U.S ARMY ENGINEER DIVISION
HUNTSVILLE, ALABAMA

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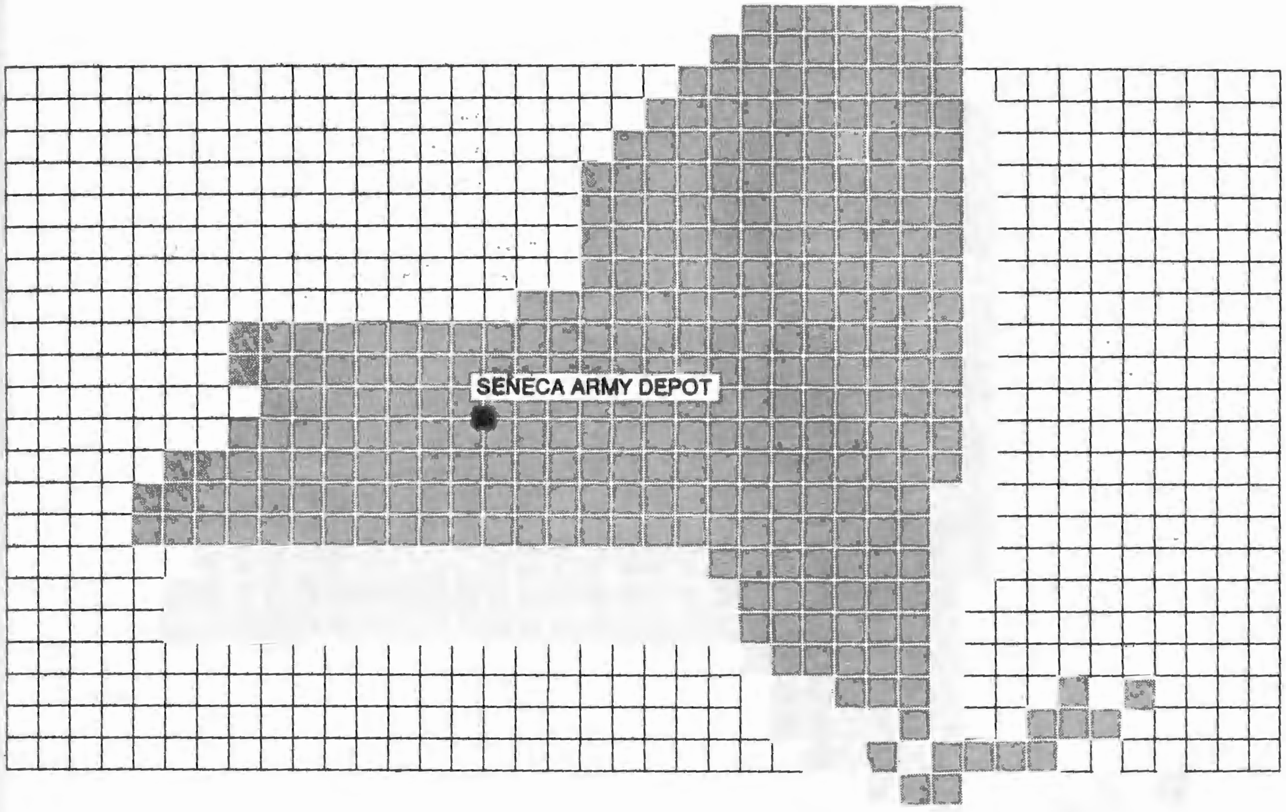

PRELIMINARY SITE CHARACTERIZATION REPORT AT THE OPEN-BURNING (OB) GROUNDS

PRELIMINARY SITE CHARACTERIZATION REPORT
OPEN BURNING (OB) GROUNDS
SENECA ARMY DEPOT
ROMULUS, NEW YORK

Prepared For:

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April 1992

APPROVAL SHEET

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LIST OF ACRONYMS

AA	Atomic Adsorption
AB/N's	Acid, base/neutrals
AOC	Areas of Concern
ASTM	American Society for Testing and Materials
B&B	Blasland and Bouck
Ba	Barium
BOD	Biological Oxygen Demand
bp	before present
CEC	Cation exchange capacity
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CLP	Contract Laboratory Program
cm	Centimeters
COD	Chemical Oxygen Demand
Cr	Chromium
Cu	Copper
$CaCO_3$	Calcium Carbonate
Cd	Cadmium
DARCOM	Development and Readiness Command
DO	Dissolved oxygen
DOT	Department of Transportation
EM	Electromatic
EPA	Environmental Protection Agency
ESE	Environmental Science and Engineering
ft	Feet
ft/ft	Feet per foot
ft/sec	Feet per second
ft/yr	Feet per year
GAE	Geophysical anomaly excavations
Gc	Gas chromatograph
gpm	Gallons per minute
GPR	Ground penetrating radar
GSSI	Geophysical Survey Systems, Inc.
ICF	ICF Technology, Incorporated
Koc	Organic carbon coefficient
L/min	Liters per minute
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

(Con.t)

MSL	Mean sea level
MW	Monitor Well
NA	Not analyzed or not available
NBS	National Bureau of Standards
NGVD	National Geologic Vertical Datum
NPL	National Priority List
NSF	National Sanitation Foundation
NTU	Nephelometric turbidity units
NYSDEC	New York State Department of Environmental Conservation
OVM	Organic Vapor Meter
Pb	Lead
PCB	Plychlorinated Biphenyls
PID	Photoionization detector
ppm	parts per million
ppmv	Part Per MIllion Per Volume
PT	Monitoring Well
PVC	Polyvinyl Chloride
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RF	Response Factor
RI	Remedial Investigation
RQD	Rock Quality Designation
SCS	Soil Conservation Service
SEAD	Seneca Army Depot
Sec	Seconds
SIR	Subsurface Interface Radar
SS	Soil sample
SW	Sediment and surface water sample station
SWMU	Solid Waste Management Unit
TAL	Target analyte list
TCE	Trichloroethylene
TCL	Target compound list
TDS	Total dissolved solids
TOC	Total Organic Carbon
TOX	Total Organic Halogens
TS	Total Solids
ug/g	Micrograms per gram
ug/kg	Micrograms per kilogram
ug/L	Micrograms per liter
USACE	United States Army Corps of Engineers

LIST OF ACRONYMS
(Con.t)

USAEHA	United States Army Environmental Hygiene Agency
USATHAMA	United States Army Toxic and Hazardous Materials Agency
USCS	Unified Soil Classification System
USGS	United States Geological Survey
VC	Vinyl Chloride
VOA	Volatile organic analyte
VOC	Volatile Organic Compound
Zn	Zinc

1.0 INTRODUCTION

This Preliminary Site Characterization Report is submitted as the first phase of the Remedial Investigation (RI). Chas. T. Main, Inc. (MAIN) has been retained by the United States Army Corps of Engineers (USACE) as part of their remedial response activities under the Comprehensive Environmental Responsibility, Compensation and Liability Act (CERCLA) to perform these activities. The purpose of this report is to discuss the physical characteristics of the site, review the analytical results from the investigation programs, and identify sources of the potential contamination at the site. The Open Burning ground site is included on the federal facilities National Priorities List (NPL) and has been listed since July 13, 1989.

1.1 BACKGROUND

1.1.1 Site Description

Seneca Army Depot (SEAD) is an active military facility constructed in 1941. The site is located approximately 40 miles (mi) south of Lake Ontario, near Romulus, New York (Figure 1-1). The facility is located in an uplands area, at an elevation of approximately 600 feet MSL, that forms a divide separating two of the New York Finger Lakes, Cayuga Lake on the east and Seneca Lake on the west. Sparsely populated farmland covers most of the surrounding area. New York State Highways 96 and 96A adjoin SEAD on the east and west boundaries, respectively. Since its inception in 1941 SEAD's primary mission has been the receipt, storage, maintenance, and supply of military items. This function includes the disposal of military ammunition and explosives by burning and detonation. The open burning/open detonation (OB/OD) grounds are located in the northwest portion of SEAD. Figure 1-2 presents a site plan of SEAD and identifies the location of the OB/OD grounds.

The OB/OD area is situated on gently sloping terrain, vegetated with grasses and brush. Drainage is generally to the east-northeast via a series of drainage ditches and culverts into Reeder Creek. There are several poor drainage areas where water collects at certain times of the year. Low surface gradients of less than 40 feet in 2,500 feet, and a high fine content in the surface soils and underlying glacial till deposits contribute to poor drainage conditions. Originally, open burning of munitions was conducted directly on the land surface. Due to the poorly drained nature of the soils, the individual burn pads were later built up with crushed, broken shale to allow for a drier burn of the munition wastes.

1.1.1.1 Regional Geologic Setting

The Finger Lakes uplands area is underlain by a broad north-to-south trending series of rock terraces mantled by glacial till. As part of the Appalachian Plateau, the region is underlain by a tectonically undisturbed sequence of Paleozoic rocks consisting of shales, sandstones, conglomerates, limestones and dolostones. Figure 1-3 shows the regional geology of Seneca County. In the vicinity of SEAD, Devonian age (385 million years bp) black shale of the Hamilton group is monoclinally folded and dips gently to the south. No evidence of faulting or folding of the sediments is present.

Locally, the shale is soft, grey, and fissile, and is mapped as the upper member of the Hamilton Group. Figure 1-4 displays the stratigraphic section of Paleozoic rocks of Central New York. The shale contains interbeds of calcareous shale and limestone. The shale is extensively jointed and weathered at the contact with overlying tills. Joint spacings are 1 inch to 4 feet in surface exposures. Prominent joint directions are N 60° E, N 30° W, and N 20° E, with the joints being primarily vertical. Corings performed on the upper 5 to 8 feet of the bedrock revealed low Rock Quality Designations (RQD's), i.e., <5% with almost 100% recovery.

Pleistocene age (Wisconsin event, 20,000 bp) glacial till deposits overlie the shales. Figure 1-5, the physiography of Seneca County, presents an overview of the subsurface sediments present in the area. The site is shown on Figure 1-5 as lying on the western edge of a large glacial till plain between Seneca Lake and Cayuga Lake. The till matrix, the result of glaciation, varies locally but generally consists of horizons of unsorted silt, clay, sand, and gravel. The soils at the site contain varying amounts of inorganic clays, inorganic silts, and silty sands. The till thickness varies from 1-50 meters. In the central and eastern portions of the SEAD the till is thin and bedrock is exposed or within 3 feet of the surface in some locations. Thickness of the glacial till deposits at SEAD generally range from 1 to 15 feet.

Darien silt-loam soils, 0 to 18 inches thick, have developed over Wisconsonian age glacial tills. These soils are developed on glacial till where they overlie the shale. In general, the topographic relief associated with these soils is 3-8%. Around the burning pads much of the topsoil has been disturbed or removed in association with construction of the berms that surround each of the pads. The burning pads themselves have a layer of broken shale fill at the surface that is as much as 2 feet thick in places. Figure 1-6 presents the U.S. Department of Agriculture General Soil map for Seneca County. Figure 1-7 presents the soil map for the area surrounding the OB/OD grounds.

The background chemical composition of these soils has not been defined. Table 1-1 compares the average metal content in shale, sandstone, limestone, soil and sediment of the Great Lakes for arsenic, barium, cadmium, chromium, mercury, lead and selenium. These are many of the same heavy metals of concern associated with open burning activities. The table shows shales to contain from 2 to more than 10 times the quantity of metals found in other sedimentary rocks. This is due to the cation complexing capacity of the clays that make up the shales. It is probable that soils developed over shales, or over tills derived from shales, would contain metal values greater than those listed for average soils.

1.1.1.2 Regional Hydrogeologic Setting

Regionally, four distinct hydrologic units have been identified within Seneca County. These include two distinct shale formations, a series of limestone units, and unconsolidated beds of Pleistocene glacial drift. Overall, the groundwater in the county is very hard, and therefore, the quality is minimally acceptable for use as potable water. Figure 1-8 shows the distribution of private wells in the area around SEAD. Approximately 95 percent of the wells are used for domestic or farm supply and the average daily withdrawal is approximately 500 gallons (0.35 gpm). About five percent of the wells in the County are used for commercial, industrial, or municipal purposes. Seneca Falls and Waterloo, the two largest communities in the County, are in the hydrogeologic region which is most favorable for the development of a groundwater supply. However, because the hardness of the groundwater is objectionable to the industrial and commercial establishments operating within the villages, both villages utilize surface water as their municipal supplies. The villages of Ovid and Interlaken, both of which are without substantial industrial establishments, utilize groundwater as their public water supplies. Ovid obtains its supply from two shallow gravel-packed wells, and Interlaken is served by a developed seepage-spring area.

Regionally, the pheratic aquifer of the unconsolidated surficial glacial deposits of the region would be expected to flow in a direction consistent with the ground surface elevations. Geologic cross-sections from Seneca Lake and Cayuga Lake have been constructed by the State of New York, (Mozola, A.J., 1951, and Crain, L.J., 1974). This information suggests that a groundwater divide exists approximately half way between the two finger lakes. SEAD is located on the western slope of this divide and therefore regional surficial groundwater flow is expected to be westward toward Seneca Lake.

A substantial amount of information concerning the hydrogeology in the area has been compiled by the State of New York, (Mozola, A.J., 1951). These reports have been reviewed in order to better understand the hydrogeology of the area surrounding SEAD. The data indicates that within a four (4) mile radius of the site a number wells exist from which geologic and hydrogeologic information has been obtained. This information includes: 1) the depth; 2) the yield; and 3) the geological strata the wells were drilled through. Although the information was compiled in the 1950's, these data are useful in providing an understanding and characterization of the aquifers present within the area surrounding SEAD.

A review of this information indicates that three geologic units have been used to produce water for both domestic and agricultural purposes. These units include: 1) a bedrock aquifer, which in this area is predominantly shale; 2) an overburden aquifer, which includes Pleistocene deposits (glacial till); and 3) a deep aquifer present within beds of limestone interlying the underlying shale. The occurrence of water derived from limestone is considered to be unusual for this area and is more commonplace to the north of this area. The limestone aquifer in this area is between 100-700 feet deep. As of 1957, twenty-five wells utilized water from the shale aquifer, six wells tapped the overburden aquifer, and one used the deep limestone as a source of water.

For the six wells which utilized groundwater extracted from the overburden, the average yield was approximately 7.5 gpm. The average depth of these wells was thirty-six feet. The geologic material which comprises this aquifer is generally Pleistocene till, with the exception of one well located to the northeast of the site. This one well had penetrated an outwash sand and gravel deposit. The yields from these overburden wells ranged from 4 to 15 gpm. The well located in the outwash sand and gravel deposit, drilled to 60 feet, yielded only 5 gpm. A 20 foot hand dug well, located southeasterly from the outwash well, yielded 10 gpm. The difference in well yield could be influenced by the difference of the diameter of the two wells.

The geologic information reviewed indicates that the upper portions of the shale formation would be expected to yield small supplies of water, although adequate for domestic use. For mid-Devonian shales such as those of Hamilton group, the average yields, (i.e., less than 15 gpm), are consistent with what would be expected for shales (LaSala, 1968). The deeper portions of the shale formation, (i.e., at depths greater than 235 feet) have provided yields up to 150 gpm. Within the deeper sections of the shale, limestone cavities are encountered which provide substantial quantities of water. This source of water is considered to comprise a separate source of groundwater for the area. Very few wells in the region adjacent to SEAD utilize the limestone as a source of water, which may be due to the drilling depths required to intercept this water.

1.1.1.3 Local Hydrogeology

The previous studies at the OB/OD site have focused upon evaluating groundwater from the unconfined till. These studies have assumed that any groundwater in the till and the underlying fractured/weathered shales are essentially the same aquifer. The water table for the shallow aquifer is 3-6 feet deep, while the shale-till contact is from 3 to 15 feet below the ground surface. Recharge to these shallow aquifers is via percolation associated with local precipitation which averages 29.4 inches per year.

Surface water and shallow groundwater flow at the OB/OD site are directed northeast into Reeder Creek which is in a sub-basin within the main Seneca Lake drainage basin. Figure 1-9 provides an indication of surface drainage patterns at the site. Reeder Creek is located approximately 1,000 feet northeast of burning pad A and flows north through the Demolition Grounds and then turns west and discharges into Seneca Lake, approximately three miles away.

On-site hydraulic conductivity determinations were performed by Metcalf and Eddy (M&E) (1989) on monitoring wells MW-8 through MW-17. These wells are all screened within the glacial till unit. The data were analyzed according to a procedure described by Hvorslev (1951). The average hydraulic conductivity measured for the ten monitoring wells was 5.0×10^{-1} ft/day (1.8×10^{-4} cm/sec). The hydraulic conductivities ranged from 2.02×10^{-2} ft/day (7.06×10^{-6} cm/sec) to 1.47 ft/day (5.19×10^{-4} cm/sec). These hydraulic conductivity measurements were within an order of magnitude agreement with previous results reported by O'Brien and Gere (1984). O'Brien and Gere determined the average hydraulic conductivity of the till material to be approximately 2.8×10^{-1} ft/day (9.9×10^{-5}cm/sec). A comparison of the measured values with the typical range of hydraulic conductivities for glacial tills indicates that the glacial till at the site exists along the more permeable end of typical glacial till values.

Soils samples were collected during the 1984 U.S. Army Environmental Hygiene Agency (USAEHA) Phase IV investigation of the burning ground to characterize the permeability of the burning pad soils. Soil permeabilities were measured by recompacting the soil in a mold to 95% standard proctor density. The average permeability for five (5) measurements was 1.01×10^{-3} ft/day (3.56×10^{-7} cm/sec). The typical range of glacial tills described by Freeze and Cherry (1979), is between 3×10^{-1} ft/day (1×10^{-4} cm/sec) and 3×10^{-7} ft/day (1×10^{-10} cm/sec).

Based upon water level measurements made in monitoring wells MW-8 through MW-17, M&E generated a groundwater elevation map for the OB grounds. This map indicates that groundwater, within the glacial till deposits, flows primarily northeast, towards Reeder Creek. The change in elevation of the groundwater surface generally follows the drop in elevation of the land surface towards Reeder Creek.

1.1.2 Site History

Open burning-open detonation (OB/OD) operations had been conducted for more than forty years in the 90 acre munitions destruction area. The OB grounds occupy an area of approximately 30 acres within the southern portion of the munitions destruction area. Originally open burning was conducted directly upon the ground surface. Due to the seasonally wet nature of the local soils the individual burn pads were subsequently built up to provide a drier environment in which to perform the munitions burning. The burning of munitions has been performed at the nine burning pads labeled A through G and J. The practice of open burning on these pads was discontinued in 1987. At present the burning of munitions is done within an open air, steel enclosure located near burning pad D.

1.1.3 Previous Investigations

A substantial volume of data is available for the open burning grounds. Soil sampling, monitoring well installation, and groundwater sampling have all been performed under various investigative programs conducted at the OB grounds. Information is available on the overburden conditions and the direction of groundwater flow at the site with a level of detail sufficient to initially characterize the physical setting of the OB Grounds.

The following reports have provided data on the OB\OD grounds:

1. Installation Assessment of Seneca Army Depot, Report No. 157, AMXTH-IR-A-157, January 1980; Conducted by the U.S. Army Toxic and Hazardous Materials Agency, (USATHAMA).

2. Phase 2, Hazardous Waste Management Special Study: No. 39-26-0147-83, US Army Material Development and Readiness Command (DARCOM) Open-Burning/Open Detonation Grounds Evaluation, 1983.

3. O'Brien and Gere Engineers, Burning Pads B and H Closure, 1985

4. Phase 4 Evaluation of the Opening Burning/Open Detonation Grounds. Investigation of Soil Contamination, 1984; Conducted by the US Army Environmental Hygiene Agency, (USAEHA).

5. Evaluation of Solid Waste Management Units, Seneca Army Depot, Interim Final Report, Groundwater Contamination Survey No. 38-26-0868-88, 1988; Conducted by USAEHA.

6. Metcalf & Eddy, Criteria Development Report for Closure of Nine Burning Pads, 1989.

The complete list of references is given in the Reference section of this document. The results of these various investigations are briefly summarized below.

The US Army Toxic and Hazardous Materials Agency (USATHAMA) conducted an evaluation of the Seneca Army Depot beginning in May of 1979. This study concluded: 1) geological conditions are such that contaminants, if present, could migrate in surface or subsurface waters; and 2) the demolition/ burning ground is potentially contaminated with heavy metals and explosives.

Following to the depot assessment, conducted by USATHAMA, a four phased DARCOM Open Burning/Open Detonation Ground Evaluation was begun in 1981. Monitoring wells MW-1 through MW-7 were installed in 1981. Six of the monitoring wells were installed along the perimeter of the site while monitoring well MW-1 was located between the detonation ground and the burn pads. The wells were screened in the glacial till at, or just above, the till-shale (bedrock) contact. Groundwater monitoring began in January, 1982. Groundwater sampling for metals and explosives has been done on a regular basis since 1982.

Historic chemical analyses for monitoring wells MW-1 through MW-7 are summarized in Table 1-2 and in Appendix A. The last 5 quarters of sampling data are included within this Appendix to provide data on the chemical constituents present within the groundwater. The full set of historic chemical analyses indicate that throughout the 6 year period of sampling no explosive components were detected within the groundwater. In addition, only iron and manganese exceeded the New York state groundwater standards.

No EP Toxicity metals or explosives were detected in the 27 samples analyzed in the first year. Monitoring of these original wells continued on an annual basis through 1987 for explosives, metals, TOC, TOX, pH, pesticides, nitrates, and specific conductivity. These results are summarized in the USAEHA Ground Water Contamination Survey No. 38-26-0868-88, Interim Final Report on the Evaluation of Solid Waste Management Units (SWMU), and are presented within Table 1-3.

The Phase II study (No. 39-26-0147-83), was performed in 1982 in order to characterize the environmental hazards associated with the OB/OD area. This study concentrated on attempting to determine total explosive and metal content in soils and residues. The Phase 2 report concluded that the areas were not hazardous by characteristic EP Toxicity for heavy metals, although two of three samples from Pad B exceeded the barium standard and two of the three Pad H samples exceeded lead standards. This study recommended that no additional studies be conducted.

Based on the data from the Phase 2 investigation, O'Brien & Gere Engineers, Inc. were contracted in 1984 to review previous studies and recommend procedures for the environmentally sound closure of Burning Pads B and H following RCRA guidelines. The report was prepared under Contract DAC87-84-C-0077, dated November 1984 and was based on analytical data from previous studies and limited geophysical surveys of the two pads. O'Brien and Gere's recommended closure procedure was excavation, on-site treatment, and removal of contaminated material to a permitted and secure off-site landfill, with subsequent capping of the site. There were no recommendations made regarding the remaining seven pads as they were not included in this study.

During 1984, in a study nearly coincident with the O'Brien and Gere study, the U.S. Army Environmental Hygiene Agency (USAEHA) conducted an additional investigation of the soils at Burn Pads B, F, and H (Phase 4 Evaluation, Hazardous Waste Study No. 37-26-0479-85, USAEHA). Sample locations and data results from the Phase 4 program for Burning Pads B, F and H are summarized in Figures 1-10 through 1-12, respectively. Soils at Pad B were found to contain Lead (101 ppm) and Barium (424 ppm) at levels that exceed the EP Toxicity limits of 5 ppm and 100 ppm (respectively). Pads F and H both had one soil sample that exceeded the standards for lead, (5 ppm), while the Pad H soil sample also showed small amounts of 2,6-DNT and 2,4-DNT. Groundwater samples contained lead concentrations up to 112 ppb at Pad F which exceed the 25 ppb NY State groundwater standards for lead. The results of this investigation are also summarized in Table 1-3.

In 1989 Metcalf and Eddy Engineers (M&E) were contracted to evaluate previous studies, conduct further investigations as necessary, and develop a closure plan at the open burning site. Their investigation included: a limited geophysical investigation to assist in locating monitoring wells, the installation of ten additional monitoring wells, and sampling and analyses of the ten new wells and six of the seven existing wells. The monitoring well construction details for wells MW-1 through MW-17 are summarized in Table 1-4.

During the installation of the ten additional monitoring wells, M&E completed sieve analyses with samples collected from the monitoring wells. The sieve analyses, were performed in accordance with ASTM methods, and characterized the till as poorly sorted sands with some silt and clay. Core samples were collected from the upper fracture zones in the shale. The Rock Quality Designations (RQD) ranged from 0-37%. Hydraulic conductivity measurements ranged from 0.02 to 1.47 feet per day. These conductivities are in general agreement for tabulated ranges in glacial tills and fractured shale. Based upon groundwater level measurement the groundwater flow direction was determined to be northeast towards Reeder Creek.

Following the development of the ten new wells and six of the seven previous wells (MW-7 was dry and not re-developed), groundwater samples were collected for EP Toxicity metals and explosive analysis. None of the groundwater samples collected from the new wells contained metals or explosives greater than established criteria. Although several of the previous six wells had elevated metals, this was attributed to poor well development as evidenced by water turbidity. No well samples were filtered prior to acidification.

1.1.4 Conceptual Site Model

1.1.4.1 Physical Site Characterization

The nine open-air munitions burning pads and adjoining area occupy a thirty acre area of concern (AOC) within the entire explosives demolition area. An active ordinance disposal site is within this demolition area, but is not a part of this study. The Open Burning (OB) Ground is located in the northwest portion of the Seneca Army Depot. Annual rainfall is approximately 30 inches and surface water drainage flows westward into Seneca Lake via several small creeks, including Reeder Creek. Overall site relief is low, approximately 20 feet in 2,500 feet ($<1\%$).

The individual burn pads at the OB grounds are constructed of crushed shale that was quarried from on-site areas. The burn pads form the topographic highs on the site. The silty clay loam soils at the site have developed over glacial tills and have very poor percolation characteristics. The original burn pads were built directly on these seasonally wet soils. Eventually the pads were built up with crushed shale because it was difficult to maintain burning on these wet soils. Berms around the pads are composed of soil and till pushed up and around the pads.

The surficial geologic deposits at the site are composed of glacial till. The till has a high clay percentage and a variable distribution of sand and gravel present within it. The thickness of the till does not exceed 20 feet anywhere within the OB grounds. The tills range in composition from a dense, clay rich till to a sandy gravel till across the site. This variation in composition also leads to variable hydraulic conductivities measured at the site.

Black fissile shale ($\pm$500 feet thick), with interbedded limestone, is the bedrock. The shale has been relatively unaffected by tectonic events as evidenced by the shallow dip of bedding of approximately 35 feet per mile towards the south. The upper 3 to 5 feet of shale is highly weathered as a result of glaciation and normal erosion. RQD's for core samples taken from the upper 5 to 8 feet of shale were generally less than 5% with the highest measured RQD value being 37%. The tectonically undisturbed nature of the shales in this area reduces the potential of vertical migration of shallow groundwater into deeper (>100 feet) aquifers.

As many as three distinct geologic units aquifers exist in the OB/OD area, which store and transmit groundwater. These include glacial till, the weathered shale immediately below the till, and the underlying competent shales and limestone. Groundwater flow within the shallow, unconfined aquifer present within the glacial till and weathered shale tends to follow surface water drainage which moves eastward towards Reeder Creek. Measured hydraulic conductivities of the glacial tills and the wetland shale fall within a broad range, indicative of the poorly sorted nature of these deposits. Hydraulic characteristics of the deep, confined, bedrock aquifer is not presently understood. The groundwater at the Seneca OB/OD grounds has been classified by NYSDEC as GA. The best usage of class GA waters is as a source of potable water supply. Class GA waters are fresh groundwater found in the saturated zone of unconsolidated deposits and consolidated rock or bedrock.

From the mouth of Reeder Creek to a point 2 miles upstream, the surface water at the site has been classified as C(T). From this point to the source of the creek, Reeder Creek is classified as D. The best use of Class C waters is for fishing and fish propagation. These waters shall be suitable for fish propagation and survival including trout. The (T) designation of the surface water classification refers to this stream being a trout stream. The water quality shall be suitable for primary and secondary contact recreation although other factors may limit the use for these purposes. Class C(T) refers to the suitability of these waters for trout, which is reflected in the water quality standards for dissolved oxygen, (the minimal daily average may not be less than 6.0 mg/l; the minimum single value is 5 mg/l). Class C(T) waters must also meet criteria for coliform, pH, and TDS. Class D waters are suitable for fishing. The water quality shall be suitable for primary and secondary contact recreation, even though other factors may limit the use for that purpose. Due to such natural conditions as intermittency of flow and the water conditions not being conducive to the propagation of game fishery of stream bed conditions, the waters will not support fish propagation. However, Class D waters must meet criteria set for coliform, pH, and dissolved oxygen.

1.1.4.2 Chemical Characterization

SEAD's primary mission has been the receipt, storage, maintenance, and supply of military items. This function includes the disposal of military ammunition and explosives by burning and detonation. During, and subsequent to burning, potential contaminants may have been dispersed into the environment, away from the individual burning pads. Explosions associated with burning may have ejected materials from pad sites. Ash generated during burning, and ash and dust subsequent to burning, can result in the wind-blown dispersal of the more volatile or light-weight particles.

Erosion, dissolution, degradation, and biodegradation allow a variety of materials to disperse into the soils beneath, and downslope from, the pads and berms. Surficial erosion may have transported dissolved and suspended materials along drainage paths, potentially into surface waters (Reeder Creek) and off the site. Relatively level topography and indirect drainage paths with intermittent poor draining areas decreases surface dispersal by erosion or surface water. The high clay content of the soil and underlying till will reduce percolation of surface water into the groundwater but will encourage run-off, particularly during large storm events.

Activities associated with pad maintenance and construction, and possible unknown activities (i.e, trenches) increase the possibility of contaminants being dispersed. Visual inspection during a preliminary site visit found metallic materials on most of the pads, with some unexploded ordnance present. The contaminant levels in the berms may constitute the most significant area for pollutant accumulation, as field evidence and previous reports suggest the pads were cleared by dozing the residual material into the berms. The berms may also be more permeable due to poor compaction and continued disturbance by heavy equipment.

Planning for burns included consideration of environmental factors. Although the possibility exists for dispersal during burn activities, precautions were taken to minimize these occurrences. These precautions would tend to reduce the possibility of contaminants leaving the disposal site. The precautions included burning only during very low wind conditions and during times of no precipitation. These restrictions reduced the risk of materials escaping the area of concern during burn operations, via wind or surface erosion. Additionally, enclosed cages were used to minimize the risk of projectiles being ejected from burn sites. Propellant burns were policed to recover unburned material which was collected and disposed of in subsequent burns.

Explosives

Table 1-5 presents information which will serve as a basis for understanding the likely environmental fate of explosives at the burning grounds. The chemical class of the compounds identified in Table 1-5 is considered to be semi-volatile. This is based upon the high molecular weights of these compounds and their low vapor pressures, typical of most semi-volatile 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 torr (24 ppm). Compared to Benzene, a volatile compound, which has a vapor pressure of 95.2 torr (125,000 ppm) it is apparent that volatilization of this compound is expected to be low, especially in soils which have a high clay content. Soils with a high clay content generally have a high, >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 soils. 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 (CEC), 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 other 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, (30,000 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 (MP) of these compounds indicates that these compounds 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. A 1985 USATHAMA evaluation of the critical parameters affecting the migration of explosives through soils 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. 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.

The sorption of organic chemicals is a function of the chemical and the media it is in contact with. The organic carbon sorption coefficient, K_{oc}, defines the ability of a chemical to sorb. The higher the K_{oc}, the better the potential for the chemical to be sorbed. Consequently, those chemicals with high K_{oc}'s will tend to remain bound to the soil, especially if the soil contains a substantial quantity of such materials as organic matter and/or clay. The compounds considered in this evaluation show sorption coefficients K_{oc} which range from approximately 100 to 500. The OB site soils have been shown to possess a high percentage of fines including clay, thereby increasing the sorption potential of these compounds to the soil. Table 1-6 provides a basis for evaluating the relationship between mobility in the soil and K_{oc}. For the range of K_{oc} exhibited by explosives, i.e., 100-500, these compounds would be considered to be intermediately mobile.

Environmental Degradation of Explosives

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, MAIN has performed a review of the available information which indicates that nitroaromatic and nitramines 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. Figure 1-13 provides a summary of the identified byproducts resulting from environmental degradation. Figure 1-14 presents byproducts which have been identified from the breakdown of 2,4-DNT. The environmental fate of RDX is less defined than that of the other two compounds previously mentioned. Figure 1-15 provides an overview of the expected degradation pathways and the byproducts produced as a result of this degradation. Clearly, the number of byproducts which have been identified is 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 is unavailable, USATHAMA has developed Method 8330. This method is intended for the analysis of explosive residues in water, soils and sediments.

Table 1-7 presents a breakdown of each explosive analyte, and evaluates each compound as either a primary explosive analyte or a breakdown product. Method 8330 has been the procedure used for the analysis of explosive residues at SEAD. This method is the latest most up-to-date version of Methods SMO-1 and SMO-2 and is the method required by the USACE.

Heavy Metals

The behavior of heavy metals in soil is unlike organic compounds in many aspects. For example, volatilization of metals from soil is not considered a realistic mechanism for pollutant migration and will not be considered. However, leaching and sorption will be considered.

Leaching of heavy metals from soil is controlled by numerous factors. Most importantly is its chemical form (base metal or cation) 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 Styphnate, Lead Azide, and Mercury Fulminate are likely heavy metal salts or complexes which were burned on the pads. During the burning of these materials, a portion of these salts were likely oxidized 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 can be solubilized, eventually leaching to the groundwater.

Heavy metals may also exist in the base metallic form as a component of the projectile itself. 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.

1.2 OFF-SITE WELL INVENTORY

Eleven private homes with private drinking water wells were identified within a one-mile radius of the OB grounds (Figure 1-8). The wells which are west and north of the site. The nearest location with wells is a house located approximately 2.400 feet west of the OB Grounds on Route 96A. Other off-site wells are located along 96A and McGrane Road.

1.3 REPORT ORGANIZATION

The remaining sections of this report are organized to describe the investigation programs, the results of the data collected during the RI and to identify the magnitude and extent of contamination. Section 2.0 (Study Area Investigation) presents a description of the important site features, characteristics, sources of contamination and discusses the investigation programs (i.e., geophysical, surface water and sediment, soils, groundwater, and ecological) performed during the RI. Section 3.0 discusses the results of the investigation programs. Specifically, surface features, ecology, surface water hydrology and sediments, geology and hydrogeology are discussed. The nature and extent of contamination on and off-site is discussed in Section 4.0. Appendices are included within a seperate volume and contain the data on which the text and conclusions are based.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 1-1
AVERAGE BACKGROUND CONCENTRATIONS FOR ROCKS, SOILS, AND SEDIMENTS

COMPOUND	SHALE	SANDSTONE	LIMESTONE	SOILS	SEDIMENTS (1)
Arsenic	15	1	2.5	5	12
Barium	700	50	100	500	NA
Cadmium	0.2	<0.1	0.1	1	2.5
Chromium	100	35	10	50	75
Mercury	0.5	0.07	0.05	0.03	0.0
Lead	40	7	8	20	55
Selenium	0.6	NA	0.08	0.2	NA

Notes:
Source, Levinson, 1980, unless otherwise noted.
All concentrations listed as total metals in ppm.
Values are averages of samples from Earth's crust, which may vary significantly.

(1) From Moe (1988): upper 95% confidence limit of pre-industrial concentrations in Great Lakes sediments.

TABLE 1-2

SUMMARY OF MONITORING WELL ANALYSES
WELLS MW-1 TO MW-7
(1981 Through 1987)

Chemical	EPA MCL[a] (ug/l)	NYSGWS[b] (ug/L)	Detection Limit (ug/L)	Range Detected (ug/L)	Total	>Det.[c]	>STD[d]	Wells of Concern[e]
Inorganics								
As	50	25	10	ND	26	0	0	
Ba	1000	1000	100	ND	26	0	0	
Cd	10	10	5	ND	26	0	0	
Cr	50	50	10	ND	26	0	0	
Hg	2	2	0.2	ND	26	0	0	
Pb	50	25	10	ND	26	0	0	
Se	10	20	5	ND	26	0	0	
Ag	50	50	10	ND	26	0	0	
Fe	NA	300	2-100	ND-1,020	65	40	3	1,7
Mn	NA	300	1-30	ND-320	65	02	17	2,5,6,7
F	4,000	1,500	100	100-300	27	27	0	5
NO_3	10,000[f]	10,000[f]	50	ND-10,000	27	23	1	5
Explosives								
HMX	NA	(35)g	100	ND	46	0	0	
RDX	NA	(35)[g]	30	ND	46	0	0	
Tetryl	NA	(1)[g]	10	ND	46	0	0	
2,4,6-TNT	NA	(1)[g]	1	ND	46	0	0	
2,6-DNT	NA	(1.1)h	1	ND	46	0	0	
2,4-DNT	NA	(1)[g]	1	ND	46	0	0	
pH	NA	(6.5-8.5)[i]		6.7-8.1[i]	300	300	0	
TOC	NA	NA	100	1,000-54,000	340	340	NA	
TOX	NA	NA	10	ND-130	335	133	NA	

Data Summarized from the 1987 USAEHA Groundwater Contamination Survey

a. MCL - Maximum Contaminant Level
b. NYSGWS - New York State Groundwater Standard
c. >Det. - Number of samples exceeding detection limits
d. >STD - Number of samples greater than standards
e. Well(s) with concentration above standard
f. Standard is for NO_3 only
g. Guidelines proposed from the Criteria Development Report for the Closure of Nine Burning Pads; (M&E, Oct. 1989)
h. EPA Water Quality Criteria for 10^{-5} Risk
i. Units are pH
NA Not Available
ND Not Detected

TABLE 1-2
(CONTINUED)

NA - Not applicable
ND - Note detected
a. For EP Toxicity the conc is mg/l, for explosives the conc. is ug/g.
b. As EP Toxicity (mg/l)
c. As total concentrations (ug/g)
d. Number of samples exceeding the detection limit
e. Number of samples exceeding the regulatory EP Toxicity Limit

TABLE 1-3

SUMMARY OF SOIL ANALYSES
DATA FROM THE USEHA PHASE 2 (1982) REPORT FOR BURN PADS B THROUGH G

CHEMICAL	EP TOXICITY LIMIT	DETECTION LIMIT$_a$	RANGE	TOTAL	>DET$_d$	>TOXICITY LIMIT$_e$	PADS IN EXCESS OF DETECTION LIMIT	PADS IN EXCESS OF EP TOXICITY
Inorganics$_b$								
As	5	0.5	ND	24	0	0	0	0
Ba	100	10	ND - 508	24	2	2	All from B	B
Cd	1	0.1	ND - 0.17	24	3	0	F,E,G$_g$	0
Cr	5	0.5	ND	24	0	0	0	0
Hg	0.02	0.02	ND	24	0	0	0	0
Pb	5	0.5	ND - 24.6	24	2	2	All from H	H
Se	1	0.1	ND	24	0	0	0	0
Ag	5	0.5	ND	24	0	0	0	0
Explosives$_c$								
HMX	NA	1	ND	24	0	NA	0	NA
RDX	NA	1	ND - 7	24	18	NA	B,C,D,E,F,G,H	NA
Tetryl	NA	1	ND - 2.7	24	1	NA	D	NA
2,4,6-TNT	NA	1	ND - 9270	24	6	NA	F+,D,G	NA
2,6-DNT	NA	1	ND - 23.0	24	4	NA	F,H	NA
2,4-DNT	NA	1	ND - 45.0	24	5	NA	F,H	NA

NOTE: All samples were collected from 0-6"
+Pad F Sample Contained The High Value

DATA FROM THE USAEHA PHASE 4 (1984) REPORT FOR BURN PADS, B, F, AND H

CHEMICAL	EP TOXICITY LIMIT	DETECTION LIMIT$_a$	RANGE	TOTAL	>DET$_d$	>TOXICITY LIMIT$_e$	PADS IN EXCESS OF DETECTION LIMIT	PADS IN EXCESS OF EP TOXICITY
Inorganics$_b$								
As	5	0.5	ND	47	0	0	0	0
Ba	100	10	ND - 424	47	3	2	B	B
Cd	1	0.1	ND	47	0	0	0	0
Cr	5	0.5	ND	47	0	0	0	0
Hg	0.02	0.02	ND	47	0	0	0	0
Pb	5	0.5	-	47	12	3	F,B,H	F,B,H
Se	1	0.1	ND	47	0	0	0	0
Ag	5	0.5	ND	47	0	0	0	0
Explosives$_c$								
HMX	NA	1	ND - 4.0	47	2	NA	B	NA
RDX	NA	1	ND - 8.2	47	4	NA	F,B	NA
Tetryl	NA	1	ND	47	0	NA	NA	NA
2,4,6-TNT	NA	1	ND - 124.5	47	7	NA	F,B	NA
2,6-DNT	NA	1	ND - 2.2	47	2	NA	H	NA
2,4-DNT	NA	1	ND - 2.2	47	5	NA	F,H	NA

TABLE 1-4

DEMOLITION GROUND MONITORING WELL SUMMARY

Well ID	Total Depth of Boring	Depth to Weathered Rock	Depth Cored	Depth to Top of Screen	Screen Length (ft)	% Rec.	% RQD	Elev. of Casing Top[2]	Depth to Water[3]	Elev. of Water[3]
MW-1	13.0	12.0	NA	7	5	NA	NA	NA	NA	NA
MW-2	7.0	6.5	NA	1	5	NA	NA	NA	NA	NA
MW-3	11.0	9.5	NA	4.5	5	NA	NA	NA	NA	NA
MW-4	10.0	9.5	NA	4.5	5	NA	NA	NA	NA	NA
MW-5	10.0	9.0	NA	4.0	5	NA	NA	NA	NA	NA
MW-6	9.0	9.0	NA	4.0	5	NA	NA	NA	NA	NA
MW-7	6.5	6.0	NA	1.0	5	NA	NA	NA	NA	NA
MW-8	18.5	9	13.5-18.5	4.5	5	100	0	122.08	6.96	115.12
MW-9	15.0	10.0	10-15	3.0	4	100	0	117.89	4.30	113.59
MW-10	18.5	15.0	13.5-18.5	4.0	5	100	0	122.24	6.40	115.84
MW-11	17.5	9.0	12.5-17.5	4.0	5	100	37	113.95	6.30	107.65
MW-12	15.0	7.5	10-15	3.0	4	100	0	107.74	3.98	103.76
MW-13	17.0	6.5	12-17	3.0	5	100	17	114.00	4.90	109.10
MW-14	16.5	9.0	11.5-16.5	3.5	5	100	0	107.43	5.47	101.96
MW-15	13.5	6.5	8.5-13.5	3.0	3.5	100	0	105.01	3.18	101.83
MW-16	13.5	6.5	8.5-13.5	3.0	3.5	100	0	105.73	5.32	100.41
MW-17	19.0	8.0	14-19	4.5	5	100	0	107.89	4.12	103.77

NA - Not available

1 - All depths are relative to the ground surface, all depths in feet

2 - Temporary Bench Mark (TBM) was assumed to be 100.00 and is located at the doorway of the bunker in northwestern corner of the Demolition Grounds.

3 - Measured in January 1988

TABLE 1-5

CHEMICAL/PHYSICAL PROPERTIES OF EXPLOSIVES

Chemical	Molecular Wt.	Density g/cm^3 (20°C)	Solubility (mg/l)	Henry's Constant (torr/M)	Volatilization Half-Life (days)	Melting Point (°C)	K_{oc} Sorption Partition Coefficient	Vapor Pressure Torr (ppm)
2,4,6-Trinitrotoluene (TNT)	227	1.654 200	130 117	0.18	990	80	190 300	$1x10^{-4}$, (0.13)
2,6-Dinitrotoluene (DNT)	182	1.283	182	18 140	9	64-66 249	100	0.018, (24)
2,4-Dinitrotoluene (DNT)	182	1.52	270	3.4 410	47	71 201	87	0.005 (6.7)
RDX	222	1.82 crystal	50 44	$2.0x10^{-5}$	$9.0x10^{-6}$	204	420 538	$4.1x10^{-9}$, ($5.4x10^{-6}$)
HMX	296	1.90 crystal	66 50	Negligible	NA	273	508	$3.9x10^{-9}$, ($5.1x10^{-6}$)

Source: Evaluation of Critical Parameters Affecting Contaminant Migration Through Soils; Report No. AMXTH-TE-CR-85030, Final Report; Prepared by: Environmental Science and Engineering, Inc., Prepared for: U.S. Army Toxic and Hazardous Materials Agency (USATHAMA); July 1985.

NA - Not Available

TABLE 1-6

RELATIVE RELATIONSHIPS BETWEEN K_{OC} AND MOBILITY

K_{oc}	Mobility Class
>2000	I - Immobile
500-2000	II - Low Mobility
150-500	III - Intermediate Mobility
50-150	IV - Mobile
<50	V - Very Mobile

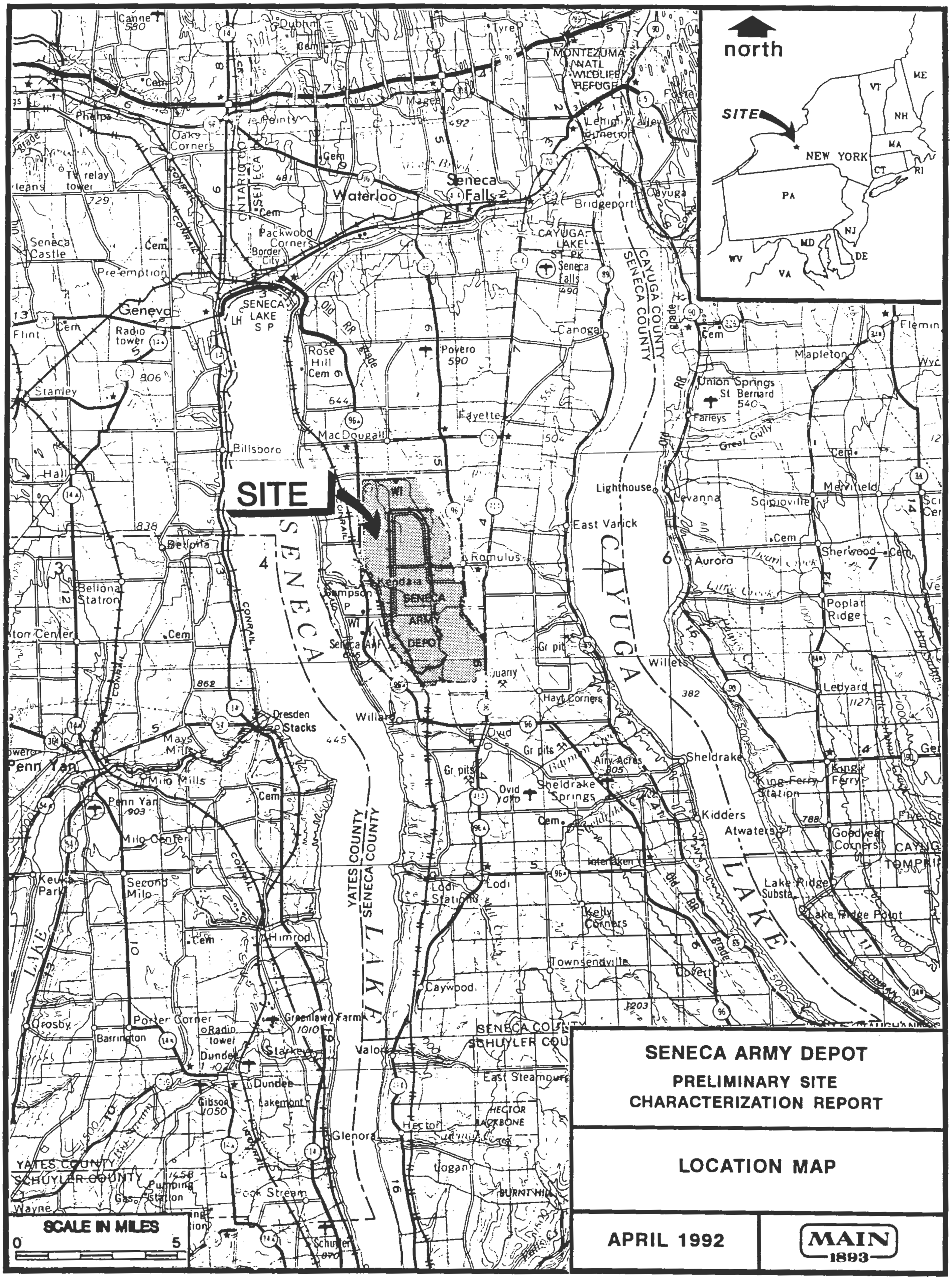
Source: The Soil Chemistry of Hazardous Materials; James Dragun, Ph.D; The Hazardous Materials Control Research Institute; 1988.

TABLE 1-7

ANALYTES FOR METHOD 8330

ANALYTE	ABBREVIATION	PRIMARY OR BY-PRODUCT
Octahydro-1,3,5,7-tetranitro-1,3,5,7-		HMXPrimary
	tetrazocine	
Hexahydro-1,3,5-trinitro-1,3,5-triazine		RDXPrimary
1,3,5-Trinitrobenzene		1,3,5-TNBPrimary
1,3-Dinitrobenzene		1,3-DNBPrimary
Methyl-2,4,6-trinitrophenylnitramine		TetrylPrimary
Nitrobenzene		NBPrimary
2,4,6-Trinitrotoulene		2,4,6-TNTPrimary
4-Amino-2,6-dinitrotoluene		4-Am-DNTBy-Product
2-Amino-4,6-dinitrotoluene		2-Am-DNTBy-Product
2,6-Dinitrotoluene		2,6-DNTPrimary
2,4-Dinitrotoluene		2,4-DNTPrimary
2-Nitrotoluene		2-NTPrimary
4-Nitrotoluene		4-NTPrimary
3-Nitrotoluene		3-NTPrimary

FIGURE 1-1



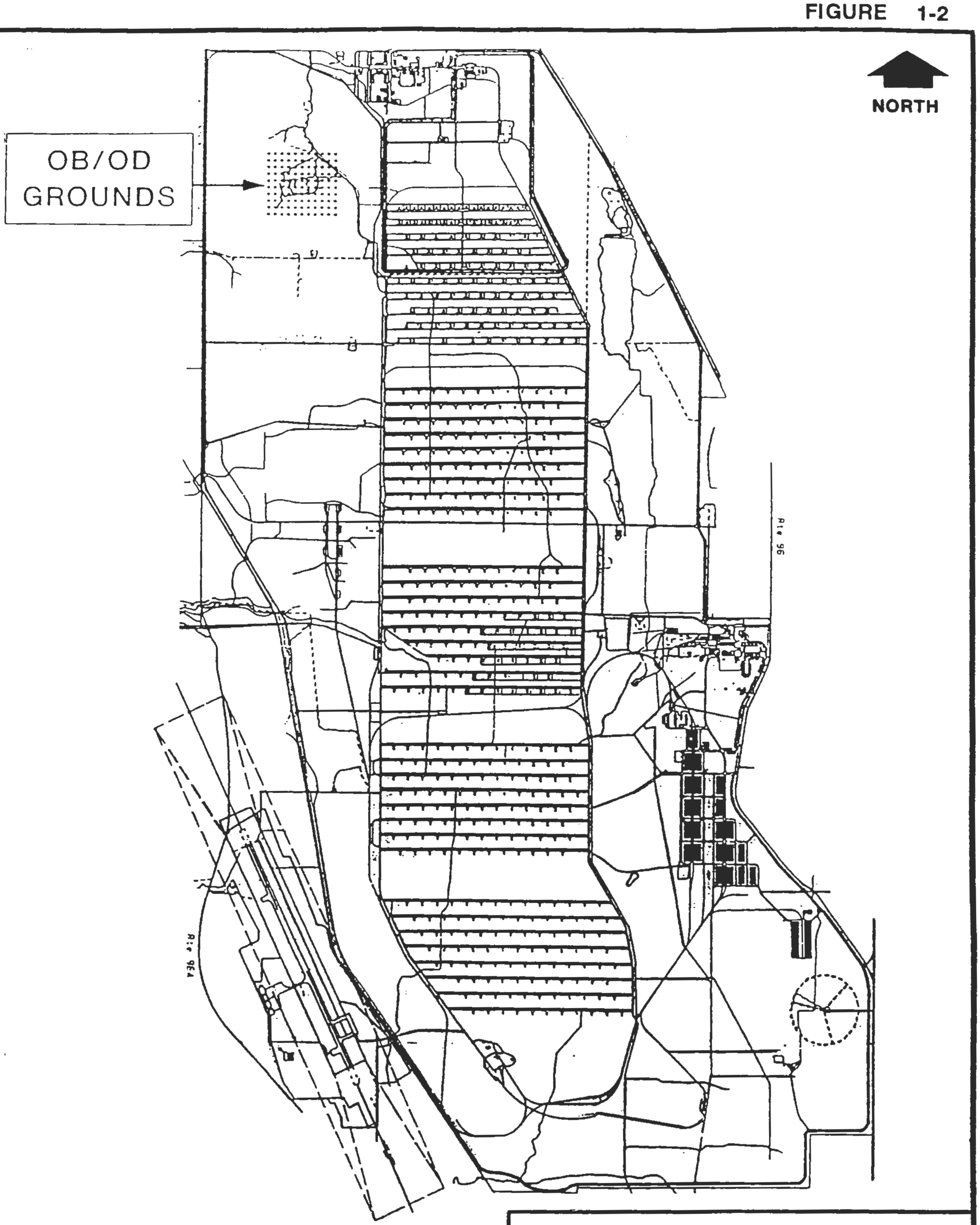
SENECA ARMY DEPOT

PRELIMINARY SITE CHARACTERIZATION REPORT

LOCATION MAP

APRIL 1992

MAIN 1893



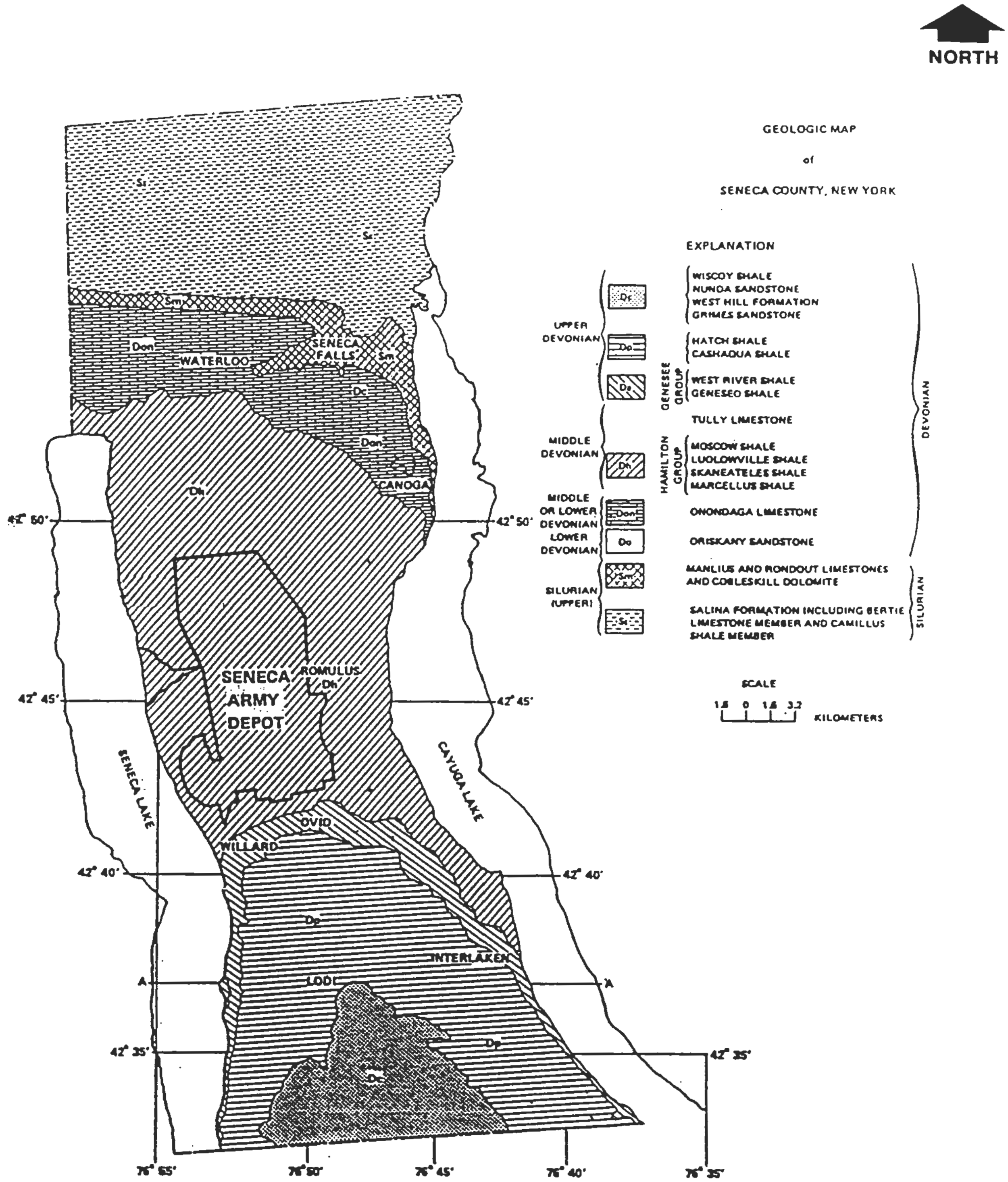
SENECA ARMY DEPOT
PRELIMINARY SITE
CHARACTERIZATION REPORT

SITE PLAN

APRIL 1992

MAIN 1893

FIGURE 1-3

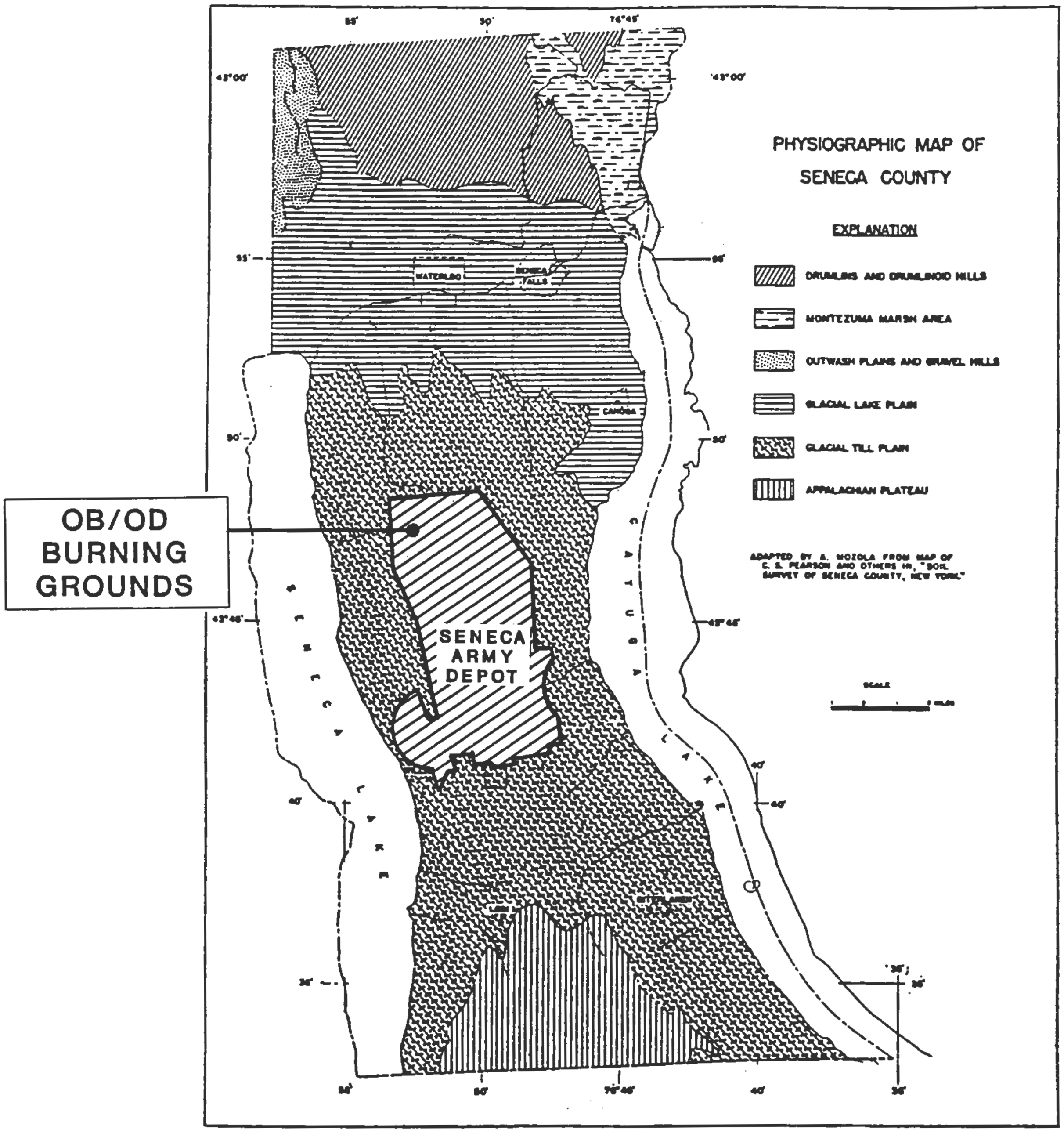


SENECA ARMY DEPOT
PRELIMINARY SITE
CHARACTERIZATION REPORT

GEOLOGIC MAP
OF
SENECA COUNTY

APRIL 1992

MAIN
1893



SENECA ARMY DEPOT

THE PHYSIOGRAPHIC MAP
OF SENECA COUNTY

FIGURE 1-5 APRIL 1992

MAIN
1893
CHAS. T. MAIN, INC., Engineers
BOSTON . NEW YORK . CHARLOTTE . PORTLAND

SOURCE: The Groundwater
Resources of Seneca County,
New York; Mozola, A.J.,
Bulletin GW-26, Albany, NY, 1951

SOURCE: RICKARD AND FISHER
GEOLOGIC MAP OF NEW YORK,
FINGER LAKES SHEET,1970

MESOZOIC

Lower Cretaceous

MESOZOIC INTRUSIVES
Kimberlite and alnoite dikes and diatremes.

PALEOZOIC

Upper Devonian

CONNEAUT GROUP
600-1000 ft. (180-300 m.)
Germania Formation—shale, sandstone; Whitesville Formation—shale, sandstone; Hinsdale Sandstone; Wellsville Formation—shale, sandstone; Cuba Sandstone.

CANADAWAY GROUP
800-1200 ft. (240-370 m.)
Machlas Formation—shale, siltstone; Rushford Sandstone; Caneadea, Canisteo, and Hume Shales; Canaseraga Sandstone; South Wales and Dunkirk Shales; In Pennsylvania: Towanda Formation—shale, sandstone.

JAVA GROUP
300-700 ft. (90-210 m.)
Wiscoy Formation—sandstone, shale; Hanover and Pipe Creek Shales.

WEST FALLS GROUP
1100-1600 ft. (340-490 m.)
Nunda Formation—sandstone, shale.
West Hill and Gardeau Formations—shale, siltstone; Rioricks Glen Shale; upper Beers Hill Shale; Grimes Siltstone.
lower Beers Hill Shale; Dunn Hill, Millport, and Moreland Shales.
Nunda Formation—sandstone, shale; West Hill Formation—shale, siltstone; Corning Shale.
"New Milford" Formation—sandstone, shale.
Gardeau Formation—shale,. siltstone; Roricks Glen Shale.
Slide Mountain Formation—sandstone, shale, conglomerate.
Beers Hill Shale; Grimes Siltstone; Dunn Hill, Millport, and Moreland Shales

SONYEA GROUP
200-1000 ft. (60-300 m.)
In west: Cashaqua and Middlesex Shales.
In east: Rye Point Shale; Rock Stream ("Enfield") Siltstone; Pulteney, Sawmill Creek, Johns Creek, and Montour Shales.

GENESEE GROUP AND TULLY LIMESTONE
200-1000 ft. (60-300 m.)
West River Shale; Genundewa Limestone; Penn Yan and Geneseo Shales; all except Geneseo replaced eastwardly by Ithaca Formation—shale, siltstone and Sherburne Siltstone.

Middle Devonian

Oneonta Formation—shale, sandstone.
Unadilla Formation—shale, siltstone.
Tully Limestone.

HAMILTON GROUP
600-1500 ft. (180-460 m.)
Moscow Formation—In west: Windom and Kashong Shales, Menteth Limestone Members; In east: Cooperstown Shale Member, Portland Point Limestone Member.
Ludlowville Formation—In west: Deep Run Shale, Tichenor Limestone, Wanakah and Ledyard Shale Members, Centerfield Limestone Member. In east: King Ferry Shale and other members, Stone Mill Sandstone Member.
Skaneateles Formation—In west: Levanna Shale and Stafford Limestone Members; In east: Butternut, Pompey, and Delphi Station Shale Members, Mottville Sandstone Member.
Marcellus Formation—In west: Oakta Creek Shale Member; In east: Cardiff and Chittenango Shale Members, Cherry Valley Limestone and Union Springs Shale Members.
Panther Mountain Formation—shale, siltstone, sandstone.

ONONDAGA LIMESTONE AND ORISKANY SANDSTONE
75-150 ft. (23-45 m.)
Onondaga Limestone—Seneca, Morehouse (cherty) and Nedrow Limestone Members, Edgecliff cherty

Lower Devonian

Limestone Member, local bioherms.
Oriskany Sandstone.

HELDERBERG GROUP
0-200 ft. (0-60 m.)
Coeymans and Manlius Limestones; Rondout Dolostone.

Upper Silurian

AKRON DOLOSTONE, COBLESKILL LIMESTONE, AND SALINA GROUP
700-1000 ft. (210-300 m.)
Akron Dolostone; Bertie Formation—dolostone, shale.
Camillus and Syracuse Formations—shale, dolostone, gypsum, salt.
Cobleskill Limestone; Bertie and Camillus Formations—dolostone, shale.
Syracuse Formation—dolostone, shale, gypsum, salt.
Vernon Formation—shale, dolostone.

LOCKPORT GROUP
80-175 ft. (25-55 m.)
Oak Orchard and Penfield Dolostones, both replaced eastwardly by Sconondoa Formation—limestone, dolostone.

CLINTON GROUP
150-325 ft. (40-~~100 m.)~~
Decew Dolostone; Rochester Shale.

Lower Silurian

Irondequoit Limestone; Williamson Shale; Wolcott Furnace Hematite; Wolcott Limestone; Sodus Shale; Bear Creek Shale; Wallington Limestone; Furnaceville Hematite; Maplewood Shale; Kodak Sandstone.
Herkimer Sandstone; Kirkland Hematite; Willowvale Shale; Westmoreland Hematite; Sauquoit Formation—sandstone, shale; Oneida Conglomerate.

MEDINA GROUP AND QUEENSTON FORMATION
0-900 ft. (0-270 m.)
Medina Group: Grimbsy Formation—sandstone, shale.
Queenston Formation—shale, siltstone.

Upper Ordovician

Undifferentiated Medina Group and Queenston Formation.

LORRAINE GROUP
700-900 ft. (210-270 m.)
Oswego Sandstone.
Pulaski and Whetstone Gulf Formations—siltstone, shale.

TRENTON GROUP
100-300 ft. (30-90 m.)

Middle Ordovician

Utica Shale.

Hamilton group	Moscow shale	43±	Lower two-thirds of section is a fossiliferous, soft gray calcareous shale; upper third highly friable but less calcareous and fossiliferous. Staining by iron oxide very common. Concretions present in greater abundance in lower beds, but irregular calcareous masses occur throughout section. Joints parallel, tightly sealed, trending N.65°E. and N.25°-30°W.
	Ludlowville shale	43±	Lower beds are thinly laminated, light-colored, fossiliferous, shaly passage beds; overlain by hard calcareous black shales 13 to 30 centimeters thick and rich in corals and brachiopods; hard layers responsible for falls and cascades. Middle beds are less fossiliferous, soft gray arenaceous shales, rich in concretions, calcareous lenses, and occasional thin sandstone layers. Upper beds (Tichenor limestone member) are thin, irregularly bedded gray shales becoming light blue gray upon exposure, calcareous, coarsely textured, and fossiliferous. Joints parallel 5 to 50 centimeters apart, well developed but tight.
	Skaneateles shale	56±	Basal beds composed of dark fissile shale. Upper shale more calcareous, grayish to bluish impure limestone layers. Joint pattern N.75°E. and N.30°W.; diagonal joints N.50°E. Joints sealed, parallel and spaced 15 centimeters to 1.2 meters apart.
	Marcellus shale	15	Black, slatelike, bituminous shale with occasional limestone layers in sequence, and containing zones rich in iron sulfides or calcareous concretions, often with septarian structures; very fissile, iron-stained and gray when weathered. Joint pattern N.25°W., N.65°E., 2.5 centimeters to 1.2 meters apart.

SENECA ARMY DEPOT
PRELIMINARY SITE
CHARACTERIZATION REPORT

BEDROCK STRATIGRAPHIC
COLUMN

APRIL 1992

MAIN
1893

FIGURE 1-4

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

SENECA COUNTY, NEW YORK

Scale 1: 190,080
1 0 1 2 3 4 Miles

SOIL ASSOCIATIONS

AREAS DOMINATED BY HIGH-LIME SOILS DEVELOPED IN GLACIAL TILL

- 1 Ontario-Ovid association: Deep, well-drained to somewhat poorly drained soils that have a loam to silty clay loam subsoil
- 2 Honeoye-Lima association: Deep, well drained and moderately well drained soils that have a heavy silt loam to heavy loam subsoil

AREAS DOMINATED BY HIGH-LIME SOILS DEVELOPED IN GLACIAL LAKE SEDIMENTS

- 3 Schoharie-Odessa association: Deep, well-drained to somewhat poorly drained soils that have a silty clay loam to clay subsoil
- 4 Odessa-Lakemont association: Deep, dominantly somewhat poorly drained and poorly drained soils that have a silty clay loam to silty clay subsoil

AREAS DOMINATED BY MEDIUM-LIME SOILS DEVELOPED IN GLACIAL TILL

- 5 Conesus-Lansing association: Deep, moderately well drained and well drained soils that have a heavy silt loam to heavy loam subsoil
- 6 Darien-Angola association: Deep and moderately deep, somewhat poorly drained soils that have a silty clay loam and clay loam subsoil

AREAS DOMINATED BY MEDIUM-LIME SOILS DEVELOPED IN GLACIAL LAKE SEDIMENTS

- 7 Dunkirk-Collamer association: Deep, well drained and moderately well drained soils that have a silt loam to silty clay loam subsoil
- 8 Dunkirk-Cazenovia association: Moderately deep and deep, well drained and moderately well drained soils that have a silt loam to silty clay loam subsoil that overlies limestone
- 9 Arkport-Claverack association: Deep, dominantly well drained and moderately well drained soils that are loamy fine sand and fine sandy loam throughout or that have a loamy fine sand subsoil over silty clay or clay

AREAS DOMINATED BY LOW-LIME SOILS DEVELOPED IN GLACIAL TILL

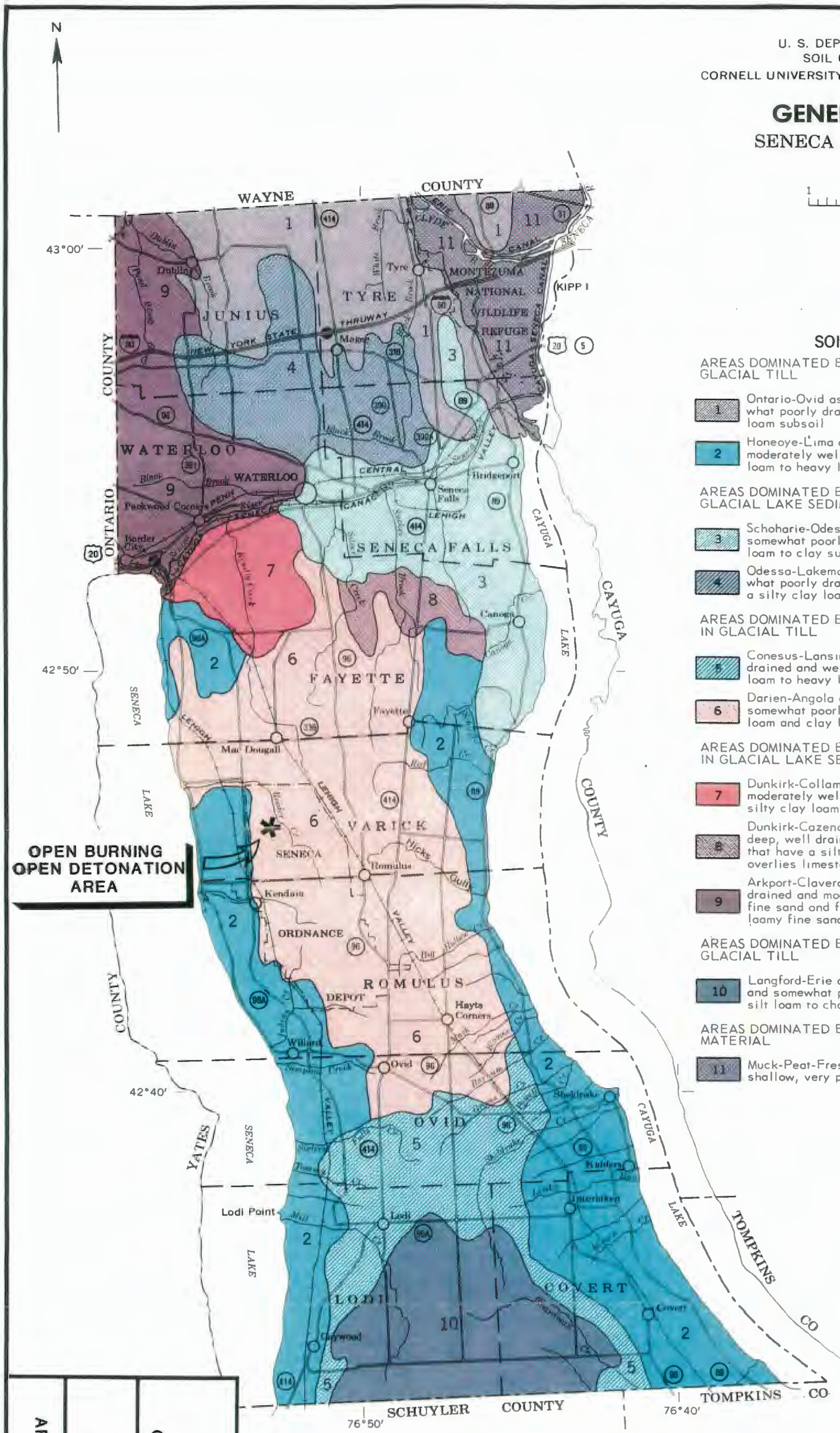
- 10 Langford-Erie association: Deep, moderately well drained and somewhat poorly drained soils that have a channery silt loam to channery loam fragipan

AREAS DOMINATED BY SOILS DEVELOPED IN ORGANIC MATERIAL

- 11 Muck-Peat-Fresh Water Marsh association: Deep to shallow, very poorly drained organic soils

February 1971

NOTE—
This map is intended for general planning. Each delineation may contain soils having ratings different from those shown on the map. Use detailed soil maps for operational planning.



SENECA ARMY DEPOT
PRELIMINARY SITE
CHARACTERIZATION REPORT

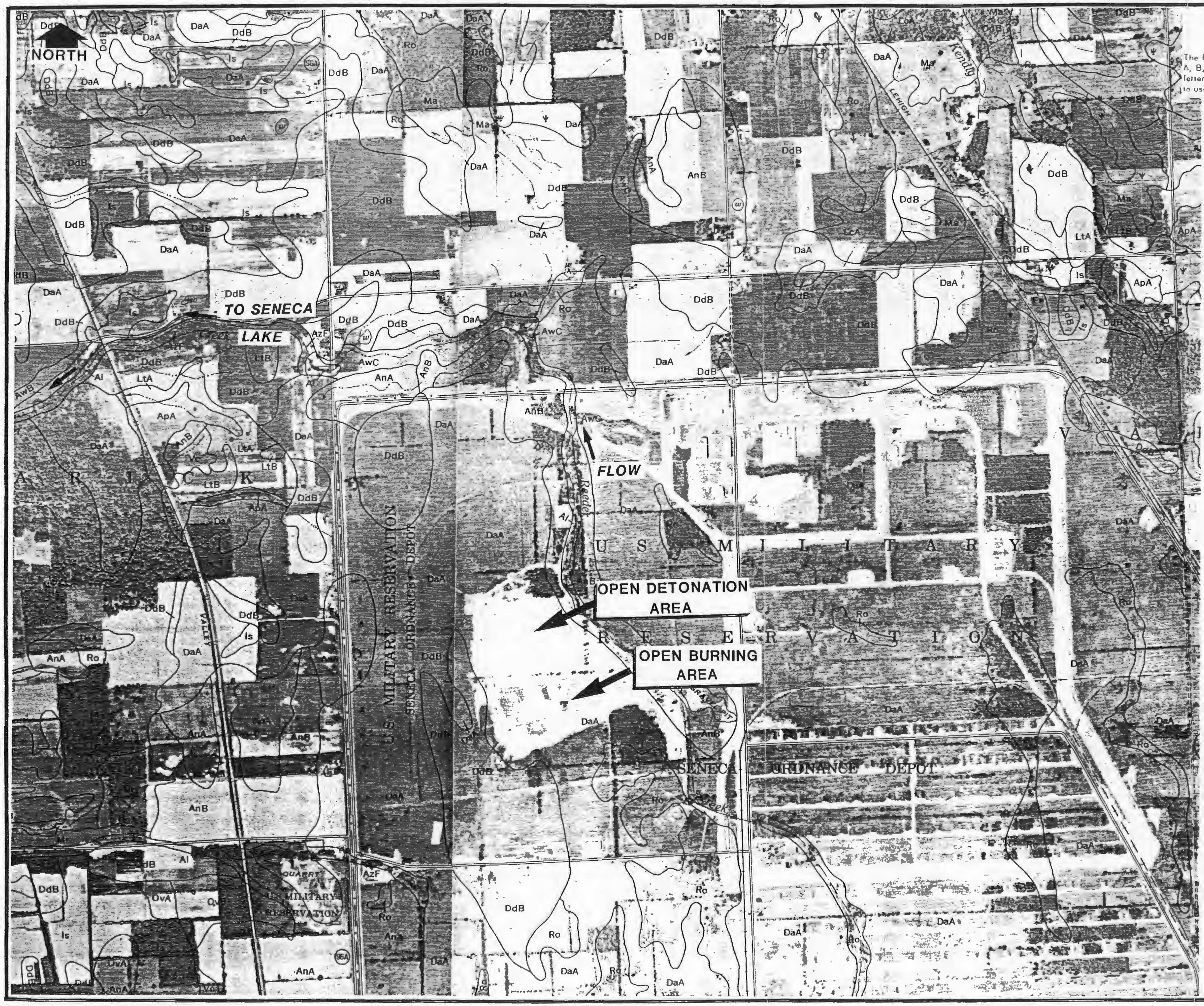
GENERAL SOIL MAP
SENECA COUNTY, NEW YORK

APRIL 1992

MAIN 1893

FIGURE 1-6

FIGURE 1-7



SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, E, or F, is a general guide to the slope class. Symbols without a slope letter are for those miscellaneous land types or soils where slope is not significant to use and management. A final number, 3, in the symbol shows that the soil is eroded.

SYMBOL	NAME
Ac	Alden mucky silt loam
Ad	Alden mucky silt loam, till substratum
Al	Alluvial land
AnA	Angola silt loam, 0 to 3 percent slopes
AnB	Angola silt loam, 3 to 8 percent slopes
AoA	Appleton gravelly silt loam, 0 to 3 percent slopes
AoB	Appleton gravelly silt loam, 3 to 8 percent slopes
ApA	Appleton silt loam, 0 to 3 percent slopes
ApB	Appleton silt loam, 3 to 8 percent slopes
ArB	Arkport loamy fine sand, 1 to 6 percent slopes
ArC	Arkport loamy fine sand, 6 to 12 percent slopes
ArD	Arkport loamy fine sand, 12 to 20 percent slopes
AuD	Arnot channery silt loam, 15 to 25 percent slopes
AwB	Aurora silt loam, 3 to 8 percent slopes
AwC	Aurora silt loam, 8 to 15 percent slopes
AwD	Aurora silt loam, 15 to 25 percent slopes
AzF	Aurora and Farmington soils, 25 to 75 percent slopes
Co	Canandaigua silt loam
CeB	Cazenovia silt loam, 3 to 8 percent slopes
CeB3	Cazenovia silt loam, 3 to 8 percent slopes, eroded
CeC	Cazenovia silt loam, 8 to 15 percent slopes
CeC3	Cazenovia silt loam, 8 to 15 percent slopes, eroded
ChD	Cazenovia soils, 15 to 25 percent slopes
ChE	Cazenovia soils, 25 to 40 percent slopes
CkA	Claverack loamy fine sand, 0 to 2 percent slopes
CkB	Claverack loamy fine sand, 2 to 6 percent slopes
ClA	Collamer silt loam, 0 to 2 percent slopes
ClB	Collamer silt loam, 2 to 6 percent slopes
ClC	Collamer silt loam, 6 to 12 percent slopes
CoA	Collamer silt loam, moderately shallow variant, 0 to 2 percent slopes
CoB	Collamer silt loam, moderately shallow variant, 2 to 6 percent slopes
CsA	Conesus gravelly silt loam, 0 to 3 percent slopes
CsB	Conesus gravelly silt loam, 3 to 8 percent slopes
Cu	Cosad loamy fine sand
DaA	Darien silt loam, 0 to 3 percent slopes
DdB	Darien-Danley-Cazenovia silt looms, 3 to 8 percent slopes
DuB	Dunkirk silt loam, 1 to 6 percent slopes
DuC3	Dunkirk silt loam, 6 to 12 percent slopes, eroded
DuD	Dunkirk silt loam, 12 to 20 percent slopes
DwB	Dunkirk silt loam, limestone substratum, 1 to 6 percent slopes

SOURCE:
U.S. DEPT. OF AGRICULTURE SOIL SURVEY,
SENECA COUNTY , NEW YORK
APRIL , 1972

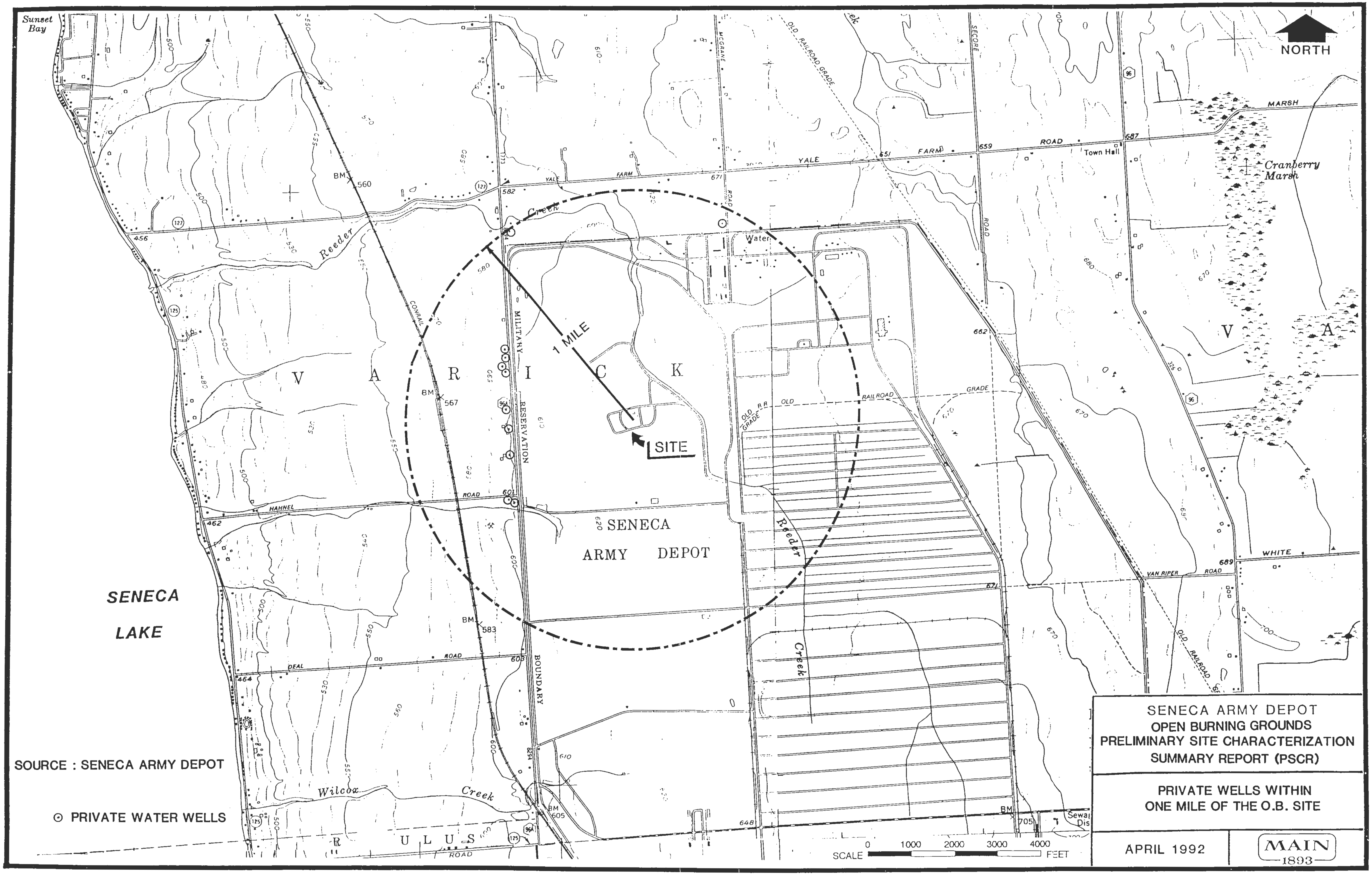
SENECA ARMY DEPOT
PRELIMINARY SITE
CHARACTERIZATION REPORT

SURFICIAL SOIL MAP
FOR OB/OD GROUNDS

APRIL 1992

MAIN
1893

FIGURE 1-8



SOURCE : SENECA ARMY DEPOT

⊙ PRIVATE WATER WELLS

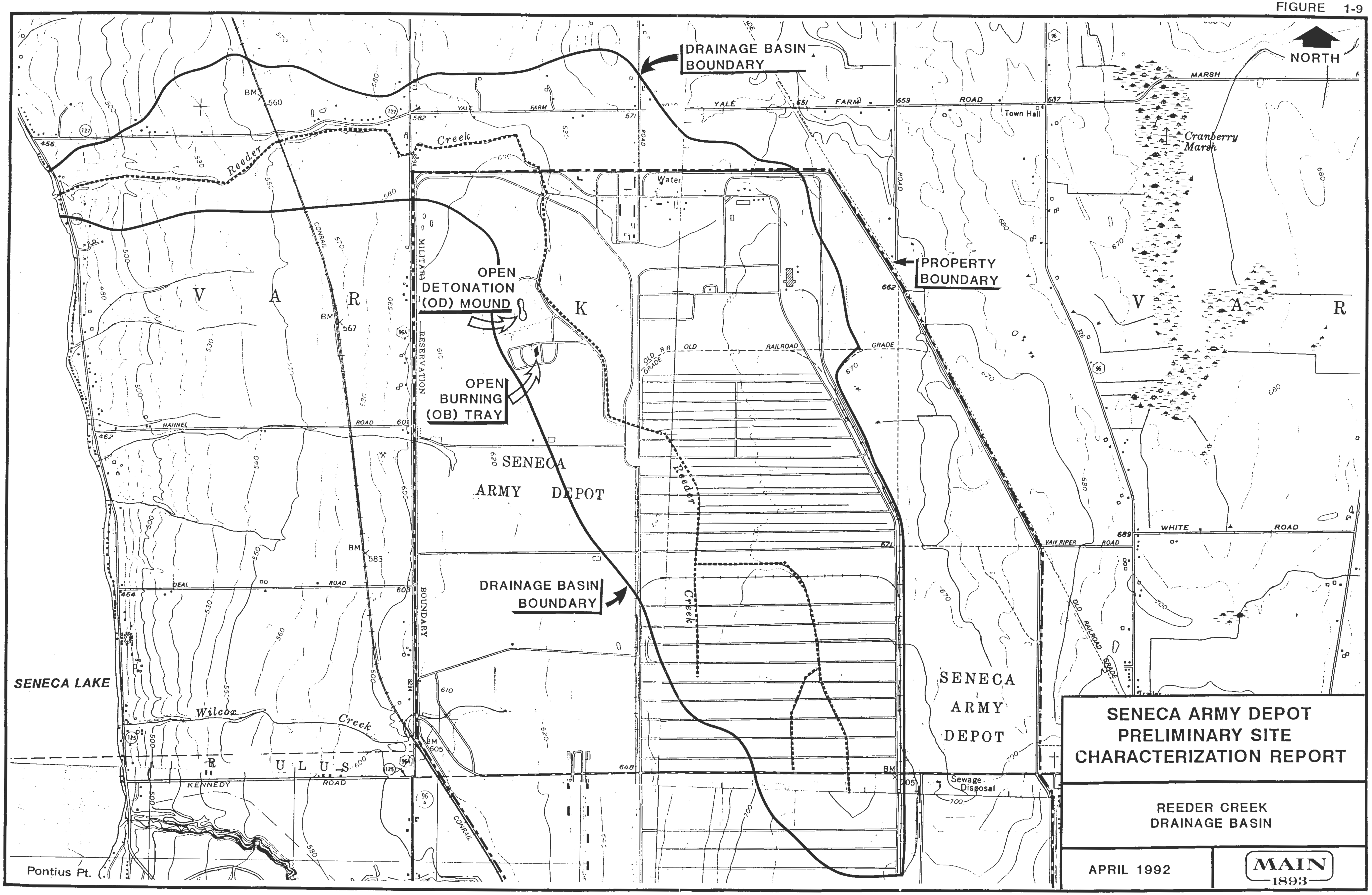
SENECA ARMY DEPOT
OPEN BURNING GROUNDS
PRELIMINARY SITE CHARACTERIZATION
SUMMARY REPORT (PSCR)

PRIVATE WELLS WITHIN
ONE MILE OF THE O.B. SITE

APRIL 1992

MAIN
1893

FIGURE 1-9

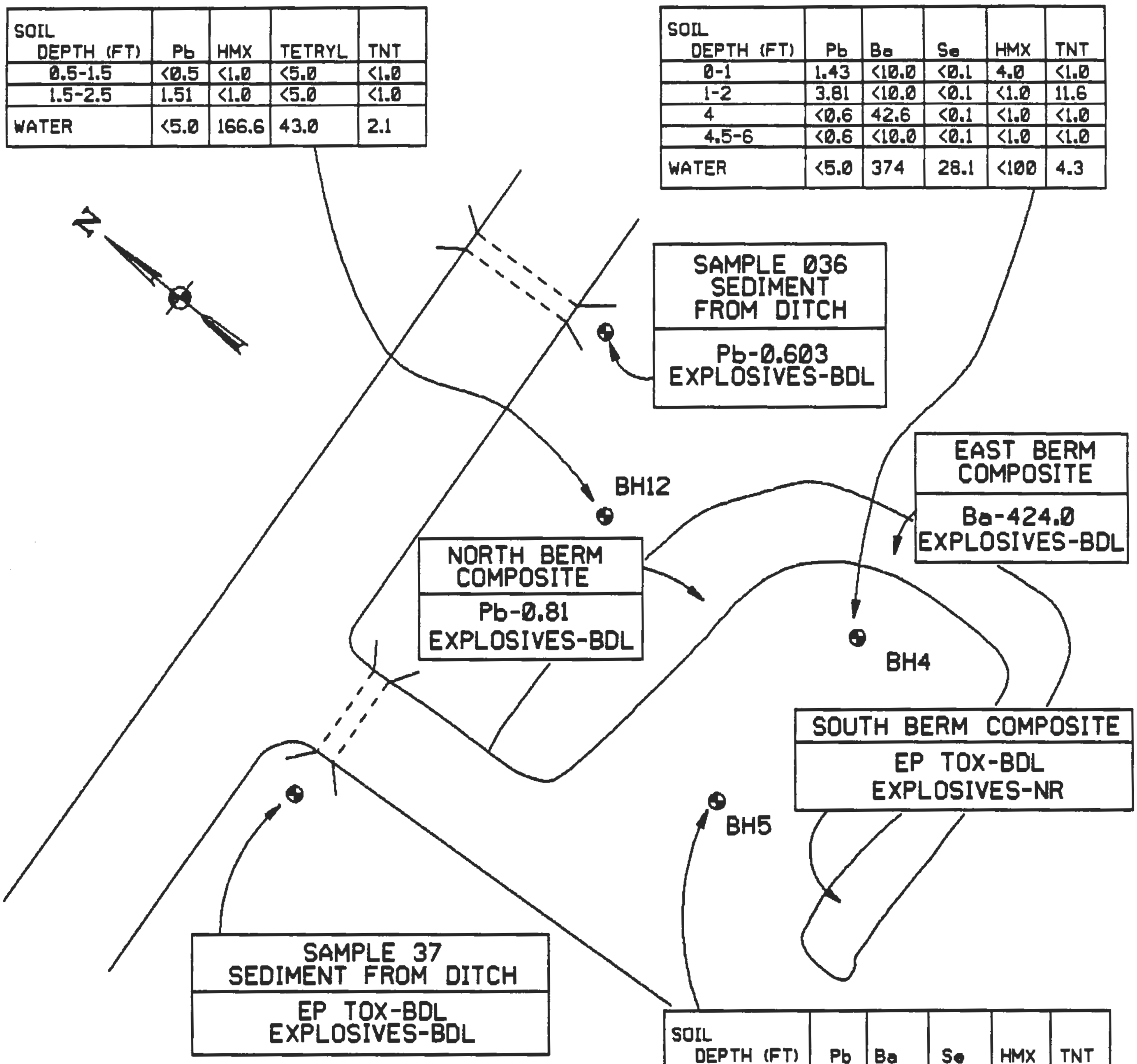


SENECA ARMY DEPOT PRELIMINARY SITE CHARACTERIZATION REPORT

REEDER CREEK DRAINAGE BASIN

APRIL 1992

MAIN 1893



SOIL DEPTH (FT)	Pb	HMX	TETRYL	TNT
0.5-1.5	<0.5	<1.0	<5.0	<1.0
1.5-2.5	1.51	<1.0	<5.0	<1.0
WATER	<5.0	166.6	43.0	2.1

SOIL DEPTH (FT)	Pb	Ba	Se	HMX	TNT
0-1	1.43	<10.0	<0.1	4.0	<1.0
1-2	3.81	<10.0	<0.1	<1.0	11.6
4	<0.6	42.6	<0.1	<1.0	<1.0
4.5-6	<0.6	<10.0	<0.1	<1.0	<1.0
WATER	<5.0	374	28.1	<100	4.3

SOIL DEPTH (FT)	Pb	Ba	Se	HMX	TNT
0-0.5	<0.6	<10.0	<0.1	<1.0	<1.0
0.5-1.0	0.83	<10.0	<0.1	3.6	<1.0
3.5-4.5	<0.6	187.0	<0.1	<1.0	<1.0
5-6	101.5	<10.0	<0.1	<1.0	<1.0
WATER	13.3	<300	22.9	<100	3.3

NOTES:

1. ONLY COMPOUNDS DETECTED ARE SHOWN
   SOIL CONCENTRATIONS ARE AS ug/g (ppm)
   WATER CONCENTRATIONS ARE AS ug/L (ppb)
2. HEAVY METALS IN SOIL REPRESENT EP TOXICITY CONCENTRATIONS
3. HEAVY METALS IN WATER ARE DISSOLVED (FILTERED SAMPLES)
4. WATER WAS OBTAINED FROM BOREHOLES USING TEMPORARY WELLS WHICH ARE CURRENTLY NON-EXISTANT
5. BDL - BELOW DETECTABLE LIMITS
6. NR - NOT REPORTED BY LABORATORY

REF: HAZARDOUS WASTE STUDY NO. 37-26-0479-85
PHASE 4 OF AMC OPEN BURNING/
OPEN-DETONATION GROUNDS
EVALUATION INVESTIGATION OF SOIL
CONTAMINATION AT THE OPEN BURNING GROUNDS

SENECA ARMY DEPOT, ROMULUS, NEW YORK
AUGUST 13-19, 1984.

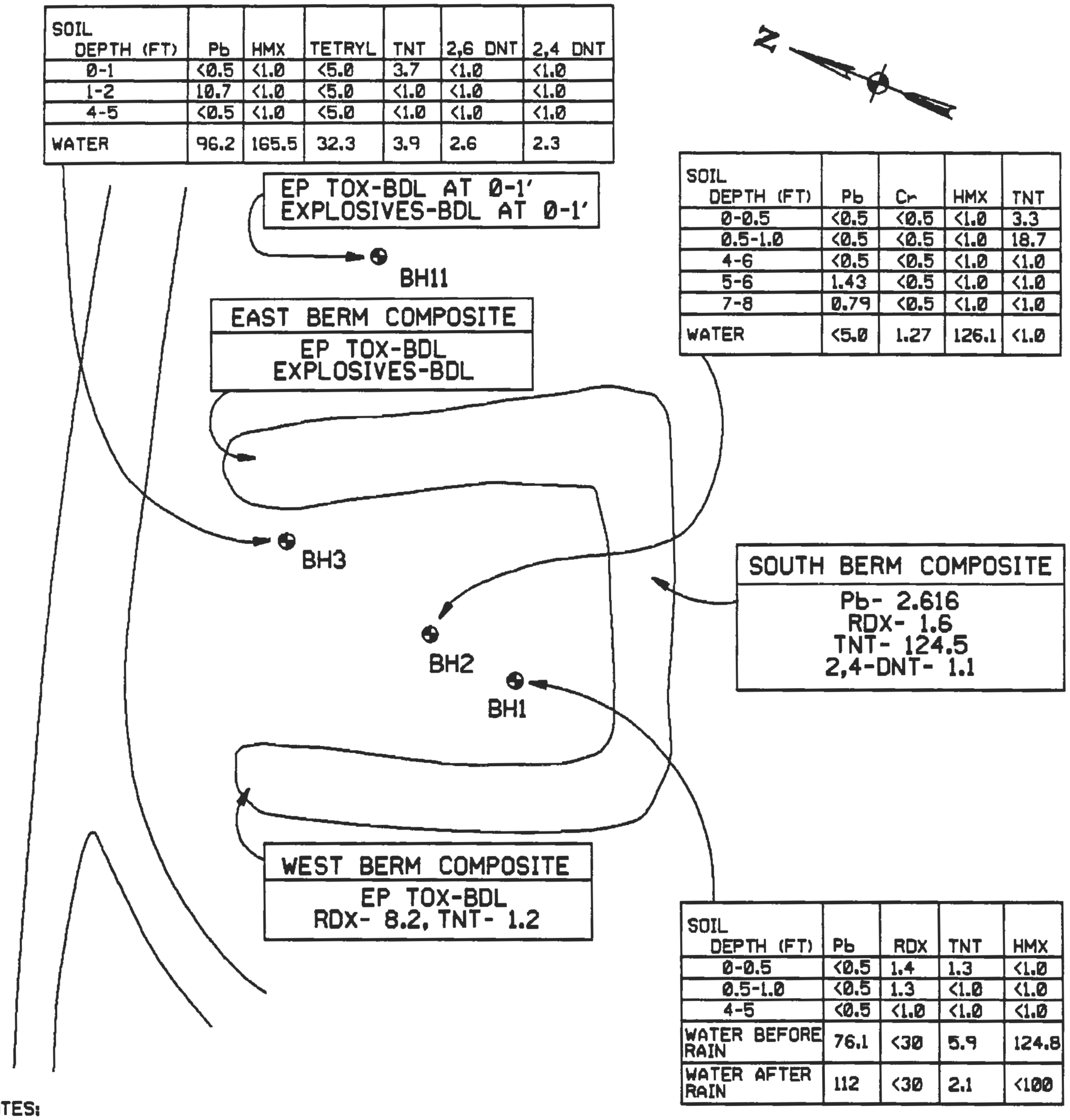
SENECA ARMY DEPOT

SOIL AND GROUND WATER
DATA FROM BURNING PAD B

FIGURE 1-10 APRIL 1992

MAIN
1893
CHAS. T. MAIN, INC., Engineers
BOSTON . NEW YORK . CHARLOTTE . PORTLAND

780 MISCE:ENV. 052:[35.1]SENDATAB.DGN



SOIL DEPTH (FT)	Pb	HMX	TETRYL	TNT	2,6 DNT	2,4 DNT
0-1	<0.5	<1.0	<5.0	3.7	<1.0	<1.0
1-2	10.7	<1.0	<5.0	<1.0	<1.0	<1.0
4-5	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0
WATER	96.2	165.5	32.3	3.9	2.6	2.3

EP TOX-BDL AT 0-1'
EXPLOSIVES-BDL AT 0-1'

SOIL DEPTH (FT)	Pb	Cr	HMX	TNT
0-0.5	<0.5	<0.5	<1.0	3.3
0.5-1.0	<0.5	<0.5	<1.0	18.7
4-6	<0.5	<0.5	<1.0	<1.0
5-6	1.43	<0.5	<1.0	<1.0
7-8	0.79	<0.5	<1.0	<1.0
WATER	<5.0	1.27	126.1	<1.0

EAST BERM COMPOSITE

EP TOX-BDL
EXPLOSIVES-BDL

SOUTH BERM COMPOSITE

Pb- 2.616
RDX- 1.6
TNT- 124.5
2,4-DNT- 1.1

WEST BERM COMPOSITE

EP TOX-BDL
RDX- 8.2, TNT- 1.2

SOIL DEPTH (FT)	Pb	RDX	TNT	HMX
0-0.5	<0.5	1.4	1.3	<1.0
0.5-1.0	<0.5	1.3	<1.0	<1.0
4-5	<0.5	<1.0	<1.0	<1.0
WATER BEFORE RAIN	76.1	<30	5.9	124.8
WATER AFTER RAIN	112	<30	2.1	<100

NOTES:

1. ONLY COMPOUNDS DETECTED ARE SHOWN
   SOIL CONCENTRATIONS ARE AS ug/g (ppm)
   WATER CONCENTRATIONS ARE AS ug/L (ppb)
2. HEAVY METALS IN SOIL REPRESENT EP TOXICITY CONCENTRATIONS
3. HEAVY METALS IN WATER ARE DISSOLVED (FILTERED SAMPLES)
4. WATER WAS OBTAINED FROM BOREHOLES USING TEMPORARY WELLS WHICH ARE CURRENTLY NON-EXISTANT
5. BDL - BELOW DETECTABLE LIMITS
6. NR - NOT REPORTED BY LABORATORY

REF: HAZARDOUS WASTE STUDY NO. 37-26-0479-85
PHASE 4 OF AMC OPEN BURNING/
OPEN-DETONATION GROUNDS
EVALUATION INVESTIGATION OF SOIL
CONTAMINATION AT THE OPEN BURNING GROUNDS

SENECA ARMY DEPOT, ROMULUS, NEW YORK
AUGUST 13-19, 1984.

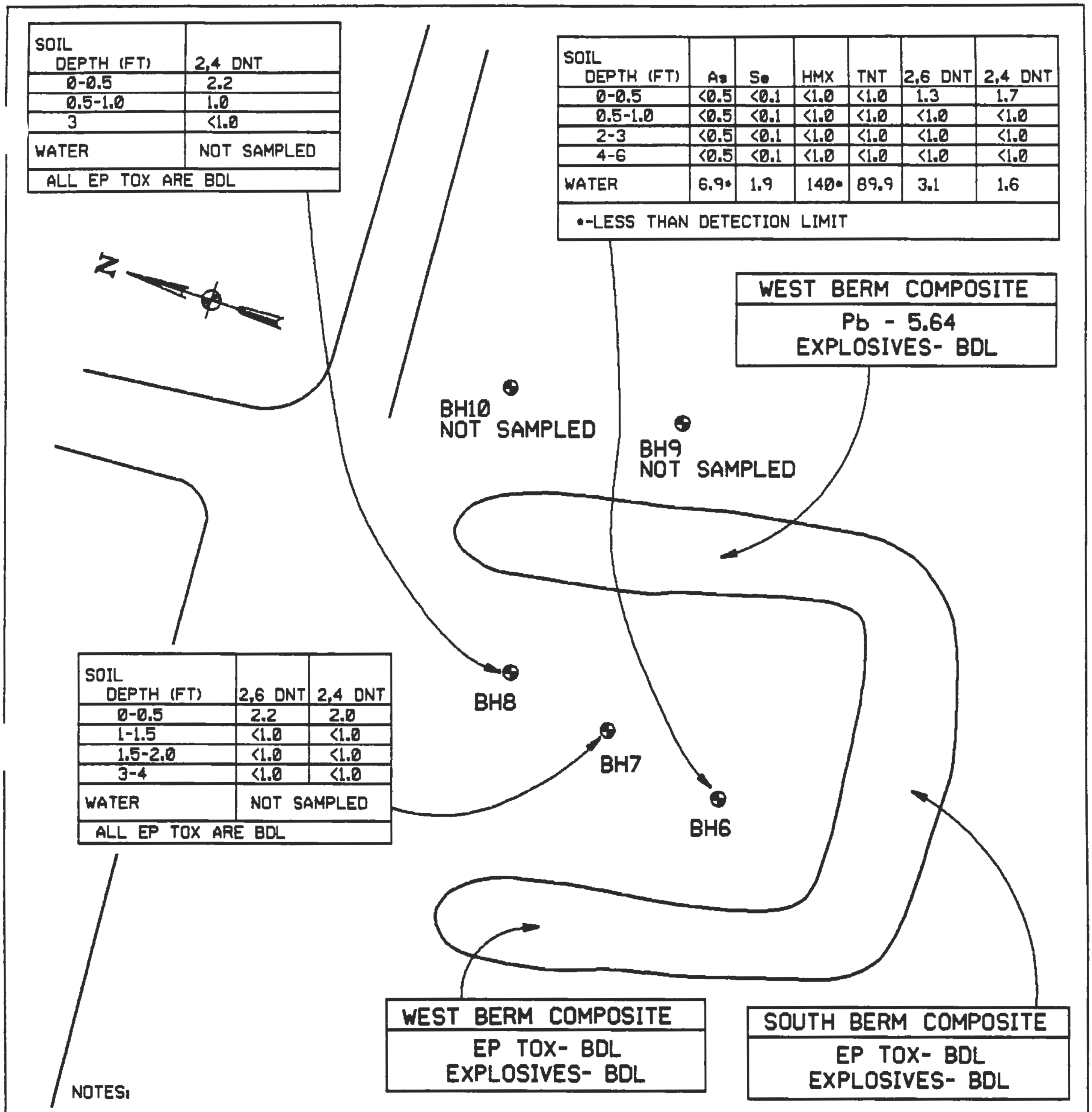
SENECA ARMY DEPOT

SOIL AND GROUND WATER
DATA FROM BURNING PAD F

FIGURE 1-11 APRIL 1992

MAIN
1893
CHAS. T. MAIN, INC., Engineers
BOSTON . NEW YORK . CHARLOTTE . PORTLAND

788 MISCE:ENV, OS2:[35.1]SENDATAF.DGN



SOIL DEPTH (FT)	2,4 DNT
0-0.5	2.2
0.5-1.0	1.0
3	<1.0
WATER	NOT SAMPLED

ALL EP TOX ARE BDL

SOIL DEPTH (FT)	As	Se	HMX	TNT	2,6 DNT	2,4 DNT
0-0.5	<0.5	<0.1	<1.0	<1.0	1.3	1.7
0.5-1.0	<0.5	<0.1	<1.0	<1.0	<1.0	<1.0
2-3	<0.5	<0.1	<1.0	<1.0	<1.0	<1.0
4-6	<0.5	<0.1	<1.0	<1.0	<1.0	<1.0
WATER	6.9*	1.9	140*	89.9	3.1	1.6

*-LESS THAN DETECTION LIMIT

WEST BERM COMPOSITE

Pb - 5.64
EXPLOSIVES- BDL

SOIL DEPTH (FT)	2,6 DNT	2,4 DNT
0-0.5	2.2	2.0
1-1.5	<1.0	<1.0
1.5-2.0	<1.0	<1.0
3-4	<1.0	<1.0
WATER	NOT SAMPLED	

ALL EP TOX ARE BDL

WEST BERM COMPOSITE

EP TOX- BDL
EXPLOSIVES- BDL

SOUTH BERM COMPOSITE

EP TOX- BDL
EXPLOSIVES- BDL

NOTES:

1. ONLY COMPOUNDS DETECTED ARE SHOWN
   SOIL CONCENTRATIONS ARE AS ug/g (ppm)
   WATER CONCENTRATIONS ARE AS ug/L (ppb)
2. HEAVY METALS IN SOIL REPRESENT EP TOXICITY CONCENTRATIONS
3. HEAVY METALS IN WATER ARE DISSOLVED (FILTERED SAMPLES)
4. WATER WAS OBTAINED FROM BOREHOLES USING TEMPORARY WELLS WHICH ARE CURRENTLY NON-EXISTANT
5. BDL - BELOW DETECTABLE LIMITS
6. NR - NOT REPORTED BY LABORATORY

REF: HAZARDOUS WASTE STUDY NO. 37-26-0479-85
PHASE 4 OF AMC OPEN BURNING/
OPEN-DETONATION GROUNDS
EVALUATION INVESTIGATION OF SOIL
CONTAMINATION AT THE OPEN BURNING GROUNDS

SENECA ARMY DEPOT, ROMULUS, NEW YORK
AUGUST 13-19, 1984.

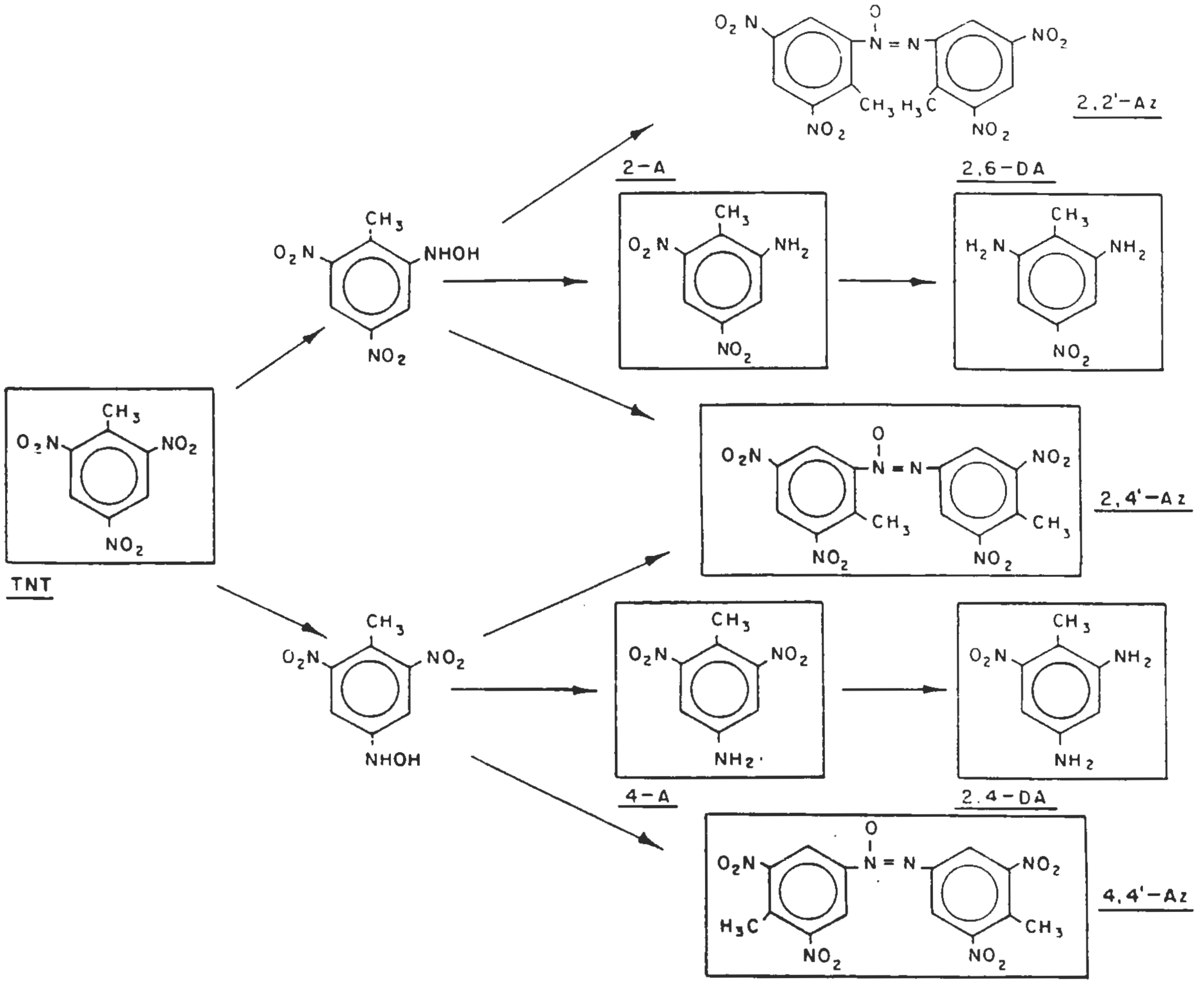
SENECA ARMY DEPOT

SOIL AND GROUND WATER
DATA FROM BURNING PAD H

FIGURE 1-12 APRIL 1992

MAIN
1893
CHAS. T. MAIN, INC., Engineers
BOSTON . NEW YORK . CHARLOTTE . PORTLAND

780 MISCE:ENV. 0S2:[35,1]SENDATAH.DGN



NOMENCLATURE:

2-A - 2-amino-4,6-dinitrotoluene
4-A - 4-amino-2,6-dinitrotoluene
2,2'-AZ - 4,4'-dinitro-2,2'-azoxytoluene
2,4'-AZ - 2'4-dinitro2,4'-azoxytoluene
4,4'-AZ - 2,2'-dinitro-4,4'-azoxytoluene
2,6-DA - 2,6-diamino-4-nitrotoluene
2,4-DA - 2,4-diamino-6-nitrotoluene

SOURCE:

Special Report 90-2; Environmental Transformation Products of Nitroaromatics and Nitramines; Literature Review and Recommendations for Analytical Method Development;

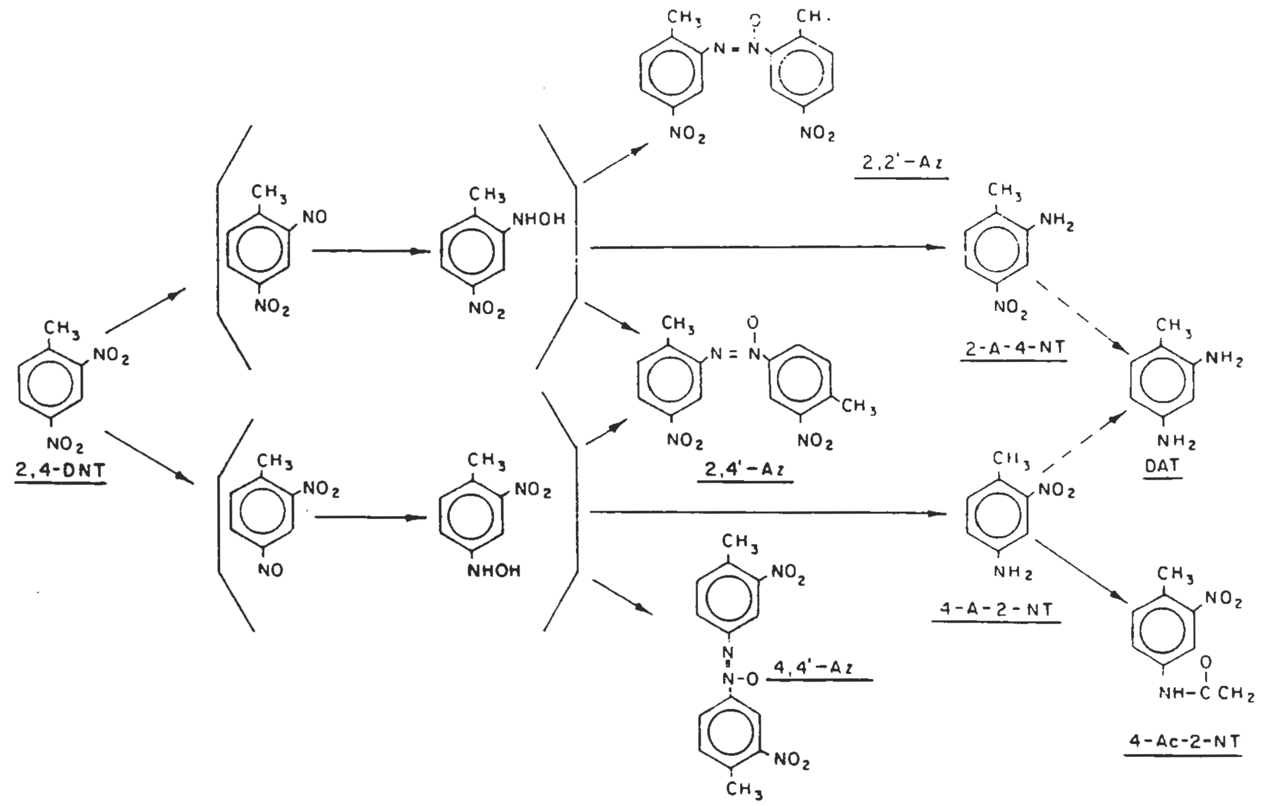
U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Feb. 1990

SENECA ARMY DEPOT

TRANSFORMATION
PATHWAYS AND PRODUCTS
FOR TNT

FIGURE 1-13 **APRIL 1992**

MAIN
1893
CHAS. T. MAIN, INC., Engineers
BOSTON . NEW YORK . CHARLOTTE . PORTLAND



NOMENCLATURE:

2,2'-AZ - 4,4'-dinitro-2,2'-azoxytoluene
2,4'-AZ - 2',4-dinitro-2,4'-azoxytoluene
4,4'-AZ - 2,2'-dinitro-4,4'-azoxytoluene
DAT - Diaminotoluene
2-A-4-NT - 2-amino-4-nitrotoluene
4-A-2-NT - 4-amino-2-nitrotoluene
4-AC-2-NT - 4-acetamide-2-nitrotoluene

SOURCE:

Special Report 90-2; Environmental Transformation Products of Nitroaromatics and Nitramines; Literature Review and Recommendations for Analytical Method Development;

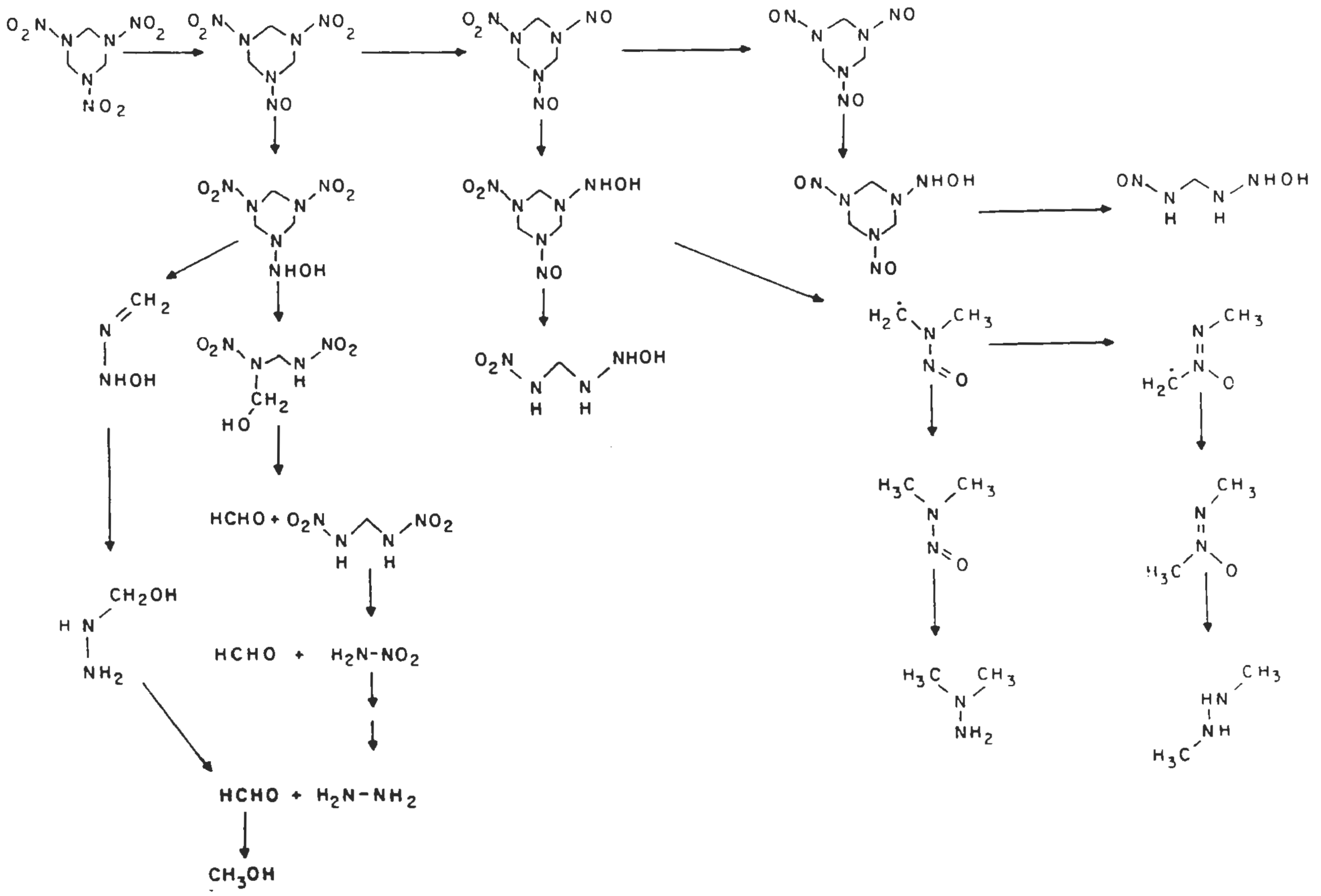
U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Feb. 1990

SENECA ARMY DEPOT

TRANSFORMATION
PATHWAYS AND PRODUCTS
FOR 2,4-DNT

FIGURE 1-14 APRIL 1992

MAIN
1893
CHAS. T. MAIN, INC., Engineers
BOSTON . NEW YORK . CHARLOTTE . PORTLAND



SOURCE:

Special Report 90-2; Environmental Transformation Products of Nitroaromatics and Nitramines; Literature Review and Recommendations for Analytical Method Development;

U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Feb. 1990

SENECA ARMY DEPOT

TRANSFORMATION
PATHWAYS AND PRODUCTS
FOR RDX

FIGURE 1-15 **APRIL 1992**

MAIN
1893
CHAS. T. MAIN, INC., Engineers
BOSTON . NEW YORK . CHARLOTTE . PORTLAND

2.0 STUDY AREA INVESTIGATIONS

2.1 INTRODUCTION

Previous geotechnical studies, conducted at the OB ground shave served as the basis for the planning of the current investigation. The initial phase of the planning process involved a development of a conceptual understanding of site conditions, which were derived from the previously described database. The focus of this investigation has been to refine the present understanding of the site. This CERCLA investigation is intended to utilize the existing database and collect additional hydrologic, geologic and ecological information required to perform a comprehensive CERCLA investigation. This additional information has been acquired through the implementation of numerous focused tasks described in the OB grounds workplan. The following sections describes, in detail, the work completed by MAIN to further characterize the environmental setting of the site.

The OB workplan was considered approved by EPA, Region II, on November 7, 1991. The workplan described the following field tasks:

1. Geophysical Investigations
2. Soil Sampling
3. Monitoring Well Installation and Sampling
4. Surface Water/Sediment Sampling
5. Ecological Investigation

2.2 SITE SURVEY PROGRAM

The site survey program consisted of field reconnaissance of the site and aerial photography. A reconnaissance of the site was performed to locate general site features and confirm the presence of significant features (i.e., burn pads) identified in the workplan. Also, sampling locations were identified and marked during this initial survey.

The site and surrounding area was photographed from the air on December 12, 1991 for the purpose of constructing a photogrammetric site plan with 2 foot contour intervals. This photogrammetric map was also utilized for the ecological survey. Ground control was performed during the months of November and December of 1991, and January and February of 1992. All sampling locations and monitoring wells are located and surveyed. Top of casing and ground surface elevations of each well were also determined. Plate 2-1 presents the base map prepared as part of this task.

2.3 GEOPHYSICAL INVESTIGATIONS

The geophysical program described in the OB grounds workplan consisted of the following tasks;

1) A UXO site clearance survey of the proposed soil boring, monitoring well, and access sites

2) GSSI Subsurface Interface (SIR) ground penetrating radar (GPR) surveys of the individual burn pads, and

3) Cross-sectional sampling of subsurface geophysical anomaly locations identified during the GPR surveys. This included test pit excavations to identify the sources of individual geophysical anomalies.

The geophysical survey program has been conducted to provide safe access to the OB grounds and to evaluate the shallow subsurface in and around each of the nine burning pads. Access to each burning pad, monitoring well, soil boring location, and surface water sampling location was cleared using geophysical techniques to insure the safe entry and exit of project personnel. The detailed GPR surveys conducted at each burning pad identified three locations where trenches or pits might have existed within the shallow subsurface. Test pit excavations were performed at these three locations to confirm the shallow stratigraphic conditions. Descriptions of these surveys are summarized below.

2.3.1 UXO Site Clearance Surveys

The objectives of these surveys were to ensure the safe entry and exit of personnel and equipment into each of the proposed sampling locations. MAIN contracted with the Explosive Ordnance Disposal (EOD) Division of Human Factors Applications (HFA) Inc. to perform a UXO site clearance survey to provide access to each burning pad and clearance for work areas for each soil boring, monitoring well, berm excavation and surface water sampling location. HFA utilized two survey methods, Electromagnetic Induction detectors and Passive Ferrous Metal detectors, to clear the above mentioned areas. The areas investigated by HFA are presented on Plate 2-2. The details of the investigation are included within the HFA report presented in Appendix B. A brief summary of the work is included below.

The burning pads at the OB grounds contain both surface and subsurface metallic objects. Some areas, such as burn pads J and G, were nearly covered with metallic waste. This precluded the utilization of the Passive Ferrous Metal detection surveys within these areas. A work area of 10' by 10' for each pad boring and 50' by 50' for each of the proposed monitoring well locations was cleared by HFA using EM induction. In addition, an access lane 25' wide was cleared to allow access to each boring or monitoring well location and to provide access to wetlands and other surface water sediment sampling locations.

HFA personnel spent 33 total days on-site performing site clearance activities. During this time a total of 4,037 subsurface objects were located and excavated. A large quantity of the metallic waste consisted of hinges, nails, banding material, and other hardware associated with ammunition packaging. No summary account of these materials was generated. Only the UXO or significant and/or potentially hazardous items discovered by HFA have been catalogued.

During the 33 days spent on-site by HFA, a total of 37,500 square feet of work area, and approximately 173,500 square feet of access routes were cleared down to a depth of approximately 18 inches.

2.3.2 Ground Penetrating Radar (GPR) Surveys

In order to evaluate the subsurface conditions below each burning pad a GPR survey was conducted by personnel from Blasland, Bouck and Lee (B&B) during the months of October and November, 1991. The areas investigated by B&B are shown on Plate 2-3. A summary of the work performed by B&B, is presented below.

A GPR survey was performed at the OB grounds to identify any burn trenches, burn pits, or UXO/residue burial areas that might exist under each burn pad site. These features were considered to be of importance due to the potential for preferential concentration of contaminants to occur within these burn pits or trenches. The GPR data were collected using a GSSI SIR-10 radar system using a 300 mHz antenna. The data were collected along variably spaced profiles across each burn pad. The profile locations are shown on Plate 2-3. A total of 104 profiles were surveyed at the 9 burning pad locations. The data were collected by hand towing the GPR antenna and recording the radar response on paper printouts. Station locations were maintained using pre-set survey points in conjunction with a surveyors tape. The radar records were annotated at 10 foot intervals along each profile to ensure an accurate determination of potential target locations.

An analysis of the GPR data has identified numerous areas of fill materials and areas exhibiting a radar response indicative of disturbed soils. In addition to these disturbed soil areas, the GPR data was used to identify three areas where the subsurface radar signatures indicated that pits or trenches may be present within the shallow subsurface. Two areas were identified on pad G and the third potential pit was identified on pad J. These locations are shown on Plate 2-3. An analysis of the GPR data indicated that no large metallic objects were present within any of the three suspected pits.

Based upon the interpretation of the geophysical data, a subsurface sampling program was completed to further evaluate the geophysical anomaly sources and to collect subsurface soil samples at each anomaly location. The results of the subsurface sampling of these suspected pits are presented in the following section.

2.3.3 Cross-Sectional Sampling

Cross sectional sampling of the three subsurface geophysical anomalies was performed to verify the interpretation made using the GPR data. A total of three Geophysical Anomaly Excavations (GAE) were performed to evaluate the subsurface conditions at each geophysical anomaly. Cross-sectional sampling was performed at the three geophysical anomaly locations shown on Plate 2-3. The logs of the individual GAE's are included within Appendix D.

The analysis of the GPR data identified three areas where suspected pits or trenches might exist. Two of the areas were on pad G and the third was located on pad J. Three excavations were performed to confirm the source of the geophysical anomalies, to provide data on the shallow stratigraphy at the site, and to provide a subsurface soil sample to be used for subsequent chemical analysis. The cross-sectional sampling was performed on October 11, 1991.

The cross-sectional sampling excavations were performed with a Case 480 backhoe operated by an HFA UXO technician. The excavations were extended to a distance of 2 feet on either side of the subsurface anomaly. The width, length, and depth of each excavation was based upon the extent of the individual geophysical anomalies. The soil sampling program for these excavations is presented in Table 2-1. One sample from each excavation was collected and analyzed for level V explosives and level IV TAL and TCL components. The contents of each bucket of material removed from the excavation and visually inspected. The excavation was continuously monitored by MAIN with a PID unit both at the excavation and approximately 40 feet downwind of each excavation. Volatile organic monitoring continued throughout the trenching process. No indications of Volatile Organic Compounds (VOC) were observed during any of the three excavations. No precipitation occurred during the excavations and therefore no surface water runoff occurred from the spoils removed from each pit. Following examination and sample collection the spoils were placed back in the pit.

2.4 SURFACE WATER AND SEDIMENTS

The objectives of the surface water investigation at the OB grounds were to determine the nature and extent of impacts to the on-site and off-site surface waters and to evaluate the relationship between groundwater and surface water at the site. The results from the surface water and sediment sampling program will also be used to determine the potential exposure levels for the risk assessment. Groundwater at the site has been shown to flow eastward toward Reeder Creek. The relationship between groundwater and surface water is of concern since if a groundwater plume is detected, it may be discharging to Reeder Creek. The results of the analytical characterization of the surface water and sediment are discussed and presented within Section 4.

In accordance with the OB grounds workplan, sixteen locations were surveyed for the collection of surface water and sediment samples in and around the OB grounds. The sampling program for surface water and sediments is summarized in Tables 2-2 and 2-3, respectively. The sample locations are shown on Plate 2-3. This work was completed by MAIN during November and December of 1991.

2.4.1 Chemical Sampling of Surface Water and Sediments

Surface water and/or sediment samples were collected at 16 stations that were representative of wetlands and areas of standing water on the OB/OD grounds. One of the wetlands sampled was beyond the probable influence of activities that may originate from the OB/OD grounds, and served as a reference location. In addition, three stations in two drainage swales were sampled to provide an indication of the degree of surface transport of contaminants from the

Open Burning grounds to Reeder Creek. If standing water was not present at the time of sampling, only sediment samples were collected.

Chemical characteristics of Reeder Creek were determined by sampling four stations that were established downstream of known points of surface water discharge from the OB/OD grounds. In addition, a downstream Reeder Creek station was established to characterize the water quality of the stream as it left the Depot. The substrate of the stream at this station was coarse gravel and bedrock, which prevented a sediment sample from being collected. A reference station was established upstream of the probable influence of the OB/OD Grounds.

Surface water samples were generally collected by directly filling appropriate sample containers. When the water depth was relatively shallow, sample containers were typically filled by bailing water into sample containers with a decontaminated glass beaker. Preservation of samples, if required, was performed after the samples were collected. Temperature, conductivity and pH were measured directly in the field with calibrated meters. Temperature and pH were measured with an Orion pH meter, Model 230A, and conductivity was measured with a YSI Model 33 conductivity meter.

Sediment samples were collected by scooping sediment into a decontaminated stainless steel bowl with a decontaminated trowel. Volatile Organic Analyte (VOA) samples were taken first, prior to any mixing of the sediments. The bowl was refilled with additional sediment, if required, thoroughly mixed and the appropriate sample containers filled with sediment. Samples were then placed in chilled coolers.

Six surface water and sediment samples were collected from Reeder Creek. Samples are considered to be the up and down gradient sample locations (respectively) on Reeder Creek. The data from the up-gradient sample location SW196 has been used to determine the background surface water and sediment chemical concentrations. At each of the surface water and sediment sample locations on Reeder Creek a staff gauge was also installed and surveyed. The cross-sectional geometry of the creek, and stream flow measurements were made at these locations. These data have been used to evaluate the stream flow variations within Reeder Creek and to evaluate the inter-relationship between surface and groundwater at the OB grounds. Surface water pH, temperature, conductivity, and dissolved oxygen (DO) were also measured at each surface water sample location.

Ten additional surface water and sediment samples were collected within the low lying areas and smaller surface water drainages within the OB grounds. At one location SW-180 no water was present although a sediment sample was collected. At a second location, SW-110, a surface water sample was collected but no sediment was readily available to be sampled. Samples were also collected from background reference, wetlands in order to establish the background wetland chemical constituents. The remaining samples have been analyzed to characterize the environmental setting as pertains to the extent and degree of constituents present within the surface water and sediments.

All of the collected samples have been analyzed for Level IV total TAL metals, hardness, TCL Organics (VOA's, AB/N's, and Pesticides/PCB's) and Explosives. The results of the chemical analyses are discussed in detail within Section 4 of this report.

2.4.2 Physical Characterization of Reeder Creek

Reeder Creek is the only perennial stream in proximity to the OB/OD Grounds. Physical characteristics of this stream were determined by field measurements as well as interpretation of existing information including stream discharge, water velocity, water depth, cross-sectional configuration, substrate properties and estimates of seasonal and historic stream flows. Field measurements, used to quantify these parameters, were taken at six stations along Reeder Creek as shown on Plate 2-4. These staff gauge locations generally corresponded to surface water and sediment sampling locations.

Stream cross-sections were determined by driving a stake into the western bank of Reeder Creek (the "head pin") and another stake on the eastern bank (the "tail pin"). The tail pin was positioned so that the transect formed by the two stakes was perpendicular to the streamflow. Both stakes were positioned above the high water mark of the stream as determined by riparian vegetation characteristics. The zero demarkation of a measuring tape was clamped onto the top of the head pin, extended across the stream, pulled tight and the other end of the tape clamped to the top of the tail pin. A calibrated rod was used to determine the distance from the tape to the ground or stream bottom along each transect. Vertical measurements were taken at each break in topography at a minimum. The elevation of the top of the head pin and tail pin was documented by surveying techniques which enabled the establishment of the relationship of each stream cross-section to the surrounding topography and the other stream cross-sections.

Stream velocity was measured by clamping the sensor of a Marsh McBirney flowmeter onto the calibrated rod, positioning it so that it was measuring the velocity at approximately 60 percent of the water column depth (e.g., if the stream was one foot deep, velocity would be measured 0.6 feet from the bottom) and recording the value to the nearest hundredth of a foot per second. Velocity measurements were typically taken at 0.2 to 0.4 ft. intervals across the stream, using the transect measuring tape for reference. Distance between measurements was smaller (0.2 ft.) at higher velocity points in the stream. These measurements enabled the stream discharge to be calculated.

Prior to measuring stream velocities, a staff gauge was installed at or near each station, which enabled quantification of the water surface elevation at a specific time. These gauges were used to document that the stream flow was not changing significantly during discharge measurements, and also enabled an estimate to be made as to whether streamflow was greater or less than the measured stream discharge during other field activities. Finding an acceptable location for installing the staff gauge also served to characterize the typical sediment depth at each station. At least 6 inches of sediment was required to firmly anchor the staff gauge in the stream bottom. The elevation of the top of the staff gauge was established by a New York State registered land surveyor and the water surface elevation determined by using the gradations on the staff.

Seasonal and historic flow characteristics of Reeder Creek were estimated by determining the drainage basin of the stream using USGS 1:24000 scale topographic maps and estimating the area of the basin by using a planimeter, establishing representative soil runoff properties by using Soil Conservation Service Mapping (SCS 1972), analyzing daily rainfall data from the Aurora Monitoring Station (approximately seven miles from the Depot) and relating these parameters to the measured stream discharge.

2.5 SOILS INVESTIGATION

In accordance with the approved workplan, a comprehensive soils investigation program has been completed at the OB grounds. The program consisted of completing 20 grid borings, 22 pad borings, and 35 berm excavations at the site. The locations of the various borings and excavations are shown on Plate 2-5. The individual boring logs are included within Appendix C.

The objectives of the soils investigation program were to determine the nature and extent of soils at the site and to provide information to develop a data base for the subsequent site risk assessment and feasibility studies. Empire Soils Investigation, Inc. of Groton, New York was contracted to provide drilling services. The berm excavations were performed by HFA under the direction of MAIN personnel. All of the grid and pad borings were installed in November and December of 1991. The berm excavations were also completed during this time. All drilling was performed remotely.

The following sections describe the procedures used to complete the borings and excavations, and discusses the sample collection and sample screening procedures used at the site.

2.5.1 Grid and Pad Borings

A geostatistical evaluation of the data collected from the USAEHA Phase 4 soils investigation was used to determine two soil sample grid spacings. One grid spacing was for the entire 30 acre OB grounds and one was for the burn pads. Section 3.5.3 of the original Workplan (Data Quality Objectives) provides a detailed discussion of these grid spacings. A grid sample spacing of 200' was determined to be appropriate for the entire 30 acre site, and a 25'-50' spacing was determined to be appropriate for the burn pads. Based upon this analysis the grid and pad boring locations were defined.

All of the Phase I borings proposed in the original WorkPlan at the OB grounds have been completed.

All of the soil borings were performed using continuous split spoon sampling methods. At each boring location a 0-6" surficial soil grab sample was collected prior to starting each boring. The soil borings were completed using remote drilling procedures. Each boring was advanced using hollow stem augers and split spoon samplers to collect undistributed soil samples ahead of the auger. Individual soil samples were collected and placed into appropriate sample bottles. The appropriate size and containers are described in Appendix C of the original Workplan (The Chemical Data Acquisition Plan). Each soil boring was completed down to refusal. In general refusal was encountered above a depth of 15 feet at this site. Tables 2-4 and 2-5 summarize the sampling for the grid and pad borings respectively.

All of the samples presented in Tables 2-4 and 2-5 underwent Level II soil analysis. Based upon the Level II results, a select portion of these samples underwent Level IV and V

NYSDEC CLP analysis for metals, explosives and volatile organics. Two complete Level IV or V analyses were performed for each borehole. The details of the analytical program are presented in Section 2.5.3.

2.5.2 Berm Excavations

In addition to the grid and pad borings, a total of 35 berm excavations have been completed at the site. The locations of the berm excavations are also shown on Plate 2-5. A Case 480 backhoe was used to open the berm for sampling. Grab samples were taken at mid-depth along the cross-section of the berm and the hill. Table 2-6 summarizes the sampling program for the berm excavations.

2.5.3 Analytical Program

Level II analyses were performed at the laboratory on all soil samples collected. These analyses were for the indicator compounds Lead, TNT, VOAs as Benzene and VOA's as TCE. The levels of these compounds were used to indicate which samples underwent further analysis. For each borehole, when possible, five samples, including the surficial sample, were collected and analyzed by Level II methods. Of these samples, the surficial soil sample and one other from the remaining four underwent Level IV and V analyses. Appendix C of the original workplan (The Chemical Data Acquisition Plan), describes the analytical protocols which were utilized in this program.

In addition to selecting samples for Level IV and V analyses, the Level II screening data has been used to evaluate the extent of vertical and horizontal contamination at the site. For the berm excavations, a Level II analysis has been performed on each sample collected. Tables 2-7, 2-8, and 2-9 summarize the Level II results and highlights the samples from each soil boring that underwent Level IV and V analyses for the grid, pad, and berm samples respectively. The results of these analyses are discussed in Section 4.

2.6 GROUNDWATER INVESTIGATIONS

2.6.1 Objectives

The goals of the groundwater investigation at the OB grounds were to determine the interrelationship between groundwater and surface water, verify the data collected from previous reports, and evaluate the vertical and lateral extent of contaminant migration. To accomplish these goals, MAIN has completed the installation of five overburden and ten weathered bedrock monitoring wells. The location of the existing monitoring wells and the additional overburden and weathered bedrock monitoring wells installed by MAIN are shown on Plate 2-6.

2.6.2 Monitoring Well Installation

Table 2-10 summarizes the monitoring well construction details. The stratigraphic well logs are presented in Appendix C while the monitoring well construction logs are presented in Appendix E. The monitoring wells were installed in late 1991 by Empire Soils Investigation, Inc. of Groton, New York under the direction of MAIN.

Five overburden groundwater monitoring wells have been installed at the site. Four of these monitoring wells have been located directly downgradient of Burning Pads C, E, G, J. These wells have been screened above the weathered shale within the glacial till. Previous investigations on the direction of groundwater flow at the site indicated that these four burning pads, (Pads C, E, G, and J), did not have monitoring wells located downgradient. Accordingly, the lateral migration of contaminants from these pads could not be adequately characterized. To address this deficiency, monitoring wells MW-18, MW-24, MW-29 and MW-19 have been installed downgradient of these pads.

The five overburden monitoring wells were installed, remotely, using hollow-stem augers. The base of these wells was installed just above the weathered shale zone. The details of the screen lengths and screen placements for each overburden monitoring well are presented in Table 2-10. Split spoon samples were collected continuously at each monitoring well installation. Soil samples were collected as described in Section 2.5, Soils Investigation. The monitoring wells were constructed using 2" National Sanitation Foundation (NSF) or ASTM approved Poly Vinyl Chloride (PVC). All of the monitoring wells had 0.010" slot size screens installed. The protective steel casing at each monitoring well was installed four feet below the ground surface to prevent heaving by frost. Locking caps and a weather resistant padlock were installed, and a cement collar was placed to surround each well. A permanent well identification maker was attached to the steel protective casing at each well location.

Ten weathered bedrock monitoring wells have been installed at the site. These wells were installed below the glacial till with the screen set within the upper zone of the weathered shale. Due to the thin nature of this weathered zone the screen lengths are quite small. The details of the screen placements and screen lengths are summarized within Table 2-10. The weathered bedrock monitoring wells were installed using the same procedures as described above for the overburden monitoring wells.

An off-site overburden well (MW-34) and an off-site weathered bedrock (MW-35) monitoring well have also been installed. These wells will be used to evaluate the background water quality of the overburden glacial till and the underlying weathered shale bedrock.

2.6.3 Monitoring Well Development

Subsequent to the well installations, each monitoring well was developed to insure a proper hydraulic connection existed between the borehole and the surrounding aquifer. The well development details are summarized within Table 2-11. Well development was performed on the new monitoring wells installed by MAIN. Prior to the commencement of the well development, a measurement of the turbidity of the groundwater was performed. The collection of representative groundwater samples is partially dependent upon the turbidity of the sample. Guidance provided by NYSDEC indicates that a valid sample is considered to be one which has a turbidity of less than 50 Nephelometric Turbidity Units (NTU's). NTU's were measured in the field with a portable field-analyzer. The procedure used to develop the wells consisted of surging the borehole water with a bailer to loosen fine grained materials present within the well screen and surrounding sand pack. The turbid water was then pumped from each borehole and stored on-site in 55 gallon drums for later disposal. The well development was continued until the turbidity of the water from each of the monitoring wells had stabilized or dropped below the 50 NTU value. As can be seen from Table 2-11, the turbidity of the samples did not drop below 100 NTU's during the well development. This is a function of the clay rich, fine grained nature of the glacial till and weathered shale. A significant effort was made to improve the turbidity of the samples. For example at monitoring well MW-22, 110 gallons of development water was removed from the well. This corresponds to approximately 42 well volumes removed with only a slight improvement in the turbidity of the samples.

2.6.4 Aquifer Testing

Measurements of in-situ hydraulic conductivity in each of the on-site monitoring wells installed by MAIN has also been completed. In cases where the water table was below the top of the screen, only the falling head methods of slug tests were performed. For the monitoring wells where the screen was installed completely below the water table both rising and falling head slug tests were completed. The results of the hydraulic conductivity testing are discussed in detail in Section 3 as they pertain to evaluating the hydraulic properties of both the glacial till and weathered bedrock aquifers.

For each slug test, an initial water level measurement was made in each monitoring well to establish the static water table. A pressure transducer was then lowered into the well to obtain hydraulic head measurements during the slug test. The slug was rapidly introduced to the well and set above the transducer but below the top of the water table. The pressure transducer then recorded the hydraulic head levels, as a function of time, as the excess head dissipated in the well. Each slug test was terminated when the excess head had reduced to equilibrium and the static water level, measured earlier, was again attained. The slug test information for each monitoring well was reduced using the procedure described by Horslev (1951) and Bouwer and Rice (1976). Normalized recovery rates were plotted against time on a semi-logarithmic plot and the hydraulic conductivity was determined both graphically and by computerized methods.

2.6.5 Groundwater Sampling

Monitoring wells MW-5 through MW-35 have had groundwater samples taken to evaluate the presence and extent of organic chemical constituents present within the groundwater. The monitoring wells at the OB grounds have been sampled for the following parameters:

1. Target Compound List (TCL) for Volatile Organic Analytes (VOA).
2. Target Compound List (TCL) for Acid, Base/Neutral, Pesticides and Polychlorinated Biphenyls (AB/N's, Pesticides and PCB's)
3. Target Analyte List (TAL) (Metals)
4. Method 8330 (Explosives)

A summary of the chemical testing performed is presented in Table 2-12. The results of the testing is discussed in detail within Section 4 of this report.

Three rounds of water level measurements have been completed for monitoring wells MW-5 through MW-35. The water level data have been used to confirm the direction of groundwater flow within the glacial till aquifer, evaluate the relationship between the glacial till and weathered bedrock aquifers, and evaluate the inter-relationship between the groundwater and surface water at the site. These data are discussed in detail within Section 3.

2.7 ECOLOGICAL INVESTIGATION PROGRAM

2.7.1 Objectives

The objective of the ecological assessment was to characterize the existing aquatic and terrestrial biotic environment on and near the OB/OD grounds. The aquatic biotic assessment focused on Reeder Creek, which is the only perennial body of water situated on or near the OB/OD grounds. The measurement endpoints of the aquatic assessment are primarily community oriented and include determining the species composition, relative abundance, species richness and guild (food web) structure of benthic macroinvertebrates and fish that are found in the stream. At an individual level, any suspected overt symptomology such as tumors or other abnormalities that could indicate adverse effects of contaminants were also quantified. These enabled the derivation of the Phase I assessment endpoints which are to identify potential aquatic receptors and characterize the existing aquatic community so that decisions regarding its value as a sport or recreational resource can be made and potential interactions with downstream aquatic communities or terrestrial communities can be identified.

The terrestrial biotic assessment focused on determining the species composition, relative abundance and species richness of the terrestrial floral and faunal communities inhabiting the OB/OD grounds and adjacent areas. The measurement endpoints are, at the individual level where any overt symptomology, such as plant leaf chlorosis (yellowing) or reduced plant growth, would be qualitatively assessed. These measurement endpoints enabled the derivation of the Phase I assessment endpoints which were to characterize and evaluate the existing terrestrial biotic community and identify potential terrestrial biotic receptors and interactions with terrestrial communities adjacent to the OB/OD grounds.

2.7.2 Aquatic Study Area

The only water body in proximity to the OB/OD grounds that flows on a year round basis is Reeder Creek. Adjacent to the OB/OD grounds, this stream is quite small, ranging in width from 4 to 10 feet with typical maximum depths ranging from 1 to 7 inches. Discharge measured during mid-November was only 0.1 cubic feet per second (cfs). Judging from the water surface elevation relative to the stream banks at the time of measurement, this discharge appears to be representative of normal conditions in this segment of Reeder Creek. The substrate is heavily influenced by near-surface shale deposits and is predominantly course, angular gravel and cobbles. There are some reaches where the stream flows directly over bedrock. Silt and some sand are typically imbedded in the interstitial spaces of the gravel and cobbles. Flow characteristics of the stream include approximately equal amounts of pool and riffle, although beaver activity has resulted in several impoundments on certain portions of the stream. Consequently, stream width and depth are atypical at these locations. The applicable State water quality standard given to Reeder Creek adjacent to the OB/OD Ground is Class D, although downstream of the Seneca Army Depot and two miles upstream of the Seneca Lake, the applicable standard is C(T). Reeder Creek discharges into Seneca Lake at a portion designated as AA(T).

The only known actively managed fisheries within two miles of the OB/OD Grounds are Seneca Lake and two "duck ponds" in the northeast corner of the Seneca Army Depot. Seneca Lake supports a significant fishery for both cold water and warm water species. The New York State Department of Environmental Conservation enforces special fisheries regulations for the Finger Lakes, of which Seneca Lake is one. These regulations pertain to lake trout, land locked salmon, rainbow trout, largemouth and small mouth bass, northern pike and walleye (NYSDEC undated). The fishery associated with the "duck ponds" is managed primarily for military family members (SEAD 1992). These ponds have been stocked in the past with channel catfish, which supplements the existing largemouth bass and bullhead fishery. The ponds are impoundments of Kendrig Creek which is in a separate drainage basin from the OB/OD Grounds. There are no other known significant aquatic resources within two miles of the OB/OD Grounds.

Conversations with the NYSDEC Regional Fish Manager (Carl Widmer of Region 8) and local residents indicated that rainbow trout ("steelheads") and rainbow smelt migrate from Seneca Lake into the lower reaches of Reeder Creek to spawn. A reconnaissance of lower Reeder Creek was conducted on foot from State Route 125, near Seneca Lake, upstream to the railroad bridge to determine the probable upstream limit of migration of these two species of fish. A barrier to upstream movement was found approximately midway between the road and the railroad bridge, a distance of roughly 0.7 miles from Seneca Lake.

The barrier consisted of a cascade over bedrock that was approximately six feet high. This cascade is near the ruins of an old mill. Consequently, steelhead and smelt are not expected to occur in Reeder Creek upstream of this location.

Aquatic biotic sampling locations within Reeder Creek were established to coincide with sediment and water quality sampling stations. This enabled direct correlations to be made between the aquatic community at different locations on Reeder Creek and the chemical constituents of the sediment and water. Stations SW-120, SW-130, SW-140 and SW-150 were all established downstream of known surface water discharge points from the OB/OD Grounds into Reeder Creek. Station SW-150 is within a stream reach that contains a series of small, relatively shallow (1-3 ft. deep) beaver ponds. Fish sampling was conducted in one of the beaver ponds. Benthic invertebrates were collected downstream of the beaver dam since the method of collection (Surber sampler) requires flowing water to be effective. The habitat at the remaining stations is representative of the non-impounded portions of the stream.

Station SW-110 was established downstream to characterize Reeder Creek as it leaves the Seneca Army Depot and provide a measure of the potential downstream transport of contaminants. Two large culverts immediately upstream of this station are installed in such a manner that they form an impassible barrier to most species of fish under all but the highest flow conditions. Therefore, fish that may occur downstream of this station cannot normally move upstream of this location, but fish that occur at upstream locations can move downstream. Station SW-110 is upstream of the influence of a small sewage treatment plant and a small tributary of Reeder Creek (State water index number ONT66-12-P369-6-1).

Station SW-196 was established as a reference on Reeder Creek approximately 0.5 mile above the expected influence of runoff from the OB/OD grounds. There are no barriers that would be considered impassable to fish between stations SW-150 and SW-196, so it is possible for fish collected at the reference station to have spent some time in a portion of Reeder Creek that could be potentially influenced by runoff from the OB/OD grounds. However, free movement upstream of Station SW-150 by most fish would be severely impeded by the beaver dams. A reconnaissance of Reeder Creek upstream of Station SW-196 failed to reveal what would be considered an impassable barrier. The number of samples collected at each station is presented in Table 2-13.

2.7.3 Terrestrial Study Area

The terrestrial biotic assessment involved two general study areas (Figure 2-1 and 2-2). Within the broadest study area, which included the OB/OD Grounds site and an area 2 miles from the site perimeter, significant resources such as NYSDEC significant habitats, habitats supporting endangered, threatened and rare species, species of concern, and state regulated wetlands, were identified. Also assessed for the 2-mile study area was the terrestrial resources used by humans that would potentially be affected by OB/OD grounds activities. The 2-mile study area is comprised of more than 50 percent private land and less than 50 percent Seneca Army Depot lands.

Within the smaller study area, which included the site and an area 0.5 mile from the site perimeter, the major vegetative communities, wildlife species associated with each cover type, and the value of the habitats to the associated wildlife were identified. Observations for signs of overt symptomology were conducted in the 0.5 mile study area. Approximately 90 percent of this study area is within the Seneca Army Depot. The remaining portion is private farmland on the western edge of SEAD.

2.7.4 Benthic Invertebrate Sampling

The benthic macroinvertebrates sampling in Reeder Creek utilized a Surber sampler. The Surber sampler used for sampling Reeder Creek was designed to sample a one square foot portion of stream bottom. The mesh of the net is 1mm square. Temperature and pH were measured with an Orion pH meter, Model 230A, dissolved oxygen was measured with a YSI Model 57 DO meter and conductivity was measured with a YSI Model 33 conductivity meter.

Samples were collected by choosing a sampling site that was representative of the stream reach. Depth of water at the sampling site did not exceed one foot. When the site was selected, the sampler was placed flat on the stream bed in such a manner that a minimum of flow was allowed to wash under the sampler. Large rocks within the confines of the sampler were manually lifted from the substrate and scrubbed at the mouth of the sampler to dislodge attached or clinging invertebrates which were then carried downstream into the net by the current. If only a portion of a rock was within the one square foot area, only the portion within the sampling area was scrubbed. When all rocks within the sampling area were scraped, any silt, sand or gravel within the sampling area was disturbed to a depth of approximately four inches by hand or with a probe to dislodge burrowing invertebrates and allow them to wash back into the net. After all materials within the sampling area were thoroughly disturbed, the net was quickly lifted out of the water and any debris or organisms adhering to the side of the net were rinsed into the bottom of the net. The net was then carefully inverted and the sample placed into a jar. Subsequent replicates were taken upstream of the previous sample to avoid the possibility of disturbances to the stream bed by sampling personnel influencing the sampling results. Samples were preserved in 70 percent ethanol and returned to the laboratory for sorting and identification.

Samples were sorted in the laboratory under magnification provided by a dissecting microscope. All invertebrates were placed in vials and identified to the lowest practicable taxon by an aquatic ecologist.

2.7.5 Fish Sampling

Fish sampling along Reeder Creek was performed using electroshocking. One additional sample was collected by seine at Station SW-150. Electroshocking was accomplished by using a Coffelt BP-2 backpack electroshocker. The seine used for fish sampling was a 25-ft. straight beach seine with one half inch stretch knotless nylon mesh. Temperature, pH, dissolved oxygen and conductivity were measured with the same instruments used during benthic sampling.

A single collection was made by seine at Station SW-150 because this was the only station on Reeder Creek where the stream bed was not clearly visible throughout the length of the station. Water depth was deeper at this location due to impounding by a small beaver dam. This collection was used to obtain voucher specimens for positive identification so that the majority of fish collected in subsequent collections could be returned alive at the station where they were collected. The seine collection at Station SW-150 was obtained on November 1, 1991, three weeks prior to the electroshocking sampling at this same location. A total of three seine hauls were made, which effectively sampled approximately a 75 ft. reach of Reeder Creek.

All Reeder Creek stations were sampled by electroshocking. Samples were collected by beginning at the downstream segment of the station and proceeding upstream for a distance of approximately 75 ft. Both pool and riffle habitat were sampled at all stations except SW-150. The electrodes of the electroshocker were swept back and forth across the entire stream, with one crew member occasionally releasing the deadman's switch to interrupt the current field. Stunned fish were netted and placed in a bucket of streamwater for later processing.

Processing of fish collected by both seining and electroshocking consisted primarily of identification and enumeration. An indication of the size range of fish in each collection was obtained by measuring at least the smallest and largest individual of each species. If field identification of a specimen was uncertain, voucher specimens were preserved in formalin and returned to the laboratory for confirmation of the identification. In addition, any individuals with overt symptomology (such as tumors) were preserved for documentation purposes. All other specimens collected were returned alive to the stream at the location that they were collected.

2.7.6 Terrestrial Assessment Methods

The presence of significant terrestrial biotic resources within the 2-mile study area was determined by contacting the NYSDEC Information Services for locations of significant habitats, rare, threatened and endangered species and species of concern. New York State regulated wetland maps were reviewed for the location of these significant wetland resources in the study area. The location of all significant resources occurring in the study area were mapped at a scale of 1" = 2000'. Information on the hunting, agricultural and forestry use of the terrestrial resources in the study area was obtained from the Seneca Army Depot, local residents, field reconnaissances and review of current (1991) aerial photography (scale 1" - 500').

The aerial photography was reviewed to delineate the major upland and wetland vegetative cover types in the 0.5 mile study area. These major cover types were mapped at a scale of 1" = 1000'. Existing wetland maps were reviewed for freshwater wetland locations. Field surveys were performed to confirm or revise the cover type identification and boundaries and determine plant species composition, relative abundance, and density. Existing information was reviewed to confirm species presence (Cowardin 1965, Seneca Army Depot 1992). Freshwater wetlands on the OB/OD grounds were identified and delineated using the Unified Federal Routine Method (Federal Interagency Committee for Wetland Delineation 1989). These wetlands were surveyed and mapped at a scale of 1" = 200'.

Wildlife species, including amphibians, reptiles, birds and mammals, expected to inhabit the study areas' identified cover types, were determined primarily from existing information obtained from the Seneca Army Depot and the nearby Montezuma National Wildlife Refuge (U.S. Fish and Wildlife Service 1990, 1991, U.S. Fish and Wildlife Service and NYS Department Environmental Conservation 1991). In addition, all wildlife observed during the course of the late fall ecological and surface water/sediment field programs were recorded to species, when possible. The habitat value of the cover types to wildlife was assessed during these field surveys. Any signs of wildlife and vegetation stress or alterations observed during the above surveys were also noted.

SENECA ARMY DEPOT
OB GROUND

TABLE 2–1
GEOPHYSICAL ANOMALY EXCAVATION SUMMARY

ANOMALY NUMBER	TEST PIT NUMBER	SAMPLE DEPTH (ft)
GAE–G–1	GAE–G–1	2.0
GAE–G–2	GAE–G–2	2.0
GAE–J–1	GAE–J–1	1.0

SENECA ARMY DEPOT
OB GROUNDS

TABLE 2-2
SURFACE WATER SAMPLING SUMMARY

SURFACE WATER SAMPLE LOCATION	MATRIX	SAMPLE NUMBER	WATER DEPTH @ SAMPLE LOC.
110	WATER	W0711-37..42	12"
120	WATER	W0711-44..49	3"
130	WATER	W0711-53..58	6"
140	WATER	W0711-62..67	3"
150	WATER	W0811-71..76	18"
150	WATER	W0811-80..85	18"
150	WATER	W1411-83A	24"
160	WATER	W1211-96	3"
170	WATER	W1211-97	2"
180	WATER	W1012-117	2"
191	WATER	W0611-13..18	3"
192	WATER	W1311-103	4"
193	WATER	W1311-100	4"
194	WATER	W1311-101	5"
195	WATER	W1311-102	4"
196	WATER	W1211-98	12"
197	WATER	W1311-104	2"

SENECA ARMY DEPOT
OB GROUNDS

TABLE 2-3
SEDIMENT SAMPLING SUMMARY

SEDIMENT SAMPLE LOCATION	MATRIX	SAMPLE NUMBER	WATER DEPTH @ SAMPLE LOC.
120	SEDIMENT	S0711-50..52	2"
120	SEDIMENT	S1012-118	3"
130	SEDIMENT	S1411-61A	2"
130	SEDIMENT	S0711-59..61	2"
130	SEDIMENT	S1411-60A	2"
140	SEDIMENT	S0811-68..70	3"
150	SEDIMENT	S0811-77..79	2"
150	SEDIMENT	S0811-86..88	2"
150	SEDIMENT	S1411-78A	4"
150	SEDIMENT	S1411-87A	4"
160	SEDIMENT	S1211-96	3"
170	SEDIMENT	S1211-97	4"
180	SEDIMENT	S0811-89..91	2"
180	SEDIMENT	S1012-117	5"
190	SEDIMENT	S0611-22..24	4"
191	SEDIMENT	S0611-19..21	4"
192	SEDIMENT	S1311-103	2"
193	SEDIMENT	S1311-100	3"
194	SEDIMENT	S1311-101	2"
195	SEDIMENT	S1311-102	2"
196	SEDIMENT	S1211-98	3"
197	SEDIMENT	S1311-104	2"

SENECA ARMY DEPOT
OB GROUNDS

TABLE 2–4
GRID BORING AND MONITORING WELL ADVANCEMENT SOIL SAMPLING SUMMARY

GRID/WELL BORING #	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE METHOD
GB–1	GB–1–1	0–6"	GS
	GB–1–2	0–2'	SS
	GB–1–3	2–4'	SS
	GB–1–4	4–6'	SS
GB–2	GB–2–1	0–6"	GS
	GB–2–2	0–2'	SS
	GB–2–3	2–4'	SS
GB–3	GB–3–2	0–2'	SS
	GB–3–3	2–4'	SS
	GB–3–4	4–6'	SS
	GB–3–5	6' +	SS
GB–4	GB–4–1	0–6"	GS
	GB–4–2	0–2'	SS
	GB–4–3	2–4'	SS
	GB–4–4	4–6'	SS
	GB–4–5	6' +	SS
GB–5	GB–5–1	0–6"	GS
	GB–5–2	0–2'	SS
	GB–5–3	2–4'	SS
GB–6	GB–6–1	0–6"	GS
	GB–6–2	0–2'	SS
	GB–6–3	2–4'	SS
	GB–6–4	4–6'	SS
	GB–6–5	6' +	SS
GB–7	GB–7–1	0–6"	GS
	GB–7–2	0–2'	SS
	GB–7–3	2–4'	SS
	GB–7–4	4' +	SS
GB–8	GB–8–1	0–6"	GS
	GB–8–2	0–2'	SS
	GB–8–3	2–4'	SS
	GB–8–4	4–6'	SS
	GB–8–5	6'+	SS
GB–9	GB–9–1	0–6"	GS
	GB–9–2	0–2'	SS
	GB–9–3	2–4'	SS
	GB–9–4	4'+	SS

SENECA ARMY DEPOT
OB GROUNDS

TABLE 2-4
GRID BORING AND MONITORING WELL ADVANCEMENT SOIL SAMPLING SUMMARY

GRID/WELL BORING #	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE METHOD
GB-10	GB-10-1	0-6"	GS
	GB-10-2	0-2'	SS
	GB-10-3	2' +	SS
GB-11	GB-11-1	0-6"	GS
	GB-11-2	0-2'	SS
	GB-11-3	2-4'	SS
	GB-11-4	4'+	SS
GB-12	GB-12-1	0-6"	GS
	GB-12-2	0-2'	SS
	GB-12-3	2-4'	SS
	GB-12-4	4-6'	SS
	GB-12-5	6' +	SS
GB-13	GB-13-1	0-6"	GS
	GB-13-2	0-2'	SS
	GB-13-3	2-4'	SS
	GB-13-4	4-6'	SS
GB-14	GB-14-1	0-6"	GS
	GB-14-2	0-2'	SS
	GB-14-3	2-4'	SS
	GB-14-4	4-6'	SS
	GB-14-5	8-10'	SS
	GB-14-6	10-12'	SS
	GB-14-7	12' +	SS
GB-15	GB-15-1	0-6"	GS
	GB-15-2	0-2'	SS
	GB-15-3	2-4'	SS
	GB-15-4	4-6'	SS
GB-16	GB-16-1	0-6"	GS
	GB-16-2	0-2'	SS
	GB-16-3	2-4'	SS
	GB-16-4	4-6'	SS
	GB-16-5	6-8'	SS
GB-17 (MW-21)	S1101-4	0-6"	GS
	S1101-5	0-2'	SS
	S1101-6	2-3.7'	SS

SENECA ARMY DEPOT
OB GROUNDS

TABLE 2–4
GRID BORING AND MONITORING WELL ADVANCEMENT SOIL SAMPLING SUMMARY

GRID/WELL BORING #	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE METHOD
GB–18 (MW–19)	S1030–1	0–6"	GS
	S1030–2	0–2'	SS
	S1030–3	2–4'	SS
	S1030–4	4–5'	SS
	S1030–5	5–7'	SS
GB–19 (MW–31)	S1511–114	0–6"	GS
	S1511–115	0–2'	SS
	S1511–116	2–4'	SS
	S1811–117	4–4.5'	SS
GB–20 (MW–29)	S1311–104	0–6"	GS
	S1311–105	0–2'	SS
	S1311–106	2–4'	SS
	S1311–107	4–6'	SS
	S1311–108	6–8'	SS
	S1311–109	8–10'	SS
MW–30	S1411–109	0–6"	GS
	S1411–110	0–2'	SS
	S1411–111	2–4'	SS
	S1411–112	4–6'	SS
	S1411–113	6–8'	SS
	S1411–114	8–10'	SS
MW–32	S1911–117	0–6"	GS
	S1911–118	0–2'	SS
	S1911–119	2–4'	SS
	S1911–120	4–6'	SS
MW–34	S2011–121	0–2'	SS
	S2011–122	2–4'	SS
	S2011–123	4–4.5'	SS

NOTES: SS = SPLIT SPOON
GS = GROUND SCRAPE

SENECA ARMY DEPOT
OB GROUND

TABLE 2–5
BURN PAD BORINGS
SOIL SAMPLING SUMMARY

BURN PAD NUMBER	SAMPLE I.D. NUMBER	SAMPLE METHOD	SAMPLE INTERVAL
A	PB–A–1–91	GS	0–6"
	PB–A–2–91	SS	0–2'
	PB–A–3–91	SS	2–4'
	PB–A–4–91	SS	4–5.8'
B	PB–B1–1–91	GS	0–6"
	PB–B1–2–91	SS	0–2'
	PB–B1–3–91	SS	2–4'
	PB–B1–4–91	SS	4–6'
	PB–B1–5–91	SS	6–8'
C	PB–C1–1–91	GS	0–6"
	PB–C1–2–91	SS	0–2'
	PB–C1–3–91	SS	2–4'
	PB–C1–4–91	SS	4–6'
	PB–C1–5–91	SS	6–8'
D	PB–D1–1–91	GS	0–6"
	PB–D1–2–91	SS	0–2'
	PB–D1–3–91	SS	2–4'
	PB–D1–4–91	SS	4–6'
	PB–D1–5–91	SS	6–8'
	PB–D1–6–91	SS	8–9.2'
E	PB–E1–1–91	SS	0–6"
	PB–E1–2–91	GS	0–2'
	PB–E1–3–91	SS	2–4'
	PB–E1–4–91	SS	4–6'
	PB–E1–5–91	SS	6–8'
	PB–E1–6–91	SS	8–10'
	PB–E1–7–91	SS	10–11.4'
F	PB–F1–1–91	GS	0–6"
	PB–F1–2–91	SS	0–2'
	PB–F1–3–91	SS	2–4'
	PB–F1–4–91	SS	4–6'
	PB–F1–5–91	SS	6–8'
	PB–F1–6–91	SS	8–8.4'

SENECA ARMY DEPOT
OB GROUND

TABLE 2-5
BURN PAD BORINGS
SOIL SAMPLING SUMMARY

BURN PAD NUMBER	SAMPLE I.D. NUMBER	SAMPLE METHOD	SAMPLE INTERVAL
G (1)	PB-G1-1-91	GS	0-6"
	PB-G1-2-91	SS	0-2'
	PB-G1-3-91	SS	2-4'
	PB-G1-4-91	SS	4-6'
	PB-G1-5-91	SS	6-9.3'
G (2)	PB-G2-1-91	GS	0-6"
	PB-G2-2-91	SS	0-2'
	PB-G2-3-91	SS	2-4'
	PB-G2-4-91	SS	4-6'
	PB-G2-5-91	SS	6-8'
G (3)	PB-G3-1-91	GS	0-6"
	PB-G3-2-91	SS	0-2'
	PB-G3-3-91	SS	2-4'
	PB-G3-4-91	SS	4-6'
	PB-G3-5-91	SS	6-6.9'
G (4)	PB-G4-1-91	GS	0-6"
	PB-G4-2-91	SS	0-2'
	PB-G4-4-91	SS	4-6'
G (5)	PB-G5-1-91	GS	0-6"
	PB-G5-2-91	SS	0-2'
	PB-G5-3-91	SS	2-4'
	PB-G5-4-91	SS	4-6'
	PB-G5-5-91	SS	6-8'
G (6)	PB-G6-1-91	GS	0-6"
	PB-G6-2-91	SS	0-2'
	PB-G6-3-91	SS	2-4'
	PB-G6-4-91	SS	4' +
G (7)	PB-G7-1-91	GS	0-6"
	PB-G7-2-91	SS	0-2'
	PB-G7-3-91	SS	2-4'
	PB-G7-4-91	SS	4-6'
	PB-G7-5-91	SS	6' +
H	PB-H1-1-91	GS	0-6"
	PB-H1-2-91	SS	0-2'
	PB-H1-3-91	SS	2-4'
	PB-H1-4-91	SS	4-5.4'

SENECA ARMY DEPOT
OB GROUND

TABLE 2–5
BURN PAD BORINGS
SOIL SAMPLING SUMMARY

BURN PAD NUMBER	SAMPLE I.D. NUMBER	SAMPLE METHOD	SAMPLE INTERVAL
J (1)	PB–J1–1–91	GS	0–6"
	PB–J1–2–91	SS	0–2'
	PB–J1–3–91	SS	2' +
J (2)	PB–J2–1–91	GS	0–6"
	PB–J2–2–91	SS	0–2'
	PB–J2–3–91	SS	2–4'
	PB–J2–4–91	SS	4' +
J (3)	PB–J3–1–91	GS	0–6"
	PB–J3–2–91	SS	0–2'
	PB–J3–3–91	SS	2–4'
	PB–J3–4–91	SS	4' +
J (4)	PB–J4–1–91	GS	0–6"
	PB–J4–2–91	SS	0–2'
	PB–J4–3–91	SS	2–4'
	PB–J4–4–91	SS	4' +
J (5)	PB–J5–1–91	GS	0–6"
	PB–J5–2–91	SS	0–2'
	PB–J5–4–91	SS	2' +
J (6)	PB–J6–1–91	GS	0–6"
	PB–J6–2–91	SS	0–2'
	PB–J6–3–91	SS	2–4'
	PB–J6–4–91	SS	4' +
J(7)	PB–J7–1–91	GS	0–6"
	PB–J7–2–91	SS	0–2'
	PB–J7–3–91	SS	2–4'
	PB–J7–4–91	SS	4–6'
	PB–J7–5–91	SS	6–7.6'
J(8)	PB–J8–1–91	GS	0–6"
	PB–J8–2–91	SS	0–2'
	PB–J8–3–91	SS	2–4'
	PB–J8–4–91	SS	4–6'

NOTES: SS = SPLIT SPOON
GS = GROUND SCRAPE

SENECA ARMY DEPOT
OB GROUNDS

TABLE 2–6
BERM EXCAVATION COMMENTS AND SAMPLING SUMMARY

BURN PAD SAMPLED	SAMPLE NUMBER	LOCATION NUMBER	SAMPLE DEPTH	COMMENTS
A	BE–A–1–91	A–1	3.5	MISC. FILL
	BE–A–2–91	A–2	3.5	MISC. FILL
B	BE–B–1–91	B–1	2.0	MISC. FILL, MANY NAILS AND HINGES
	BE–B–2–91	B–2	2.5	MISC. FILL, MANY LEAD SLUGS, HINGES AND NAILS
C	BE–C–1–91	C–1	1.5	MISC. FILL
	BE–C–2–91	C–2	4.0	HEAVY BLACK ASH CONTENT
	BE–C–3–91	C–3	4.0	HEAVY BLACK ASH CONTENT
	BE–C–4–91	C–4	1.5	MISC. FILL
D	BE–D–1–91	D–1	3.0	MISC. FILL
	BE–D–2–91	D–2	2.5	MISC. FILL
E	BE–E–1–91	E–1	3.0	MISC. FILL
	BE–E–2–91	E–2	3.0	MISC. FILL
F	BE–F–1–91	F–1	2.0	MISC. FILL, MANY LEAD SLUGS AND NAILS
	BE–F–2–91	F–2	2.0	MISC. FILL, MANY LEAD SLUGS, HINGES AND NAILS
	BE–F–3–91	F–3	3.0	MISC. FILL, MANY LEAD SLUGS, HINGES AND NAILS
G	BE–G–1–91	G–1	2.5	MISC. FILL, MUCH ASSORTED DEBRIS
	BE–G–2–91	G–2	4.0	MISC. FILL, MUCH ASSORTED DEBRIS
	BE–G–3–91	G–3	4.5	MISC. FILL, MUCH ASSORTED DEBRIS
	BE–C–4–91	G–4	2.0	MISC. FILL, MUCH ASSORTED DEBRIS
	BE–G–5–91	G–5	4.0	LARGE AMOUNTS OF SCRAP METAL
	BE–G–6–91	G–6	3.0	MISC. FILL, MUCH ASSORTED DEBRIS
	BE–G–7–91	G–7	3.0	MISC. FILL, MUCH ASSORTED DEBRIS
H	BE–H–1–91	H–1	3.0	MISC. FILL, MANY LEAD SLUGS, HINGES AND NAILS
	BE–H–2–91	H–2	4.0	MISC. FILL, MANY LEAD SLUGS,
	BE–H–3–91	H–3	4.0	MISC. FILL, MANY NAILS
	BE–H–4–91	H–4	4.0	MISC. FILL, MANY NAILS AND HINGES
J	BE–J–1–91	J–1	2.5	MISC. FILL, SOME ASSORTED DEBRIS
	BE–J–2–91	J–2	2.5	MISC. FILL, SOME ASSORTED DEBRIS
	BE–J–3–91	J–2	4.0	MISC. FILL, SOME ASSORTED DEBRIS
	BE–J–4–91	J–3	3.0	MISC. FILL, SOME ASSORTED DEBRIS
	BE–J–5–91	J–4	3.0	MISC. FILL, SOME ASSORTED DEBRIS
	BE–J–6–91	J–5	3.0	MISC. FILL, SOME ASSORTED DEBRIS
	BE–J–7–91	J–6	4.0	MISC. FILL, SOME ASSORTED DEBRIS

SENECA ARMY DEPOT
OB GROUNDS

TABLE 2–7
GRID BORINGS
SUMMARY OF LEVEL II SCREENING RESULTS

GRID BORING	SAMPLE NUMBER	Pb, Total mg/Kg	TNT mg/Kg	VOA–Benzene ug/Kg	VOA–TCE ug/Kg
GB–1	GB–1–1				
	GB–1–2	280			
	GB–1–3	970			
	GB–1–4	21			
GB–2	GB–2–1				
	GB–2–2	1940			
	GB–2–3	25			
	GB–2–4	19.5			
GB–3	GB–3–1				
	GB–3–2	230.0			
	GB–3–3	11.4			
	GB–3–4	18.3			
	GB–3–5	24			
GB–4	GB–4–1				
	GB–4–2	18.7			
	GB–4–3	<10			
	GB–4–4	16.0			
	GB–4–5	19.1			
GB–5	GB–5–1				
	GB–5–2	<10	1.15		
	GB–5–3	<10			
GB–6	GB–6–1				
	GB–6–2	<10			
	GB–6–3	<10			
	GB–6–4	16.0			
	GB–6–5	19.9			
GB–7	GB–7–1				
	GB–7–2	22.0			
	GB–7–3	15.6			
	GB–7–4	19.6			
GB–8	GB–8–1				
	GB–8–2	131.0			
	GB–8–3	<10			
	GB–8–4	9800			
	GB–8–5	55			
GB–9	GB–9–1				
	GB–9–2	<10			
	GB–9–3	23.0			
	GB–9–4	11.7			
GB–10	GB–10–1				
	GB–10–2	21.0			
	GB–10–3	15.0			

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OB GROUNDS

TABLE 2-7
GRID BORINGS
SUMMARY OF LEVEL II SCREENING RESULTS

GRID BORING	SAMPLE NUMBER	Pb, Total mg/Kg	TNT mg/Kg	VOA-Benzene ug/Kg	VOA-TCE ug/Kg
GB-11	GB-11-1				
	GB-11-2	10.1			
	GB-11-3	15.1			
	GB-11-4	<10			
GB-12	GB-12-1				
	GB-12-2	138.0			
	GB-12-2A	149.0			
	GB-12-3	15.7			
	GB-12-3A	18.9			
	GB-12-4	30.0			
	GB-12-4A	19.5			
	GB-12-5				
GB-13	GB-13-1				
	GB-13-2	910.0			
	GB-13-3	20.0			
	GB-13-4	420.0			
GB-14	GB-14-1				
	GB-14-2	87.0			
	GB-14-2A	84.0			
	GB-14-3	<10			
	GB-14-3A	<10			
	GB-14-4	10.9			
	GB-14-4A	<10			
	GB-14-5	<10			
	GB-14-5A	20.0			
	GB-14-6	10.8			
	GB-14-6A	11.8			
	GB-14-7	17.0			
	GB-14-7A	12.3			
GB-15	GB-15-1				
	GB-15-2	830.0			
	GB-15-3	14.9			
	GB-15-4	153.0			
GB-16	GB-16-1				
	GB-16-2	<10			
	GB-16-3	<10			
	GB-16-4	<10			
	GB-16-5	<10			
GB-17 (MW-21)	GB-17-1				
	S1101-5				
	S1101-6				

SENECA ARMY DEPOT
OB GROUNDS

TABLE 2-7
GRID BORINGS
SUMMARY OF LEVEL II SCREENING RESULTS

GRID BORING	SAMPLE NUMBER	Pb, Total mg/Kg	TNT mg/Kg	VOA-Benzene ug/Kg	VOA-TCE ug/Kg
GB-18 (MW-19)	GB-18-1	▨	▨	▨	▨
	S1030-2				
	S1030-3				
	S1030-4				
	S1030-5				
GB-19 (MW-31)	GB-19-1	▨	▨	▨	▨
	S1511-115	▨	▨	▨	▨
	S1511-116				
	S1811-117				
GB-20 (MW-29)	GB-20-1	▨	▨	▨	▨
	S1311-105				
	S1311-106	▨	▨	▨	▨
	S1311-107				
	S1311-108				
	S1311-109				
MW-30	S1411-110	▨	▨	▨	▨
	S1411-111				
	S1411-112				
	S1411-113				
	S1411-114				
MW-32	S1911-118	▨	▨	▨	▨
	S1911-119				
	S1911-120				
MW-34	S2011-121	▨	▨	▨	▨
	S2011-122				
	S2011-123				

▨ **LEVEL 4 ANALYSES PERFORMED**

SENECA ARMY DEPOT
OB GROUNDS

TABLE 2–8
PAD BORINGS
SUMMARY OF LEVEL II SCREENING RESULTS

BURNING PAD	SAMPLE NUMBER	Pb, Total mg/Kg	TNT mg/Kg	VOA–Benzene ug/Kg	VOA–TCE ug/Kg
A	PB–A–1–91				
	PB–A–2–91	2100.0			
	PB–A–2A–91	940.0	1.46		
	PB–A–3–91	97.0			
	PB–A–3A–91	101.0			
	PB–A–4–91	68.0			
	PB–A–4A–91	51.0			
B	PB–B1–1–91				
	PB–B1–2–91	77.0			
	PB–B1–3–91	2600.0			
	PB–B1–4–91	2100.0			
	PB–B1–5–91	960.0	1.01		
C	PB–C1–1–91				
	PB–C1–2–91	173.0			
	PB–C1–2A–91	250.0			
	PB–C1–3–91	670.0		44500	19700
	PB–C1–3A–91	770.0		25200	13000
	PB–C1–4–91	900.0		1800	890
	PB–C1–4A–91	370.0		8800	99
	PB–C1–5–91	98.0			
	PB–C1–5A–91	800.0			
D	PB–D1–1–91				
	PB–D1–2–91	1270.0			
	PB–D1–2A–91	2800.0			
	PB–D1–3–91	12400.0			
	PB–D1–3A–91	3600.0			
	PB–D1–4–91	63.0			
	PB–D1–4A–91	1100.0			
	PB–D1–5–91	1090.0			
	PB–D1–6–91	1850.0			
E	PB–E1–1–91				
	PB–E1–2–91	36.0			
	PB–E1–3–91	970.0			
	PB–E1–4–91	32.0			
	PB–E1–5–91	33.0			
	PB–E1–6–91	280.0			
	PB–E1–7–91	17.4			
F	PB–F1–1–91				
	PB–F1–2–91	30.0			
	PB–F1–3–91	55.0			
	PB–F1–4–91	141.0			
	PB–F1–5–91	<10			
	PB–F1–6–91	28.0			

SENECA ARMY DEPOT
OB GROUNDS

TABLE 2−8
PAD BORINGS
SUMMARY OF LEVEL II SCREENING RESULTS

BURNING PAD	SAMPLE NUMBER	Pb, Total mg/Kg	TNT mg/Kg	VOA−Benzene ug/Kg	VOA−TCE ug/Kg
G (1)	PB−G1−1−91				
	PB−G1−2−91	14100.0	2.6		
	PB−G1−3−91	2100.0	24.0		
	PB−G1−4−91	590.0			
	PB−G1−5−91	135.0			
	PB−G1−6−91	23.0	1.11		
G (2)	PB−G2−1−91				
	PB−G2−2−91	1250.0			
	PB−G2−3−91	18.0			
	PB−G2−4−91	64.0			
	PB−G2−5−91	14.8			
G (3)	PB−G3−1−91				
	PB−G3−2−91	350.0			
	PB−G3−3−91	<10			
	PB−G3−4−91	21.0			
	PB−G3−5−91	<10			
G (4)	PB−G4−1−91				
	PB−G4−2−91	15.9			
	PB−G4−4−91	11.7			
G (5)	PB−G5−1−91				
	PB−G5−2−91	31.0		127	
	PB−G5−3−91	11.0		134	
	PB−G5−4−91	17.2			
	PB−G5−5−91	21.0			
G (6)	PB−G6−1−91				
	PB−G6−2−91	44.0			
	PB−G6−3−91	51.0			
	PB−G6−4−91	900.0			
	PB−G6−5−91	21.0			
G (7)	PB−G7−1−91				
	PB−G7−2−91	280.0			
	PB−G7−3−91	15.7			
	PB−G7−4−91	191.0			
	PB−G7−5−91	22.0			
H	PB−H1−1−91				
	PB−H1−2−91	92.0			
	PB−H1−3−91	16.1			
	PB−H1−4−91	<10			

SENECA ARMY DEPOT
OB GROUNDS

TABLE 2–8
PAD BORINGS
SUMMARY OF LEVEL II SCREENING RESULTS

BURNING PAD	SAMPLE NUMBER	Pb, Total mg/Kg	TNT mg/Kg	VOA–Benzene ug/Kg	VOA–TCE ug/Kg
J (1)	PB–J1–1–91				
	PB–J1–2–91	95.0			
	PB–J1–3–91	36.0			
J (2)	PB–J2–1–91				
	PB–J2–2–91	230.0			
	PB–J2–3–91	17.4			
	PB–J2–4–91	13.7			
J (3)	PB–J3–1–91				
	PB–J3–2–91	880.0			
	PB–J3–3–91	21.0			
	PB–J3–4–91	17.9			
J (4)	PB–J4–1–91				
	PB–J4–2–91	85.0			
	PB–J4–3–91	15.6			
	PB–J4–4–91	11.9		210	
J (5)	PB–J5–1–91				
	PB–J5–2–91	450.0			
	PB–J5–4–91	24.0			
J (6)	PB–J6–1–91				
	PB–J6–2–91	51.0			
	PB–J6–3–91	<10			
	PB–J6–4–91	10.2			
J(7)	PB–J7–1–91				
	PB–J7–2–91	400.0			
	PB–J7–3–91	<10			
	PB–J7–4–91	27.0			
	PB–J7–5–91	48.0			
J(8)	PB–J8–1–91				
	PB–J8–2–91	55.0			
	PB–J8–3–91	18.2			
	PB–J8–4–91	10.6			

▨ LEVEL 4 ANALYSES PERFORMED

SENECA ARMY DEPOT
OB GROUNDS

TABLE 2-9
BERM EXCAVATIONS
SUMMARY OF LEVEL II SCREENING RESULTS

BERM LOCATION	SAMPLE NUMBER	Pb, Total mg/Kg	TNT mg/Kg	VOA-Benzene ug/Kg	VOA-TCE ug/Kg
A	BE-A-1-91	6600			
	BE-A-2-91	800			
B	BE-B-1-91	4000			
	BE-B-2-91	34000	1.27		
C	BE-C-1-91	3600			
	BE-C-2-91	44000	1.11		
	BE-C-3-91	22000			
	BE-C-4-91	270			
D	BE-D-1-91	12000			
	BE-D-2-91	1870	12.5		
E	BE-E-1-91	1030			
	BE-E-2-91	310			
F	BE-F-1-91	2200	1.02		
	BE-F-1A-91	1170			
	BE-F-2-91	4500	29		
	BE-F-2A-91	7700	69		
	BE-F-3-91	159			
	BE-F-3A-91	140			
G	BE-G-1-91	103	1.47		
	BE-G-2-91	19700	3.4		
	BE-G-3-91	7100	1.46		
	BE-G-4-91	2600			
	BE-G-5-91	850	1.64		
	BE-G-6-91	7900	1.41		
	BE-G-7-91	31			
H	BE-H-1-91	35			
	BE-H-2-91	6000	1.18		
	BE-H-3-91	17400	1.12		
	BE-H-4-91	260			
J	BE-J-1-91	18.6			
	BE-J-2-91	16.7			
	BE-J-3-91	19.1			
	BE-J-4-91	22.0			
	BE-J-5-91	690			
	BE-J-6-91	30			
	BE-J-7-91				

▨ LEVEL 4 ANALYSES PERFORMED

SENECA ARMY DEPOT
OB GROUNDS

TABLE 2–10
MONITORING WELL ADVANCEMENT SUMMARY

MONITORING WELL NUMBER	WELL TYPE	POINT OF WELL	SCREEN LENGTH	SLOT SIZE (")	SCREEN INTERVAL
MW–18	WBR	11'	5'	0.010	6–11'
MW–19	OB	7'	2'	0.010	3–5'
MW–21	WBR	14'	7'	0.010	7–14'
MW–22	WBR	16'	10'	0.010	6–16'
MW–23	WBR	12.5'	5'	0.010	7.5–12.5'
MW–24	OB	7'	2'	0.010	5–7'
MW–25	WBR	12.5'	5'	0.010	7.5–12.5'
MW–26	OB	5'	2'	0.010	3–5'
MW–27	WBR	12.7'	5'	0.010	7.7–12.7'
MW–28	WBR	10.5'	2'	0.010	8.5–10.5'
MW–29	OB	10.5'	5'	0.010	5.5–10.5'
MW–30	WBR	10'	2'	0.010	8–10'
MW–31	WBR	8.75'	2'	0.010	6.75–8.75'
MW–32	WBR	13.5'	8'	0.010	5.5–13.5'
MW–34	OB	4.5'	1.5'	0.010	3.0–4.5'
MW–35	WBR	9.5'	2'	0.010	7.5–9.5'

NOTES:

OB = OVERBURDEN
WBR = WEATHERED BEDROCK

SENECA ARMY DEPOT
OB GROUNDS

TABLE 2-11
MONITORING WELL DEVELOPMENT SUMMARY

MONITORING WELL NUMBER	GALLONS REMOVED	INIT/FINAL DEG. C	INIT/FINAL NTU	INIT/FINAL pH	INIT/FINAL uMHO
MW-18	105	8.9/8.7	+100/+100	7.1/8.8	510/500
MW-19	40	5.0/7.0	+100/+100	7.1/8.8	510/500
MW-21	30	8.5/8.2	+100/+100	7.6/7.8	490/480
MW-22	110	8.0/8.5	+100/+100	6.8/6.8	425/410
MW-23	110	9.5/9.0	+100/+100	6.8/6.9	700/690
MW-24	30	8.0/8.0	+100/+100	7.0/7.2	800/790
MW-25	110	8.0/8.6	+100/+100	7.8/7.7	435/440
MW-26	DRY	DRY	DRY	DRY	DRY
MW-27	110	7.8/7.8	+100/+100	7.6/7.7	520/520
MW-28	30	9.6/9.2	+100/+100	7.3/7.3	550/520
MW-29	110	8.0/8.0	+100/+100	7.4/7.2	600/590
MW-30	110	9.6/9.2	+100/+100	7.3/7.4	650/620
MW-31	45	7.6/7.4	+100/+100	7.4/7.4	600/630
MW-32	40	8.1/7.8	+100/+100	7.7/7.5	460/450
MW-34	DRY	DRY	DRY	DRY	DRY
MW-35	20	9.0/9.2	86/90	7.6/7.8	485/465

SENECA ARMY DEPOT
OB GROUND

TABLE 2–12
MONITORING WELL SAMPLING SUMMARY

MONITORING WELL NUMBER	SAMPLE DATE	uMHO	pH	DEG. C
MW–5	1–8–92	209	6.9	4.2
MW–6	1–14–92	330	7.1	7.2
MW–7	1–10–92	303	5.8	4.1
MW–8	1–15–92	1100	5.9	6.2
MW–9	1–9–92	620	6.5	5.4
MW–10	1–10–92	540	6.1	5.8
MW–11	1–15–92	720	6.5	4.1
MW–12	1–15–92	450	6.7	4.0
MW–13	1–9–92	550	6.8	7.0
MW–14	1–14–92	680	6.4	4.9
MW–15	1–9–92	910	6.8	6.6
MW–16	1–14–92	510	6.3	7.2
MW–17	1–17–92	390	7.3	5.5
MW–18	1–13–92	550	7.4	8.2
MW–19	1–16–92	480	7.0	2.0
MW–21	1–8–92	389	6.5	7.8
MW–22	1–13–92	380	7.4	7.0
MW–23	1–14–92	420	6.5	10.0
MW–24	1–15–92	710	6.6	5.5
MW–25	1–13–92	490	7.1	8.7
MW–26	▨	▨	▨	▨
MW–27	1–15–92	590	6.7	6.0
MW–28	1–14–92	550	7.1	10.2
MW–29	1–14–92	500	7.1	9.0
MW–30	1–9–92	650	6.2	9.2
MW–31	1–16–92	590	7.1	5.0
MW–32	1–16–92	400	6.9	6.1
MW–34	1–8–92	248	7.3	4.0
MW–35	1–8–92	470	7.1	6.9

NOTES: ▨ = DRY WELL

SENECA ARMY DEPOT
OB GROUNDS

TABLE 2–13
BIOTA SAMPLING SUMMARY

SAMPLE LOCATION	FISH COLLECTIONS	SAMPLE METHOD	INVERTEBRATE COLLECTIONS	SAMPLE METHOD
SW110	1	(ES)	3	(SU)
SW120	1	(ES)	3	(SU)
SW 130	1	(ES)	3	(SU)
SW 140	1	(ES)	3	(SU)
SW 150	2	(ES), (SE)	3	(SU)
SW–196	1	(ES)	3	(SU)
TOTALS	**7**		**18**	

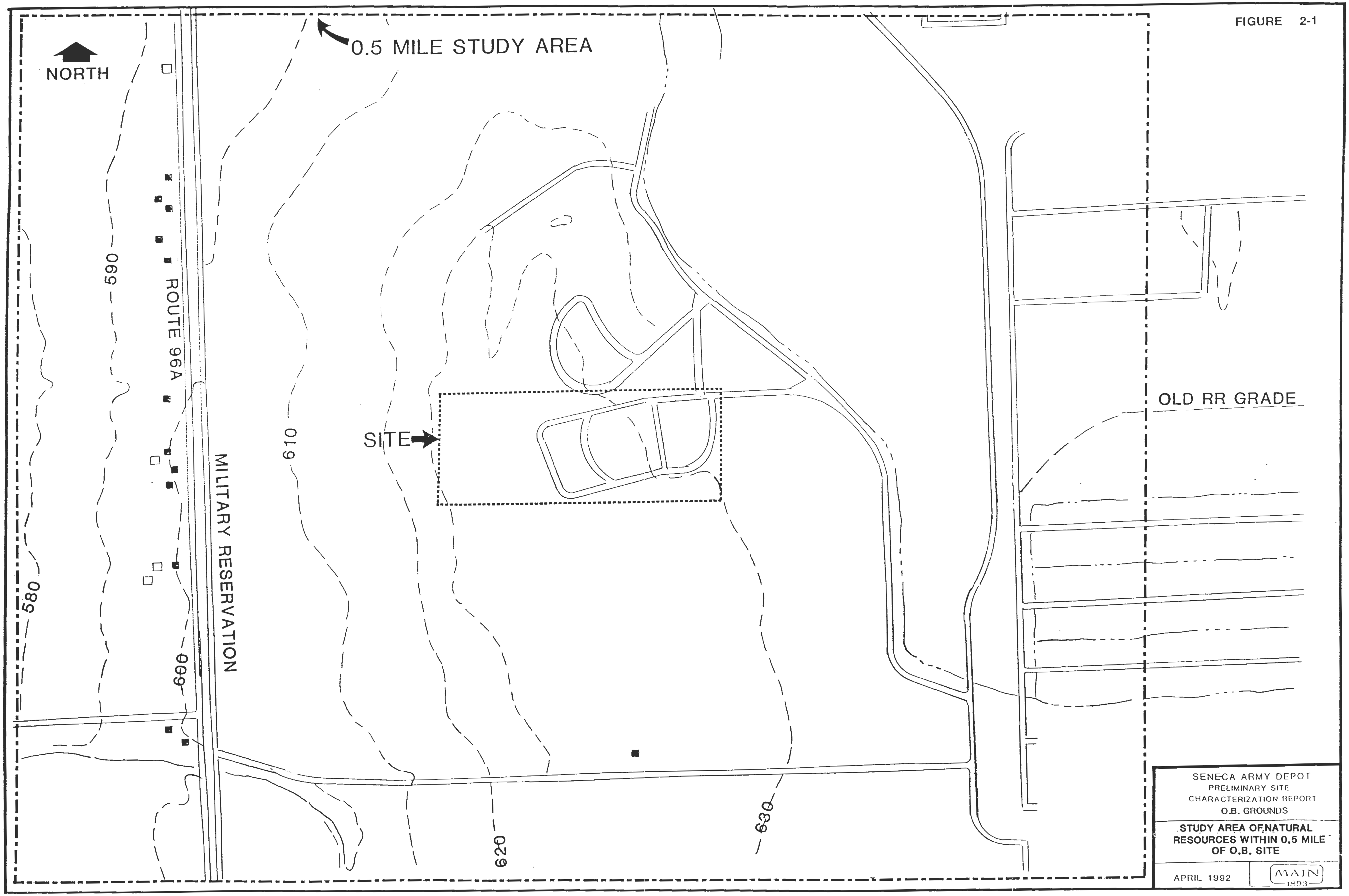
SAMPLE METHODS:

(ES)=BACKPACK ELECTROSHOCKER

(SE) = 25 FOOT SEINE

(SU) = SURBER SAMPLER

FIGURE 2-1

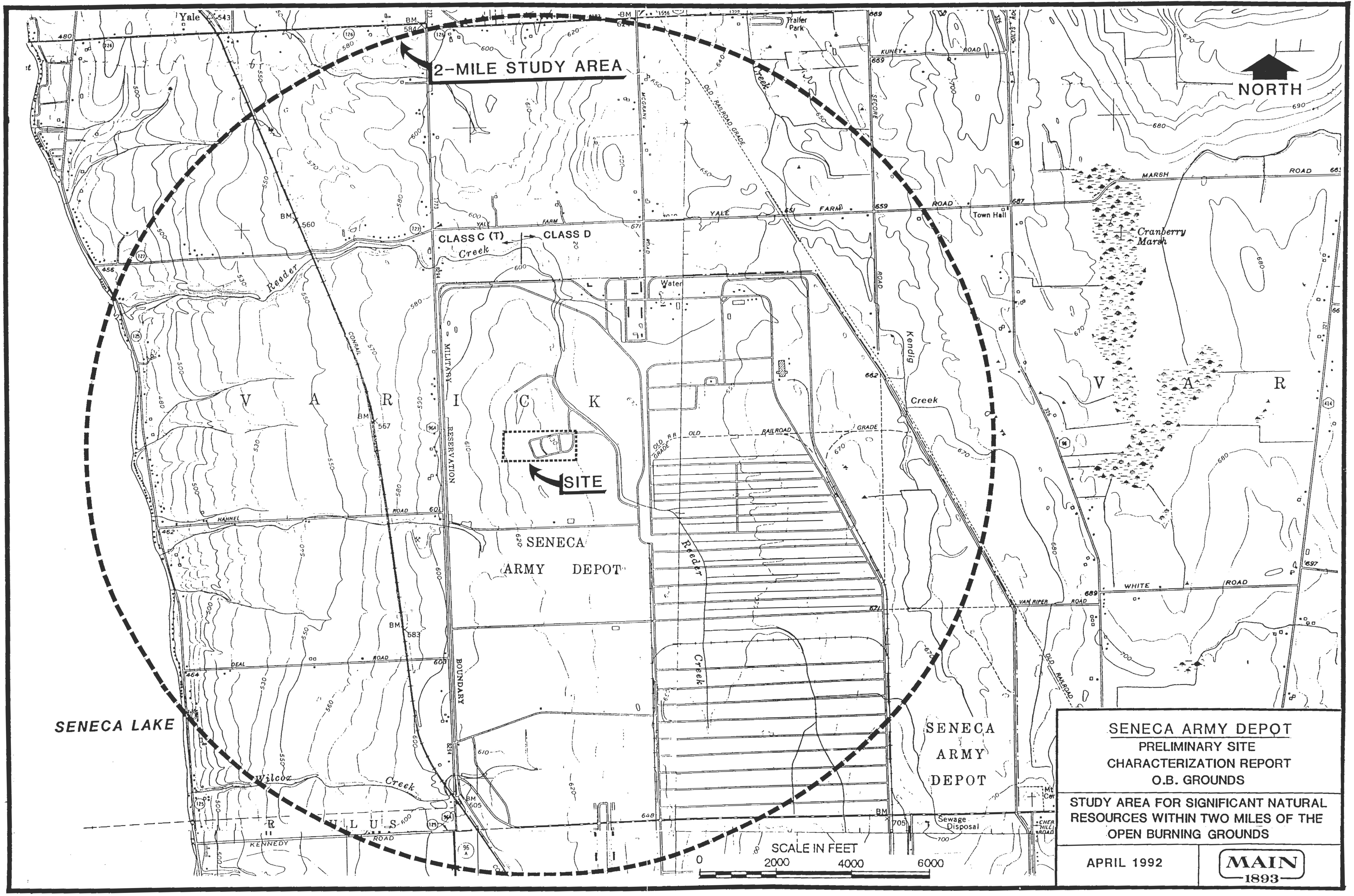


SENECA ARMY DEPOT
PRELIMINARY SITE
CHARACTERIZATION REPORT
O.B. GROUNDS

STUDY AREA OF NATURAL RESOURCES WITHIN 0.5 MILE OF O.B. SITE

APRIL 1992

FIGURE 2-2



SENECA ARMY DEPOT

PRELIMINARY SITE
CHARACTERIZATION REPORT
O.B. GROUNDS

STUDY AREA FOR SIGNIFICANT NATURAL RESOURCES WITHIN TWO MILES OF THE OPEN BURNING GROUNDS

APRIL 1992

MAIN
1893

3.0 DETAILED SITE DESCRIPTION

3.1 INTRODUCTION

The Open Burning (OB) Grounds comprise an area of approximately 30 acres within the northern section of the Seneca Army Depot (SEAD). There are no permanent structures within the OB grounds other than small concrete bunkers and access to the site is limited to a locked gate near the southern portion of the site. Access to and across the site is provided by a group of looping crushed shale roads that allow access to the individual burning pads. Located within the OB grounds are 9 separate burning pads upon which munitions waste were open burned up to 1987. Subsequent to 1987, munitions have been destroyed by burning within a steel encased structure to minimize the impact of the burning on the environment.

The burning pads at the site are built up upon the natural soils. Each burn pads has from 1/2 to 2 feet of broken shale at the surface. Below that is a section of the natural soils and glacial till. A berm, composed of soils, glacial till, and burn wastes surrounds each burn pad on three sides. There are a total of 9 burning pads located within the OB grounds and these range in site from approximately 100 x 100 feet for burning pad D to 300 x 800 feet for the largest burning pad G. In general, each of the burning pad surfaces are approximately 2 to 3 feet above the surrounding land surface.

Within the OB grounds the land surface drops in elevation from the west towards the east. The overall surface relief is approximately 15 feet over a west to east distance of approximately 4000 feet. Surface water drainage is through a series of drainage ditches and surface swales. Due to the nature of the activities at the site these drainages are poorly defined and may be blocked and/or reworked in some areas. On the western side of the OB grounds is located Reeder Creek which drains all of the OB/OD grounds. This is a perennial creek that is generally less than 1 foot deep and does not exceed 15 feet in width. In places the creek is ponded due to beaver and other natural dams.

The surficial soils at the site are composed of clay, silty loams. These soils are poorly drained and range in thickness from 0 to as much as 18 inches across the site. Due to the poorly drained nature of these soils numerous low lying wet areas exist within the OB grounds. A total of 38 wetland areas have been identified in and around the OB grounds and these range in size from less than 1000 square feet to as much as 140,000 square feet. These wetlands are widely distributed across the site and are primarily formed within topographic lows.

At present a total of 33 monitoring wells have been installed within the OB/OD grounds. Of these, 30 are within or directly adjacent to the OB grounds. These monitoring wells have been installed to characterize the subsurface geologic environment, the direction of groundwater flow and the chemistry of the groundwater at the site. In addition to these wells, 42 soil borings and 33 berm excavations have been completed to assist in characterizing the subsurface geology and the chemical composition of the soils at the site. A complete Phase I Ecological Assessment has also been completed.

The surficial geologic deposits present at the OB grounds are composed of glacial tills. The tills range in composition from clayey to sandy and have a high percentage of larger coarse materials within some area of the OB grounds. The till has a relatively low hydraulic conductivity which is consistent with the poorly sorted and dense nature of the unit.

The bedrock at the OB grounds is composed of the Devonion age Hamilton Group shale. This unit is subdivided into four members all of which are primarily fossiliferous, calcareous shales. The upper member of the Hamilton Group is the Moscow Shale which is a black, highly fissile shale. This unit is moderately to highly weathered at its upper surface. The thickness of the weathered shale zone ranges from approximately 1 foot to as much as 15 feet across the site. The depth to the competent shale is generally no more than 15 feet at the site.

Based upon water level measurements made in the on-site monitoring wells, groundwater flow is primarily from west to east across the site. The water table surface drops in elevation from a high of 636 feet above MSL on the west, to a low of 618 feet above MSL on the eastern side of the site adjacent to Reeder Creek. Groundwater flow directions within the weathered shale are also primarily from the west to the east.

3.2 TOPOGRAPHY

SEAD lies on the western side of a series of north to south trending rock terraces which separate Cayuga Lake on the east and Seneca Lake on the west. The rock terraces range in elevation from 490 feet above Mean Sea Level (MSL) in northern Seneca County to as much as 1600 feet above MSL at the southern end of the lakes. Elevations on SEAD range from 450 feet above MSL on the western boundary to 760 feet above MSL in the southeast corner. The Depot's surface generally consists of a west and north sloping surface.

A topographic map of the OB/OD area is presented as Plate 2-1. This plate includes (1) 2-foot surface contours, (2) 1" = 200' scale, (3) Reeder Creek, (4) tree lines, (5) protective dirt mounds, and (6) protective bunkers. The OB/OD area is situated on gently sloping terrain, vegetated with grasses and brush. Drainage is generally to the east-northeast via a series of drainage ditches and culverts into Reeder Creek. There are several seasonal poor drainage areas where water collects. Low surface gradients, less than 40 ft. in 2,500 ft., a high fine content in the surface soil and underlying till contribute to poor drainage conditions.

3.3 CLIMATOLOGY

Table 3-1 summarizes climatological data for the SEAD area. The nearest source of climatological data is Ithaca Cornell University, New York, which is approximately 27 miles southeast of the army depot. However, only precipitation and temperature measurements are available from this location. The remainder of the data reported in Table 3-1 have been taken from isopleth drawings from a climatic atlas, or from data collected at Syracuse, New York, 40 miles northeast of the SEAD. Meteorological data collected from 1965 to 1974 at Hancock International Airport in Syracuse, New York, were utilized in preparation of the wind rose. The airport is located approximately 60 miles northeast of SEAD, and the data can be considered representative of wind patterns at SEAD. The wind rose is presented in Figure 3-1.

A cool climate exists in the locality of SEAD with temperatures ranging from an average of 23°F in January to 69°F in July. Marked temperature differences are found between daytime highs and nighttime lows during the summer and portions of the transitional seasons. Precipitation is uncommonly well-distributed, averaging approximately 3 inches per month. This precipitation is derived principally from cyclonic storms which pass from the interior of the county through the St. Lawrence Valley. Lakes Seneca, Cayuga, and Ontario provide a significant amount of the winter precipitation and moderate the local climate. The annual average snowfall is approximately [illegible] inches. Wind velocities are moderate, but during the winter months, there are numerous days with sufficient winds to cause blowing and drifting snow. The most frequently occurring wind directions are westerly and west-southwesterly.

WO
"and"

In general, climatological conditions which will tend to promote good dispersions during OB/OD activities are high and ambient temperatures, high wind speeds, low precipitation amounts, and a preponderance of clear skies. As Table 3-1 shows, temperature tend to be highest from June through September. Precipitation and relative humidity tend to be rather high throughout the year. The months with the most amount of sunshine are June through September. Mixing heights tend to be lowest in the summer and during the morning hours. Wind speeds also tend to be lower during the morning, which suggests that dispersion will often be reduced at those times, particularly during the summer. However, no episode-days are expected to occur with low mixing heights (less than 500 m) and light wind speeds (less than or equal to 2 m/s).

Daily precipitation data measured at the Aurora Research Farm in Aurora, New York for the period (1957-1991) were obtained from the Northeast Regional Climate Center at Cornell University. This station is located approximately 10 miles east of the depot. The maximum 24-hour precipitation event during this 35-year period of record is summarized in Table 3-2 for each month. The maximum 24-hour precipitation measured at this station during this period was 3.91 inches on September 26, 1975. Values of 35 inches mean annual pan evaporation and 28 inches for annual lake evaporation were already reported in Table 3-1. An independent value of 27 inches for mean annual evaporation from open water surfaces was estimated from an isoplethed figure in "Water Atlas of the United States" (Water Information Center, 1973).

Information on the frequency of inversion episodes for a number of National Weather Service stations is summarized in "MixingHeights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States" (George C. Holzworth, US EPA, 1972). The closest stations for which inversion information is available for Albany, New York and Buffalo, New York. The Buffalo station is nearer to SEAD but almost certainly exhibits influences from Lake Erie. These influences would not be expected to be as noticeable at SEAD.

SEAD is located in the Genesee-Finger Lakes Air Quality Control Region (AQCR). The AQCR is designated as non-attainment for ozone and attainment or unclassified for all other criteria pollutants. Data for existing air quality in the immediate area surrounding the SEAD, however, can not be obtained since the nearest state air quality stations are 40 to 50 miles away from the army depot (Rochester or Monroe County or Syracuse of Onondaga County). A review of the data for Rochester, which is in the same AQCR as the SEAD, indicates that all monitored pollutants (sulfur dioxide, particulates, carbon monoxide, lead, ozone) are below state and federal limits, with the exception of ozone. In 1987, the maximum ozone concentration observed in Rochester was 0.127 ppm. However, this value may not be representative of the SEAD area which is a more rural environment.

3.4 SURFACE WATER AND SEDIMENT INVESTIGATIONS

3.4.1 Physical Characteristics of Reeder Creek

Reeder Creek is a small, second order perennial stream that originates on the Seneca Army Depot (Plate 2-1). Reeder Creek flows in a northwesterly direction past the OB/OD grounds and then turns sharply to the west after leaving the Seneca Army Deport property where it discharges into Seneca Lake. The total drainage basin of Reeder Creek is 3,211 acres (5.02 square miles). Approximately 71 percent (of the drainage basin) is within the confines of the Depot. The drainage area upgradient of the OB/OD Grounds is approximately 1,503 acres. The 29 acre OB grounds comprises 0.9 percent of the total Reeder Creek drainage basin.

Prior to the late fall of 1980, the headwaters of Reeder Creek and Kendaia Creek were the same. Flow was split into these two streams downstream of a wetland that serves as part of the treatment system for effluent from an on-site sewage treatment plant. Drainage into Reeder Creek from this wetland was totally blocked during the fall of 1980 (USAEHA 1981).

The normal width of Reeder Creek is from 4 to 10 feet, and typical maximum depths range from 1 to 7 inches. Width and depth of sections of the stream influenced by beaver dams is up to 15 feet wide and 3 feet deep. During high flow events width and depth increase, although the steep banks along much of the stream adjacent to the OB/OD grounds limits the width of the flood plain as shown in (Figures 3-3 and 3-4).

The substrate of Reeder Creek is heavily influenced by the occurrence of shale near and at the surface. Most of the stream bottom consists of coarse, angular gravel as well as angular cobbles. There is some deposition of interstitial silt and also a small amount of sand. In some places, the stream bed consists of exposed bedrock. Nearly all components of the substrate are dark grey. The average depth of sediment, including gravel, is approximately 3 inches. In general, the stream bottom which usually comes in contact with the stream water of Reeder Creek is characteristic of mountain streams with loose cobbles. Such streams usually have Manning's N values (a measure of "stream resistance") of 0.040 to 0.050 (Milhouse, Wegner, Waddle 1984).

The velocity of water in a stream is a function of width, depth, and gradient. The minimum depth at which velocity measurements could be obtained with the Marsh McBirney flowmeter was approximately 3 inches, so velocity in shallow, riffle areas could not be determined.

Transects where stream velocity was measured were chosen because stream flow was laminar. The highest water velocity measured at any transect was 0.11 feet per second (fps) at Station SW-196. The lowest stream velocity of 0.03 fps was measured at the widest transect SW 130. Average stream velocities ranged from 0.02 FPS SW-130 to 0.06 fps at SW-140.

The discharge measured at each transect was 0.1 cubic feet per second (cfs). Discharge was measured on November 19 and 20, 1991. Rainfall during and prior to these measurements was sparse. This suggests that there is little discharge of groundwater or surface water via tributaries into Reeder Creek near the OB/OD Grounds during the relatively dry base flow conditions.

The surface water elevation of Reeder Creek showed little variability during field studies near the OB/OD Grounds (Table 3-2). The maximum change in surface water elevations that was directly measured at any station was 2.90 inches at Station SW-150. Since the drainage area upstream of the OB/OD grounds is relatively small (1,503 acres or 2.35 square miles), Reeder Creek is likely to return to base flow conditions shortly after any precipitation event.

Precipitation data from the nearest monitoring station, Aurora Research Farm, was reviewed to gain a perspective on the seasonal and historical variations in the water surface elevations of Reeder Creek. This data indicates that November 1991 was the second wettest month of the year with 3.63 inches of precipitation. April was the wettest month with 4.60 inches of precipitation. Consequently, the stream elevations measured in Reeder Creek during November may have been somewhat higher than for most of the rest of the year. Average monthly precipitation based on data collected from 1958 through 1991, as shown in Figure 3-2, indicates that the highest rainfall amounts normally occur during June and the lowest amount of precipitation occurs during January. Seasonal stream flow would be expected to mimic the precipitation data. Historically maximum stream flows are expected to occur during maximum rainfall events. Based on data from the Aurora Research Farm, a precipitation event of 3.25 inches per 24 hours occurs once every 5 years; 3.8 inches per 24 hours every 10 years; and 5 inches per 24 hours every 100 years. Minimum stream flow would be expected during prolonged dry spells. The lowest monthly precipitation value recorded at Aurora was 0.10 inches during October 1963.

3.4.2 Surface Water Run-off

Plate 3-1 has been developed to show the assumed direction of surface water run-off patterns at the site. Although run-off directions are primarily from the west to the east, a total of 13 culverts and the various roads at the site significantly channelize surface water run-off. Based upon the surface water run-off patterns depicted on Plate 3-1, a large percentage of run-off from burning pads D,E,F,G,H and J is expected to drain through wetland W-3 north of burning pad B. Surface water run-off from Burning Pads A,B and C would be expected to drain partially through wetland W-3, but primarily would drain eastward through the two surface swales located north and south of Burning Pad A. A small percentage of run-off from the south side of Burning Pad G would also drain through the swale south of Pad A.

3.5 SITE GEOLOGY

Four distinct geologic units have been identified at the OB grounds. These include artificial fill, glacial till, weathered shale and competent shale. With the exception of the artificial fill these units are distributed across the entire site. The fill materials are primarily associated with the burning pad construction and comprise each burning pad surface and the berms surrounding each burning pad. Two cross-sections of the site geology have been developed for the OB grounds, based upon the stratigraphic information acquired during the pad and grid soil boring and monitoring well installations. The cross-sections locations are shown on Plate 3-2 and the two cross-sections are presented on Plate 3-3. Cross-section A-A' has been drawn approximately parallel to the direction of groundwater flow, while cross-section B-B' has been drawn approximately perpendicular to the direction of groundwater flow.

Artificial fill is present at the individual burning pad surfaces and within the berms that surround each burning pad. At each pad surface the fill is composed of crushed and broken shale. The thickness of the fill ranges from 6" to as much as 2 feet. Within the berms surrounding each pad, the fill is composed of local soils, glacial till, crushed and broken shale, and munitions waste that remains after each burn event. These berms range in height from as little as 3 feet to as much as 8 feet.

The predominant surficial geologic unit present at the site is the glacially derived till. The till is distributed across the entire site and ranges in thickness from less than 2 to as much as 10 feet. The thickest section of glacial till was encountered in well MW-30 while the thinnest till section was found at MW-32. Grain size analyses performed by Metcalf & Eddy on glacial till sediments collected during the installation of monitoring wells MW-8 through MW-17 show a wide distribution of sediment sizes. These tills have a high percentage of silt and clay with trace amounts of fine gravel. Test pits conducted during the geophysical investigation showed the till to vary from a silty, claying till to till with trace amounts of gravel and boulders.

Below the glacial till unit is weathered bedrock which was encountered at all of the monitoring wells locations. The weathered bedrock is composed of clay with thin, laminar pieces of unweathered shale present within a primarily clay matrix. The thickness of the weathered bedrock layer ranges from less than 1 foot at grid borings GB-03 and GB-10, to as much as 14 feet at MW-22.

Plate 3-4 presents an isopach of the thickness of the weathered bedrock unit. The central section of the OB grounds shows a broad area of thin weathered bedrock. Within the central portion of the site, in the vicinity of burning pads G and F, the weathered shale unit is less than 2 feet thick. East of burning pads C and D the thickness of the weathered shale increases appreciably to where 9 feet of weathered bedrock was encountered in monitoring well MW-18. In this area of the site the weathered shale isopach has been drawn by incorporating information from the bedrock topographic map as described below. East of MW-18 the weathered layer thins. In burning pad borings PB-A-1 and PB-A-1 only 1 foot of weathered bedrock was encountered. This zone of thin weathering corresponds to a bedrock high as described below. Northeast of burning pad A the thickest section of weathered bedrock was identified at MW-22 where a 14 foot section of weathered shale was encountered.

The bedrock underlying the site is composed of the upper member of the Devonian age Hamilton Group shale. Three predominant joint directions, N60°E, N30°W, and N20°E are present within this unit. These joints are primarily vertical. The Hamilton Group Shale is a gray, black, sandy shale that is fissile and shows partings along bedding planes. The bedding plane partings are from 1" to 8" apart based upon rock cores collected by Metcalf & Eddy in 1989. Plate 3-5 shows the elevation of the competent shale at the site. This map was developed based upon blow counts from the various borings and monitoring wells and upon visual observations of the drilling supervisors. In some instances the determination of the elevation of the competent bedrock interface is subjective although generally, blow counts increased from 20 to 30 per 6 inches to over 100 blows per 6 inches when competent bedrock was encountered.

The bedrock elevation varies across the site from a high of 631 feet above MSL at grid boring GB-10 to a low of 605 feet above MSL at MW-22. The overall bedrock surface undulates considerably across the site reflective of the weathering processes in action. On the western side of the site a broad bedrock plateau underlies burning pad J at an elevation of approximately 630 feet MSL. Between burning pads J and F the bedrock surface drops approximately 10 feet in elevation. Another broad plateau is present in the area between burning pads F and E where the bedrock surface changes by less than 2 feet in elevation. A narrow northwest to southeast trending bedrock trough has been identified between burning pads D and B on the north and between pads C and A on the south. This trough parallels the present course of Reeder Creek and may represent an ancient surface drainage channel. This trough is also parallel to one of the major joint sets, N30^{0}W, measured in the bedrock. East of this trough a narrow bedrock knob has been identified underneath burning pads A and B. East of burning pad A the bedrock surface drops again in elevation to a low of 605 feet MSL at monitoring well MW-22. This is the lowest bedrock elevation identified at the site.

3.6 SITE GEOPHYSICS

3.6.1 UXO Site Clearance

Plates 2-1 and 2-2, presented earlier, provide the locations of the geophysical surveys conducted at the OB Grounds. As described in Section 2.3, two phases of geophysical investigations were performed at the site. The first phase of geophysical surveys were conducted by the Explosives Ordnance Division (EOD) of Human Factors Applications, Inc. (HFA). HFA performed an unexploded ordnance (UXO) search of selected areas at the OB Grounds. The complete details of the work conducted by HFA are included within the HFA report presented in Appendix B.

The project site contained both surface and subsurface metallic objects. The residues was the result of decades of ordnance destruction by open burning and detonation. Some areas such as burn pads J and G were nearly covered with metallic litter making it virtually impossible to conduct standard magnetometery surveys of those areas. A work area of 10 x 10 feet for each pad boring and an access lane 25 feet wide to each site was cleared by HFA. During the 33 days of EOD operations, a total of 4,037 subsurface objects were located and excavated. Due to the large volume of metallic objects located and excavated only the UXO or significant and/or potentially hazardous items were catalogued. These objects are described in Table 3-3. A large quantity of the metallic material located consisted of hinges, nails, banding material and other hardware associated with ammunition packaging. No attempt was made to account for this material.

With the exception of the small wooded and brush covered areas located behind the long berm at the southern end of the open burning and demolition grounds, the site was relatively open and easily searched with magnetometers.

Burn pads G and J were the most heavily impacted with metallic objects. Both had large amounts of surface and subsurface contamination, which interfered significantly with the Mk 26 Ordnance Locator (Forster Ferex 4.021) and the Whites Eagle II all metals detector. A 10 x 10 foot work area was cleared out at each of the points designated for soil sampling. Each area was raked to remove as much surface debris as possible and the soil was removed by hand until there was no longer an appreciable signal from the Mk 26 Ordnance Locator. After checking the loose soil to insure it held no hazardous material (i.e., ordnance) it was placed back into the hole. Each 10 x 10 foot site was flagged and the ground marked, with florescent paint. Two sites on Pad J were moved to avoid an area which was completely covered with metal debris. One site was eliminated on pad G because of a large metal structure that prevented access. The average depth dug for each site was approximately 16 inches, with some isolated deeper excavations to investigate larger metallic contacts.

A work area, 50 x 50 feet, was cleared for each of sixteen proposed monitoring well locations. An access lane 25 feet wide was cleared to each work site. The terrain to each site was generally clear and presented little or no obstacle for sweeping or clearing, with the exception of a small area behind the long berm at the southern end of the OB/OD Grounds. This area was cleared using a back hoe and when possible the access route was modified to minimize damage to the brush and or small trees. Some access lanes were widened or their course slightly modified to facilitate entry and egress of the well drilling rig. Additional lanes were cleared for access to existing wells, wetlands, and to provide work areas for the grid borings. Some additional walkways were cleared to allow easier access to some wells for purging and collecting water samples. Approximately 37,500 square feet was cleared for work areas and 173,750 square feet for access to work areas and well sites.

Berm excavations began on 2 December, 1991. Each berm was excavated to the mid depth of the berm and soil samples collected at the points preselected in the Workplan. Berm excavations were essentially uneventful and were completed on 10 December 1991.

3.6.2 Ground Penetrating Radar Survey

The second phase of the geophysical investigation at the OB grounds consisted of a Ground Penetrating Radar (GPR) survey of each burning pad. The objective of this investigation was to identifying the locations of any burn pits or trenches within the subsurface. MAIN contracted with Blasland and Bouck Engineers, Inc. (B&B) of Syracuse, New York to conduct this geophysical survey. Plate 2-2 shows the locations of the geophysical profiles surveyed. In general the GPR profiles were spaced at 25 foot intervals although for the smaller burn pads, i.e. pads A,B,C,D and E, the GPR profiles were spaced at 10 or 15 foot intervals.

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Table 3-4 summarizes the results of the GPR investigation. The analysis of the radar data has identified numerous areas of fill with small debris present. This type of radar response is not considered to be unusual given the land use history of each burning pad. Of particular interest were the anomalies identified or burning pads G (lines, 1, 13 and 14) and J (line 15) where the source of the anomaly was characterized as a small pit. In general the radar response of a trench or pit is quite distinct with the walls of the pit seen as steeply dipping reflection events on the radar records. In order to further characterize these geophysical anomalies, test pit excavations were conducted at these locations.

3.6.3 Cross-Sectional Sampling

Cross-sectional sampling was performed at three locations as shown on Plate 2-2. These included two test pit excavations on pad G (GAE-G-1 and GAE-G-2) and one test pit excavation on pad J (GAE-J-1). The procedures used to perform the excavations are described in Section 2.3.3. The logs of the individual test pits are included within Appendix D.

No evidence of previous trenches or pits were identified at the three geophysical anomaly excavation locations. In addition, no ordnance was encountered during the excavations. The two excavations performed on pad G identified and 18 inch thick broken shale layer at the surface. This is considered to be fill materials. At excavation location GAE-G-2, a 6 inch thick layer of various metal wastes including nails, hinges, and metal banding was encountered directly below the broken shale. Both of the excavations on Pad G encountered a clayey, silty glacial till below the broken shale and metallic waste layers. The till did not exhibit signs of previous trenching or pit activities. Soil samples were collected at the base of the broken shale layer at both locations and analyzed along with the soil boring samples. The results of the analytical testing are discussed in detail within Section 4.

3.7 SITE HYDROGEOLOGY

3.7.1 Objectives

The goals of the groundwater investigation conducted at the OB grounds were to confirm the direction of groundwater flow at the site, evaluate the degree of hydraulic communication between the glacial till and the weathered shale, determine the interrelationship between groundwater and surface water, and evaluate the presence and extent of contaminants within the groundwater.

Sixteen wells, composed of 5 overburden and 11 weathered bedrock monitoring wells have been installed. The 5 overburden monitoring wells were installed within the glacial till while the 11 weathered bedrock wells have been installed within the thin weathered shale layer present across the site. Well development was completed at each location and hydraulic conductivity measurements for the weather shale and glacial till have been performed. Three rounds of water levels have also been completed to evaluate the direction of groundwater flow across the site. Three well locations MW-24/MW-25, MW-28/MW-29 and MW-34/MW-35 have had both glacial till and weathered bedrock monitoring wells installed in order to evaluate the degree of hydraulic communication between the glacial till and weathered shale aquifers.

3.7.2 Groundwater Flow Direction

Table 3-5 summarizes the water level measurements made at the site. Three rounds of ground water level measurements have been made at wells MW-5 through MW-35. Water level measurements were made during January and February of 1992 when the depth to the water table was from 3 to 6 feet below the ground surface. Some of the wells were frozen during the late January and early February rounds of sampling. No wells were frozen during the January 7, 1992 round of sampling so that the water table elevation maps presented here are based upon this round of measurements.

Plate 3-6 shows the water table elevation for the overburden monitoring wells screened within the glacial till. The water table drops in elevation from west to east across the site. At MW-10 on the western side of the OB grounds the water table elevation was 636.27 feet above MSL while at MW-25 on the eastern side of the site the water table elevation was 617.71 feet above MSL. The total drop in elevation of the water table surface is 18.56 feet over a linear distance of approximately 1670 feet. This represents a horizontal gradient of .011 ft/ft.

Groundwater flow directions, based upon the January 7, 1992 round of sampling, are primarily from southwest to northeast across the site. The horizontal gradients appear to be fairly uniform with the exception of the northwest corner of the site in the vicinity of MW-9. Here the horizontal gradients are somewhat steeper than the remainder of the site. This may reflect subtle variations within the subsurface material types. Based upon the present understanding of groundwater flow within the glacial till the present monitoring well network appears to provide for complete monitoring well coverage downgradient of each burning pad.

Plate 3-7 shows the groundwater elevation for the monitoring wells screened within the weathered shale. Although MW-21 is upgradient of these pads there are no weathered bedrock monitoring wells near enough to MW-21 to reliably project the groundwater elevation contours. Nonetheless from MW-3, just south and east of pad G, to the east side of the site the monitoring well network coverage is sufficient to create reliable groundwater elevation contours.

Within the weathered shale the water table elevation drops from 631.42 feet above MSL at MW-3 on the western side of the site to 617.26 feet above MSL at MW-25 on the east side of the site. This represents a drop in elevation of 14.16 feet over a linear distance of approximately 1100 feet. Based upon these measurements a horizontal gradient of .013 ft/ft has been calculated for the weathered shale unit. This horizontal gradient is quite similar to the value determined for the glacial till unit (.011 ft/ft) suggesting similar groundwater flow conditions exist within the two geologic units.

Groundwater flow directions within the weathered shale, as with the glacial till, are primarily from southwest to northeast. The groundwater elevation surface shows a uniform drop across the site with no unusual gradients noted.

3.7.3 Average Flow Velocity

The average linear velocity of groundwater flowing through the aquifer has been calculated. Velocities have been determined based upon average hydraulic conductivities of 5.27×10^{-4} cm/.sec in the glacial till and 6.81×10^{-4} cm/sec in the weathered shale as described in Section 3.7-4. Using Darcy's Law, the average linear velocity of groundwater flow, based upon the hydraulic conductivity, the assumed porosity, and the horizontal gradient of the groundwater surface was obtained. The Darcy equation is:

$$V = \frac{K \frac{dh}{dL}}{n}$$

where K is the hydraulic conductivity, n is the effective porosity of the aquifer and dh/dL represents the horizontal gradient.

The average linear velocity has been determined using effective porosities of 10% and of 25% to show the potential range in velocities. These values, i.e. 10% and 25%, represent the range of effective porosities expected for glacial till deposits (Driscoll, 1986). Table 3-6 summarizes the range of velocities calculated for both the glacial till and weathered bedrock monitoring wells. Velocities have been calculated using the average hydraulic conductivities for the two geologic units and assuming porosities of 10% and 25%.

For the glacial till the average linear velocity varies from a low of 23.9 feet per year for a porosity of 25 percent to a high of 59.8 feet per year for a porosity of 10 percent. This reflects an approximate 2 fold variation in the estimated linear velocity. For the weathered shale the average linear velocity is slightly higher and varies from a low of 36.6. feet per year for a porosity of 25% to a high of 91.6 feet per year for a porosity of 10%. These calculated velocities are considered slow and reflect the fine grained nature and associated low hydraulic conductivities of both the glacial till and weathered shale units. These low velocities also suggest that contaminants present within the groundwater are, on average, moving at slow rates, eastward towards Reeder Creek.

3.7.4 Vertical Gradients

At three locations both glacial till and weathered shale monitoring wells have been installed. Three rounds of groundwater level measurements have been made at these locations. Table 3-7 summarizes the groundwater elevation measurements made at these well couplets. At the monitoring well couplet MW-25/MW-26 the overburden well MW-26 shows a consistently higher groundwater elevation than monitoring well MW-25 which was screened in the weathered shale. This would indicate groundwater is flowing from the overburden into the lower weathered shale.

At the MW-28/MW-29 monitoring well location the data do not clearly indicate the direction of flow between the two geologic units. During the January 7, 1992 sampling round the weathered shale monitoring well MW-28 showed a groundwater elevation 0.51 feet higher than the associated overburden monitoring well MW-29. During the two subsequent rounds of measurements, the water levels were within .02 and .01 feet respectively. The results from the first round would indicate flow upwards from the weathered shale into the glacial till. The two subsequent rounds of data suggest little variation between the two units.

Only one set of water level measurements are available for the MW-34/MW-25 couplet. At this location MW-34 is screened within the overburden and MW-35 is screened within the weathered shale. Water level elevations were measured for both wells during the January 7, 1992 round of sampling monitoring well MW-34 was frozen during the second round of sampling and both wells were frozen during the third round of sampling. The groundwater elevations for the two wells varied by only .01 feet during the January 7, 1992 sampling event. This data suggests that flow is mostly horizontal through the aquifer at this location toward Reeder Creek.

3.7.5 Hydraulic Conductivities

Hydraulic conductivity measurements have been performed at 20 of the monitoring wells at the OB Grounds. Rising head tests have been performed at the wells and the results are presented in Table 3-8. Two methods of data reduction have been utilized as described in Section 2.6.4. The hydraulic conductivity measurements were made during January of 1992. Slug tests were performed on all available monitoring wells at the site. As noted, the hydraulic conductivities have been calculated using a method developed by Horslev and using a computerized technique developed by Bouwer and Rice (1976). The results of these analyses are presented in Table 3-8 along with the average of the two methods.

The calculated hydraulic conductivities for the overburden wells vary over a wide range from a high of 1.02×10^{-3} cm/sec at MW-29 to a low of 3.28×10^{-5} cm/sec at MW-32. The average hydraulic conductivity for all of the overburden wells installed by MAIN (MW-18 through MW-32) was 5.27×10^{-4} cm/sec. For the weathered shale monitoring wells the calculated hydraulic conductivities range from a high of 3.3×10^{-3} cm/sec to a low of 3.6×10^{-5} cm/sec. The average hydraulic conductivity for all of the weathered shale wells installed by MAIN (MW-18 through MW-32) was 6.81×10^{-4} cm/sec. Based upon these averages, and the wide range of hydraulic conductivity values, there is little significant variation between the hydraulic conductivities of the glacial till and those for the weathered shale.

Of the three monitoring well couplets, where both glacial till and weathered shale monitoring wells were installed (MW-25/MW-26, MW-28/MW-29, and MW-34/MW-35) only the MW-28/MW-29 couplet has hydraulic conductivity valves available for both wells. Based upon the average of the two data reduction methods, Horslev and Bouwer and Rice, monitoring well MW-28, installed in the weathered shale, has an average hydraulic conductivity of 6.65x10^{-5} cm/sec, while the associated glacial till monitoring well, MW-28, has a hydraulic conductivity of 1.02x10^{-3} cm/sec. However, based upon the method of Bouwer & Rice, hydraulic conductivities for the two units are similar. The Bouwer & Rice analysis yields hydraulic conductivities of 4.16x10^{-5} and 4.37x10^{-5} cm/sec for MW-28 and MW-29 respectively. These data indicate that, in the vicinity of the monitoring well couplet MW-28/MW-29, the glacial till and weathered shale have quite similar hydraulic conductivities. The wide range of variability produced from the method of Horslev is not understood.

3.8 LAND USE

The Seneca Army Depot (SEAD) is situated between Seneca Lake and Cayuga Lake and encompasses portions of Romulus Township and Varick Township. Land use in this region of New York is largely agricultural, with some forestry and public land (school, recreational and state parks).

The most recent land use report is that issued by Cornell University. This report classifies in further detail land uses and environments of this region (Cornell 1967). Agricultural land use is categorized as inactive and active use. Inactive agricultural land consists of land committed to eventual forest regeneration, land waiting to be developed, or land presently under construction. Active agricultural land surrounding SEAD consists of largely cropland and cropland pasture. The U.S. Geologic Survey (USGS) quadrangle maps for the Towns of Ovid and Dresden, New York (1970), New York State Department of Transportation (DOT) quadrangles for Romulus, New York (1978) and Geneva South, New York (1978) do not indicate land designated for dairy production in the vicinity of SEAD.

The SEAD is a government-owned installation under the jurisdiction of the U.S. Army Material Command (AMC). SEAD lies immediately west of the village of Romulus, NY (refer to Figure 1-1), 12 miles south of the villages of Waterloo and Seneca Falls, and 2.5

miles north of the village of Ovid, NY (refer to Figure 1-1). The nearest major cities are Rochester, NY and Syracuse, NY located 60 miles northwest and northeast, respectively. The total area of SEAD is 10,587 acres, of which 8,382 are designated storage areas for ammunition, storage and warehouse, and open storage and warehouse. On-post family housing is in two parcels, a 54-acre development adjacent to Route 96 and another 69 acres situated along Seneca Lake. Additionally, troop housing is available for 270 enlisted men (Buildings 703, 704, and 708). Bachelor officer quarters are located in Building 702, which is designated for 18 men. Other land uses include Administration, Community Services and an airfield. SEAD has a swimming pool at the north end of the facility, along with tennis courts, a gymnasium, and a sports field complex. Picnic and playground areas are found on the installation at Hancock Park, the Lake Area and the Family Housing Area. There is also a skeet and trap range at the field. There are no recreational facilities located within 1,000 feet of the OB/OD facility.

The OB/OD facility is situated in the northwest corner of SEAD. The closest SEAD property boundary is approximately 3,000 feet from the OB/OD facility. Land use adjacent to and off-site of the northwestern corner of SEAD is sparse residential areas with some farmland.

Forestland adjacent to SEAD is primarily under regeneration with sporadic occurrence of mature forestry. Public and semi-public land use surrounding and within the vicinity of SEAD is Sampson State Park, Willard Psychiatric Center, and Central School (at the Town of Romulus). Sampson State Park entails approximately 1,853 acres of land and includes a boat ramp on Seneca Lake.

Historically, Varick and Romulus Townships within Seneca County has developed as an agricultural center supporting a rural population. However, increased population occurred in 1941 due to the opening of SEAD. Population has progressed since then largely due to the increased emphasis on promoting tourism and recreation in this area. Records provided by the Town of Varick show approximately 15 residences adjacent to the northwestern border of SEAD which are within 4,000 feet of the OB/OD facility. These residences all obtain drinking water from private water wells. Detailed information regarding the construction of these wells was not available.

3.9 ECOLOGY

3.9.1 Aquatic Assessment Program

3.9.1.1 Benthic Invertebrate Community

The benthic community of Reeder Creek is dominated by insects based on the results of the macroinvertebrate Surber sampling program at six stations as shown in Table 3-9. Insects comprised approximately 87 percent of the almost 3,000 specimens collected and identified, whereas the remaining 13 percent was a combination of worms (Turbellaria and Oligochaeta), leeches (Hirudinea), snails (Gastropoda), clams (Bivalvia), seed shrimp (Ostracoda) and scuds (Amphipoda). Insects collected included stoneflies (Plecoptera), caddisflies (Trichoptera), hellgramites (Megaloptera), beetles (Coleoptera), mayflies (Ephemeroptera), true flies (Diptera) and damselflies (Odonata). This fauna is characteristic of stony, riffle/run habitat such as Reeder Creek (Hynes 1979).

The true flies dominated the combined collections (38.4 percent), closely followed by beetles (30.1 percent). Subdominant taxa in order of abundance include caddisfly larvae, stoneflies and snails as described in Table 3-9. All seven remaining groups collected comprised a total of 7.8 percent of the overall collection. Thus, as frequently occurs in streams of this nature, the benthic macroinvertebrate taxa in Reeder Creek are unevenly distributed.

The relative abundance of taxa identified at the downstream stations was similar to that of the entire collection, where insects comprised from 76.9 percent to 92.5 percent of the collection at a specific station. Specifically, true flies and beetles were the dominant insect groups at all downstream stations except at station SW-110. At the upstream reference Station SW196 beetles were the dominant macroinvertebrate group.

Species richness at each station was fairly similar. The number of taxa identified was the lowest at reference Station SW196 (22) and the highest at Station SW-130 (29). Overall, 45 different taxa were identified at the six stations in Reeder Creek. If adverse effects of contaminants in Reeder Creek were affecting the water quality and thus the benthic community, lower species richness would be expected at the downstream stations rather than at the reference Station SW196. Since there is no apparent difference between species richness there is no evidence of adverse effects on the benthic community of Reeder Creek, based on the variety of organisms collected.

The distribution of taxa among the downstream stations was fairly similar. At the reference Station SW-196 the distribution of taxa was somewhat different when compared to the downstream stations. At SW-196 no mayflies were collected, compared with two to three different families of mayfly reported at each downstream station. Combining all three replicates at each station, the total number of organisms collected at the downstream stations ranged between 959 at Station SW120 and 223 at Station SW140. The mean number of organisms collected at the five downstream stations was 520. The number of individuals collected at the reference Station (SW196) was within the range of all downstream stations (297).

Although organisms were not identified to the species level, it is possible to discuss guild structure in Reeder Creek in a generalized manner. Trophic relationships of all insect families identified are presented in Table 3-10. The functional feeding groups of insect families in Reeder Creek appear varied and incorporate virtually all types of feeding mechanisms. This overall hierarchy-including scrapers, herbivores, detritivores, predators and piercers suggest that no apparent vacancies in trophic relationships exist in Reeder Creek.

The macroinvertebrate community in Reeder Creek within proximity of the OB grounds offers little direct value to humans since they are not consumed by man. Many of the taxa collected in Reeder Creek are consumed by fish but the fish species that occur in the studied stream reach are generally not sought by anglers. The restricted access to the site further reduces the value of the fisheries to the general public.

The presence or absence of "indicator species" is commonly used to assess adverse effects to ecological communities. Pollution tolerance values for each of the aquatic arthropods identified in Reeder Creek are given in Table 3-11.

The pollution tolerance of the arthropods identified in Reeder Creek is wide and ranges from pollution tolerant organisms such as the Coenagrionidae, with a tolerance value of 9, to pollution intolerant organisms such as Nemouridae, with a tolerance value of 2. However, most of the individuals identified, are within the facultative classification (4-6). These are organisms that have a wide range of tolerance and are often associated with moderate levels of organic contamination (USEPA 1990). The presence of an intolerant group, specifically Nemouridae, in relatively high abundance at stations SW-110, SW-120, and SW-130 provides evidence of favorable water quality at these downstream locations. The absence of this taxa at stations SW-140 and SW-196 does not necessarily imply degraded water quality at these locations. If the water quality at specific location were consistently degraded, tolerant taxa such as Coenagrionidae would be expected to be especially common. Such was not the case at any Reeder Creek Station. Most healthy benthic communities have a mixture of tolerant, facultative and intolerant organisms.

An additional measure of pollution sensitivity is the presence and/or absence of mayflies, (Ephemeroptera), stoneflies, (Plecoptera), and caddisflies (Tricoptera), otherwise known as EPTs. These organisms are generally sensitive or facultative and are often first to suffer in a polluted environment (USEPA 1990, USEPA 1989). The abundance of all three of these groups ranges from 17 at SW-140 to 280 at SW-120 and is suggestive of good water quality. The total number of taxa within these groups generally increases with improving water quality (USEPA 1990). The relative abundance of EPTs compared to the generally tolerant Chironomidae is also used as a measure of biotic conditions. Chironomids tend to increase in relative abundance along a gradient of increasing enrichment of heavy metals concentration (USEPA 1990). There is no clearly defined trend of EPT's compared to chironomids at the six Reeder Creek stations based on the data collected in 1991.

3.9.1.2 Fish Community

Based on the aquatic sampling program, the fish community of Reeder Creek is dominated by minnows (Table 3-12). Seven of the ten species collected were minnows. The related white sucker, which is often found in association with minnows, was also collected. Banded killifish and pumpkinseeds were the only non-Cypriniforme (suckers and minnows) fish collected. As is frequently the case in small streams, most of the fish were relatively small. The largest fish collected was a 161 mm (6 inch) creek chub, although the great majority of fish collected were from 27 to 76 mm (1-3 inches) in length.

Overall, common shiners were the dominant species in Reeder Creek comprising 31.1 percent of the total catch (Table 3-13). Subdominant species were represented by a group of six species with overall relative abundance differing by only 2.2 percent. These species and their relative abundances were: central stoneroller (12.1 percent), fathead minnow (11.1 percent), creek chub (10.8 percent), white sucker (10.4 percent), blacknose dace (10.2 percent) and bluntnose minnow (9.9 percent). The remaining three species (banded killifish, pumpkinseed and finescale dace) comprise relatively minor components of the overall Reeder Creek fish community. Taken as a whole, the Reeder Creek community appears to have an unusually high degree of species evenness. It is much more frequent for a fish community to have only one or two species comprising the majority of the overall community.

The catch data from each station frequently did not reflect the relatively even distribution of individuals among species, with different species being dominant at different stations (Table 3-13). The differences in species composition at each station may be due to slight habitat differences which could favor one species over another.

Total number of individuals collected at each station can only validly be compared for the electroshocking data. The most fish (79) were collected at Station SW-110. This station has a fairly deep (approximately 4 feet) plunge pool below two large culverts, which offers cover to resident fish. The least number of fish (16) were collected at the reference station, SW-196. This may not be truly indicative of the abundance of fish in this general reach of Reeder Creek, as several sizeable groups of fish were observed in pools approximately 1000 feet upstream of this location.

Species richness at each station was quite variable and showed little in the way of a defined trend. All ten species were collected at Station SW-150, although only seven were collected by electroshocking. Seven species were also collected at Stations SW-140, SW-130 and SW-110. The least number of species (4) was collected at the reference station, SW-196.

As with many species of animals, fish often consume on several different trophic levels, as is evident in Table 3-14, with diet shifting as the fish grow, as the seasons change and as the availability of prey increases and decreases. The fish community of Reeder Creek consists predominantly of primary and secondary consumers. There are no fish that would be considered strictly piscivorous (fish eating) and the three species known to consume fish (creek chubs, common shiners and pumpkinseeds) are considered to be omnivorous (opportunistic).

There does not appear to be an unexpected vacancy in the fish guilds found in Reeder Creek that would be indicative of adverse effects of contaminants. There is a paucity of piscivorous fish but the small size of the stream would not support more than a few tertiary consumers. Some of the species of fish collected (e.g. common shiner and blacknose dace) are typically found in cool streams (Lee et al. 1989) which suggests that at least parts of Reeder Creek remain cool for most of the year. This raises the possibility that a missing component of the Reeder Creek fish community could be brook trout, especially since this species is often found in association with blacknose dace. However, there were few, if any, areas of the stream that would support trout spawning, since the interstitial spaces of any gravel beds were heavily imbedded with silt. This silt would tend to smother any brook trout eggs deposited in these gravel beds. Even without the silt, Reeder Creek in proximity to the OB/OD Grounds is too small to support a substantial population of brook trout.

Any abnormalities observed in the fish collected were also documented. There was a degree of subjectivity in these observations, since the time spent examining each fish was by necessity brief in an effort to quickly return collected fish alive to the stream. The most commonly observed abnormality were tumors (Table 3-15). At least some fish at every station had tumors. There was not a consistent trend in the percentage of fish with tumors, as the highest incidence was at reference station SW-196 and the lowest incidence was immediately downstream at Station SW-150. Differential species sensitivity was evident, as blacknose dace usually had more tumors than other species. The cause of observed tumors cannot be definitely stated but may be associated with parasitic cysts. Dissection of tumors on 16 fish revealed the presence of unidentified parasites within all tumors. Many fish at all stations also had varying degrees of infestations of "black spot", thought to be the "black grub" phase of parasitic trematodes. Parasitic infestations are not directly caused by chemical agents, although in some instances there may be an indirect relationship due to reduction of the immunosuppressive abilities of effected organisms. However, the distribution of fish with tumors in Reeder Creek was such that the causative agent does not appear to be associated with the OB/OD Grounds. The only other abnormality observed was one creek chub with an asymmetrical caudal fin. Such occasional occurrences are typically found in most populations of fish and are not considered to be unusual.

The results of the Phase I aquatic assessment indicate that the fish species in Reeder Creek which are potential aquatic receptors of contamination from the OB/OD Grounds are predominantly white suckers and minnows. The only species collected that would be considered by some to be a sport fish would be the pumpkinseed, although it is extremely doubtful that there is any fishing activity in the portion of Reeder Creek that is in proximity to the OB/OD Grounds or immediately downstream. Most, if not all, fish collected normally have fairly localized home ranges. The only species collected which is documented to show organized migrations is the white sucker (Smith 1985). However, these migrations are associated with lake dwelling populations that move into rivers and streams to spawn. It is unlikely that white sucker populations that live in Reeder Creek undergo extensive spawning migrations, other than to find suitable spawning substrate.

Localized movements of all species collected are expected in response to environmental factors such as low flow conditions. Another normal response of fish populations that exceed the carrying capacity of a stream reach is for some individuals to move into a less crowded portion of the stream. It is therefore possible that some fish move from the portion of Reeder Creek adjacent to the OB/OD Grounds to off-site, downstream locations. This could result in a limited number of fish (most likely minnows) moving into a class C(T) portion of Reeder Creek, where they would be susceptible to predation by piscivorous fish that may inhabit these off-site stream segments. It is considered unlikely that downstream movement would extend to the impassable barrier on Reeder Creek, which is approximately two miles downstream of Station SW-110. Therefore, predation on minnows originating from Reeder Creek on the Seneca Army Depot by steelhead or rainbow smelt is considered highly improbable, since these sportfish are not expected to occur above this barrier.

Movement of fish from lower stream reaches upstream onto the Seneca Army Depot is not possible under normal stream flows due to the presence of a culvert at the Depot fence line. Under high flow conditions, strong swimming fish may be able to move through the culvert, but this is not considered to represent a significant source of additional fish joining the existing fish community near the OB/OD Grounds.

The significance of the fisheries resources of Reeder Creek should be considered in terms of its value to associated fauna and its value to humans. It is clear from the species of fish collected that the on-site community is essentially non-piscivorous, relying mostly on other food sources. Although small fish may occasionally migrate to downstream stream reaches where more carnivorous fish are present, they certainly do not contribute substantially to the diet of such fish. During a reconnaissance of lower Reeder Creek, from State Route 125 to the Conrail Railroad bridge, numerous schools of minnows were observed throughout the entire stream segment indicating that sufficient prey already exist for resident predators.

The primary value of the fish community in Reeder Creek near the OB/OD Grounds is to fish-eating wildlife. Examples of wildlife that could consume the fish in Reeder Creek, as well as other aquatic organisms, include the northern water snake, various turtles, wading birds such as herons and egrets, and occasional ducks that may use the small beaver ponds, or other pools on this portion of the creek. Use of this area of the creek by such wildlife is considered to be minimal due to the small size of the stream and the availability of more suitable habitat elsewhere.

Given the fish community in Reeder Creek adjacent to the OB/OD Grounds, this biotic resource has negligible value to humans. The stream is located in a secured area and access to this area is restricted. Security guards patrol the area to ensure that unauthorized personnel are not in the area. The only fish that could be considered a sport fish would be pumpkinseed. However, it is unlikely that there is sufficient habitat for this species to support a fishery even if access to the stream was unrestricted.

3.9.2 Terrestrial Assessment Program

3.9.2.1 Significant Resources and Resources Used by Humans

Based on state regulated wetland maps there are seven New York State regulated wetlands within the 2-mile study area, but none are in close proximity to the site perimeter (Figure 3-6). The closest wetland is GS-2 which is over 4,400 feet west of the site perimeter. The other six regulated wetlands are over one mile from the site perimeter. GS-3 and GS-4 are to the south, RO-19 and RO-20 are to the east, while RO-7 and RO-8 are to the north-northeast. None of the seven regulated wetlands are hydrologically connected to Reeder Creek.

The only other significant terrestrial resource known to occur in the 2-mile study area is the rare population of white-pelaged white-tailed deer (Odocoileus virginiana), which inhabits the fenced Seneca Army Depot (Buffington 1991). Although the normal brown-pelaged deer are also common, the white deer are predominant.

In the 2-mile study area agricultural crops and deciduous forests comprise the vegetative resources used by humans. Although no crops are grown on the Depot, farmland is the predominant land use in the surrounding private lands. Crops including corn, wheat, oats, beans and hay mixtures, are grown primarily for livestock feed. Deciduous forestland on the depot and surrounding private lands is under active forest management (Morrison 1992, SEAD 1992). Timber and firewood are harvested from private woodlots (Morrison 1992). No timber harvesting occurs on the Depot (SEAD 1992). Although there are woods and tree rows in proximity to the OB/OD Grounds these resources were observed to be in normal, healthy condition with no apparent impacts noted.

Within the 2-mile study area, there are several wildlife species which are hunted and trapped on private lands. Game species hunted include the eastern cottontail, white-tailed deer, ruffed grouse, ring-necked pheasant and various waterfowl. Gray squirrel and wild turkey are hunted to a lesser extent. Furbearing species trapped in this study area include red and gray fox and raccoon. Muskrat and beaver are trapped to a lesser extent (Woodruff 1992). On the Depot, deer, waterfowl and small game hunting is allowed, although the designated waterfowl hunting area is outside the study area. Trapping is also permitted (SEAD 1992).

Due to the expected low populations of waterfowl in the OB/OD Grounds, no impact to these gamebirds is expected. The same holds true for the populations of squirrel, gray fox, and ruffed grouse due to the limited forest habitat. The eastern cottontail, red fox and ring-necked pheasant would utilize the habitats (old fields) present on the OB/OD Grounds, although pheasant populations on the depot are low (SEAD 1992). Raccoon would be found in all habitats on and adjacent to the OB/OD Grounds. Muskrat may occur in the wetlands and creek habitats, and beaver are known to inhabit nearby Reeder Creek. Those game and furbearing species with the most potential as receptors of OB/OD Ground contaminants would be the eastern cottontail, red fox, deer, raccoon and muskrat. Although deer have an average home range of a square mile, the other four species have more localized or smaller home ranges (Dalrymple 1978).

3.9.2.2 Vegetative Resources

The major vegetative communities in the 0.5-mile study area are primarily upland cover types. Some freshwater wetlands occur, principally on the OB/OD Grounds and along Reeder Creek. Reeder Creek, and another small unnamed tributary of Seneca Lake in the southwestern corner of the study area form the only aquatic environments. Figure 3-7 shows the location of the major cover types in the study area.

The upland cover types in the study area include old fields, shrubland, deciduous forests and agricultural fields. Old fields and shrublands are the dominate cover types. Old fields are prevalent on the OB/OD Grounds and adjacent environs, as well as the ammunition storage area to the east and an area in the southern section of the study area. These old fields are comprised of a mixture of herbaceous and shrub plant species with some small trees. Appendix H lists the various plant species associated with the four major cover types present in the area. Queen Anne's lace, panic grass, teasel, goldenrods, asters and field thistle are the most abundant species in these fields. Shrublands and old fields dominate much of the remaining Depot land surrounding the OB/OD Grounds in the study area. Shrublands are comprised primarily of shrubs and small trees with some herbaceous species. Gray-stemmed dogweed, raspberry and blackberry vines, multiflora rose, buckhorn, black locust, sumacs and wild grape are the most common shrubs and vines in this cover type. Prior to becoming part of the Seneca Army Depot in 1941, most of the old fields and shrublands were active farmland. When they become part of the Depot and left fallow, these croplands succeeded to old fields and shrubland.

Agricultural fields are the next most prevalent cover type in the study area, but all occur on the privately owned farms in the western section. Crops typically grown in these cropfields surrounding the Depot include corn, wheat, soybeans, and various hay mixtures.

Deciduous forests comprise a relatively minor cover type in the study area and occur as woodlots and tree rows which line the fields, roads and the two streams. Various oaks, sugar maple, hickory, black locust, black cherry and aspens are the major overstory trees in these woodlots and tree rows.

Several non-vegetated areas occur on and near the OB/OD Grounds. The active demolition (bomb disposal) area is mostly bare ground because of the bulldozer earth moving and filling activities. The construction of the new ammunition incineration pad in the fall of 1991 resulted in some vegetative clearing and creation of bare soil conditions on and near the pad.

Several small freshwater wetlands are located on the OB/OD Grounds (Plate 3-8). Most of these emergent wetlands were created by soil excavation operations for the construction of the nine burn pad mounds. Several drainage ditches were also constructed to catch surface water run-off from the OB/OD Grounds and dirt roads. These ditches are also vegetated with emergent wetland plants. Narrow-leaved cattail is the most abundant and widely distributed emergent plant species in these areas. Rush and sphagnum moss also have wide distribution, but are not as abundant. Common reed has very limited distribution on the OB/OD Grounds with only one dense stand of this tall emergent species located west of the active demolition area.

There are three other freshwater emergent wetlands within the study area, although all are small (0.3 to 1.2 acres) in size. Two of these wetlands are connected to the east side of Reeder Creek, directly east of the OB/OD Grounds, whereas the third wetland is to the northwest of the active demolition area. Two of the wetlands are dominated by narrow-leaved cattail, while the third is comprised of narrow-leaved cattail and common reed. This latter wetland was artificially created since it is a former soil excavation pit.

3.9.2.3 Wildlife Resources

The wildlife species expected to inhabit the 0.5 mile study area would be those typically occurring in the central New York region including some 18 species of amphibians, 15 species of reptiles, 166 species of birds), and 48 species of mammals. The complete list of wildlife species potentially found within this area is included within Appendix H. The most prevalent wildlife would be upland species, particularly those preferring old fields and shrublands, since these are abundant habitats in the study area. Such wildlife species would include the American toad, eastern garter snake, northern cardinal, and woodchuck. The mixture of these habitats with small woodlots and tree rows provides ideal habitat for the white-tailed deer which is common throughout the Depot. This combination of habitats is present within the study area, so it is expected that deer populations in the area would be high. The mixture of these upland habitats is also excellent for other wildlife such as the wood turtle, red-tailed hawk and raccoon. Reeder Creek and the unnamed stream in the study area provide sources of drinking water for deer and other wildlife, as well as permanent habitat to the northern water snake, pickerel frog and muskrat. The agricultural fields outside the Depot would serve as a source of food (grain, vegetation, insects) to many wildlife species, including deer, raccoon, mourning dove, common grackle and ring-billed gull. Since woodland habitat is relatively limited in the study area, populations of strictly forest-dwelling species such as the gray squirrel, blue jay and four-toed salamander would not be overly abundant. However, species richness is usually high in forested habitats. The series of small emergent wetlands in the study area do not comprise significant wildlife habitat due to their size. Frogs, salamanders and a few ducks would use the study area's wetlands. Much larger, higher quality wetland habitats occur on and off the Depot to attract waterfowl and other waterbirds.

Overall, the mixture of old fields, shrublands, woodlots, tree rows, agricultural fields and two small streams provides valuable wildlife habitat in the study area, although similar habitats are abundant on and surrounding the Depot. Expected wildlife species diversity would be relatively high in the study area due to the variety of habitats present. The numbers and species of wildlife observed during the late fall surveys were actually low, but this was undoubtedly due to the time of year since many mammals, reptiles and amphibians would have gone into hibernation and only winter resident birds were present. During the surveys no reptiles were observed, and the only amphibians noted were a few salamanders and green frog tadpoles in Reeder Creek and the beaver ponds. White-tailed deer, woodchuck, gray squirrel, mice and voles (Cricetidae), and beaver comprised the only mammals that were observed at the site (Table 3-16).

3.9.2.4 Stressed or Altered Terrestrial Biota

No signs of stressed or altered terrestrial biota (vegetation and wildlife species) were observed during the surveys in the 0.5-mile study area. Due to late fall period of the surveys, many of the plant species had naturally lost their leaves or had been killed by frost and cold. However, there was no indications of unnatural die-off or stunted vegetation.

3.9.2.5 Potential Terrestrial Receptors

The results of the Phase I terrestrial assessment indicate that five vegetative communities are potential receptors of possible contamination from the OB/OD Grounds. The old fields and small wetlands, as well as some drainage ditches, presently occupy the OB/OD Grounds and would have the highest potential as terrestrial receptors. The other vegetative communities, including shrubland, deciduous wood lots and tree rows, and agricultural fields (off the Depot), as well as other old fields and small wetlands, would be less likely to be receptors due to their distance from the site. However, a field reconnaissance of the OB/OD Grounds and some of the adjacent environs indicated that the existing vegetative communities are all visibly healthy and appear normal in terms of species composition and density. No community that should be present was missing. The dominance of certain communities in the study area was due to past disturbances and activities associated with the burning and demolition, as well as wildlife management practices, and cannot be attributed to OB/OD Grounds contamination.

State regulated wetlands are the only significant vegetative resource in the vicinity of the OB/OD Grounds. Their far distance away from the grounds (0.8 mile or greater) probably precludes these large wetland communities from contamination influence. This is likely the case for the agricultural crops, one of the two vegetative resources used by man. The other, deciduous woods in the study area, are under SEAD forest management, but also appear to be in a healthy, normal condition.

The wildlife communities inhabiting the vegetative communities also appear to be normal. Although no intensive sampling program was conducted, the observations made in the late fall indicated that the seasonal (fall) wildlife species composition and density for the habitats present were normal.

The vegetative and wildlife species inhabiting the old fields, wetlands and ditches on the OB/OD Grounds would have the highest potential as receptors of contamination. Those having the lowest potential would be the plants and wildlife species inhabiting the shrublands, deciduous forest and tree rows, and agricultural fields, as well as other old fields and small wetlands, beyond the OB/OD Grounds. The white-tailed deer is the only big game species hunted in the study area, as well as being the only significant wildlife resource in its rare white-pelaged form. Deer utilize all habitat types in the study area, including those on the OB/OD Grounds. Observations of the deer herd in the study area showed this game population to be in healthy condition. Waterfowl and other small game species are hunted on the Depot, although waterfowl are not hunted in or near the OB/OD Grounds. In addition, waterfowl usage of the OB/OD Grounds and vicinity would be limited due to the small size of waterfowl habitat. The eastern cottontail, red fox, raccoon and muskrat are the game and furbearing species with the most potential as receptors since they would inhabit the OB/OD Grounds. Other game and furbearing species with less potential for exposure include the ruffed grouse, wild turkey, ring-necked pheasant, gray squirrel and beaver since these wildlife species would occur in habitats outside the OB/OD Grounds. Many non-game wildlife species are potential receptors, in particular those which are permanent residents and have localized home ranges such as amphibians, reptiles, small mammals, and some small non-migratory birds. Based on the fall 1991 surveys, none of the floral and faunal species observed in the OB/OD Grounds and adjacent habitats showed any visible signs of stress or alteration.

TABLE 3–1
CLIMATOLOGICAL DATA FOR SENECA ARMY DEPOT

	Temperature (°F)[1]			Precip.[1]	RH[3]		Sky	Mean No. of Days[4]		
Month	Max.	Min.	Mean	Mean (in)	Mean (%)	Sunshine[3] (%)	Cover[3] (tenths)	Clear	Partly Cloudy	Cloudy
Jan.	30.9	14.0	22.5	1.88	70	35	7.5	3	7	21
Feb.	32.4	14.1	23.3	2.16	70	50	7.0	3	6	19
Mar.	40.6	23.4	32.0	2.45	70	50	7.0	4	7	20
Apr.	54.9	34.7	44.8	2.86	70	50	7.0	6	7	17
May	66.1	42.9	54.5	3.17	70	50	6.5	6	10	15
June	76.1	53.1	64.6	3.70	70	60	6.5	8	10	12
July	80.7	57.2	69.0	3.46	70	60	6.0	8	13	10
Aug.	78.8	55.2	67.0	3.18	70	60	6.0	8	11	12
Sept.	72.1	49.1	60.7	2.95	70	60	6.0	7	11	12
Oct.	61.2	39.5	50.3	2.80	70	50	6.0	7	8	16
Nov.	47.1	31.4	39.3	3.15	70	30	7.5	2	6	22
Dec.	35.1	20.4	27.8	2.57	70	30	8.0	2	5	24
Annual	56.3	36.3	46.3	34.33	70	50	6.5	64	101	200

Period	Mixing Height (m)[2]	Wind Speed (m/s)[2]
Morning (annual)	650	6
Morning (winter)	900	8
Morning (spring)	700	6
Morning (summer)	500	5
Morning (autumn)	600	5
Afternoon (annual)	1400	7
Afternoon (winter)	900	8
Afternoon (spring)	1600	8
Afternoon (summer)	1800	7
Afternoon (autumn)	1300	7

Mean Annual Pan Evaporation (in.)[3]: 35
Mean Annual Lake Evaporation (in.)[3]: 28
No. of episodes lasting more than 2 days (No. of episode-days)[2]:
  Mixing Height < 500 m, wind speed < 2 m/s: 0 (0)
  Mixing Height < 1000 m, wind speed < 2 m/s: 0 (0)
No. of episodes lasting more than 5 days (No. of episode-days)[2]:
  Mixing Height < 500 m, wind speed < 4 m/s: 0 (0)

REFERENCES:

[1] Climate of New York Climatography of the United States No. 60. National Oceanic and Atmospheric Administration, June 1982. Data for Ithaca Cornell Univ., NY.

[2] Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution throughout the Contiguous United States. George C. Holzworth, Jan. 1972

[3] Climatic Atlas of the United States. U.S. Department of Commerce, 1983.

[4] Climate of New York Climatography of the United States No. 60. National Oceanic and Atmospheric Administration, June 1982. Data for Syracuse, NY.

TABLE3-2

STREAM SURFACE ELEVATIONS

Station	11/7/91	11/8/91	11/12/91	11/14/91	11/19/91	11/20/91	11/21/91	11/22/91	12/10/91
SW110-Gauge Reading (in.)	25.81					25.69⁽¹⁾		25.12	
Surface Elevation (ft.)	593.39					593.40		593.45	
SGT=595.54 ft.⁽²⁾⁽³⁾									
SW120-Gauge Reading (in.)	33.81				33.94	33.81⁽¹⁾		33.25	33.00
Surface Elevation (ft.)	601.85				601.85	601.85		601.90	601.92
SGT=604.97 ft.⁽²⁾									
SW130-Gauge Reading (in.)				32.40	33.64⁽¹⁾		33.39		
Surface Elevation (ft.)				604.37	604.27		604.29		
SGT=607.07 ft.⁽²⁾									
SW140-Gauge Reading (in.)		34.38			34.59⁽¹⁾		34.44		
Surface Elevation (ft.)		605.37			605.35		605.36		
SGT=608.23 ft.⁽²⁾									
SW150-Gauge Reading (in.)		34.06		31.56	33.28⁽¹⁾		33.00	32.56	
Surface Elevation (ft.)		608.73		608.94	608.80		608.82	608.86	
SGT=611.57 ft.⁽²⁾									
SW196-Gauge Reading (in.)			26.12		28.38⁽¹⁾		28.00		
Surface Elevation (ft.)			616.33		616.15		616.18		
SGT=618.51 ft.⁽²⁾									
Nature of Field Study⁽⁴⁾	S	S	S	S	D	D	F	F,B	S

(1) Discharge measurement associated with this surface water elevation.

(2) SGT=Elevation of staff gauge top in feet.

(3) Staff gauge destroyed prior to survey; top of staff gauge estimated from water surface elevation determined during discharge measurements. Staff gauge located in same pool as discharge transect.

(4) S=Sediment and surface water sampling; F=Fish sampling; B=Benthic invertebrate sampling; D=Stream discharge measurements.

SENECA ARMY DEPOT
OB GROUND

TABLE 3–3
HFA FINAL SITE SURVEY SUMMARY

ITEM CLASS	NUMBER RECOVERED	ITEM DESCRIPTION	COMMENTS
HAZARDOUS	3	FRAGMENTATION BOMBS	U.S. 20lb FRAGMENTATION BOMBS CONTAINING A YELLOW CRYSTALLINE MATERIAL.
	1	BOMB FUSE	U.S. BOMB FUSE, M120 SERIES WITH BOOSTER INTACT.
	1	75mm PROJECTILE	U.S. 75mm RECOILLESS PROJECTILE WHICH APPEARS TO BE A LOW ORDER DETONATION.
	1	35mm PROJECTILE	U.S. 35mm PROJECTILE.
UXO RELATED	SEVERAL HUNDRED	3.2 INCH ROCKET HEADS	SEVERAL HUNDRED WERE LOCATED (ALL WERE FUNCTIONED OR BURNED OUT).
	5	75/76mm PROJECTILES	ALL WERE ARMOR PIERCING (W/O FUZES OR TRACERS).
	2	4.2 INCH MORTAR	BOTH APPEARED TO BE BASE EJECTION TYPE (FUNCTIONED/NO HAZARDOUS COMPONENTS).
	2	105mm PROJECTILES	BOTH WERE BASE EJECTION TYPE (FUNCTIONED/NO HAZARD).
	1	106mm HEP PROJECTILE	IT APPEARED TO HAVE BEEN BURNED OUT.
	2	37mm PROJECTILE	ONE WAS W/O FUSE AND BURNED OUT, THE OTHER, DESCRIBED ABOVE, WAS THOUGHT TO BE LIVE.
	TNTC	SMALL ARMS AMMO	ALL CALIBERS UP TO 50 CALIBER INCLUDING BULLETS AND CARTRIDGES (NO HAZARD, TNTC, SOME AREAS WERE NEARLY SATURATED).
	TNTC	FLASH TUBES	ALL TYPES AND SIZES WERE ENCOUNTERED, TNTC (ALL APPEARED TO BE EXPENDED, NO HAZARD).
	MANY	20mm PROJECTILES	THESE PROJECTILES WERE LOCATED IN NEARLY EVERY AREA SURVEYED, SOME AREAS WERE MORE HEAVILY CONTAMINATED THAN OTHERS, ie; BURN PAD G AND THE SURROUNDING AREA. THESE MUNITIONS ARE DIFFICULT TO CLASSIFY DUE TO THEIR ADVANCED DETERIORATION, IT IS FELT THAT THEY PRESENT NO OVERT THREAT BUT THEY SHOULD BE AVOIDED IF POSSIBLE AND IF THEY MUST BE HANDLED THEN IT SHOULD BE DONE ONLY BY THE HFA EOD TECHNICIAN/SAFETY PERSON ON SITE.

TABLE 3-4

GPR ANOMALY REVIEW AND CHARACTERIZATION

Burning Pad	Line #	Profile Direction	Anomaly Location	Characterization
A	2	West to East	13’ to 37’E	fill area - small debris
A	3	West to East	13’ to 21’E 43’ to 51’E	fill area - small debris fill area - small debris
A	1	South to North	21’N; 27’ to 37’N	fill area - small debris
A	2	South to North	11’ to 18’N	fill area - small debris
A	4	South to North	16’ to 28’N	fill area - small debris
B	1	West to East	4’ to 36’E	fill area - small debris
B	2	West to East	50’ to 58’E and 66’E	fill area - small debris
B	3	West to East	3’ to 63’E	fill area - small debris
B	1	South to North	2’ to 32’N	fill area - small debris
B	2	South to North	2’ to 33’N	fill area - small debris
B	3	South to North	2’ to 30’N	fill area - small debris
B	4	South to North	2’ to 30’N	fill area - small debris
C	1	West to East	37’ to 44’E	fill area - small debris
C	2	West to East	2’ to 19’E	fill area - small debris
C	3	West to East	2’ to 12’E	fill area - small debris
C	4	West to East	2’ to 18’E	fill area - small debris
C	2	South to North	12’N	small unknown
C	3	South to North	16’ to 30’N	fill area - small debris
C	4	South to North	5’ to 21’N	fill area - small debris
D	2	South to North	10’ to 30’N	fill area - small debris
D	3	South to North	23’ to 27’N	small unknown
D	4	South to North	2’ to 18’N	fill area - small debris
D	2	West to East	20’ to 43’E	fill area - small debris
D	3	West to East	16’ to 50’E	fill area - small debris
D	4	West to East	17’ to 52’E	fill area - small debris
E	1	West to East	12’E’; 22’E & 24’E	small unknowns
E	2	West to East	35’ to 65’E	fill area - small debris
E	3	West to East	20’ to 40’E	fill area - small debris
E	4	West to East	27’ to 45’E	fill area - small debris
E	1	South to North	2’ to 14’ & 28’ to 34’N	fill area - small debris
E	2	South to North	12’ to 28’N	fill area - small debris
E	3	South to North	6’ to 15’N	fill area - small debris
F	1	West to East	3’ to 46’E	disturbed area(?)
F	2	West to East	60’ to 70’E	disturbed area(?)
F	4	West to East	17’E; 23’E; and 30’ to 55’E	fill area - small debris
F	5	West to East	66’ to 68’E	small fill area
F	6	West to East	3’ to 35’E	fill area - small debris
F	7	West to East	12’ to 14’E	small fill area

TABLE 3-4
(CONTINUED)

Burning Pad	Line #	Profile Direction	Anomaly Location	Characterization
F	2	North to South	72' to 132'S	fill area - small debris
F	3	North to South	62' to 130'S	fill area - small debris
F	4	North to South	57' to 145'S	fill area w/2 small unknowns @ 116'S & 129'S
G	1	East to West	53' to 65'W 112' to 138'W 195' to 213'W 313' to 349'W	small pit(?) disturbed area disturbed area fill area
G	2	East to West	45' to 58'W & 188' to 203'W	distrubed area(?)
G	3	East to West	27' to 42'W 185' to 265'W	fill area fill area w/several small(?)
G	4	East to West	22' to 36'W & 152' to 168'W	fill area(?)
G	5	East to West	127' to 159'W 275' to 305'W 318' to 338'W 360' to 370'W	fill area w/several(?) fill area w/several(?) fill area - small debris fill area - small debris
G	6	East to West	63' to 80'W 175' to 225'W	disturbed area(?) fill area w/several small(?)
G	1	North to South	15' to 25'; 43' to 52' & 63' to 75'S 125' to 132'S	3 possible fill areas fill area
G	2	North to South	40' to 50'S 53' to 65'S 71' to 85'S	3 possible fill areas
G	3	North to South	26' to 29'S	small unknowns
G	6	North to South	80' to 110'S	fill area - small debris
G	7	North to South	80' to 108'S	fill area - small debris
G	8	North to South	25' to 40'S & 81' to 109'S	fill area - small debris
G	9	North to South	5' to 65'S & 84' to 126'S	fill area(?)
G	10	North to South	5' to 19'S & 42' to 125'S	fill areas(?)
G	11	North to South	5' to 10'S & 65' to 130'S	fill areas(?)
G	12	North to South	3' to 10'S& 31' to 51'S & 75' to 125'S	3 possible fill areas
G	13	North to South	5' to 15'S & 31' to 36'S 63' to 78'S	small fill areas small pit(?)
G	14	North to South	56' to 75'S 115' to 130'S	small pit(?) fill area
G	15	North to South	40' to 50'S & 85' to 95'S	fill areas(?)
G	16	North to South	5' to 30'S	small fill area(?)
H	1	North to South	35' to 55'S	possible fill area
H	2	North to South	30' to 50'S & 55' to 125'S	possible fill areas
H	3	North to South	18' to 120'S	fill area w/small(?) @ 70'S & 110'S
H	4	North to South	32' to 90'S	possible fill area(?)
H	5	North to South	32' to 48'S	possible fill area(?)
H	2	West to East	22' to 64'E	possible fill area(?)
H	3	West to East	9' to 85'E	possible fill area(?)

TABLE 3-4
(CONTINUED)

Burning Pad	Line #	Profile Direction	Anomaly Location	Characterization
J	1	South to North	241’ to 249’N & 266’ to 288’N	possible fill area
J	2	South to North	135’ to 155’N; 175’ to 198’N; 240’ to 260’N & 292’ to 296’N	possible fill areas
J	3	South to North	30’ to 47’N; 71’ to 86’N; 112’ to 119’N; 163’ to 185’N & 250’ to 285’N	possible fill areas
J	4	South to North	75’N; 145’N & 210’ to 230’N	possible fill areas
J	5	South to North	70’ to 80’N; 102’ to 110’N & 212’ to 236’N	possible fill areas
J	6	South to North	20’ to 30’N & 253’ to 267’N	possible fill areas
J	1	East to West	60’ to 118’W	possible fill area - small debris
J	2	East to West	60’ to 90’W	possible fill area - small debris
J	3	East to West	75’ to 125’W	possible fill area - small debris
J	4	East to West	42’ to 70’W; 90’ to 110’W & 130’ to 142’W	possible fill area - small debris
J	5	East to West	60’ to 70’W; 90’ to 108’W & 112’ to 120’W	possible fill area - small debris
J	6	East to West	28’ to 54’W; 70’ to 80’W & 110’ to 122’W	possible fill area - small debris
J	7	East to West	56’ to 82’W	possible fill area - small debris
J	8	East to West	15’ to 25’W & 45’ to 67’W	possible fill area - small debris
J	9	East to West	15’ to 35’W	possible fill area - small debris
J	11	East to West	30’ to 55’W	possible fill area - small debris
J	13	East to West	15’ to 35’W	small fill area Note: debris @ surface from 60’ to 83’W
J	15	East to West	5’ to 12’W 25’ to 34’W	small pit(?) possible fill area - small debris
J	16	East to West	2’ to 35’W	possible fill area - small debris
J	17	East to West	2’ to 28’W	possible fill area - small debris

SENECA ARMY DEPOT
OB GROUNDS

TABLE 3–5
MONITORING WELL WATER LEVEL SUMMARY

MONITORING WELL NUMBER	1–7–92 GROUNDWATER LEVEL (ft), TOC	1–24–92 GROUNDWATER LEVEL (ft), TOC	2–4–92 GROUNDWATER LEVEL (ft), TOC	T.O.C. ELEVATION	GROUND WATER ELEVATION
MW–5	3.06	ND	3.52	637.99	634.93
MW–6	4.12	3.75	4.17	630.31	626.19
MW–7	3.16	3.25	4.95	622.94	619.78
MW–8	3.35	3.5	4.19	638.78	635.43
MW–9	2.19	FROZEN	FROZEN	634.95	632.76
MW–10	2.35	3.6	3.48	638.62	636.27
MW–11	2.72	2.7	3.37	630.65	627.93
MW–12	2.26	DRY	FROZEN	624.5	622.24
MW–13	2.38	2.8	FROZEN	627.09	624.71
MW–14	3.1	DRY	FROZEN	624.51	621.41
MW–15	2.44	2.7	FROZEN	621.99	619.55
MW–16	2.09	2.5	FROZEN	622.6	620.51
MW–17	2.08	1.8	FROZEN	624.53	622.45
MW–18	2.42	2.35	FROZEN	623.95	621.53
MW–19	2.2	FROZEN	FROZEN	636.34	634.14
MW–21	3.02	3.1	3.93	637.88	634.86
MW–22	3.13	3.25	4.56	623.15	620.02
MW–23	3.45	3.35	3.83	622.87	619.42
MW–24	3.39	3.55	4.31	627.33	623.94
MW–25	6.54	7	7.92	623.8	617.26
MW–26	6.6	6.6	7.58	624.31	617.71
MW–27	3.29	3.2	3.8	625.94	622.65
MW–28	4.26	4.45	4.61	631.9	627.64
MW–29	4.94	4.6	4.79	632.07	627.13
MW–30	4.18	4.2	4.62	628.12	623.94
MW–31	2.88	2.87	3.42	634.57	631.69
MW–32	3.39	3.9	2.99	634.81	631.42
MW–34	2.44	FROZEN	FROZEN	640.43	637.99
MW–35	2.97	2.8	FROZEN	640.97	638

SENECA ARMY DEPOT
OB GROUNDS

TABLE 3–6
AVERAGE LINEAR VELOCITY IN OVERBURDEN AND WEATHERED BEDROCK WELLS

UNIT	POROSITY (%)	K (ft/day)	GRADIENT (ft/day)	AVE. LIN VELOCITY (ft/yr)
OVB	10	1.49	0.011	59.8
WB	10	1.93	0.013	91.6
OVB	25	1.49	0.011	23.9
WB	25	1.93	0.013	36.6

NOTES:

OVB = OVERBURDEN WELL

WB = WEATHERED BEDROCK

K = HYDRAULIC CONDUCTIVITY

SENECA ARMY DEPOT
OB GROUNDS

TABLE 3–7
GROUNDWATER ELEVATION SUMMARY OVERBURDEN AND WEATHERED BEDROCK MONITORING WELL CLUSTERS

Well Number	Well Type	Sample Date	Elevation (ft)	Sample Date	Elevation (ft)	Sample Date	Elevation (ft)
MW–25	WB	1–7–92	617.26	1–24–92	616.80	2–4–92	615.88
MW–26	OVB	1–7–92	617.71	1–24–92	617.71	2–4–92	616.73
		Difference:	+0.45	Difference:	+0.91	Difference:	+0.85
MW–28	WB	1–7–92	627.64	1–24–92	627.45	2–4–92	627.29
MW–29	OVB	1–7–92	627.13	1–24–92	627.47	2–4–92	627.28
		Difference:	–0.51	Difference:	+0.02	Difference:	–0.01
MW–34	OVB	1–7–92	637.99	1–24–92	Frozen	2–4–92	Frozen
MW–35	WB	1–7–92	638.00	1–24–92	638.17	2–4–92	Frozen
		Difference:	–0.01	Difference:	NA	Difference:	NA

OVB	Well screened in glacial till.
WB	Well screened in weathered shale bedrock.
NA	Calculation not applicable.

Difference is defined as the Overburden minus the Weathered Bedrock Elevation

SENECA ARMY DEPOT OB GROUNDS

TABLE 3-8
Hydraulic Conductivity Values For Rising Head Slug Tests
OB Grounds
(cm/sec)

Monitoring Well	Bouwer and Rice (1976)	Horslev (1951)	Average
MW-1 (1)	1.643E-06	5.000E-04	2.508E-04
MW-5 (1)	3.546E-05	2.000E-04	1.177E-04
MW-6 (1)	8.947E-07	8.000E-05	4.045E-05
MW-7 (1)	5.180E-06	3.000E-04	1.526E-04
MW-8 (2)	7.884E-06	7.000E-05	3.894E-05
MW-10 (2)	1.401E-05	2.000E-04	1.070E-04
MW-11 (2)	4.602E-04	2.000E-03	1.230E-03
MW-14 (2)	7.546E-05	4.000E-04	2.377E-04
MW-18 (3)	5.893E-05	6.000E-04	3.295E-04
MW-21 (3)	1.285E-05	6.000E-05	3.642E-05
MW-22 (3)	6.839E-05	2.000E-04	1.342E-04
MW-23 (3)	4.713E-04	4.000E-03	2.236E-03
MW-24 (2)	4.976E-05	1.590E-05	3.283E-05
MW-25 (3)	2.680E-04	1.040E-05	1.392E-04
MW-27 (3)	3.542E-04	2.730E-04	3.136E-04
MW-28 (3)	4.156E-05	9.140E-05	6.648E-05
MW-29 (2)	4.371E-05	2.000E-03	1.022E-03
MW-30 (3)	1.438E-03	5.200E-03	3.319E-03
MW-31 (3)	1.003E-04	2.450E-04	1.726E-04
MW-32 (3)	3.457E-05	1.000E-04	6.728E-05
Site Average:	1.771E-04	8.273E-04	5.022E-04
Till:	6.146E-04	3.019E-03	1.817E-03
W. Shale:	2.817E-03	1.069E-02	6.753E-03

Notes:

(1) Well construction details not available

(2) Well screened in till

(3) Well screened in weathered shale

TABLE 3–9
SENECA ARMY DEPOT – OB GROUNDS
TOTAL NUMBER AND RELATIVE ABUNDANCE OF MACROINVERTEBRATES COLLECTED DURING THE PHASE I AQUATIC ECOLOGICAL ASSESSMENT OF REEDER CREEK IN PROXIMITY TO THE SENECA ARMY DEPOT OB GROUNDS, NOVEMBER, 1991

CLASS Order Family Genus species	STATION SW110 REPLICATE					STATION SW120 REPLICATE					STATION SW130 REPLICATE					STATION SW140 REPLICATE					STATION SW150 REPLICATE					STATION SW196 REPLICATE					GRAND ORDINAL TOTAL	COMBINED RELATIVE ABUNDANCE
OBOO	A	B (#/ft^2)	C	Ordinal Total	Relative Abundance	A	B (#/ft^2)	C	Ordinal Total	Relative Abundance	A	B (#/ft^2)	C	Ordinal Total	Relative Abundance	A	B (#/ft^2)	C	Ordinal Total	Relative Abundance	A	B (#/ft^2)	C	Ordinal Total	Relative Abundance	A	B (#/ft^2)	C	Ordinal Total	Relative Abundance		
TURBELLARIA (flatworms)																																
Tricladida				3	0.86				21	2.19				1	0.17				1	0.45				23	4.65				2	0.67	51	1.76
Planaridae	1	2				2	3	16					1				1					21	2			2						
ANNELIDA																																
Oligochaeta (aquatic earthworms)				8	2.31				17	1.77				16	2.77				8	3.59				10	2.02				0		59	2.04
Lumberculidae		8				12		5			11	1	4			7	1				4	4	2									
Hirundinea (leeches)				0	0.00							3	1	4	0.69		1		1	0.45				0				1	1	0.34	6	0.21
MOLLUSCA																																
Gastropoda (snails)				14	4.03				15	1.56				15	2.60				26	11.66				0					102	34.34	172	5.94
* UNID Gastropod		1					2																									
Ancylidae											1	3	1					1									1					
Limnephilidae A							1																									
Lymnaeidae A	9		3														4									56		20				
Lymnaeidae B																		6									4	10				
Physidae	1						5				3	3					1	1								4		5				
Planorbidae A						1	5	1			3	1				12		1														
Planorbidae B																												2				
Bivalvia (clams)				3	0.86				11	1.15				7	1.21				1	0.45				3	0.61				33	11.11	58	2.00
Sphaeridae		1	2			6	2	1			1	6					1				1	2				1	26	6				
CRUSTACEA				**																												
Ostracoda (seed shrimps)				0		1	1	6	8	0.83			1	1	0.17		1		1	0.45		13	5	18	3.64		1		1	0.34	29	1.00
Amphipoda (scuds, sideswimmers)				0					0					3	0.52				0					1	0.20				0		4	0.14
Gammaridae																																
Gammarus sp.											1		2									1										
INSECTA																																
Plecoptera (stoneflies)				74	21.33				100	10.43				20	3.47				0					2	0.40				1	0.34	197	6.80
UNID Plecoptera	1	8	2			5		30					2															1				
Nemouridae	17	38	8			7	20	38			12	2	4									1	1									
Trichoptera (caddisflies)				15	4.32				176	18.35				13	2.25				3	1.35				20	4.04				2	0.67	229	7.90
UNID Trichoptera (larvae)	1					30		23				1										2				2						
Hydropsycidae	1	8	1								8	2	1																			
Hydropsychidae A (larvae)						68	3	30								1	2					16	2									
Hydropyschidae B (larvae)						1		1																								
Limnephleidae (larvae)												1																				
Phryganeidae (larvae)		3	1																													
Megaloptera (hellgramites)				0					6	0.63				6	1.04				0					0					1	0.34	13	0.45
Sialidae																																
Sialis sp.						3	3				2	4															1					
Coleoptera (beetles)				58	16.71				281	29.30	4			174	30.16				132	59.19				104	21.01				122	41.08	671	30.06
Dytiscidae A (adult)			1																		1											
Dytiscidae B (adult)	4		2													3		7				1					1					
Elmidae A (adult)																	4					2										
Elmidae A (larvae)												3														6						
Elmidae B (adult)	1	3	30			38		15			2	7	14			1	2	7				3	3			69	2	2				
Elmidae B (larvae)		2	1			92	5	24			26	4	13			32	6	13			1	12	40			5	10					
Elmidae C (larvae)		1											1			1	3	1				1	1				9					
Hydrophilidae (larvae)			3									3						4									1					
Psephenidae																																
Psephenus herricki	2		2			31	40	28			31	34	18			11	8	2				5	9			2	2	8				
Ectopria nervosa	2		4			7		1				11	3			13	4	10				8	17				4	1				
Ephemeroptera (mayflies)				5	1.44				4	0.42				8	1.39				14	6.28				61	12.32				0		92	3.17
UNID Ephemeroptera																						1										
Baetidae	1		2			1		2			3					5		5				17	24									
Heptagenidae																																
Stenonema sp.	1		1					1			3	2				2		2			2	10	7									
Diptera (trueflies)				167	48.13				320	33.37				307	53.21				35	15.70				251	50.71				32	10.77	1112	38.37
Ceratopogonidae (biting midge)																						1					2	1				
Chironomidae (midge larvae)	36	65	59			107	20	189			44	179	62			12		22			24	84	134				16	13				
Culicidae (mosquito larvae)		3																														
Empididae B larvae																							1									
Empididae C larvae																							1									
Tabanidae (horsefly larvae)		2				1															2	1	1									
Tipulidae A (cranefly larvae)								3			1					1						1	1									
Tipulidae B (larvae)											1																					
Tipulidae C (larvae)			2																													
Odonata				0					0					2	0.35				1	0.45				2	0.40				0	0.00	5	0.17
Zygoptera (damselfly)																						1										
Coenagrionidae											2							1				1										
Total Specimens	78	145	124	347	100	435	110	414	959	100	159	270	148	577	100	101	39	83	223	100	35	209	251	495	100	147	80	70	297	100	2898 2898	100
Total Taxa	14	14	17	25		18	13	18	23		19	19	15	29		13	14	15	24		7	24	17	27		9	14	12	22		45	

* UNID: unidentified

** In addition to the listed Crustacea, one crayfish was collected at Station SW110 in an aborted Ponar dredge collection associated with sediment sampling.

SENECA ARMY DEPOT
OB GROUNDS
TABLE 3-10
TROPHIC RELATIONSHIPS OF SELECTED MACROINVERTEBRATES

CLASS ORDER FAMILY	TROPHIC RELATIONSHIP
Insecta	
Plecoptera	
Nemouridae	Generally shredders; detritivores
Trichoptera	
Hydropsychidae	Generally collectors; filterers some engulfers (predators)
Limnephliedae	Generally shredders; detritivores (chewers) collectors; gatherers and scrapers
Phryganeidae	Generally shredders; herbivores engulfers (predators)
Megaloptera	
Sialidae	Engulfers (predators-one species reported to be collector-gatherer).
Coleoptera	
Dytiscidae (larvae and adult)	Generally piercers
Psephenidae (larvae)	Scrapers
Elmidae	Generally collectors scrapers and gatherers
Ephemeroptera	
Baetidae	Generally collectors gatherers and scrapers
Heptageniidae	Generally collectors gatherers and scrapers
Diptera	
Ceratopogonidae	Generally engulfers predators, collectors-gatherers
Chironomidae	Generally of two types: 1. Collectors-gatherers and filterers 2. Engulfers (predators) and piercers-predators
Culicidae	Generally collectors-filterers (gatherers)
Tabanidae	Generally piercers-predators
Tipulidae	Generally shredders-detritivores, collectors gatherers
Odonata	
Coenagrionidae	Engulfers, predators

After Merritt and Cummins 1978.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 3-11
POLLUTION TOLERANCE VALUES OF MACROBENTHIC ARTHROPODS

ORDER FAMILY	TOLERANCE VALUE
Amphipoda	
Gammaridae	4*
Plecoptera	
Nemouridae	2
Trichoptera	
Hydropsycidae	4
Limnephleidae	4
Phryganeidae	4
Megaloptera	
Salidae	4
Odondata	
Coenagrionidae	9
Coleoptera	
Elmidae	4
Psephenidae	4
Ephemeroptera	
Baetidae	4
Heptageniidae	4
Diptera	
Ceratopogonidae	6
Chironomidae	6
Empididae	6
Tabanidae	6
Tipulidae	3

*ranking from 0-10 with 0 being least tolerant
Source: USEPA 1990

SENECA ARMY DEPOT
OB GROUNDS

TABLE 3-12

COMMON AND SCIENTIFIC NAMES OF FISH COLLECTED DURING THE PHASE I AQUATIC ECOLOGICAL ASSESSMENT

Common Name	Scientific Name	Length Range(mm)
White Sucker	Catostomus commersoni	44-137
Central Stoneroller	Campostoma anomalum	30-108
Creek Chub	Semotilus atromaculatus	32-161
Blacknose Dace	Rhinichthys atratulus	27- 85
Bluntnose Minnow	Pimephales notatus	28- 65
Fathead Minnow	Pimephales promelas	34- 58
Finescale Dace	Phoxinus neogaeus	37- 51
Common Shiner	Notropis cornutus	28-103
Banded Killifish	Fundulus diaphanus	35- 60
Pumpkinseed	Lepomis gibbosus	31- 78

TABLE 3-13

TOTAL CATCH AND RELATIVE ABUNDANCE OF FISH COLLECTED DURING THE PHASE I AQUATIC ECOLOGICAL ASSESSMENT

	STATION AND COLLECTION METHOD								
	SW110	SW120	SW130	SW140	SW150			SW196	
SPECIES	E[1]	E[1]	E[1]	E[1]	S[1]	E[1]	S+E	E[1]	TOTAL
White Sucker	7(8.9)[2]	8(17.0)	20(30.8)	10(14.5)	26(5.5)	11(30.5)	37(7.2)		82(10.4)
Central Stoneroller	32(40.5)	3(6.4)	19(29.2)	13(18.8)	18(3.8)	7(19.4)	24(4.9)	3(18.8)	95(12.1)
Creek Chub	12(15.2)		4(6.2)	4(5.8)	63(13.3)	1(2.8)	64(12.5)	1(6.2)	85(10.8)
Blacknose Dace	15(19.0)	23(48.9)	5(7.7)	20(29.0)	6(1.3)		6(1.2)	11(68.2)	80(10.2)
Bluntnose Minnow					73(15.4)	4(11.1)	77(15.1)	1(6.2)	78(9.9)
Fathead Minnow		7(14.9)	5(7.7)	6(8.7)	66(13.9)	3(8.3)	69(13.5)		87(11.1)
Finescale Dace					3(0.6)		3(0.6)		3(0.4)
Common Shiner	10(12.7)	6(12.8)	6(9.2)	5(7.2)	209(44.0)	9(25.0)	218(42.7)		245 (31.1)
Banded Killifish	1(1.3)		6(9.2)	11(15.9)		1(2.8)	1(0.2)		19(2.4)
Pumpkinseed	2(2.5)				11(2.3)		11(2.2)		13(1.7)
TOTAL (Fish)	79(100.1)	47(100.0)	65(100.0)	69(99.9)	475(100.1)	36(99.9)	511(100.1)	16(99.9)	787(100.1)
Tadpoles(Rana sp.)			10	3					13
Temperature(°C)	8.6	13.4	8.4	8.3	8.8	7.9		8.7	
Dissolved Oxygen (mg/l)	10.5	-	10.6	11.0	6.7	9.2		11.8	
Conductivity (micromhos) (not corrected to 25°C)	450	510	475	465	405	450		400	
pH	8.1	8.2	7.8	7.6	8.1	7.4		7.6	

---

[1] E= Electroshocking; S = 25-ft. seine. Stations arranged sequentially with downstream-most station to the left. Station SW196 is upstream of OB/OD grounds site influence.

[2] Relative abundance values are presented in parenthesis after the total catch values.

SENECA ARMY DEPOT
OB GROUNDS
TABLE 3-14
TROPHIC LEVEL OF FISH COLLECTED IN REEDER CREEK

	PRIMARY CONSUMERS			SECONDARY CONSUMERS				TERTIARY CONSUMERS			
DIETARY[1] COMPONENT	ALGAE	HIGHER PLANTS	MICRO-ZOOPLANKTON	WORMS	MOLLUSKS	SMALL INSECTS	SMALL CRUSTACEANS	LARGE[2] INSECTS	LARGE CRUSTACEANS	SALAMANDERS	FISH
SPECIES											
White Sucker	x		x	x	x	x	x	x			
Central Stoneroller	x					x					
Creek Chub	x	x	x^3			x^3		x^3	x^3		x^3
Blacknose Dace	x					x^3					
Bluntnose Minnow	x	x	x			x					
Fathead Minnow	x^3		x			x					
Finescale Dace					x^3	x^3	x				
Common Shiner	x	x	x			x^3		x^3			x
Banded Killifish			x^3	x	x	x^3		x			
Pumpkinseed					x	x	x	x		x	x

[1] Based solely on published data, with some condensation for presentation purposes. Components of generalized categories are as follows: Algae (diatoms, desmids, bluegreen algae); higher plants (detritus); microzooplankton (protozoans, copepods, cladocerans, ostracods); worms (tubificids, flatworms); mollusks (small clams and snails); small insects (midges); small crustaceans (amphipods); large insects (odonates); and large crustaceans (crayfish).

[2] Some large aquatic insects are herbaceous. Therefore fish consuming these insects would be secondary consumers.

[3] Dietary preference for these food items indicated in the literature.

Source of dietary information: Lee et al. 1989 and Smith 1985.

SENECA ARMY DEPOT
OB GROUNDS
TABLE 3-15
ABNORMALTIES OBSERVED IN FISH COLLECTED DURING THE PHASE I AQUATIC ECOLOGICAL ASSESSMENT

STATION	SPECIES	NATURE OF ABNORMALTY	NUMBER OF INDIVIDUALS AFFECTED	PERCENT OF INDIVIDUALS AFFECTED	PERCENT OF ENTIRE COLLECTION (All SPECIES) AFFECTED
SW110	Blacknose Dace	Tumors	12	80	15
SW120	Blacknose Dace	Tumors	22	96	47
SW130	White Sucker	Tumors	1	5	12
	Creek Chub	Tumors	2	50	
	Banded Killifish	Tumors	1	17	
	Blacknose Dace	Tumors	4	80	
SW140	Blacknose Dace	Tumors	13	65	20
	Central Stoneroller	Tumors	1	8	
SW150(S)*	White Sucker	Tumors	1	4	7
	Creek Chub	Tumors	30	48	
	Creek Chub	Assymetrical caudal fin	1	2	
	Blacknose Dace	Tumors	1	17	
(E)*	Creek Chub	Tumors	1	100	3
SW196	Creek Chub	Tumors	1	100	81
	Bluntnose Minnow	Tumors	1	100	
	Blacknose Dace	Tumors	11	100	
TOTAL			103		13

*S = Seine collection; E = Electroshocker collection.

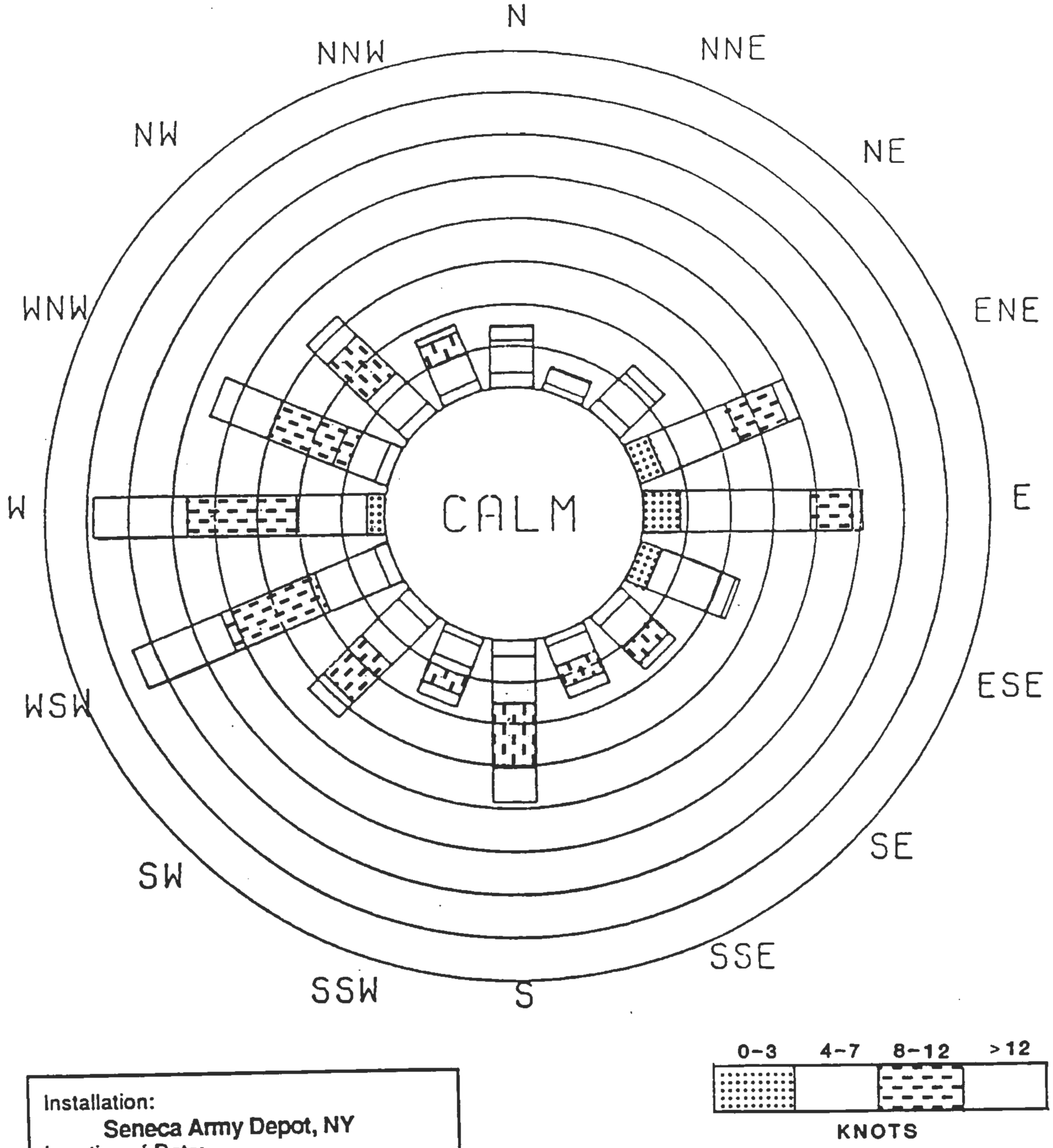
SENECA ARMY DEPOT
OB GROUNDS

TABLE 3-16

MAMMAL SPECIES AND/OR THEIR SIGN OBSERVED IN THE 0.5-MILE STUDY AREA

Species	Habitat				
	Old Field	Shrubland	Deciduous Woods	Reeder Creek	Wetland
Woodchuck		x (burrows)	x (burrows)		
Beaver				x	
Mouse/Vole (Cricetidae)	x				x (scat)
Eastern Gray Squirrel			x (nests)		
White-tailed Deer	x	x	x	x	x

FIGURE 3-1



Installation:
Seneca Army Depot, NY
Location of Data:
Syracuse, NY
Source:
US Army Environmental
Hygiene Agency

NOTE : EACH DIVISION IS 2% OF TOTAL TIME .

SENECA ARMY DEPOT
PRELIMINARY SITE
CHARACTERIZATION REPORT

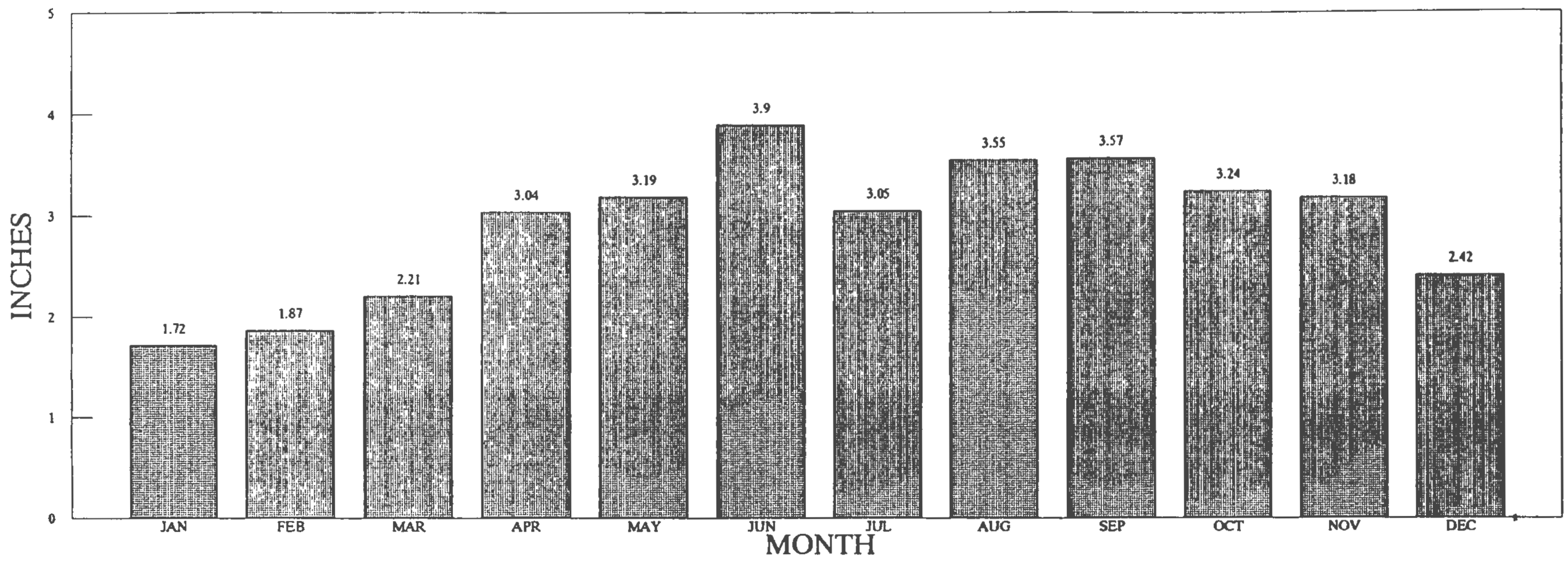
WIND ROSE
SYRACUSE, N.Y.

APRIL 1992

MAIN
1893

FIGURE 3-2

AVERAGE MONTHLY PRECIPITATION IN PROXIMITY TO THE SENECA ARMY DEPOT, 1958–1991 (AURORA RESEARCH FARM)



MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
INCHES	1.72	1.87	2.21	3.04	3.19	3.9	3.05	3.55	3.57	3.24	3.18	2.42

AVERAGE MONTHLY PRECIPITATION BASED ON DATA GATHERED 1958–PRESENT

SENECA ARMY DEPOT

PRELIMINARY SITE
CHARACTERIZATION REPORT

AVERAGE
MONTHLY PRECIPITATION
1958-1991

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MAIN
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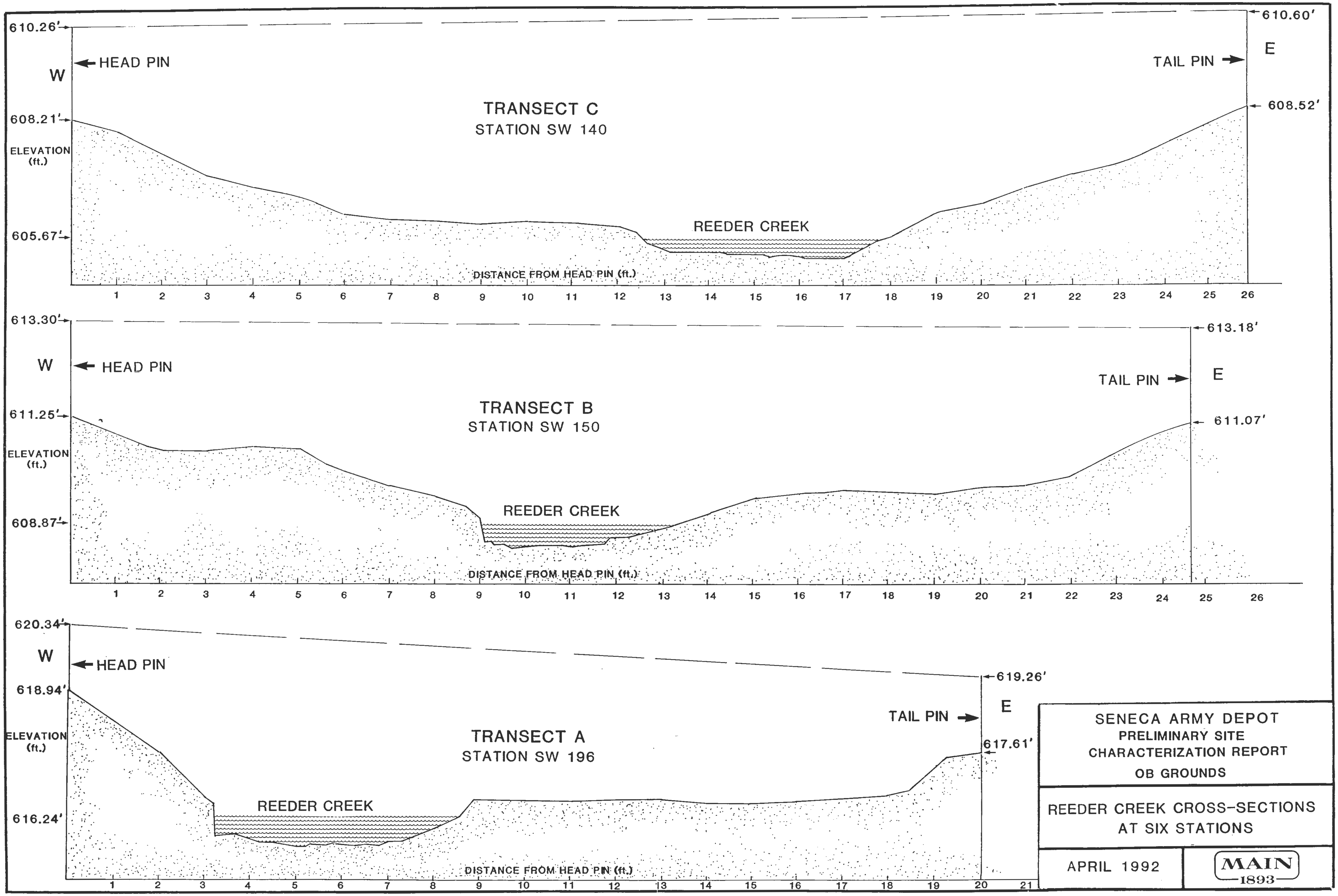


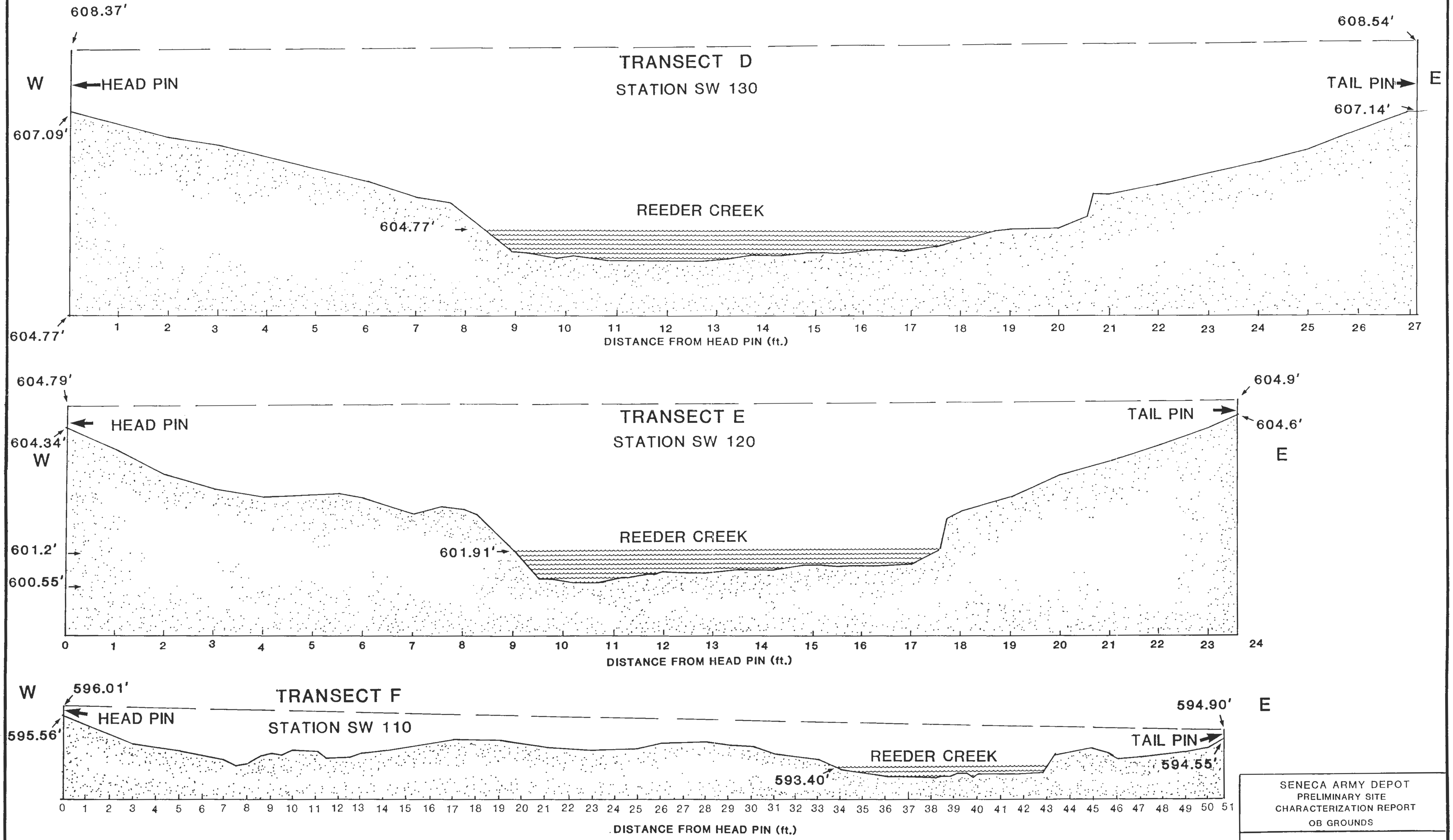
SENECA ARMY DEPOT
PRELIMINARY SITE
CHARACTERIZATION REPORT
OB GROUNDS

REEDER CREEK CROSS-SECTIONS
AT SIX STATIONS

APRIL 1992

MAIN
1893

FIGURE 3-3



SENECA ARMY DEPOT
PRELIMINARY SITE
CHARACTERIZATION REPORT
OB GROUNDS

REEDER CREEK CROSS-SECTIONS
AT THREE SECTIONS

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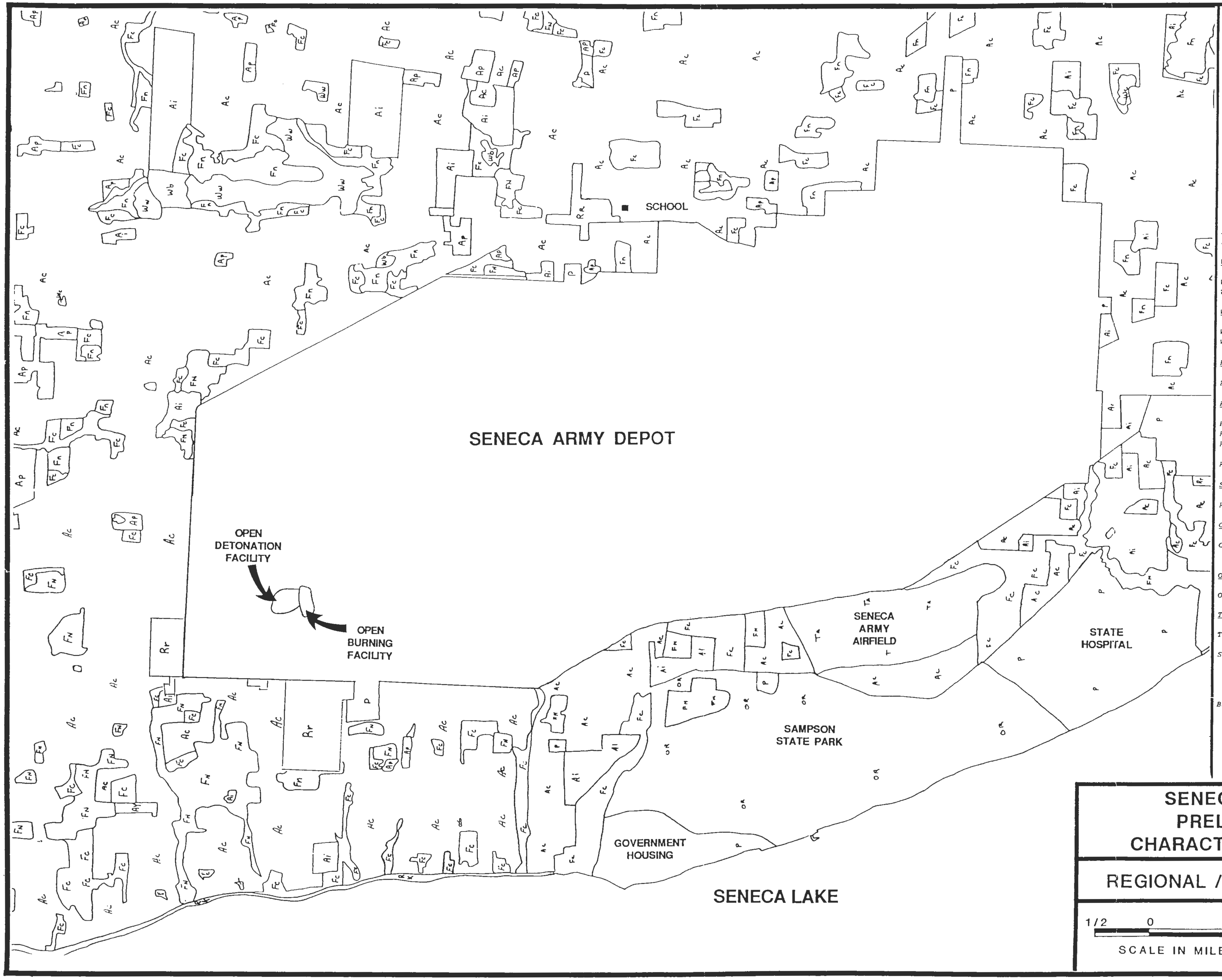
MAIN
1893

FIGURE 3-4



NORTH

LEGEND

Active

Ao	Orchard
Av	Vineyard
Ac	Cropland/cropland pasture
Ap	Permanent pasture

Inactive

Ai	Agriculture Inactive

Forestland

Fc	Brush cover up to fully stocked poles less than 30 feet
Fn	Forest over 30 feet
Fp	Plantations, any size

Water

Wn	Natural, any size
Wc	Artificial, one acre

Wetlands

Wb	Bogs, shrub wetlands
Ww	Wooded wetlands

Public

P	All categories

Residential

Rh	High density, 50 feet frontage
Rm	Medium density, 50-100 feet frontage
Rs	Strip with max of 1/3 intermixture of Cs commercial
Rr	Rural hamlet

Shoreline

Rk	Shoreline developed

Commercial

Cs	Commercial strip with max of 1/3 intermixture of Rs or density housing

Outdoor Recreation

OR	All categories

Transportation

Ta	Airport

Source: New York State Land Use and
Natural Resources Inventory

Base Maps: U.S.G.S. Quadrangles:Ovid, NY 1970
& Dresden, NY - Photorevised 1978
NYS DOT Quadrangles:Romulus, NY 1978
& Geneva South, NY 1976

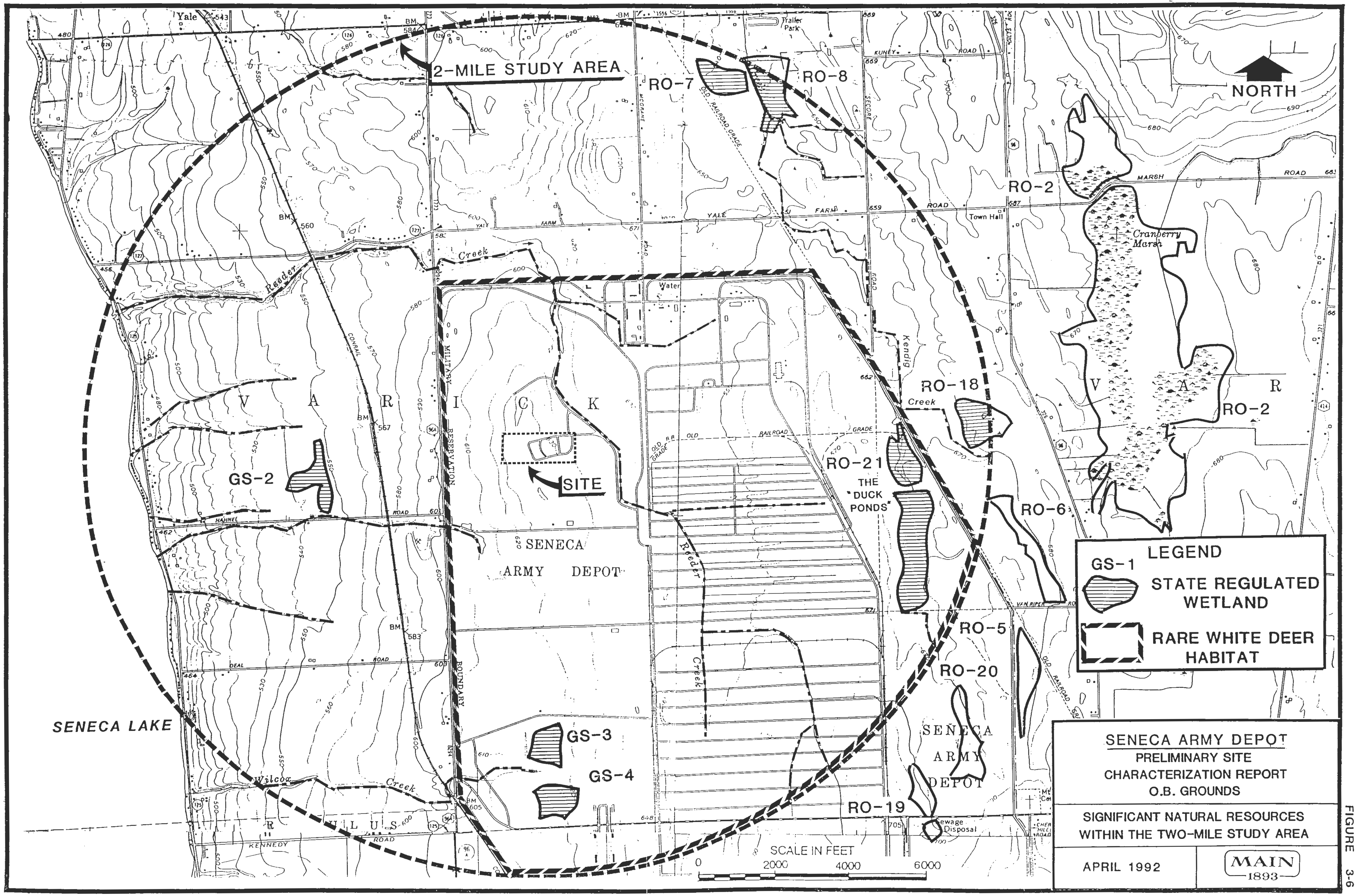
SENECA ARMY DEPOT PRELIMINARY SITE CHARACTERIZATION REPORT

REGIONAL / LOCAL LAND USE MAP

1/2 0 1
SCALE IN MILES

MAIN
1893

FIGURE 3-5



SENECA ARMY DEPOT

PRELIMINARY SITE CHARACTERIZATION REPORT
O.B. GROUNDS

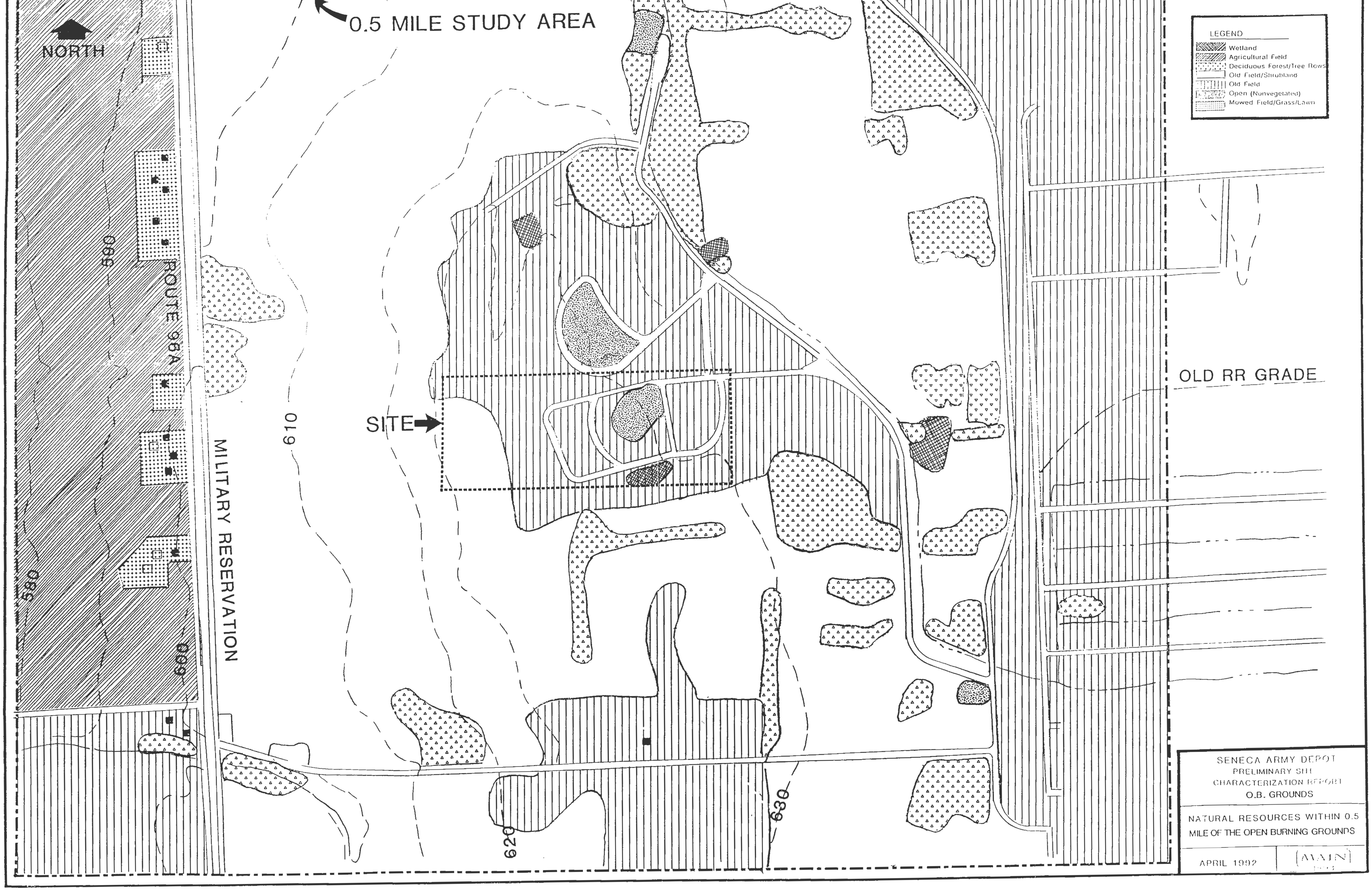
SIGNIFICANT NATURAL RESOURCES WITHIN THE TWO-MILE STUDY AREA

APRIL 1992

MAIN
1893

FIGURE 3-6

FIGURE 3-7



SENECA ARMY DEPOT
PRELIMINARY SITE
CHARACTERIZATION REPORT
O.B. GROUNDS

NATURAL RESOURCES WITHIN 0.5
MILE OF THE OPEN BURNING GROUNDS

APRIL 1992

4.0 NATURE AND EXTENT OF CONTAMINATION

This section presents the results of analyses of all media sampled for this investigation. The Level II Screening results are discussed first, followed by results for volatile organic compounds, semi-volatile, organic compounds, pesticides and PCBs, metals and cyanide, and herbicides in soil, groundwater and sediment and surface water samples. Where possible, the extent of these parameters in the various media is presented.

4.1 LEVEL II SCREENING ANALYSIS

4.1.1 Objective of Level II Screening

As described is the original Workplan submitted by MAIN (1991), Level II screening was performed on all soil samples collected from the pad and grid borings and from the berm excavations. All surface water and sediment samples, along with groundwater samples from the monitoring wells were not sent for Level II screening but went directly for Level IV and Level V analyses.

The reasons for performing Level II screening were as follows:

- Cost - Comparing the cost of performing Level II screening vs Level IV and V data collection was approximately four (4) times less,
- Efficient Sample Collection - Due to the large number of samples required to be collected it was determined that screening could be conducted to provide a basis for selecting samples for vertical profiling.
- Constituents to be Screened - Several previous investigations had identified heavy metals and explosives as the constituents of concern at the site which focused the choice of screening constituents. Methodologies were available to provide acceptable data. Level II screening was performed for lead, and total volatile organics as benzene and TCE.
- Trinitrotoluene (TNT) Sample Turnaround Time - Level II results were available within 24 to 48 hours enabling the field personnel to make decisions concerning field operations. Level IV and V analyses up to 35 days to be completed.

4.1.2 Procedures Used For Level II Screening

All sample screening was performed under controlled conditions in the laboratory. The method utilized for screening explosives (i.e., TNT) was developed by the U.S. Army Cold Regions Research & Engineering Laboratory (CRREL). The method is based upon written procedures published as a special report entitled "Development of a Simplified Field Method for the Determination of TNT in Soil".

The procedure for screening explosives in soils involves extracting the explosives in acetone. The red colored Jackson-Meisenheimer anion is produced by the addition of KOH, and Na_2SO_3. The adsorbance of the anion is then determined by the spectrographic analysis using a Spectronic 20 or equivalent. MAIN's review of existing data indicated that 2,4,6-TNT was a reasonable indicator compound for explosives screening.

The screening methodology followed identical sample preparation steps as those which were required for Level IV analysis. The only difference between the screening method and the Level IV analyses is the amount of QA/QC supporting information performed. The screening of heavy metals in soil involved an acid extraction followed by analysis, using Inductively Coupled Plasma Emission (ICP). MAIN's review of the existing data indicated that lead was a suitable indicator compound for the presence of heavy metals in soil.

The screening of volatile organics was performed both in the field and in the laboratory. An organic vapor analyzer was used in the field, to determine the presence of volatiles in the headspace. In the laboratory, soil was extracted using standard purge and trap techniques and was analyzed using a Gas Chromatograph equipped with a PhotoIonization Detector (PID) and a Flame Ionization Detector (FID), in series. The total volatile organics determined from the PID was quantified relative to TCE, whereas, the total volatile organics determined from the FID was quantified relative to benzene.

Section 4.2.2.3 of the original workplan summarized the procedures the laboratory followed to determine which of the soil samples would be analyzed using Level IV and V methods. The samples sent for Level II and Level IV analyses are summarized in Tables 2-7, 2-8, and 2-9. The Level II screening analysis was performed on all soil samples collected from the grid and pad borings along with all the soil samples collected from the berm excavations. At each grid and pad boring location the surficial soil grab samples were sent directly for Level IV analysis. No Level II screening was performed on these samples.

4.1.3 Level II Versus Level IV and Level V Results

The explosive compound 2,4,6-trinitrotoluene (TNT) was chosen as the indication compound to be used for Level II screening. The results of the Level II screening, and the associated Level IV sample analysis results are presented in Table 4-1. A total of 189 soil samples were screened as Level II samples. The Level II screening analyses detected explosives, as TNT, in 1 grid boring, 5 pad borings, and 13 berm excavation soil samples. Of these 19 total samples, 16 underwent Level V analysis. Of the 16 samples analyzed using Level IV methods, 10 had explosive compounds present above the detection limits. The results of the Level II and Level IV analysis are presented in Table 4-1. The Level II data present the screening results for TNT while the Level V data presents the concentration of the total explosives found in each soil sample. Method 8330, used as the Level V protocol, includes 14 differenct explosive compounds.

The highest concentrations of TNT were detected in the sample BE-F-2A taken from the berm surrounding Pad F. The Level II analysis yielded a concentration of 69 mg/Kg of TNT. The level V analysis determined 90.65 mg/Kg of total explosives to be present. A regression analysis comparing results of the Level II versus Level V results has been performed. Figure 4-1 shows a plot of the Level II versus Level V results along with a plot of the best fit regression line. The regression analysis yielded an R squared value of 0.995, which is indicative of a strong linear relationship existing between the Level II and Level V results. The slope of the best fit regression line was determined to be 1.33 indicating that the Level II screening results predicted lower concentrations than the actual Level V results by approximately 30 percent. Although these data show a high R squared value it should be noted that many of the Level II and Level V results were in the concentration range of 1 to 2 mg/Kg which was at or slightly above the screening method detection limit. Nonetheless, the TNT screening correlated well with the locations that appear to have residual explosive material present.

For the analysis of metals within soils, Lead was chosen as the Level II screening compound. A total of 56 soil samples have both Level II and Level IV results for lead. Table 4-2 summarizes the Level II and Level IV analysis results for lead. The concentration of lead from the Level II analyses ranges from a low of 15 mg/Kg to a high of 44,000 mg/Kg. As with the explosives screening, a regression analysis has been performed on the data in Table 4-2 to evaluate the relationship between the Level II and Level IV data. Figure 4-2 shows a plot of the Level II versus Level IV data along with a plot of the best fit regression line for these data. The regression analysis yielded an R squared value of 0.943, indicative of a strong linear relationship between these data. The slope of the regression best fit line was calculated to be 1.19 indicating that the Level II data predicted lower concentrations the Level IV results by approximately 20 percent.

Tables 4-3 and 4-4 compare the highest concentrations of lead to other metals for pad borings and berm excavation soil samples, respectively. The sample location and the concentrations of the various metals are listed along with the relative ranking of each sample. Each sample concentration was ranked in terms of the magnitude of the valve, i.e., the highest concentration was given the lowest number, 1.

Table 4-3 summarizes the pad boring soil samples with lead concentrations greater than 1000 mg/Kg. The samples are ordered and ranked from the highest concentration to the lowest. A total of 13 pad boring soil samples had lead concentrations greater than 1000 mg/Kg. The associated metals, barium, chromium, copper and zinc along with the relative ranking for each sample is shown. The soil sample D1-3, taken from Burning Pad D, was the highest lead concentration in any pad boring. At this location, barium was detected at 1970 mg/Kg. This correspond to the fourteenth highest Barium concentration. The averages of the metals based upon these 13 samples has been calculated.

For barium, copper, and zinc the average of these 13 samples appears to be significantly higher than the average for all pad boring soil samples. This suggests that, in general, when high lead levels were detected, associated high barium, copper and zinc levels were also found. For chromium the average of the 13 samples is quite close to both the average for all pad boring soil samples and the background value, thus, suggesting that the measured range of chromium reflects average background conditions. With the exception of chromium, the averages concentrations for the other metals all exceed the site background values. The final comparison considers the number of ranked samples for each metal that are within the top 13 samples. For barium only 4 of the 13 highest concentration samples are associated with the 13 highest lead samples. Copper shows the best correlation where 8 of the 13 highest concentration copper samples were found with the 13 highest lead concentration samples.

Table 4-4 summarizes the data for the ten highest lead concentrations from the berm excavation soil samples. For barium, chromium, copper and zinc the average of these 10 samples appears to be significantly higher than the average of all berm samples, indicating that elevated concentrations of these metals are associated with elevated lead concentrations. For antimony the average of the 10 samples is slightly less than the average of all berm samples. For the 5 metals considered, all 10 samples exceeded the associated background concentration. The final comparison considers the number of ranked samples for each metal. For barium 7 of the 10 highest concentration samples are associated with the 10 highest lead concentrations. This comparison suggests that for antimony, barium, chromium, copper, and zinc high concentrations of these metals appear to be associated with high lead concentrations.

4.2 GEOSTATISTICAL DATA EVALUATION

Data from the grid soil borings and from the soil borings completed on Burning Pads G and J were evaluated using the geostatistical program GEOEAS. The goal of this geostatistical evaluation was to determine if the sample spacings proposed in the original workplan were sufficient for a statistically complete characterization of the Open Burning grounds. Methods used in this evaluation included the use of variogram models, cross-validation, cross checking of actual data versus modelled data, kriging to contour the modelled data, and indicator kriging to determine the likelihood of the sample values being greater than a particular action level. The principles of the geostatistics method are discussed in detail in Section 3.5.3of the Work Plan (Revision 1, August 30, 1991).

The extensive list of analytes involved in the, OB grounds evaluation precluded an analysis of all analytes using this technique. Further, the organic compounds analyzed were consistently below detection limits making a meaningful statistical evaluation impossible. Therefore, lead was evaluated for grid and pad borings, and barium was evaluated for the grid boring data.

4.2.1 Geostatistical Methods

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As stated above, a number of geostatistical tools were used to evaluate the data. The following is a brief summary of the technique. Myers (1990) provides and excellent discussion on the technique, the use of GEOEAS, and the application of this technique to environmental data.

Geostatistics is a method where the variability of data can be modelled based on its spatial relationship to other data points. Geostatistical models employ the use of variogram analysis to model the variance with distance between points in a data set. Cross-validation uses this model to determine the difference between the actual data and the modelled data for a particular point. Kriging uses the variogram model to develop a weighted average set of grid data which can subsequently be contoured.

Important terms for geostatistics relate to the variogram model. These are:

1. Sill — The highest level of variance model in the variogram. In some instances, the distance where the sill is reached may be beyond the effective range of the model.

2. Range — The distance of influence that one sample may be statistically related to another. Beyond the range the sample values are independent of each other. For proper variogram modelling the sampling distance should be approximately one-fourth the range distance.

3. Nugget — The level of variance which is inherent to geological conditions and which is independent of variance. The nugget can be considered an internal error which is a uniform contributor to the variance of all samples in a data set.

4. Indicator Kriging — This is used to predict the possibility of a particular point being greater than a selected action level. This method is quite useful for modelling where additional samples may be necessary to determine if a constituent is indeed above an action level. Kriged contours are based upon a percent level that indicates whether a point is above or below that level.

4.2.2 Grid Borings.

Based on the variogram evaluation presented in the original Workplan it was recommended that sample spacings be approximately 200 feet for the grid boring evaluation of the site. This was based on a variogram model with a range of approximately 400 feet. While this 200 foot spacing is larger than the preferred 1/4 range limit for variogram analysis, it was felt that a 200 foot grid boring spacing would be sufficient to characterize the site.

Chemical analysis data from 21 grid boring soil samples have been used in the geostatistical evaluation. The shortest linear distance between any two grid boring locations was 149 feet, with the average grid boring spacing being approximately 200 feet. From the 21 grid boring samples a total of 210 data pairs have been used in the analysis.

Variogram analysis has been performed on the grid boring data using the metal compounds lead and barium. It was not possible to model 2,4,6-trinitrotoluene due to the limited number of grid boring samples where explosive compounds were found above the detections limit.

The lead concentration database from the grid borings has been evaluated using three different approaches as follows;

- Using the actual lead concentration values data from the shallowest sample in each grid boring
- Using the highest lead concentration values for each grid boring
- Using indicator valves where samples with concentrations greater than 1000 mg/Kg were set to 1 and all other sample values set to 0.

The variogram for lead is shown in Figure 4-3. This variogram shows a spherical model for lead based upon the shallowest grid boring soil samples. This variogram model has a range of 1400 feet, however, the best fit of the data would limit the range to no more than 550 feet. These results suggest a sample interval of approximately 150 feet which is in good agreement with the 200 foot grid boring spacing used in this investigation would be accomplish.

The variogram model for barium is shown in Figure 4-4. As with lead, the model has a range of approximately 500 feet. This range again suggests a sample distance of 125 to 200 feet as being valid for the grid boring data. Thus, it appears that a 200 foot spacing was sufficient for sample spacing.

4.2.3 Burn Pad Borings

Only lead was used for modelling the chemical analysis data collected from the burning pad soil borings. Burn Pads G and J were the only pads modelled because they had the greatest number of data points. The remaining pads could not be modelled as only one or two samples were collected from the smaller pad.

With 7 soil boring locations, Burning Pad G had 21 data pairs available to be used in modeling. The variogram model presented in Figure 4-5 shows a range of influence of approximately 275 feet. As with the lead data from the grid borings, the effective range for these data is estimated at from 100 to 200 feet. A wide degree of variability is present within these data increasing the scatter of the variogram and making the true effective range variable. Nonetheless, based upon the model results, which yielded a range of 275 feet, the pad boring soil sample interval of 50 feet appears to have been sufficient to characterize the site soils.

A model of the lead data from Burn Pad J has been developed that has yielded a range of 160 feet. This range is in good correlation with the closest grid spacing on the pad of 67 feet between the closest 2 points. As with the data from Burning Pad G, these data suggest that the burn pad sample interval of 50 feet was sufficient to characterize the pad soils.

In summary, the geostatistical evaluation supports the grid spacing used during the grid boring investigation. For characterization of lead in the soil samples from the upper 2 feet, the present boring spacing is sufficient.

4.3 SOILS

4.3.1 Distribution of Volatile Organics Compounds

4.3.1.1 Pad Borings

Table 4-5 summarizes the distribution of volatile organic compounds (VOC's) detected in soil samples obtained from the pad borings. A total of 71 soil samples were analyzed for total volatile organics. The complete list of volatile analytes is presented in Table 2-7. The complete analytical results and the individual detection limits for each compound are presented in Appendix G. Of the 71 soil samples analyzed, 24 soil samples were found to contain some volatile compounds. Of the 24 soil samples that were found to contain VOC's, 20 of these had VOC's detected at low estimated concentrations. Four soil samples collected from Burning Pad G had VOC concentrations above the detection limits. Chloroform was detected in four samples taken from pad borings PB-G-1, PB-G-2, PB-G-3 and PB-G-7. These four samples were all surficial grab samples taken from the upper 6 inches. None of the associated deeper samples had VOC's detected. The highest concentration of chloroform found on Pad G was 12 ug/Kg collected at PB-G-1. The remainder of the detected compounds were estimated concentrations, below the sample quantitation limit.

4.3.1.2 Berm Excavations

Table 4-6 summarizes the distribution of volatile organic compounds (VOC's) detected in soil samples collected during the excavations of the berm areas. A total of 17 soil samples were submitted for total volatile organic analyses and 9 were found to contain some level of volatile organics. Tetrachloroethene was the only compound detected above the sample quantitation limits. The highest concentration of tetrachloroethene was detected at Pad H, from a sample collected at a depth of 4 feet, where the concentration was 110 ug/Kg. Soil samples collected at Pads C and G had tetrachloroethene concentrations of 6 and 15 ug/Kg respectively. Both of these samples were also collected from a depth of 4 feet. A complete listing of samples submitted compounds, analyzed, detection limits, and results are presented in Appendix G.

4.3.1.3 Grid Borings

The grid boring soil samples where volatile organic compounds (VOC's) were found above the detection limits are presented in Table 4-7. A complete listing of soil samples submitted, compounds analyzed, detection limits and results is presented within Appendix G. A total of 36 grid boring soil samples were submitted for analysis. Of the 36 samples, 7 samples had volatile organic compounds found above the detection limits. Only two of these 7 soil samples had volatile organic compounds detected of above the sample quantitative limit. These compounds were chloroform and tetrachloroethene. Chloroform was detected at grid borings GB-02, GB-08, and GB-12 with concentrations of 10, 13 and 8 ug/Kg respectively. These samples were collected from varying depths. The soil samples from grid borings GB-08 and GB-12 were surface samples collected from 0 to 6 inches, while the soil sample at grid boring GB-02 was collected from the 4 to 6 foot depth. Tetrachloroethene was detected in one soil sample from grid boring GB-08 at a concentration of 13 ug/Kg. This soil sample was the surficial grab sample collected from the 0 to 6" depth.

4.3.1.4 Geophysical Anomaly Excavations

The complete chemical analyses for the geophysical anomaly excavations are included within Appendix G. The soil sample collected from Geophysical Anomaly Excavation (GAE) GAE-

G-2, collected from a depth of 2 feet on Burning Pad G detected the volatile organic compounds chloroform and tetrachloroethene at concentrations of 9 and 11 ug/Kg respectively. The compound methyl chloride was present in the laboratory blank and in all three Geophysical Anomaly Excavation samples at estimated concentrations all less than 5 ug/Kg.

4.3.2 Distribution of Semi-Volatile Organic Compounds

4.3.2.1 Pad Borings

Tables 4-8 and 4-9 summarize the distribution of semi-volatile organic compounds detected within soils samples obtained from the pad borings. Two suites of semi-volatile compounds have been included within the analyses. A complete list of compounds, samples, detection limits and results are presented in Appendix G. A total of 55 pad borings soil samples were submitted for semi-volatile organic analysis. A wide range of semi-volatile compounds have been detected below the sample quantition limits. A total of 30 of the 50 pad boring soil samples had semi-volatile compounds detected but of these 30 samples, only 8 soil samples had semi-volatile compounds found above the sample quantitation limits. The compounds that were found above the quantitation limits were 2,4-dinitrotoluene, di-n-butylphthalate, chrysene, and bi (2-Ethylhenyl) phthalate. Concentrations of 2,4-dintrotoluene above the quantitation limits were found in five pad boring soil samples collected from Burning Pads A,G and H. The soil sample from Pad A was obtained at PB-A-2 from a depth of 0 to 2 feet and had a concentration of 1500 ug/Kg. Pad G had two soil samples collected with detectable concentrations, the first from PB-G-5 taken from a depth of 0 to 2 feet with a concentration of 1300 ug/Kg. The remaining sample from Pad G was taken at PB-G-7 from a depth of 0 to 2 feet and had a concentration of 3600 ug/Kg. A surface sample from Pad H, PB-H-1, contained 2,4-dintrotoluene at a concentration of 2200 ug/Kg. This sample also had the only detectable concentrations of di-n-butylphthalate which was 1500 ug/kg. Bis(2-Ethylheyl)phthalate was detected in Pad J from sample PB-J-7-2 taken from between 0 and 2 feet. The final semi-volatile compound found above the quantitation limits was chryene which was found at a concentration of 100 ug/Kg on Pad G in soil sample PBG-G-1. This sample was a surficial soil grab sample taken from a depth of 0 to 6 inches. The remaining constituents were found to be estimated concentrations, below the sample quantitation limits.

4.3.2.2 Berm Excavations

Tables 4-10 and 4-11 summarize the distribution of semi-volatile organics found within soil samples obtained during the excavation of the berms. A total of 23 soil samples were submitted for semi-volatile organic analysis and of these, 10 were found to contain semi-volatiles compounds above the detection limits. Of these 10 samples, 6 had semi-volatile compounds above the sample quantitation limits. The remaining 4 samples had only estimated concentrations of semi-volatile compounds, (i.e., concentrations were below the sample quantitation limit). A complete listing of samples submitted, compounds, detection limits and results are presented in Appendix G.

For the six soil samples which detected semi-volatiles, only two semi-volatile compounds, 2,4-dinitrotoluene and N-nitrosodiphenylamine(1) were reported above the quantitation limits. The highest concentration of 2,4-dinitrotoluene was found in Berm F, at a concentration of 4,200 ug/Kg. Soil samples from the berms surrounding Burning Pads G and H had concentrations of 1,800 ug/Kg and 3,600 ug/Kg respectively. N-nitrosodiphenylamine(1) was found in soil samples BE-F-2, BE-F-2A and BE-H-3 at concentrations of 1000, 580 and 1,500 ug/Kg respectively.

4.3.2.3 Grid Borings

Tables 4-12 and 4-13 summarizes the distribution of semi-volatiles organics detected in soil samples obtained from the grid borings. A total of 49 grid boring soil samples were analyzed for semi-volatile organics. Appendix G presents the samples submitted, compounds analyzed, detection limits and results for all samples. Of the 49 samples, 23 samples were found to contain semi-volatile constituents. Of these 23 samples that had semi-volatile compounds present, only six samples taken from four grid boring locations, had compounds present above the sample quantitation limits. The remaining samples all had semi-volatile compounds present at concentrations below this limit. The following compounds were detected at concentrations above the sample quantitation limits: 2,4-dinitrotoluene, N-nitrosodiphenylamine, di-n-butylphalate and bis(2-ethlhexy)phthalate. Bis(2-ethylhexyl)phthalate was detected in only one grid boring soil sample, taken from grid boring GB-11. This sample was taken from a depth of 0 to 6 inches and the concentration was 100 ug/Kg. The remaining three compounds, nitrosodiphenylamine, di-n-butylphalate and bis(2-ethhexy)phthalate were detected at grid borings GB-02, GB-03 and GB-08 in samples taken from depths ranging from ground surface to 6 feet. 2,4,-dinitrotoluene concentrations ranged from 2,000 to 7,000 ug/kg with the highest concentration of 7,000 ug/Kg found within the surface grab sample at GB-03. N-nitrosodiphenylamine concentrations ranged from 510 to 1,000 ug/kg and di-n-butylphalate concentrations ranged from 840 to 1,400 ug/Kg. Both of these compounds were found in soil samples from grid borings GB-02 and GB-03. Concentrations of these two compounds were approximately equal at the two locations.

4.3.2.4 Geophysical Anomaly Excavations

The complete analytical results for the geophysical anomaly excavations are presented within Appendix G. Of the three geophysical anomaly sample only GAE-G-2 detected semi volatile compounds. The compounds 2,4-dinitrotoluene and N-nitrosodiphenylamine (1) were detected at GAE-G-2 at concentrations of 33,000 ug/Kg and 7,000 ug/Kg respectively. In addition to these two compounds di-n-butylphthalate and 2,6-dinitrotuluene were detected at estimated concentrations of 730 ug/Kg and 2,000 ug/Kg respectively. No other semi-volatile constituents were detected in the geophysical anomaly excavation soil samples.

4.3.3 <u>Distribution of Pesticides and PCB's</u>

4.3.3.1 Pad Borings

Table 4-14 summarizes the distribution of pesticides and PCB's found in the burn pad soil boring samples. A total of 50 burning pad soil samples were analyzed for pesticides and PCB's. The complete list of analytes is summarized in Table 2-7. The complete analytical results are presented within Appendix G. Of these 50 samples, eleven soil samples had pesticides at concentrations below the specified reporting limits. The two herbicides 4-4'-DDE and 4,4'-DDT were detected within soil samples from burning pads A, G and J. All four soil samples from Burning Pad A showed low levels of 4,4'-DDE. For all of the Pad A samples the 4,4'-DDE concentrations are less than 150 ug/Kg. Both the surficial grab sample PB-A-1, from the 0 to 6 inch depth, and the deeper sample PB-A-2 from the 2 to 4 foot depth detected 4,4' -DDE. One soil sample from burn pad G (PB-G-1-1) detected an estimated low level concentration of 33 ug/Kg of 4,4'-DDT.

The herbicides 4,4'-DDE, 4,4'-DDT, and Endrin were detected in soil samples taken from Burning Pad J. The herbicide 4,4'-DDE was detected in 8 samples, 4,4-DDT was found in 3 samples, and Endrin was present within one soil sample. The highest concentration of 4,4'-

DDE was found in the surface grab sample of PB-J-1 were the concentration was 830 ug/Kg. This soil sample location also has the highest concentration of 4,4'-DDT at 320 ug/Kg.

With this exception, all of the remaining samples from Pad J have 4,4'-DDE concentrations of less than 100 ug/Kg. The surficial grab sample at PB-J-6 contained very low levels of 4,4'-DDT while Endrin was detected in the surficial grab sample at PB-J-8 also at very low levels.

Of the seven locations on Pad J that detected herbicides five of these only showed constituents present in the 0-6" depth surficial grab sample. No herbicides were found in the associated 0 to 2 foot depth sample. This suggests that the presence of the herbicides 4,4'-DDE and 4,4'-DDT is limited to the very near surface soils.

4.3.3.2 Berm Excavations

Pesticides and PCB's were not detected within any of the berm excavation soil samples.

4.3.3.3 Grid Borings

Of the 42 soil samples analyzed from the grid borings, only three detected the presence of any herbicides or PCB's. Table 4-15 summarizes the results of the chemical analyses. The complete analytical results are presented in Appendix G. As with the pad borings, 4,4'-DDE was the principal herbicide detected. This was found at very low concentrations at GB-03 (sample depth 0-6") and at MW-30 (sample depth 0-2'). For these locations the concentrations were 32 ug/Kg and 27 ug/Kg, respectively. Aroclor -1260 was detected at 240 ug/Kg at GB-08 within the surficial grab sample.

4.3.3.4 Geophysical Anomaly Excavations

The complete results of the chemical analyses for the geophysical anomaly excavation soil samples are presented in Appendix G. No pesticides or PCB's were detected in the 3 soil samples submitted for analysis.

4.3.4 Distribution of Metals

The distribution of metals in soils has been evaluated using chemical analyses performed on soils collected from burning pad borings, berm excavations, and grid borings. A total of 50 pad boring samples, 45 grid boring samples, and 17 berm excavation samples were analyzed for metals. The full results are presented within Appendix G.

As noted in Section 1, variations in the metallic content of soils is strongly controlled by the composition of the underlying bedrock. Table 1-1 summarized the range of distribution for some metals in soils. Soils that are developed over bedrock composed of shales appear to show significantly higher metal concentrations. To address the background composition of the soils at the OB Grounds MAIN collected a soil sample during the installation of monitoring well MW-34 to provide data on the distribution of metals in the local soils. MW-34 was chosen due to its location away from the site, and therefore this sample is not expected to be influenced by activities performed at the site. The chemical analyses of the pad, berm, and grid samples have been compared to the background soil profile derived from the soil sample collected from MW-34.

Although only one soil sample has been used to tentatively describe the background concentration of metals in the soils, this sample data has been compared to background soil samples collected at the Ash Landfill (MAIN, 1992). The comparison indicates a generally consistent soil profile between the sample collected at MW-34 and the 7 samples used to define background conditions at the Ash Landfill. In addition, a complete analysis of the 112 soil samples collected and analyzed at the OB grounds show that for many metals the background sample collected at MW-34 is representative of the many of site soil samples. The following sections describe in detail the distribution of metals with the soils.

As described in Section 4.1, MAIN utilized lead as an indicator metal during Level II screening. The data presented in Section 4.1 indicated that Lead appeared to be a reasonable indicator metal given the variability of the concentrations of metals in the site soils and the understanding of the site history. To facilitate the discussion of the distribution of metals within site soils MAIN has developed Figures 4-6 through 4-9 which show the concentrations of lead detected within the pad and grid boring and berm excavation soil samples. The concentration of lead within the surface sample, collected from a depth of 0 to 6", and the sample with the highest concentrations of lead are shown for each sample location.

4.3.4.1 Pad Borings

Table 4-16 summarizes the distribution of the analyzed metals for the 50 pad boring soil samples. The complete parameter list, the background sample, the minimum, the maximum, the mean, and the standard deviation are tabulated for each metal. In addition the number of samples both above, and below the background level is listed. Finally the total number of samples that were above the detection limit is listed for each parameter. The data presented in this table are helpful in evaluating the presence of metals and the range in concentrations of the analyzed metals within the soils. In addition, Figure 4-6 through 4-8 present the concentrations of lead found within the surface sample, and present the sample with the highest concentration of lead.

The metals arsenic, mercury, selenium, silver, sodium, thallium and cyanide were not detected in the background sample. By comparison, arsenic was detected in all of the 50 pad boring soil samples and ranged in concentration from a minimum of 3.5 mg/Kg to a high of 10.3

mg/Kg. The average for arsenic in the 50 pad boring samples was 5.37 mg/Kg. For the remaining metals not detected at the background locations, the 50 pad boring soil samples all have a very narrow range of concentrations which is considered to be reflective of background soil conditions. As an example, mercury was detected in 31 samples that only showed a range from 0.09 mg/Kg to a high of only 1.10 mg/Kg. The other metals listed above also show similar narrow ranges of concentrations.

The aluminum, barium, cadmium, chromium, copper, lead, magnesium, potassium, and zinc were detected at levels above the background value in more than half of the pad burning soil samples. Of the 50 samples that had aluminum above the detection limit, 27 of the samples had concentrations above the background value. Additionally, the average of 17,026 mg/Kg for all 50 Aluminum samples is quite close to the background value of 16,100 mg/Kg. Of these metals, aluminum, cadmium, magnesium, and potassium all have mean values very close to the background value. In addition, these metals, with the exception of cadmium, are presumed to be the predominant components of soils derived from shale bedrock.

The remaining 5 metals that have more than half of their concentrations above the background sample include barium, chromium, copper, lead, and zinc. Many of these metals are associated with munitions and munitions destruction. For barium, 48 of the 50 pad boring samples showed concentrations above the associated background value. In addition, the concentration of barium within the 50 samples ranged from a low of 38 mg/Kg to a high of 14,700 mg/Kg. The highest barium levels were found on pad B at pad at pad boring PB-B1-1 at a concentration of 14,700 mg/Kg and pad J in Pad boring PB-J-7 at concentration of 10,300 mg/Kg.

The metals chromium, copper, and zinc were all detected at the highest levels on Pad G. Lead was detected at its highest level of 16,000 mg/Kg on Pad D with the sample taken from the 2 to 4 foot depth interval. The second highest lead concentration in pad boring soils was found at PB-G-1 where a concentration of 3,360 mg/Kg of lead was detected in the sample from 2 to 4 foot depth.

4.3.4.2 Berm Excavations

Table 4-17 summarizes the distribution of the analyzed metals for the 17 berm excavation soil samples. Sixteen of the 24 metals analyzed have more than half of their samples with concentrations above the associated background value. Of these sixteen, the ten metals aluminum, arsenic, cadmium, magnesium, mercury, potassium, selenium, silver, vanadium, and cyanide all have average values close to the background values and show little variation in their range of concentrations. As an example 16 of the 17 vanadium samples exceeded the background concentration of 22.3 mg/Kg. The range of concentrations for the 17 vanadium samples was from a low of only 2.5 mg/Kg to a high of 41.4 mg/Kg with an average of 28.0 mg/Kg. The limited range of the sample concentrations, along with the similarity of the average of these samples and the background sample suggest that these variations in concentration are reflective of natural soil conditions.

The remaining six metals include antimony, barium, chromium, copper, lead, and zinc. All of these metals are possible by-products of munitions waste destruction. All of the eleven soil samples that detected antimony had concentrations above the background value of 5.7 mg/Kg. The average of the eleven samples was 50.42 mg/Kg with a range from 8.70 mg/Kg to 115.0 mg/Kg. The soil samples with the highest antimony levels came from berm excavations BE-G-2 at 115.0 mg/Kg and BE-H-3 at 108 mg/Kg.

All seventeen berm excavation samples detected barium concentrations above the background value of 67.5 mg/Kg. The average of the 17 samples was 3151 mg/Kg with a range from a low of 136.0 mg/Kg to a high of 19,600 mg/Kg. The soil samples with the highest barium concentrations came from berm excavation BE-B-2 at 19,600 mg/Kg and BE-G-2 at 4,740 mg/Kg.

Chromium was detected in all seventeen of the berm excavation soil samples. Of these seventeen samples, twelve had chromium concentrations above the background level of 26.6 mg/Kg. The average chromium concentration for the berm excavation samples was 37.80 mg/Kg with a range from 19.0 mg/Kg to a high of 87.8 mg/Kg. The highest chromium concentrations were found in soils samples taken from berm excavations BE-G-6 at 87.8 mg/Kg and BE-G-3 at 71 mg/Kg. Although the chromium concentrations range by a factor of four for the berm samples the highest concentrations detected do not exceed 100 mg/Kg.

Copper was detected in all 17 berm excavation soil samples. Sixteen of the seventeen samples had copper concentrations above the background level of 32.7 mg/Kg. The average copper concentration was 3,651 mg/Kg, ranging from a low of 29.8 mg/Kg to a high of 38,100 mg/Kg. The highest copper concentrations were found in soil samples taken from BE-B-2 at 38,100 mg/Kg and BE-G-2 at 5300 mg/Kg.

All seventeen of the berm excavation soil samples detected lead at concentrations above the background value of 11.9 mg/Kg. The lead concentrations for the 17 berm excavation samples had an average of 14,010 mg/Kg and ranged from a low of 32.4 mg/Kg to a high of 56,700 mg/Kg. Of the six metals considered lead appears to show the highest average concentration above the background level. Six of the seventeen berm excavation samples had Lead concentrations above 10,000 mg/Kg. The highest lead concentrations were found in soil samples taken at BE-C-2 at 56,700 mg/Kg, and at BE-B-2 at 41,200 mg/Kg. Other significantly elevated lead levels were found at BE-C-3 (29,000 mg/Kg), BE-H-3 (24,200 mg/Kg), BE-G-2 (22,400 mg/Kg) and BE-D-1 (14,400 mg/Kg).

Zinc was detected in all 17 of the berm excavation soil samples. All seventeen samples had zinc concentrations above the background level of 95.7 mg/Kg. The mean zinc concentration of the seventeen berm samples was 2,765 mg/Kg ranging from a low of 138 mg/Kg to a high of 13,000 mg/Kg. The highest concentrations of zinc were found in soils taken from berm excavations BE-D-1 at 13,000 mg/Kg and BE-C-2 at 7,640 mg/Kg.

4.3.4.3 Grid Borings

Table 4-18 summarizes the distribution of the analyzed metals for the 45 grid boring soil samples. Thirteen of the 24 metals analyzed have more than half of their samples with concentrations above the associated background values. Of these thirteen, eight metals, aluminum, arsenic, beryllium, cadmium, potassium, selenium, thallium, and vanadium all have average values close to the background and show a narrow range in their concentrations. As an example, 33 of the 45 samples that detected cadmium had concentrations above the background value of 2.3 mg/Kg. The 45 samples had an average concentration of 3.0 mg/Kg and only ranged from 1.8 mg/Kg to a high of 7.0 mg/Kg. The presence and limited variation of these metals reflects only natural variations in soil chemistry.

The remaining five metals include antimony, barium, copper, lead and zinc. All of these metals are possible by-products of munitions waste destruction.

Six soil samples were found to contain detectable concentrations of antimony. Of these six, five samples had concentrations above the background level of 5.7 mg/Kg. The average concentration of the six samples was 14.9 mg/Kg ranging from a low of 5.7 mg/Kg to a high of 40.0 mg/Kg. The soil samples with the highest concentrations of antimony included GB-12-1 at 40 mg/Kg and GB-2-1 with a concentration of 19.6 mg/Kg.

Copper was detected in all 45 of the grid boring soil samples. Thirty-three of the 45 samples had concentrations above the background value of 32.7 mg/Kg. The average concentration for the grid boring soil samples was 173.5 mg/Kg ranging from a low of 15.7 mg/Kg to a high of 1,060 mg/Kg. The highest concentrations of copper were found at grid borings GB-2-1 at 1,060 mg/Kg and GB-1-1 at a concentration of 1,010 mg/Kg.

Lead was also detected in all 45 of the grid boring soil samples. Of these 45 samples, 43 had lead concentrations above the background level of 11.9 mg/Kg. The average concentration of lead within the 45 grid boring soil samples was 638.5 mg/Kg, ranging from a low of 10.8 mg/Kg to a high of 6,230 mg/Kg. The highest lead concentrations were found in grid boring samples GB-12-1 at 6,230 mg/Kg and at GB-2-2 at a concentration of 3,400 mg/Kg. Other elevated lead values were found at GB-13-1 (2,440 mg/Kg) and GB-15-1 (2,340 mg/Kg).

The final metal of interest is zinc. Zinc was found above the detection limits in all 45 of the grid boring soil samples. Thirty-four of these 45 samples had zinc concentrations above the background value of 95.7 mg/Kg. The average concentration of zinc within the 45 grid boring soil samples was 229.5 mg/Kg ranging from a low of 51 mg/Kg to a high of 900 mg/Kg. The highest zinc concentrations were found in grid boring samples GB-13-1 (900 mg/Kg) and GB-2-1 (780 mg/Kg).

4.3.4.4 Geophysical Anomaly Excavations

The complete results of the chemical analyses for the geophysical anomaly excavation soil samples are presented in Appendix G. Due to the limited number of samples it is not felt that a discussion on the distribution of metals in soils is appropriate for these data. In general these data do not show metal concentrations that exceed valves derived from the pad boring samples.

4.3.5 Distribution of Explosives in Soils

4.3.5.1 Pad Borings

Table 4-19 summarizes the distribution of explosives found within the burning pad soil samples. A total of 50 burning pad soil samples were analyzed. Figures 4-10 through 4-13 summarize the distribution of explosive compounds detected within the various soil borings completed at the site. The analytical results from the surface sample, along with the sample containing the highest concentration of explosives are presented on these figures. Of the 50 soil samples, 27 samples were found to contain explosive compounds. Explosive compounds were found within soil samples collected from burning pads A, D, E, F, G, H and J. Soil samples collected from the borings completed on Pads B and C did not identify explosive compounds.

Both soil samples from pad boring PB-A-1 detected, the explosive compound 2,4-dinitrotoluene. This compound was found in both the 0 to 6 inch and the 0 to 2 foot depth soil samples. This was the only explosive compound found in these samples. The single borings on Burning Pads D and E, PB-D-1 and PB-E-1 respectively, both detected isolated explosive compounds. An estimated 190 ug/Kg of RDX was found in sample PB-D-1-3A collected on Pad D from a depth of 2 to 4 feet. The compound 2,4-dinitrotoluene was detected at a concentration of 510 ug/Kg in sample PB-E-1-3 collected from a depth of 2 to 4 feet on Burning Pad E.

The single pad boring completed on Pad F had a wide distribution of explosive compounds identified. This sample was the surficial grab sample collected from a depth of 0 to 6 inches. The highest concentration of explosive compounds detected within this sample was 2700 ug/Kg of the breakdown product 2-amino-4,6-dinitrotoluene.

Soil samples collected from five of the seven borings completed on Pad G detected explosive compounds. The two exceptions were Burning Pad borings PB-G-4 and PB-G-5. The highest concentration of explosives detected on Burning Pad G was at the pad boring PB-G-2 where 4,800 ug/Kg of RDX was detected. The second highest concentration of RDX (2,900 ug/Kg) was found in sample PB-G-1-1 collected from boring PB-G-1. The explosive compound 2,4-dinitrotoluene was found in all five of the Pad G samples as shown in Table 4-19.

The single soil boring completed on Burning Pad H (PB-H-1) had explosive compounds present in both the surficial grab sample and the deeper sample taken from the 0 to 2 foot depth. A wide distribution of explosion compounds was found, with the highest concentrations being 2,4-dinitrotoluene at 3900 ug/Kg in sample PB-H-1-1 and 1,500 ug/Kg of 2,4-dinitrotoluene in sample PB-H-1-2.

All eight of the soil borings completed on Pad J had explosive compounds detected. The primary explosive found was 2,4-dinitrotoluene with the highest concentration of 4,000 ug/Kg detected in the sample PB-5-7-2. The second highest concentration of explosives on Pad J was 420 ug/Kg of 2,4-dinitrotoluene found in the soil sample PB-J-1-1.

Table 4-20 summarizes the distribution of the various explosive compounds that were detected within the 50 pad boring soil samples. A total of 27 soil samples had explosive compounds of one type or another detected. Tetryl and 2,6-dinitrotoluene were not found within any of the pad boring soil samples. By comparison, of the 27 soil samples that had explosive compounds, 2,4-dinitrotoluene was found in 26 of them. The explosive compound 1,3,5-trinitrobenzene was the second most prevalent, being found within 9 of the 27 soil samples. The other prevalent explosive compounds include 4-amino-2,6-dinitrotoluene, 2-amino-4,6-dinitrotoluene and RDX.

4.3.5.2 Berm Excavations

Table 4-21 summarizes the distribution of explosives found within soil samples collected from the berm excavations. A total of 20 berm excavation soil samples were analyzed for explosive compounds. Of these 20 samples, sixteen were found to contain explosive compounds above the detection limits. Explosive compounds were found within the berms at all of the burning pads. The concentrations of explosive compounds varies dramatically from a low value of 83 ug/Kg in sample BE-G-1 for RDX, to an estimated high of 80,000 ug/Kg at BE-F-2A for the compound 2,4,6-trinitrotoluene (2,4,6-TNT).

The explosive compounds Tetryl and HMX were not detected within any of the berm excavation soil samples. The compound 2,6-dinitrotoluene was found in only one soil sample, BE-E-1. The compound 2,4-dinitrotoluene was detected in all 16 of the berm excavation soil samples where explosives were found. In addition, 1,3,5-trinitrobenzene, 2,4,6-TNT,4-Amino-2,6-DNT and 2-Amino-4,6-DNT were also widely present within the berm excavation soil samples.

4.3.5.3 Grid Borings

Table 4-22 summarizes the distribution of explosives found within the grid boring soil samples. A total of 44 grid boring soil samples were analyzed. Of these 44 samples, 12 soil samples were found to contain explosive compounds. Plate 4-1 presents the total explosives found within soil samples collected from the grid borings. The highest levels of explosives were identified at GB-03 where both the 0 to 6" depth and the 0 to 2' depth samples detected total explosives of 2,014 ug/Kg and 73 ug/Kg respectively. The remaining 12 grid boring soil samples had concentrations of less than 500 ug/kg of total explosives.

Table 4-23 summarizes the distribution of the various explosive compounds that were detected within the 12 grid boring soil samples. Of these 12 samples, 2,4-Dinitrotoluene was found in six locations at an average concentration of 335 ug/Kg. The most prevalent explosive compound found within the grid boring soil samples was 2-Amino-4,6-DNT which was found in 7 samples at an average concentration of 154 ug/Kg. The explosive compounds HMX, 1,3-dinitrobenzene, and Tetryl were not detected in any samples. Table 4-22 shows the low level of average concentrations found throughout the site. This small variation in average concentration, in comparison to the pad boring soil samples, suggest a limited, low level dispersion of explosives outside of the burning pads themselves.

4.3.5.4 Geophysical Anomaly Excavations

The complete results of the chemical analyses for the geophysical anomaly excavation soil samples are presented in Appendix G. The analysis for explosive compounds has identified 2,4-dinitrotoluene in sample GAE-G-2 at a concentration of 4,000 ug/Kg. No other explosive compounds were identified within the three soil samples.

4.4 GROUNDWATER

4.4.1 Distribution of Volatile Organic Compounds

Groundwater samples from 28 monitoring wells have been collected and analyzed for a full range of volatile organic compounds. The list of analytes, along with the complete chemical analyses are included within Appendix G.

Table 4-24 summarizes the occurrence of volatile organic compounds found within the 28 monitoring well samples. The compound acetone was found at very low levels within 7 groundwater samples. The chemical analysis results for acetone have all been qualified to indicate that the concentrations reported are all estimated and are below the sample quantitation limits. Based upon the locations of the monitoring wells were acetone was found, no discernable plume of contaminants can be identified. The presence of acetone at these low levels may suggest contamination associated with laboratory procedures.

4.4.2 Distribution of Semi-Volatile Compounds

Table 4-25 summarizes the distribution of semi-volatile organic compounds found within the 28 monitoring well groundwater samples. The compound diethylphthalate was detected at very low concentrations at 5 monitoring well locations.

The chemical analysis results for diethylphthalate have been qualified to indicate that diethylphthalate was found in the associated sample blank and that the concentrations are estimated values due to the concentrations being below the sample quantitation limits. The presence of this compound within the sample blank suggests possible contamination associated with laboratory procedures.

4.4.3 Distribution of Pesticides and PCB's

A total of 32 groundwater samples, including 4 duplicate samples were analyzed for pesticides and PCB's. The complete list of analytes, along with the chemical analyses, is presented within Appendix G. No pesticides or PCB's were detected within any of the groundwater samples collected at the site.

4.4.4 Distribution of Metals

A total of 32 groundwater samples, including 4 duplicate samples, were analyzed for metals. The complete list of analytes, along with the chemical analyses, are presented within Appendix G. Both filtered and unfiltered groundwater samples were analyzed. Due to the fine grained nature of the aquifer materials, groundwater samples collected from the monitoring wells had turbidities greater than 50 NTU's. For this reason, the unfiltered samples show elevated constituent levels. The following discussion on the distribution of metals in the groundwater is based upon the chemical analyses of the filtered groundwater samples.

The data presented in Appendix G indicate that of all the metals analyzed, only manganese is presented within the groundwater at elevated levels. Elevated manganese levels were found in monitoring wells, MW-18, 19, 21, 23, 27, 78, 31, 32, and 35.

The highest manganese level detected was 306 ug/l at monitoring well MW-35. In general the filtered groundwater samples showed high levels of calcium, magnesium, and sodium, reflective of the bedrock and soil chemical composition. Trace levels of mercury were detected at 0.2 ug/l in monitoring well MW-16, while monitoring well MW-19 showed zinc at a concentration of 67.4 ug/l. Chromium was also detected at a concentration of 6.1 ug/l in monitoring well MW-24.

4.4.5 Distribution of Explosives

A total of 32 groundwater samples, including 4 duplicate samples, were analyzed for explosive compounds. The list of monitoring wells sampled is presented in Table 2.6.5-1 while the complete list of analytes, and the complete results from the chemical analyses are presented in Appendix G.

Table 4-26 summarizes the distribution of explosives found within the 32 groundwater samples. Plate 4-2 shows the distribution of total explosives detected within the groundwater. Explosive compounds were found within the groundwater samples taken from monitoring wells MW-13, MW-15, MW-24, and MW-28. The explosive compound RDX was detected at two locations (MW-13 and MW-15) while 2,4,6-trinitrotoluene was detected at MW-24 and 2,6-DNT was detected at MW-28. The highest concentration of explosives found was 0.6ug/l of RDX within the groundwater sample collected from monitoring well MW-13. The areal distribution of these monitoring wells along with the limited number of detections and the low measured concentrations all suggest that a readily discernable plume of groundwater contaminated with explosives is not present at the site. The low hydraulic conductivity of the site aquifer, in conjunction with the relatively high sorption potential of the aquifer materials appears to have retarded significant explosive migration through the groundwater system. While MW-13 had the highest explosive concentrations in groundwater at 0.6 ug/l, MW-30, which is approximately 100 feet downgradient of MW-13, did not have explosives detected within the groundwater. Similarly while MW-15 had explosives detected at 0.08 ug/l, no explosives where detected within the downgradient well MW-23. At the well couplet MW-28/MW-29, the groundwater sample from MW-28 had 0.09 ug/l of explosives in the groundwater while the adjacent monitoring well MW-29 had no explosives detected.

None of the monitoring wells adjacent to Reeder Creek, including MW-7, MW-16, MW-22, MW-23 and the MW-25/MW-26 couplet, had explosives detected within the groundwater. This would indicate that a plume of groundwater contaminated with explosive compounds is not discharging to Reeder Creek.

The low level concentrations identified at the four monitoring well locations may reflect localized soil and/or groundwater phenomena or maybe associated with variations within groundwater levels at the site. During high groundwater level periods, such as was present during the January 1992 round of sampling, more site soils were saturated and potentially more explosive compounds were present within the groundwater.

The distribution of explosives in the groundwater does not appear to be directly associated with areas of elevated explosive concentrations within the soils. Plate 4-1 shows the distribution of total explosives detected in soils collected from grid borings. Although no monitoring wells are located near the highest explosives based upon grid boring samples (GB-03, 3793 ug/Kg), MW-18 is directly down gradient of GB-02 when the second highest concentration of explosives (510 ug/Kg) was found in grid boring soils. By comparison the groundwater sample from MW-18 did not identify the presence of explosive compounds above the detection limits.

4.5 SURFACE WATER AND SEDIMENTS

4.5.1 Distribution of Volatile Organic Compounds

4.5.1.1 Surface Water

A total of 14 surface water samples were analyzed for volatile organic compounds. The complete list of analytes, along with the results of the chemical analyses are presented in Appendix G. Thirteen of the 14 surface water samples had the compounds methyl chloride and acetone detected within the blanks and within the surface water samples. All of the samples had very low estimated concentrations of these compounds. The highest estimated concentration found was 14 ug/l detected in samples collected at stations SW-192 and SW-193. The compound carbon disulfide was detected in sample SW-197 at an estimated concentration of 3 ug/l. No other volatile organic compounds were detected in the surface water samples. The presence of these compounds in the samples are likely the result of laboratory contamination and not related to on-site conditions.

4.5.1.2 Surface Sediments

A total of 17 surface sediment samples were analyzed for volatile organic compounds. The complete list of analytes, along with the results of the chemical analyses are presented in

Appendix G. Sixteen of the 17 surface sediment samples had the compounds methyl chloride and acetone detected within the blanks and within the surface sediment samples. The surface sediment sample collected at station SW-191 had only methyl chloride present in the blank and in the surface sediment sample. The compound toluene was detected in the sample blank and the surface sediment samples collected at stations SW-150 and SW-160. The highest estimated concentration of toluene was 5 ug/Kg at station SW-150. Chloroform was detected in the sample collected at station SW-150 at a concentration of 20 ug/Kg.

4.5.2 Distribution of Semi-Volatile Compounds

4.5.2.1 Surface Water

A total of 20 surface water samples, including duplicates, were analyzed for semi-volatile organic compounds. The complete list of analytes, along with the results of the analyses are presented in Appendix G.

Only the surface water sample collected at station SW-192 had semi-volatile compounds present above the detection limits. The compound bis(2-Ethylhexyl)phthalate was detected in the sample collected at station SW-192 at a concentration of 71 ug/L.

4.5.2.2 Surface Sediments

A total of 19 surface sediment samples, including duplicates, were analyzed for semi-volatile organic compounds. The complete list of analytes, along with the results of the analyses are presented in Appendix G.

The compound 4-methylphenol was detected at an estimated concentration of 350 ug/Kg in the surface sediment sample collected at station SW-120 located on Reeder Creek. Station SW-120 is downstream of both the OB grounds and the OD area.

The semi-volatile compound di-n-butylphthalate was also detected in the surface sediment sample collected at station SW-120 at an estimated concentration of 250 ug/Kg. The only other semi-volatile compound found within surface sediment samples was pyrene. This compound was detected at an estimated concentration of 100 ug/Kg in the surface sediment sample collected at station SW-190. This sample location is within a surface drainage swale east of the OD mound and the chemical analysis of this sediment sample may reflect activities from OD activities more so than from OB activities.

4.5.3 Distribution of Pesticides and PCB's

A total of 16 surface water and 17 surface sediment samples, including duplicates, were collected and analyzed for pesticides and PCB's. The sample locations are shown on Plate 2-4. The complete list of analytes, along with the results of the chemical analyses, are presented within Appendix G. No pesticides or PCB's were detected in any of the surface water or surface sediment samples collected on-site.

4.5.4 Distribution of Metals

Sixteen surface water, and eighteen surface sediment samples, including duplicates, were analyzed for metals. The sample locations are shown on Plate 2-4. The complete list of analytes, along with the results of the chemical analyses, are presented within Appendix G.

4.5.4.1 Surface Water

Table 4-27 summarizes the distribution of metals within the surface water samples collected at the site. Only those compounds that were found above the detection limits are shown. The complete chemical analyses are presented within Appendix G. In general the surface water samples show high concentrations of calcium, iron, magnesium and sodium, reflective of the general soil and bedrock chemistry for the site. Elevated levels of aluminum were also detected within samples SW-120, SW-191, SW-193 through SW-195, and SW-197. Since aluminum is generally a component of shale rocks it is assumed that these levels are associated with the background surface water chemistry.

Trace amounts of copper at low levels were recorded in samples SW-194 and SW-195. Elevated levels of lead within the surface water were detected at SW-191, SW-192, SW-194 and SW-195. Trace amounts of zinc at low concentrations were also detected at SW-191, SW-192, SW-194, SW-195, and SW-197. The presence of elevated levels of lead within the surface water samples at stations SW-191 and SW-192 corresponds to the location where the highest lead levels were found within the surface sediment samples.

4.5.4.2 Surface Sediments

Table 4-28 summarizes the distribution of metals found within the surface water sediment samples. Of the 24 metals analyzed, twelve metals were detected at levels above the associated background values at more than half of the sample locations. Of these twelve metals (antimony, arsenic, beryllium, cadmium, mercury, potassium, vanadium, and cyanide) Only four that had average concentrations significantly above the associated background values. These four metals include barium, copper, lead, and zinc.

Barium was detected at sixteen of the eighteen surface sediment sample locations. Eleven of the sixteen sample locations had barium concentrations at levels above the background value of 67.5 mg/Kg. The surface sediment samples had an average barium concentration of 183.7 mg/Kg, ranging from a low of 35.6 mg/Kg to a high of 701 mg/Kg. The highest concentrations of barium were found in the surface water samples collected at stations SW-191 at 701 mg/Kg and SW-180 at 385 mg/Kg. The third highest concentration of barium was found at SW-180 were 313 mg/Kg were detected in the surface sediments. All three of these stations are located on the far eastern side of the site. As can be seen on Plate 2-4, sample locations SW-191 and SW-192 are located within the same surface water drainage channel. Surface water sample location SW-170, directly downstream of SW-191 and SW-192, had the fourth highest barium concentration at 245 mg/Kg in the surface sediments.

Copper was detected within all 18 surface sediment samples. Ten of these samples had copper at concentrations that exceeded the background level of 32.7 mg/Kg. The surface sediment samples had an average copper concentration of 96.5 mg/Kg, with a range from 18.7 mg/Kg to 416 mg/Kg. The highest concentrations of copper were found in the surface water samples collected at stations SW-190 at 416 mg/Kg and SW-191 at 254 mg/Kg. This highest copper concentration was measured in a surface water drainage ditch that collects runoff from the Open Detonation Mound. Surface water drainage patterns suggest that it is unlikely that sediment collected within this ditch could have been derived from soils within the OB grounds. The third highest copper concentrations were found in surface sediments collected at station SW-192 where copper was detected at 217 mg/Kg. Both SW-191 and SW-192 are located within the same surface water drainage channel. This is also the location where high barium concentrations were noted.

Lead was detected in all 18 of the surface sediment samples. All eighteen of the samples had lead concentrations above the background level of 11.9 mg/Kg. The surface sediment samples had an average lead concentration of 138.1 mg/Kg and ranged from a low of 15.4 mg/Kg to a high of 463 mg/Kg. The surface sediment samples that had the highest concentrations of lead include SW-191 at 463 mg/Kg, SW-193 at 331.9 mg/Kg and SW-192 at 280 mg/Kg. As with both copper and barium the surface drainage north of Pad B contains sediments with the highest concentrations of lead.

Zinc was detected in all 18 of the surface sediment samples. Of these eighteen, twelve samples had zinc concentrations above the background level of 95.7 mg/Kg. The surface sediment samples had an average zinc concentration of 193.4 mg/Kg ranging from a low of 39.6 mg/Kg to a high of 655 mg/Kg. The highest concentrations of zinc were found at SW-192 at 655 mg/Kg and at SW-191 at 419 mg/Kg. As with the other metals, zinc has been found at its highest concentrations within the surface sediments in the drainage swale north of Pad B that contains sample locations SW-191 and SW-192.

4.5.5 Distribution of Explosives

A total of seventeen surface water and seventeen surface sediment samples were analyzed for explosives. The sample locations are shown on plate 2-4 and the list of analytes and complete chemical analyses are included in Appendix G. Explosive compounds were detected in seven surface water samples and at one surface sediment sample location.

Table 4-29 summarizes the distribution of explosive compounds found within the surface water and surface sediment samples collected at the site. Plate 4-3 shows the distribution and concentrations of explosives found within these samples. Of the seven surface water samples, six detected only the explosive compound RDX. The seventh sample, SW-197, identified only Tetryl within the surface water. The highest concentration of explosives in surface waters was found at station SW-160 where an estimated 9.4 ug/l of RDX was detected. A total of six explosive compounds were found in the surface sediment sample collected at station SW-190. This surface sample location is within a ditch that drains runoff from the OD Mound. In addition, the highest concentration of explosive compounds within the surface water, detected at station SW-160, is also within this same drainage ditch. It is likely that the presence of these explosives are associated with OD operations and not with munitions destruction activities conducted within the OB Grounds.

Of the seven surface water and sediment sample locations on Reeder Creek (SW-110, SW-120, SW-130, SW-140, SW-150, and SW-196), only the surface water sample collected at station SW-120 had explosive compounds detected. A concentration of 0.67 ug/L of RDX was detected in this surface water sample. This station is downstream of both the OB Grounds and the OD Mound so that a definitive source can not be attributed to this anomaly.

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TABLE 4-1
LEVEL II vs LEVEL IV RESULTS
EXPLOSIVES IN SOILS
(mg/Kg)

SAMPLE	LEVEL II	LEVEL IV
BE-F-1	1.02	2.51
BE-C-2	1.11	1.05
BE-H-3	1.12	3.01
BE-H-2	1.18	0.97
BE-B-2	1.27	1.5
PB-A-2A	1.46	0.6
BE-G-1	1.47	1.9
BE-G-2	3.4	9.93
BE-F-2	29	40.1
BE-F-2A	69	90.65

Notes:

Level II analyses reflect screening results for 2,4,6-Trinitrotoluene.

Level IV results reflect total explosives.

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TABLE 4-2
LEVEL II vs LEVEL IV RESULTS
LEAD IN SOILS
(mg/Kg)

SAMPLE	LEVEL II	LEVEL IV
GB-10-3	15.0	18.0
GB-11-3	15.1	14.1
PB-G-4-2	15.9	43.3
GB-4-5	19.1	18.1
GB-2-4	19.5	27.9
GB-6-5	19.9	22.0
BE-J-4	22.0	32.4
GB-7-2	22.0	18.1
GB-9-3	23.0	14.4
BE-J-6	30.0	48.0
PB-G-5-2	31.0	50.2
PB-J-6-2	51.0	74.3
PB-J-8-2	55.0	34.9
PB-J-4-2	85.0	105.0
GB-14-2	87.0	78.0
PB-H-1-2	92.0	58.8
PB-J-1-2	95.0	80.9
GB-12-2	138.0	171.0
PB-F-1-4	141.0	59.6
PB-J-2-2	230.0	115.0
GB-3-2	230.0	252.0
PB-G-7-2	280.0	332.0
PB-G-3-2	350.0	65.7
PB-C-1-4A	370.0	475.0
PB-J-7-2	400.0	453.0
PB-J-5-2	450.0	530.0
BE-J-5	690.0	644.0
GB-15-2	830.0	985.0
PB-J-3-2	880.0	29.2
PB-C-1-4	900.0	256.0
PB-G-6-4	900.0	37.5
GB-13-2	910.0	1060.0
PB-E-1-3	970.0	205.0
GB-1-3	970.0	481.0
BE-E-1	1030.0	1260.0
PB-G-2-2	1250.0	7.7
GB-2-2	1940.0	3400.0
PB-A-2	2100.0	2530.0
BE-F-1	2200.0	2350.0
PB-B-1-3	2600.0	3180.0
PB-D-1-3A	3600.0	3930.0
BE-F-2	4500.0	5310.0
BE-H-2	6000.0	6900.0
BE-A-1	6600.0	7800.0
BE-G-3	7100.0	7800.0
BE-F-2A	7700.0	9340.0
BE-G-6	7900.0	8710.0
GB-8-4	9800.0	182.0
BE-D-1	12000.0	14400.0
PB-D-1-3	12400.0	16000.0
PB-G-1-2	14100.0	3360.0
BE-H-3	17400.0	24200.0
BE-G-2	19700.0	22400.0
BE-C-3	22000.0	29000.0
BE-B-2	34000.0	41200.0
BE-C-2	44000.0	56700.0

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TABLE 4–3
PAD BORINGS
LEAD AS AN INDICATOR METAL IN SOILS

PAD	SAMPLE	BARIUM	RANK	CHROMIUM	RANK	COPPER	RANK	LEAD	RANK	ZINC	RANK
D	D1–3	1970	14	40	9	1640	8	16000	1	1060	15
D	D1–3A	359	35	22	46	254	20	3930	2	457	30
G	G1–3	1390	22	30.5	23	1650	7	3360	3	615	24
B	B1–3	6040	6	27	34	6890	2	3180	4	712	22
A	A–2	1540	21	46.4	6	3160	4	2530	5	2150	7
F	F1–1	1560	20	24.2	43	90.9	36	2320	6	494	29
A	A–1	1290	23	26.1	37	962	11	1980	7	222	41
J	J5–1	5650	7	39.8	10	520	14	1840	8	2160	6
G	G7–1	1860	16	54.7	2	15500	1	1700	9	6380	1
A	A–1A	1910	15	25.9	39	1660	6	1560	10	350	34
J	J7–1	10300	2	32.1	19	182	23	1370	11	2170	5
J	J4–1	5610	8	50.8	4	262	19	1340	12	1510	13
A	A–2A	1820	17	35.9	15	2090	5	1220	13	926	18
Average of These Samples		3177		35		2682		3528		1477	
Average for all Pad Borings		2127		34.22		988		1000		1049	
Site Background Value		67.5		26.6		32.7		11.9		95.7	
Number of Samples Above Background Value			13		9		13		13		13
Number of Samples in Top 13			4		5		8		13		5

Note:
All units in mg/Kg.

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TABLE 4–4
BERM EXCAVATIONS
LEAD AS AN INDICATOR METAL IN SOILS

PAD	SAMPLE	ANTIMONY	RANK	BARIUM	RANK	CHROMIUM	RANK	COPPER	RANK	LEAD	RANK	ZINC	RANK
C	BE–C–2–91	U	12	2240	9	53.6	3	3800	3	56700	1	7640	2
B	BE–B–2–91	68.8	3	19600	1	48.1	4	38100	1	41200	2	5380	3
C	BE–C–3–91	67.7	4	3900	5	46	5	3620	4	29000	3	3380	5
H	BE–H–3–91	108	2	4400	4	35.4	7	2900	5	24200	4	992	10
G	BE–G–2–91	115	1	4740	2	32.2	9	5300	2	22400	5	1650	8
D	BE–D–1–91	54.2	5	740	12	31.1	11	704	11	14400	6	13000	1
F	BE–F–2A–91	19.9	9	4570	3	37	6	1770	7	9340	7	2160	7
G	BE–G–6–91	8.7	11	2890	7	87.8	1	998	8	8710	8	5300	4
A	BE–A–1–91	14.5	10	1040	11	24.5	13	767	10	7880	9	210	14
G	BE–G–3–91	35.7	7	1400	10	71	2	632	12	7800	10	862	12
Average of These Samples		49.3		4552.0		46.7		5859.1		22163.0		4057.4	
Average for all Berms		50.4		3151.0		37.8		3651.0		14010.0		2764.0	
Background Value		5.7		67.5		26.6		32.7		11.9		95.7	
Number above Background			10		10		10		10		10		10
Number in Top 10			7		8		8		8		10		8

Note:
All units in mg/Kg.

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TABLE 4-5
PAD BORINGS
SUMMARY OF VOLATILE ORGANICS IN SOILS (ug/Kg)

	LOCATION	PAD-A	PAD-B	PAD C	PAD C	PAD C	PAD D	PAD E
	DEPTH	0-6"	6-8"	2-4'	2-4'	2-4'	2-4'	0-6"
COMPOUND	MAIN ID	PB-A-1A	PB-B-1-5RE	PBC-1-3	PBC-1-3A	PBC-1-3ADL	PBD-1-3A	PBE-1-1
Chloromethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromomethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Vinyl Chloride		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Methyl Chloride		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acetone		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Carbon Disulfide		BDL	BDL	2 J	BDL	BDL	BDL	BDL
1,1-Dichloroethene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1-Dichloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2-Dichloroethene (total)		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chloroform		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2-Dichloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2-Butanone		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,1-Trichloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Carbon Tetrachloride		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Vinyl Acetate		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromodichloromethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2-Dichloropropane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
cis-1,3-Dichloropropene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trichloroethene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibromochloromethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,2-Trichloroethene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzene		BDL	BDL	BDL	2 J	180 JD	3 J	BDL
trans-1,3-Dichloropropene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromoform		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Methyl-2-Pentanone		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2-Hexanone		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Tetrachloroethene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,2,2-Tetrachloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Toluene		2 J	3 J	BDL	2 J	BDL	BDL	4 J
Chlorobenzene		4 J	BDL	BDL	BDL	BDL	BDL	BDL
Ethylbenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Styrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Xylene (total)		BDL	BDL	BDL	BDL	BDL	BDL	BDL

NOTES:
BDL = BELOW THE DETECTION LIMIT
J = ESTIMATED CONCENTRATION, BELOW SAMPLE QUANTITATION LIMIT
D = MATRIX SPIKE/MATRIX SPIKE DUPLICATE (FORM III, ALL FRACTIONS)

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TABLE 4–5
PAD BORINGS
SUMMARY OF VOLATILE ORGANICS IN SOILS (ug/Kg)

	LOCATION	PAD E	PAD–F	PAD G	PAD G	PAD G	PAD G	PAD G
	DEPTH	0–6"	4–6'	0–6"	0–6"	0–6"	0–6"	0–6"
COMPOUND	MAIN ID	PBE–1–1RE	PB–F–1–4	PBG–1–1	PBG–1–1RE	PBG–2–1	PBG–3–1	PBG–7–1RE
Chloromethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromomethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Vinyl Chloride		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Methyl Chloride		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acetone		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Carbon Disulfide		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1–Dichloroethene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1–Dichloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2–Dichloroethene (total)		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chloroform		BDL	BDL	12	9	6	10	1 J
1,2–Dichloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–Butanone		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,1–Trichloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Carbon Tetrachloride		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Vinyl Acetate		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromodichloromethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2–Dichloropropane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
cis–1,3–Dichloropropene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trichloroethene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibromochloromethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,2–Trichloroethene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
trans–1,3–Dichloropropene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromoform		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Methyl–2–Pentanone		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–Hexanone		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Tetrachloroethene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,2,2–Tetrachloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Toluene		3 J	2 J	BDL	BDL	BDL	BDL	BDL
Chlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Ethylbenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Styrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Xylene (total)		BDL	BDL	BDL	BDL	BDL	BDL	BDL

NOTES:

BDL = BELOW THE DETECTION LIMIT

J = ESTIMATED CONCENTRATION, BELOW SAMPLE QUANTITATION LIMIT

D = MATRIX SPIKE/MATRIX SPIKE DUPLICATE (FORM III, ALL FRACTIONS)

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TABLE 4–5
PAD BORINGS
SUMMARY OF VOLATILE ORGANICS IN SOILS (ug/Kg)

COMPOUND	LOCATION DEPTH MAIN ID	PAD G 0–2' PBG–7–2	PAD–H 0–2' PB–H–1–2	PAD H 0–2' PB–H–1–2RE	PAD J 0–6" PBJ–2–1	PAD J 0–2' PBJ–2–2	PAD–J 0–2' PBJ–5–2RE	PAD–J 0–2' PBJ–6–2
Chloromethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromomethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Vinyl Chloride		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Methyl Chloride		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acetone		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Carbon Disulfide		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1–Dichloroethene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1–Dichloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2–Dichloroethene (total)		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chloroform		BDL	BDL	BDL	BDL	2 J	BDL	3 J
1,2–Dichloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–Butanone		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,1–Trichloroethane		2 J	BDL	BDL	BDL	BDL	BDL	BDL
Carbon Tetrachloride		BDL	BDL	BDL	BDL	BDL	BDL	4 J
Vinyl Acetate		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromodichloromethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2–Dichloropropane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
cis–1,3–Dichloropropene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trichloroethene		BDL	BDL	BDL	BDL	BDL	BDL	7
Dibromochloromethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,2–Trichloroethene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
trans–1,3–Dichloropropene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromoform		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Methyl–2–Pentanone		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–Hexanone		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Tetrachloroethene		BDL	BDL	2 J	BDL	BDL	BDL	BDL
1,1,2,2–Tetrachloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Toluene		BDL	3 J	1 J	1 J	BDL	1 J	BDL
Chlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Ethylbenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Styrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Xylene (total)		BDL	BDL	BDL	BDL	BDL	BDL	BDL

NOTES:
BDL = BELOW THE DETECTION LIMIT
J = ESTIMATED CONCENTRATION, BELOW SAMPLE
QUANTITATION LIMIT
D = MATRIX SPIKE/MATRIX SPIKE DUPLICATE
(FORM III, ALL FRACTIONS)

SENACA ARMY DEPOT
OB GROUNDS

TABLE 4–5
PAD BORINGS
SUMMARY OF VOLATILE ORGANICS IN SOILS (ug/Kg)

COMPOUND	LOCATION	PAD–J	PAD–J	PAD–J
	DEPTH	0–2'	0–2'	0–2'
	MAIN ID	PBJ–6–2RE	PBJ–7–2	PBJ–7–2RE
Chloromethane		BDL	BDL	BDL
Bromomethane		BDL	BDL	BDL
Vinyl Chloride		BDL	BDL	BDL
Chloroethane		BDL	BDL	BDL
Methyl Chloride		BDL	BDL	BDL
Acetone		BDL	BDL	BDL
Carbon Disulfide		BDL	BDL	BDL
1,1–Dichloroethene		BDL	BDL	BDL
1,1–Dichloroethane		BDL	BDL	BDL
1,2–Dichloroethene (total)		BDL	BDL	BDL
Chloroform		BDL	BDL	BDL
1,2–Dichloroethane		BDL	BDL	BDL
2–Butanone		BDL	BDL	BDL
1,1,1–Trichloroethane		BDL	BDL	BDL
Carbon Tetrachloride		2 J	BDL	BDL
Vinyl Acetate		BDL	BDL	BDL
Bromodichloromethane		BDL	BDL	BDL
1,2–Dichloropropane		BDL	BDL	BDL
cis–1,3–Dichloropropene		BDL	BDL	BDL
Trichloroethene		4 J	BDL	BDL
Dibromochloromethane		BDL	BDL	BDL
1,1,2–Trichloroethene		BDL	BDL	BDL
Benzene		BDL	BDL	BDL
trans–1,3–Dichloropropene		BDL	BDL	BDL
Bromoform		BDL	BDL	BDL
4–Methyl–2–Pentanone		BDL	BDL	BDL
2–Hexanone		BDL	BDL	BDL
Tetrachloroethene		BDL	BDL	BDL
1,1,2,2–Tetrachloroethane		BDL	BDL	BDL
Toluene		BDL	3 J	2 J
Chlorobenzene		BDL	BDL	BDL
Ethylbenzene		BDL	BDL	BDL
Styrene		BDL	BDL	BDL
Xylene (total)		BDL	3 J	BDL

NOTES:
BDL = BELOW THE DETECTION LIMIT
J = ESTIMATED CONCENTRATION, BELOW SAMPLE
QUANTITATION LIMIT
D = MATRIX SPIKE/MATRIX SPIKE DUPLICATE
(FORM III, ALL FRACTIONS)

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–6
BERM EXCAVATIONS
SUMMARY OF VOLATILE ORGANICS IN SOILS (ug/Kg)

	LOCATION	PAD C	PAD C	PAD D	PAD F	PAD F	PAD G	PAD G	PAD G	PAD H
	DEPTH	4.0'	4.0'	2.5'	2.0'	2.0'	2.5'	4.0'	4.5'	4.0'
COMPOUND	MAIN ID	BE–C–2–91	BE–C–3–91	BE–D–2–91	BE–F–2–91	BE–F–2A–91	BE–G–1–91	BE–G–2–91	BE–G–3–91	BE–H–2–91
Chloromethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromomethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Vinyl Chloride		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Methyl Chloride		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acetone		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Carbon Disulfide		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1–Dichloroethene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1–Dichloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2–Dichloroethene (total)		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chloroform		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2 J
1,2–Dichloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–Butanone		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,1–Trichloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Carbon Tetrachloride		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Vinyl Acetate		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromodichloromethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2–Dichloropropane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
cis–1,3–Dichloropropene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trichloroethene		BDL	BDL	BDL	BDL	BDL	1 J	BDL	BDL	BDL
Dibromochloromethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,2–Trichloroethene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
trans–1,3–Dichloropropene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromoform		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Methyl–2–Pentanone		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–Hexanone		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Tetrachloroethene		6	1 J	1 J	2 J	1 J	BDL	15	BDL	110
1,1,2,2–Tetrachloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Toluene		BDL	BDL	BDL	BDL	2 J	BDL	BDL	1 J	BDL
Chlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Ethylbenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Styrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Xylene (total)		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

NOTES:
BDL = BELOW THE DETECTION LIMIT
J = ESTIMATED CONCENTRATION
BELOW SAMPLE QUANTITATION LIMIT

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4-7
GRID BORINGS
SUMMARY OF VOLATILE ORGANICS IN SOILS (ug/Kg)

	LOCATION	GB-02	GB-08	GB-08	GB-12	GB-15	GB17/MW21	GB-18/MW19
	DEPTH	4-6'	0-6"	0-6"	0-6"	0-6"	0-2'	5-5 1/2'
COMPOUND	MAIN ID	GB02-4	GB-08-1	GB-08-1RE	GB-12-1A	GB-15-1	S110105	S103104
Chloromethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromomethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Vinyl Chloride		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Methyl Chloride		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acetone		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Carbon Disulfide		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1-Dichloroethene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1-Dichloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2-Dichloroethene (total)		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chloroform		10	13	BDL	8	2 J	BDL	BDL
1,2-Dichloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2-Butanone		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,1-Trichloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Carbon Tetrachloride		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Vinyl Acetate		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromodichloromethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2-Dichloropropane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
cis-1,3-Dichloropropene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trichloroethene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibromochloromethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,2-Trichloroethene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
trans-1,3-Dichloropropene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromoform		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Methyl-2-Pentanone		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2-Hexanone		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Tetrachloroethene		BDL	2 J	13	3 J	BDL	BDL	BDL
1,1,2,2-Tetrachloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Toluene		BDL	BDL	BDL	BDL	BDL	2 J	2 J
Chlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Ethylbenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Styrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Xylene (total)		BDL	BDL	BDL	BDL	BDL	BDL	BDL

NOTES:
BDL = BELOW THE DETECTION LIMIT
J = ESTIMATED CONCENTRATION
BELOW SAMPLE QUANTITATION LIMIT

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4-8
PAD BORING
SUMMARY OF SEMI-VOLATILE ORGANICS IN SOILS (ug/Kg)

COMPOUND	LOCATION DEPTH SAMPLE #	PAD A 0-6" PB-A-1	PAD A 0-6" PB-A-1A	PAD A 0-2' PB-A-2	PAD A 0-2' PB-A-2A	PAD C 4-6' PBC-1-4	PAD C 4-6' PBC-1-4A	PAD D 2-4' PBD-1-3
3-Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acenaphthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4-Dinitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Nitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibenzofuran		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4-Dinitrotoluene		470 J	310 J	860	1500	670 J	BDL	BDL
Diethylphthalate		BDL	250 J	BDL	BDL	BDL	BDL	BDL
4-Chlorophenyl-phenylether		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fluorene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4,6-Dinitro-2-methylphenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
N-Nitrosodiphenylamine (1)		BDL	BDL	BDL	BDL	1100 J	510 J	BDL
4-Bromophenyl-phenylether		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hexachlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pentachlorophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Phenanthrene		79 J	73 J	78 J	80 J	220 J	200 J	160 J
Anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Di-n-butylphthalate		BDL	160 J	BDL	BDL	BDL	BDL	BDL
Fluoranthene		BDL	100 J	BDL	BDL	BDL	BDL	BDL
Pyrene		BDL	86 J	BDL	BDL	BDL	BDL	BDL
Butylbenzylphthalate		BDL	140 J	BDL	BDL	BDL	BDL	BDL
3,3'-Dichlorobenzidine		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a)anthracene		BDL	120 J	BDL	BDL	BDL	BDL	BDL
Chrysene		BDL	120 J	BDL	BDL	BDL	BDL	BDL
bis(2-Ethylhexyl)phthalate		BDL	190 J	BDL	BDL	290 J	240 J	420 J
Di-n-octylphthalate		BDL	140 J	BDL	BDL	BDL	BDL	BDL
Benzo(b)fluoranthene		BDL	130 J	BDL	BDL	BDL	BDL	BDL
benzo(k)fluoranthene		BDL	120 J	BDL	BDL	BDL	BDL	BDL
Benzo(a)pyrene		BDL	120 J	BDL	BDL	BDL	BDL	BDL
Indeno(1,2,3-cd)pyrene		BDL	87 J	BDL	BDL	BDL	BDL	BDL
Dibenz(a,h)anthracene		BDL	74 J	BDL	BDL	BDL	BDL	BDL
Benzo(g,h,i)perylene		BDL	86 J	BDL	BDL	BDL	BDL	BDL

NOTES:
BDL = BELOW DETECTION LIMIT
J = ESTIMATED CONCENTRATION,
BELOW SAMPLE QUANTITATION LIMIT

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4-8
PAD BORING
SUMMARY OF SEMI-VOLATILE ORGANICS IN SOILS (ug/Kg)

	LOCATION	PAD D	PAD E	PAD G	PAD G	PAD G	PAD G	PAD G	PAD G
	DEPTH	2-4'	2-4'	2-4'	0-6"	0-2'	0-6"	0-2'	0-6"
COMPOUND	SAMPLE #	PBD-1-3A	PBE-1-3	PBG-1-3	PBG-2-1	PBG-2-2	PBG-5-1	PBG-5-2	PBG-6-1
3-Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acenaphthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4-Dinitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Nitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibenzofuran		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4-Dinitrotoluene		BDL	160 J	BDL	BDL	81 J	510 J	1300	290 J
Diethylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Chlorophenyl-phenylether		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fluorene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4,6-Dinitro-2-methylphenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
N-Nitrosodiphenylamine (1)		BDL	290 J	BDL	190 J	BDL	BDL	280 J	BDL
4-Bromophenyl-phenylether		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hexachlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pentachlorophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Phenanthrene		180 J	BDL	BDL	BDL	BDL	BDL	BDL	96 J
Anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Di-n-butylphthalate		BDL	660 J	BDL	BDL	BDL	BDL	BDL	BDL
Fluoranthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	120 J
Pyrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	110 J
Butylbenzylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
3,3'-Dichlorobenzidine		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a)anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	75 J
Chrysene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	100
bis(2-Ethylhexyl)phthalate		290 J	BDL	200 J	BDL	420 J	BDL	BDL	BDL
Di-n-octylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(b)fluoranthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	120 J
benzo(k)fluoranthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	75 J
Benzo(a)pyrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Indeno(1,2,3-cd)pyrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibenz(a,h)anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(g,h,i)perylene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

NOTES:
BDL = BELOW DETECTION LIMIT
J = ESTIMATED CONCENTRATION,
BELOW SAMPLE QUANTITATION LIMIT

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4-8
PAD BORING
SUMMARY OF SEMI-VOLATILE ORGANICS IN SOILS (ug/Kg)

	LOCATION	PAD G	PAD G	PAD G	PAD H	PAD H	PAD J	PAD J
	DEPTH	4' +	0-6"	0-2'	0-6"	0-2'	0-6"	0-6"
COMPOUND	SAMPLE #	PBG-6-4	PBG-7-1	PBG-7-2	PB-H-1-1	PB-H-1-2	PBJ-1-1	PBJ-2-1
3-Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acenaphthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4-Dinitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Nitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibenzofuran		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4-Dinitrotoluene		78 J	BDL	3600	2200	760	130 J	820 J
Diethylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Chlorophenyl-phenylether		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fluorene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4,6-Dinitro-2-methylphenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
N-Nitrosodiphenylamine (1)		BDL	BDL	480 J	71 J	BDL	BDL	81 J
4-Bromophenyl-phenylether		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hexachlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pentachlorophenol		BDL	300 J	BDL	BDL	BDL	BDL	BDL
Phenanthrene		BDL	230 J	BDL	BDL	BDL	93 J	BDL
Anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Di-n-butylphthalate		BDL	320 J	BDL	1500	110 J	480 J	BDL
Fluoranthene		BDL	420 J	BDL	BDL	BDL	96 J	BDL
Pyrene		BDL	400 J	BDL	BDL	BDL	100 J	BDL
Butylbenzylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL
3,3'-Dichlorobenzidine		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a)anthracene		BDL	270 J	BDL	BDL	BDL	BDL	BDL
Chrysene		BDL	330 J	BDL	BDL	BDL	BDL	BDL
bis(2-Ethylhexyl)phthalate		BDL	BDL	BDL	BDL	BDL	BDL	190 J
Di-n-octylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(b)fluoranthene		BDL	400 J	BDL	BDL	BDL	BDL	BDL
benzo(k)fluoranthene		BDL	210 J	BDL	BDL	BDL	BDL	BDL
Benzo(a)pyrene		BDL	230 J	BDL	BDL	BDL	BDL	BDL
Indeno(1,2,3-cd)pyrene		BDL	180 J	BDL	BDL	BDL	BDL	BDL
Dibenz(a,h)anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(g,h,i)perylene		BDL	210 J	BDL	BDL	BDL	BDL	BDL

NOTES:
BDL = BELOW DETECTION LIMIT
J = ESTIMATED CONCENTRATION,
BELOW SAMPLE QUANTITATION LIMIT

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–8
PAD BORING
SUMMARY OF SEMI–VOLATILE ORGANICS IN SOILS (ug/Kg)

	LOCATION	PAD J	PAD J	PAD J	PAD J	PAD J	PAD J	PAD J	PAD J
	DEPTH	0–2'	0–6"	0–2'	0–2'	0–6"	0–2'	0–6"	0–2'
COMPOUND	SAMPLE #	PBJ–2–2	PBJ–4–1	PBJ–4–2	PBJ–6–2	PBJ–7–1	PBJ–7–2	PBJ–8–1	PBJ–8–2
3–Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acenaphthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4–Dinitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Nitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibenzofuran		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4–Dinitrotoluene		BDL	BDL	380 J	BDL	BDL	BDL	BDL	BDL
Diethylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Chlorophenyl–phenylether		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fluorene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4,6–Dinitro–2–methylphenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
N–Nitrosodiphenylamine (1)		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Bromophenyl–phenylether		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hexachlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pentachlorophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Phenanthrene		BDL	69 J	BDL	270 J	BDL	BDL	BDL	BDL
Anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Di–n–butylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fluoranthene		BDL	90 J	BDL	330 J	BDL	BDL	BDL	BDL
Pyrene		BDL	78 J	BDL	230 J	BDL	BDL	BDL	BDL
Butylbenzylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
3,3'–Dichlorobenzidine		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a)anthracene		BDL	BDL	BDL	86 J	BDL	BDL	BDL	BDL
Chrysene		BDL	BDL	BDL	120 J	BDL	BDL	BDL	BDL
bis(2–Ethylhexyl)phthalate		110 J	140 J	710 J	130 J	120 J	1100	190 J	430 J
Di–n–octylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(b)fluoranthene		BDL	BDL	BDL	81 J	BDL	BDL	BDL	BDL
benzo(k)fluoranthene		BDL	BDL	BDL	96 J	BDL	BDL	BDL	BDL
Benzo(a)pyrene		BDL	BDL	BDL	76 J	BDL	BDL	BDL	BDL
Indeno(1,2,3–cd)pyrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibenz(a,h)anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(g,h,i)perylene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

NOTES:

BDL = BELOW DETECTION LIMIT

J = ESTIMATED CONCENTRATION,
BELOW SAMPLE QUANTITATION LIMIT

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–9
PAD BORINGS
SUMMARY OF SEMI–VOLATILE ORGANICS IN SOILS (ug/Kg)

	LOCATION	PAD A	PAD A	PAD A	PAD A	PAD B	PAD C	PAD C	PAD D	PAD D	PAD F	PAD G
	DEPTH	0–6"	0–6"	0–2'	0–2'	0–6"	2–4'	2–4'	2–4'	2–4'	0–6"	0–2'
COMPOUND	SAMPLE #	PB–A–1	PB–A–1A	PB–A–2	PB–A–2A	PB–B–1–1	PBC–1–4	PBC–1–4A	PBD–1–3	PBD–1–3A	PB–F–1–1	PBG–5–2
Phenol		BDL	BDL	BDL	BDL	BDL	360 J	360 J	BDL	BDL	BDL	BDL
bis(2–Chloroethyl) ether		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–Chlorophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,3–Dichlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,4–Dichlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzyl Alcohol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2–Dichlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–Methylphenol		BDL	BDL	BDL	BDL	BDL	650 J	760 J	BDL	BDL	BDL	BDL
bis(2–Chloroisopropyl) ether		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Methylphenol		BDL	BDL	BDL	BDL	BDL	1100 J	1300 J	BDL	BDL	BDL	BDL
N–Nitroso–di–n–propylamine		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hexachloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Nitrobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Isophorone		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–Nitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4–Dimethylphenol		BDL	BDL	BDL	BDL	BDL	120 J	630 J	BDL	BDL	BDL	BDL
Benzoic acid		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
bis(2–Chloroethoxy) methane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4–Dichlorophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2,4–Trichlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Naphthalene		BDL	BDL	BDL	BDL	160 J	84 J	80 J	210 J	190 J	BDL	BDL
4–Chloroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hexachlorobutadiene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Chloro–3–methylphenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–Methylnaphthalene		88 J	87 J	67 J	100 J	BDL	360 J	330 J	220 J	160 J	100 J	BDL
Hexachlorocyclopentadiene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4,6–Trichlorophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4,5–Trichlorophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–Chloronaphthalene		BDL	BDL	BDL	BDL	130 J	BDL	BDL	BDL	BDL	BDL	BDL
2–Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dimethylphalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acenaphthylene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,6–Dinitrotoluene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	86 J

NOTES:
BDL = BELOW THE DETECTION LIMIT
J = ESTIMATED CONCENTRATION,
BELOW SAMPLE QUANTITATION LIMIT

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4-9
PAD BORINGS
SUMMARY OF SEMI-VOLATILE ORGANICS IN SOILS (ug/Kg)

COMPOUND	LOCATION DEPTH SAMPLE #	PAD G 0-6" PBG-6-1	PAD G 0-2' PBG-7-2	PAD H 0-6" PB-H-1-1
Phenol		BDL	BDL	BDL
bis(2-Chloroethyl) ether		BDL	BDL	BDL
2-Chlorophenol		BDL	BDL	BDL
1,3-Dichlorobenzene		BDL	BDL	BDL
1,4-Dichlorobenzene		BDL	BDL	BDL
Benzyl Alcohol		BDL	BDL	BDL
1,2-Dichlorobenzene		BDL	BDL	BDL
2-Methylphenol		BDL	BDL	BDL
bis(2-Chloroisopropyl) ether		BDL	BDL	BDL
4-Methylphenol		BDL	BDL	BDL
N-Nitroso-di-n-propylamine		BDL	BDL	BDL
Hexachloroethane		BDL	BDL	BDL
Nitrobenzene		BDL	BDL	BDL
Isophorone		BDL	BDL	BDL
2-Nitrophenol		BDL	BDL	BDL
2,4-Dimethylphenol		BDL	BDL	BDL
Benzoic acid		98 J	BDL	BDL
bis(2-Chloroethoxy) methane		BDL	BDL	BDL
2,4-Dichlorophenol		BDL	BDL	BDL
1,2,4-Trichlorobenzene		BDL	BDL	BDL
Naphthalene		BDL	BDL	BDL
4-Chloroaniline		BDL	BDL	BDL
Hexachlorobutadiene		BDL	BDL	BDL
4-Chloro-3-methylphenol		BDL	BDL	BDL
2-Methylnaphthalene		BDL	BDL	BDL
Hexachlorocyclopentadiene		BDL	BDL	BDL
2,4,6-Trichlorophenol		BDL	BDL	BDL
2,4,5-Trichlorophenol		BDL	BDL	BDL
2-Chloronaphthalene		BDL	BDL	BDL
2-Nitroaniline		BDL	BDL	BDL
Dimethylphalate		BDL	BDL	BDL
Acenaphthylene		BDL	BDL	BDL
2,6-Dinitrotoluene		BDL	150 J	510 J

NOTES:

BDL = BELOW THE DETECTION LIMIT

J = ESTIMATED CONCENTRATION,
BELOW SAMPLE QUANTITATION LIMIT

SENACA ARMY DEPOT
OB GROUNDS

TABLE 4–10
BERM EXCAVATION
SUMMARY OF SEMI–VOLATILE ORGANIC RESULTS IN SOILS (ug/Kg)

COMPOUND	LOCATION DEPTH MAIN ID	PAD F 2.0' BE–F–2–91	PAD F 2.0' BE–F–2A–9	PAD G 4.0' BE–G–2–91	PAD G 4.5' BE–G–3–91	PAD H 4.0' BE–H–2–91	PAD H 4.0' BE–H–3–91	PAD J 3.0' BE–J–4–91
Phenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
bis(2–Chloroethyl) ether		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–Chlorophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,3–Dichlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,4–Dichlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzyl Alcohol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2–Dichlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–Methylphenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
bis(2–Chloroisopropyl) ether		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Methylphenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
N–Nitroso–di–n–propylamine		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hexachloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Nitrobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Isophorone		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–Nitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4–Dimethylphenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzoic acid		BDL	BDL	BDL	BDL	BDL	BDL	88 J
bis(2–Chloroethoxy) methane		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4–Dichlorophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2,4–Trichlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Naphthalene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Chloroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hexachlorobutadiene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Chloro–3–methylphenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–Methylnaphthalene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hexachlorocyclopentadiene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4,6–Trichlorophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4,5–Trichlorophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–Chloronaphthalene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dimethylphalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acenaphthylene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,6–Dinitrotoluene		100 J	250 J	150 J	100 J	200 J	760 J	BDL

NOTES:

BDL = BELOW DETECTION LIMIT

J = ESTIMATED CONCENTRATION, BELOW SAMPLE QUANTITATION LIMIT

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4-11
BERM EXCAVATIONS
SUMMARY OF SEMI-VOLATILE ORGANICS IN SOILS (ug/Kg)

	LOCATION	PAD B	PAD C	PAD C	PAD D	PAD F	PAD F	PAD G	PAD G	PAD H	PAD H
	DEPTH	2.5'	4.0'	4.0'	2.5'	2.0'	2.0'	4.0'	4.5'	4.0'	4.0'
COMPOUND	SAMPLE #	BE-B-2-91	BE-C-2-91	BE-C-3-91	BE-D-2-91	BE-F-2-91	BE-F-2A-91	BE-G-2-91	BE-G-3-91	BE-H-2-91	BE-H-3-91
3-Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acenaphthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4-Dinitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Nitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibenzofuran		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4-Dinitrotoluene		130 J	BDL	730 J	BDL	1400	4200	2800	2500	3600	12000 E
Diethylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Chlorophenyl-phenylether		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fluorene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4,6-Dinitro-2-methylphenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
N-Nitrosodiphenylamine (1)		BDL	BDL	190 J	BDL	1000	580	530 J	270 J	120 J	1500
4-Bromophenyl-phenylether		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hexachlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pentachlorophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Phenanthrene		BDL	BDL	BDL	BDL	BDL	75 J	BDL	BDL	BDL	BDL
Anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Di-n-butylphthalate		380 J	740 J	200 J	400 J	200 J	3100 J	BDL	140 J	540 J	430 J
Fluoranthene		BDL	BDL	BDL	BDL	BDL	66 J	BDL	BDL	BDL	BDL
Pyrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Butylbenzylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
3,3'-Dichlorobenzidine		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a)anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chrysene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
bis(2-Ethylhexyl)phthalate		170 J	BDL	BDL	BDL	BDL	89 J	BDL	BDL	BDL	BDL
Di-n-octylphthalate		BDL	BDL	BDL	BDL	220 J	BDL	BDL	BDL	BDL	BDL
Benzo(b)fluoranthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
benzo(k)fluoranthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a)pyrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Indeno(1,2,3-cd)pyrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibenz(a,h)anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(g,h,i)perylene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

NOTES:

BDL = BELOW DETECTION LIMIT

J = ESTIMATED CONCENTRATION,
BELOW SAMPLE QUANTITATION LIMIT

E = METHOD BLANK SUMMARY
(FORM IV, ALL FRACTIONS)

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4-12
GRID BORINGS
SUMMARY OF SEMI-VOLATILE RESULTS IN SOILS (ug/Kg)

COMPOUND	LOCATION DEPTH SAMPLE #	GB-02 0-6" GB02-1	GB-02 4-6' GB02-4RE	GB-03 0-6" GB03-1	GB-03 0-2' GB03-2RE	GB-05 0-6" GB05-1	GB-05 0-2' GB05-2	GB-07 0-2' GB-07-2	GB-08 0-6" GB-08-1RE	GB-11 0-6" GB-11-1RE
3-Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acenaphthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4-Dinitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Nitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibenzofuran		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4-Dinitrotoluene		2000	4200	7000	2200	BDL	BDL	BDL	780	BDL
Diethylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	94 J	BDL	BDL
4-Chlorophenyl-phenylether		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fluorene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4,6-Dinitro-2-methylphenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
N-Nitrosodiphenylamine (1)		340 J	1000	1000	510	BDL	BDL	BDL	260 J	BDL
4-Bromophenyl-phenylether		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hexachlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	90 J	BDL
Pentachlorophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Phenanthrene		BDL	BDL	BDL	BDL	290 J	BDL	BDL	BDL	BDL
Anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Di-n-butylphthalate		1100	1400	840	1400	BDL	BDL	BDL	73 J	BDL
Fluoranthene		BDL	BDL	BDL	BDL	480 J	BDL	BDL	BDL	BDL
Pyrene		BDL	BDL	BDL	BDL	300 J	BDL	BDL	BDL	BDL
Butylbenzylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
3,3'-Dichlorobenzidine		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a)anthracene		BDL	BDL	BDL	BDL	200 J	BDL	BDL	BDL	BDL
Chrysene		BDL	BDL	BDL	BDL	250 J	BDL	BDL	BDL	BDL
bis(2-Ethylhexyl)phthalate		BDL	BDL	BDL	BDL	BDL	300 J	BDL	BDL	100
Di-n-octylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(b)fluoranthene		BDL	BDL	BDL	BDL	180 J	BDL	BDL	BDL	BDL
benzo(k)fluoranthene		BDL	BDL	BDL	BDL	190 J	BDL	BDL	BDL	BDL
Benzo(a)pyrene		BDL	BDL	BDL	BDL	150 J	BDL	BDL	BDL	BDL
Indeno(1,2,3-cd)pyrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibenz(a,h)anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(g,h,i)perylene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

NOTES:

BDL = BELOW DETECTION LIMIT

J = ESTIMATED CONCENTRATIONS, BELOW SAMPLE QUANTITATION LIMIT

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4-12
GRID BORINGS
SUMMARY OF SEMI-VOLATILE RESULTS IN SOILS (ug/Kg)

	LOCATION	GB-12	GB-12	GB-12	GB-12	GB-13	GB-13	GB-14
	DEPTH	0-6"	0-6"	0-2'	0-2'	0-6"	0-2'	0-6"
COMPOUND	SAMPLE #	GB-12-1	GB-12-1A	GB-12-2	GB-12-2A	GB-13-1	GB-13-2	GB-14-1ARE
3-Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acenaphthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4-Dinitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Nitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibenzofuran		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4-Dinitrotoluene		130 J	BDL	BDL	BDL	260 J	BDL	260 J
Diethylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Chlorophenyl-phenylether		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fluorene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4-Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4,6-Dinitro-2-methylphenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
N-Nitrosodiphenylamine (1)		BDL	BDL	BDL	BDL	130 J	BDL	BDL
4-Bromophenyl-phenylether		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hexachlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pentachlorophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Phenanthrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Di-n-butylphthalate		490 J	460 J	86 J	180 J	BDL	110 J	BDL
Fluoranthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pyrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Butylbenzylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL
3,3'-Dichlorobenzidine		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a)anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chrysene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
bis(2-Ethylhexyl)phthalate		260 J	BDL	BDL	BDL	520 J	290 J	BDL
Di-n-octylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(b)fluoranthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
benzo(k)fluoranthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a)pyrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Indeno(1,2,3-cd)pyrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibenz(a,h)anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(g,h,i)perylene		BDL	BDL	BDL	BDL	BDL	BDL	BDL

NOTES:

BDL = BELOW DETECTION LIMIT

J = ESTIMATED CONCENTRATIONS, BELOW SAMPLE QUANTITATION LIMIT

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–12
GRID BORINGS
SUMMARY OF SEMI–VOLATILE RESULTS IN SOILS (ug/Kg)

	LOCATION	GB–14	GB–15	GB–15	GB–16	GB–16	GB–19	MW–30
	DEPTH	0–6"	0–6"	0–2'	0–6"	0–2'		0–2'
COMPOUND	SAMPLE #	GB–14–1	GB–15–1	GB–15–2	GB–16–1	GB–16–2	GB–19–1	S1411110MW30
3–Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acenaphthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4–Dinitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Nitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibenzofuran		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4–Dinitrotoluene		150 J	BDL	BDL	BDL	BDL	280 J	BDL
Diethylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Chlorophenyl–phenylether		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fluorene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4,6–Dinitro–2–methylphenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
N–Nitrosodiphenylamine (1)		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Bromophenyl–phenylether		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hexachlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pentachlorophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Phenanthrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Di–n–butylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fluoranthene		BDL	BDL	BDL	BDL	BDL	BDL	78 J
Pyrene		BDL	BDL	BDL	BDL	BDL	BDL	120 J
Butylbenzylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL
3,3'–Dichlorobenzidine		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a)anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chrysene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
bis(2–Ethylhexyl)phthalate		BDL	620 J	970 J	430 J	860 J	BDL	BDL
Di–n–octylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(b)fluoranthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
benzo(k)fluoranthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a)pyrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Indeno(1,2,3–cd)pyrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibenz(a,h)anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(g,h,i)perylene		BDL	BDL	BDL	BDL	BDL	BDL	BDL

NOTES:

BDL = BELOW DETECTION LIMIT

J = ESTIMATED CONCENTRATIONS, BELOW SAMPLE QUANTITATION LIMIT

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–13
GRID BORINGS
SUMMARY OF SEMI–VOLATILE ORGANICS IN SOILS (ug/Kg)

	LOCATION	GB–2	GB–3	GB–3
	DEPTH	0–2'	0–6"	0–2'
COMPOUND	SAMPLE #	GB02–4RE	GB03–1	GB03–2RE
Phenol		BDL	BDL	BDL
bis(2–Chloroethyl) ether		BDL	BDL	BDL
2–Chlorophenol		BDL	BDL	BDL
1,3–Dichlorobenzene		BDL	BDL	BDL
1,4–Dichlorobenzene		BDL	BDL	BDL
Benzyl Alcohol		BDL	BDL	BDL
1,2–Dichlorobenzene		BDL	BDL	BDL
2–Methylphenol		BDL	BDL	BDL
bis(2–Chloroisopropyl) ether		BDL	BDL	BDL
4–Methylphenol		BDL	BDL	BDL
N–Nitroso–di–n–propylamine		BDL	BDL	BDL
Hexachloroethane		BDL	BDL	BDL
Nitrobenzene		BDL	BDL	BDL
Isophorone		BDL	BDL	BDL
2–Nitrophenol		BDL	BDL	BDL
2,4–Dimethylphenol		BDL	BDL	BDL
Benzoic acid		BDL	BDL	BDL
bis(2–Chloroethoxy) methane		BDL	BDL	BDL
2,4–Dichlorophenol		BDL	BDL	BDL
1,2,4–Trichlorobenzene		BDL	BDL	BDL
Naphthalene		BDL	BDL	BDL
4–Chloroaniline		BDL	BDL	BDL
Hexachlorobutadiene		BDL	BDL	BDL
4–Chloro–3–methylphenol		BDL	BDL	BDL
2–Methylnaphthalene		BDL	BDL	BDL
Hexachlorocyclopentadiene		BDL	BDL	BDL
2,4,6–Trichlorophenol		BDL	BDL	BDL
2,4,5–Trichlorophenol		BDL	BDL	BDL
2–Chloronaphthalene		BDL	BDL	BDL
2–Nitroaniline		BDL	BDL	BDL
Dimethylphalate		BDL	BDL	BDL
Acenaphthylene		BDL	BDL	BDL
2,6–Dinitrotoluene		200 J	340 J	110 J

NOTES:
BDL = BELOW THE DETECTION LIMIT
J = ESTIMATED CONCENTRATION, BELOW SAMPLE
QUANTITATION LIMIT

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4-14
PAD BORINGS
SUMMARY OF PESTICIDES AND PCB'S IN SOILS
(µg/Kg)

	LOCATION	PAD A	PAD-A	PAD-A	PAD-A	PAD G	PAD J	PAD J	PAD J	PAD J	PAD J	PAD-J
	DEPTH	0-6"	0-6"	0-2'	0-2'	0-6"	0-6"	0-6"	0-2'	0-6"	0-6"	0-6"
COMPOUND	SAMPLE #	PB-A-1	PB-A-1A	PB-A-2	PB-A-2A	PB-G-1-1	PBJ-1-1DL	PBJ-1-1DL1	PB-J-1-2	PB-J-2-1	PB-J-3-1	PB-J-4-1
alpha-BHC		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
beta-BHC		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
delta-BHC		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
gamma-BHC (Lindane)		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Heptachlor		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Heptachlor epoxide		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Endosulfan I		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dieldrin		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4,4'-DDE		140 Y	100 Y	21 Y	28 Y	BDL	980 X	830 Y	32 Y	38 Y	21 Y	25 Y
Endrin		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Endosulfan II		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4,4'-DDD		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Endosulfan sulfate		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4,4'-DDT		BDL	BDL	BDL	BDL	33 Y	320 C	BDL	BDL	BDL	BDL	BDL
Methoxychlor		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Endrin ketone		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
alpha-Chlordane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
gamma-Chlordane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Toxaphene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aroclor-1016		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aroclor-1221		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aroclor-1232		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aroclor-1242		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aroclor-1248		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aroclor-1254		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aroclor-1260		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Notes:
BDL = Below Detection Limits
Y = The reported result is below the specified reporting limit.
X = The reported result was derived from instrument response outside the calibration range.
C = Compound required confirmation by GC/MS.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–14
PAD BORINGS
SUMMARY OF PESTICIDES AND PCB'S IN SOILS
(ug/Kg)

	LOCATION	PAD –J	PAD–J	PAD–J	PAD–J	PAD–J
	DEPTH	0–6"	0–6"	0–6"	0–2'	0–6"
COMPOUND	SAMPLE #	PB–J–5–1	PB–J–6–1	PBJ–6–1DL	PB–J–6–2	PB–J–8–1
alpha–BHC		BDL	BDL	BDL	BDL	BDL
beta–BHC		BDL	BDL	BDL	BDL	BDL
delta–BHC		BDL	BDL	BDL	BDL	BDL
gamma–BHC (Lindane)		BDL	BDL	BDL	BDL	BDL
Heptachlor		BDL	BDL	BDL	BDL	BDL
Aldrin		BDL	BDL	BDL	BDL	BDL
Heptachlor epoxide		BDL	BDL	BDL	BDL	BDL
Endosulfan I		BDL	BDL	BDL	BDL	BDL
Dieldrin		BDL	BDL	BDL	BDL	BDL
4,4'–DDE		18 Y	97 X	79 Y	19 Y	BDL
Endrin		BDL	BDL	BDL	BDL	41 Y
Endosulfan II		BDL	BDL	BDL	BDL	BDL
4,4'–DDD		BDL	BDL	BDL	BDL	BDL
Endosulfan sulfate		BDL	BDL	BDL	BDL	BDL
4,4'–DDT		BDL	23 Y	BDL	BDL	BDL
Methoxychor		BDL	BDL	BDL	BDL	BDL
Endrin ketone		BDL	BDL	BDL	BDL	BDL
alpha–Chlordane		BDL	BDL	BDL	BDL	BDL
gamma–Chlordane		BDL	BDL	BDL	BDL	BDL
Toxaphene		BDL	BDL	BDL	BDL	BDL
Aroclor–1016		BDL	BDL	BDL	BDL	BDL
Aroclor–1221		BDL	BDL	BDL	BDL	BDL
Aroclor–1232		BDL	BDL	BDL	BDL	BDL
Aroclor–1242		BDL	BDL	BDL	BDL	BDL
Aroclor–1248		BDL	BDL	BDL	BDL	BDL
Aroclor–1254		BDL	BDL	BDL	BDL	BDL
Aroclor–1260		BDL	BDL	BDL	BDL	BDL

Notes:
BDL = Below Detection Limits
Y = The reported result is below the specified reporting limit.
X = The reported result was derived from instrument response outside the calibration range.
C = Compound required confirmation by GC/MS.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4-15
GRID BORINGS
SUMMARY OF PESTICIDES AND PCB'S IN SOILS
(ug/Kg)

COMPOUND	LOCATION	GB-03	GB-08	MW-30
	DEPTH	0-6"	0-6"	0-2'
	SAMPLE #	GB-3-1	GB-08-1	S1411110MW30
alpha-BHC		BDL	BDL	BDL
beta-BHC		BDL	BDL	BDL
delta-BHC		BDL	BDL	BDL
gamma-BHC (Lindane)		BDL	BDL	BDL
Heptachlor		BDL	BDL	BDL
Aldrin		BDL	BDL	BDL
Heptachlor epoxide		BDL	BDL	BDL
Endosulfan I		BDL	BDL	BDL
Dieldrin		BDL	BDL	BDL
4,4'-DDE		32 Y	BDL	27 Y
Endrin		BDL	BDL	BDL
Endosulfan II		BDL	BDL	BDL
4,4'-DDD		BDL	BDL	BDL
Endosulfan sulfate		BDL	BDL	BDL
4,4'-DDT		BDL	BDL	BDL
Methoxychor		BDL	BDL	BDL
Endrin ketone		BDL	BDL	BDL
alpha-Chlordane		BDL	BDL	BDL
gamma-Chlordane		BDL	BDL	BDL
Toxaphene		BDL	BDL	BDL
Aroclor-1016		BDL	BDL	BDL
Aroclor-1221		BDL	BDL	BDL
Aroclor-1232		BDL	BDL	BDL
Aroclor-1242		BDL	BDL	BDL
Aroclor-1248		BDL	BDL	BDL
Aroclor-1254		BDL	BDL	BDL
Aroclor-1260		BDL	240 Y	BDL

Notes:
BDL = Below Detection Limits
Y = The reported result is below the specified reporting limit.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–16
PAD BORINGS
SUMMARY OF METALS IN SOILS
(mg/Kg)

PARAMETER	Background (MW–34)	On–Site Samples				Number Above Background	Number Below Background	Total Number Detections
		Minimum	Maximum	Average	Standard Deviation			
Aluminum	16100.00	6860.00	26900.00	17026.60	3881.43	27	23	50
Antimony	5.70	6.60	75.60	16.89	16.84	15	35	15
Arsenic	U	3.50	10.30	5.37	1.60	50	0	50
Barium	67.50	38.00	14700.00	2127.89	2998.57	48	2	50
Beryllium	0.86	0.50	1.30	0.80	0.16	14	36	46
Cadmium	2.30	2.40	20.70	6.35	4.04	50	0	50
Calcium	28600.00	3410.00	138000.00	31401.80	27292.40	21	29	50
Chromium	26.60	14.30	156.00	34.22	19.70	35	15	50
Cobalt	17.00	6.70	17.20	12.42	2.52	1	49	50
Copper	32.70	27.00	15500.00	988.45	2517.89	48	2	50
Iron	35000.00	19400.00	49700.00	32870.00	7370.11	19	31	50
Lead	11.90	7.70	16000.00	1000.04	2369.24	49	1	50
Magnesium	6850.00	3230.00	16700.00	8286.60	2950.34	34	16	50
Manganese	803.00	186.00	1620.00	531.20	222.38	3	47	50
Mercury	U	0.08	1.10	0.19	0.18	31	19	31
Nickel	49.30	19.80	64.80	43.40	10.04	14	36	50
Potassium	1290.00	799.00	3240.00	1963.38	564.44	47	3	50
Selenium	U	1.20	3.30	2.20	1.05	3	47	3
Silver	U	1.20	2.90	1.71	0.69	7	43	7
Sodium	U	618.00	618.00	618.00	NA	1	49	1
Thallium	U	0.44	0.47	0.46	0.02	2	48	2
Vanadium	22.30	10.90	39.00	22.87	5.40	24	26	50
Zinc	95.70	93.10	6380.00	1049.32	1275.30	49	1	50
Cyanide	U	0.52	1.10	0.81	0.41	2	48	2

Note:
U = Below Detection Limits.
NA = Not Applicable.
Number Below Background includes samples below the detection limit.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–17
BERM EXCAVATIONS
SUMMARY OF METALS IN SOILS
(mg/Kg)

PARAMETER	Background (MW–34)	On–Site Samples				Number Above Background	Number Below Background	Total Number Detections
		Minimum	Maximum	Average	Standard Deviation			
Aluminum	16100.00	13400.00	38900.00	19900.00	6278.24	13	4	17
Antimony	5.70	8.70	115.00	50.42	36.41	11	6	11
Arsenic	U	3.40	25.80	11.37	7.54	16	1	16
Barium	67.50	136.00	19600.00	3151.35	4534.33	17	0	17
Beryllium	0.86	0.59	1.00	0.82	0.11	5	12	17
Cadmium	2.30	3.40	28.20	10.24	7.76	17	0	17
Calcium	28600.00	3310.00	30000.00	11791.88	6361.28	1	16	16
Chromium	26.60	19.00	87.80	37.80	18.77	12	5	17
Cobalt	17.00	7.40	19.50	11.96	3.15	2	15	17
Copper	32.70	29.80	38100.00	3651.69	9010.93	16	1	17
Iron	35000.00	18500.00	52000.00	33329.41	9401.85	7	10	17
Lead	11.90	32.40	56700.00	14010.26	15969.84	17	0	17
Magnesium	6850.00	3320.00	9910.00	6662.94	1980.95	8	9	17
Manganese	803.00	451.00	1260.00	737.24	193.65	4	13	17
Mercury	U	0.10	0.52	0.27	0.12	15	2	15
Nickel	49.30	15.70	64.50	38.05	13.36	4	13	17
Potassium	1290.00	1120.00	3570.00	2150.59	763.29	15	2	17
Selenium	U	1.90	3.20	2.50	0.66	3	14	3
Silver	U	1.10	15.30	3.92	4.36	10	7	10
Sodium	U	0.00	0.00	0.00	0.00	0	17	0
Thallium	U	0.00	0.00	0.00	0.00	0	17	0
Vanadium	22.30	20.50	41.40	28.09	4.72	16	1	17
Zinc	95.70	138.00	13000.00	2764.94	3413.98	17	0	17
Cyanide	U	2.00	2.20	2.10	0.14	2	15	2

Note:
U = Below Detection Limits.
Number Below Background includes samples below detection limit.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–18
GRID BORINGS
SUMMARY OF METALS IN SOILS
(mg/Kg)

PARAMETER	Background (MW–34)	On–Site Samples				Number Above Background	Number Below Background	Total Number Detections
		Minimum	Maximum	Average	Standard Deviation			
Aluminum	16100.00	10100.00	25300.00	17373.33	3131.90	31	14	45
Antimony	5.70	5.70	40.00	14.85	13.31	5	40	6
Arsenic	U	2.80	18.50	5.41	2.60	44	1	44
Barium	67.50	51.50	2290.00	361.69	456.97	42	3	45
Beryllium	0.86	0.68	1.60	0.97	0.20	23	22	35
Cadmium	2.30	1.80	7.00	3.04	1.06	33	12	45
Calcium	28600.00	2160.00	90400.00	19378.89	23110.92	9	36	45
Chromium	26.60	17.10	34.90	26.38	3.82	20	25	45
Cobalt	17.00	9.00	26.60	14.62	4.34	8	37	37
Copper	32.70	15.70	1060.00	173.50	266.81	33	12	45
Iron	35000.00	19700.00	39700.00	30348.89	4608.42	8	37	45
Lead	11.90	10.80	6230.00	638.53	1355.96	43	2	45
Magnesium	6850.00	4360.00	13300.00	6790.44	1826.07	18	27	45
Manganese	803.00	242.00	1650.00	598.40	284.96	5	40	45
Mercury	U	0.08	1.10	0.29	0.31	15	30	15
Nickel	49.30	24.70	69.30	41.18	10.25	9	36	45
Potassium	1290.00	872.00	3140.00	1815.60	483.58	39	6	45
Selenium	U	0.91	0.91	0.91	0.00	1	44	1
Silver	U	0.00	0.00	0.00	0.00	0	45	0
Sodium	U	0.00	0.00	0.00	0.00	0	45	0
Thallium	U	0.37	0.39	0.38	0.01	2	43	2
Vanadium	22.30	16.20	38.60	25.55	4.68	31	14	45
Zinc	95.70	51.00	900.00	229.56	202.49	34	11	45
Cyanide	U	0.00	0.00	0.00	0.00	0	45	0

Notes:

U = Below Detection Limits.

Number Below Background includes samples below detection limit.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–19
BURN PAD BORINGS
SUMMARY OF EXPLOSIVES IN SOILS

COMPOUND	LOCATION SAMPLE # DEPTH UNITS	PAD–A PB–A–1 0–6"	PAD–A PB–A–2 0–2'	PAD–A PB–A–2A 0–2'	PAD–D PB–D–1–3 2'–4'	PAD–E PB–E–1–3 2'–4'	PAD–F PB–F–1–1 0–6"	PAD–G PB–G–1–1 0–6"	PAD–G PB–G–1–3 2'–4'
HMX	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	980 Y	BDL
RDX	ug/Kg	BDL	BDL	BDL	190 Y	BDL	280	2900	BDL
1,3,5–Trinitrobenzene	ug/Kg	BDL	BDL	BDL	BDL	BDL	160	250	210
1,3–Dinitrobenzene	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Tetryl	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4,6–Trinitrotoluene	ug/Kg	BDL	BDL	BDL	BDL	BDL	590	390	290
4–amino–2,6–Dinitrotoluene	ug/Kg	BDL	BDL	BDL	BDL	BDL	2500	600	270
2–amino–4,6–Dinitrotoluene	ug/Kg	BDL	BDL	BDL	BDL	BDL	2700	480	530
2,6–Dinitrotoluene	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4–Dinitrotoluene	ug/Kg	1400	1600	600	BDL	510	570	180	110 Y

BDL = Below Detection Limits.

Y = The reported result is below the specified reporting limit.

* = Matrix interference precluded positive second column confirmation for RDX.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–19
BURN PAD BORINGS
SUMMARY OF EXPLOSIVES IN SOILS

	LOCATION	PAD–G	PAD–G	PAD–G	PAD–G	PAD–G	PAD–G	PAD–J	PAD–H	PAD–H
	SAMPLE #	PB–G–2–1	PB–G–2–2	PB–G–3–1	PB–G–6–1	PB–G–6–4	PB–G–7–1	PB–G–7–2	PB–H–1–1	PB–H–1–2
	DEPTH	0–6"	0–2'	0–6"	0–6"	4'+	0–6"	0–2'	0–6"	0–2'
COMPOUND	UNITS									
HMX	ug/Kg	1300	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
RDX	ug/Kg	4800	170 *	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,3,5–Trinitrobenzene	ug/Kg	260	BDL	BDL	250	BDL	80 Y	BDL	200	350
1,3–Dinitrobenzene	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	440	150
Tetryl	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4,6–Trinitrotoluene	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	910
4–amino–2,6–Dinitrotoluene	ug/Kg	250	BDL	BDL	590	BDL	BDL	210	BDL	810
2–amino–4,6–Dinitrotoluene	ug/Kg	150	BDL	BDL	360	BDL	BDL	220	BDL	1300
2,6–Dinitrotoluene	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4–Dinitrotoluene	ug/Kg	240	300	76 Y	1200	260	79 Y	4000	3900	1500

BDL = Below Detection Limits.
Y = The reported result is below the specified reporting limit.
* = Matrix interference precluded positive second column confirmation for RDX.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–19
BURN PAD BORINGS
SUMMARY OF EXPLOSIVES IN SOILS

	LOCATION	PAD–J	PAD–J	PAD–J	PAD–J	PAD–J	PAD–J	PAD–J	PAD–J
	SAMPLE #	PB–J–1–1	PB–J–2–1	PB–J–3–1	PB–J–4–1	PB–J–4–2	PB–J–5–1	PB–J–5–2	PB–J–6–1
	DEPTH	0–6"	0–2'	0–6"	0–2'	0–2'	0–6"	0–2'	0–6"
COMPOUND	UNITS								
HMX	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
RDX	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	270 *
1,3,5–Trinitrobenzene	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	120
1,3–Dinitrobenzene	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Tetryl	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4,6–Trinitrotoluene	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–amino–2,6–Dinitrotoluene	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–amino–4,6–Dinitrotoluene	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,6–Dinitrotoluene	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4–Dinitrotoluene	ug/Kg	420	370	300	86 Y	130	210	330	77 Y

BDL = Below Detection Limits.

Y = The reported result is below the specified reporting limit.

* = Matrix interference precluded positive second column confirmation for RDX.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–19
PAD BORINGS
SUMMARY OF EXPLOSIVES IN SOILS

COMPOUND	LOCATION SAMPLE # DEPTH UNITS	PAD–J PB–J–6–2 0–2'	PAD–J PB–J–8–1 0–6'
HMX	ug/Kg	BDL	BDL
RDX	ug/Kg	BDL	BDL
1,3,5–Trinitrobenzene	ug/Kg	BDL	BDL
1,3–Dinitrobenzene	ug/Kg	BDL	BDL
Tetryl	ug/Kg	BDL	BDL
2,4,6–Trinitrotoluene	ug/Kg	BDL	BDL
4–amino–2,6–Dinitrotoluene	ug/Kg	BDL	BDL
2–amino–4,6–Dinitrotoluene	ug/Kg	BDL	BDL
2,6–Dinitrotoluene	ug/Kg	BDL	BDL
2,4–Dinitrotoluene	ug/Kg	140	71 Y

BDL = Below Detection Limits.
Y = The reported result is below the specified reporting limit.
* = Matrix interference precluded positive second column confirmation for RDX.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–20
PAD BORINGS
DISTRIBUTION OF EXPLOSIVES FOUND

COMPOUND	TOTAL SAMPLES (1)	NUMBER OF OCURRENCES (2)	PERCENT	AVERAGE CONC. (3)
HMX	27	2	7	1140
RDX	27	6	22	1435
1,3,5–Trinitrobenzene	27	9	33	209
1,3–Dinitrobenzene	27	2	7	295
Tetryl	27	0	0	0
2,4,6–Trinitrotoluene	27	4	15	545
4–amino–2,6–Dinitrotoluene	27	7	26	747
2–amino–4,6–Dinitrotoluene	27	7	26	820
2,6–Dinitrotoluene	27	0	0	0
2,4–Dinitrotoluene	27	26	96	714

Notes:

(1) This number represents the total number of Level IV Burn Pad soil samples that contained explosives.

(2) This number represents the number of ocurrences of this explosive compound.

(3) This is an estimated concentration only, units ug/Kg. See Appendix G for ananalytical results.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–21
BERM EXCAVATIONS
SUMMARY OF EXPLOSIVES IN SOILS

COMPOUND	SAMPLE # DEPTH UNITS	BE–A–1–91 3 1/2'	BE–B–2–91 2 1/2'	BE–C–2–91 4.0'	BE–C–3–91 4.0'	BE–D–2–91 2 1/2'	BE–E–1–91 3.0'	BE–F–1–91 2.0'	BE–F–2–91 2.0'
HMX	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
RDX	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	180	1000
1,3,5–Trinitrobenzene	ug/Kg	BDL	250	610	180	170	120 Y	110 Y	7700 X
1,3–Dinitrobenzene	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	180
Tetryl	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4,6–Trinitrotoluene	ug/Kg	BDL	300	BDL	240	BDL	BDL	150	26000 X
4–amino–2,6–Dinitrotoluene	ug/Kg	BDL	BDL	BDL	240	BDL	BDL	870	1300
2–amino–4,6–Dinitrotoluene	ug/Kg	BDL	360	BDL	BDL	110 Y	86 Y	1000	2500
2,6–Dinitrotoluene	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4–Dinitrotoluene	ug/Kg	140	590	440	460	360	1900	200	1600

BDL = Below Detection Limits.
Y = The reported result is below the specified reporting limit.
* = Matrix interference precluded positive second column confirmation for RDX.
X = The reported result was derived from instrument response outside the calibration range.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–21
BERM EXCAVATIONS
SUMMARY OF EXPLOSIVES IN SOILS

COMPOUND	SAMPLE # DEPTH UNITS	BE–F–2A–91 2.0'	BE–G–1–91 2 1/2'	BE–G–2–91 4.0'	BE–G–3–91 4 1/2'	BE–H–2–91 4.0'	BE–H–3–91 4.0'	BE–J–5–91 3.0'	BE–J–6–91 3.0'
HMX	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
RDX	ug/Kg	1100	83 Y	BDL	BDL	BDL	BDL	BDL	BDL
1,3,5–Trinitrobenzene	ug/Kg	5800 X	127 Y	3900	350	330	320	BDL	BDL
1,3–Dinitrobenzene	ug/Kg	200	BDL	160	BDL	BDL	BDL	BDL	BDL
Tetryl	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4,6–Trinitrotoluene	ug/Kg	80000 X	BDL	2100	760	110 Y	210	BDL	BDL
4–amino–2,6–Dinitrotoluene	ug/Kg	150	710	1300	300	190	540	BDL	BDL
2–amino–4,6–Dinitrotoluene	ug/Kg	1800	880	1800	320	110 Y	440	BDL	BDL
2,6–Dinitrotoluene	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4–Dinitrotoluene	ug/Kg	1600	100 Y	670	800	230	1500	170	92 Y

BDL = Below Detection Limits.
Y = The reported result is below the specified reporting limit.
• = Matrix interference precluded positive second column confirmation for RDX.
X = The reported result was derived from instrument response outside the calibration range.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4−22
GRID BORINGS
SUMMARY OF EXPLOSIVES IN SOILS

COMPOUND	BORING # DEPTH UNITS	GB−02−1 0−6"	GB−02−2 0−2'	GB−03−1 0−6"	GB−03−2 0−2'	GB−04−1 0−6"	GB−08−1 0−6"	GB−11−3 2'−4'	GB−12−1A 0−6"	GB−13−1 0−6"	GB−15−1 0−6"	GB−19−1 0−6"	GB−20−1 0−6"	MW−30 0−2'
HMX	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
RDX	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	90 Y	BDL	BDL	240
1,3,5−Trinitrobenzene	ug/Kg	82 Y	BDL	184	280	BDL	BDL	BDL	BDL	BDL	BDL	BDL	66 Y	BDL
1,3−Dinitrobenzene	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Tetryl	ug/Kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4,6−Trinitrotoluene	ug/Kg	BDL	BDL	150	69 Y	BDL	BDL	BDL	BDL	BDL	BDL	BDL	350	BDL
4−amino−2,6−Dinitrotoluene	ug/Kg	BDL	BDL	370	280	BDL	86 Y	BDL	BDL	BDL	99 Y	BDL	BDL	130
2−amino−4,6−Dinitrotoluene	ug/Kg	85 Y	73 Y	370	300	BDL	94 Y	BDL	BDL	BDL	130	BDL	BDL	110 Y
2,6−Dinitrotoluene	ug/Kg	BDL	BDL	BDL	BDL	67 Y	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4−Dinitrotoluene	ug/Kg	270	BDL	940	850	BDL	BDL	120 Y	64 Y	100 Y	BDL	160	BDL	BDL

BDL = Below Detection Limits, See Appendix G for analytical results.
Y = The reported result is below the specified reporting limit.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–23
GRID BORINGS
DISTRIBUTION OF EXPLOSIVES FOUND

COMPOUND	TOTAL SAMPLES (1)	NUMBER OF OCURRENCES (2)	PERCENT	AVERAGE CONC. (3)
HMX	12	0	0	0
RDX	12	2	17	115
1,3,5–Trinitrobenzene	12	4	33	36
1,3–Dinitrobenzene	12	0	0	0
Tetryl	12	0	0	0
2,4,6–Trinitrotoluene	12	3	25	25
4–amino–2,6–Dinitrotoluene	12	5	42	193
2–amino–4,6–Dinitrotoluene	12	7	58	154
2,6–Dinitrotoluene	12	1	8	67
2,4–Dinitrotoluene	12	6	50	335

Notes:
(1) This number represents the total number of Level IV Grid Boring soil samples that contained explosives.
(2) This number represents the number of ocurrences of the explosive compound.
(3) This is an estimated concentration only, units ug/Kg. See Appendix G for analytical results.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–24
MONITORING WELLS
SUMMARY OF VOLATILE ORGANICS IN GROUNDWATER (ug/L)

	LOCATION	MW–5	MW–7	MW–10	MW–18	MW–18A	MW–21	MW–34	MW–35
COMPOUND	MAIN ID	MW–5	MW–7	MW–10	MW–18	MW–18A	MW–21	MW–34	MW–35
Chloromethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromomethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Vinyl Chloride		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Methyl Chloride		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acetone		9 J	8 J	6 J	2 J	2 J	9 J	4 J	4 J
Carbon Disulfide		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1–Dichloroethene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1–Dichloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2–Dichloroethene (total)		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chloroform		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2–Dichloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–Butanone		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,1–Trichloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Carbon Tetrachloride		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Vinyl Acetate		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromodichloromethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,2–Dichloropropane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
cis–1,3–Dichloropropene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trichloroethene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibromochloromethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,2–Trichloroethene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
trans–1,3–Dichloropropene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bromoform		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Methyl–2–Pentanone		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2–Hexanone		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Tetrachloroethene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,1,2,2–Tetrachloroethane		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Toluene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Ethylbenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Styrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Xylene (total)		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

NOTES:
BDL = BELOW THE DETECTION LIMIT
J = ESTIMATED CONCENTRATIONS, BELOW SAMPLE
QUANTITATION LIMIT

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–25
MONITORING WELLS
SUMMARY OF SEMI–VOLATILE ORGANICS IN GROUNDWATER (ug/L)

COMPOUND	LOCATION	MW–11	MW–12	MW–14	MW–14	MW–24	MW–27	MW–30
	SAMPLE #	MW–11	MW–12	MW–14	MW–14A	MW–24	MW–27	RINSATE MW30
3–Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Acenaphthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4–Dinitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Nitrophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibenzofuran		BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4–Dinitrotoluene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diethylphthalate		4 BJ	9 BJ	6 BJ	6 BJ	5 BJ	5 BJ	BDL
4–Chlorophenyl–phenylether		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fluorene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Nitroaniline		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4,6–Dinitro–2–methylphenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
N–Nitrosodiphenylamine (1)		BDL	BDL	BDL	BDL	BDL	BDL	BDL
4–Bromophenyl–phenylether		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hexachlorobenzene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pentachlorophenol		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Phenanthrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Di–n–butylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fluoranthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pyrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Butylbenzylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL
3,3'–Dichlorobenzidine		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a)anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chrysene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
bis(2–Ethylhexyl)phthalate		BDL	BDL	BDL	BDL	BDL	BDL	4 J
Di–n–octylphthalate		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(b)fluoranthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
benzo(k)fluoranthene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a)pyrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Indeno(1,2,3–cd)pyrene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dibenz(a,h)anthracene		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(g,h,i)perylene		BDL	BDL	BDL	BDL	BDL	BDL	BDL

NOTES:

BDL = BELOW DETECTION LIMIT

B = DETECTED IN BLANK

J = ESTIMATIMATED CONCENTRATIONS, BELOW SAMPLE QUANTITATION LIMIT

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–26
MONITORING WELLS
SUMMARY OF EXPLOSIVES IN GROUNDWATER (ug/L)

COMPOUND	WELL NUMBER			
	MW–13	MW–15	MW–24	MW–28
HMX	BDL	BDL	BDL	BDL
RDX	0.6	0.082 Y	BDL	BDL
1,3,5–Trinitrobenzene	BDL	BDL	BDL	BDL
1,3–Dinitrobenzene	BDL	BDL	BDL	BDL
Tetryl	BDL	BDL	BDL	BDL
2,4,6–Trinitrotoluene	BDL	BDL	0.21	BDL
4–amino–2,6–Dinitrotoluene	BDL	BDL	BDL	BDL
2–amino–4,6–Dinitrotoluene	BDL	BDL	BDL	BDL
2,6–Dinitrotoluene	BDL	BDL	BDL	0.087 Y
2,4–Dinitrotoluene	BDL	BDL	BDL	BDL

BDL = Below Detection Limits, see Appendix G for analytical results.
Y = The reported result is below the specified reporting limit.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4-27
SUMMARY OF METALS IN SURFACE WATER
(ug/L)

LOCATION	SW-110	SW-120	SW-120	SW-130	SW-140	SW-150	SW-150	SW-160
MAIN ID	WO711-41	WO711-48	W1012118	WO711-57	WO711-66	W0811-75	WO811-84	W1211-96
COMPOUND								
Aluminum	BDL	300	102 B	BDL	BDL	BDL	139 B	BDL
Antimony	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Barium	BDL	65.7 B	48.9 B	52.3 B	51.2 B	59.5 B	53.2 B	68.5 B
Beryllium	BDL	BDL	1.4 B	BDL	BDL	BDL	BDL	BDL
Cadmium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Calcium	121000	114000	96000	100000	87100	85600	83800	93300
Chromium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cobalt	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Copper	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Iron	98.4	670	142	236	314	737	737	189
Lead	BDL	2.2 B	BDL	BDL	BDL	1 B	1.2 B	1.4 B
Magnesium	18700	17300	13700	14400	12800	12900	12700	9320
Manganese	14.6 B	121	43.7	34.5	68.4	236	230	14.9 B
Mercury	BDL	BDL	BDL	BDL	BDL	0.11 B	BDL	BDL
Nickel	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Potassium	3800 B	3800	949 B	3070 B	3000 B	3470 B	2800 B	1860 B
Selenium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Silver	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Sodium	26500	24700	21900	24100	23100	BDL	22500	4170 B
Thallium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Vanadium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	37.2 B
Zinc	BDL	15.1 B	14.1 B	BDL	BDL	BDL	BDL	BDL
Cyanide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Notes:
BDL = Below Detection Limits
B = Found in sample blank.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4-27
SUMMARY OF METALS IN SURFACE WATER
(ug/L)

LOCATION MAIN ID COMPOUND	SW-170 W1211-97	SW-191 WO611-17	SW-192 W1311-103	SW-193 W1311-100	SW-194 W1311-101	SW-195 W1311-102	SW-196 W1211-98	SW-197 W1311-104
Aluminum	BDL	1430	74.8 B	269	481	5220	BDL	1490
Antimony	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	BDL	BDL	BDL	4.4	3.9 B	3.9 B	BDL	BDL
Barium	109 B	196 B	111 B	43.5 B	69.8 B	98.7 B	BDL	35.5 B
Beryllium	BDL	BDL	BDL	1.2 B	BDL	1.3 B	BDL	BDL
Cadmium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Calcium	78600	183000	106000	66200	78000	42000	65800	24800
Chromium	BDL	BDL	BDL	BDL	BDL	8.6 B	BDL	BDL
Cobalt	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Copper	BDL	24 B	20.9 B	BDL	28.1	37.2	BDL	10.5 B
Iron	181	3190	152	319	741	6730	75.3 B	2210
Lead	3.6	74.2	6.6	BDL	8.3	37.9	BDL	3
Magnesium	10400	34700	16000	7290	7900	7340	8980	4340 B
Manganese	12.6 B	240	13.5 B	31	29.9	297	16.8	247
Mercury	BDL	BDL	BDL	BDL	0.09 B	BDL	BDL	BDL
Nickel	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Potassium	4590 B	6050	2700 B	1840 B	2360 B	5960	2420 B	5610
Selenium	BDL	2 B	0.99 B	BDL	BDL	BDL	BDL	BDL
Silver	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Sodium	4850 B	13800	7720	7400	5250	6010	59100	1830 B
Thallium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Vanadium	33 B	BDL	11.2 B	BDL	11 B	19.5 B	39.2 B	BDL
Zinc	BDL	98	52.3	BDL	26.6	154	BDL	39.3
Cyanide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Notes:
BDL = Below Detection Limits
B = Found in sample blank.

SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–28
SURFACE WATER SEDIMENT SAMPLES
SUMMARY OF METALS IN SEDIMENTS
(mg/Kg)

PARAMETER	Background (MW–34)	On–Site Samples				Number Above Background	Number Below Background	Total Number Detections
		Minimum	Maximum	Mean	Standard Deviation			
Aluminum	16100.00	6450.00	25800.00	15486.67	4868.84	7	11	18
Antimony	5.70	8.30	8.30	8.30	NA	1	17	1
Arsenic	U	2.50	7.40	5.04	1.47	17	1	17
Barium	67.50	35.60	701.00	183.76	170.97	11	7	16
Beryllium	0.86	0.68	1.20	0.94	0.17	5	13	7
Cadmium	2.30	1.80	9.70	3.43	1.96	12	6	18
Calcium	28600.00	2020.00	104000.00	20301.67	23335.27	4	14	18
Chromium	26.60	14.40	41.80	25.66	6.77	7	11	18
Cobalt	17.00	8.00	16.10	11.65	2.34	0	18	10
Copper	32.70	18.70	416.00	96.48	105.78	10	8	18
Iron	35000.00	23700.00	40900.00	30461.11	5285.85	3	15	18
Lead	11.90	15.40	463.00	138.08	141.65	18	0	18
Magnesium	6850.00	3720.00	12000.00	6631.11	2041.54	7	11	18
Manganese	803.00	322.00	1520.00	510.72	272.87	1	17	18
Mercury	U	0.13	2.00	0.71	0.64	8	10	8
Nickel	49.30	22.10	64.40	39.02	10.46	2	16	18
Potassium	1290.00	938.00	3530.00	1933.63	819.15	12	6	16
Selenium	U	0.00	0.00	0.00	0.00	0	18	0
Silver	U	0.00	0.00	0.00	0.00	0	18	0
Sodium	U	0.00	0.00	0.00	0.00	0	18	0
Thallium	U	0.00	0.00	0.00	0.00	0	18	0
Vanadium	22.30	10.40	39.80	25.06	8.59	12	6	17
Zinc	95.70	39.60	655.00	193.40	159.22	12	6	18
Cyanide	U	0.77	0.77	0.77	0.00	1	17	1

Notes:

U = Below Detection Limits.

Number Below Background includes samples below detection limit.

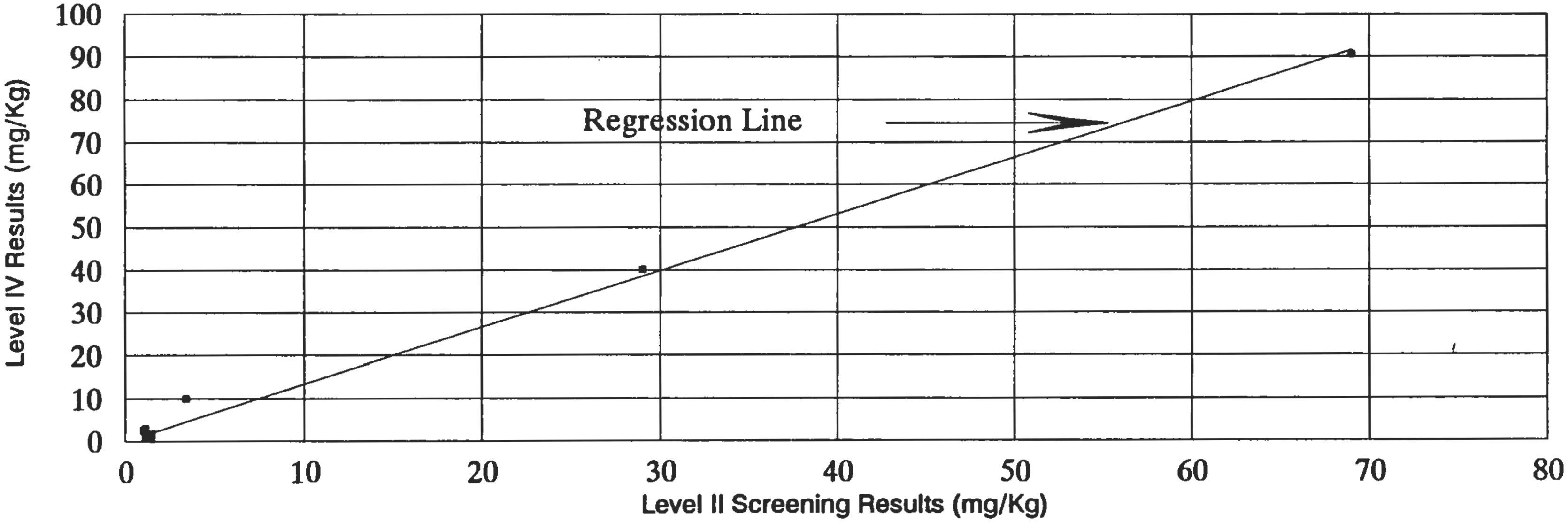
SENECA ARMY DEPOT
OB GROUNDS

TABLE 4–29
SURFACE WATER AND SEDIMENTS SUMMARY OF EXPLOSIVESRESULTS

	WATER (ug/L)							SOIL (ug/Kg)
LOCATION SAMPLE #	**SW–120 WO711–47**	**SW–160 W1211–96**	**SW–170 W1211–97**	**SW–193 W1311–100**	**SW–194 W1311–101**	**SW–195 W1311–102**	**SW–197 W1311–104**	**SW–190 S0611–23**
COMPOUND								
HMX	BDL	BDL	BDL	BDL	BDL	BDL	BDL	120 Y
RDX	0.67	9.4 X	0.67	1.3	4.6	0.44	BDL	500
1,3,5–Trinitrobenzene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
1,3–Dinitrobenzene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Tetryl	BDL	BDL	BDL	BDL	BDL	BDL	0.52	BDL
2,4,6–Trinitrotoluene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	100 Y
4–amino–2,6–Dinitrotoluene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	160
2–amino–4,6–Dinitrotoluene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	180
2,6–Dinitrotoluene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
2,4–Dinitrotoluene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	98 Y

Notes:
BDL = Below Detection Limits
Y = The reported result is below the specified reporting limit.
X = The reported result was derived from instrument response outside the calibration range.

FIGURE 4-1



SENECA ARMY DEPOT

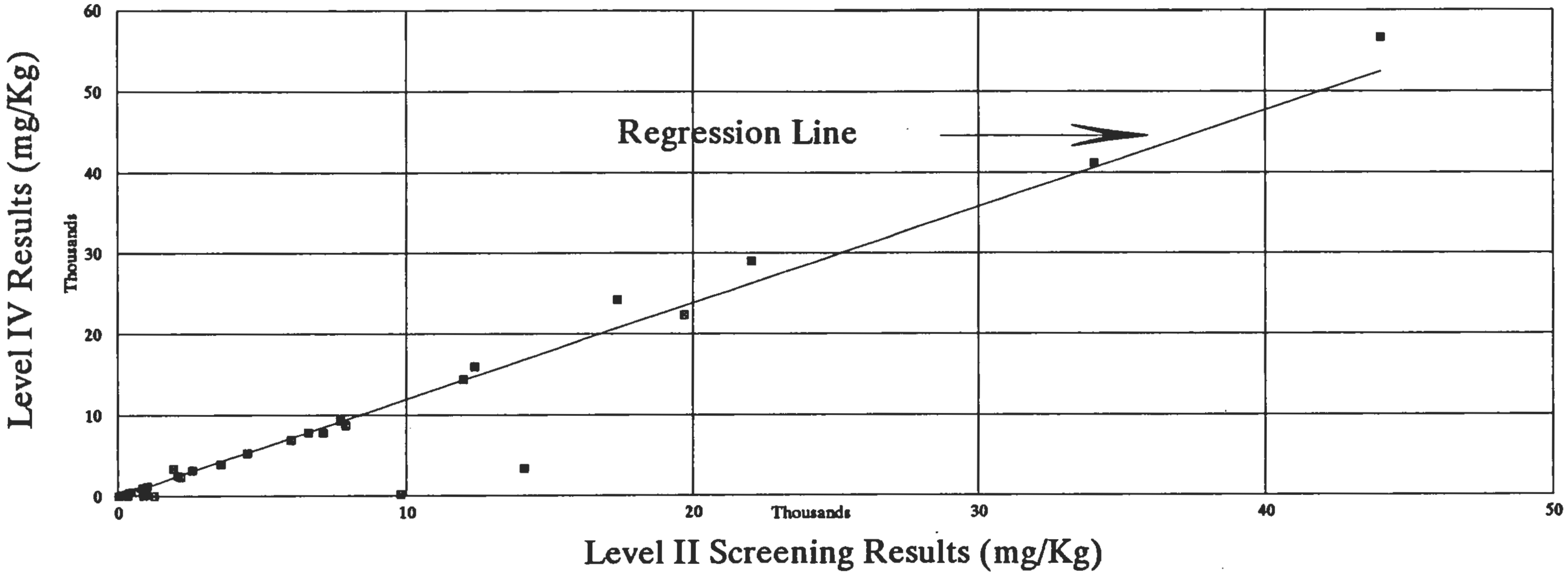
PRELIMINARY SITE CHARACTERIZATION REPORT

LEVEL II VS LEVEL IV RESULTS EXPLOSIVES IN SOILS

APRIL 1992

MAIN
1893

FIGURE 4-2



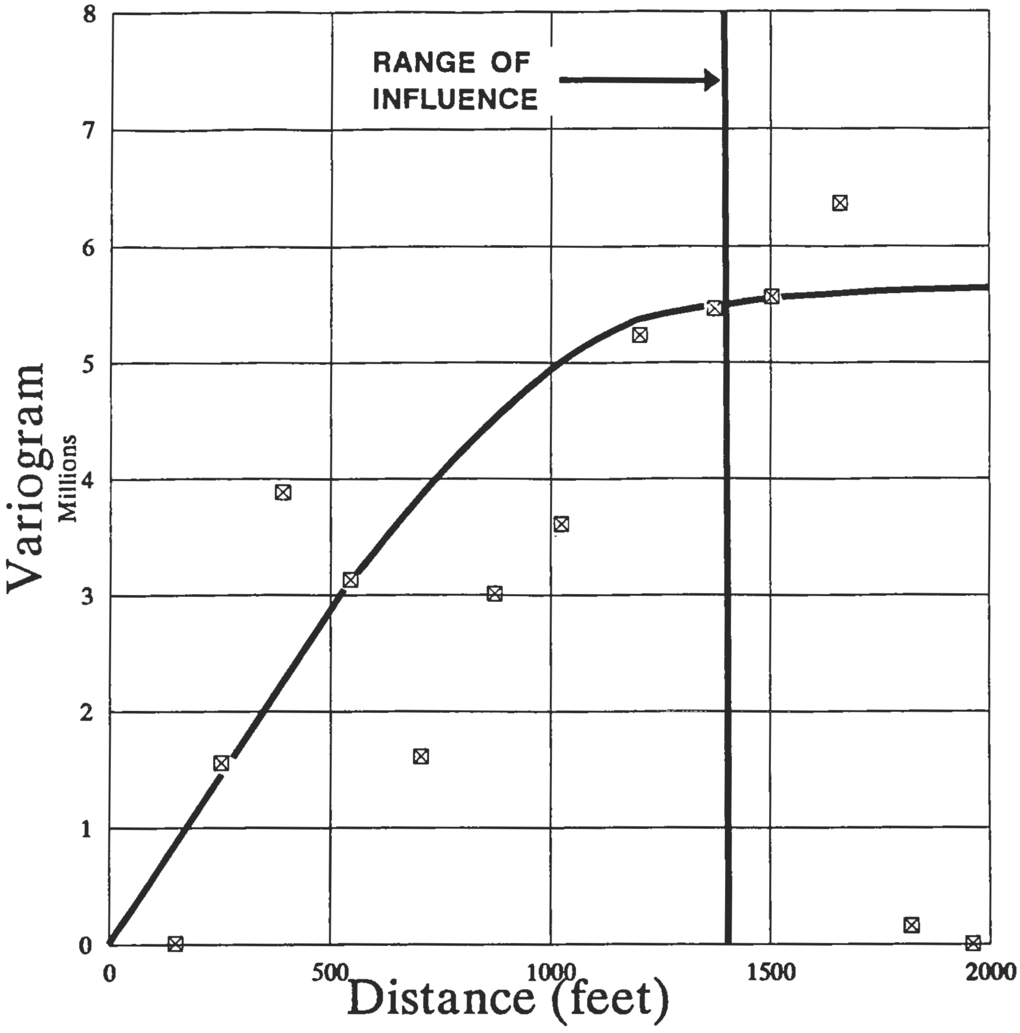
SENECA ARMY DEPOT

PRELIMINARY SITE
CHARACTERIZATION REPORT

LEVEL II VS LEVEL IV RESULTS
LEAD IN SOILS

APRIL 1992

MAIN
1893

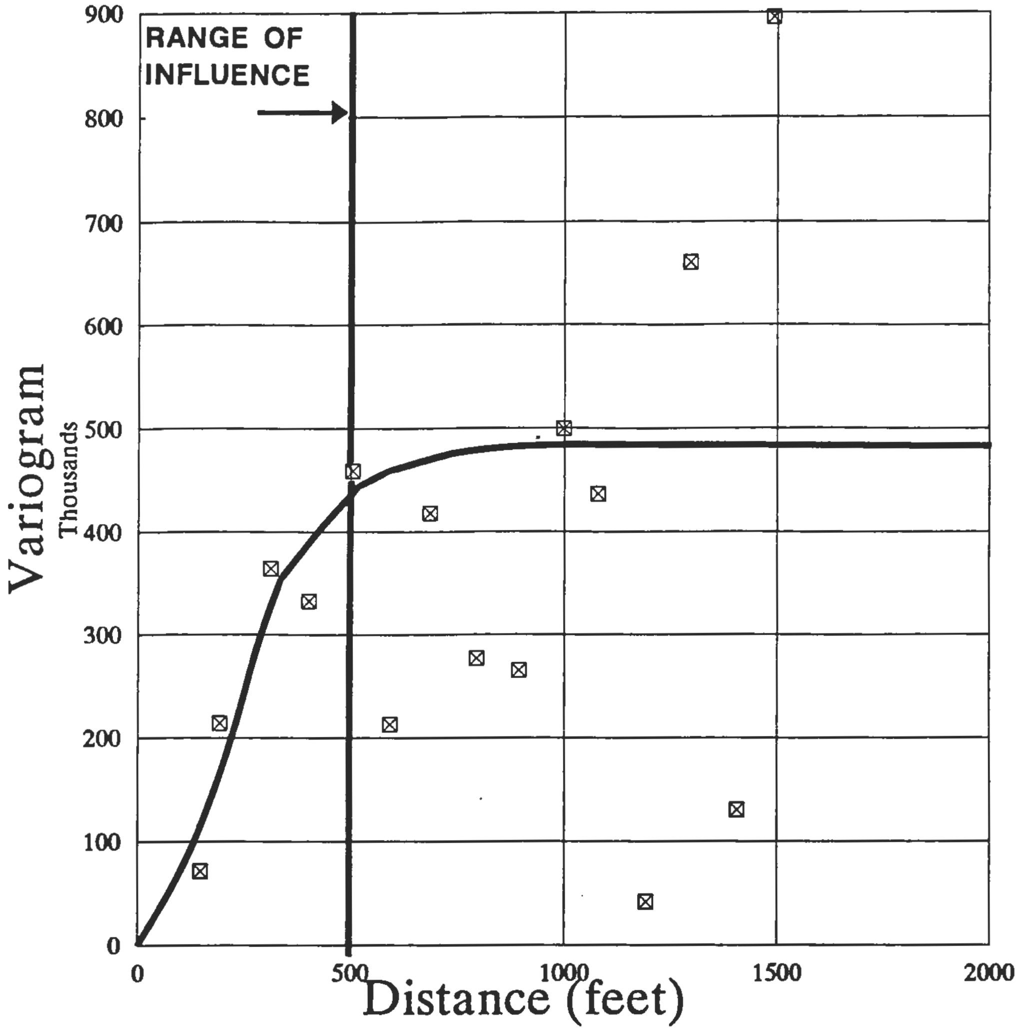


SENECA ARMY DEPOT
PRELIMINARY SITE
CHARACTERIZATION REPORT

VARIOGRAM FOR LEAD
IN GRID BORING SOILS

APRIL 1992

MAIN
1893

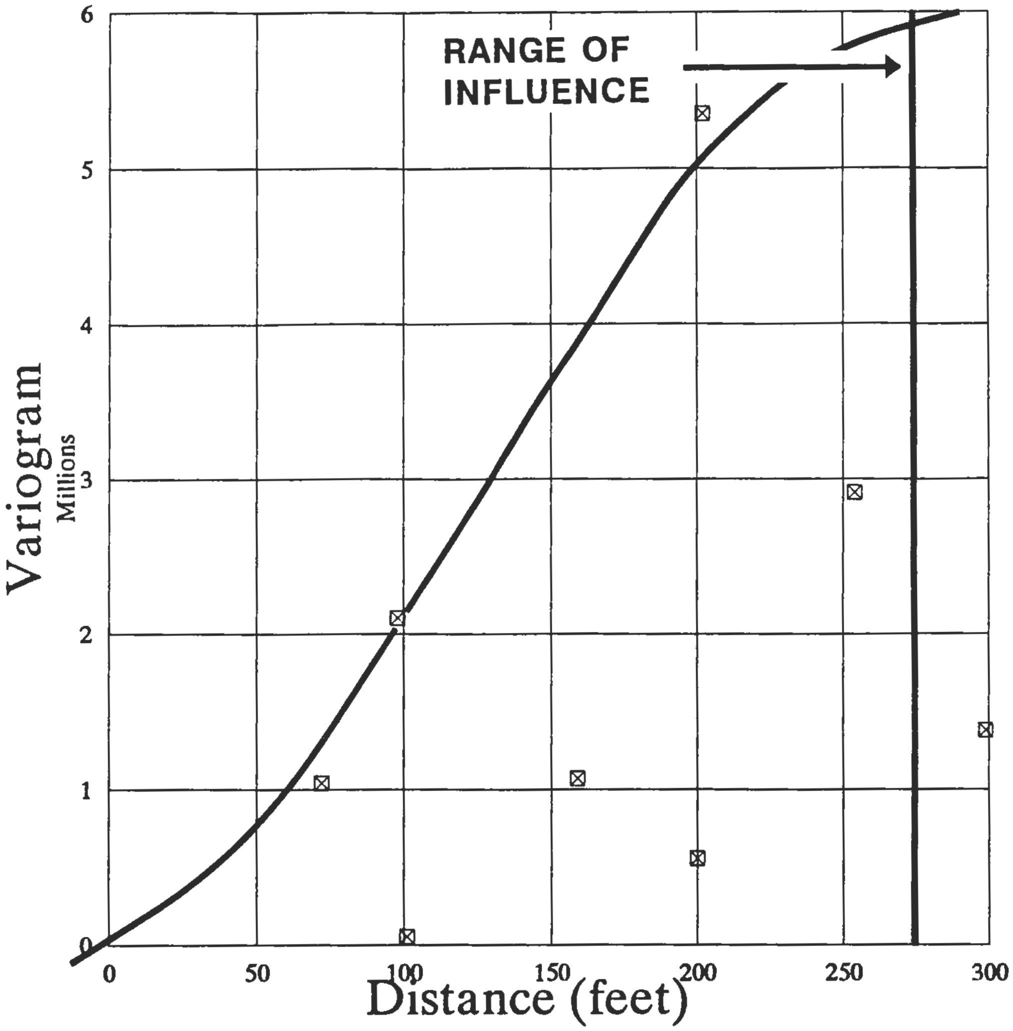


SENECA ARMY DEPOT
PRELIMINARY SITE
CHARACTERIZATION REPORT

VARIOGRAM FOR BARIUM
IN GRID BORING SOILS

APRIL 1992

MAIN
1893



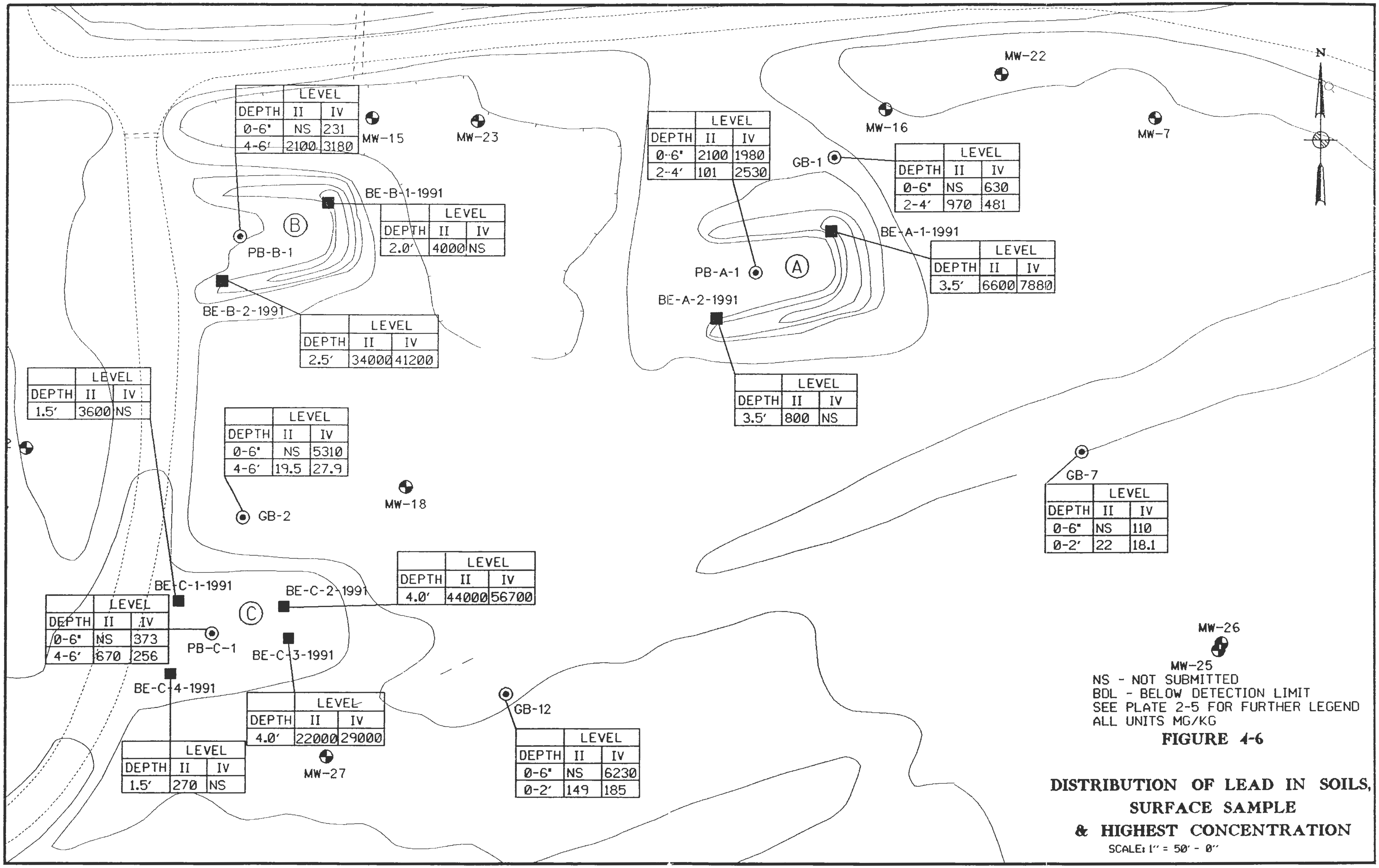
SENECA ARMY DEPOT

PRELIMINARY SITE
CHARACTERIZATION REPORT

VARIOGRAM FOR LEAD
IN PAD BORINGS

APRIL 1992

MAIN
1893



PB-B-1

	LEVEL	
DEPTH	II	IV
0-6"	NS	231
4-6′	2100	3180

BE-B-1-1991

	LEVEL	
DEPTH	II	IV
2.0′	4000	NS

BE-B-2-1991

	LEVEL	
DEPTH	II	IV
2.5′	34000	41200

	LEVEL	
DEPTH	II	IV
0-6"	2100	1980
2-4′	101	2530

GB-1

	LEVEL	
DEPTH	II	IV
0-6"	NS	630
2-4′	970	481

BE-A-1-1991

	LEVEL	
DEPTH	II	IV
3.5′	6600	7880

BE-A-2-1991

	LEVEL	
DEPTH	II	IV
3.5′	800	NS

	LEVEL	
DEPTH	II	IV
1.5′	3600	NS

	LEVEL	
DEPTH	II	IV
0-6"	NS	5310
4-6′	19.5	27.9

GB-7

	LEVEL	
DEPTH	II	IV
0-6"	NS	110
0-2′	22	18.1

BE-C-1-1991

BE-C-2-1991

	LEVEL	
DEPTH	II	IV
4.0′	44000	56700

	LEVEL	
DEPTH	II	IV
0-6"	NS	373
4-6′	670	256

BE-C-3-1991

	LEVEL	
DEPTH	II	IV
4.0′	22000	29000

BE-C-4-1991

	LEVEL	
DEPTH	II	IV
1.5′	270	NS

GB-12

	LEVEL	
DEPTH	II	IV
0-6"	NS	6230
0-2′	149	185

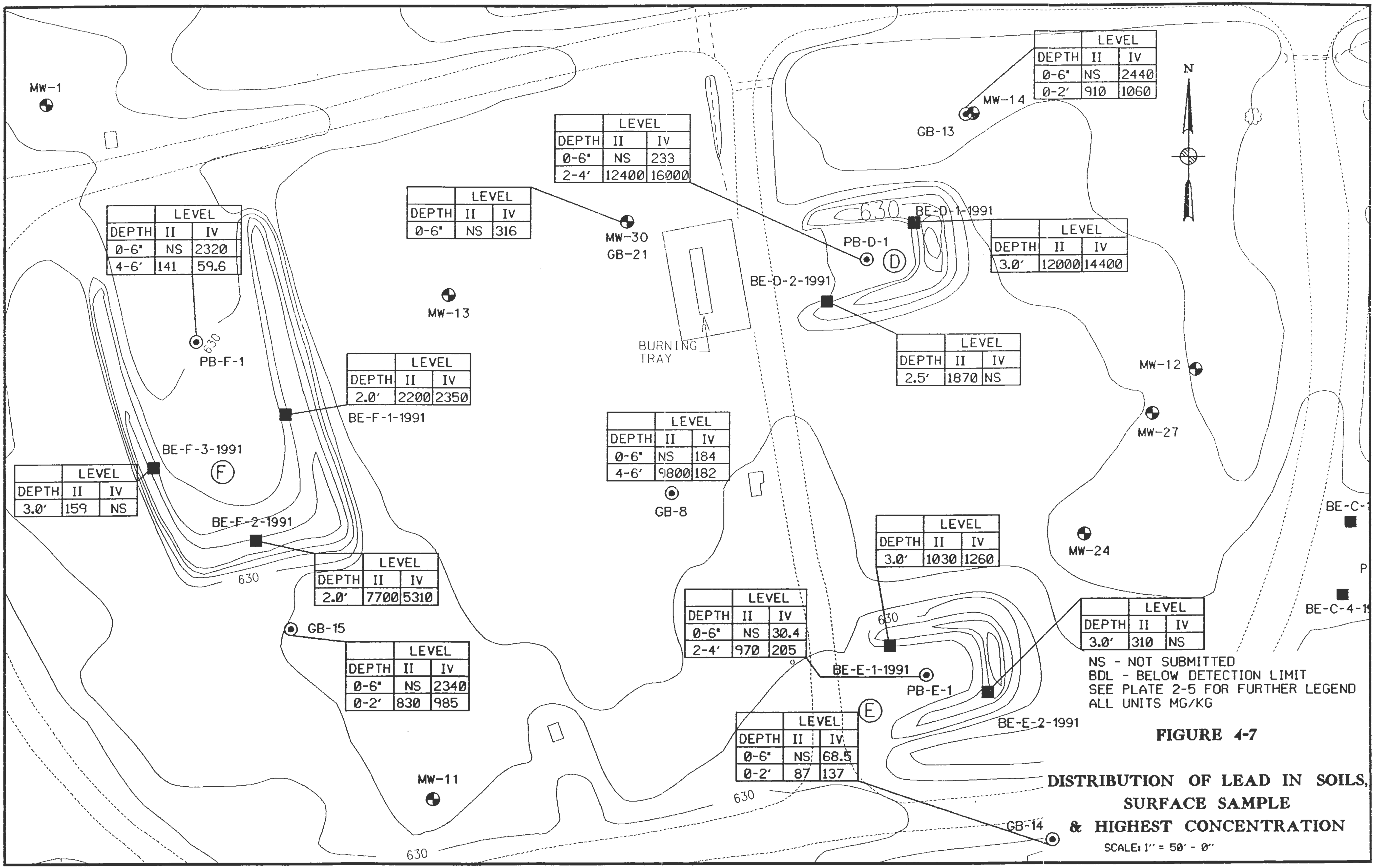
NS - NOT SUBMITTED
BDL - BELOW DETECTION LIMIT
SEE PLATE 2-5 FOR FURTHER LEGEND
ALL UNITS MG/KG

FIGURE 4-6

DISTRIBUTION OF LEAD IN SOILS, SURFACE SAMPLE & HIGHEST CONCENTRATION

SCALE: 1" = 50′ - 0"

mstation, environ/env, #1, sent18.dgn



	LEVEL	
DEPTH	II	IV
0-6"	NS	2440
0-2'	910	1060

	LEVEL	
DEPTH	II	IV
0-6"	NS	233
2-4'	12400	16000

	LEVEL	
DEPTH	II	IV
0-6"	NS	316

	LEVEL	
DEPTH	II	IV
0-6"	NS	2320
4-6'	141	59.6

	LEVEL	
DEPTH	II	IV
3.0'	12000	14400

	LEVEL	
DEPTH	II	IV
2.5'	1870	NS

	LEVEL	
DEPTH	II	IV
2.0'	2200	2350

	LEVEL	
DEPTH	II	IV
0-6"	NS	184
4-6'	9800	182

	LEVEL	
DEPTH	II	IV
3.0'	159	NS

	LEVEL	
DEPTH	II	IV
3.0'	1030	1260

	LEVEL	
DEPTH	II	IV
2.0'	7700	5310

	LEVEL	
DEPTH	II	IV
3.0'	310	NS

	LEVEL	
DEPTH	II	IV
0-6"	NS	30.4
2-4'	970	205

	LEVEL	
DEPTH	II	IV
0-6"	NS	2340
0-2'	830	985

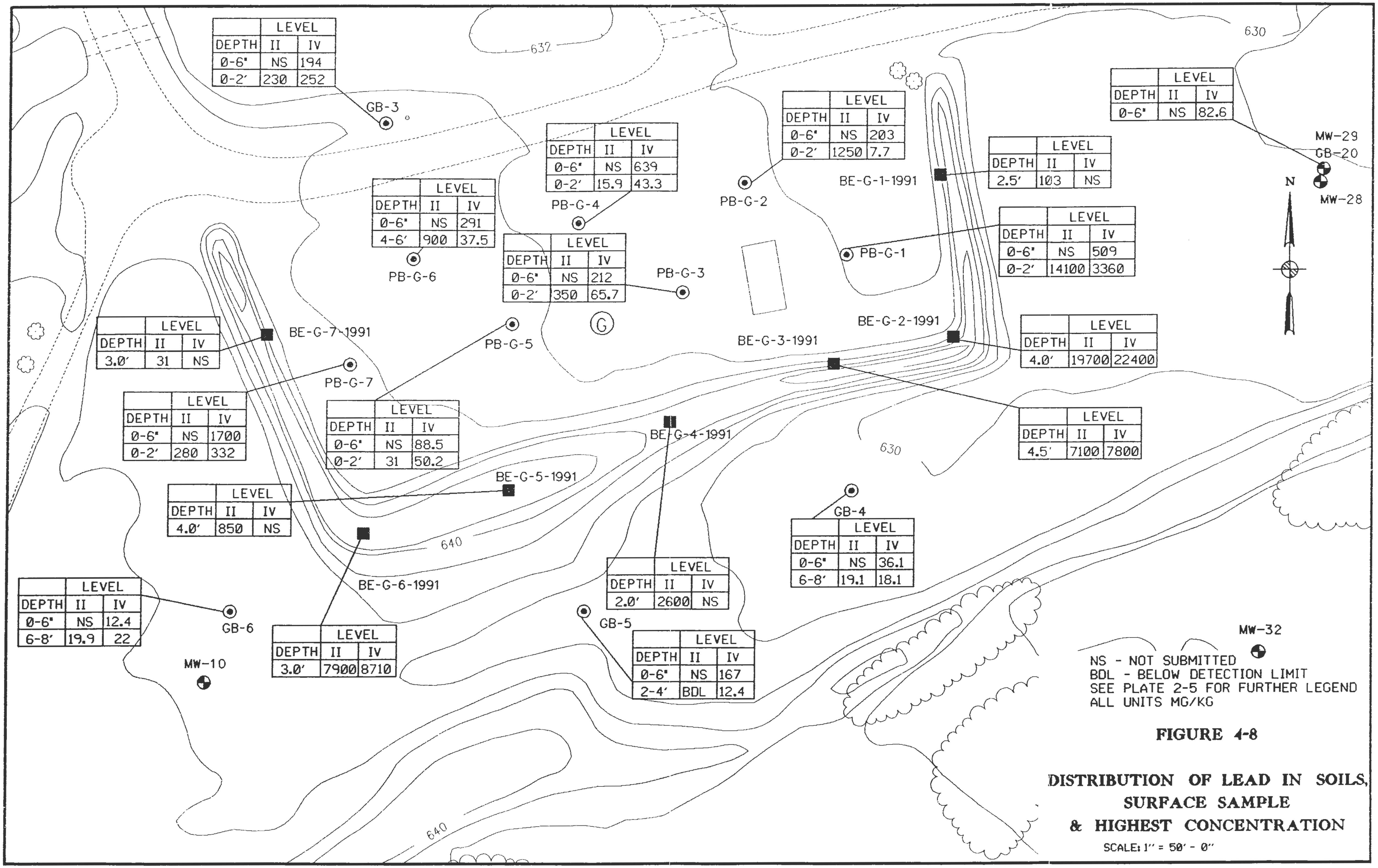
	LEVEL	
DEPTH	II	IV
0-6"	NS	68.5
0-2'	87	137

NS - NOT SUBMITTED
BDL - BELOW DETECTION LIMIT
SEE PLATE 2-5 FOR FURTHER LEGEND
ALL UNITS MG/KG

FIGURE 4-7

DISTRIBUTION OF LEAD IN SOILS, SURFACE SAMPLE & HIGHEST CONCENTRATION

SCALE: 1" = 50' - 0"



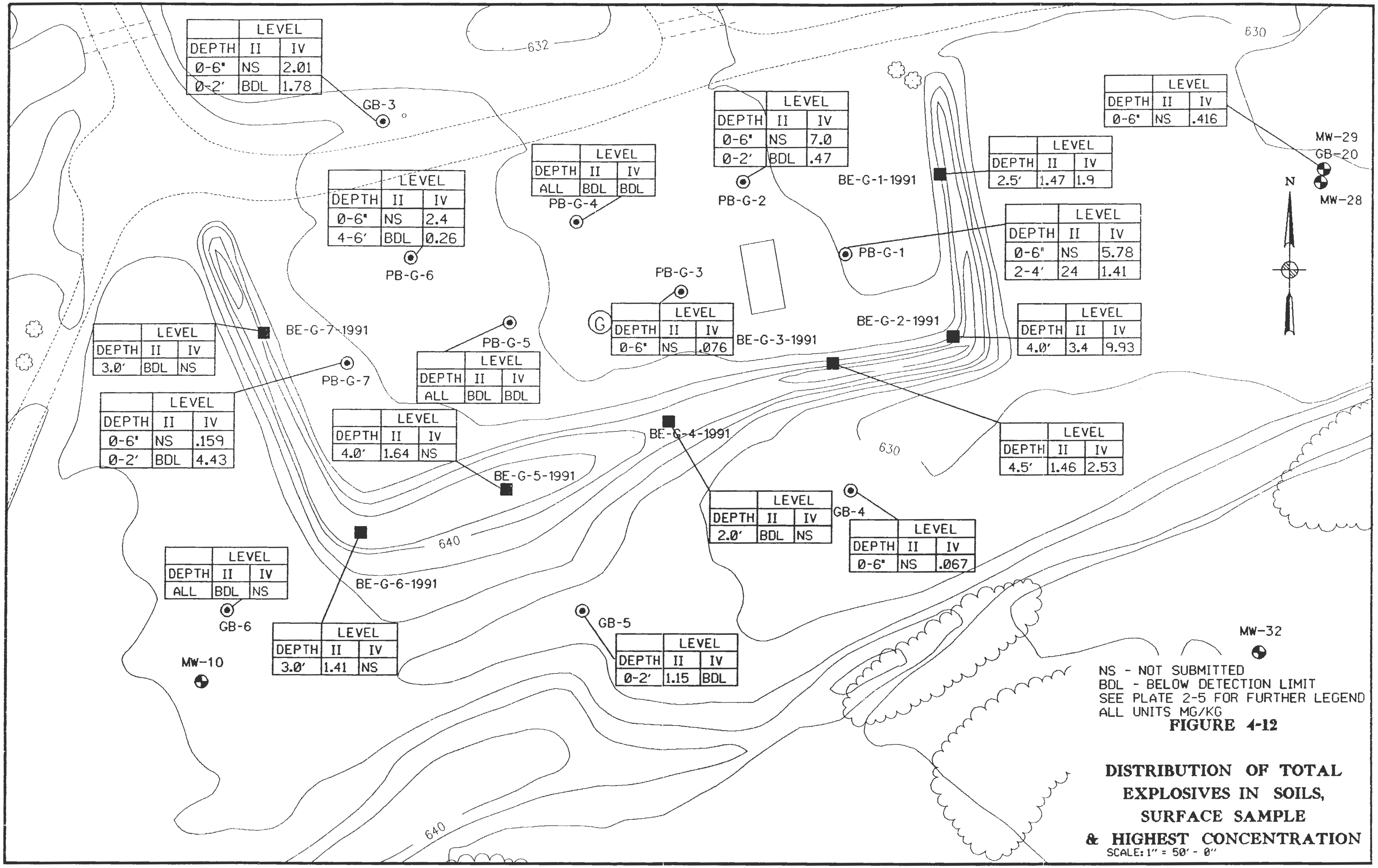
NS - NOT SUBMITTED
BDL - BELOW DETECTION LIMIT
SEE PLATE 2-5 FOR FURTHER LEGEND
ALL UNITS MG/KG

FIGURE 4-8

DISTRIBUTION OF LEAD IN SOILS, SURFACE SAMPLE & HIGHEST CONCENTRATION

SCALE: 1" = 50' - 0"

mstation, environ/env. #1, sent18.cgr



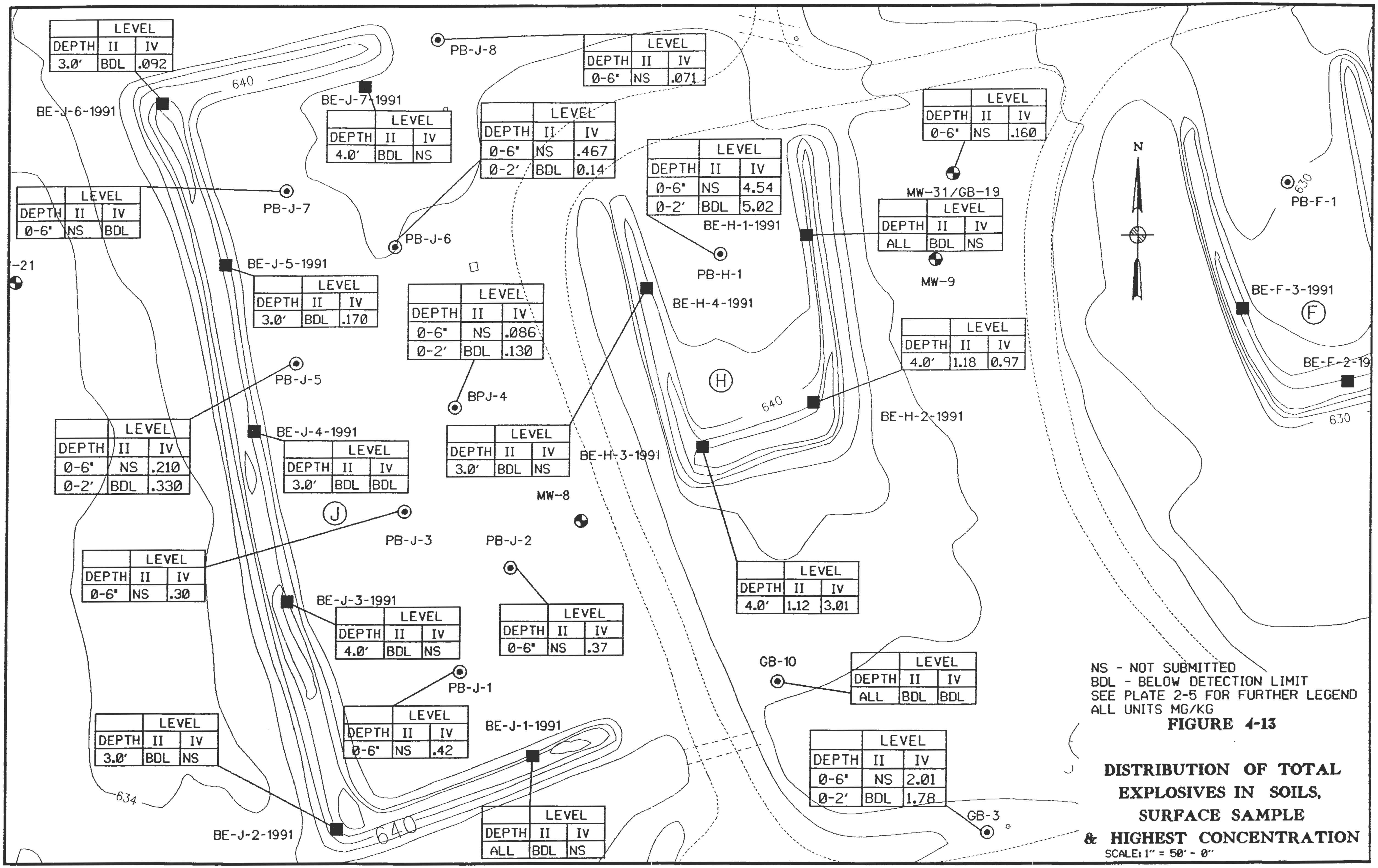
NS - NOT SUBMITTED
BDL - BELOW DETECTION LIMIT
SEE PLATE 2-5 FOR FURTHER LEGEND
ALL UNITS MG/KG

FIGURE 4-12

DISTRIBUTION OF TOTAL EXPLOSIVES IN SOILS, SURFACE SAMPLE & HIGHEST CONCENTRATION

SCALE: 1" = 50' - 0"

mstation, environ/env, #1, sent16.dgn



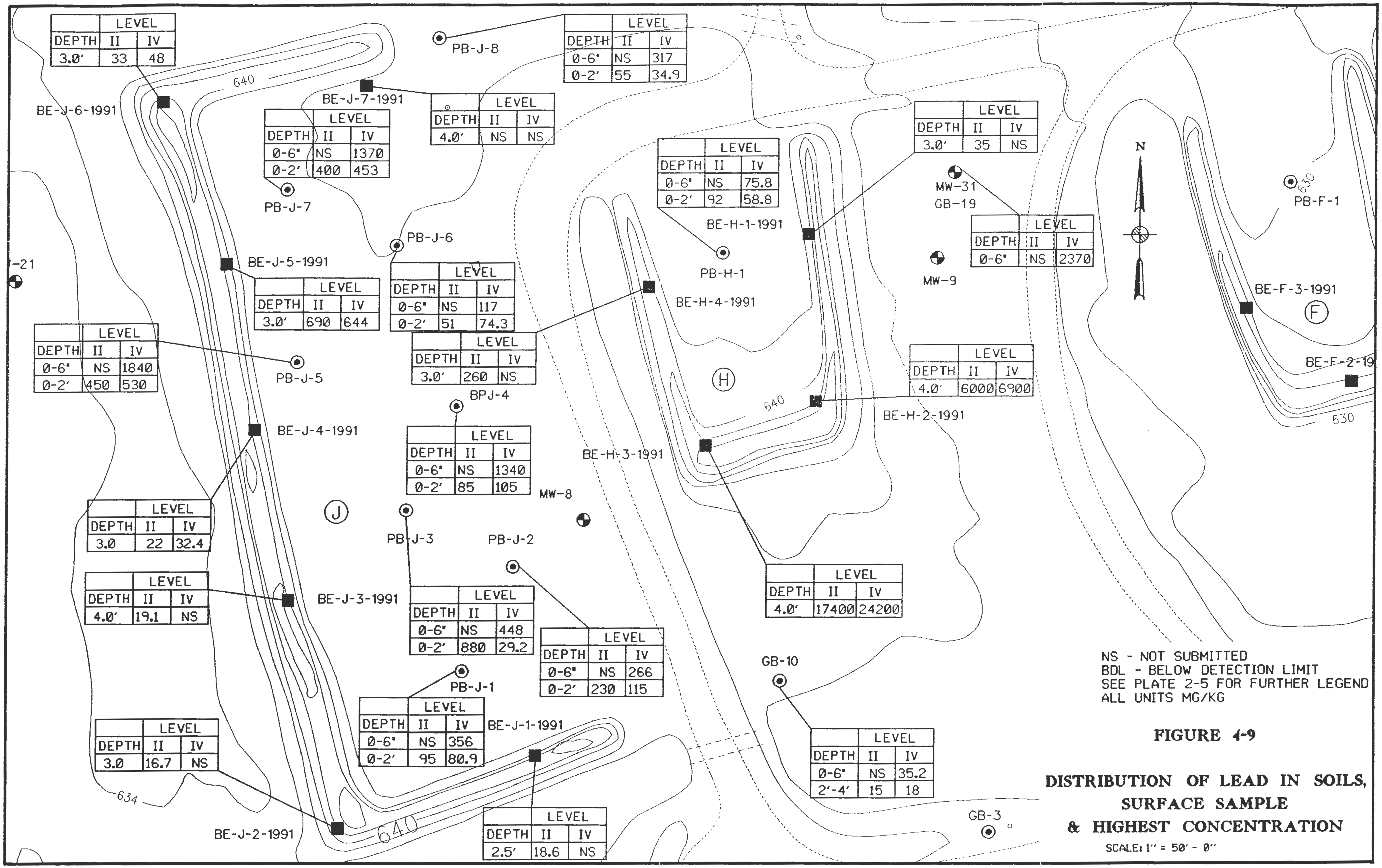
NS - NOT SUBMITTED
BDL - BELOW DETECTION LIMIT
SEE PLATE 2-5 FOR FURTHER LEGEND
ALL UNITS MG/KG

FIGURE 4-13

DISTRIBUTION OF TOTAL EXPLOSIVES IN SOILS, SURFACE SAMPLE & HIGHEST CONCENTRATION

SCALE: 1" = 50' - 0"

mstation, environ/env, #1, sent16.dgn



	LEVEL	
DEPTH	II	IV
3.0′	33	48

	LEVEL	
DEPTH	II	IV
0-6"	NS	317
0-2′	55	34.9

	LEVEL	
DEPTH	II	IV
4.0′	NS	NS

	LEVEL	
DEPTH	II	IV
0-6"	NS	1370
0-2′	400	453

	LEVEL	
DEPTH	II	IV
3.0′	35	NS

	LEVEL	
DEPTH	II	IV
0-6"	NS	75.8
0-2′	92	58.8

	LEVEL	
DEPTH	II	IV
0-6"	NS	2370

	LEVEL	
DEPTH	II	IV
3.0′	690	644

	LEVEL	
DEPTH	II	IV
0-6"	NS	117
0-2′	51	74.3

	LEVEL	
DEPTH	II	IV
0-6"	NS	1840
0-2′	450	530

	LEVEL	
DEPTH	II	IV
3.0′	260	NS

	LEVEL	
DEPTH	II	IV
4.0′	6000	6900

	LEVEL	
DEPTH	II	IV
0-6"	NS	1340
0-2′	85	105

	LEVEL	
DEPTH	II	IV
3.0	22	32.4

	LEVEL	
DEPTH	II	IV
4.0′	17400	24200

	LEVEL	
DEPTH	II	IV
4.0′	19.1	NS

	LEVEL	
DEPTH	II	IV
0-6"	NS	448
0-2′	880	29.2

	LEVEL	
DEPTH	II	IV
0-6"	NS	266
0-2′	230	115

	LEVEL	
DEPTH	II	IV
0-6"	NS	356
0-2′	95	80.9

	LEVEL	
DEPTH	II	IV
3.0	16.7	NS

	LEVEL	
DEPTH	II	IV
0-6"	NS	35.2
2′-4′	15	18

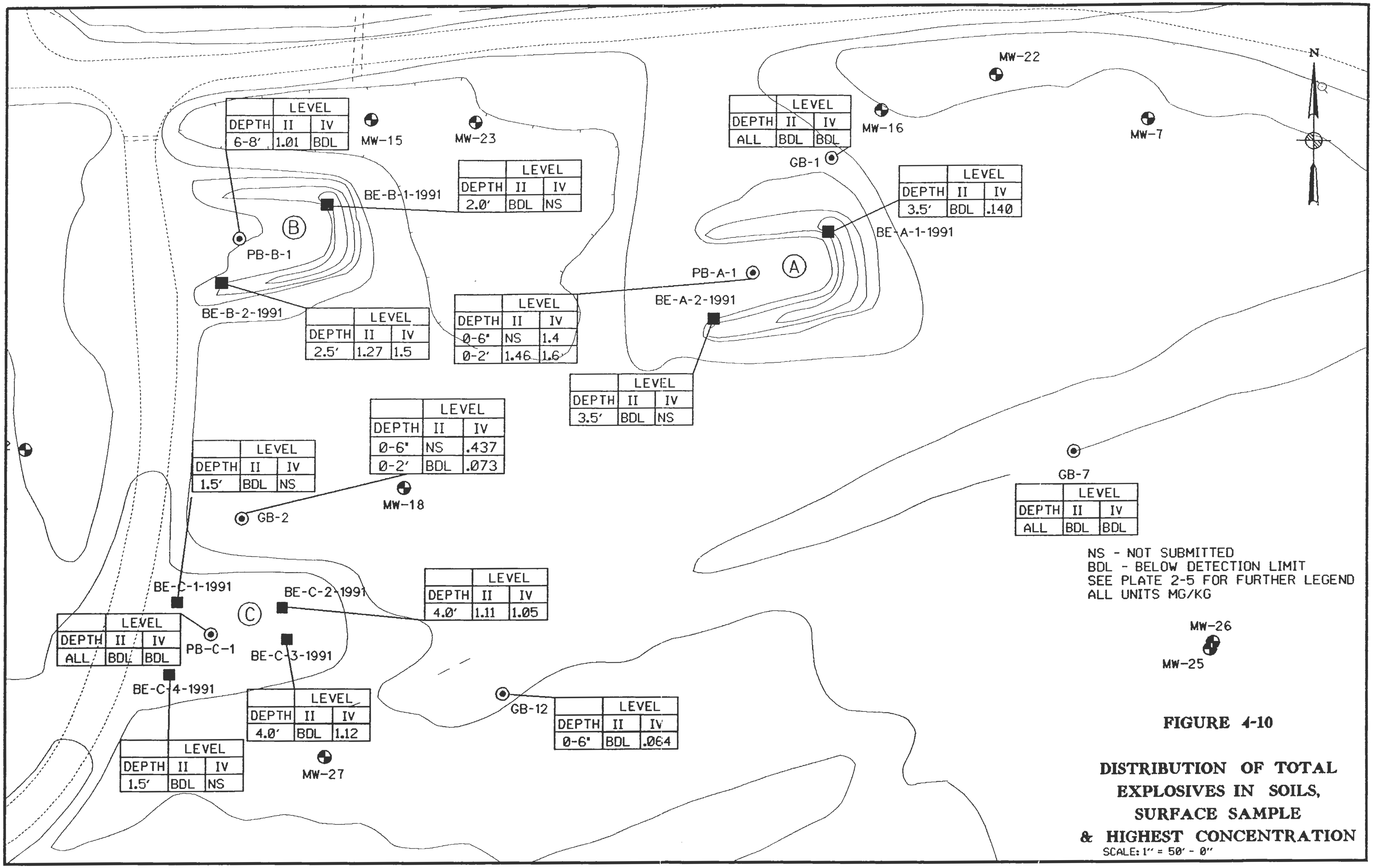
	LEVEL	
DEPTH	II	IV
2.5′	18.6	NS

NS - NOT SUBMITTED
BDL - BELOW DETECTION LIMIT
SEE PLATE 2-5 FOR FURTHER LEGEND
ALL UNITS MG/KG

FIGURE 4-9

DISTRIBUTION OF LEAD IN SOILS, SURFACE SAMPLE & HIGHEST CONCENTRATION

SCALE: 1" = 50′ - 0"



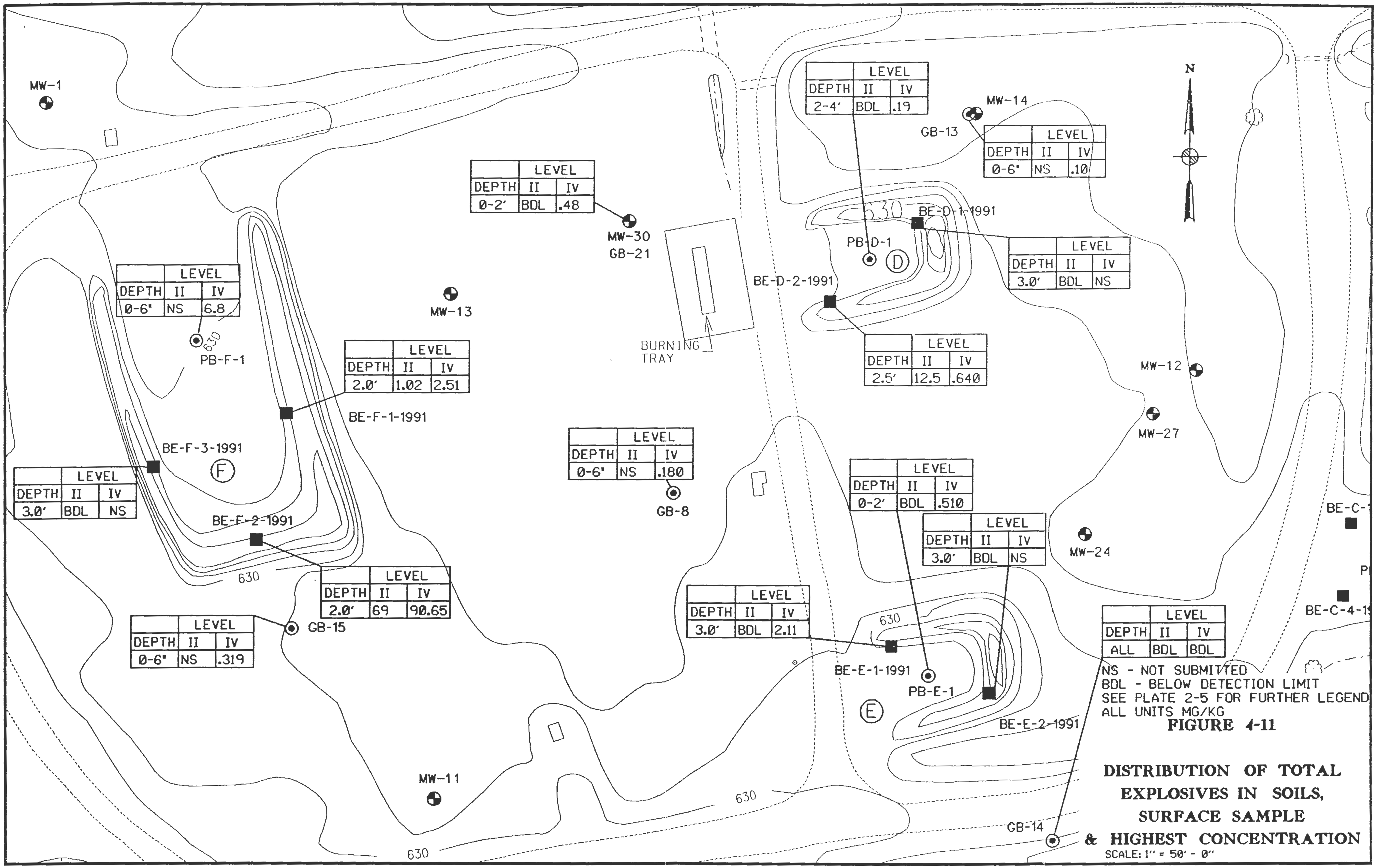
NS - NOT SUBMITTED
BDL - BELOW DETECTION LIMIT
SEE PLATE 2-5 FOR FURTHER LEGEND
ALL UNITS MG/KG

FIGURE 4-10

DISTRIBUTION OF TOTAL EXPLOSIVES IN SOILS, SURFACE SAMPLE & HIGHEST CONCENTRATION

SCALE: 1" = 50′ - 0"

mstation, environ/env, #1, sent16.dgn



NS - NOT SUBMITTED
BDL - BELOW DETECTION LIMIT
SEE PLATE 2-5 FOR FURTHER LEGEND
ALL UNITS MG/KG

FIGURE 4-11

DISTRIBUTION OF TOTAL EXPLOSIVES IN SOILS, SURFACE SAMPLE & HIGHEST CONCENTRATION

SCALE: 1" = 50' - 0"

mstation, environ/env, #1, sent16.dgn