPOT ACTIVITY
RI/FS PROJECT SCOPING PLAN
SEAD-60 OIL DISCHARGE ADJACENT TO BUILDING 609

DEPT. ENVIRONMENTAL ENGINEERING
DWG NO. 727651-02009

FIGURE 3-7
EXPOSURE PATHWAY SUMMARY
FOR SEAD-60

SCALE NA
DATE JULY 1995

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The primary human receptors of the surface water and sediment impacts are current site workers, who could experience dermal exposure from walking in the drainage ditch near the spill area, but they would be considered to have an unlikely risk of exposure from ingesting surface water or sediment. Terrestrial biota that ingest and come in contact with the impacted surface water bodies (e.g., water-filled drainage ditches) may also be affected.

Incidental Soil Ingestion and Dermal Contact

Incidental ingestion of soil is a potential exposure pathway for current site workers and terrestrial biota. During the course of work activities conducted at the site, a SEDA worker may, on occasion, involuntarily ingest and/or make dermal contact with contaminated surficial soils. This exposure pathway assumes that during the course of a work day involuntary ingestion of the surficial soil occurs, therefore this pathway is considered to pose a risk of exposure to visitors to the site.

Dermal contact with soil is a potential exposure pathway for current site workers and terrestrial biota.

Ingestion of Groundwater and Dermal Contact

Ingestion of groundwater and dermal contact are not potential exposure pathways for current site workers or terrestrial biota. The groundwater beneath the oil-stained soil adjacent to Building 609 is currently not used as a drinking water source and connection to other potable groundwater aquifers has not been demonstrated. It is not anticipated that there would be direct exposure to the groundwater from the site under current uses to site workers and terrestrial biota. Groundwater beneath the site flows to the west-northwest. The potential groundwater contribution to the surface water (i.e., water-filled drainage ditches) during periods of high groundwater could result in the exposures identified for surface water and sediments above.

Dust Inhalation and Dermal Contact

Inhalation of and dermal contact with dust are considered to be potential exposure pathways for site workers and terrestrial biota.

3.2.2.3 Potential Exposure Pathways and Receptors - Future Uses

For future uses of SEAD-60, the receptor population that would be included in addition to the above-mentioned receptors would be on-site residents. For the ingestion of soils, surface water, and sediment, the primary receptors would be children. Dermal contact with soil is a potential exposure pathway for future on-site adults and children; ingestion of groundwater is a potential route of exposure to all future on-site residents assuming on-site groundwater is used as their water supply. Inhalation and dermal contact of fugitive dust is also a potential route of exposure for any on-site future residents.

The numerical assumptions that will be used in the risk assessment for the future uses exposure scenario are listed in Table 4-1 of the Generic Installation RI/FS Workplan.

3.3 SCOPING OF POTENTIAL REMEDIAL ACTION ALTERNATIVES

Remedial action alternatives for each site will be formed during the FS process from the general response actions and process options for each medium or operable unit. Depending on the site, two categories of alternatives will be assembled; the two categories are designated as source control and migration control. A number of remedial action alternatives, which are available for the treatment of soils impacted by semivolatile organics, metals, and explosives at the sites, will be considered during the development of remedial action alternatives. They include the following technologies:

- land treatment
- bioventing
- vapor extraction
- off-site disposal
- soil washing
- low temperature thermal desorption
- composting

Section 3.3.2 of the Generic RI/FS Workplan provides a description of each type of technology.

A comprehensive list of remedial response action alternatives as they pertain to SEDA is provided in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan.

3.4 PRELIMINARY IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Identification and refinement of ARARs will be performed during the RI/FS process. As additional data is collected regarding the nature and extent of contamination, site specific conditions, and potential use of various remedial technologies, additional ARARs will be selected and existing ARARs will be reviewed for their applicability. These data will be reported within the SEAD-52 and SEAD-60 RI/FS Report.

A preliminary identification of ARARs has been performed based upon the initial site characterization data compiled by the Army. The following federal and state regulatory requirements are potentially applicable or relevant and appropriate to SEAD-52 and SEAD-60.

SOURCES OF CHEMICAL SPECIFIC ARARS

Federal:

- Resource Conservation and Recovery Act (RCRA), Groundwater Protection Standards and Maximum Concentration Limits (40 CFR 264, Subpart F)
- Clean Water Act, Water Quality Criteria (Section 304) (May 1, 1987 - Gold Book)
- Safe Drinking Water Act, Maximum Contaminant Levels (MCLs) (40 CFR 141.11-.16)

New York State:

- New York State Codes, Rules and Regulations (NYCRR) Title 6, Chapter X
- New York Groundwater Quality Standards (6 NYCRR 703)
- New York Safe Drinking Water Act, Maximum Contaminant Levels (MCLs) (10 NYCRR 5)

- New York Surface Water Quality Standards (6 NYCRR 702)
- New York State Raw Water Quality Standards (10 NYCRR 170.4)
- New York RCRA Groundwater Protection Standards (6 NYCRR 373-2.6 (e))
- New York State Department of Environmental Conservation, Division of Water, Technical and Operational Guidance Series (1.1.1), Ambient Water Quality Standards and Guidance Values, November 15, 1990
- Surface Water and Groundwater Classifications and Standards (6 NYCRR 700-705)
- Declaration of Policy, Article 1 Environmental Conservation Law (ECL)
- General Functions, Powers, Duties and Jurisdiction, Article 3 Environmental Conservation Law, Department of Environmental Conservation
- ECL, Protection of Water, Article 15, Title 5.
- Use and Protection of Waters, (6 NYCRR, Part 608)

SOURCES OF LOCATION SPECIFIC ARARS

Federal:

- Executive Orders on Floodplain Management and Wetlands Protection (CERCLA Floodplain and Wetlands Assessments) #11988 and 11990
- National Historic Preservation Act (16 USC 470) Section 106 et seq. (36 CFR 800) (Requires Federal agencies to identify all affected properties on or eligible for the National Register of Historic Places and consult with the State Historic Preservation Office and Advisory Council on Historic Presentation)
- RCRA Location Requirements for 100-year Floodplains (40 CFR 264.18(b)).
- Clean Water Act, Section 404, and Rivers and Harbor Act, Section 10, Requirements for Dredge and Fill Activities (40 CFR 230)

- Wetlands Construction and Management Procedures (40 CFR 6, Appendix A).
- USDA/SCS - Farmland Protection Policy (7CFR 658)
- USDA Secretary's memorandum No. 1827, Supplement 1, Statement of Prime Farmland, and Forest Land - June 21, 1976.
- EPA Statement of Policy to Protect Environmentally Significant Agricultural Lands - September 8, 178.
- Farmland Protection Policy Act of 1981 (FPPA)(7 USC 4201 et se q).
- Endangered Species Act (16 USC 1531).
- Wilderness Act (16 USC 1131).

New York State:

- New York State Freshwater Wetlands Law (ECL Article 24, 71 in Title 23).
- New York State Freshwater Wetlands Permit Requirements and Classification (6 NYCRR 663 and 664).
- New York State Floodplain Management Act and Regulations (ECL Article 36 and 6 NYCRR 500).
- Endangered and Threatened Species of Fish and Wildlife Requirements (6 NYCRR 182).
- New York State Flood Hazard Area Construction Standards.

SOURCES OF ACTION SPECIFIC ARARS

Federal:

- RCRA Subtitle C Hazardous Waste Treatment Facility Design and Operating Standards for Treatment and Disposal systems, (i.e., landfill, incinerators, tanks, containers, etc.) (40 CFR 264 and 265); Minimum Technology Requirements.

- RCRA, Subtitle C, Closure and Post-Closure Standards (40 CFR 264, Subpart G).
- RCRA Groundwater Monitoring and Protection Standards (40 CFR, Subpart F).
- RCRA Generator Requirements for Manifesting Waste for Offsite Disposal (40 CFR 262).
- RCRA Transporter Requirements for Off-Site Disposal (40 CFR 263).
- RCRA, Subtitle D, Non-Hazardous Waste Management Standards (40 CFR 257).
- Safe Drinking Water Act, Underground Injection Control Requirements (40 CFR 144 and 146).
- RCRA Land Disposal Restrictions (40 CFR 268) (On and off-site disposal of excavated soil).
- Clean Water Act, - NPDES Permitting Requirements for Discharge of Treatment System Effluent (40 CFR 122-125).
- Effluent Guidelines for Organic Chemicals, Plastics and Resins (Discharge Limits) (40 CFR 414).
- Clean Water Act Discharge to Publically - Owned Treatment Works (POTW) (40 CFR 403).
- DOT Rules for Hazardous Materials Transport (49 CFR 107, 171.1-171.500).
- Occupational Safety and Health Standards for Hazardous Responses and General Construction Activities (29 CFR 1904, 1910, 1926).
- SARA (42 USC 9601)
- OSHA (29 CFR 1910.120)
- Clean Air Act (40 CFR 50.61)

New York State:

- New York State Pollution Discharge Elimination System (SPDES) Requirements (Standards for Stormwater Runoff, Surfacewater, and Groundwater discharges (6 NYCRR 750-757).

- New York State RCRA Standards for the Design and Operation of Hazardous Waste Treatment Facilities (i.e., landfills, incinerators, tanks, containers, etc.); Minimum Technology Requirements (6 NYCRR 370-373).

- New York State RCRA Closure and Post-Closure Standards (Clean Closure and Waste-in-Place Closures) (6 NYCRR 372).

- New York State Solid Waste Management Requirements and Siting Restrictions (6 NYCRR 360-361), and revisions/enhancements effective October 9, 1993.

- New York State RCRA Generator and Transporter Requirements for Manifesting Waste for Off-Site Disposal (6 NYCRR 364 and 372).

3.5 DATA QUALITY OBJECTIVES (DQOs)

The RI/FS process requires decisions regarding future site remedial actions, including whether or not any actions are required. These decisions will be based upon the data collected during the RI. Consequently, the collected data must be of sufficient quantity and quality to support this decision-making process. Data Quality Objectives (DQO)s are the portion of the RI/FS which consider issues related to data quality and quantity. As the name implies, DQOs establish objectives and requirements for data collection which, if reasonably met, will assure that the collected data is valid for its intended use.

Since the intended use of the data is to support several decisions for the RI/FS process, the first step in establishing DQOs is to identify these decisions. Once the decisions, which the collected data will support, have been identified, the levels of data quality can be specified. The sampling program and the analytical techniques to be employed must be consistent with the required levels of data quality. For the three sites described in this Scoping Plan these decisions have been identified and include the following:

- Determining the nature and extent of current environmental impacts;
- Monitoring for health and safety;

- Assessing the risk to human health and the environment;
- Selecting appropriate remedial alternatives;
- Designing remedial actions, if necessary;
- Determining background levels of constituents of concern; and
- Determining regulatory compliance with ARARs.

USEPA has indicated that at a minimum, Level 3 quality data should be collected to support many of the decisions to be made at these sites, such as Risk Assessment. However, in order to meet the requirements of New York State, samples for metals in soils/sediments and surface water/groundwater will be collected and analyzed according to NYSDEC CLP protocols and the data reported as Level 4. Specifying Level 4 quality data will assure that the data collected in this program is of sufficient quality for the intended use.

Level 4 data will be generated by analyses performed in the Contract laboratory Program (CLP). Routine Analytical Services (RAS) will be performed according to methods established by the USEPA and the CLP Statement of Work (SOW). The New York State Department of Environmental Conservation (NYSDEC) has also established CLP Protocols for routine analyses with requirements that are considered equivalent to the USEPA requirements for Level 4 data. Level 4 analyses are characterized by rigorous QA/QC requirements defined in the SOW. The data package submittal from the laboratory contains all the raw data generated in the analyses, including mass spectral identification charts, mass spectral tuning data, spike recoveries laboratory duplicate results, method blank results, instrument calibration, and holding times documentation.

Level 1 data, defined as field screening data, will be collected during soil boring operations. Precision and accuracy for Level 1 data has not been established by USEPA. The intended use of this information is for health and safety monitoring and to assist in the optimization of sampling locations. Data can be generated regarding the presence or absence of certain contaminants (especially volatile organic compounds, VOCs), at sampling locations. For these sites, the soils obtained from the split-spoon sampler will be screened for the presence of volatile organics using a hand-held instrument equipped with a Photoionization Detector (PID). The occurrence of high readings, above normal background levels, from a sampling location will provide a qualitative indication that volatiles are present and, therefore, samples collected from this location should be subjected to more rigorous analytical techniques.

Level 2 data will be collected during the microwell screening program at SEAD-60. Level 2 data will include field analyses which require the use of portable analytical instruments at the site without the extensive QA/QC of the higher level of data quality. Depending upon the types of contaminants, sample matrices, and personnel skills, reliable qualitative and quantitative data can be obtained.

Further discussion of the DQOs as they pertain to SEDA is presented in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan.

3.6 DATA GAPS AND DATA NEEDS

3.6.1 SEAD-52

The Limited Sampling Program at SEAD-52 was conducted to gain a preliminary understanding of the nature and extent of impacts to the site from explosive compounds. The data needs for SEAD-52 are a result of the need to meet the DQOs identified in the Generic Installation RI/FS Workplan. By media, these needs are:

Groundwater Data

- Install and sample overburden monitoring wells in the till/weathered shale aquifer. Determine whether groundwater has been impacted by constituents on-site and establish concentrations in the aquifer with collected data.
- In addition to assessing the ground water quality, determine hydrologic properties of the aquifer hydraulic conductivity) to assess contaminant migration and potential remedial actions.
- Establish database to determine compliance with ARARs, to perform baseline risk assessment and to develop remedial action alternatives.

Surface Water/Sediment Data

- Establish potential for contamination of off-site surface water and sediment.
- Assess the sorptive potential of the sediment by performing total organic carbon (TOC) and grain size analysis on sediment samples.
- Establish database to determine compliance with ARARs, to perform baseline risk assessment and to develop remedial action alternatives.

Soil Data

- Verify surface soil sampling results from the Limited Sampling Program.
- Determine the nature and extent of contamination across the site. Collect samples for risk evaluation.

- Establish potential for soil contamination to infiltrate groundwater.
- Assess the sorptive potential of the soil by performing TOC and grain size analysis on soil samples.
- Establish database to determine compliance with ARARs, to perform baseline risk assessment and to develop remedial action alternatives.
- Compare SEAD-52 soil data to site-wide soil background data that has been compiled from 57 background samples obtained from the ESIs performed at 25 SEADs and RIs completed at the OB Grounds and the Ash Landfill.

Ecological Data

- Document visual observations discriminating between obviously and potentially impacted and non-impacted areas. This will determine where and if there is a need for further investigation.
- Establish database to determine compliance with ARARs, to perform baseline risk assessment and to develop remedial action alternatives.

3.6.2 SEAD-60

Investigations conducted during the ESI at SEAD-60 was conducted to gain a preliminary understanding of the nature and extent of contamination. The data collected as part of the ESI were used to evaluate the potential for risks to human health and the environment. A conceptual site model was developed identifying potential source area release mechanisms and receptor pathways. The results of the investigations at SEAD-60 were used to determine additional data requirements for a complete evaluation of risks to human health and the environment, compliance with ARARs and the development of preliminary remedial action alternatives.

The data needs for SEAD-60 are a direct result of the need to meet the DQOs identified in the Generic Installation RI/FS Workplan. By media, these data needs are:

Soil Data

- Obtain additional surface and subsurface soil samples to evaluate the extent of impacted soils. The soil samples will be analyzed for general chemical and physical parameters for risk assessment and evaluation of remedial action alternatives.
- Determine the background soil quality at SEAD-60 to allow comparison to other SEAD-60 soil data.

- Establish a database to determine compliance with ARARs, to perform baseline risk assessment and to develop remedial action alternatives.
- Compare SEAD-60 data to site-wide soil background data that has been compiled from 57 samples obtained from the ESIs performed at 25 SEADs and RIs performed at the OB Grounds and the Ash Landfill.

Groundwater Data

- Determine the hydraulic conductivity of the aquifer to assess the potential for contaminant migration and to select potential remedial action alternatives.
- Install 5 additional monitoring wells.
- Analyze groundwater samples for general chemical parameters to evaluate potential remedial actions.
- Determine the background groundwater quality by obtaining an additional groundwater sample hydraulically upgradient from the present background monitoring well, to allow comparison to other SEAD-60 groundwater data.
- Obtain additional groundwater samples downgradient of the oil spill area to determine the extent of impacted groundwater. This includes sampling of 3 existing monitoring wells.
- Perform headspace analysis on groundwater samples to determine where a plume of volatiles may be present in the groundwater. Perform microwell sampling and field screening of groundwater samples for BTEX compounds, and position monitoring wells in optimum locations to define the extent of the TPHs in groundwater.
- Establish database to determine compliance with ARARs, to perform baseline risk assessment and to develop remedial action alternatives.

Surface Water/Sediment Data

- Determine extent of impacted sediment by obtaining additional surface water and sediment samples from the drainage swales downstream of the oil spill area.
- Analyze surface water and sediment samples for general chemical parameters to evaluate potential remedial alternatives.
- Establish database to determine compliance with ARARs, to perform baseline risk assessment and to develop remedial action alternatives.

Ecological Data

- Conduct an ecological assessment to systematically document visual observations discriminating between obviously and potentially impacted and non-impacted areas.
- Establish database to determine compliance with ARARs, to perform baseline risk assessment and to develop remedial action alternatives.

4.0 TASK PLAN FOR THE REMEDIAL INVESTIGATION (RI)

This section describes the tasks required for completion of the Remedial Investigation (RI) at SEAD-52 and SEAD-60. These include the following:

- Pre-field Activities
- Field Investigations
- Data Reduction, Interpretation and Assessment
- Data Reporting
- Task Plan Summary

4.1 PRE-FIELD ACTIVITIES

The pre-field activities include the following:

- A site inspection to familiarize key project personnel with site conditions and finalize direction and scope of field activities.
- A comprehensive review of Health & Safety Plan with field team members to ensure that site hazards and preventive and protective measures are completely understood.
- Inspection and calibration of all equipment necessary for field activities to ensure proper functioning and usage.
- A comprehensive review of sampling and work procedures with field team members.
- At SEAD-60, site clearance particularly in the western portion of the site where additional monitoring wells are to be installed.

4.2 FIELD INVESTIGATIONS AT SEAD-52

The following field investigations will be performed to complete the RI at SEAD-52:

- Soil Investigation
- Surface Water and Sediment Investigation
- Groundwater Investigation
- Ecological Investigation
- Surveying

These investigations are described in the following sections.

4.2.1. Soil Investigations

The purpose of the soil investigation program at SEAD-52 is to:

- Determine the extent of surface and subsurface soil impacts exceeding TAGM values,
- Locate areas for potential removal actions,
- Provide database for baseline risk assessment, and
- Provide a database for the feasibility study and scoping of remedial actions.

The sampling program will consist of surface and subsurface soil sampling.

The results of the Limited Sampling Program soil investigation, which was summarized previously in the SWMU Classification Report (Parsons ES, September 1994) and in Section 3.1.1.2.3of this Project Scoping Plan, indicate that the surface soil at SEAD-52 has been impacted by explosives.

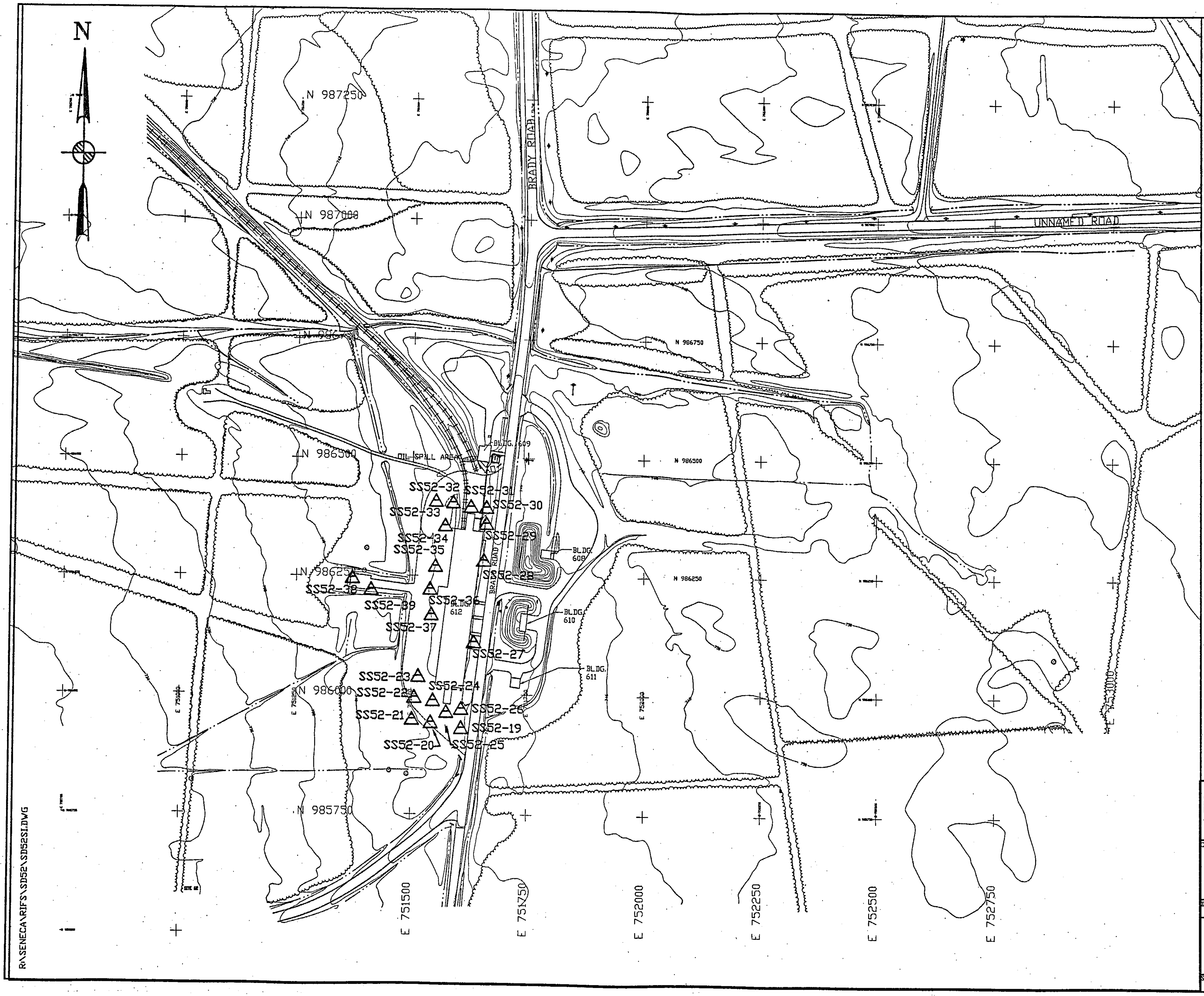
4.2.1.1 Surface Soil Sampling

Figure 4-1 shows the locations of the proposed surface soil samples (0-2") to be collected. A total of 21 surface soil samples will be collected around the perimeter of Building 612 at SEAD-52. These samples are intended to determine if there is a wide distribution of impacts to surface soil at the site. These samples will be spaced approximately 40 feet apart.

Surface soil sampling procedures are described in Appendix A, Field Sampling and Analysis Plan. The samples will be tested according to the analyses specified in Section 4.2.5 Analytical Program.

4.2.1.2 Subsurface Soils Sampling

A total of 12 soil borings will be completed at SEAD-52 as shown in Figure 4-2. Three (3) of the soil borings will be completed as monitoring wells and screened across the aquifer. The purpose of the soil borings will be to observe subsurface soils, to measure bedrock elevation, and to obtain soil samples for chemical analysis. These data will also be used to assess the potential for contaminant migration to groundwater from the soil.



LEGEND

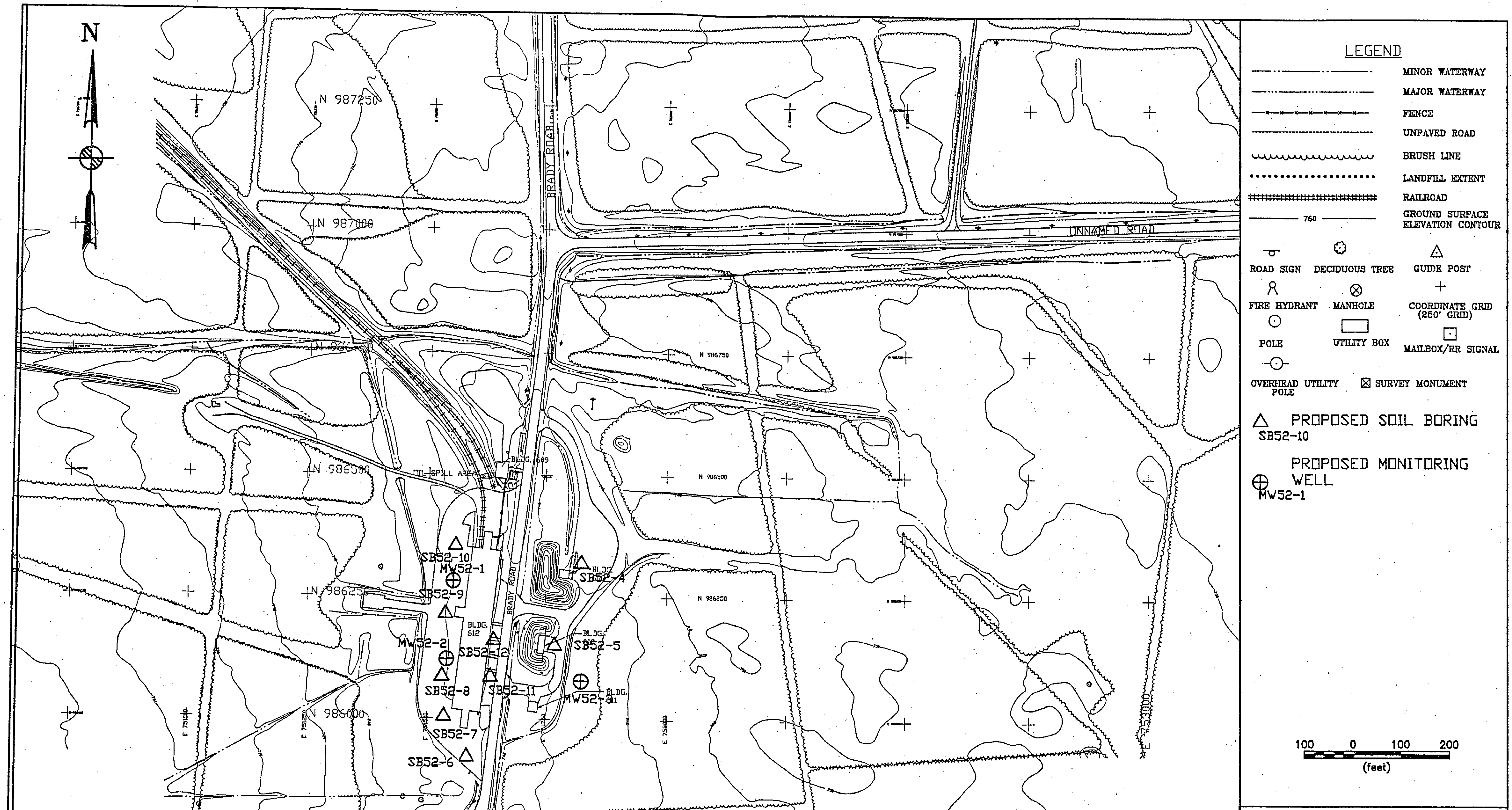
PARSONS
PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE
SENECA ARMY DEPOT ACTIVITY
RI/FS PROJECT SCOPING PLAN
SEAD-52 AMMUNITION BREAKDOWN AREA

DEPT. ENVIRONMENTAL ENGINEERING
Dwg. No.

FIGURE 4-1
LOCATION OF PROPOSED SURFACE SOIL SAMPLES

SCALE 1" = 200'
DATE JULY 1995
REV A



PARSONS

PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT ACTIVITY
RI/FS PROJECT SCOPING PLAN
SEAD-52 AMMUNITION BREAKDOWN AREA

DEPT.	Dwg. No.
ENVIRONMENTAL ENGINEERING	

FIGURE 4-2
LOCATION OF PROPOSED SOIL
BORINGS AND MONITORING WELLS

SCALE	DATE	REV
1" = 200'	JULY 1995	A

Soil borings will be performed by the continuous split-spoon method. Samples will be collected every two feet from the ground surface to the bottom of the boring. At each boring location a 0-2" surface soil sample will be collected and submitted for chemical testing. Two subsurface soil samples will also be collected from each soil boring to be submitted for chemical testing. The criteria for the selection of the subsurface soil samples submitted to the lab for chemical testing is provided in Appendix A, Field Sampling and Analysis Plan. Each soil boring will be drilled until auger refusal is encountered. Auger refusal for this project is defined in Appendix A, Field Sampling and Analysis Plan.

Additional soil samples will be collected from two soil boring locations and analyzed for grain size, total organic carbon, cation exchange capacity, pH, and density. The two soil borings will be chosen at random from the twelve soil borings that are proposed. At the chosen soil boring locations, three samples will be collected: one from near the surface, one from below the water table and one intermediate sample.

4.2.1.3 **Soil Sampling Summary**

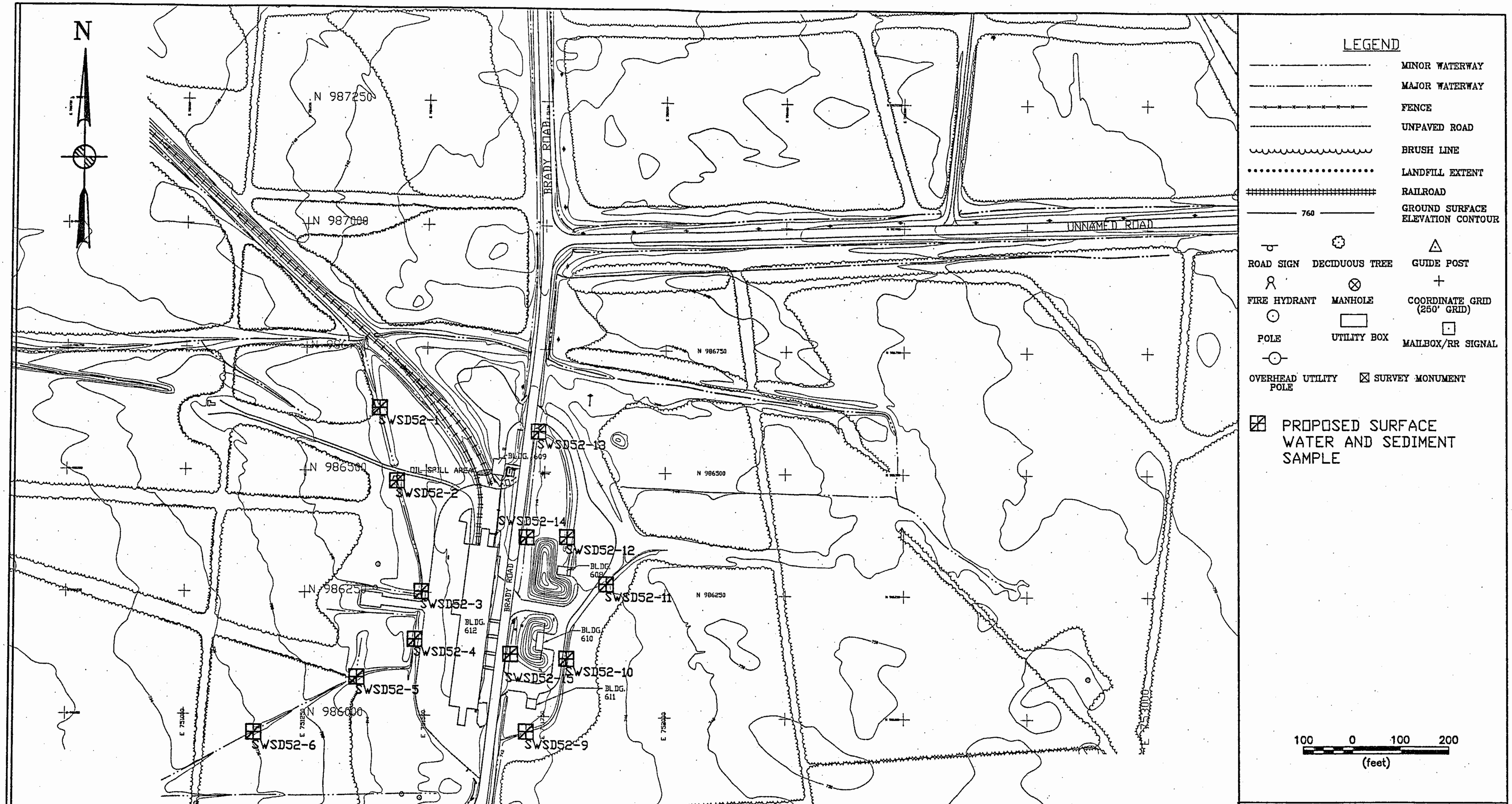
A total of twenty-four (24) subsurface soil samples will be collected from the 12 soil borings. Thirty-three (33) surface soil samples will be collected. Twenty-one (21) will be collected around the perimeter of Building 612 and twelve (12) will be collected from each soil boring location. The soil sampling procedures are described in Appendix A, Field Sampling and Analysis Plan.

The soil samples will be tested according to the analyses specified in section 4.2.5, Analytical Program.

4.2.2 **Surface Water and Sediment Investigation**

Surface water and sediment samples will be collected in areas of SEAD-52 that have the potential for acting as an exposure pathway or for transporting contaminants off-site.

A total of fifteen (15) surface water and sediment samples will be collected from the drainage ditches that flow from SEAD-52. The approximate locations of these surface water and sediment samples are shown in Figure 4-3. Surface water and sediment sampling will occur during or immediately after a rainstorm when there is water in the drainage channels.



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CLIENT/PROJECT TITLE

SENECA ARMY DEPOT ACTIVITY
RI/FS PROJECT SCOPING PLAN
SEAD-52 AMMUNITION BREAKDOWN AREA

DEPT. ENVIRONMENTAL ENGINEERING
Dwg. No.

FIGURE 4-3
LOCATION OF PROPOSED
SURFACE WATER/SEDIMENT SAMPLES

SCALE 1" = 200'
DATE JULY 1995
REV A

No standing water bodies are known to exist at SEAD-52, so the site will be carefully inspected for other bodies of water influenced by runoff from SEAD-52. If standing water is located at SEAD-52, up to 2 additional surface water and sediment samples will be collected from these areas.

These data will be used to determine if there is a surface water or sediment exposure pathway at SEAD-52. If concentrations exceeding applicable guidelines are present, the data will be used to perform a baseline risk assessment for this exposure pathway. The surface water and sediment sampling procedures are described in Appendix A, Field Sample and Analysis.

The surface water and sediment samples will be tested according to the analyses described in section 4.2.5, Analytical Program.

4.2.3 Groundwater Investigation

4.2.3.1 Monitoring Well Installation and Sampling

The goals of the groundwater investigation during the RI are to determine the extent of groundwater contamination, to characterize the aquifer and to confirm the groundwater flow direction. To accomplish this, three (3) monitoring wells will be installed at the approximate locations shown in Figure 4-2. All wells will be screened in the saturated overburden overlying the shale bedrock.

The groundwater flow direction was determined to be to the north-northwest at SEAD-60, which is located 150 feet to the north of SEAD-52. Groundwater flow is assumed to be in the same direction at SEAD-52, and this was used as the basis for the proposed locations of the 3 monitoring wells.

Monitoring well installation and development procedures for overburden wells are described in Appendix A, Field Sampling and Analysis Plan. All wells will be properly developed prior to sampling.

Groundwater from the 3 new monitoring wells will be sampled twice and analyzed for the parameters listed in Section 4.2.5. The second round of sampling will occur approximately three months after the first round of sampling. The wells will be sampled using the latest version of the EPA groundwater sampling procedure, which is a low flow pump purging and sampling method.

4.2.3.2 Aquifer Testing

Aquifer testing will be performed at the 3 monitoring wells. In-situ hydraulic conductivity tests will be performed on the monitoring wells using either a rising or falling head test.

Three rounds of water level measurements will be performed. One measurement will take place before well development and the measurement will be used for well development calculations. The remaining two rounds of measurements will be performed before both rounds of groundwater sampling and will be used to construct a groundwater elevation contour map and evaluate seasonal changes in the groundwater flow direction.

Procedures for in-situ conductivity tests and water level measurements are outlined in Appendix A, Field Sampling and Analysis Plan.

4.2.4 Ecological Investigation

The following procedure for the ecological investigation was developed from the New York State Department of Environmental Conservation (NYSDEC) Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites (1994). The purpose of the ecological investigation is to determine if aquatic and terrestrial resources have been affected by a release of contaminants from the site. The investigation will be completed in two parts. The first part will be the site description, which will involve the accumulation of data describing the physical characteristics of the site, as well as the identification of aquatic and terrestrial resources present or expected to be present at the site. The second part will be the contaminant-specific impact analysis, which involves the determination of whether the identified aquatic and terrestrial resources have been impacted by contaminants that have been released at the site. The second part of the ecological investigation is dependent upon the chemical analysis data obtained for the RI.

4.2.4.1 Site Description

The purpose of the site description is to determine whether aquatic and terrestrial resources are present at the site and if they were present at the site prior to contaminant introduction. If they were present prior to contaminant introduction, the appropriate information will be provided to design a remedial investigation of the resources. The information to be gathered includes site maps, descriptions of aquatic and terrestrial resources at the site, the assessment of the value of the aquatic and terrestrial resources, and the appropriate contaminant-specific and site-specific regulatory criteria applicable to the remediation of the identified aquatic and terrestrial resources.

A topographic map showing the site and documented aquatic and terrestrial resources within a two mile radius from the site will be obtained. The aquatic and terrestrial resources of concern are Significant Habitats as defined by the New York State Natural Heritage Program; habitats supporting endangered, threatened or rare species or species of concern; regulated wetlands; wild and scenic rivers; significant coastal zones; streams; lakes; and other major resources.

A map showing the major vegetative communities within a half mile radius of the site will be developed. The major vegetative communities will include wetlands, aquatic habitats, NYSDEC Significant Habitats, and areas of special concern. These covertypes will be identified using the NYSDEC Natural Heritage Program descriptions and classifications of natural communities.

To describe the covertypes at the site, the abundance, distribution, and density of the typical vegetative species will be identified. To describe the aquatic habitats at the site, the abundance and distribution of aquatic vegetation will be identified. The physical characteristics of the aquatic habitats will also be described and will include parameters such as the water chemistry, water temperature, dissolved oxygen content, depth, sediment chemistry, discharge, flow rate, gradient, stream-bed morphology, and stream classification.

The aquatic and terrestrial species that are expected to be associated with each covertype and aquatic habitat will be determined. In particular, endangered, threatened and rare species, as well as species of concern, will be identified. Alterations in biota, such as reduced vegetation growth or quality will be described. Alterations in, or absence of, the expected distribution or assemblages of wildlife will be described.

A qualitative assessment will be conducted evaluating the ability of the area within a half mile of the site to provide a habitat for aquatic and terrestrial species. The factors that will be considered will include the species' food requirements and the seasonal cover, bedding sites, breeding sites and roosting sites that the habitats provide.

The current and potential human use of the aquatic and terrestrial resources of the site and the area within a half mile of the site will be assessed. In addition to assessing this area, documented resources within two miles of the site and downstream of the site that are potentially affected by contaminants will also be assessed. Human use of the resources that will be considered will be activities such as hunting, fishing, wildlife observation, scientific studies, agriculture, forestry, and other recreational and economic activities.

The appropriate regulatory criteria will be identified for the remediation of aquatic and terrestrial resources and will include both site-specific and contaminant-specific criteria.

4.2.4.2 Contaminant-Specific Impact Analysis

Information from the site description developed in Section 4.2.4.1 and from the characterization of the contaminants at the site developed from the results of the RI will be used to assess the impacts of contaminants on aquatic and terrestrial resources. The impact analysis will involve three steps, each using progressively more specific information and fewer conservative assumptions and will depend upon the conclusion reached at the previous step regarding the degree of impact. If minimal impact can be demonstrated at a specific step, additional steps will not be conducted.

Pathway Analysis

A pathway analysis will be performed identifying aquatic and terrestrial resources, contaminants of concern and potential pathways of contaminant migration and exposure. After performing the pathway analysis, if no significant resources or potential pathways are present, or if results from field studies show that contaminants have not migrated to a resource along a potential pathway, the impact on aquatic and terrestrial resources will be considered to be minimal and additional impact analyses will not be performed.

Criteria-Specific Analysis

Presuming that the presence of contaminated resources and pathways of migration of site-related contaminants has been established, the contaminant levels identified in the field investigation will be compared with available numerical criteria or criteria developed according to methods established as part of the criteria. If contaminant levels are below criteria, the impact on resources will be considered to be minimal and additional impact analyses will not be performed. If numerical criteria are exceeded or if they do not exist and cannot be developed, an analysis of the toxicological effects will be performed.

Analysis of Toxicological Effects

The analysis of toxicological effects is based on the assumption that the presence of contaminated resources and pathways of migration of site-related contaminants has been established. The purpose of the analysis of toxicological effects is to assess the degree to which contaminants have affected the productivity of a population, a community, or an ecosystem and the diversity of species assemblages, species communities or an entire ecosystem through direct toxicological and indirect ecological effects.

A number of approaches are available to conduct an analysis of toxicological effects. One or more of the four following approaches will be used to assess the toxicological effects.

- **Indicator Species Analysis**–A toxicological analysis for a indicator species will be used if the ecology of the resource and the exposure scenarios are simple. This approach assumes that exposure to contaminants is continuous throughout the entire life cycle and does not vary among individuals.

- **Population Analysis**–A population level analysis is relevant to and will be used for the evaluation of chronic toxicological effects of contaminants to an entire population or to the acute toxicological effect of contaminant exposure limited to specific classes of organisms within a population.

- **Community Analysis**– A community with highly interdependent species including highly specialized predators, highly competitive species, or communities whose composition and diversity is dependent on a key-stone species, will be analyzed for alternations in diversity due to contaminant exposure.

- **Ecosystem Analysis**–If contaminants are expected to uniformly affect physiological processes that are associated with energy transformation within a specific trophic level, an analysis of the effects of contaminant exposure on trophic structure and trophic function within an ecosystem will be performed. Bioconcentration, bioaccumulation, biomagnification, etc., are concepts that may be used to evaluate the potential effects of contaminant transfer on trophic dynamics.

4.2.5 Analytical Program

A total of 57 soil samples, 6 groundwater samples and 15 surface water and sediment samples will be collected from SEAD-52 for analysis. All of these samples will be analyzed for the following: Target Compound List (TCL) volatile organic compounds, (EPA Method 524.2 on groundwater), SVOCs, pesticides/polychlorinated biphenyls (PCBs), Target Analyte List (TAL) metals and cyanide according to the NYSDEC Contract Laboratory Program (CLP) Statement of Work (SOW), explosive compounds by EPA Method 8330 and nitrate-nitrogen by EPA Method 353.2. Additional analyses to be performed on specific media are provided below.

The 6 groundwater samples will be analyzed for volatile organic compounds by EPA Method 524.2. The 30 surface water samples will also be analyzed for pH, hardness, TOC, total suspended solids, total dissolved solids, alkalinity, ammonia, nitrate/nitrite, phosphate, and turbidity.

The 15 sediment samples will also be analyzed for TOC, grain size distribution (including the distribution within the silt and clay size fractions), cation exchange capacity, pH, and density.

Six (6) subsurface samples from two soil boring locations will be tested for TOC, grain size distribution (including the distribution within the silt and clay size fraction), cation exchange capacity, pH and density.

Quality Assurance/Quality Control (QA/QC) sampling requirements are described in Section 5.3 of Appendix C of the Generic Installation RI/FS workplan.

Analyses for all of the media to be sampled are summarized in Table 4-1. A detailed description of these methods, as well as lists of each compound included in each of the categories is presented in Appendix C, Chemical Data Acquisition Plan.

4.2.6 Handling of UXOs

Due to the danger of unexploded ordnance (UXO) at SEAD-52, UXO personnel will be on-site to monitor the subsurface explorations and sampling. UXO personnel will decide when remote drilling and site clearance will be necessary based on site conditions. The following represents the proposed procedures for handling UXOs and explosives at SEAD-52.

Table 4-1

Summary of Sampling and Analyses
Seneca Army Depot Activity
SEAD-52

MEDIA	VOCs		SVOCs	Pesticides/PCBs	Metals	Explosives	Nitrate-Nitrogen	Grain Size*	pH	Hardness	TOC
	TCL NYSDEC CLP	Method 524.2	TCL NYSDEC CLP	TCL NYSDEC CLP	TAL NYSDEC CLP	Method 8330	Method 353.2	ASTM or Similar Method	Method 150.1	Method 130.2	Method 415.1
Soil Surface	33	0	33	33	33	33	33	0	0	0	0
Subsurface	24	0	24	24	24	24	24	6	0	0	6
Groundwater	0	6	6	6	6	6	6	0	0	0	0
Surface water	15	0	15	15	15	15	15	0	15	15	15
Sediment	15	0	15	15	15	15	15	15	0	0	15

Notes:
1) * Grain size analysis includes determination of the grain size distribution within the silt and clay size fraction.

During drilling operation, a UXO Safety Officer will monitor the work. UXO personnel will also clear areas for field personnel to walk on-site, to obtain surface soil, surface water, sediment, and groundwater samples.

UXO clearance procedures are discussed in detail in Appendix A, Field Sampling and Analysis Plan and Appendix B, Health and Safety Plan.

4.2.7 Surveying

Surveying will be performed at SEAD-52 to provide data to be used for the following purposes:

- Map the direction and compute the velocity of groundwater movement
- Locate all the environmental sampling points
- Serve as the basis for volume estimates of impacted soil and sediment which may require a remedial action
- Map the extent of any impacted groundwater above established ARAR limits.

The location, identification, coördinates and elevations of all the control points recovered and/or established at the site and all of the soil borings, monitoring wells (new and existing) and all surface water and sediment sampling points will be plotted on a topographic map to show their location with respect to surface features within the project area.

Site surveys will be performed in accordance with good land surveying practices and will conform to all pertinent state, federal, and USCOE laws and regulations governing land surveying. The surveyor shall be licensed and registered in the state of New York.

A detailed discussion of the site field survey requirements is presented in Appendix A, Field Sampling and Analysis Plan of the Generic Installation RI/FS Workplan.

4.3 FIELD INVESTIGATIONS AT SEAD-60

The following field investigations will be performed to complete the RI characterization of SEAD-60:

- Geophysical Investigation
- Soil Investigation (soil borings)
- Surface Water and Sediment Investigation
- Groundwater Investigation (microwells, overburden wells)
- Survey of Building 609
- Ecological Investigation
- Analytical Program
- Surveying

These investigations are described in the following sections.

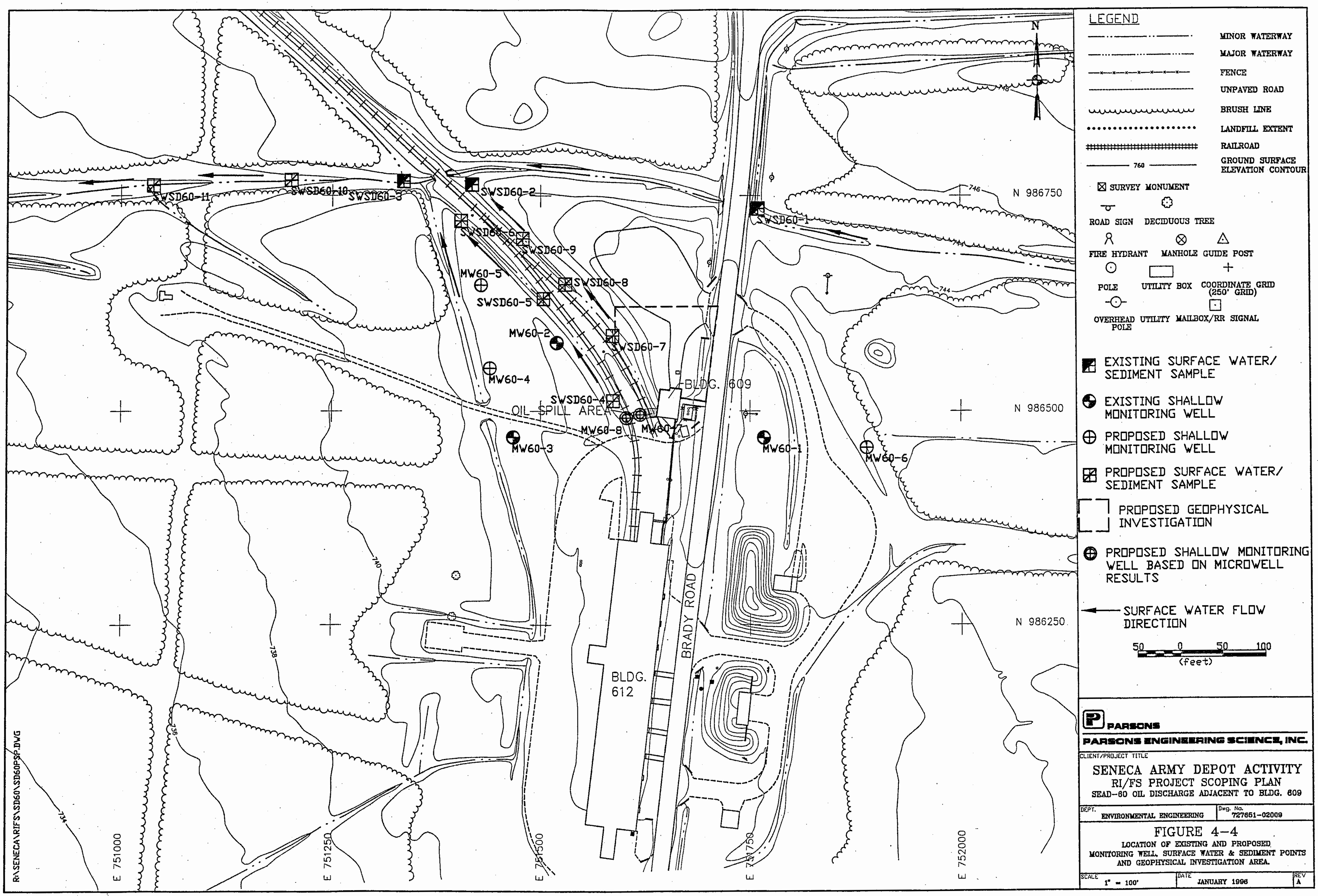
4.3.1 Geophysical Investigation

Metal detector (Fisher TW-6) and Ground Penetrating Radar (GPR) surveys will be performed at SEAD-60 in areas along the perimeter of Building 609 and in the mounded area north of Building 609. The initial geophysical investigation will be a metal detector survey performed along the perimeter of Building 609, and on a 10 by 10 foot grid throughout the mounded area north of Building 609, as shown on Figure 4-4. The objective of the metal detector survey is to identify locations where an underground storage tank(s) and/or piping, possibly associated with the boiler at Building 609, may be buried.

Subsequent to the metal detector survey, a GPR survey will be performed on the same grid as the metal detector survey. GPR data will be collected over each distinct metal detector anomaly in order to provide a better characterization of the suspected metallic source.

4.3.2 Soil Investigation

The soil investigation program will consist of collecting both surface and subsurface soil samples from soil borings in the oil discharge area and surrounding areas. Ten (10) soil borings will be performed at SEAD-60.



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CLIENT/PROJECT TITLE

SENECA ARMY DEPOT ACTIVITY
RI/FS PROJECT SCOPING PLAN
SEAD-60 OIL DISCHARGE ADJACENT TO BLDG. 609

DEPT. ENVIRONMENTAL ENGINEERING

Dwg. No. 727651-02009

FIGURE 4-4

LOCATION OF EXISTING AND PROPOSED MONITORING WELL, SURFACE WATER & SEDIMENT POINTS AND GEOPHYSICAL INVESTIGATION AREA.

SCALE 1" = 100'

DATE JANUARY 1996

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4.3.2.1 Soil Boring Program

A total of ten soil borings will be performed at the locations shown in Figure 4-5. The purpose of the soil borings is to determine the extent of impacted soils in the oil discharge area and adjacent to Building 609, and to obtain soil samples in the oil discharge area and at locations surrounding the oil discharge area for chemical analysis. This data will also be used to assess the potential for infiltration to groundwater as part of the groundwater receptor pathway. One of the soil borings will be completed as a monitoring well.

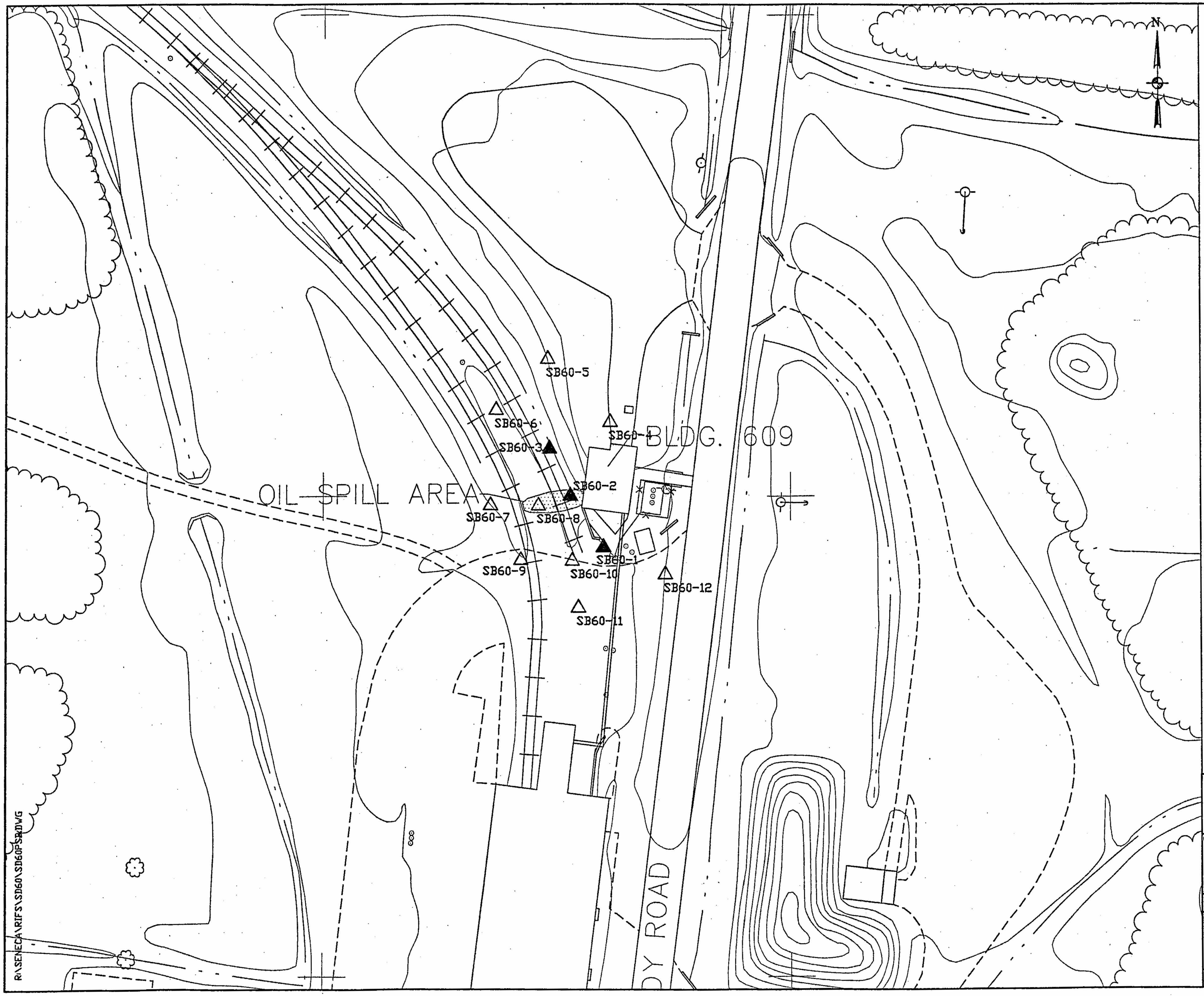
The specific locations of the soil borings are described below. One soil boring, SB60-8, will be drilled within the oil stained area between the two SEDA railroad spurs. One soil boring will be drilled in the background location east of the present background well location (MW60-1), and will be completed as an overburden monitoring well (MW60-6). The remaining 8 soil borings will be drilled at locations surrounding the oil discharge area.

Soil borings will be performed by the continuous split-spoon method. Samples will be collected every two feet from the ground surface to the bottom of the boring. Two subsurface soil samples will be selected from each soil boring to be submitted for chemical testing. At each boring location a 0-2" surface soil sample will be collected and submitted for chemical testing. The criteria for the selection of the subsurface soil samples submitted to the lab for chemical testing is provided in Appendix A, Field Sampling and Analysis Plan.

In addition, soil samples will be collected for limited chemical testing and physical testing at 2 soil boring locations. One location will be in the oil stained area adjacent to Building 609 (SB60-8). The second location will be in the area south of the oil stained area (SB60-10). At each of the two locations, 3 subsurface soil samples (one near the surface, an intermediate sample, and one immediately below the water table or at the bottom of the overburden soils) will be collected.

The soil sampling will be performed until split-spoon refusal is encountered. The soil boring (i.e., augering) will be drilled until auger refusal is reached. Auger refusal for this project is defined in Appendix A, Field Sampling and Analysis Plan.

Soil boring procedures are described in Appendix A, Field Sampling and Analysis Plan.



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RI/FS PROJECT SCOPING PLAN
SEAD-60 OIL DISCHARGE ADJACENT TO BLDG. 609

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FIGURE 4-5
EXISTING AND PROPOSED
SOIL BORING LOCATIONS

SCALE 1" = 50'

DATE JANUARY 1996

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4.3.2.2 Soil Sampling Summary

One (1) surface soil sample and 2 subsurface soil samples will be collected from each of the 10 soil borings. The sampling program will consist of 10 surface soil samples and 20 subsurface soil samples from the 10 soil borings. In total, 30 soil samples will be collected for chemical testing.

In addition, six (6) subsurface soil samples will be collected from two soil borings for physical testing and limited chemical testing.

The soil sampling procedures are described in Appendix A, Field Sampling and Analysis Plan.

The soil samples will be tested according to the analyses specified in section 4.3.7, Analytical Program.

4.3.3 Surface Water and Sediment Investigation

Surface water and sediment sampling will be conducted in areas of SEAD-60 which have the potential for acting as an exposure pathway or for off-site transport of site contaminants.

Potential on-site surface water areas include small drainage swales which traverse the west-northwest portion of SEAD-60 and may act as a drainage pathway during precipitation events.

Six sediment samples will be collected at the on-site locations shown on Figure 4-4. Surface water samples will be collected at the same locations as the sediment samples if there is water present. Two surface water and sediment samples, SWSD60-10 and SWSD60-11, will be collected at off-site locations west and downstream of the ESI surface water and sediment sample location, SWSD60-3.

These data will be used to determine if there is a surface water or sediment exposure pathway at SEAD-60. If concentrations exceeding applicable guidelines are present, the data will be used to perform a baseline risk assessment for this exposure pathway.

The surface water and sediment sampling procedures are described in Appendix A, Field Sample and Analysis.

The surface water and sediment will be tested according to the analyses described in Section 4.3.7, Analytical Program.

4.3.4 Groundwater Investigation

4.3.4.1 Microwell Installation and Sampling

A groundwater screening program will be conducted using 30 microwells. The microwells will be used to more accurately locate the extent of VOCs in the groundwater by placing them in and around the oil discharge area adjacent to Building 609 and the impacted monitoring wells. The microwell installation area is shown on Figure 4-6.

Each microwell will be composed of an AW drilling rod and penetrometer point. The rod and point will be driven at least one (1) foot beyond the depth of the water table, and then the rod will be raised a few inches allowing the penetrometer point to fall out. The groundwater will be permitted to equilibrate within the drill pipe. A sample of the water will be collected using a Teflon tube and transferred to a 40 ml vial. A syringe will be used to collect the vapor in the headspace of the vial for injection into a Photovac 10S50 portable gas chromatograph, which will be calibrated using the appropriate volatile organic standards for BTEX compounds.

Subsequent to the sample collection for the liquid headspace analysis, additional groundwater samples will be collected from the microwells for laboratory analysis of TRPHs, by EPA Method 418.1. Results of the TRPH analysis will be obtained from the laboratory within 48 hours of sample collection. Based upon the results of the headspace and TRPH analyses, two monitoring wells will be installed. One monitoring well will be installed at the sample location with the highest reported TRPH concentration. The other monitoring well will be installed at the toe of the plume, based upon TRPH sample results.

4.3.4.2 Monitoring Well Installation and Sampling

Three groundwater monitoring wells were installed at SEAD-60 as part of the ESI previously conducted on the site; the groundwater flow direction was determined to be to the west. Groundwater samples from the ESI contained TRPH. Volatile organic compounds and metals were either present at low concentrations and/or only a small number of samples exceeded their associated TAGM values. However, the vertical and lateral extents of potential

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DEPT. ENVIRONMENTAL ENGINEERING

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FIGURE 4-6
PROPOSED MICROWELL AND
HEADSPACE ANALYSIS AREA

SCALE 1" = 100'

DATE JANUARY 1996

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contaminant migration from the oil discharge area has not been fully characterized.

The goals of the groundwater investigation during the RI are to verify previous sampling data, determine the extent of impacted groundwater, gather additional potentiometric data to confirm groundwater flow direction, determine background groundwater quality using overburden monitoring wells, and determine hydraulic conductivity. To accomplish this, a total of five monitoring wells will be installed at the approximate locations shown in Figure 4-4. The location of the two monitoring wells, MW60-7 and MW60-8, will be determined based on the results of the headspace and TRPH analyses. The 5 monitoring wells will be continuously sampled to competent bedrock. A monitoring well will then be installed in the boring and screened in the saturated overburden overlying the shale bedrock.

Monitoring well installation and development procedures for overburden wells are described in Appendix A, Field Sampling and Analysis Plan. All wells will be properly developed prior to sampling.

Groundwater from the 8 existing and new monitoring wells will be sampled twice and analyzed for the parameters listed in Section 4.3.7. The second round of sampling will occur apprpoimately three months after the first round of sampling. The wells will be sampled usingthe latest version of the EPA groundwater sampling procedure, which is a low flow pump purging and sampling method.

4.3.4.3 Aquifer Testing

Slug testing will be performed on the 8 wells at SEAD-60 and used to estimate hydraulic conductivity and transmissivity of the overburden aquifer.

Three rounds of water level measurements will be performed. One measurement will take place before well development and the measurement will be used for well development calculations. The remaining two rounds of measurements will be performed before both rounds of groundwater sampling and will be used to construct a groundwater elevation contour map and evaluate seasonal changes in the groundwater flow direction.

Procedures for slug testing and water level measurements are outlined in Appendix A, Field Sampling and Analysis Plan.

4.3.5 Survey of Building 609

A visual inspection survey will be performed in Building 609 to identify any sources which may have contributed to the oil discharge adjacent to Building 609. Vessels, tanks, pipes, floor drains, etc., will be evaluated for their integrity.

4.3.6 Ecological Investigation

The following procedure for the ecological investigation was developed from the New York State Department of Environmental Conservation (NYSDEC) Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites (1994). The purpose of the ecological investigation is to determine if aquatic and terrestrial resources have been affected by a release of contaminants from the site. The investigation will be completed in two parts. The first part will be the site description, which will involve the accumulation of data describing the physical characteristics of the site, as well as the identification of aquatic and terrestrial resources present or expected to be present at the site. The second part will be the contaminant-specific impact analysis, which involves the determination of whether the identified aquatic and terrestrial resources have been impacted by contaminants that have been released at the site. The second part of the ecological investigation is dependent upon the chemical analysis data obtained for the RI.

4.3.6.1 Site Description

The purpose of the site description is to determine whether aquatic and terrestrial resources are present at the site and if they were present at the site prior to contaminant introduction. If they were present prior to contaminant introduction, the appropriate information will be provided to design a remedial investigation of the resources. The information to be gathered includes site maps, descriptions of aquatic and terrestrial resources at the site, the assessment of the value of the aquatic and terrestrial resources, and the appropriate contaminant-specific and site-specific regulatory criteria applicable to the remediation of the identified aquatic and terrestrial resources.

A topographic map showing the site and documented aquatic and terrestrial resources within a two mile radius from the site will be obtained. The aquatic and terrestrial resources of concern are Significant Habitats as defined by the New York State Natural Heritage Program; habitats supporting endangered, threatened or rare species or species of concern; regulated wetlands; wild and scenic rivers; significant coastal zones; streams; lakes; and other major resources.

A map showing the major vegetative communities within a half mile radius of the site will be developed. The major vegetative communities will include wetlands, aquatic habitats, NYSDEC Significant Habitats, and areas of special concern. These covertypes will be identified using the NYSDEC Natural Heritage Program descriptions and classifications of natural communities.

To describe the covertypes at the site, the abundance, distribution, and density of the typical vegetative species will be identified. To describe the aquatic habitats at the site, the abundance and distribution of aquatic vegetation will be identified. The physical characteristics of the aquatic habitats will also be described and will include parameters such as the water chemistry, water temperature, dissolved oxygen content, depth, sediment chemistry, discharge, flow rate, gradient, stream-bed morphology, and stream classification.

The aquatic and terrestrial species that are expected to be associated with each covertype and aquatic habitat will be determined. In particular, endangered, threatened and rare species, as well as species of concern, will be identified. Alterations in biota, such as reduced vegetation growth or quality will be described. Alterations in, or absence of, the expected distribution or assemblages of wildlife will be described.

A qualitative assessment will be conducted evaluating the ability of the area within a half mile of the site to provide a habitat for aquatic and terrestrial species. The factors that will be considered will include the species' food requirements and the seasonal cover, bedding sites, breeding sites and roosting sites that the habitats provide.

The current and potential human use of the aquatic and terrestrial resources of the site and the area within a half mile of the site will be assessed. In addition to assessing this area, documented resources within two miles of the site and downstream of the site that are potentially affected by contaminants will also be assessed. Human use of the resources that will be considered will be activities such as hunting, fishing, wildlife observation, scientific studies, agriculture, forestry, and other recreational and economic activities.

The appropriate regulatory criteria will be identified for the remediation of aquatic and terrestrial resources and will include both site-specific and contaminant-specific criteria.

4.3.6.2 Contaminant-Specific Impact Analysis

Information from the site description developed in Section 4.3.6.1 and from the characterization of the contaminants at the site developed from the results of the RI will be used to assess the impacts of contaminants on aquatic and terrestrial resources. The impact analysis will involve three steps, each using progressively more specific information and fewer conservative assumptions and will depend upon the conclusion reached at the previous step regarding the degree of impact. If minimal impact can be demonstrated at a specific step, additional steps will not be conducted.

Pathway Analysis

A pathway analysis will be performed identifying aquatic and terrestrial resources, contaminants of concern and potential pathways of contaminant migration and exposure. After performing the pathway analysis, if no significant resources or potential pathways are present, or if results from field studies show that contaminants have not migrated to a resource along a potential pathway, the impact on aquatic and terrestrial resources will be considered to be minimal and additional impact analyses will not be performed.

Criteria-Specific Analysis

Presuming that the presence of contaminated resources and pathways of migration of site-related contaminants has been established, the contaminant levels identified in the field investigation will be compared with available numerical criteria or criteria developed according to methods established as part of the criteria. If contaminant levels are below criteria, the impact on resources will be considered to be minimal and additional impact analyses will not be performed. If numerical criteria are exceeded or if they do not exist and cannot be developed, an analysis of the toxicological effects will be performed.

Analysis of Toxicological Effects

The analysis of toxicological effects is based on the assumption that the presence of contaminated resources and pathways of migration of site-related contaminants has been established. The purpose of the analysis of toxicological effects is to assess the degree to which contaminants have affected the productivity of a population, a community, or an ecosystem and the diversity of species assemblages, species communities or an entire ecosystem through direct toxicological and indirect ecological effects.

A number of approaches are available to conduct an analysis of toxicological effects. One or more of the four following approaches will be used to assess the toxicological effects.

- **Indicator Species Analysis**–A toxicological analysis for a indicator species will be used if the ecology of the resource and the exposure scenarios are simple. This approach assumes that exposure to contaminants is continuous throughout the entire life cycle and does not vary among individuals.

- **Population Analysis**–A population level analysis is relevant to and will be used for the evaluation of chronic toxicological effects of contaminants to an entire population or to the acute toxicological effect of contaminant exposure limited to specific classes of organisms within a population.

- **Community Analysis**– A community with highly interdependent species including highly specialized predators, highly competitive species, or communities whose composition and diversity is dependent on a key-stone species, will be analyzed for alternations in diversity due to contaminant exposure.

- **Ecosystem Analysis**–If contaminants are expected to uniformly affect physiological processes that are associated with energy transformation within a specific trophic level, an analysis of the effects of contaminant exposure on trophic structure and trophic function within an ecosystem will be performed. Bioconcentration, bioaccumulation, biomagnification, etc., are concepts that may be used to evaluate the potential effects of contaminant transfer on trophic dynamics.

The protocols and procedures for conducting the ecological investigation at SEAD-60 are discussed in detail in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan.

4.3.7 Analytical Program

A total of 30 soil samples, 16 groundwater samples (from two rounds of sampling), and 8 surface water and sediment samples will be collected from SEAD-60 for chemical testing. All of these samples will be analyzed for the following: Target Compound List (TCL) VOCs

(EPA Method 524.2 for groundwater samples only), semivolatile organic compounds, TCL pesticides/PCBs, Target Analyte List (TAL) metals and cyanide according to the NYSDEC Contract Laboratory Program (CLP) Statement of Work (SOW), and total recoverable petroleum hydrocarbons (TRPH) by EPA Method 418.1. Additional analyses to be performed on specific media are provided below.

Six (6) of the subsurface soil samples from two borings will also be analyzed for limited chemical testing and physical testing including Total Organic Carbon (TOC) by EPA Method 415.1, grain size distribution (including the distribution within the silt and clay size fraction), Cationic Exchange Capacity (CEC), pH, and density. Samples collected from the soil boring advanced in the oil stained area and samples collected from the soil boring advanced south of the oil stained area, will also be analyzed for density.

The 16 groundwater samples will be analyzed in the field for pH, temperature, specific conductivity, dissolved oxygen, turbidity and oxidation-reduction potential. The following analyses will be performed by the laboratory: alkalinity, ferrous iron, sulfate, sulfide, nitrate, TOC, biological oxygen demand (BOD), hardness, total dissolved solids (TDS), and chemical oxygen demand (COD) and methane.

The 8 surface water samples will be analyzed in the field for pH, temperature, specific conductivity, and dissolved oxygen. The following analyses will be performed by the laboratory: total suspended solids (TSS), TDS, alkalinity, hardness, ammonia, nitrate/nitrite, phosphate, TOC, and turbidity.

The 8 sediment samples will be analyzed for grain size, TOC, CEC, and pH. The midstream sample from the drainage swale which runs along the northeastern side of the SEDA railroad tracks will also be analyzed for density.

The 45 groundwater samples collected from the microwells will be laboratory analyzed for TRPH by EPA Method 418.1. The laboratory will report the results of the TRPH analysis within 48 hours of sample receipt.

Analyses for all of the media to be sampled are summarized in Table 4-2.

A detailed description of these methods, as well as lists of each compound included in each of the categories is presented in Appendix C, Chemical Data Acquisition Plan.

Table 4-2

Seneca Army Depot Activity
SEAD-60 RI/FS SCOPING PLAN
Summary of Sampling and Analyses

MEDIA	VOCs		SVOCs	Pesticides/PCBs	Metals	TRPH	Limited Chemical/
	TCL NYSDEC CLP	Method 524.2	TCL NYSDEC CLP	TCL NYSDEC CLP	TAL NYSDEC CLP	Method 418.1	Physical Testing (2)
Soil Surface	10	0	10	10	10	10	0
Subsurface	20	0	20	20	20	20	6
Groundwater	0	16	16	16	16	61	16
Surface water	8	0	8	8	8	8	8
Sediment	8	0	8	8	8	8	8

Notes:

1) QA/QC sampling requirements are described in Appendix C, Section 5.3 of the Generic Installation RI/FS Workplan.

2) The limited chemical testing and physical testing parameters for each media are described in Section 4.2.6, Analytical Program.

4.3.8 Surveying

Surveying will be performed at SEAD-60 for the following purposes:

- Locate all the environmental sampling points.
- Serve as the basis for volume estimates of impacted soil and sediment which may require a remedial action.
- Map the extent of any impacted groundwater above established ARAR limits.
- Map the direction and compute the velocity of groundwater movement.

The location, identification, coordinates and elevations of all the control points recovered and/or established at the site and all of the geophysical survey areas, soil borings, monitoring wells (new and existing) and all surface water and sediment sampling points will be plotted on a topographic map to show their location with respect to surface features within the project area. Site surveys will be performed in accordance with good land surveying practices and will conform to all pertinent state, federal, and USCOE laws and regulations governing land surveying. The surveyor shall be licensed and registered in New York. A detailed discussion of the site field survey requirements is presented in Appendix A, Field Sampling and Analysis Plan of the Generic Installation RI/FS Workplan.

4.4 DATA REDUCTION, ASSESSMENT AND INTERPRETATION

Data reduction, assessment, and interpretation is discussed in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan.

4.5 BASELINE RISK ASSESSMENT

The baseline risk assessment is discussed in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan.

Because SEDA has recently been added to the BRAC list, the scenarios evaluated in the baseline risk assessment will be based on the community reuse plan, as described in BRAC guidance. Therefore, the future receptors currently listed in the Risk Assessment section of the Generic Installation RI/FS Workplan will be revised when the community reuse plan is written.

4.6 DATA REPORTING

Data reporting is discussed in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan.

4.7 TASK PLAN SUMMARY FOR THE RI

General information about the Task Plan Summary is given in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan.

Detailed Task Plan Summaries that indicate the number and type of samples to be collected at SEAD-52 and SEAD-60 are provided in Tables 4-1 and 4-2, respectively.

5.0 TASK PLAN FOR THE FEASIBILITY STUDY (FS)

The task plan for the FS is given in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan.

5.1 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

A discussion of the development of remedial action objectives for the FS is given in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan.

5.2 DEVELOPMENT OF REMEDIAL ACTION ALTERNATIVES

A discussion of the development of remedial action alternatives for the FS is given in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan.

5.3 SCREENING OF REMEDIAL ACTION ALTERNATIVES

A discussion of the screening of remedial action alternatives for the FS is given in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan.

Additionally, as part of the FS process, at least one innovative technology will be evaluated for SEAD-60.

5.4 DETAILED ANALYSIS OF REMEDIAL ACTION ALTERNATIVES

A discussion of the detailed analysis of remedial action alternatives for the FS is given in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan.

Additionally, as part of the FS process, at least one innovative technology will be evaluated for SEAD-60.

5.5 TASK PLAN SUMMARY FOR THE FS

The task plan summary for the FS is given in the Generic Installation RI/FS workplan that serves as a supplement to this RI/FS Project Scoping Plan.

6.0 PLANS AND MANAGEMENT

The purpose of this Work Plan is to present and describe the activities that will be required for the site Remedial Investigation/Feasibility Study at SEAD-52 and SEAD-60. The Field Sampling and Analysis Plan (Appendix A), details procedures which will be used during the field activities. Included in this plan are procedures for sampling soil, sediments, surface water, fish, shellfish and groundwater. Also included in this plan are procedures for developing and installing monitoring wells, measuring water levels and packaging and shipment of samples.

The Health and Safety Plan (Appendix B) details procedures to be followed during field activities to protect personnel involved in the field program.

The Chemical Data Acquisition Plan (Appendix C) describes the procedures to be implemented to assure the collection of valid data. It also describes the laboratory and field analytical procedures which will be utilized during the RI.

6.1 SCHEDULING

The proposed schedules for performing the RI/FS at SEAD-52 and SEAD-60 are presented in Figures 6-1 and 6-2.

6.2 STAFFING

The project team organization for performing the RI/FS is presented in Figure 6-3.

Figure 6-1
SEAD-52 and SEAD-60 RI Field Investigation Schedule
Seneca Army Depot Activity

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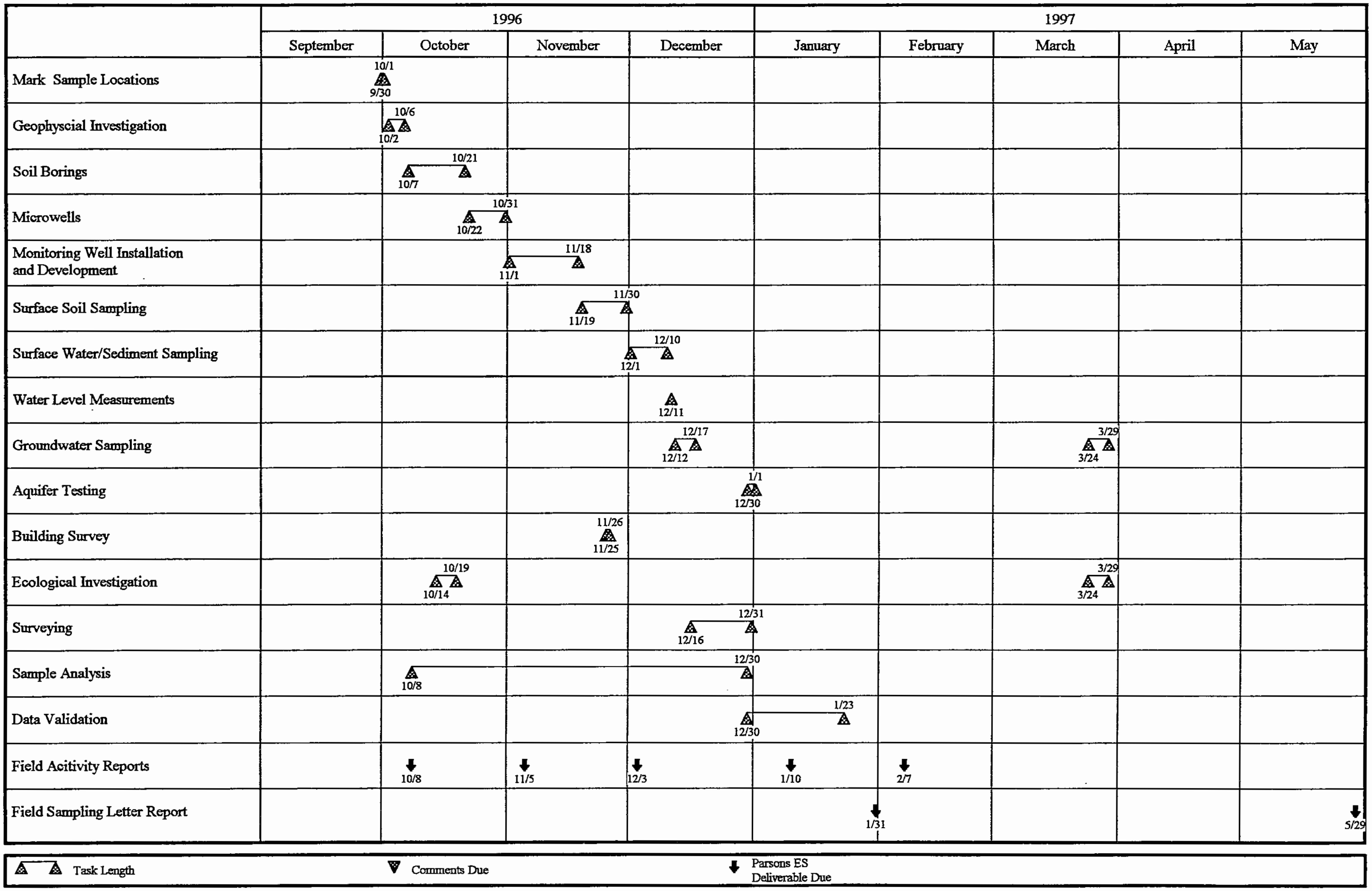

Figure 6-2
SEAD-52 and SEAD-60 RI/FS Schedule: Risk Assessment and Reports
Seneca Army Depot Activity

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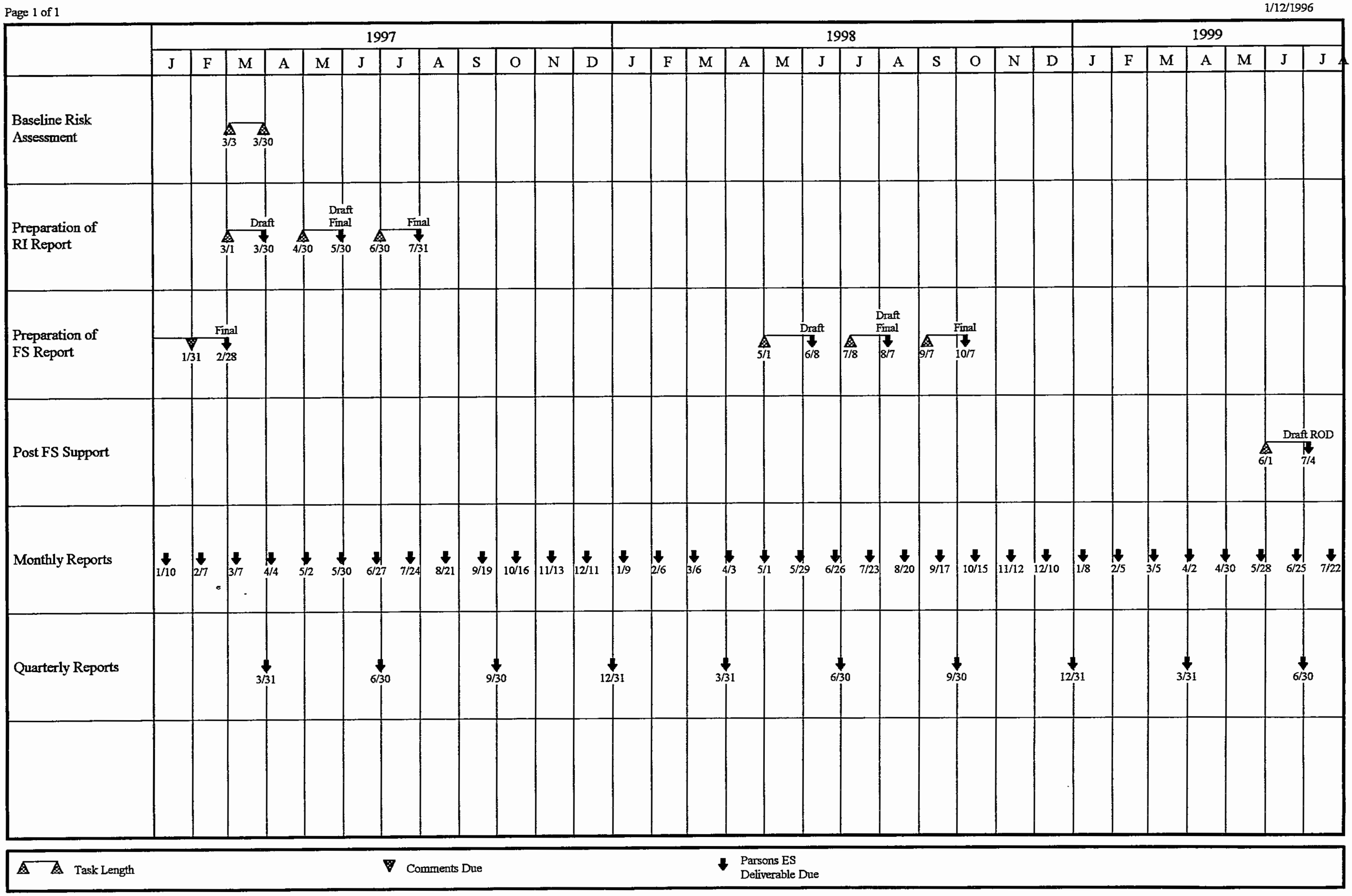

Parsons ES Project Team Organization

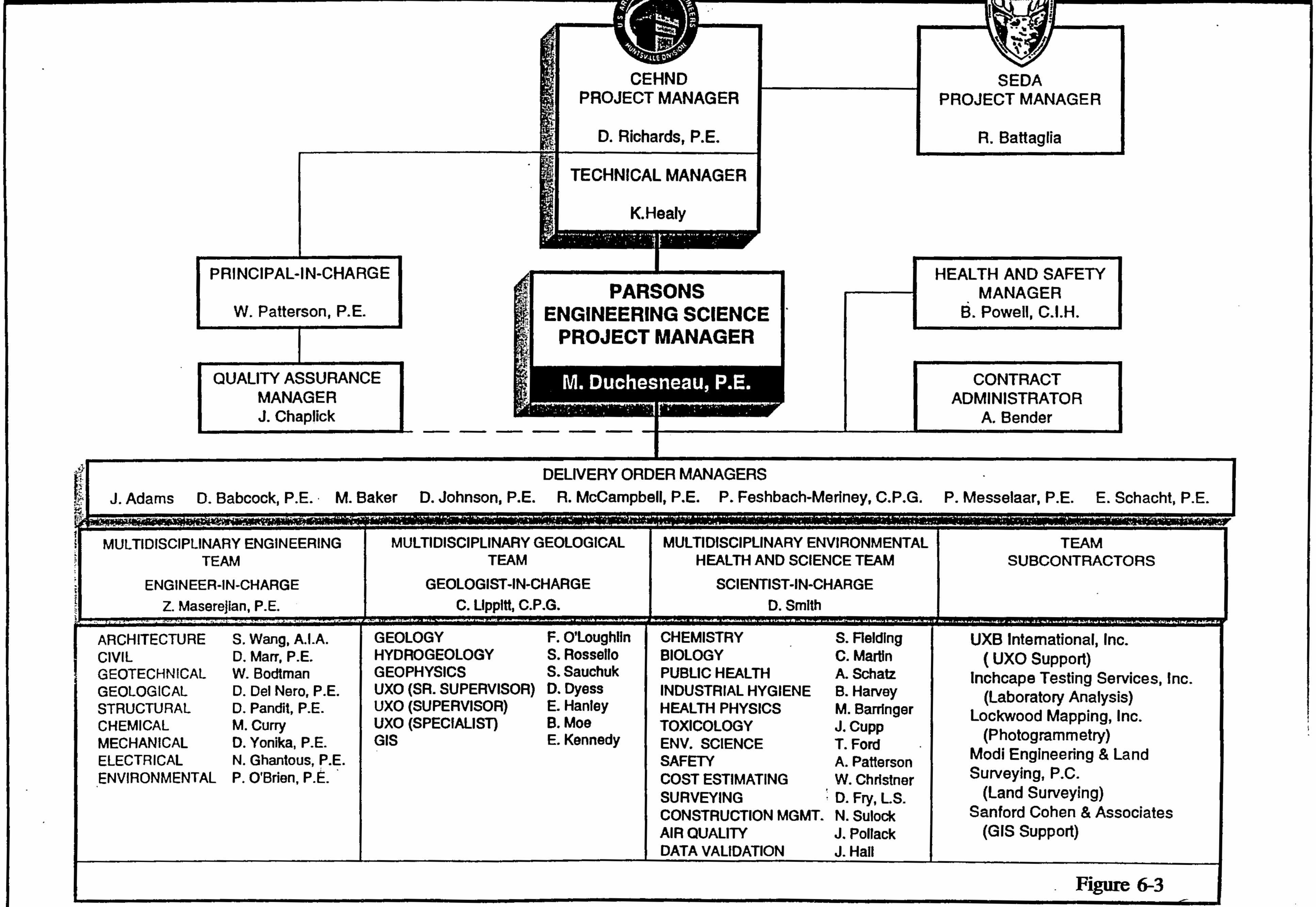

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Figure 6-3

H:\PROP\BALTIMORG-CHT.DRW

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APPENDIX A

FIELD SAMPLING AND
ANALYSIS PLAN

Appendix A information is contained in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan

APPENDIX B

HEALTH AND SAFETY PLAN

Appendix B information is contained in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan

APPENDIX C

CHEMICAL DATA AQUISITION PLAN

Appendix C information is contained in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan.

APPENDIX D

UNITED STATES DEPARTMENT OF INTERIOR FISH AND WILDLIFE SERVICES ENDAGERED AND THREATENED SPECIES LETTER

Appendix D information is contained in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan

APPENDIX E

RESPONSE TO REVIEW COMMENTS

COMMENTS AND RECOMMENDATIONS
PRE-DRAFT PROJECT SCOPING PLAN
REMEDIAL INVESTIGATION/FEASIBILITY STUDY FOR
OIL DISCHARGE AREA ADJACENT TO BUILDING 609, SEAD-60
SENECA ARMY DEPOT ACTIVITY
ROMULUS, NEW YORK
JULY 1995

<u>Comments By: Maly, Waterbury, Hoddinott</u>

Comment #1

Page 1-1, Section 1.1, A. Maly - Purpose of the Report.

Why are the sites for a CERCLA investigation referred to as SWMUs, which is a RCRA term?

<u>Recommendation</u>: Provide a clarification for this issue.

Response #1

Agreed. The sites for the CERCLA RI/FS investigations are called SWMUs (a RCRA term) because the Army elected in their Federal Facilities Agreement to combine RCRA and CERCLA obligations, and the Army has decided to use RCRA terms in referencing various units. Clarification of this issue is provided on page 1-1.

Comment #2

Page 2-1, Section 2.0, A. Maly - Site Conditions.

The lack of including the Generic RI/FS workplan means that relevant information may have been overlooked in this review.

<u>Recommendation</u>: If specifically requested information is contained in other documents, refer the reader to the proper document.

Response #2

Acknowledged. However, though a cooperative effort between the Army and Parsons ES, the preparation of RI/FS workplans at SEDA has been formulated so that the Project Scoping Plans contain specific information about the site and additional information that is not specific to the site is contained in the Generic RI Installation Workplan. This was done to avoid repeating large sections of generic text for the individual scoping plans.

Comment #3

Page 3-1, Section 3.1.1, A. Maly - Site History

The report states that no information is known about the spill. However, the spill is listed as the result of overfilling at AST. This event had to occur while the site was occupied, yet no effort was made to find out the details of the incident.

<u>Recommendation</u>: Ensure that effort is put into collecting basic site

background information. This site might, under normal circumstances, be eligible for a closure action. Inappropriately linking contaminants to a particular event is a cost and effort saving measure which has been precluded.

Response #3

The text in Section 3.1.1 states that no information is available on the date of the spill or the volume of oil released. However, the location and lateral extent of the spill area are known and are evidenced by visibly stained soils within a 6 feet by 30 feet area. Investigations conducted during the preparation of the SWMU Classification Report (Parsons ES, 1994) and the Draft ESI for 7 Low-Priority SWMUs Report (Parsons ES, April 1995) indicated that no further information is available about the spill at this site.

Comment #4

Page 3-8, Section 3.1.2.4,A. Maly - Chemical Analysis Results.

The impact of potential laboratory contaminants seem to be ignored, and the presence of such contaminants may potentially be the basis for site-wide investigations. No discussion is made of these "hits" which are potential laboratory contaminants.

Recommendations: Explain the impact of laboratory contaminants on the existing data, whether such an evaluation was made, and what were the results of the evaluation.

Response #4

Agreed. A discussion of the impact of laboratory contaminants on the existing data was added to the soil, sediment, and groundwater discussions in Section 3.1.2.2.4,Chemical Analysis Results.

Comment #5

Page 3-17, Section 3.1.2.4, M. Waterbury - Chemical Analysis Results - Ground Water Sampling Summary

Page 3-15 suggests that the groundwater at the site has been contaminated by VOCs. The VOCs detected in groundwater samples are acetone and benzene (low level estimated). However, there is no discussion of trip or laboratory blanks that may have contained these compounds too. It should be noted in the text that acetone is a common laboratory contaminant. It should be emphasized in the text that the detected low level of benzene was only detected in the upgradient well.

Recommendation: Discuss QA/QC samples collected for VOC analysis. Note in the text that acetone is a common laboratory contaminant. Note in the text that the benzene detected was an estimated concentration found only in an upgradient well. Resample wells to confirm the absence or presence of acetone and benzene. Perform the necessary QA/QC.

Response #5

Agreed. A sentence has been added to the text in the VOC discussion of the Groundwater Sampling Summary, stating that acetone is a common laboratory contaminant. Also, a sentence has been added stating that benzene was only found in the groundwater sample from the background well.

A formal data validation process was conducted for the Draft ESI for 7 Low Priority SWMUs Report (Parsons ES, April 1995), which included data for SEAD-60, in order to evaluate the data quality for this site. The quality of the data was evaluated from a laboratory perspective. This process considered numerous factors such as laboratory blanks, spike recoveries, holding time consideration, spectral identification matching, and instrument calibration. In addition to the evaluation of the data from a laboratory perspective, consideration was given to the precision of the data from a field perspective. This involved the collection of sufficient field duplicate samples, usually between 5% and 10%, field blanks, and trip blanks. This data validation process was discussed in Section 6 of the Draft ESI Report (Parsons ES, April 1995). The data validation process involved a quantitative comparison between the concentrations of contaminants in samples and concentrations of the same contaminants, if any, in the trip blanks or lab blanks.

All monitoring wells at SEAD-60 including the three existing wells and the 5 proposed wells, will be sampled as part of the RI field program for this site. The data validation process discussed above will be conducted and is described in the Generic Installation RI/FS Workplan (Parsons ES, August 1995).

Comment #6

Page 3-17, Section 3.1.2.4, M. Waterbury - Chemical Analysis Results - Ground Water Sampling Summary

a) Page 3-17 of the text notes that several metals exceeded the federal or state criteria in groundwater samples. The well with the most and highest metal exceedances was the upgradient well. The water sample from the upgradient well also had the highest turbidity level (104 NTU). The turbidity level suggests that the nitric acid preservative probably mobilized metals which are naturally incorporated in the soil mineral matrix. Considering that the metal levels of greatest apparent concern were detected in a turbid, unfiltered sample from an upgradient well, it does not appear that metals have impacted the ground water at the site.

b) The pesticide analysis detected one compound at a low level estimated concentration below the method detection level. Considering the estimated pesticide concentration and the fact that pesticides are not considered compounds of concern for fuel spills, pesticides should not be considered as chemicals of concern in ground water at the site. The highest TPH level was also detected in the upgradient well (2.2 mg/L). The analytical method for TRPH is not selective for only fuel-related high molecular compounds. High molecular natural organic compounds will be detected by the analysis, so TPH (which has no health based criteria) in groundwater does not appear to be a concern at the site.

Recommendation: a) Discuss turbidity of samples and consequence of preserving a turbid sample. Emphasize that the upgradient well had the highest metal levels and was very turbid. Resample wells with greater emphasis placed on collecting low turbidity ground-water samples (This may require more development of the well screen pack and using a low flow sampling procedure). Collect additional filtered metal samples for comparison with the unfiltered metal samples.

b) Discuss the fact that the pesticide result was an estimated value below the method detection limit. Discuss the implications of the TPH analysis and its nonselective detection of high molecular compounds of natural origins other than fuels. Do not consider pesticides and TPH as compounds of concern at the site (e.g., impacted the groundwater) in Section 3.1.4.

Response #6

a) Agreed. A sentence has been added to the metals section of the Groundwater Sampling Summary that states that the higher metals concentrations in the upgradient well may be due to silt as evidenced by the high turbidity of the groundwater sample.

As part of this RI field investigation, groundwater samples will be collected from the 3 existing and 5 proposed monitoring wells. Because the collection of low turbidity samples is a goal of the groundwater sampling program for this RI, we will use the USEPA low flow sampling method in these wells. To ensure that low turbidity samples are collected, the wells will be developed using a surge block and purged with a peristaltic pump using low flows at the end of the development process to remove all of the silt and clay from the wells. Then low flow sampling (100 ml/min) will be performed with a submersible pump such as the Redi-Flow2.

NYSDEC has indicated that filtered groundwater samples are unacceptable. During earlier RIs conducted at SEDA both filtered and unfiltered samples were collected, and comparisons between the two types were made, but the NYSDEC indicated that only unfiltered results were valid. For this reason, and to save on unnecessary analytical costs, only unfiltered samples are collected for the RIs at SEDA. No changes were made to the text.

b) Agreed. Pesticides and TPH compounds have been removed as compounds of concern in the groundwater at SEAD-60 in Section 3.1.4. In addition, a discussion was added to the Groundwater Sampling Summary about the fact that the pesticide result was an estimated value below the method detection limit and that the TPH analysis may be nonselective in the detection of high molecular compounds of natural origins other than fuels.

Comment #7

Page 3-54, Section 3.1.4, A. Maly - Data Summary and Conclusions

This section asserts that the site has been impacted by TPHs, metals, VOCs, SVOCs, and pesticides. The report links this contamination to the oil spill at this site, yet the volatile constituents found in groundwater are higher upgradient of the spill. Further, neither metals nor pesticides, in general, are considered constituents of fuel oil. It appears that no thought was given to other potential, and more probable reasons for these constituents existing at this site.

Recommendation: Reevaluate the data collected, and assess the potential causes for why the contaminants are found at this site. Base the recommendations and future actions at this site on this evaluation, rather than associating all contamination with the oil spill.

Response #7

Agreed. The evaluation of the data from the four media sampled at SEAD-60 shows that the soils at the site have been impacted by TPHs, PAHs, and metals. Sediment has been impacted by PAHs and TPHs. The TPH and PAH compounds were associated with the oil spill area. The groundwater section of the text has been revised to indicate that groundwater has been impacted only by VOCs and metals; pesticides and TPHs have been removed as constituents of concern for groundwater. Potential sources of VOCs in the background well, MW60-1, are unknown. A new background well will be installed further upgradient to MW60-1 in order to evaluate whether activities east of Brady Road in the vicinity of MW60-1 are the source of the VOCs. High metals in groundwater from MW60-1 may be attributed to the high turbidity of the groundwater sample, however, no source can be determined for high metals concentrations detected in the surface soil samples. Ten soil borings have been proposed in Section 4 of this Scoping Plan to determine the extent of impacted soils adjacent to Building 609.

Comment #8

Page 4-2, Section 4.2.2,K. Hoddinott - Soil Investigation.

The soil sampling outlined in this section does not seem to include a determination of soil background.

Recommendation: Include an adequate determination of the background levels of chemicals in the soil.

Response #8

Agreed. We agree that background soil sampling should be performed at this site. Currently, the task plan calls for one (1) background soil boring, which will be completed as monitoring well MW60-6. The three proposed RI soil samples from this soil boring will be incorporated into the background soil database for all of SEDA which contains approximately 30 samples. The background soil concentrations for all sites at SEDA are derived from this large database.

Comment #9

Page 4-6, Section 4.2.4.1,M. Waterbury

The proposal to do microwell installation and sampling (VOCs) appears to be unnecessary. Initial groundwater sampling results indicate the possible presence of acetone and benzene in one or more wells; however, the detection of these two compounds is questionable. Acetone is a common laboratory contaminant and is not expected to be a compound of concern when investigating a fuel/oil release. Benzene was detected at a low level estimated concentration in only the upgradient well (suggesting that it may be a spurious result). Before embarking on such an extensive groundwater investigation program, the existing wells should be resampled and appropriate QA/QC should be conducted to confirm the results of the initial groundwater sampling.

Recommendation: Do not perform groundwater screening program of 45 microwells. Resample wells to confirm the absence or presence of acetone and benzene. Perform the necessary QA/QC.

Response #9 Acknowledged. We have been authorized to write this workplan, which does not include resampling of existing wells prior to beginning the RI fieldwork. This additional task would be a modification to our current task order and would have to be discussed with the Technical Manager, Kevin Healy. Furthermore, the RI field work described in this workplan is not intended to be a phased study, but requires the installation of five additional wells and subsequent sampling of all the wells at the site, including the three existing wells and the new wells, in order to evaluate the groundwater.

The results of the ESI conducted at this site indicated that the soils in the area of the oil release have been impacted by TPHs and PAHs both in the surface soils and subsurface soils. The purpose of the microwells is to accurately locate two monitoring wells in the area of the oil release near the southwestern corner of Building 609 to determine the extent of groundwater impacted by the oil-stained soils. The area of microwell installation shown on Figure 4-6 has been reduced to include only the area around the oil discharge area adjacent to Building 609 and the area around the background monitoring well, MW60-1. The number of microwells has been reduced to 30.

A formal data validation process was conducted for the Draft ESI for 7 Low Priority SWMUs Report, which includes the data for SEAD-60, in order to evaluate the data quality for this site. The quality of the data was evaluated from a laboratory perspective. This process considered numerous factors such as laboratory blanks, spike recoveries, holding time consideration, spectral identification matching, and instrument calibration. In addition to the evaluation of the data from a laboratory perspective, consideration was given to the precision of the data from a field perspective. This involved the collection of sufficient field duplicate samples, usually between 5% and 10%, field blanks, and trip blanks. This data validation process will be conducted for the data collected during the RI field work as outlined in the Generic Installation RI/FS Workplan.

Comment #10 Page 4-13, Section 4.2.6, A. Maly - Analytical Program

The analytical program includes a provision for including analysis for explosives. All the information provided in the report gives no indication that explosives are even a concern at this site.

Recommendation: Remove explosives from the analytical program.

Response #10 Agreed. Explosives have been removed from the analytical program for SEAD-60.

Comment #11 Appendix E, K. Hoddinott - Response to Comments

How can the response to comments about this report be in the generic workplan?

Recommendation: Remove the explanation page for this section until you get comments about this report.

Response #11 Agreed. The explanation page for Appendix E has been removed. Comments from the Army, EPA, and NYSDEC will be inserted into this section when they are received.

Comments By: Forget

Comment #1 Another scoping plan described Seneca may be put on the BRAC list. If it does, as described in the BRAC guidance, the scenarios evaluated in the baseline risk assessment should be based on the community reuse plan. Therefore, revise future receptors to be evaluated in the risk assessment when the reuse plan is developed.

Even if the project remains under CERCLA, EPA's new Future Land Use guidance emphasizes input from the community to determine the future land use. This guidance also states that assuming current non-residential sites become residential in the future is not always warranted. This important risk management decision should be carefully evaluated at this time.

Response #1 Agreed. The scenarios evaluated in the baseline risk assessment will be based on the community reuse plan, as described in BRAC guidance. Specifically, the future receptors currently identified in the baseline risk assessment will be revised when the community reuse plan is written. The text in Section 4.4, Baseline Risk Assessment, on page 4-16 has been modified to include this recommendation.

Comments By: Breckenridge

Comment #1 General

See previous comments on Generic Installation RI/FS Workplan.

Response #1 Acknowledged.

Comment #2 Recommend that at least one innovative technology be evaluated for this site.

Response #2	Agreed. The workplan has been changed to state that at least one innovative technology will be evaluated for this site. Text was added to Sections 5.2 and 5.3 of the Project Scoping Plan (page 5-1).
Comment #3	Recommend on future submittals for individual sites that the applicable portions of the Generic Installation RI/FS Work Plan be provided in the document rather than referenced. This will insure that the generic work plan is tailored more specifically for a particular site rather than blindly referencing the generic work plan and allow for more continuity in the review process.
Response #3	Acknowledged. However, though a cooperative effort between the Army and Parsons ES, the preparation of RI/FS workplans at SEDA has been formulated so that the Project Scoping Plans contain specific information about the site and additional information that is not specific to the site is contained in the Generic RI Installation Workplan. This was done to avoid repeating large sections of generic text for the individual scoping plans.

D#14

COMMENTS AND RECOMMENDATIONS
PRE-DRAFT PROJECT SCOPING PLAN
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
AMMUNITION BREAKDOWN AREA (SEAD-52)
SENECA ARMY DEPOT ACTIVITY
ROMULUS, NEW YORK
JULY 1995

Comments By: K. Hoddinott/D. Robinson

Comment #1 Page 3-16, Section 3.2.

The scoping document should outline the future use scenario. Nothing is gained by holding the future use scenario for the FS, since the future use scenario can have an effect on the current planned sampling.

Recommendation: Include a discussion of the future use scenario in this document.

Response #1 The future use scenario for SEAD-52 is discussed in Section 3.2.3, Potential Exposure Pathways and Receptors - Future Uses.

Comment #2 Page 3-21, Section 3.6.

A determination of the soil background needs to be added to this section.

Recommendation: Include a determination of soil background in this section.

Response #2 Agreed. Background data for the Seneca Army Depot Activity already exists. These samples were previously collected as part of the OB Grounds and Ash Landfill RI/FS programs and as part of the 25 SWMU investigation. All of these data are being used to define the site wide concentrations of inorganic constituents in soils. A statement has been added to Section 3.6, Soil Data, which states that soil data from SEAD-52 will be compared to site-wide soil background data.

Comment #3 **Overall Comment, D. Robinson.**

The affects of ambient air quality has not been addressed in the Pre-Draft Project Scoping Plan. The investigation identifies regulated pollutants under Title III of the Clean Air Act Amendment of 1990 (CAAA-90) within the soil that have the potential to be emitted into the air. Inhalation is also listed as an exposure pathway for current site workers and future on-site adults and children.

Recommendation: Include air monitoring sampling as part of the Remedial Investigation characterization of SEAD-52 since inhalation is listed as potential exposure pathway.

Response #3	Disagree. Although regulated pollutants have been identified as Hazardous Air Pollutants under Title III of the CAAA-90, Title III does not apply to the RI characterization at this site. Title III applies to industrial source categories. Generally, the amendment applies to specific major source categories which have the potential to emit 10 tons/year of a single pollutant or 25 tons/year of several hazardous air pollutants. Furthermore, Title III provides the list of hazardous air pollutants, but does not contain air quality criteria for these toxins. Title III is controls oriented and therefore provides maximum achievable control technology (MACT) standards for specific major source categories and a few area sources. For the risk assessment, inhalation of emissions from the soil will be considered as a potential exposure pathway. Emissions will be estimated using the approaches described by USEPA in the Air/Superfund National Technical Guidance Study (NTGS) Series documents. Equations from these documents will be used to estimate emissions from undisturbed areas of contamination as well as other operations including soil excavation, truck transport of soil, and uncovered soil piles, as appropriate. Once emission rates have been developed, the emission rates will be used as input to a model which estimates the ambient air concentrations near the work area or at a downwind receptor. A box modeling approach will be used to assess near-field exposures of site workers. In addition, representative particulate air concentrations, if available, and the concentration of contamination in the surface soils will be used to estimate the concentration of contamination in the airborne particulates. The methodologies for emission and particulate estimations are described in the Generic Installation RI/FS Workplan.

Comment By: L.L. Tate

Comment #1	Page 5-1. Treatability studies should be considered.
Response #1	Agreed. The need for treatability studies is related to the technology that will be selected for implementation. As part of the Feasibility Study, Parsons ES will assess the need to conduct treatability studies. This is discussed in Section 5 of the Generic Installation RI/FS Workplan. At this stage of the RI/FS process, it would be inappropriate to address this need since all the data has not been collected and the FS is not done.

Comment By: Crawford

Comment #1	Table 3-2, Summary of Fate and Transportation Parameters for Selected Compounds, Crawford. Identify the temperature basis for the solubility, vapor pressure, and Henry's

Law Constant data.

Response #1 The fate and transport parameters are presented in Table 3-2 at standard temperature (25 degrees C) and pressure. A footnote has been added to the table.

Comments By: Healy

Comment #1 Page 3-16, Section 3.2.

In the first full paragraph, delete "Currently, the Army has ... transfer the ownership." Also, delete "Until the BRAC Commission recommendations...will remain open." Also recommend combining what's left of these two paragraphs into one. Although both thoughts were accurate two months ago, the SEDA BRAC listing has changed the overall situation completely.

Response #1 Agreed. The referenced text has been removed from Section 3.2 and the paragraphs combined.

Comment #2 Page 3-16, Section 3.2

In the third paragraph, delete "However, not all sites at SEDA will be...residential use." At this point in time, we still don't wish to suggest the potential for future residential use if we don't have to.

Response #2 Agreed. The sentence has been removed.

Comment #3 Section 3.2.3, 1st paragraph

I believe "ensured" should be "assured" in the second line. In the second paragraph (last line), change "all future" to "any future" for reasons similar to that presented in Comment 2, above.

Response #3 Agreed. The words has been changed.

Comment #4 Table 6-2

There appears to be an error in showing the Draft ROD in June of 1997. Also, the initiation date of this RI/FS (and hence, all others) will likely change based on my recent conversation with Mr. Duchesneau. Please check with him for the latest information.

Response #4 Agreed. The due dates and start date have been revised on the table.

APPENDIX F

SCOPE OF WORK

Appendix F information is contained in the Generic Installation RI/FS Workplan that serves as a supplement to this RI/FS Project Scoping Plan

APPENDIX G

SUBSURFACE INVESTIGATIONS

- Boring Logs
- Monitoring Well Installation Diagrams

BORING LOGS

LOG OF BORING NO. MW60-1

PROJECT: **SEVEN LOW PRIORITY AOCs**
PROJECT LOCATION: **SENECA ARMY DEPOT, ROMULUS NY**
ASSOCIATED UNIT/AREA: **SEAD-60**
PROJECT NO: **720518-01000**
DATE STARTED: **03/23/94**
DATE COMPLETED: **03/23/94**
DRILLING CONTRACTOR: **EMPIRE SOILS INVESTIGATIONS**
DRILLING METHOD: **HOLLOW STEM AUGER**
SAMPLING METHOD: **3" SPLIT SPOONS**

DEPTH TO WATER (ft): **14.0**
BORING LOCATION (N/E): **986468.8 751766.4**
REFERENCE COORDINATE SYSTEM: **New York State Plane**
GROUND SURFACE ELEVATION (ft): **746.3**
DATUM: **NAD 1983**
INSPECTOR: **FO**
CHECKED BY: **FO**

This log is part of the report prepared by Engineering-Science, Inc. for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations.

Sample Number	Blow Counts (# Blows per 6")	Sample Advance (ft)	Sample Recovery (ft)	VOC Screen-PID (ppm)	Rad Screen (cps)	Depth (ft)	Macro Lithology	DESCRIPTION	USCS
.01	3 4 7 8	2.00	1.7	0	BGD	0.4		Brown SILT, trace(+) Organic material, frozen	ML
						0.7		AA ,trace(-) Organic material, wet, not frozen.	ML
						1.5		Gray/orange/brown CLAY, trace Silt, trace fine to coarse Shale fragments, medium stiff, moist. Plastic	CL
						1.7		Gray/orange/brown SILT, CLAY and very fine SAND, trace fine Shale fragments, moist.	ML
						2.0		No Recovery	-
.02	9 15 18 27	2.00	1.6	0	BGD	2.7		AA(1.5'-1.7')	ML
						3.1		Gray/orange/brown SILT, some Clay, trace fine to medium Shale fragments, dry	ML
						3.2		Gray/brown very fine SAND and SILT, saturated.	SM
						3.6		Gray/brown SILT, little Clay, little(-) fine to medium Shale fragments, medium stiff, dry.	ML
						4.0		No Recovery	-
.03	15 18 26 21	2.00	1.5	0	BGD	5.5		AA(3.2'-3.6')	ML
						6.0		No Recovery	-
.04	25 31 30 36	2.00	1.8	0	BGD	6.6		Light brown SILT, little(-) Clay, little(-) fine to medium Shale fragments, medium stiff, moist.	ML
						7.2		Light brown SILT, trace(+) Clay, trace fine Shale fragments, loose, moist to wet.	ML
						7.8		Light brown SILT, trace very fine Sand, trace(-) Clay, moist with trace saturated lenses.	ML
						8.0		No Recovery	-
.05	18 41 46 100/.4	1.90	1.9	0	BGD	9.0		Light brown/gray SILT, some very fine Shale fragments, trace Clay, trace medium to coarse Shale fragments, medium stiff, moist to wet, trace saturated lenses.	ML
						9.9		AA, brown/gray, dry	ML

NOTES: Bottom of overburden at 15.3'. No soil samples were collected for chemical analysis.

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LOG OF BORING MW60-1

PROJECT: **SEVEN LOW PRIORITY AOCs**
PROJECT NO: **720518-01000**
PROJECT LOCATION: **SENECA ARMY DEPOT, ROMULUS NY**

GROUND SURFACE ELEVATION: **746.3**
INSPECTOR: **FO**
CHECKED BY: **FO**

This log is part of the report prepared by Engineering-Science, Inc. for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations.

Sample Number	Blow Counts (# Blows per 6")	Sample Advance (ft)	Sample Recovery (ft)	VOC Screen-PID (ppm)	Rad Screen (cps)	Depth (ft)	Macro Lithology	DESCRIPTION	USCS
.06	38 71 62 88	2.00	1.8	0	BGD	10.0		Dark gray fractured SHALE, saturated.	-
						10.2		Brown/gray SILT, little(+) fine to medium Shale fragments with trace coarse Shale fragments, trace(+) Clay, moist with saturated lenses from 10-11'.	ML
						11.6 11.8		AA with some very fine Sand, medium stiff.	ML
						12.0		No Recovery	-
.07	70 72 80 100/.45	1.95	1.8	0	BGD	12.4		Brown/gray SILT, some fine Shale fragments, trace(+) very fine Sand.	ML
								Dark gray weathered, fractured SHALE, some Silt, trace Clay, trace very fine Sand, wet to saturated.	ML
						12.8		Brown/gray SILT and very fine SAND, some weathered Shale, medium stiff, wet to saturated. Reddish-brown very fine weathered Shale fragments at 13.7'.	SM
						13.8 14.0		No Recovery	-
.08	32 48 100/.3	1.30	1.3	0	BGD			Brown/gray SILT, some very fine Sand, some weathered, fractured Shale, saturated.	ML
						15.3		No Recovery	-
.09	100/.2	0.20	0.2	0	BGD	16.0 16.2		Dark gray weathered, fractured Shale, saturated. Trace Silt and Clay interbedded between fracture planes.	-
								No Recovery	-
.10	100/.15	0.15	0.15	0	BGD	18.0		AA (16.0-16.2)	-
						18.1		Dark gray fractured SHALE.	-
						18.2		No Recovery	-

BORING TERMINATED AT 18.3'

NOTES: Bottom of overburden at 15.3'. No soil samples were collected for chemical analysis.

LOG OF BORING NO. MW60-2

PROJECT:	SEVEN LOW PRIORITY AOCs
PROJECT LOCATION:	SENECA ARMY DEPOT, ROMULUS NY
ASSOCIATED UNIT/AREA:	SEAD-60
PROJECT NO:	720518-01000
DATE STARTED:	03/22/94
DATE COMPLETED:	03/22/94
DRILLING CONTRACTOR:	EMPIRE SOILS INVESTIGATIONS
DRILLING METHOD:	HOLLOW STEM AUGER
SAMPLING METHOD:	3" SPLIT SPOONS
DEPTH TO WATER (ft):	11.3
BORING LOCATION (N/E):	986579.5 751519.3
REFERENCE COORDINATE SYSTEM:	New York State Plane
GROUND SURFACE ELEVATION (ft):	744.1
DATUM:	NAD 1983
INSPECTOR:	FO
CHECKED BY:	FO

This log is part of the report prepared by Engineering-Science, Inc. for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations.

Sample Number	Blow Counts (# Blows per 6")	Sample Advance (ft)	Sample Recovery (ft)	VOC Screen-PID (ppm)	Rad Screen (cps)	Depth (ft)	Macro Lithology	DESCRIPTION	USCS
.01	5 7 9 12	2.00	1.9	0	BGD	0.5		Brown SILT, trace Clay, trace(+) Organic material.	ML
						1.3		AA, trace fine Shale fragments.	ML
						1.9		Yellow-brown SILT + CLAY, trace fine Shale fragments, soft, moist.	CL
						2.0		No Recovery	
.02	18 18 26 30	2.00	1.5	0	BGD	3.5		Gray-brown-yellow SILT + CLAY, trace fine to medium Shale fragments, trace weathered Shale, stiff, moist to wet.	CL
						4.0		No Recovery	-
.03	35 31 30 42	2.00	1.0	0	BGD	4.5		Gray fractured SHALE, trace iron staining.	-
						5.0		Light brown SILT, little fine Shale fragments, medium stiff, moist.	ML
						6.0		No Recovery	-
.04	85 52 61 88	2.00	2.0	0	BGD	8.0		AA(4.5'-5'), with gray fractured shale stiff, dry.	ML
.05	42 61 83 76	2.00	1.7	0	BGD	9.2		Gray-brown, trace yellow SILT, little fine to medium Shale fragments, soft, moist	ML
						9.7		Gray fractured SHALE.	-
						10.0		No Recovery	-

NOTES: Bottom of overburden at 16.0'. No samples were collected for chemical analysis.

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LOG OF BORING MW60-2

PROJECT: **SEVEN LOW PRIORITY AOCs**
PROJECT NO: **720518-01000**
PROJECT LOCATION: **SENECA ARMY DEPOT, ROMULUS NY**

GROUND SURFACE ELEVATION: **744.1**
INSPECTOR: **FO**
CHECKED BY: **FO**

This log is part of the report prepared by Engineering-Science, Inc. for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations.

Sample Number	Blow Counts (# Blows per 6")	Sample Advance (ft)	Sample Recovery (ft)	VOC Screen-PID (ppm)	Rad Screen (cps)	Depth (ft)	Macro Lithology	DESCRIPTION	USCS
.06	30 38 46 91	2.00	1.7	0	BGD	11 11.7		Gray-brown SILT, little fine Shale fragments, trace coarse fragments, moist from (10-11'), wet from (11-11.3'), saturated lenses from (11.3-11.7').	ML
						12.0		No Recovery	-
.07	100/.4	0.40	0.4	0	BGD	12 12.4		Dark gray weathered, fractured SHALE, some Clay, little Silt, saturated.	CL
						13 14.0		No Recovery	-
.08	27 29 44 81	2.00	1.7	0	BGD	14 15 15.7		Gray SILT, little(+) Clay, little weathered Shale lenses, wetness on shale lenses.	ML
						16.0		No Recovery	-
.09	100/.3	0.30	0.3	0	BGD	16 16.3		Dark gray, highly fractured, weathered Shale, some Clay, trace lenses of Silt, saturated.	-
						17 18.0		No Recovery	-
.10	110/.5	0.50	0.5	0	BGD	18 18.3		Dark gray weathered SHALE, trace Silt + Clay.	-
						18.5		Gray fractured SHALE, slightly weathered, saturated.	-
						19		No Recovery	-

BORING TERMINATED AT 19.6'

NOTES: Bottom of overburden at 16.0'. No samples were collected for chemical analysis.

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LOG OF BORING MW60-2

Sheet 2 of 2

LOG OF BORING NO. MW60-3

PROJECT: **SEVEN LOW PRIORITY AOCs**
PROJECT LOCATION: **SENECA ARMY DEPOT, ROMULUS NY**
ASSOCIATED UNIT/AREA: **SEAD-60**
PROJECT NO: **720518-01000**
DATE STARTED: **03/02/94**
DATE COMPLETED: **03/02/94**
DRILLING CONTRACTOR: **EMPIRE SOILS INVESTIGATIONS**
DRILLING METHOD: **HOLLOW STEM AUGER**
SAMPLING METHOD: **3" SPLIT SPOONS**

DEPTH TO WATER (ft): **16.0**
BORING LOCATION (N/E): **986469.1 751467.0**
REFERENCE COORDINATE SYSTEM: **New York State Plane**
GROUND SURFACE ELEVATION (ft): **743.3**
DATUM: **NAD 1983**
INSPECTOR: **FO**
CHECKED BY: **FO**

This log is part of the report prepared by Engineering-Science, Inc. for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations.

Sample Number	Blow Counts (# Blows per 6")	Sample Advance (ft)	Sample Recovery (ft)	VOC Screen-PID (ppm)	Rad Screen (cps)	Depth (ft)	Macro Lithology	DESCRIPTION	USCS
.01	2 3 4 3	2.00	1.7	0	11	1.0	▨	Brown SILT, little Organic material, moist.	ML
						1.7	▨	Brown-gray SILT, trace Organic material, trace fine Shale fragments, trace Clay, little mottling, loose, moist.	ML
						2.0		No Recovery	-
.02	7 40 51 65	2.00	1.7	0	11	3.1	▨	Brown-gray SILT, little Clay, little mottling, dense, moist.	ML
						3.7	▨	Dark gray fractured SHALE, trace Silt, dry, saturated at the tip of the spoon.	-
						4.0		No Recovery	-
.03	32 28 25 100/.3	1.80	1.6	0	6	4.4	▨	Dark gray fractured SHALE, saturated	-
						5.6	▨	Light brown SILT, little fine to medium Shale fragments, trace Clay, dense, moist.	ML
						6.0		No Recovery	-
.04	48 48 55 60	2.00	1.8	0	11	6.3	▨	Gray fractured SHALE with calcite filled veins, dry.	-
						7.8	▨	Light brown SILT, some fine to very coarse Shale fragments, loose, dry.	ML
						8.0		No Recovery	-
.05	100/.4	0.40	0.4	0	9	8.4	▨	Light brown SILT, little fine to medium Shale fragments, loose, dry.	ML
						10.0		No Recovery	-

NOTES: Bottom of overburden - 19.3'. No samples were collected for chemical analysis.

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LOG OF BORING MW60-3

PROJECT: **SEVEN LOW PRIORITY AOCs**
PROJECT NO: **720518-01000**
PROJECT LOCATION: **SENECA ARMY DEPOT, ROMULUS NY**

GROUND SURFACE ELEVATION: **743.3**
INSPECTOR: **FO**
CHECKED BY: **FO**

This log is part of the report prepared by Engineering-Science, Inc. for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations.

Sample Number	Blow Counts (# Blows per 6")	Sample Advance (ft)	Sample Recovery (ft)	VOC Screen-PID (ppm)	Rad Screen (cps)	Depth (ft)	Macro Lithology	DESCRIPTION	USCS
.06	18 41 40 55	2.00	1.5	0	14	11 11.5		Dark gray CLAY + SILT, little fine to very coarse Shale fragments, soft to stiff, dry. Wet at tip.	ML
						12.0		No Recovery	-
.07	50 52 56 60	2.00	2	0	14	12 12.2		Dark gray SILT, trace fine Shale fragments, saturated.	ML
						13 14.0		Dark gray SILT, some Clay, little fine to medium Shale fragments, stiff, moist. Trace wetness at 12.5'.	ML
.08	41 85 100/.3	1.30	1.3	0	9	14 14.3		AA, loose.	ML
						14.8		Dark gray weathered SHALE.	-
						15 15.3		AA (14-14.3') soft, dry. Saturated at the interface of soil + weathered Shale (14.9').	ML
						16.0 ▼		No Recovery	-
.09	100/.4	0.40	0.4	0	11	16 16.4		Dark gray SILT + CLAY + weathered SHALE, saturated.	ML
						17 18.0		No Recovery	-
.10	44 85 100/.3	1.30	1.3	0	14	18 18.3		Dark gray weathered SHALE, saturated.	-
						19 19.3		Dark gray-brown SILT, some(+) Clay, some Shale, stiff, moist.	ML
						20.0		No Recovery	-
.11	100/.3	0.30	0.3	0	10	20 20.3		Dark gray weathered SHALE, saturated.	-
						21 22.0		No Recovery	-
.12	100/.3	0.30	0.3	0	9	22 22.3		Dark gray SHALE (Bedrock)	-

NOTES: Bottom of overburden - 19.3'. No samples were collected for chemical analysis.

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LOG OF BORING MW60-3

PROJECT: **SEVEN LOW PRIORITY AOCs**
PROJECT NO: **720518-01000**
PROJECT LOCATION: **SENECA ARMY DEPOT, ROMULUS NY**

GROUND SURFACE ELEVATION: **743.3**
INSPECTOR: **FO**
CHECKED BY: **FO**

This log is part of the report prepared by Engineering-Science, Inc. for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations.

Sample Number	Blow Counts (# Blows per 6")	Sample Advance (ft)	Sample Recovery (ft)	VOC Screen-PID (ppm)	Rad Screen (cps)	Depth (ft)	Macro Lithology	DESCRIPTION	USCS
								No Recovery	-
						23			
						24.0			
.13	100/.1	0.10	0.1	0	11	24		Dark gray SHALE.	

BORING TERMINATED AT 24.1'

NOTES: Bottom of overburden - 19.3'. No samples were collected for chemical analysis.

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LOG OF BORING MW60-3

Sheet 3 of 3

LOG OF BORING NO. SB60-1

PROJECT: **SEVEN LOW PRIORITY AOCs**
PROJECT LOCATION: **SENECA ARMY DEPOT, ROMULUS NY**
ASSOCIATED UNIT/AREA: **SEAD-60**
PROJECT NO: **720518-01000**
DATE STARTED: **02/28/94**
DATE COMPLETED: **02/28/94**
DRILLING CONTRACTOR: **EMPIRE SOILS INVESTIGATIONS**
DRILLING METHOD: **HOLLOW STEM AUGER**
SAMPLING METHOD: **3" SPLIT SPOON**

DEPTH TO WATER (ft): **11.3**
BORING LOCATION (N/E): **986473.4 751650.2**
REFERENCE COORDINATE SYSTEM: **New York State Plane**
GROUND SURFACE ELEVATION (ft): **NA**
DATUM: **NAD 1983**
INSPECTOR: **FO,KK**
CHECKED BY: **FO**

This log is part of the report prepared by Engineering-Science, Inc. for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations.

Sample Number	Blow Counts (# Blows per 6")	Sample Advance (ft)	Sample Recovery (ft)	VOC Screen-PID (ppm)	Rad Screen (cps)	Depth (ft)	Macro Lithology	DESCRIPTION	USCS
.01	18 14 13 10	2.00	1.6	0	BGD	0.8		Light brown-gray SILT, some fine Shale fragments and Gravel, little fine Sand, little Organic, loose, dry.	ML
						1 1.7		Light brown-gray SILT, little coarse Shale fragments and fine Gravel, trace Clay, trace Organic, very stiff.	ML
						2.0		No Recovery	-
.02	14 10 13 13	2.00	0.8	0	BGD	2 2.4		Brown-gray SILT, some Clay and medium to coarse Shale, medium stiff, dry to moist.	ML
						2.8		Brown-gray SILT, some fine to medium Shale fragments, little Clay, soft, moist. Saturated at 2.7'	ML
						3 4.0		No Recovery	-
.03	40 100/.4	0.90	0.6	0	BGD	4 4.6		Brown-gray SILT, little Clay and fine to medium Shale fragments, wet(+). Saturated at 4.5'	ML
						5 6.0		No Recovery	-
.04	100/.4	0.40	.4	0	BGD	6 6.4		Light brown SILT, some fine Shale fragments, trace Clay, trace medium Shale fragments, stiff, moist.	ML
						7 8.0		No Recovery	-
.05	44 70 75 80	2.00	1.6	0	BGD	8 9 9.6		Gray SILT, some fine to medium weathered Shale fragments, very stiff, moist to wet.	ML
						10 10.0		No Recovery	-

NOTES: Bottom of overburden at 18.4'. Samples SB60-1.00(0-2"), SB60-1.01(0.2'-2'), SB60-1.02(2'-4'), SB60-1.02(2'-4') MRD, and SB60-1.20 (duplicate of .02) sent to lab for chemical analysis.

PROJECT: **SEVEN LOW PRIORITY AOCs**
PROJECT NO: **720518-01000**
PROJECT LOCATION: **SENECA ARMY DEPOT, ROMULUS NY**

GROUND SURFACE ELEVATION: **NA**
INSPECTOR: **FO,KK**
CHECKED BY: **FO**

This log is part of the report prepared by Engineering-Science, Inc. for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations.

Sample Number	Blow Counts (# Blows per 6")	Sample Advance (ft)	Sample Recovery (ft)	VOC Screen-PID (ppm)	Rad Screen (cps)	Depth (ft)	Macro Lithology	DESCRIPTION	USCS
.06	17 24 42 40	2.00	1.3	0	BGD	11.0		Gray Silt and fine to coarse SHALE fragments, medium stiff, wet.	GM
						11 11.3		Black fractured SHALE fragments, some Silt, wet to saturated.	GM
						12.0		No Recovery	-
.07	36 34 40 60	2.00	1.8	0	BGD	12 13 13.5		Gray SILT, some medium to coarse Shale fragments,stiff, wet to saturated.	ML
						13.8		Gray SILT and coarse competent SHALE fragments, stiff, dry with saturated lenses.	GM
.08	100/.4	0.40	.35	0	BGD	14.0 14		No Recovery	-
						14.4		Dark gray SILT and SHALE, little Clay, loose, moist to wet.	GM
						15 16.0		No Recovery	-
.09	100/.3	0.30	.3	0	BGD	16 16.3		Dark gray SILT and SHALE, medium stiff, wet.	GM
						17 18.0		No Recovery	-
.10	80 100/.3	0.80	.8	0	BGD	18 18.4		Gray SILT, some Shale fragments, very stiff, moist.	ML
						18.8		Gray weathered SHALE, some Silt, very stiff, moist.	-
						19 20.0		No Recovery	-
.11	85 100/.2	0.70	.5	0	BGD	20 20.2		Gray SILT, some fine to medium Shale fragments, stiff, saturated.	ML
						20.5		Gray fractured SHALE coarsely laminated, loose, saturated.	-
						21 22.0		No Recovery	-
.12	100/.3	0.30	.3	0	BGD	22 22.1		Gray SILT, little fine Shale fragments, soft, saturated.	ML
						22.3		Black SHALE-fractured, finely laminated, saturated	-

NOTES: Bottom of overburden at 18.4'. Samples SB60-1.00(0-2"), SB60-1.01(0.2'-2'), SB60-1.02(2'-4'), SB60-1.02(2'-4') MRD, and SB60-1.20 (duplicate of .02) sent to lab for chemical analysis.

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LOG OF BORING SB60-1

PROJECT: **SEVEN LOW PRIORITY AOCs**
PROJECT NO: **720518-01000**
PROJECT LOCATION: **SENECA ARMY DEPOT, ROMULUS NY**

GROUND SURFACE ELEVATION: **NA**
INSPECTOR: **FO,KK**
CHECKED BY: **FO**

This log is part of the report prepared by Engineering-Science, Inc. for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations.

Sample Number	Blow Counts (# Blows per 6")	Sample Advance (ft)	Sample Recovery (ft)	VOC Screen-PID (ppm)	Rad Screen (cps)	Depth (ft)	Macro Lithology	DESCRIPTION	USCS
						23 24		No Recovery	-
								BORING TERMINATED AT 24.5' AUGER REFUSAL	

NOTES: Bottom of overburden at 18.4'. Samples SB60-1.00(0-2"), SB60-1.01(0.2'-2'), SB60-1.02(2'-4'), SB60-1.02(2'-4') MRD, and SB60-1.20 (duplicate of .02) sent to lab for chemical analysis.

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LOG OF BORING SB60-1

LOG OF BORING NO. SB60-2

PROJECT: **SEVEN LOW PRIORITY AOCs**
PROJECT LOCATION: **SENECA ARMY DEPOT, ROMULUS NY**
ASSOCIATED UNIT/AREA: **SEAD-60**
PROJECT NO: **720518-01000**
DATE STARTED: **06/07/94**
DATE COMPLETED: **06/07/94**
DRILLING CONTRACTOR: **EMPIRE SOILS INVESTIGATIONS**
DRILLING METHOD: **HOLLOW STEM AUGER**
SAMPLING METHOD: **3" SPLIT SPOONS**

DEPTH TO WATER (ft): **8.0**
BORING LOCATION (N/E): **986501.8 751634.2**
REFERENCE COORDINATE SYSTEM: **New York State Plane**
GROUND SURFACE ELEVATION (ft): **NA**
DATUM: **NAD 1983**
INSPECTOR: **FO**
CHECKED BY: **FO**

This log is part of the report prepared by Engineering-Science, Inc. for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations.

Sample Number	Blow Counts (# Blows per 6")	Sample Advance (ft)	Sample Recovery (ft)	VOC Screen-PID (ppm)	Rad Screen (cps)	Depth (ft)	Macro Lithology	DESCRIPTION	USCS
.01	1 1 3 13	2.00	1.2	7 4 1 1	BGD	0.3		Dark gray-black SILT, some very fine Sand, trace fine Shale fragments, trace(-) Organic material, strong petroleum odor (soil is stained), contains oily sheen.	ML
						0.6		Gray SILT, some fine Sand, trace Organic material, wet.	ML
						1.2		Light brown SILT, little very fine Sand, trace very fine to fine Shale fragments, trace coarse Shale fragments at tip, loose, moist.	ML
						2.0		No Recovery	-
.02	27 45 100/.4	1.40	1.4	2.4	BGD	2.4		AA (0.6-1.2')	ML
						3.4		AA and weathered-fractured Shale.	ML
						4.0		No Recovery	-
.03	51 100/.3	0.80	0.6	0.6	BGD	4.6		Light brown very fine SAND and SILT, trace very fine to fine Shale fragments, loose, moist.	SM
						6.0		No Recovery	-
.04	50 66 100/.3	1.30	1.1	0	BGD	7.1		Gray-brown SILT, little very fine Sand, little(-) fine to coarse Shale fragments, loose to medium stiff, wet.	ML
						8.0 ▼		No Recovery	-
.05	21 31 52 42	2.00	1.7	0	BGD	9.2		AA (6.0-7.1') with fine to medium SHALE fragments, little Clay, saturated 8.0'-8.3', wet 8.3-9.2'	GM
						9.3		Highly weathered SHALE, saturated.	-
						9.7		Gray Brown SILT, some Shale fragments little(+) Clay, trace very fine Sand, wet to saturated.	ML
						10.0			-

NOTES: Bottom of overburden at 10'. Perched water at 2'. Samples SB60-2.00(0-2"), SB60-2.02(2'-4'), SB60-2.04(6'-8'), SB60-2.00MRD, and SB60-2.20 (duplicate of .00) sent to lab for chemical analysis.

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LOG OF BORING SB60-2

PROJECT: **SEVEN LOW PRIORITY AOCs**
PROJECT NO: **720518-01000**
PROJECT LOCATION: **SENECA ARMY DEPOT, ROMULUS NY**

GROUND SURFACE ELEVATION: **NA**
INSPECTOR: **FO**
CHECKED BY: **FO**

This log is part of the report prepared by Engineering-Science, Inc. for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations.

Sample Number	Blow Counts (# Blows per 6")	Sample Advance (ft)	Sample Recovery (ft)	VOC Screen-PID (ppm)	Rad Screen (cps)	Depth (ft)	Macro Lithology	DESCRIPTION	USCS
.06	60 100/.2	0.70	0.7	0	BGD	10.7		Gray fractured and weathered SHALE.	-
						11 12.0		No Recovery	-
.07	63 100/.2	0.70	0.7	0	BGD	12		AA (10'-10.7')	-
								BORING TERMINATED AT 12.7'	

NOTES: Bottom of overburden at 10'. Perched water at 2'. Samples SB60-2.00(0-2"), SB60-2.02(2'-4'), SB60-2.04(6'-8'), SB60-2.00MRD, and SB60-2.20 (duplicate of .00) sent to lab for chemical analysis.

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UNITED STATES ARMY
CORPS OF ENGINEERS
Seneca Army Depot
Romulus, New York

LOG OF BORING SB60-2

LOG OF BORING NO. SB60-3

PROJECT: **SEVEN LOW PRIORITY AOCs**
PROJECT LOCATION: **SENECA ARMY DEPOT, ROMULUS NY**
ASSOCIATED UNIT/AREA: **SEAD-60**
PROJECT NO: **720518-01000**
DATE STARTED: **06/08/94**
DATE COMPLETED: **06/08/94**
DRILLING CONTRACTOR: **EMPIRE SOILS INVESTIGATIONS**
DRILLING METHOD: **HOLLOW STEM AUGER**
SAMPLING METHOD: **3" SPLIT SPOONS**

DEPTH TO WATER (ft): **8.0**
BORING LOCATION (N/E): **986527.0 751622.8**
REFERENCE COORDINATE SYSTEM: **New York State Plane**
GROUND SURFACE ELEVATION (ft): **NA**
DATUM: **NAD 1983**
INSPECTOR: **FO**
CHECKED BY: **FO**

This log is part of the report prepared by Engineering-Science, Inc. for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations.

Sample Number	Blow Counts (# Blows per 6")	Sample Advance (ft)	Sample Recovery (ft)	VOC Screen-PID (ppm)	Rad Screen (cps)	Depth (ft)	Macro Lithology	DESCRIPTION	USCS
.01	1 1 4 8	2.00	1.7	0	BGD	0.3		Brown SILT + very fine to fine SAND, some organic material, little medium Sand, loose, wet to saturated.	ML
						0.6		Gray-brown SILT, little very fine Sand, little(-) organic material, loose, wet.	ML
						0.7		Light brown very fine SAND, trace(+) Silt, saturated.	SP
						1.0		Light gray-brown SILT + CLAY, little(-) very fine Sand, trace organic material, loose, wet.	ML
						1.7		Light gray-brown SILT, little very fine Sand, trace fine Shale fragments, medium stiff, moist.	ML
						2.0		No Recovery	-
.02	46 100/.4	0.90	0.8	0	BGD	2.4		Light brown SILT + very fine SAND, loose, dry.	SM
						2.8		Fractured SHALE, trace iron staining, dry.	-
						4.0		No Recovery	-
.03	50 110	1.00	1.0	0	BGD	5.0		Light brown SILT, little very fine Sand, trace fine Shale fragments, medium stiff, damp.	ML
						6.0		No Recovery	-
.04	36 40 44 50	2.00	1.8	0	BGD	7.8		Gray-brown SILT, little(-) very fine Sand, trace(+) fine Shale fragments, trace medium Shale fragments (7.6-7.8'), trace iron staining, medium stiff, moist.	ML
						8.0	▼	No Recovery	-
.05	21 40 62 45	2.00	1.6	0	BGD	9.2		Gray-brown SILT, little fine to medium Shale fragments, trace very fine Sand, saturated. Very fine Gravel lense (8.9-9.1').	ML
						9.6		Gray weathered, fractured SHALE, saturated.	-
						10.0		No Recovery	-

NOTES: Bottom of overburden at 9.2'. The following samples were collected for chemical analysis: SB60-3.00(0-2"), SB60-3.03(4'-6'), SB60-3.04(6'-8').

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LOG OF BORING SB60-3

PROJECT: **SEVEN LOW PRIORITY AOCs**
PROJECT NO: **720518-01000**
PROJECT LOCATION: **SENECA ARMY DEPOT, ROMULUS NY**

GROUND SURFACE ELEVATION: **NA**
INSPECTOR: **FO**
CHECKED BY: **FO**

This log is part of the report prepared by Engineering-Science, Inc. for the named project and should be read together with that report for complete interpretation. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations.

Sample Number	Blow Counts (# Blows per 6")	Sample Advance (ft)	Sample Recovery (ft)	VOC Screen-PID (ppm)	Rad Screen (cps)	Depth (ft)	Macro Lithology	DESCRIPTION	USCS
.06	20 25 50 45	2.00	1.8	0	BGD	11		Gray, highly weathered SHALE, saturated.	-
								BORING TERMINATED AT 11.8'	

NOTES: Bottom of overburden at 9.2'. The following samples were collected for chemical analysis: SB60-3.00(0-2"), SB60-3.03(4'-6'), SB60-3.04(6'-8').

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LOG OF BORING SB60-3

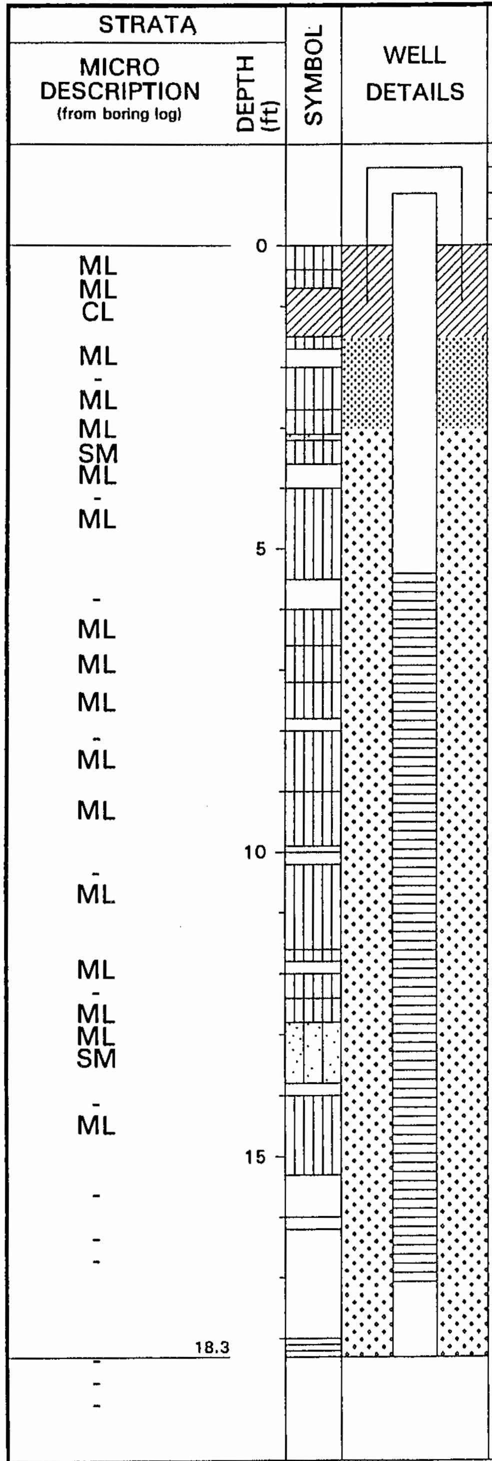
Sheet 2 of 2

MONITORING WELL INSTALLATION DIAGRAMS

COMPLETION REPORT OF WELL No. MW60-1

PROJECT: **SEVEN LOW PRIORITY AOCs**
PROJECT LOCATION: **SENECA ARMY DEPOT, ROMULUS NY**
DRILLING CONTRACTOR: **EMPIRE SOILS INVESTIGATIONS**
DRILLING METHOD: **HOLLOW STEM AUGER**
WELL INSTALLATION STARTED: **03/23/94**
WELL INSTALLATION COMPLETED: **03/23/94**

WELL LOCATION (N/E): **986468.8 751766.4**
REFERENCE COORDINATE SYSTEM: **New York State Plane**
GROUND SURFACE ELEVATION (ft): **746.3**
DATUM: **NAD 1983**
GEOLOGIST: **F. O'LOUGHLIN**
CHECKED BY: **FO**



DEPTH (ft)		ELEVATION (ft)
	TPC	
	TR	
	TC	
0.0	GS	746.3
1.5	TBS	744.8
3.0	TSP	743.3
5.4	TSC	740.9
17.2	BSC	729.1
18.3	POW	728.0

WELL CONSTRUCTION DETAILS

PROTECTIVE COVER
Diameter: **4**
Type: **RISER**
Interval: **3.5**

RISER
Diameter: **2**
Type: **SCH. 40-PVC**
Interval: **5**

SCREEN
Diameter: **2**
Type: **SCH. 40-PVC/0.010**
Interval: **9, 2**

SURFACE SEAL
Type: **CEMENT**
Interval: **1.5**

GROUT
Type: **N/A**
Interval: **N/A**

SEAL
Type: **BENTONITE**
Interval: **1.5**

SANDPACK
Type: **#1, #3**
Interval: **15.3**

WELL DEVELOPMENT DATA
Date: **4/1/94**
Method: **BAIL/PUMP**
Duration: **2 DAYS**
Rate: **2.1 L/MIN**

WATER LEVELS

	Date	Time	Depth,TR
▽	3/31	1605	2.88
▼	4/1	0945	4.20
▽			
▼			
▽			
▼			

Final Measurements:

pH	Temperature (degrees C)	Conductivity (micromhos/cm)	Turbidity (NTU)
7.01	8.5	900	.88

LEGEND

▨	SURFACE SEAL	●	GRAVEL	TPC	TOP OF PROTECTIVE CASING
▩	GROUT	⁘	SAND	TR	TOP OF WELL RISER
░	SEAL	▥	SILT	GS	GROUND SURFACE
⁙	SANDPACK	▨	CLAY	TBS	TOP BENTONITE SEAL
		☒	NO RECOVERY	TSP	TOP OF SANDPACK
				TSC	TOP OF SCREEN
				BSC	BOTTOM OF SCREEN
				TD	TOTAL DEPTH
				POW	POINT OF WELL

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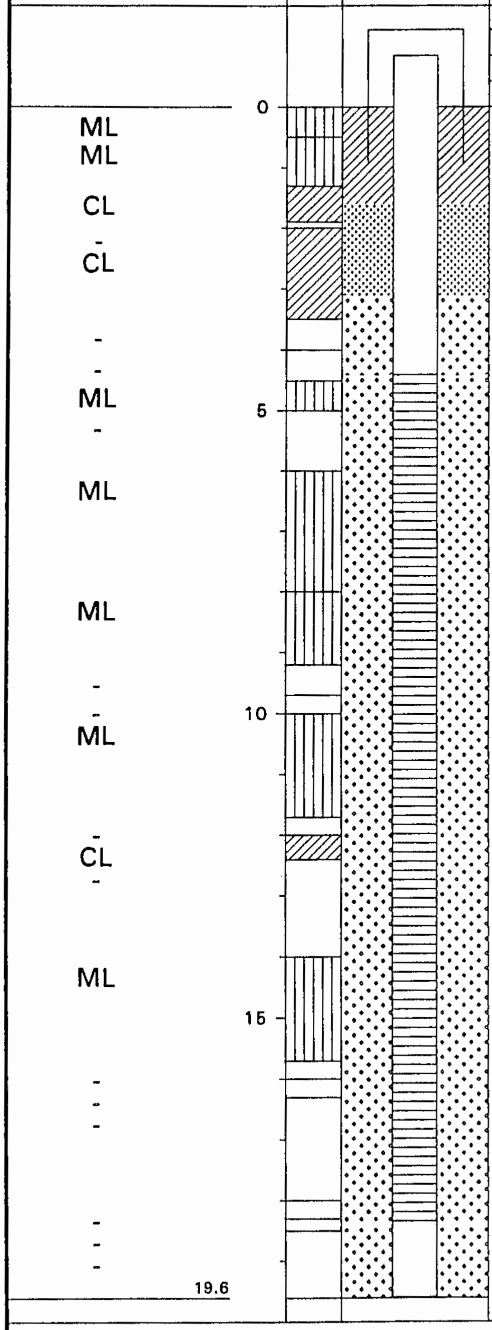
COMPLETION REPORT OF WELL No. MW60-1

COMPLETION REPORT OF WELL No. MW60-2

PROJECT: **SEVEN LOW PRIORITY AOCs**
PROJECT LOCATION: **SENECA ARMY DEPOT, ROMULUS NY**
DRILLING CONTRACTOR: **EMPIRE SOILS INVESTIGATIONS**
DRILLING METHOD: **HOLLOW STEM AUGER**
WELL INSTALLATION STARTED: **03/22/94**
WELL INSTALLATION COMPLETED: **03/22/94**

WELL LOCATION (N/E): **986579.5 751519.3**
REFERENCE COORDINATE SYSTEM: **New York State Plane**
GROUND SURFACE ELEVATION (ft): **744.1**
DATUM: **NAD 1983**
GEOLOGIST: **F. O'LOUGHLIN**
CHECKED BY: **FO**

STRATA — MICRO DESCRIPTION (from boring log) | DEPTH (ft) | SYMBOL | WELL DETAILS



DEPTH (ft)		ELEVATION (ft)
	TPC	
	TR	
	TC	
0.0	GS	744.1
1.6	TBS	742.5
3.1	TSP	741.0
4.4	TSC	739.7
18.4	BSC	725.7
19.6	POW	724.5

WELL CONSTRUCTION DETAILS

PROTECTIVE COVER
Diameter: **4**
Type: **RISER**
Interval: **3.5**

RISER
Diameter: **2**
Type: **SCH. 40-PVC**
Interval: **5.45**

SCREEN
Diameter: **2**
Type: **SCH. 40-PVC/0.010**
Interval: **9, 4**

SURFACE SEAL
Type: **CEMENT**
Interval: **1.6**

GROUT
Type: **N/A**
Interval: **N/A**

SEAL
Type: **BENTONITE**
Interval: **1.5**

SANDPACK
Type: **#1, #3**
Interval: **16.3**

WELL DEVELOPMENT DATA
Date: **3/31/94**
Method: **BAIL/PUMP**
Duration: **2 DAYS**
Rate: **2.1 L/MIN**

WATER LEVELS

	Date	Time	Depth,TR
▽	3/30	1625	3.51
▼	3/31	1451	4.80

Final Measurements:

pH	Temperature (degrees C)	Conductivity (micromhos/cm)	Turbidity (NTU)
7.32	8.0	625	3.40

LEGEND

▨	SURFACE SEAL	●	GRAVEL
▩	GROUT	⁘	SAND
▒	SEAL	▥	SILT
⁙	SANDPACK	▨	CLAY
		☒	NO RECOVERY

TPC	TOP OF PROTECTIVE CASING
TR	TOP OF WELL RISER
GS	GROUND SURFACE
TBS	TOP BENTONITE SEAL
TSP	TOP OF SANDPACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
POW	POINT OF WELL

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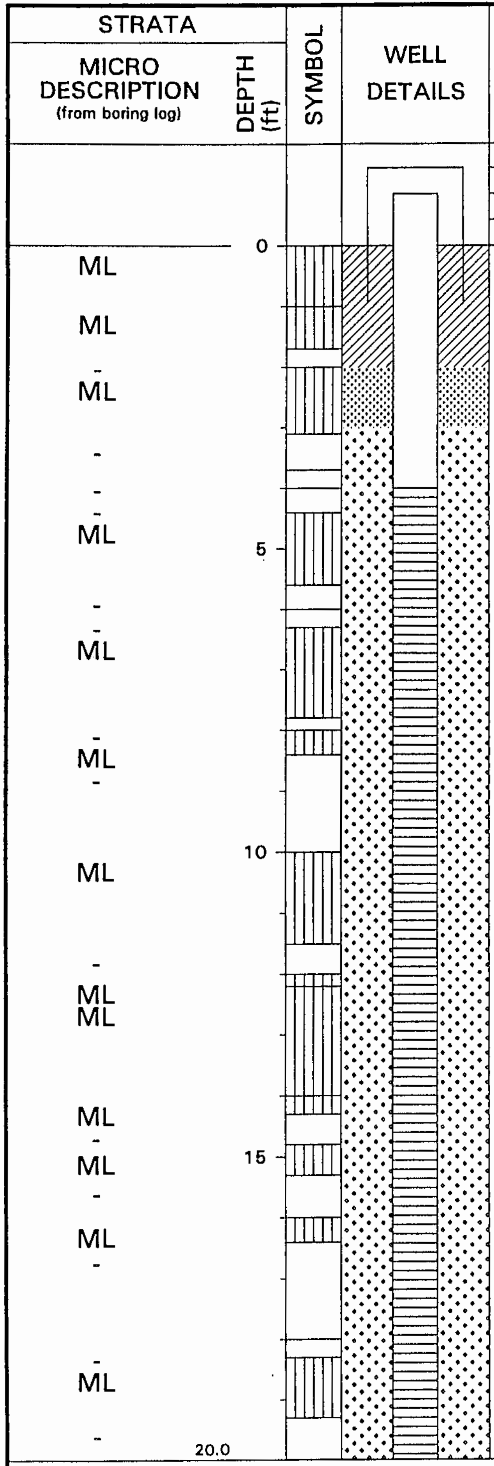
COMPLETION REPORT OF
WELL No. MW60-2

COMPLETION REPORT OF WELL No. MW60-3

PROJECT:	SEVEN LOW PRIORITY AOCs	WELL LOCATION (N/E):	986469.1 751467.0
PROJECT LOCATION:	SENECA ARMY DEPOT, ROMULUS NY	REFERENCE COORDINATE SYSTEM:	New York State Plane
DRILLING CONTRACTOR:	EMPIRE SOILS INVESTIGATIONS	GROUND SURFACE ELEVATION (ft):	743.3
DRILLING METHOD:	HOLLOW STEM AUGER	DATUM:	NAD 1983
WELL INSTALLATION STARTED:	03/02/94	GEOLOGIST:	F. O'LOUGHLIN
WELL INSTALLATION COMPLETED:	03/02/94	CHECKED BY:	FO



DEPTH (ft)		ELEVATION (ft)
	TPC	
	TR	
	TC	
0.0	GS	743.3
2.0	TBS	741.3
3.0	TSP	740.3
4.0	TSC	739.3

WELL CONSTRUCTION DETAILS

PROTECTIVE COVER
Diameter: **4**
Type: **RISER**
Interval: **3.5**

RISER
Diameter: **2**
Type: **SCH. 40-PVC**
Interval: **5.1**

SCREEN
Diameter: **2**
Type: **SCH. 40-PVC/0.010**
Interval: **9, 9**

SURFACE SEAL
Type: **CEMENT**
Interval: **2**

GROUT
Type: **N/A**
Interval: **N/A**

SEAL
Type: **BENTONITE PELLETS**
Interval: **1**

SANDPACK
Type: **#1, #3**
Interval: **21**

WELL DEVELOPMENT DATA
Date: **3/5/94**
Method: **BAIL**
Duration: **95 MIN**
Rate: **2.1 L/MIN**

WATER LEVELS

	Date	Time	Depth,TR
∇	3/5	1000	2.48
▼	3/5	1205	5.00
▼			
∇			
▼			

Final Measurements:

pH	Temperature (degrees C)	Conductivity (micromhos/cm)	Turbidity (NTU)
7.26	9.5	650	4.19

LEGEND

▨	SURFACE SEAL	●	GRAVEL	TPC	TOP OF PROTECTIVE CASING
▩	GROUT	⁘	SAND	TR	TOP OF WELL RISER
▒	SEAL	▥	SILT	GS	GROUND SURFACE
⁘	SANDPACK	▨	CLAY	TBS	TOP BENTONITE SEAL
		☒	NO RECOVERY	TSP	TOP OF SANDPACK
				TSC	TOP OF SCREEN
				BSC	BOTTOM OF SCREEN
				TD	TOTAL DEPTH
				POW	POINT OF WELL

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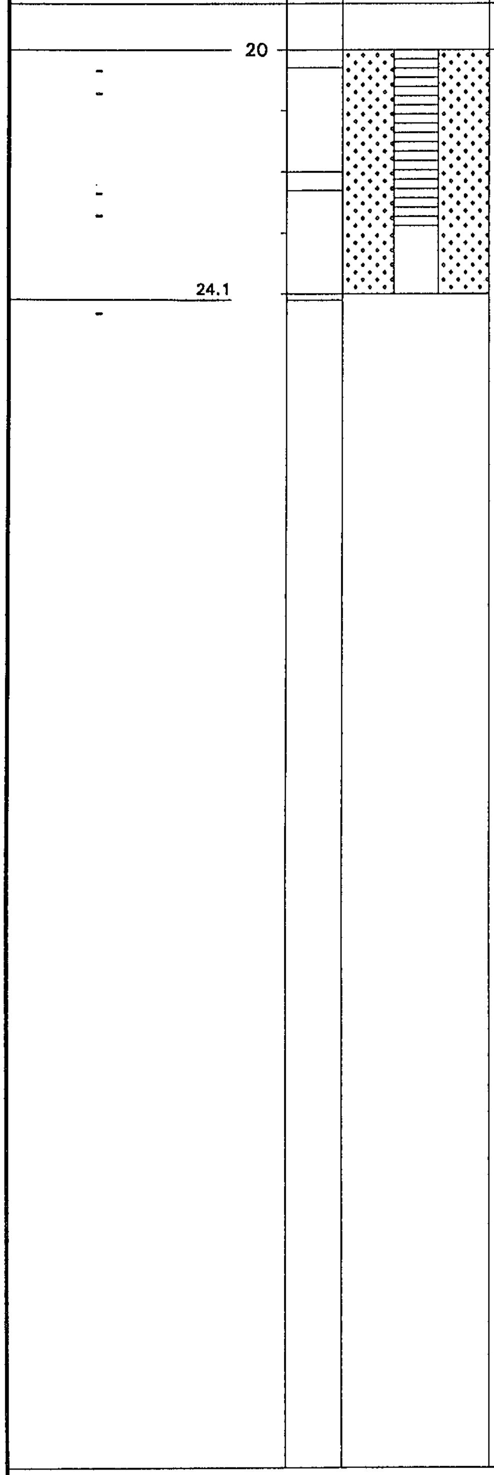
COMPLETION REPORT OF WELL No. MW60-3

COMPLETION REPORT OF WELL No. MW60-3

PROJECT: **SEVEN LOW PRIORITY AOCs**
PROJECT NO: **720518-01000**
PROJECT LOCATION: **SENECA ARMY DEPOT, ROMULUS NY**

GROUND SURFACE ELEVATION (ft): **743.3**
GEOLOGIST: **F. O'LOUGHLIN**
CHECKED BY: **FO**



STRATA MICRO DESCRIPTION (from boring log)	DEPTH (ft)	SYMBOL	WELL DETAILS	DEPTH (ft)		ELEVATION (ft)	WELL CONSTRUCTION DETAILS
							(See Page 1)
	20						
				23.0	BSC	720.3	
	24.1			24.0	POW	719.3	

LEGEND

▨	SURFACE SEAL	●	GRAVEL
▩	GROUT	⁚	SAND
░	SEAL	‖	SILT
⁘	SANDPACK	▨	CLAY
		☒	NO RECOVERY

TPC	TOP OF PROTECTIVE CASING
TR	TOP OF WELL RISER
GS	GROUND SURFACE
TBS	TOP BENTONITE SEAL
TSP	TOP OF SANDPACK
TSC	TOP OF SCREEN
BSC	BOTTOM OF SCREEN
TD	TOTAL DEPTH
POW	POINT OF WELL

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