LANDFILLS LF-022/LF-023
REMEDIAL INVESTIGATION REPORT

Plattsburgh Air Force Base
Plattsburgh, New York

FINAL
February 1992

Submitted by:
Hazardous Waste Remedial Actions
Program (HAZWRAP)
Support Contractor Office
Oak Ridge, Tennessee 37831

Managed by:
Martin Marietta Energy Systems, Inc.
for the
U.S. Department of Energy

Prepared by:
ABB Environmental Services, Inc.
261 Commercial Street
Portland, Maine 04112

Plattsburgh Air Force Base

Installation Restoration
Program



LF-022/LF-023
REMEDIAL INVESTIGATION REPORT

PLATTSBURGH AIR FORCE BASE
PLATTSBURGH, NEW YORK

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DIVISION OF HAZARDOUS
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Project No. 6091-10

FEBRUARY 1992

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

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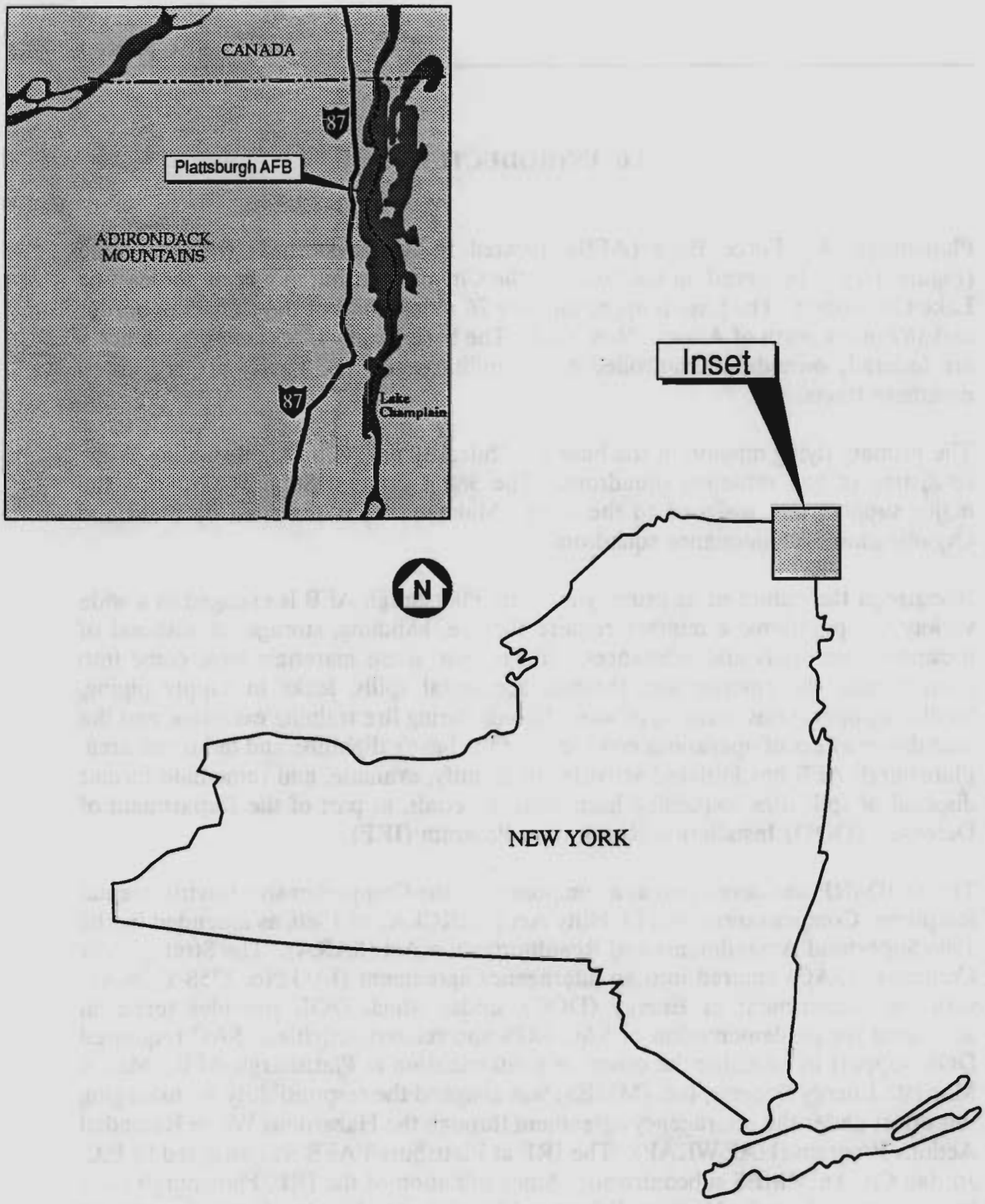
1.0 INTRODUCTION

Plattsburgh Air Force Base (AFB), located in northeastern New York State (Figure 1-1), is bordered on the north by the City of Plattsburgh and on the east by Lake Champlain. The base is approximately 26 miles south of the Canadian border and 167 miles north of Albany, New York. The base covers 4,795 acres: 3,365 acres are federally owned and controlled by the military, and 1,430 acres are registered easement tracts.

The primary flying mission of the base is fulfilled by the 380th Air Refueling Wing, consisting of two refueling squadrons. The 380th Combat Support Group is the major support unit assigned to the wing. Maintenance is provided by Field and Organizational Maintenance squadrons.

Because of the nature of its primary mission, Plattsburgh AFB is engaged in a wide variety of operations; a number require the use, handling, storage, or disposal of hazardous materials and substances. In the past, these materials have come into contact with the environment through accidental spills, leaks in supply piping, landfilling operations, burning of waste liquids during fire training exercises, and the cumulative effect of operations conducted at the base's flightline and industrial area. Plattsburgh AFB has initiated activities to identify, evaluate, and remediate former disposal or spill sites containing hazardous materials, as part of the Department of Defense's (DOD) Installation Restoration Program (IRP).

The DOD IRP was developed as a component of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the 1986 Superfund Amendments and Reauthorization Act (SARA). The Strategic Air Command (SAC) entered into an interagency agreement (IAG No. 1758-1758-A1) with the Department of Energy (DOE), under which DOE provides technical assistance for implementation of SAC IRPs and related activities. SAC requested DOE support in assessing the extent of contamination at Plattsburgh AFB. Martin Marietta Energy Systems, Inc. (MMES) was assigned the responsibility for managing this effort under the interagency agreement through the Hazardous Waste Remedial Actions Program (HAZWRAP). The IRP at Plattsburgh AFB was assigned to E.C. Jordan Co., an MMES subcontractor. Since initiation of the IRP, Plattsburgh AFB has been placed on the National Priorities List of sites to be remediated through the U.S. Environmental Protection Agency (USEPA) Superfund Program.



SOURCE: NORTH AMERICAN ROAD ATLAS, H. M. GOUSHA CO., 1982

FIGURE 1-1
VICINITY LOCATION MAP
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

E.C. JORDAN CO.

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The IRP at Plattsburgh AFB has included a Preliminary Assessment to determine which sites are potentially contaminated, Site Inspections (SIs) to confirm the presence or absence of contamination at identified sites, and Remedial Investigations (RIs) at sites confirmed to have contamination. The objectives of the RI are to acquire the data necessary to define the distribution, types, and concentrations of contaminants, and to assess the associated risks to human health and the environment from exposure to these contaminants. Landfills LF-022 and LF-023 (Figure 1-2) are two sites that have been the subject of SIs and RIs. The results of the RIs conducted at these sites are contained in this report.

1.1 REPORT ORGANIZATION

Because of the similarities between Landfills LF-022 and LF-023 (e.g., sources of contamination, exploration techniques used during the RIs, and factors affecting human health and the environment), results of the RIs conducted at these sites have been incorporated into one report. The purpose of this report and some site background information are described in Section 1.0. The methods used to conduct the RIs at LF-022 and LF-023 are described in Section 2.0. The results of the RI conducted at LF-022 are presented in Section 3.0. The results of the RI conducted at LF-023 are presented in Section 4.0. Sections 3.0 and 4.0 are each divided into five subsections: (1) physical characteristics, (2) nature and extent of contamination, (3) contaminant fate and transport, (4) baseline risk assessment, and (5) summary and conclusions.

Section 5.0 was added to the report at the final report stage. This section consists of three subsections that address additional data/information needs requested by USEPA and NYSDEC during review of the draft and draft final version of this report. Additional data collected during the summer and fall of 1991 are presented in Subsection 5.1 and compared to sampling results from previous sampling episodes. The new data were consistent with data collected during previous sampling rounds. Subsection 5.2 describes the results of additional risk calculations which are based on more compounds than the original calculations. Although some risks were greater than those originally calculated, the basic conclusions of the risk assessment were not affected. Subsection 5.3 contains clarifications of existing data and provides additional historical and physical data for the two landfills.

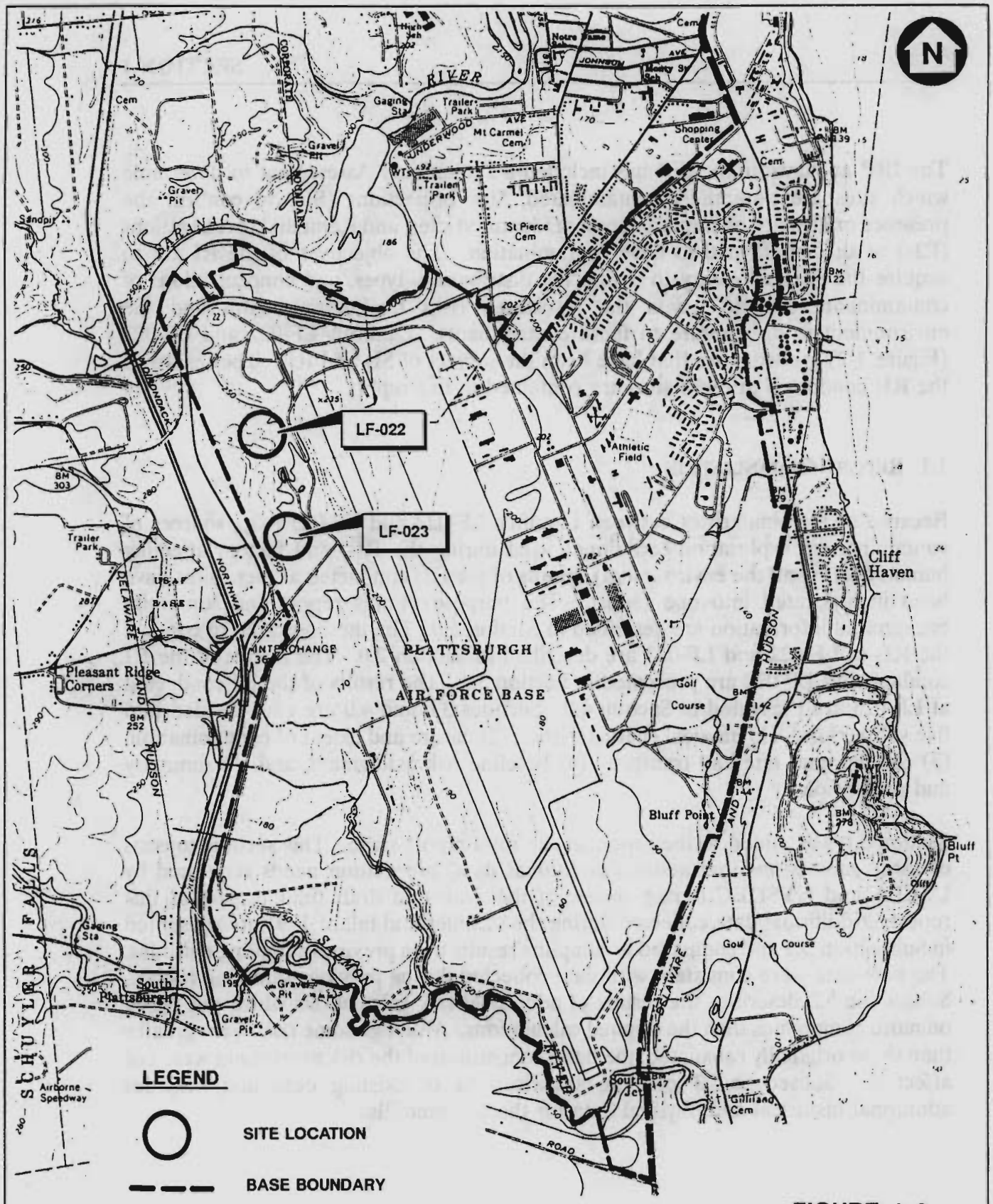


FIGURE 1-2
LF-022 AND LF-023 LOCATIONS
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
E.C. JORDAN CO.

6091-10

1.2 PURPOSE OF THE REPORT

The objectives of an RI are to identify the (1) nature and extent of contamination, (2) potential migration pathways for contaminants, and (3) risks posed to human health and the environment. This report presents the results of RIs conducted at LF-022 and LF-023. The information in this report will be used to support the development and evaluation of remedial alternatives during the LF-022 and LF-023 Feasibility Studies.

1.3 SITE BACKGROUND

The following subsections describe Landfills LF-022 and LF-023, their site histories, and the investigations conducted at each site prior to the RIs. A chronology of investigations conducted at the landfills and the source documents for data from those investigations are listed in Table 1-1.

1.3.1 General Background

The following subsections describe background information that is common to both LF-022 and LF-023.

1.3.1.1 Physical Geography and Topography. Plattsburgh AFB is in Clinton County, which lies in a physical geographic province called the St. Lawrence-Lake Champlain Lowland. The Adirondack Upland province (the Adirondack Mountains) borders Clinton County to the west and is the source of groundwater recharge and many of the rivers in the western Lake Champlain Valley. The Adirondack Mountains lie 20 to 30 miles west of Plattsburgh AFB.

The Plattsburgh AFB physical geography is characterized by a land surface that slopes gently in an eastward direction toward Lake Champlain and to a lesser degree toward the Saranac and Salmon rivers, which border the base to the north and south, respectively. Additionally, a basin feature, located in the southwestern portion of the base, drains south to the Salmon River.

1.3.1.2 Meteorology. Plattsburgh AFB is located in the rain shadow of the Adirondack Mountains; therefore, it has one of the driest climates in New York State. The average annual precipitation is 28.9 inches, including 63 inches of snow.

TABLE 1-1
INVESTIGATION CHRONOLOGY AND SOURCE DOCUMENTS

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

INVESTIGATION	DATES CONDUCTED	SOURCE DOCUMENT
Preliminary Assessment	Spring 1984 - Spring 1985	Records Search [1]
Site Inspection	Fall 1987 - Summer 1988	Site Inspection Report [2] Site Confirmation Work Plan [3]
Supplemental Site Inspection	Summer 1988	Site Inspection Report [2]
Remedial Investigation	Fall 1988	Remedial Investigation Report Phase II Quantification Work Plan [4]
Supplemental Remedial Investigation	Fall 1989	Remedial Investigation Report
Drainage Flow Study	Fall 1989 - Fall 1990	Drainage Flow Study Report [5]

NOTES:

[1] Radian, 1985

[2] E.C. Jordan Co., 1989

[3] E.C. Jordan Co., 1987

[4] E.C. Jordan Co., 1988

[5] E.C. Jordan Co., 1991

The maximum recorded 24-hour rainfall is 3.1 inches and the maximum recorded 24-hour snowfall is 21 inches. The average annual relative humidity is 66 percent.

Plattsburgh AFB is also located in the coldest lowland of New York State. The average daily maximum temperature is 53 degrees Fahrenheit (°F) and the average daily minimum is 35°F. The highest and lowest temperatures on record are 98°F and -34°F.

Predominant wind directions at Plattsburgh AFB are north and southeast. Wind speeds rarely exceed 27 knots and are less than 10 knots 84 percent of the time.

1.3.1.3 Population and Land Use. Plattsburgh AFB covers 4,857 acres. As of August 1991, there were 4,089 military personnel and their families living on-base. These personnel resided in 1,639 Family Housing Units split between two housing areas on the Main Base and two on the old base. Another 789 military personnel worked on-base but lived off-base. An additional 744 civilian employees worked on-base. Therefore, the total base population present during a typical work day at that time was approximately 5,600 people. Two elementary schools are on-base, serving both on-base and off-base populations. The Northside School is composed of kindergarten through grade 3, plus special education. A total of 474 children attend the Northside School. The Southside School is composed of grades 4 through 6, plus special education, with a total of 324 students.

The source of potable water for the entire base is the municipal water supply from the City of Plattsburgh. The extent to which on-site water supply wells were used in the past is unknown.

The base perimeter is surrounded by either a chain-link fence around the populated areas of the base, or a three-wire fence around the remote areas. In certain areas, these fences are posted with "Controlled Area, No Trespassing" signs. Both types of fences can be scaled, and sections of the three-wire fence have been knocked down along populated areas of the base (i.e., the eastern side). Therefore, these fences do not serve as an effective physical barrier to off-base persons seeking access to the base. However, the base perimeter is patrolled by security police.

Plattsburgh AFB is bordered by both the City of Plattsburgh and the Town of Plattsburgh. According to the 1986 U.S. Census, there are approximately 20,800 residents of the City of Plattsburgh, and 15,650 residents of the Town of Plattsburgh.

Other municipalities in the vicinity of Plattsburgh AFB include Peru to the south and Schuyler Falls to the west.

Most of the City of Plattsburgh is connected to the municipal water supply, which derives from the Westbrook, Patterson, and Mead reservoirs located about 7.5 miles to the northwest. All homes in the city north of the base are on municipal water. The waterline extends south along NY Route 9 as far as Clinton Community College. This line connects all homes in the Cliff Haven residential community, located between the base and Lake Champlain. South of the college, all homes rely on private wells or Lake Champlain as their source of potable water.

To the west and south of the base, all homes rely on private water supply wells, including a cluster of mobile homes on Old Route 22, located along the western boundary of the base at the NY Route 22 and US Route 87 interchange.

1.3.2 LF-022

The following subsections describe Landfill LF-022, its site history, and previous investigations conducted at the landfill.

1.3.2.1 Site Description and History. Landfill LF-022 is located approximately 1,000 feet west of the instrument runway's northern overrun, approximately 500 feet east of the Plattsburgh AFB boundary, and north of Fire Training Area FT-002 (Figure 1-3). The landfill is approximately 500 feet wide and 1,200 feet long. Site topography is relatively flat; however, the land slopes gradually away from the site toward the east and southeast, and steeply away from the site toward the north. LF-022 consists of two landfills, D-3 and D-7, which were identified during the Preliminary Assessment. The D-3 landfill was active from 1959 to 1966, and received domestic wastes. D-7 which was a disposal area for spent munitions, was identified as a separate landfill during the Preliminary Assessment but located within the boundaries of D-3. Landfill operations reportedly included digging 25-foot-deep trenches, spreading and burning the trash in the trenches, and covering it with sandy soil. Since operations at the landfill ceased, vegetation has covered most of the site, a small arms range has been constructed on the northwestern edge of the landfill, and an access road has been built across the landfill.

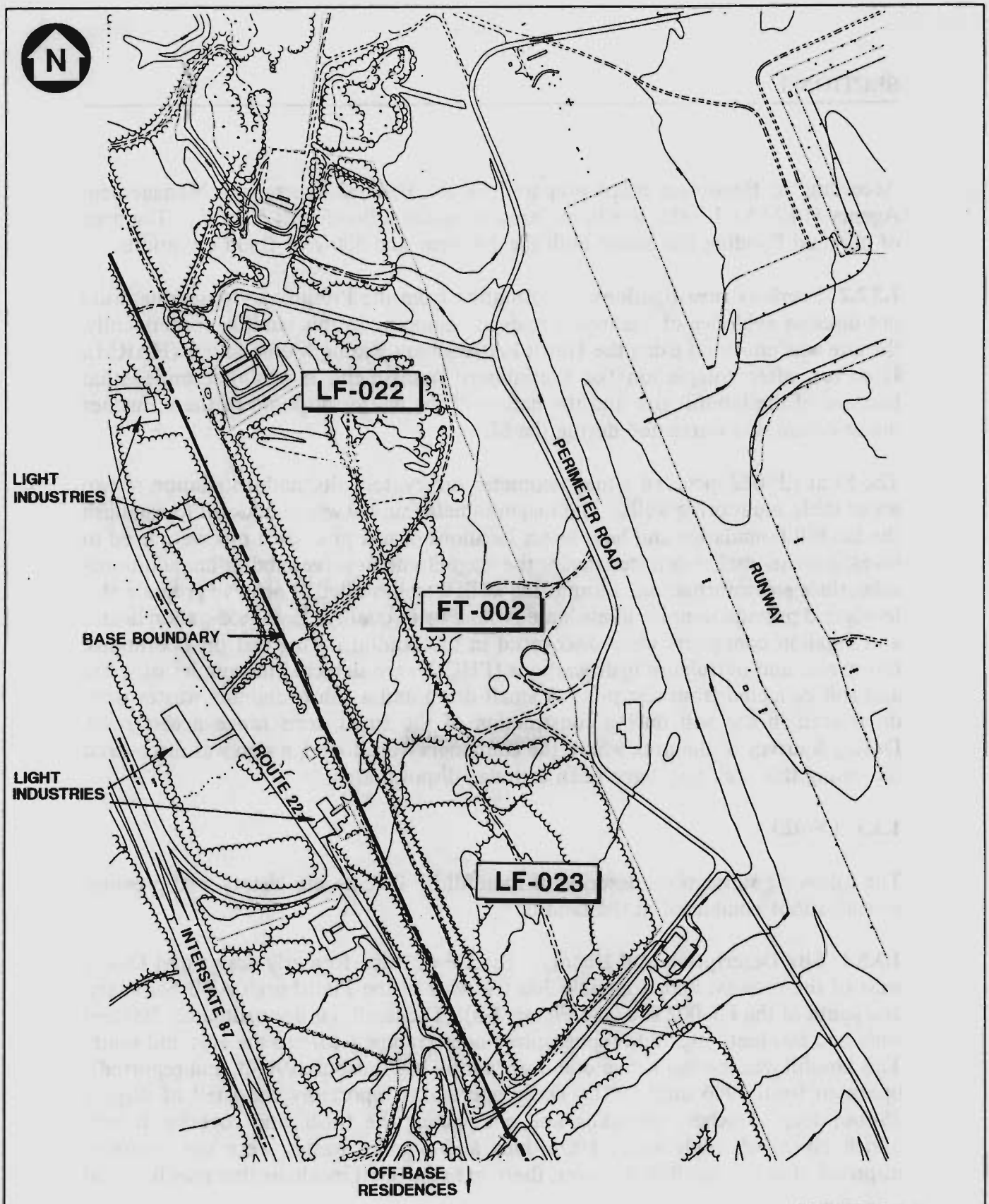


FIGURE 1-3
LF-022 AND LF-023 VICINITY MAP
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
E.C. JORDAN CO.

According to floodplain maps prepared by the Federal Emergency Management Agency (FEMA), LF-022 lies in an "area of minimal flooding" (Zone C). The area of minimal flooding lies above both the 100-year and 500-year flood elevations.

1.3.2.2 Previous Investigations. Information from the Preliminary Assessment did not disclose evidence of hazardous material dumping in this landfill, consequently, the site was not rated using the Hazard Assessment Rating Methodology (HARM). However, after completion the Preliminary Assessment, it was determined that because of the landfill size and the nature of the wastes disposed of there, further investigation was warranted during the SI.

The SI at LF-022 included a magnetometer survey, test pits, and installation of two water table monitoring wells. The magnetometer survey was conducted to establish the landfill boundaries and help select locations of test pits. Test pits were used to investigate anomalies detected during the magnetometer survey and gather additional subsurface soil information. Monitoring wells were installed to observe groundwater levels and provide samples to evaluate groundwater quality. Empty 55-gallon drums and 5-gallon containers were discovered in the landfill during test pit operations. Inorganics and petroleum hydrocarbons (PHCs) were detected in samples of waste and soil collected from test pits. A small drum and a can containing wastes were discovered in the soil during construction of the small arms range access road. During a survey of the area where the containers were found, a sign was discovered indicating this area may have been a sludge disposal area.

1.3.3 LF-023

The following subsections describe of Landfill LF-023, its site history, and previous investigations conducted at the landfill.

1.3.3.1 Site Description and History. The LF-023 site, formerly designated D-4, is west of the runway, approximately 300 feet east of the Plattsburgh AFB boundary, and south of the FT-002 site (see Figure 1-3). The landfill is approximately 500 feet wide and 800 feet long. Site topography slopes gradually toward the east and south. This landfill was the last active domestic landfill at Plattsburgh AFB, and reportedly operated from 1966 until 1981. Daily operations reportedly consisted of digging 25-foot-deep trenches, spreading and compacting the trash, and covering it with 6-inch layers of sandy soil. Hazardous and organic wastes were not routinely disposed of in this landfill; however, there are suspected incidents that may have led

to hazardous materials being disposed of in this landfill. Since operations at the landfill ceased, vegetation has begun to cover the site, and an obstacle course has been constructed in the northern section of the site.

According to floodplain maps prepared by FEMA, LF-023 lies in an "area of minimal flooding" (Zone C). The area of minimal flooding lies above both the 100-year and 500-year flood elevations.

1.3.3.2 Previous Investigations. During the Preliminary Assessment, LF-023 received a HARM score of 62. HARM scores provide a relative ranking of sites at a facility with respect to the potential for contamination and contaminant migration. Among the 13 sites rated during the Preliminary Assessment, LF-023 ranked sixth.

Based on the results of the Preliminary Assessment, an SI was conducted at LF-023. This included a magnetometer survey, test pits, and installation of three water table monitoring wells. The magnetometer survey was conducted to establish the landfill boundaries and help select test pit locations. Test pits were used to investigate anomalies detected during the magnetometer survey and gather additional subsurface soil information. Monitoring wells were installed to observe groundwater gradients and provide samples to evaluate groundwater quality. A supplemental SI was also conducted at LF-023, including the installation of seven additional monitoring wells and sampling of private wells along the western boundary of the base.

Data from the SI indicate the presence of vinyl chloride and aromatic organic chemicals in groundwater east and southeast of the landfill. Dichlorobenzene was detected in samples of waste and soil collected from test pits.

2.0 EXPLORATION METHODS FOR SITE CHARACTERIZATION

The following subsections describe the exploration methods used during the RIs at LF-022 and LF-023. The results of these investigations are contained in Sections 3.0 and 4.0. Because of the impact of SARA on the CERCLA process, as described in the National Contingency Plan, Plattsburgh AFB RI activities were performed in accordance with the USEPA guidance manual, "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (USEPA, 1988d).

2.1 TOPOGRAPHIC FEATURES

A topographic survey was conducted for LF-022 and LF-023, and base maps were prepared using photogrammetric techniques. Topographic maps were prepared at a scale of 1 inch = 100 feet with a contour interval of 2 feet.

An elevation survey was conducted by a New York-licensed surveyor to locate the monitoring wells, soil borings, and other control points established during the RI. The inner casing of the monitoring wells were surveyed for both horizontal and vertical control, to a degree of accuracy of 0.1 feet and 0.01 feet, respectively. All other locations were surveyed for horizontal control, to a degree of accuracy of 0.1 feet.

2.2 METEOROLOGICAL INFORMATION

Meteorological information (e.g., precipitation, temperature, and wind speed) was obtained from Plattsburgh AFB meteorological records.

2.3 GEOPHYSICAL INVESTIGATIONS

The geophysical investigations conducted at Landfills LF-022 and LF-023 during the RIs were ground-penetrating radar (GPR), electromagnetic induction, and seismic refraction surveys. A magnetometer survey was conducted at both sites during the SIs. Methods used to conduct these surveys are summarized in the following subsections and discussed in detail in Appendix A.

2.3.1 Magnetometer

Magnetometer surveys were conducted at Landfills LF-022 and LF-023 during the SIs to define the landfill boundaries, locate buried metal objects (e.g, drums) and help determine the location of future explorations. Magnetometers measure changes in the earth's magnetic field (sometimes referred to as its "ambient" field) caused by both naturally occurring and man-made magnetic materials. A "proton precession" magnetometer was used to measure the vertical gradients of the magnetic fields at each landfill. A grid with 100 feet between nodes was established at each landfill. Based on these grids, measurements were taken every 20 feet.

2.3.2 Ground-Penetrating Radar

GPR was used at LF-023 to help define the boundary and depth of the landfill. The GPR technique uses high-frequency radio waves to determine the presence of subsurface objects and structures. The radar system consists of a control unit, an antenna assembly (i.e., transmitter/receiver), and a recording device for analog field recordings. A Geophysical Survey Systems, Inc., Subsurface Interface Radar System III was used.

2.3.3 Seismic Refraction

Seismic refraction surveys were conducted at Landfills LF-022 and LF-023 to evaluate landfill depths based on the assumption that there should be a noticeable difference in seismic velocity between the soils surrounding these sites and the fill material. A total of six seismic lines were shot during the surveys. Two seismic lines were shot across each landfill. Two seismic refraction lines were also shot to provide baseline subsurface information and evaluate the geologic environment in the area of the landfills. One line paralleled the base boundary west of LF-022 and FT-002, and the second was north of LF-022. The seismic refraction profiling method is an indirect means of determining the thickness of various seismic layers underlying a site. There is often a direct correlation between geologic strata and the layers defined during a seismic refraction investigation. Instrumentation consisted of an EG&G Geometrics ES2415-F 24-channel, signal enhancement seismograph.

2.3.4 Terrain Conductivity

Terrain Conductivity (i.e., electromagnetic induction) surveys were conducted at Landfills LF-022 and LF-023 to determine the presence and possible extent of a conductive leachate plume from these landfills. Instrumentation consisted of a Geonics EM-34 Terrain Conductivity Meter.

2.4 SUBSURFACE EXPLORATION METHODS

The stratigraphy and distribution of contaminants in subsurface soil and groundwater at the landfills were evaluated using test pits and monitoring wells. Monitoring wells and test pit designations were changed after the SI to incorporate the appropriate site code; new designations are shown in Table 2-1. Procedures for the subsurface exploration and monitoring well installation program are presented in the following subsections.

2.4.1 Test Pits

Test pits/trenches were excavated at LF-022 to examine subsurface conditions and assess the vertical and horizontal distribution of shallow soil contamination (i.e., within 15 feet of the surface). Test pits were not dug within the boundaries of D-7 (a subsection of LF-022) because of the general health and safety consideration of the contractor, and given the data from the Preliminary Assessment and SI, no further investigation was needed. Test pits/trenches were also used at LF-023 to investigate the extent and distribution of trench disposal activities. A backhoe was used to excavate the test pits/trenches. The final test pit locations were determined in the field based on results of the magnetometer survey. Soil classifications and stratigraphy were logged visually using the Unified Soil Classification System. Soil samples were collected in glass jars for headspace screening with a photoionization detector (PID). Based on screening results or visual evidence of contamination, samples were selected and submitted for chemical laboratory analysis. Upon completion of a test pit, soil removed during the excavation was returned to the pit. The backhoe bucket was steam-cleaned between test pits/trenches to prevent cross-contamination. Test pit logs are contained in Appendix B.

TABLE 2-1
EXPLORATION IDENTIFIER CHANGES

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

		MONITORING WELLS		SURFACE SOILS		SURFACE WATER		SEDIMENT		TEST PITS	
SITE CODE	SITE	PREVIOUS	CURRENT	PREVIOUS	CURRENT	PREVIOUS	CURRENT	PREVIOUS	CURRENT	PREVIOUS	CURRENT
02	FT-002	MW-306	MW-02-016								
22	LF-022	MW-112	MW-22-001	SS-1	SS-22-001					TP-110	TP-22-001
		MW-139	MW-22-002	SS-2	SS-22-002					TP-111	TP-22-002
		MW-328	MW-22-003	SS-3	SS-22-003					TP-112	TP-22-003
		MW-329	MW-22-004	SS-4	SS-22-004					TP-113	TP-22-004
		MW-330	MW-22-005							TP-114	TP-22-005
		MW-331	MW-22-006							TP-115	TP-22-006
		MW-332	MW-22-007							TP-116	TP-22-007
		MW-333	MW-22-008							TP-130	TP-22-008
		MW-334	MW-22-009							TP-131	TP-22-009
		MW-335	MW-22-010							TP-132	TP-22-010
										TP-133	TP-22-011
										TP-134	TP-22-012
										TP-135	TP-22-013
										TP-117	TP-22-014
23	LF-023	MW-109	MW-23-001	SS-1	SS-23-001	SW-307	SW-23-001	SD-307	SW-23-001	TP-101	TP-23-001
		MW-110	MW-23-002	SS-2	SS-23-002	SW-308	SW-23-002	SW-308	SW-23-002	TP-102	TP-23-002
		MW-111	MW-23-003	SS-3	SS-23-003					TP-103	TP-23-003
		MW-201	MW-23-004	SS-4	SS-23-004					TP-104	TP-23-004
		MW-202	MW-23-005							TP-105	TP-23-005
		MW-203	MW-23-006							TP-106	TP-23-006
		MW-204	MW-23-007							TP-107	TP-23-007
		MW-205	MW-23-008							TP-108	TP-23-008
		MW-206	MW-23-009							TP-109	TP-23-009
		MW-207	MW-23-010								
		MW-325	MW-23-011								
		MW-326	MW-23-012								
		MW-327	MW-23-013								

2.4.2 Monitoring Wells

Groundwater monitoring wells were installed at Landfills LF-022 and LF-023 to collect groundwater samples and to measure groundwater elevations. Monitoring wells were installed using 4.25-inch inside diameter hollow-stem augers. Most monitoring wells were constructed of 2-inch, Schedule 40, polyvinyl chloride (PVC) screen and riser. Because chemical compounds detected in the groundwater at LF-023 could degrade PVC well material, monitoring wells MW-23-011, MW-23-012, and MW-23-013 were constructed of 2-inch ID, flush-threaded, Schedule 5, Type 304 stainless steel, with wire-wrapped 10-foot and 15-foot sections of 0.010-inch slotted screen. All well materials were steam-cleaned and well joints were wrapped with Teflon tape before installation. The annulus around well screens was backfilled with a clean silica sand from approximately 2 feet below to 3 feet above the well screen. A minimum 2-foot bentonite pellet seal was installed above the sandpack in the shallow wells. A mixture of 95 percent cement and 5 percent bentonite grout was tremie-grouted into place above the bentonite pellet seal, extending to the ground surface. At each of the deep wells, a bentonite slurry seal (minimum 6-foot thickness) was installed by the tremie method on top of the sandpack, prior to tremie-grouting the remaining annulus of the borehole with cement/bentonite grout. The monitoring well screen and sandpack were developed to remove fine sediments and provide a hydraulic connection with natural soils. Monitoring wells were developed by alternately pumping and hydraulic surging (i.e., a combination of air and manual lift). The wells were surged for at least an hour or until the water appeared clear and free of silts. A hydrocarbon air filter was used within the airlift system. At 15-minute intervals, development water was captured in a container and pH, temperature, and conductivity were measured using a Model 3500 "Water Quality Monitoring System" manufactured by Yellow Springs Instruments. When these readings stabilized and the water was clear, development was considered complete.

Aboveground protective steel casing was installed and sealed into the ground over well risers and equipped with locking covers. A continuous-pour concrete apron was formed around the casing to add stability and divert runoff. The aboveground portions of both the well riser and protective casing were vented. Weep holes were drilled in the protective casing near ground level to allow water to drain from inside the casing. Boring logs and well installation diagrams are contained in Appendix C and D, respectively.

2.4.2.1 Aquifer Testing. Aquifer tests were conducted in selected wells to assess the hydraulic properties of the geologic formations. Hydraulic conductivity tests were performed by (1) removing water or depressing the water table (rising-head test), or (2) adding water or raising the water level (i.e., falling-head test). As the water level returned to its static level, changes in the water levels were measured as a function of time using a pressure transducer and data logger. Six wells were tested at LF-022 and eight wells were tested at LF-023. Hydraulic conductivity was calculated using three different methods (i.e., Hvorslev, Bouwer and Rice, and Cooper). Aquifer test results are contained in Appendix E.

2.4.2.2 Groundwater Sampling. Groundwater samples were collected from new and existing monitoring wells at LF-022 and LF-023, and were submitted for chemical analysis. New monitoring wells were sampled at least 14 days after well development.

Wells were purged (three well volumes) before sampling using a pump or bailer, depending on site hydrogeology and monitoring well depth. Purged water was allowed to discharge onto the ground surface unless deemed hazardous, at which time it was collected in U.S. Department of Transportation-approved 55-gallon drums. Samples for inorganic analysis were collected using a submersible pump and filtered through 0.45-micron filter paper. Samples for organic analysis were sampled by lowering a stainless steel bailer with a ball check valve to the midpoint of the screened interval. Water level and ambient air quality data (i.e., PID readings) were obtained and recorded on field data sheets. All field instrumentation (i.e. PIDs and the Model 3500 "Water Quality Monitoring System") was calibrated on a daily basis in accordance with manufacturer's instructions. The calibration data were recorded on daily field calibration records (calibration records are maintained in the ABB Environmental project file). Groundwater sampling data sheets are contained in Appendix F.

2.4.2.3 Soil Sampling. Soil samples were obtained for geologic interpretation and grain size analysis by using split-spoon samplers. These soil samples were visually logged using the Unified Soil Classification System.

Samples were collected at 5-foot intervals in most borings for stratigraphic interpretation. Samples were collected at 2-foot intervals at the bottom of deep borings to help define geologic features (e.g., the depth of the clay that underlies LF-022 and LF-023).

2.5 SURFACE EXPLORATION METHODS

The distribution of contaminants in surface soil, surface water, and sediment was investigated during the RI. Surface soil, sediment, and surface water sample location designations were changed after the SI to incorporate the appropriate site code; new designations are shown in Table 2-1. Procedures for the surface exploration program are described in the following subsections.

2.5.1 Surface Soil Investigation

Composite and discrete surface soil samples were collected at LF-022 and LF-023 for laboratory analysis. For composite samples, each landfill was divided into four quadrants and each quadrant was sampled by compositing 15 to 25 surface soil samples. Soil samples were visually logged using the Unified Soil Classification System.

2.5.2 Soil Organic Vapor Survey

Passive soil gas surveys (Petrex technique) were conducted at LF-022 and LF-023 to identify areas of potential contamination and help determine the location of future explorations. Samples were collected at 50-foot intervals using the grids established for the geophysical surveys. Holes were cored to approximately 1 foot. Collector tubes were installed vertically, open end down, in the holes and covered with clean sand. Collectors consisted of activated charcoal applied to the end of a ferromagnetic wire housed in a collector tube. Collectors were left in the ground for approximately four weeks, then retrieved and shipped to the laboratory. The gas collectors were analyzed by thermal desorption directly into a mass spectrometer. The analytical results are based on a relative scale of ion counts. Quantitative values were not determined; instead, values were compared on a relative scale to other samples. Depending on the complexity of the sample matrix, compounds were reported by general category (e.g., alkanes, simple aromatics, and trichloroethene [TCE]). Because data from this survey is nonquantitative, only survey patterns or the relative difference between values from two samples of the same survey were considered during interpretation. Results of the surveys are contained in Appendix G.

2.5.3 Surface Water and Sediment Investigation

Because there are no surface water features within the boundaries of LF-022 and LF-023, no surface water or sediment samples were collected from the landfills. However, surface water and sediment samples were collected at two seeps south (i.e., downgradient) of LF-023 to assess the extent of potential contaminant migration from LF-023 via groundwater, which is discharged to surface water seeps. These two seeps were selected for sampling because they were closest to potential receptors on the western side of the base (i.e., residents in a nearby housing development). Based on the flows and depths of surface water at the designated sampling locations, water samples were collected at approximately mid-depth levels in the water column. Where water depths are 2 to 6 feet, these samples were collected using a stainless steel water sampler. At shallow locations, samples were collected by direct immersion of sample bottles. Care was taken to avoid stirring up sediments that would contaminate the water sample. Sediment samples were collected using a stainless steel spoon and a aluminum tray. At each location, several spoonfuls of sediments were collected from the same sample point, mixed in an aluminum tray, and placed in sample jars. Sediment samples collected for volatile organic analysis were not homogenized before bring placed in the sample jars. Sediment and surface water sampling data sheets are contained in Appendix H.

2.6 Laboratory Analytical Methods and Validation Procedures

The analytical methods and validation procedures used during the investigations at LF-022 and LF-023 are listed in Table 2-2. The qualifiers assigned to data during validation are defined in Table 2-3.

2.7 Assessment of Analytical Data

To determine which compounds are site contaminants, the analytical results were compared to background concentrations and/or standards established by the New York State Department of Environmental Conservation (NYSDEC) or USEPA. The specific methods used to evaluate the laboratory results are described in the following paragraphs.

TABLE 2-2
SUMMARY OF ANALYTICAL METHODS AND DATA VALIDATION

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

MEDIA	YEAR SAMPLED	METHOD	VALIDATION
WATER			
Groundwater	1987	CLP-COP, CLP-CIP	4
Surface Water	1988	CLP-COP, CLP-CIP, PHCs (USEPA Method 418.1)	1, 2, 3
Groundwater	1988-1989	CLP-COP, CLP-CIP USEPA Method 8010	1, 2, 3
SOIL			
Test Pit Soil	1987	CLP-COP, CLP-CIP	4
Sediments	1988	CLP-COP, CLP-CIP, PHCs (USEPA Method 418.1)	1, 2, 3
Surface Soil	1988-1989	CLP-COP, CLP-CIP	1, 2, 3

NOTES:

[1] "Laboratory Data Validation Functional Guidelines for Evaluating Oganics Analyses", February, 1988

[2] "Region I Laboratory Data Validation Functional Guidelines for Evaluating Oganics Analyses", November, 1988

[3] "Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses", February, 1989

[4] Site Inspection data were evaluated based on blank contamination using guidelines 1 and 3

CLP USEPA National Contract Laboratory Program
COP Caucus Organic Protocol
CIP Caucus Inorganic Protocol
PHC Petroleum hydrocarbon

TABLE 2-3
DATA QUALIFIER DEFINITIONS

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

QUALIFIER	DEFINITION
Qualifiers for Organic Data	
C	Gas chromatograph results were confirmed by mass spectrometry.
J	Indicates an estimated concentration because results are either below the contract required detection level (CRQL) or quality control criteria were not met.
JJ	Validation qualifier for concentrations below the CRQL.
U	Indicates that compound was analyzed but not detected.
UJ	Indicates that quantitation level was estimated because quality control (QC) criteria were not met.
B	Indicates analyte was detected in both the sample and the associated laboratory method blank.
E	Indicates that the analyte concentration exceeded the calibration range of the gas chromatograph/mass spectrograph and that a re-analysis of a diluted sample is required.
D	Indicates that sample concentration was obtained by dilution to bring result within calibration range.
R	Indicates that data is unusable because QC criteria were not met.
X	Laboratory-defined qualifier used to provide additional information not covered by the other qualifiers.
Qualifiers for Inorganic Data	
E	The reported concentration is estimated because of the presence of an interference.
J	Indicates an estimated concentration because QC criteria were not met.
R	Indicates that data is unusable because QC criteria were not met.
M	Duplicate precision criteria were not met.
N	Spiked sample recovery not within control limits.
s	The reported concentration was determined by the method of standard additions.
W	Postdigestion spike for furnace atomic adsorption analysis is outside control limits.
[]	Concentration reported is below CRQL.

TABLE 2-3
(Continued)
DATA QUALIFIER DEFINITIONS

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

QUALIFIER	DEFINITION
Inorganic Data Qualifiers (continued)	
*	Duplicate analysis not within control limits.
+	Correlation coefficient for the method of standard additions was less than 0.995.
Other Notations	
NR	Analysis not requested.
NA	Analysis requested but not performed.
-	Compound analyzed but not detected.

For soil and sediment samples, organics detected at concentrations above the detection limit were considered site contaminants unless they could be attributed to laboratory or sampling contamination. Inorganic concentrations were compared to the background concentrations shown in Table 2-4. The Northern New York Region background concentrations shown in Table 2-4 were established by using soil data published by the U.S. Geological Survey (Shacklette, 1984). Data from selected samples collected in northern New York were compiled to establish the regional ranges. The background concentrations based on soil type (i.e., U.S. alluvial soil) were obtained from other literature (Kabata-Pendias, 1984). A compound was considered a site contaminant if the concentration of an inorganic compound exceeded both ranges. Samples of soils from other locations on the base have been analyzed for inorganics. The results of these analyses cannot be used to establish site-specific background concentrations for inorganics but can be used for comparison. Concentrations of inorganics detected in soils at the landfills were compared to concentrations from other locations. If concentrations of a compound were significantly higher relative to other locations, the compound was considered a site contaminant even if it was within the two ranges listed in Table 2-5.

For groundwater, concentrations of both organic and inorganic compounds were compared to New York State and federal standards and background concentrations detected in upgradient wells (Tables 2-5 and 2-6). The primary standards for comparison were New York State Class GA groundwater standards. If a compound has no associated Class GA standard, concentrations were compared to New York State Drinking Water Standards or federal maximum contaminant levels. If the concentration of a compound exceeded the appropriate standard, it was compared to background concentrations to determine if the contaminant is site-related. If the concentration of a compound was less than the appropriate standard but greater than background concentrations, it was still considered a site contaminant. If no standards exist for a compound, its concentration was compared to background concentrations to determine if it is a site contaminant. The decision process to determine if a compound is a site contaminant is shown in Figure 2-1.

The results of the laboratory analysis of surface water samples collected near LF-023 were compared to New York State and federal ambient water quality criteria. The criteria used are listed in Table 2-7. The analytical results for sediment samples were compared to the same criteria as soils to determine which compound are site contaminants.

TABLE 2-4
BACKGROUND SOIL CONCENTRATIONS

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

COMPOUND	NORTHERN NEW YORK REGION RANGE* (mg/kg)	KABATA-PENDIAS U.S. ALLUVIAL SOILS RANGE (mg/kg)
Aluminum	700-70,000	
Antimony		0.25-0.60
Arsenic	<0.1-6.5	<1-93
Barium	10-300	70-3000
Beryllium	<1-1.5	<1-5
Cadmium		0.41-0.57
Calcium	130-12,000	
Chromium	1-2,000	7-1,500
Cobalt	5-10	3-50
Copper	<1-20	3-300
Iron	100-30,000	
Lead	10-20	<10-70
Magnesium	50-7,000	
Manganese	<2-700	20-3,000
Mercury	0.051-0.13	0.02-1.50
Nickel	<5-700	<5-150
Potassium	16,000-20,000	
Selenium	<0.1-5.1	<0.1-4.0
Silver		0.03-2.8
Sodium	3,000-10,000	
Vanadium	<7-70	0.7-98
Zinc	28-45	13-300

NOTES:

* Concentrations obtained from U.S. Geological Survey Paper 1270

TABLE 2-5
GROUNDWATER STANDARDS AND GUIDANCE

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

	NY STATE Groundwater Quality Class GA (ug/l)	NY STATE Drinking Water Supplies (ug/l)	FEDERAL MCL (ug/l)	FEDERAL MCLG (ug/l)	FEDERAL WQC Drink (ug/l)
VOLATILE ORGANIC COMPOUNDS					
Chloromethane		5			0(0.19)
Bromomethane		5			0(0.19)
Vinyl Chloride	2	2	2	0	0(2.0)
Chloroethane		5			IND
Methylene Chloride	5	5	(5)	(0)	0(0.19)
Acetone		50			
Carbon Disulfide		50			
1,1-Dichloroethene	5	5	7	7	0(33 ng/l)
1,1-Dichloroethane	5	5			
1,2-Dichloroethene (total)	5	5	*	**	IND
Chloroform	100 T	100 T	100 T		0(0.19)
1,2-Dichloroethane	5	5	5	0	0(0.94)
2-Butanone		50			
1,1,1-Trichloroethane	5	5	200	200	19000
Carbon Tetrachloride	5	5	5	0	0(0.42 ng/l)
Vinyl Acetate		50			
Bromodichloromethane	50 GT	100 T	100 T		
1,2-Dichloropropane	5	5	(5)	(0)	IND
Trans-1,3-Dichloropropene	5	5			87
Trichloroethene	5	5	5	0	0(2.8)
Dibromochloromethane	50 GT	100 T	100 T		0(0.19)
1,1,2-Trichloroethane	5	5	(5)	(3)	0(0.6)
Benzene	ND	5	5	0	0(0.67)
Cis-1,3-Dichloropropene	5	5			87
2-Chloroethylvinylether		5			
Bromoform	50 GT	100 T	100 T		
4-Methyl-2-Pentanone		50			
2-Hexanone	50 G	50			
Tetrachloroethene	5	5	(5)	(0)	0(0.88)
1,1,2,2-Tetrachloroethane	5	5			0(0.17)
Toluene	5	5	(1000)	(1000)	15000
Ethylbenzene	5	5	(700)	(700)	2400
Chlorobenzene	5	5	(100)	(100)	488
Styrene	5 $	50	(100)	(100)	
Xylenes (Total)	5	5	(10000)	(10000)	

TABLE 2-5
(continued)
GROUNDWATER STANDARDS AND GUIDANCE

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

	NY STATE Groundwater Quality Class GA (ug/l)	NY STATE Drinking Water Supplies (ug/l)	FEDERAL MCL (ug/l)	FEDERAL MCLG (ug/l)	FEDERAL WQC Drink (ug/l)
SEMI-VOLATILE ORGANIC COMPOUNDS					
Phenol	+	50			3500
bis(2-Chloroethyl)ether	1	5			0(30 ng/l)
2-Chlorophenol	+	50			0.1(ol)
1,3-Dichlorobenzene	5	5	(600)	(600)	470
1,4-Dichlorobenzene	4.7 P	5	75	75	470
Benzyl alcohol		50			
1,2-Dichlorobenzene	4.7 P	5	(600)	(600)	470
2-Methylphenol	+	50			
bis(2-Chloroisopropyl)ether		5			34.7
4-Methylphenol	+	50			
N-Nitroso-di-n-propylamine		50			
Hexachloroethane		5			0(2.4)
Nitrobenzene	5	5			19800
Isophorone	50 G	50			5200
2-Nitrophenol	+	50			
2,4-Dimethylphenol	+	50			400(ol)
Benzoic acid		50			
bis(2-Chloroethoxy)methane		50			
2,4-Dichlorophenol	+	50			3090
1,2,4-Trichlorobenzene	5	5	(9)	(9)	IND
Naphthalene	10 G	50			IND
4-Chloroaniline		5			
Hexacholorobutadiene	5	5			0(0.45)
4-Chloro-3-Methylphenol	+	50			3000
2-Methylnaphthalene		50			0(3.1 ng/l)
Hexachlorocyclopentadiene	5	5	(50)	(50)	206
2,4,6-Trichlorophenol	+	50			0(1.8)
2,4,5-Trichlorophenol	+	50			2600
2-Chloronaphthalene	5	50			IND
2-Nitroaniline		5			
Dimethylphthalate	50 G	50			350000
2,6-Dinitrotoluene	5	5			
3-Nitroaniline		5			
Acenaphthene	20 G	50			0(3.1 ng/l)
2,4-Dinitrophenol	+	50			70

TABLE 2-5
(continued)
GROUNDWATER STANDARDS AND GUIDANCE

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

	NY STATE Groundwater Quality Class GA (ug/l)	NY STATE Drinking Water Supplies (ug/l)	FEDERAL MCL (ug/l)	FEDERAL MCLG (ug/l)	FEDERAL WQC Drink (ug/l)
4-Nitrophenol	+	50			
Dibenzofuran		50			
2,4-Dinitrotoluene		5			0(0.11)
Diethylphthalate	50 G	50			434000
4-Chlorophenyl-phenylether		5			
Fluorene	50 G	50			0(2.8 ng/l)
4-Nitroaniline		5			
4,6-Dinitro-2-methylphenol	+	50			
N-Nitrosodiphenylamine	50 G	50			0(7.0)
4-Bromophenyl-phenylether		5			
Hexachlorobenzene	0.35	5	(1)	(0)	0(21 ng/l)
Pentachlorophenol	+	50	(1)	(0)	200
Phenanthrene	50 G	50			0(3.1 ng/l)
Anthracene	50 G	50			0(3.1 ng/l)
Di-n-butylphthalate	50 $	50			44000
Fluoranthene	50 G	50			188
Pyrene	50 G	50			0(3.1 ng/l)
Butylbenzylphthalate	50 G	50			
3,3'-Dichlorobenzidine		50			470
Benzo(a)Anthracene	0.002 G	50			0(3.1 ng/l)
Chrysene	0.002 G	50			0(3.1 ng/l)
bis(2-Ethylhexyl)phthalate	50 $	50			
Di-n-octylphthalate	5	50			
Benzo(b)Fluoranthene	0.002 G	50			0(3.1 ng/l)
Benzo(k)Fluoranthene	0.002 G	50			0(3.1 ng/l)
Benzo(a)Pyrene	ND	50	(0.2)	(0)	0(3.1 ng/l)
Indeno(1,2,3-cd)pyrene	0.002 G	50			0(3.1 ng/l)
Dibenz(a,h)anthracene		50			0(3.1 ng/l)
Benzo(g,h,i,)perylene		50			0(3.1 ng/l)
PESTICIDES/PCB COMPOUNDS					
alpha-BHC	ND				0(73 ng/l)
beta-BHC	ND				0(23.3 ng/l)
delta-BHC	ND				IND
gamma-BHC (Lindane)	ND	4	4	(0.2)	0(17.4 ng/l)
Heptachlor	ND		(0.4)	(0)	0(11 ng/l)

TABLE 2-5
(continued)
GROUNDWATER STANDARDS AND GUIDANCE

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

	NY STATE Groundwater Quality Class GA (ug/l)	NY STATE Drinking Water Supplies (ug/l)	FEDERAL MCL (ug/l)	FEDERAL MCLG (ug/l)	FEDERAL WQC Drink (ug/l)
Aldrin ***	ND				
Heptachlor epoxide	ND		(0.2)	(0)	
Endosulfan I					138
Dieldrin ***	ND				0(1.1 ng/l)
4,4'-DDE	ND				
Endrin	ND	0.0002	0.2		1
Endosulfan II					
4,4'-DDD	ND				
Endrin Aldehyde					
Endosulfan sulfate					
4,4'-DDT	ND				0(1.2 ng/l)
Methoxychlor	35	50	100	(400)	
Endrin ketone					
alpha-Chlordane	0.1		(2)	(0)	0(22 ng/l)
gamma-Chlordane	0.1		(2)	(0)	0(22 ng/l)
Toxaphene	ND	50	5	(0)	0(26 ng.l)
Aroclor-1016	0.1				0(>12.6 ng/l)
Aroclor-1221	0.1				0(>12.6 ng/l)
Aroclor-1232	0.1				0(>12.6 ng/l)
Aroclor-1242	0.1				0(>12.6 ng/l)
Aroclor-1248	0.1				0(>12.6 ng/l)
Aroclor-1254	0.1				0(>12.6 ng/l)
Aroclor-1260	0.1				0(>12.6 ng/l)
INORGANIC COMPOUNDS					
Aluminum					
Antimony	3 G		(10/5)	(3)	
Arsenic	25	50	50		0.0022
Barium	1000	1000	1000	(5000)	
Beryllium	3 G		(1)	(0)	
Cadmium	10	10	10	(5)	10
Calcium					
Chromium	50	50	50	(100)	
Chromium VI	50				50
Chromium III					179000
Cobalt					

TABLE 2-5
(continued)
GROUNDWATER STANDARDS AND GUIDANCE

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

	NY STATE Groundwater Quality Class GA (ug/l)	NY STATE Drinking Water Supplies (ug/l)	FEDERAL MCL (ug/l)	FEDERAL MCLG (ug/l)	FEDERAL WQC Drink (ug/l)
Copper	200	1000		(1300)	1000(ol)
Cyanide	100		(200)	(200)	
Iron	300	300			
Lead	25	50	50	(0)	50
Magnesium	35000 G				
Manganese	300	300			
Mercury	2	2	2	(2)	10
Nickel			(100)	(100)	15.4
Potassium					
Selenium	10	10	10	(50)	10
Silver	50	50	50		50
Sodium	20000				
Thallium	4 G		(2/1)	(0.5)	17.8
Vanadium					
Zinc	300	5000			5000(ol)

NOTES:

Federal MCLs and MCLGs from 40 CFR 141.

Federal MCLs and MCLGs in parentheses are proposed (from 54FR22062, 55FR30370, and 56FR3521)

Federal WQCs taken from EPA's Superfund Public Health Evaluation Manual, October 1987, Table 4-7 and Exhibits C-4 and C-6.

New York State Groundwater Quality standards taken from 6NYCRR 703 (March 31, 1986) and Division of Water Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards and Guidance Values (September 25, 1990). New York State Public Water Supply MCLs taken from 10 NYCRR 5-1 (January 19, 1990).

MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
WQC	Water Quality Criteria (for the protection of human health).
G	Guidance values taken from New York State Division of Water Technical and Operational Guidance Series (Ambient Water Quality Standards and Guidance Values, September 25, 1990).
IND	Insufficient data.
ND	Not detectable.
ol	Organoleptic, criteria based on odor and taste, not health. No health-based criteria available.
P	Total para and ortho.
T	Total trihalomethanes = 100 μg/L.
*	Cis-1,2-Dichloroethene = 70 μg/L; Trans-1,2-dichloroethene = 100 μg/L.
**	Cis-1,2-Dichloroethene = (70 ug/L) and trans-1,2-dichloroethene = (100 ug/L).
***	Combined Aldrin/Dieldrin <.001 Aquatic.
****	Chlordane = (2μg/L).
+	Total phenols limit of 1.0 ug/l.
$	Not included in 100 ug/l organic total.

TABLE 2-6
UPGRADIENT GROUNDWATER CONCENTRATIONS

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

COMPOUND	REPORTED RANGE LF-023	LF-022
VOCs (1 g/L)		
Acetone	<10	<10
Vinyl Chloride	<0.3	<10
Chloroform	<5-15	<5
2-Butanone	<10-160	<10
Benzene	<5	<5
Chlorobenzene	<5	<5
Ethylbenzene	<5	<5
Xylenes (total)	<5	<5
Chloroethane	<0.5	<10
1,1-Dichloroethene	<0.3	<5
1,1-Dichloroethane	<0.4	<5
1,2-Dichloroethane	<0.3	<5
SVOCs (1 g/L)		
Phenol	<10	<10
2-Chlorophenol	<10	<10
2-Methylphenol	<10	<10
4-Methylphenol	<10	<10
2-Nitrophenol	<10	<10
2,4-Dimethylphenol	<10	<10
Benzoic Acid	<50	<50
2,4-Dichlorophenol	<10	<10
Naphthalene	<10	<10
4-Chloro-3-methylphenol	<10	<10
2,4,6-Trichlorophenol	<10	<10
2,4,5-Trichlorophenol	<50	<50
2,4-Dinitrophenol	<50	<50
4-Nitrophenol	<50	<50
4,6-Dinitro-2-methylphenol	<50	<50
Pentachlorophenol	<10	<50
bis(2-Ethylhexyl)phthalate	<10-14	<10-52
Inorganics (1 g/L)		
Aluminum	<200	<200
Arsenic	<10	<10
Calcium	28,500-53,000	50,000-74,000
Chromium	<10	<10
Iron	103-18,400	<100
Magnesium	<5,000-21,000	18,700-25,900
Manganese	<15-183	<15-166
Nickel	<40	<40
Potassium	<5,000-5,200	9,530-10,200
Selenium	<5	<5
Sodium	6,440-100,000	54,500-125,000
Zinc	<20-80	<20-83

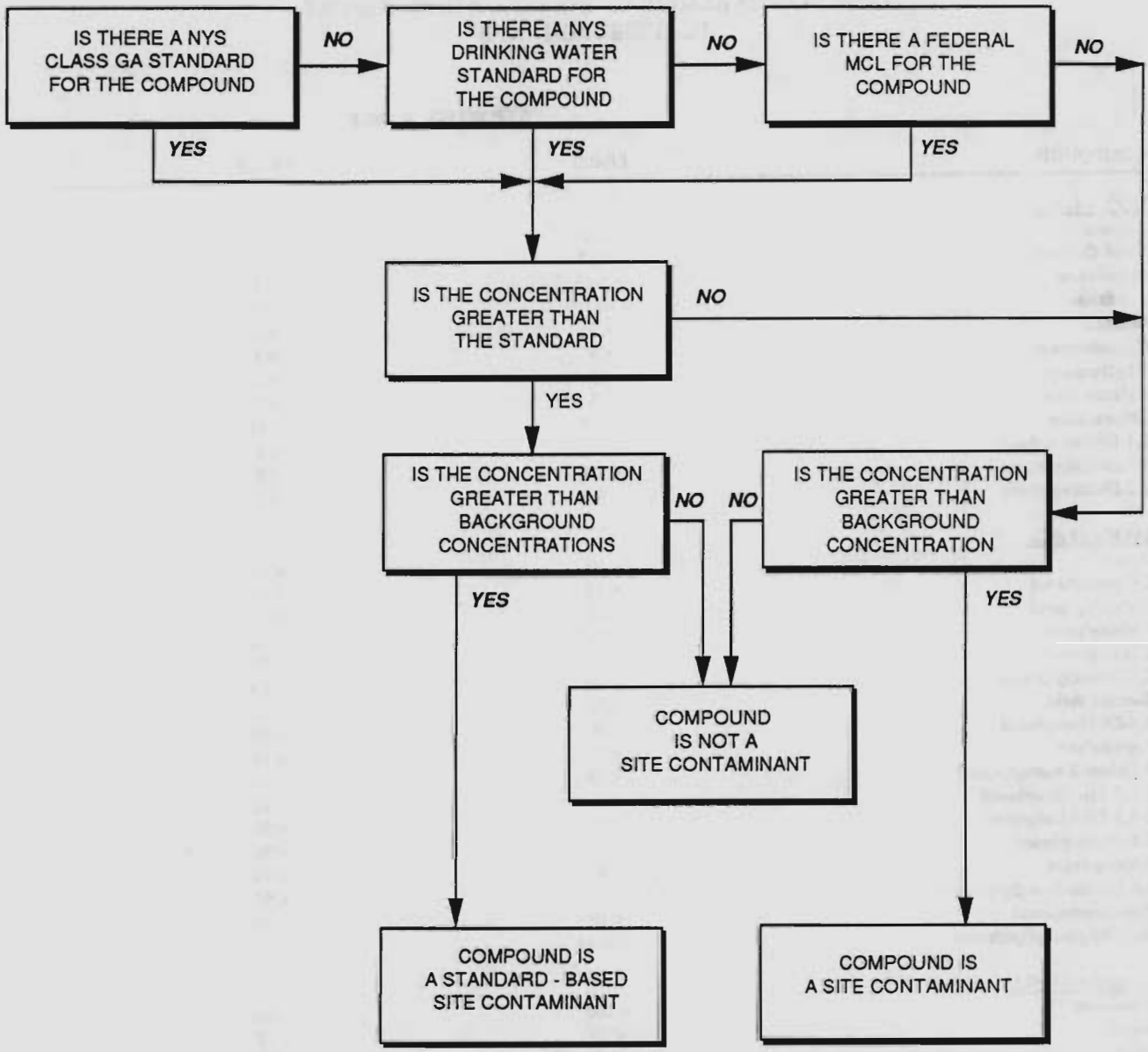


FIGURE 2-1
DECISION TREE FOR IDENTIFYING-
SITE CONTAMINANTS IN GROUNDWATER
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

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TABLE 2-7
SURFACE WATER CRITERIA

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

COMPOUND	NEW YORK STATE AWQC (ug/l)	FEDERAL AWQC FRESH ACUTE (ug/l)	FEDERAL AWQC FRESH CHRONIC (ug/l)
Aluminum		750[2]	87[2]
Arsenic		850/360[3]	48/190[3]
Iron	300		1000
Lead	13[1]	82	3.2
Zinc	796[1]	120[1]	110[1]

NOTES:

[1] Hardness dependent, New York State AWQC based on a hardness of 300 mg/l as $CaCO_3$ calculated using USEPA standard methods and calcium and magnesium concentrations from surface water sample SW-23-002

[2] pH dependent

[3] Arsenic IV and arsenic III, respectively

AWQC - Ambient water quality criteria

For each media, tables listing the analytical data for compounds identified as site contaminants have been included in the text. Only the site contaminants are presented on these tables to prevent them from becoming cumbersome and to minimize confusion. Complete analytical data is contained in Appendix I.

2.8 HUMAN POPULATION SURVEY

Data on human populations at or in the vicinity of Plattsburgh AFB were obtained through use of 1986 U.S. Census information, census information provided by Plattsburgh AFB, as well as a site reconnaissance to determine housing distribution, land use, and location of potable water supplies.

Plattsburgh AFB is composed of several individual sites and has a significant on-site population. Therefore, the population survey focused on the relative accessibility of each site to both on-base and off-base populations based on the proximity of the sites to population centers and/or restricted areas.

2.9 SITE ECOLOGICAL SURVEY

The site ecological survey serves as a basis for identifying potential ecological receptors of chemical contamination. It includes evaluation of the different biological habitats present, and the animal life associated with these habitats.

The ecological surveys conducted at LF-022 and LF-023 included site surveys and a review of background information. During the site survey, plant species were identified and habitats were characterized. Additionally, any incidental observations of terrestrial wildlife were recorded. Sources of background information used in the site ecological survey include: the "Fish and Wildlife Management Plan for Plattsburgh Air Force Base" (U.S. Fish and Wildlife Service, 1986), the draft Environmental Impact Statement for the sea lamprey control program (NYSDEC, 1987), the New York Vertebrate Characterization Abstract and Breeding Bird Atlas provided by NYSDEC, the New York Natural Heritage Program, U.S. Geological Survey topographic maps, and aerial photographs. Vegetative cover maps and a wetland identification map are contained in Appendix J.

3.0 LANDFILL LF-022

3.1 PHYSICAL CHARACTERISTICS

The following subsections contain the results of field investigations related to the physical characteristics of the site. LF-022 site features are shown in Figure 3-1.

3.1.1 Topography

Topography across the LF-022 site is relatively flat; the land slopes gradually towards the east and southeast. Elevations range from 258 to 271 feet above sea level with a surface gradients between 0 and 3 percent. However, north of LF-022, there is a relatively steep slope into a natural depression (see Figure 3-1).

3.1.2 Surface Features

Landfill activities ceased at LF-022 in 1966. Since then, secondary growth has established itself across the landfill surface. The organic soil layer is very thin or nonexistent over most of the landfill. Surface soils within the landfill boundaries are medium sands with little to trace silt. These soils appear to be native soils mined in the area and used as cover material after landfill operations ceased.

Surface depressions in many areas of the landfill are associated with trenches dug during landfill operations. The refuse disposed of in trenches has compacted and settled naturally, forming shallow surface depressions. Information from the magnetometer survey, old aerial photographs, and test pits has revealed no consistent trenching pattern. The trenches appear to have been dug in one direction for a period of time and then changed to another direction.

3.1.3 Surface Water

There are no surface water bodies within LF-022. The relatively low surface relief, highly permeable surface soils, deep water table, vegetative cover, and lack of observed erosion or deposition features also indicate that there is no major surface water runoff during storms. However, groundwater from LF-022 may collect in a natural depression, approximately 600 feet north of the site (see Figure 1-3), during high water conditions (i.e., spring runoff). Two pairs of wells were installed north of

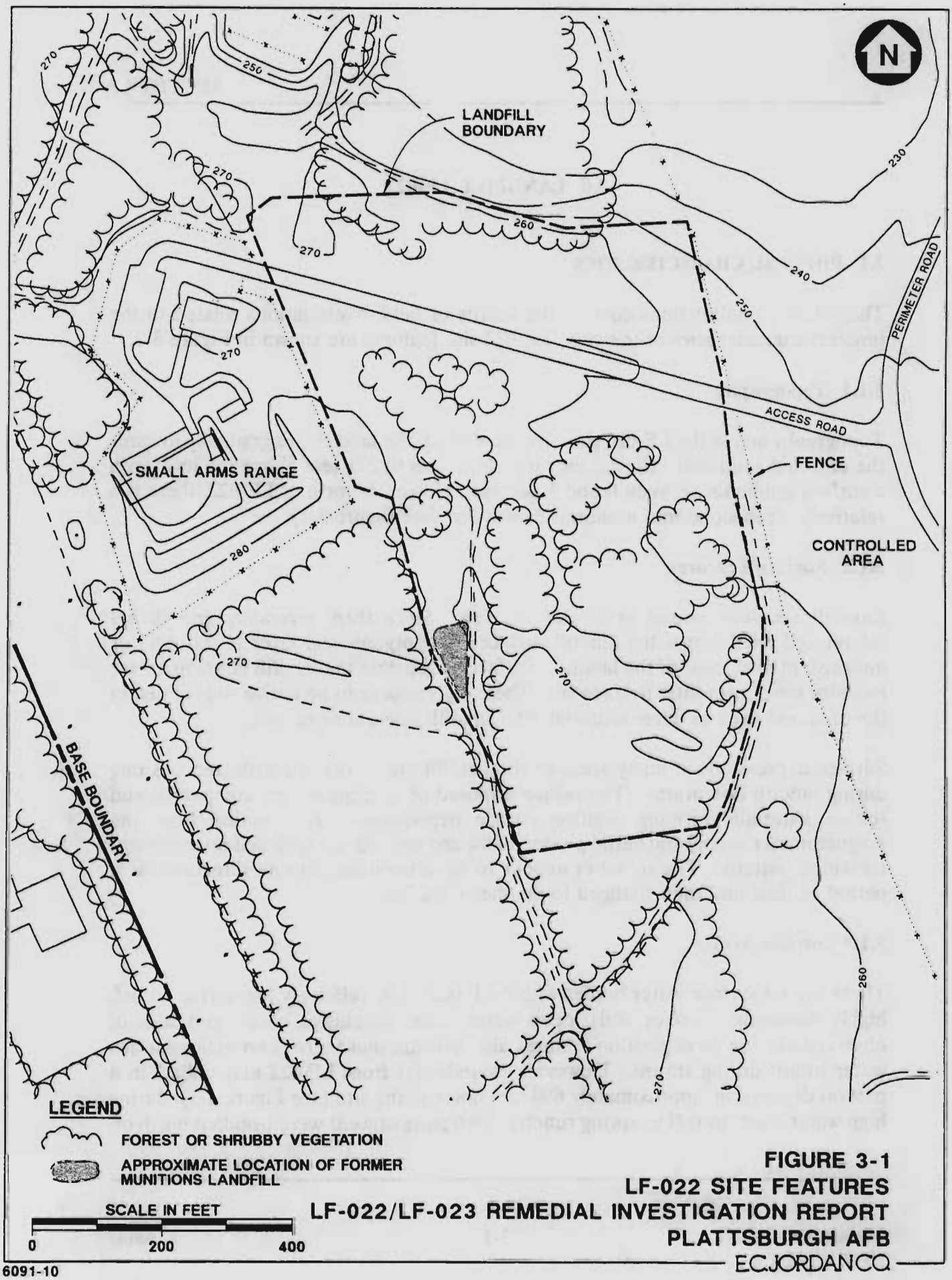


FIGURE 3-1
LF-022 SITE FEATURES
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
ECJORDANCO

6091-10

the landfill to evaluate the quality of groundwater flowing north from the landfill toward the depression.

In 1987, the U.S. Air Force built a small arms range on northwestern edge of the landfill and an access road across part of the landfill (see Figure 3-1). This construction changed some surface features at the site but has had no observable effects on overall surface drainage from the site.

3.1.4 Geology

LF-022 geology and subsurface conditions were characterized by using information from test pits, borings made during the installation of monitoring wells, laboratory grain size analyses, geophysical surveys, and literature searches. Soil samples collected from borings are representative of Pleistocene marine depositional conditions described by Fisher (1968) and Denny (1974). The stratigraphy in this area consists of four geologic units: sand, clay, till, and carbonate bedrock. Geologic information collected during the SI and RI has been used to construct interpretive profiles of the stratigraphy at LF-022. The location of the geologic profiles is shown in Figure 3-2; north to south and east to west profiles are shown in Figures 3-3 and 3-4, respectively. The following descriptions and average depths of strata were interpreted from boring logs and the results of the seismic refraction survey and are summarized in Table 3-1.

3.1.4.1 Sand. The upper sand unit extends from the ground surface to approximately 80 feet below ground surface (bgs) and is interpreted as deltaic and near shore marine deposits. It is well-sorted, medium-to-fine sand, with trace to some silt. Larger size particles are not common but gravel and/or cobbles are occasionally encountered. In general, the particle size decreases with depth (i.e., fine sands and silts become more prominent at the bottom of the unit).

The color of the sand changes from light brown to gray at the water table. This change represents the difference between the oxidation/reduction conditions above and below the water table. The light brown color above the water table indicates oxidizing conditions, while the gray color is an indication of reducing conditions below the water table.

Sedimentary structures were observed in test pits and split-spoon samples from borings. However, because of the limitations imposed by 2-inch-diameter split-spoon

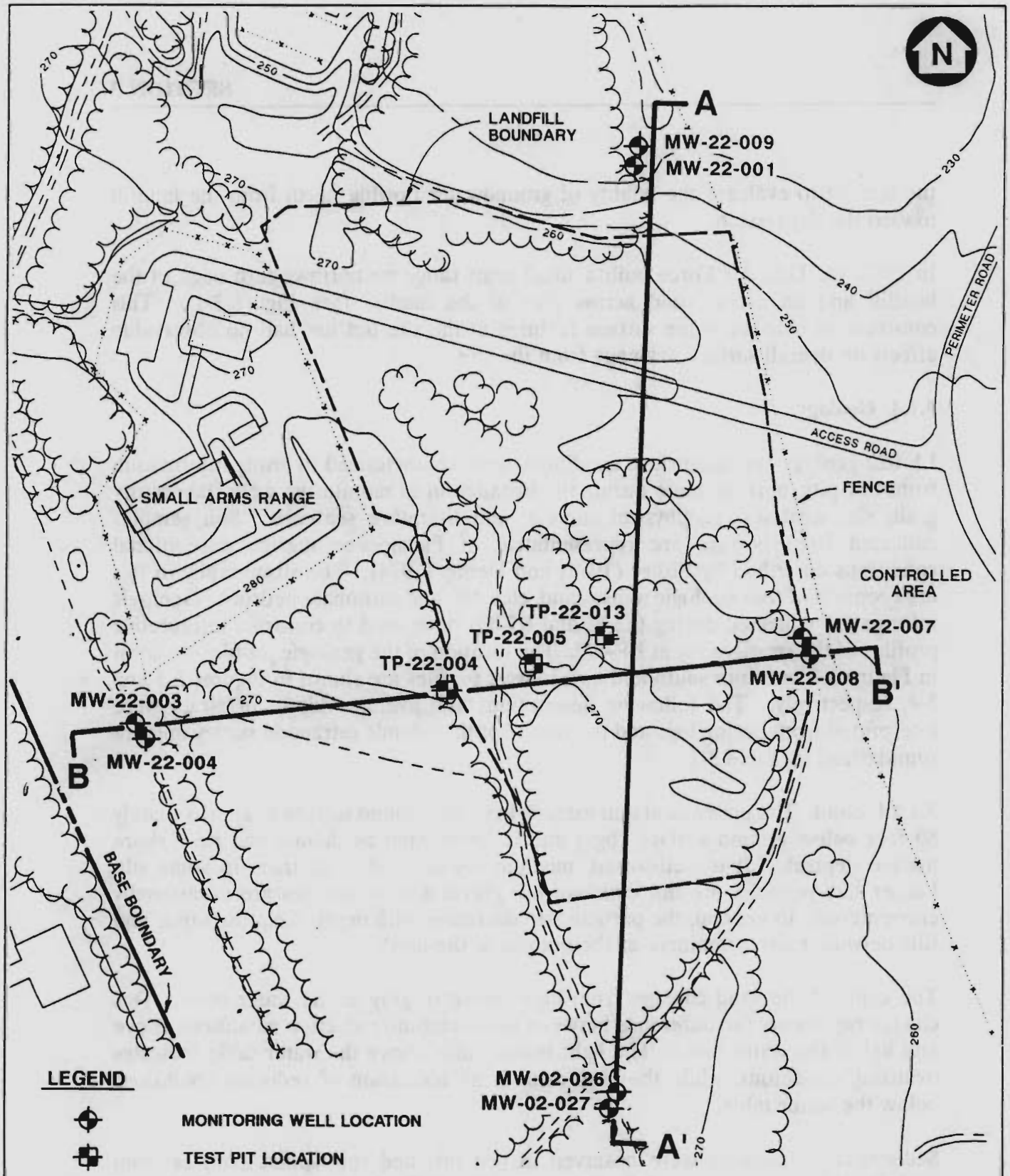


FIGURE 3-2
LF-022 GEOLOGIC PROFILE LOCATIONS
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
E.C.JORDAN CO.

6091-10

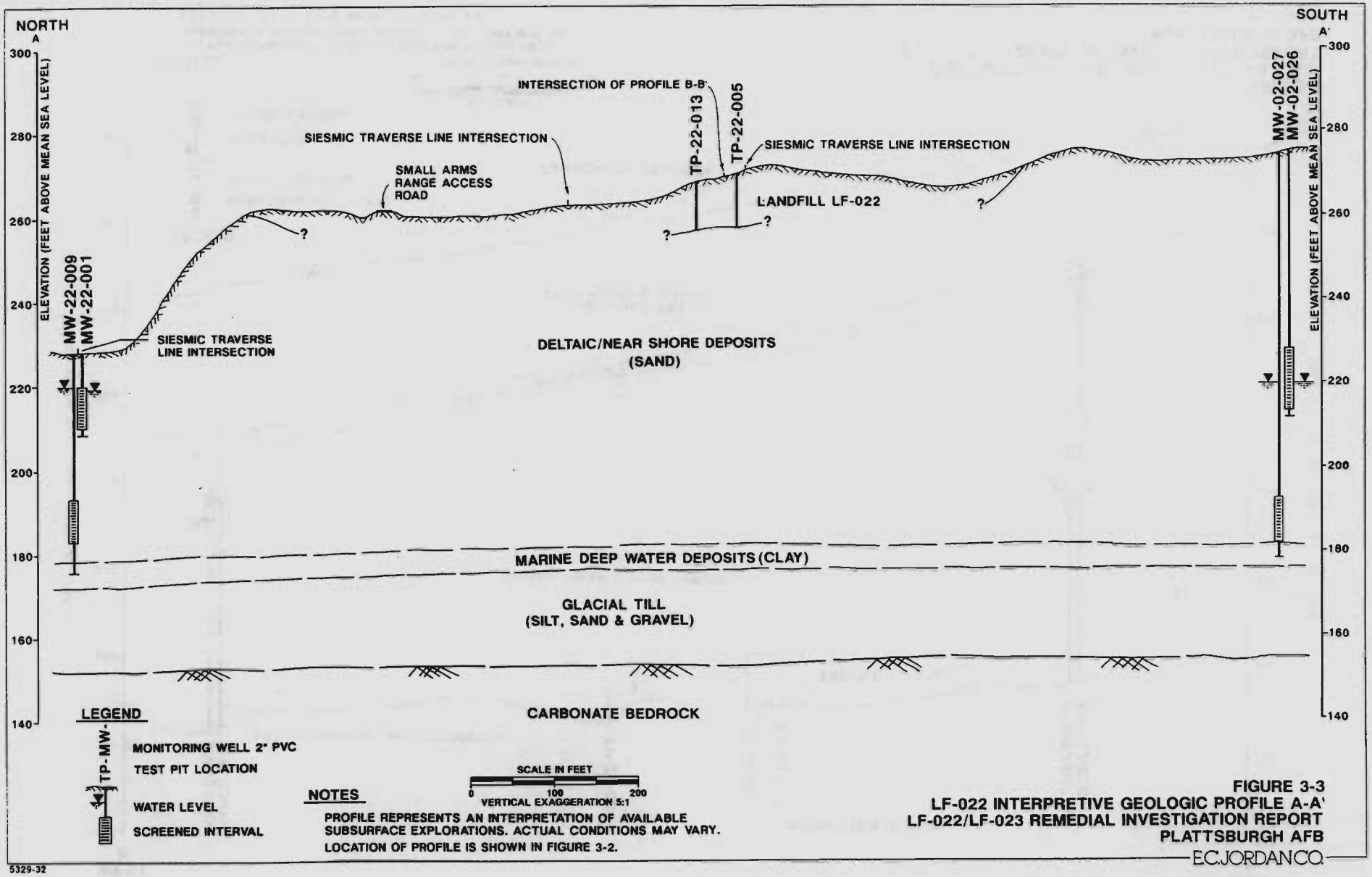


FIGURE 3-3
LF-022 INTERPRETIVE GEOLOGIC PROFILE A-A'
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
E.C. JORDAN CO.

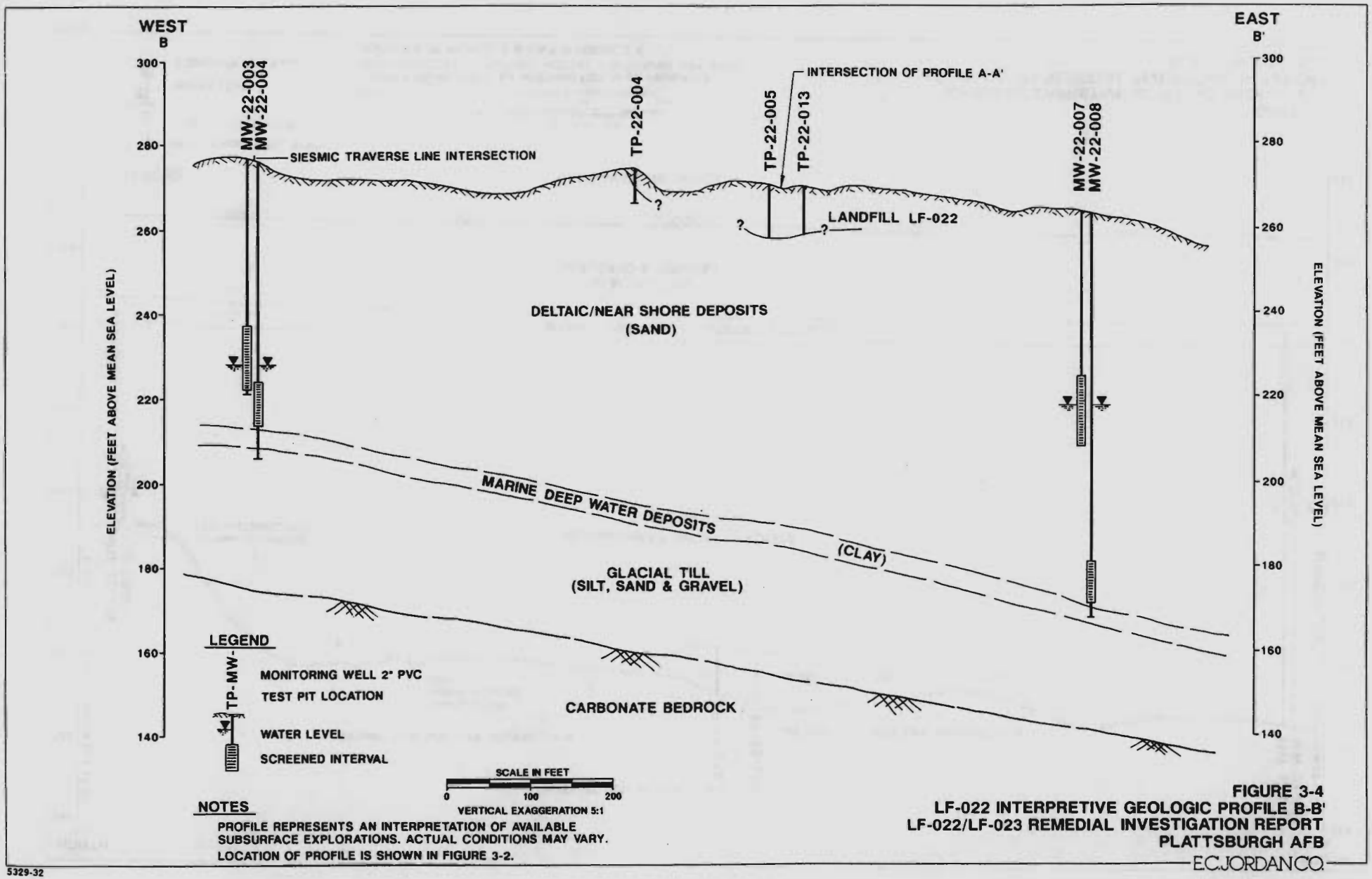


FIGURE 3-4
LF-022 INTERPRETIVE GEOLOGIC PROFILE B-B'
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
E.C. JORDAN CO.

TABLE 3-1
SUMMARY OF LF-022 STRATIGRAPHY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

DEPTH BELOW GROUND SURFACE (feet)	DESCRIPTION AND INTERPRETED DEPOSITIONAL ENVIRONMENT
0 to 80	SAND - Light brown to gray, poorly graded, medium-to-fine sand, trace to some silt, dark mineral laminations are common, the percent fines increasing with depth, interpreted as near shore marine delta and beach deposits.
80 to 90	CLAY - Dark gray, moderately plastic to plastic, firm, dark mineral laminations are present, interpreted as deep water marine deposits.
90 to 120	GLACIAL TILL - Gray, well-graded, clay and slit size particles to gravels, moderate dense to very dense, with angular rock fragments.
120	CARBONATE BEDROCK - Limestone or dolostone.

samplers (i.e., small sample size), large sedimentary structures could only be observed in test pits. Horizontal laminations, only a few millimeters (mm) thick, consisting of dark malic minerals were commonly found throughout the stratum between layers of sand approximately 1 centimeter (cm) thick. These depositional features are indicative of a near shore (i.e., beach) environment. Several test pits excavated in native soils adjacent to the landfill revealed larger scale structures such as cross laminations, ripple marks, and apparent channel fill deposits. These types of structures are commonly associated with deltaic depositional environments. Near the lower part of the sand unit, thin (i.e, 3 to 6 cm) silt and clay layers become predominant, suggesting a transition from deep water to shallow water deposition.

3.1.4.2 Clay. The next lower unit in the profile is a clay at a depth of approximately 75 to 85 feet. The depth and thickness of the clay have been determined based on soil borings drilled during the installation of monitoring wells (see Figures 3-3 and 3-4). This unit has been interpreted as a deep water glacial marine deposit. Based on visual interpretation of samples recovered from borings, the clay has been classified as an inorganic clay of medium-to-high plasticity with high water content and a Unified Soil Classification System designation of "CH." Plant fiber material is still visible in some partings within the clay.

Together, the clay and overlying sands represent a regressive sequence; coarse-grained sediments at the top and finer ones at the bottom. This sequence of deposition was caused by a retreating shoreline resulting from the shrinkage of the former Champlain Sea (Fisher, 1968).

3.1.4.3 Till. The gray till is found below the clay at an estimated depth of 85 to 110 feet. The depth of the till was determined using samples collected from the soil borings drilled during the installation of MW-22-004. Thickness of the till has been inferred from bedrock depths established by the seismic line shot parallel to the base boundary. The depth and thickness of the till are supported by samples collected from the soil boring drilled during the installation of a deep well at FT-002. The till is poorly sorted, with particle size ranging from clays and silts to gravel and cobbles. The soil is moderately dense to very dense. Angular fragments of carbonate bedrock are common close to the underlying till/bedrock contact. The depositional environment represented by this till is associated with advancing and retreating ice sheets. Till near the base of the unit was overridden and compacted by the advancing ice, forming what is referred to as basal till. However, the upper part of

the unit is more likely the debris dropped by the glacier as it melted and retreated. These sediments are massive in structure.

3.1.4.4 Bedrock. The bedrock is at a depth of approximately 125 feet bgs. No rock was cored at Plattsburgh AFB during the SI or RI; however, seismic surveys have indicated depth to bedrock and outcrops in the area have been identified as Ordovician Period carbonate rock (i.e., limestone and dolostone).

3.1.5 Hydrogeology

There are four distinct hydrogeologic units in the LF-022 study area: (1) an unsaturated zone (vadose zone); (2) a water table aquifer (i.e., unconfined aquifer); (3) a series of aquitards and aquicludes consisting of silts, clays, and glacial till (i.e., confining layers); and (4) an aquifer within the carbonate bedrock (i.e., confined aquifer [Geise and Hobba, 1970]).

3.1.5.1 Vadose Zone. The vadose zone at LF-022 is approximately 40 to 50 feet thick and consists of medium-to-fine sand as described in Subsection 3.1.4.1. The highly permeable sands allow precipitation to infiltrate rapidly and reach the groundwater table.

3.1.5.2 Unconfined Aquifer. The aquifer of major concern at Plattsburgh AFB is the water table aquifer, which consists of highly permeable medium-to-fine sand grading to fine sand and sandy silt. This aquifer is bounded by discharge areas (i.e., surface water bodies) on three sides: (1) the Saranac River to the north, (2) Lake Champlain to the east, and (3) the Salmon River to the south. The aquifer is recharged by precipitation at the site and the Adirondack highlands to the west. Eleven wells were installed during the SI and RI field studies at LF-022 to investigate the properties of the unconfined aquifer.

The groundwater table at LF-022 is approximately 40 to 50 feet bgs, and the saturated thickness of the water table aquifer ranges from 30 feet on the western side of the landfill to 50 feet on the eastern side (see Figure 3-4). Regional groundwater flow is from west to east toward Lake Champlain and dominates local flow patterns at the site. However, LF-022 is located on a topographic high on the western side of the base, which also affects local groundwater flow.

Interpretation of head measurements in the area indicate a semiradial flow in the unconfined aquifer outward from LF-022. Flow directions and groundwater table contours are shown in Figure 3-5. Groundwater flow is influenced on the northern side by a fairly steep hydraulic gradient (i.e., approximately 0.007) to the Saranac River. Hydraulic gradients to the east and south of the site are less steep, approximately 0.004. No significant vertical groundwater gradients have been observed in the water table aquifer. Groundwater levels measured during the SI and RI are listed in Appendix K.

Permeability tests have been conducted in selected monitoring wells screened in the unconfined aquifer at LF-022. Hydraulic conductivity (K) values for the upper portion of the water table aquifer are in the range of 10^{-3} to 10^{-2} centimeters per second (cm/sec) (3 to 30 feet per day). K values in the range of 10^{-4} to 10^{-3} cm/sec (0.3 to 3 feet per day) were measured in wells screened near the clay boundary, where the soil contains a higher percentage of fines. Principal flow occurs within the upper portion of the water table aquifer where the sand is most permeable, as reflected in the conductivity values reported above. Seepage velocities have been estimated to be approximately 180 feet per year. Results of aquifer testing are contained in Appendix E.

The major source of groundwater recharge is infiltration of precipitation. The amount of precipitation that reaches the groundwater table is approximately 24 percent of annual precipitation (Giese and Hobba, 1970). For the Plattsburgh AFB area, this would be in the range of 6 to 8 inches per year.

3.1.5.3 Confining Layers. The confining layers at LF-022 are approximately 35 feet thick and consist of a combination of silts, clays, and till. Because wells were not screened in the confining layers, permeability tests were not conducted for these materials. However, K values for these materials may be in the order of 10^{-7} cm/sec (Freeze and Cherry, 1979).

3.1.5.4 Confined Aquifer. No wells were installed in the confined bedrock aquifer during the SI and RI at Plattsburgh AFB. However, characteristics of the bedrock aquifer have been described by Giese and Hobba (1970). West of Plattsburgh, on the slopes of the Adirondack Mountains, the bedrock aquifer consists of sandstone and crystalline rocks and is not confined. In the mountains, groundwater leaks into the unconfined bedrock aquifer from overlying unconsolidated deposits and flows eastward toward Lake Champlain. Before reaching Plattsburgh AFB, the aquifer



LEGEND

214 GROUNDWATER ELEVATION CONTOUR

MW-02-010 MONITORING WELL LOCATION

SCALE IN FEET

0 300 600 1200

FIGURE 3-5
LF-022 GROUNDWATER CONTOURS
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT -- PLATTSBURGH AFB

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changes from sandstone to carbonate rocks (i.e., Ordovician limestones and dolostones) and is confined by overlying clay and till. Water is discharged from the confined aquifer to topographic lows, the Salmon and Saranac rivers, and eventually Lake Champlain. Groundwater from the confined bedrock aquifer also leaks upward into the unconfined aquifer (Geise and Hobba, 1970).

3.1.6 Land Use and Site Access

The LF-022 site is located between the western boundary of the base and the main aircraft runway (see Figure 1-2). The base boundary is approximately 500 feet west (upgradient) of the western edge of the landfill. The landfill is situated in the limited access area of the base's western border. Access to the landfill from the north and east is restricted because the site is bordered on two sides by controlled access areas, the active runway to the east and the small arms range to the northwest. Access from the west and south is less restrictive. The western border in this area is bounded by an intact 4-foot-high three-wire fence. This fence is posted as a controlled area with "No Trespassing" signs. According to base personnel, evidence of trespassing on LF-022 has not been observed.

Although access to the landfill from the west and south is possible, this area is patrolled on a regular basis. Anyone observed trespassing in this area is escorted off-base. The landfill lacks features, such as pits or mounds, that would tend to attract off-site populations for activities such as dirt-biking. The surface is covered with grasses and small trees. These aspects combine to make trespassing by off-site populations unlikely. Therefore, access by off-base populations should be unlikely, if not nonexistent.

On-base populations are also unlikely to come in contact with areas at LF-022. Access to the LF-022 site is controlled by Plattsburgh AFB security personnel. While the landfill and small arms range northwest of the landfill are not located in a controlled area, the only access road to the site is from the western Perimeter Road, which is in a controlled area. Plattsburgh AFB controls access to the Perimeter Road because it is adjacent to the runway and is the main access road to the weapons storage area. Only military personnel who need to work within the controlled area are allowed access to Perimeter Road. Civilians (e.g., contractors) must obtain clearance from security personnel before entering the controlled area. Occasionally, civilian law enforcement agencies (e.g., State Police) are permitted to use the small arms range. Because access to the site is controlled and the small arms

range is not located within the bounds of the landfill, the possibility of military personnel or civilians coming in direct contact with cover material or wastes is low. Access to the site by base personnel and/or the general public is unlikely.

The nearest on-base housing unit is more than 6,000 feet east (downgradient) of the site. The closest off-base residential area is the cluster of mobile homes located approximately 1,350 feet south (crossgradient) of the landfill. About 700 feet west of the site are various light industries along NY Route 22. These are the closest off-base nonresidential buildings. Interstate 87 is approximately 200 feet further west.

3.1.7 Description of the Existing Environment

In this section potential receptors of contaminants present at LF-022 are described. This information is used to develop exposure scenarios in Section 3.4.3.1 in the ecological risk assessment.

The plant community at LF-022 contains successional plant species typical of disturbed areas or waste ground. These include staghorn sumac (*Rhus typhina*), mullein (*Verbascum thapsus*), grasses (Gramineae), cottonwood (*Populus deltoides*), and pines (*Pinus* spp.). Wetland habitats are not present at LF-022. There are surface depressions north of the site where groundwater and runoff may collect during high water conditions. The plant community of the eastern depression is dominated by cattail (*Typha latifolia*), with red-osier dogwood (*Cornus stolonifera*), pussy willow (*Salix discolor*), black willow (*Salix nigra*), and sensitive fern (*Onoclea sensibilis*) also present. Sumac and trembling aspen (*Populus tremuloides*) occur in upland areas surrounding this area.

A covertype map of the site and surrounding areas is presented in Figure J-1 in Appendix J. This map indicates New York Natural Heritage Program (NHP) covertypes specified in Reschke (1990) in accordance with the NYSDEC "Habitat-Based Assessment Guidance Document for Conducting Environmental Risk Assessments at Hazardous Waste Sites" (NYSDEC, 1989a). The map was prepared using aerial photographs, USGS topographic maps, and information from a site survey in June 1989.

Many of the covertypes in the vicinity of the site fall under the broad NHP category of "Terrestrial Cultural". These include landfill/dump (the site itself), unpaved roads, paved roads, rural structure exterior (buildings), and mowed lawns. In addition to

the landfill/dump category assigned to the site itself, various other NHP covertypes exist on the landfill surface, including successional old field, successional shrubland, and successional northern hardwood forest. Another extensive covertype in the vicinity of the site is the broad category of "Forested Uplands". The depressions to the north of the site mentioned previously are classified as shallow emergent marsh and shrub swamp.

The locations of wetlands regulated by NYSDEC as of March 1990 at Plattsburgh AFB are illustrated in Figure J-2 in Appendix J. No wetlands regulated by NYSDEC are present on or adjacent to LF-022.

Species of birds, mammals, reptiles, and amphibians that occur in the general vicinity of Plattsburgh AFB are listed in Tables J-1 through J-4 in Appendix J, respectively. The plant communities at LF-022 provide food and cover for a subset of the species listed in these tables. Because no aquatic, wetland, or other moist habitats exist on or adjacent to LF-022, the species of wildlife expected at the site are primarily terrestrial organisms. Birds, mammals, and reptiles requiring open water, moist woods, or wetland habitat, waterfowl, and most species of amphibians listed in Table J-4 are not expected at the site. Species common in the area of Plattsburgh AFB that may occur at the site based on habitat types present include: white-footed mouse (*Peromyscus leucopus*); meadow vole (*Microtus pennsylvanicus*); red fox (*Vulpes vulpes*); wood thrush (*Hylocichla mustelina*); mourning dove (*Zenaida macroura*); gray catbird (*Dumetella carolinensis*); red-tailed hawk (*Buteo jamaicensis*); and eastern garter snake (*Thamnophis sirtalis sirtalis*).

The New York NHP was contacted regarding the presence of rare animals, plants, and natural communities and/or significant wildlife habitats within a 2-mile radius of Plattsburgh AFB. As of March 7, 1991, the NHP database lists no rare species, communities, or significant habitats on the base itself, although nine locations with rare plant species and two rare natural communities are listed within a 2-mile radius of the base. Most of the locations are north of the base, with some near the shore of Lake Champlain. No location appears to be in an area that may be affected by chemical contamination from Plattsburgh AFB or as a result of remedial activities at any site on the base.

The U.S. Fish and Wildlife Service (USFWS) has also been contacted regarding rare species in the vicinity of Plattsburgh AFB. The USFWS reported that, except for occasional transient individuals, no federally listed or proposed endangered or

threatened species under their jurisdiction are know to exist at or within 2 miles of Plattsburgh AFB. Therefore, no Biological Assessment under the Endangered Species Act is required.

3.2 NATURE AND EXTENT OF CONTAMINATION

The following subsections describe the results of the site characterization study at LF-022. The conceptual model that was developed based on the results of the SI and RI is described in the first subsection. The distribution of contaminants in the various media at LF-022 is described in more detail in the subsequent subsections.

3.2.1 Conceptual Model

LF-022 encompasses two landfills identified during the Preliminary Assessment (i.e., D-3 and D-7) and covers an area of approximately 461,000 square feet. The landfill was active from 1959 to 1966. During that time, domestic wastes were reportedly burned, dumped into trenches, and covered with fill. Trenches may extend up to 25 feet bgs in some sections; in other areas of the landfill soils were relatively undisturbed by disposal operations. Trenches were not excavated in any discernible pattern. Spent munitions residue, including used jet engine starter cartridges, were deposited in a small area (i.e., D-7) in the southwestern portion of the landfill (see Figure 3-1).

Geologically, the site is located in highly permeable sand and silt deposits. An unconfined aquifer is located in the sand unit and the water table is approximately 15 feet below the deepest reported depth of the landfill. Groundwater in the unconfined aquifer flows to the east and southeast toward Lake Champlain. Directly below the sand unit is a clay of low permeability. Between the clay and the carbonate bedrock is a layer of basal till with low permeability. The low permeability clay and till layers form an apparent hydrogeologic barrier that separates the unconfined aquifer from the confined bedrock aquifer. Groundwater in the confined aquifer flows east toward Lake Champlain. The site conceptual model is shown in Figure 3-6.

Several site contaminants have been identified in various media at LF-022 based on the criteria outlined in Subsection 2.7 (Table 3-2). The primary source of contamination at LF-022 is the landfill waste. Site contaminants detected in the

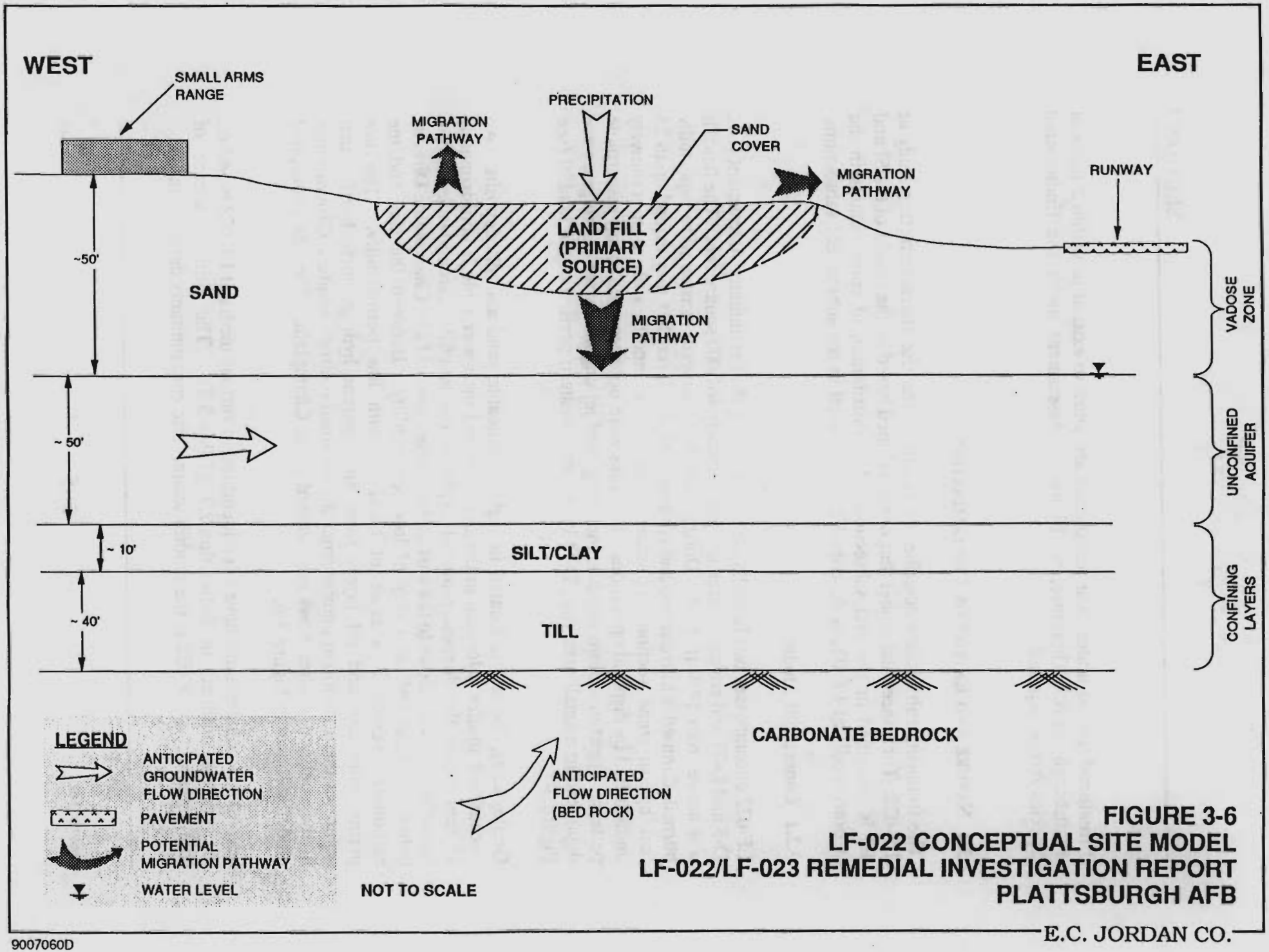


FIGURE 3-6
LF-022 CONCEPTUAL SITE MODEL
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

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TABLE 3-2
LF-022 SITE CONTAMINANTS BY MEDIA

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

COMPOUND	CONCENTRATION RANGE [1] MINIMUM	MAXIMUM	FREQUENCY OF DETECTION [2]
GROUNDWATER (µg/L)			
Iron	<100	8,760	3/12
Manganese	<15	877	6/12
SURFACE SOILS [3] (µg/kg)			
DDD	<16	16,000	2/4
DDE	<16	855	1/4
DDT	<16	3,505	2/4
SUBSURFACE SOILS (mg/kg, unless otherwise noted)			
Lead	4.1	116	2/3
WASTE (mg/kg)			
Carbon tetrachloride	<5	18,000	1/7
Chloroform	<5	19,000	1/7
Bis(2-Ethylhexyl)Phthalate (µg/kg)	<300	1,700	1/2
PHCs	<1	2,100	5/6
Aluminum	<40	128,000	3/7
Cadmium	<1	151	3/7
Chromium	<10	412	1/7
Copper	<5	5,150	3/7
Iron	140	130,500	2/7
Lead	<1	974	4/7
Manganese	<3	7,365	1/7
Silver	<2	18	3/7
Sodium	<1000	23,300	1/7
Zinc	18	33,300	5/7

NOTES:

[1] Concentrations of duplicate samples were averaged.

[2] Number of samples in which the compound was detected above background concentrations or appropriate standards divided by the total number of samples analyzed for that parameter. Duplicate samples represent one sample.

[3] Concentrations detected in composite samples.

PHCs - Petroleum Hydrocarbons, as detected by USEPA method 418.1

waste material include: carbon tetrachloride and chloroform detected in a sample of white powder collected from a pail found on the ground surface; bis(2-ethyl-hexyl)phthalate (BEHP) detected in one sample of waste; and aluminum, cadmium, chromium, copper, iron, lead, silver, zinc, and sodium detected in several samples at concentrations above the background range for soil. Neither the volatile organic compounds (VOCs) nor semivolatile organic compounds (SVOCs) are considered pervasive contaminants of the landfill. PHCs were also detected in the subsurface waste samples. The PHC results suggest a fuel or hydrocarbon distribution in the waste samples. Although a variety of contaminants are present in the wastes, the only site contaminant identified in the subsurface soils is lead.

Pesticides were identified as site contaminants in the surface soil. DDT (dichlorodiphenyltrichloroethane) and its associated analogs (i.e., DDD and DDE, dichlorodiphenyldichloroethane and dichlorodiphenyldichloroethene, respectively) were detected in two of four surface soil samples. The samples were collected as composites and do not represent the actual distribution of pesticides in the surface soils.

Iron and manganese were present in the groundwater under the landfill due to site related conditions. The absence of other site contaminants indicates that contaminants in the soil/waste are not leaching into the groundwater. The iron and manganese concentrations may be attributable to low oxygen conditions in the groundwater.

Potential migration pathways for the site contaminants and possible receptors are shown in Figure 3-7.

3.2.2 Source Area

Geophysical techniques were used to investigate the depth and areal extent of the landfill. Two seismic refraction survey lines, shown in Figure 3-8, were shot across the landfill during the RI to help determine the maximum depth of the fill materials. However, the seismic lines provided no information on the depth of the landfill or the stratigraphy directly below the landfill. The terrain conductivity survey conducted at LF-022 did not detect conductive leachate. The areal extent of the landfill was delineated by a magnetometer survey conducted during the SI, site walk overs and aerial photographs. The area covered by the magnetometer survey is shown in Figure 3-9 and the results of the survey are shown in Figure 3-10. Magnetic

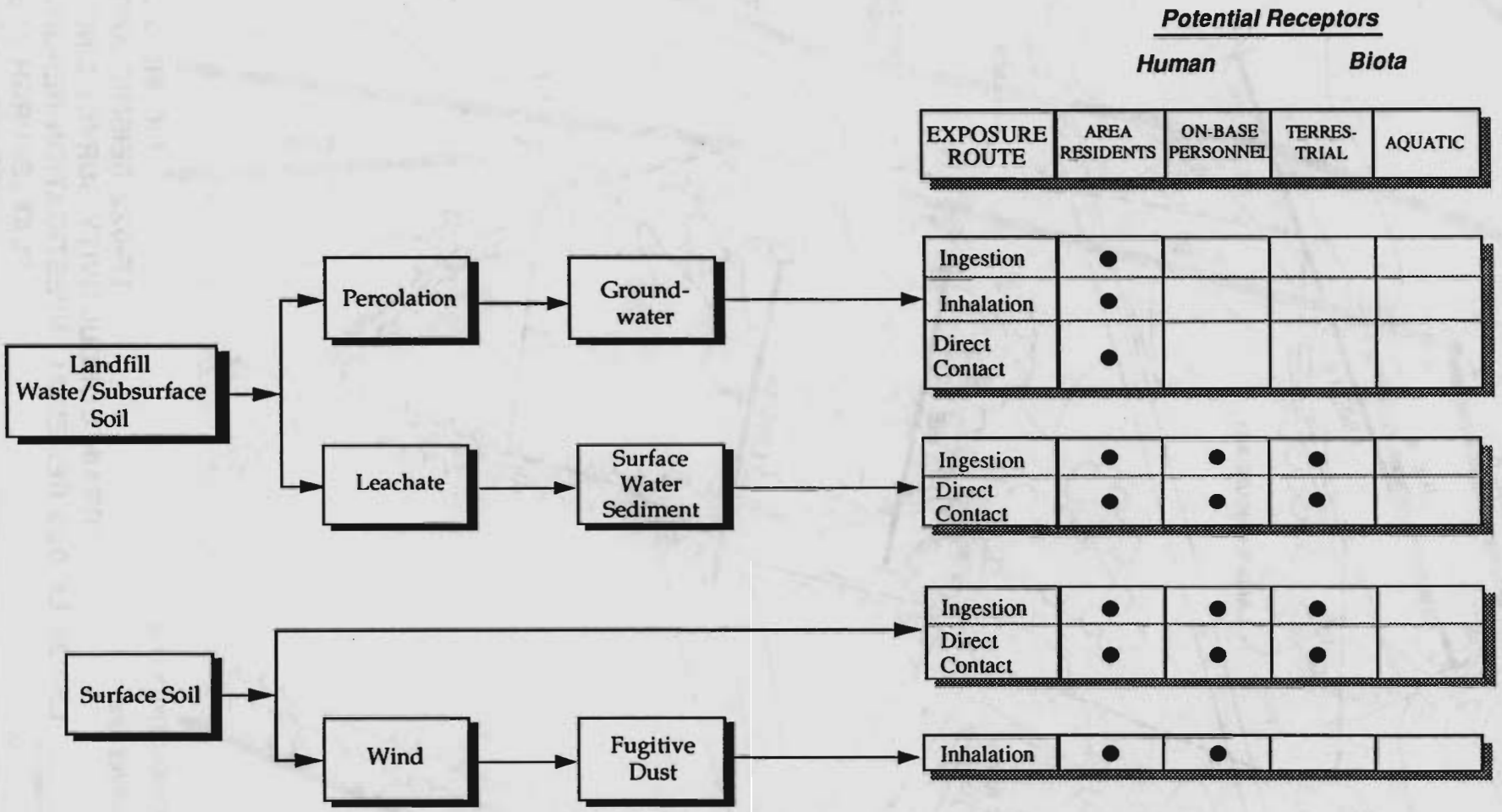


FIGURE 3-7
LF-022 POTENTIAL MIGRATION PATHWAYS AND RECEPTORS
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

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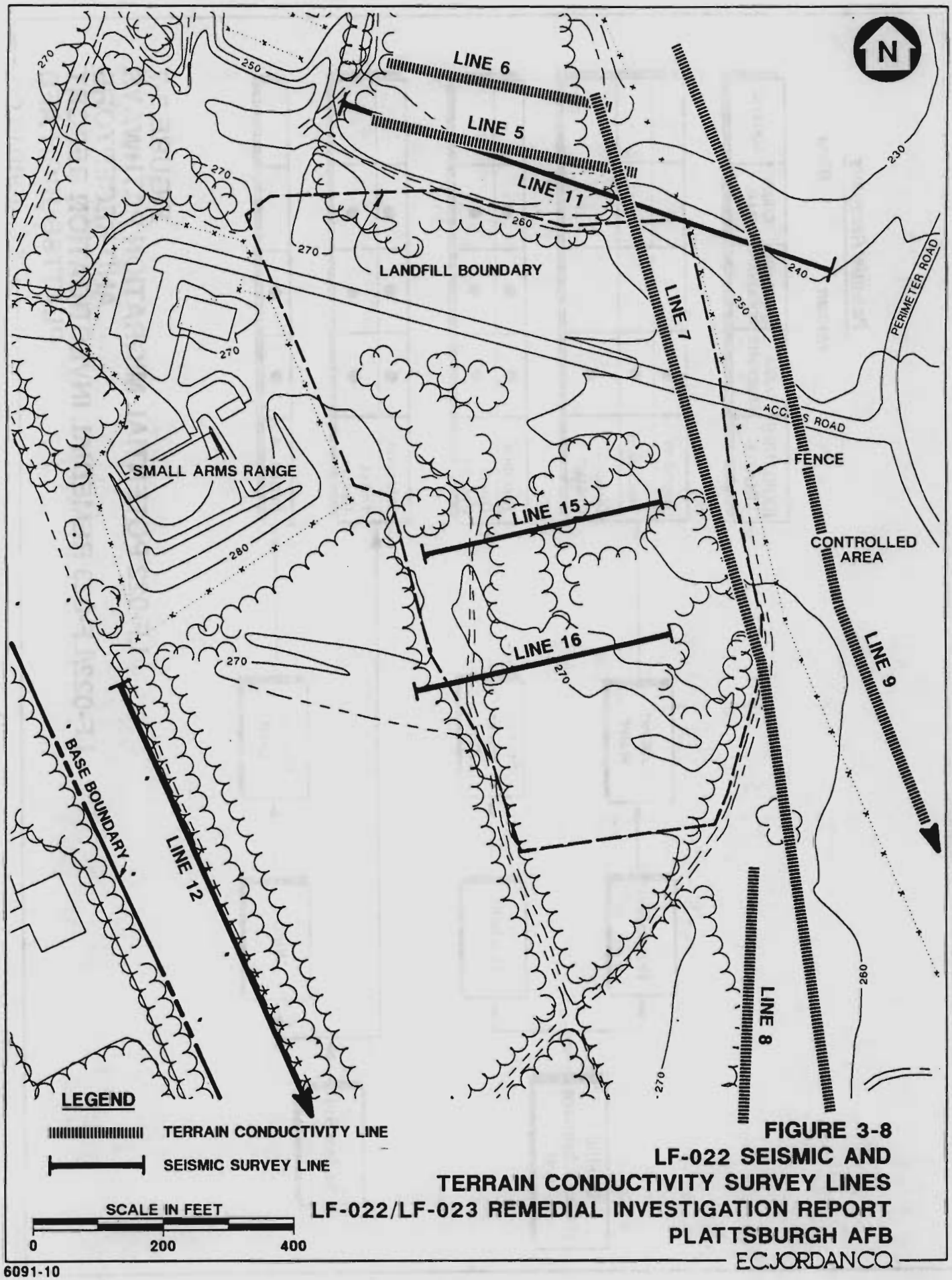


FIGURE 3-8
LF-022 SEISMIC AND TERRAIN CONDUCTIVITY SURVEY LINES
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
E.C. JORDAN CO.

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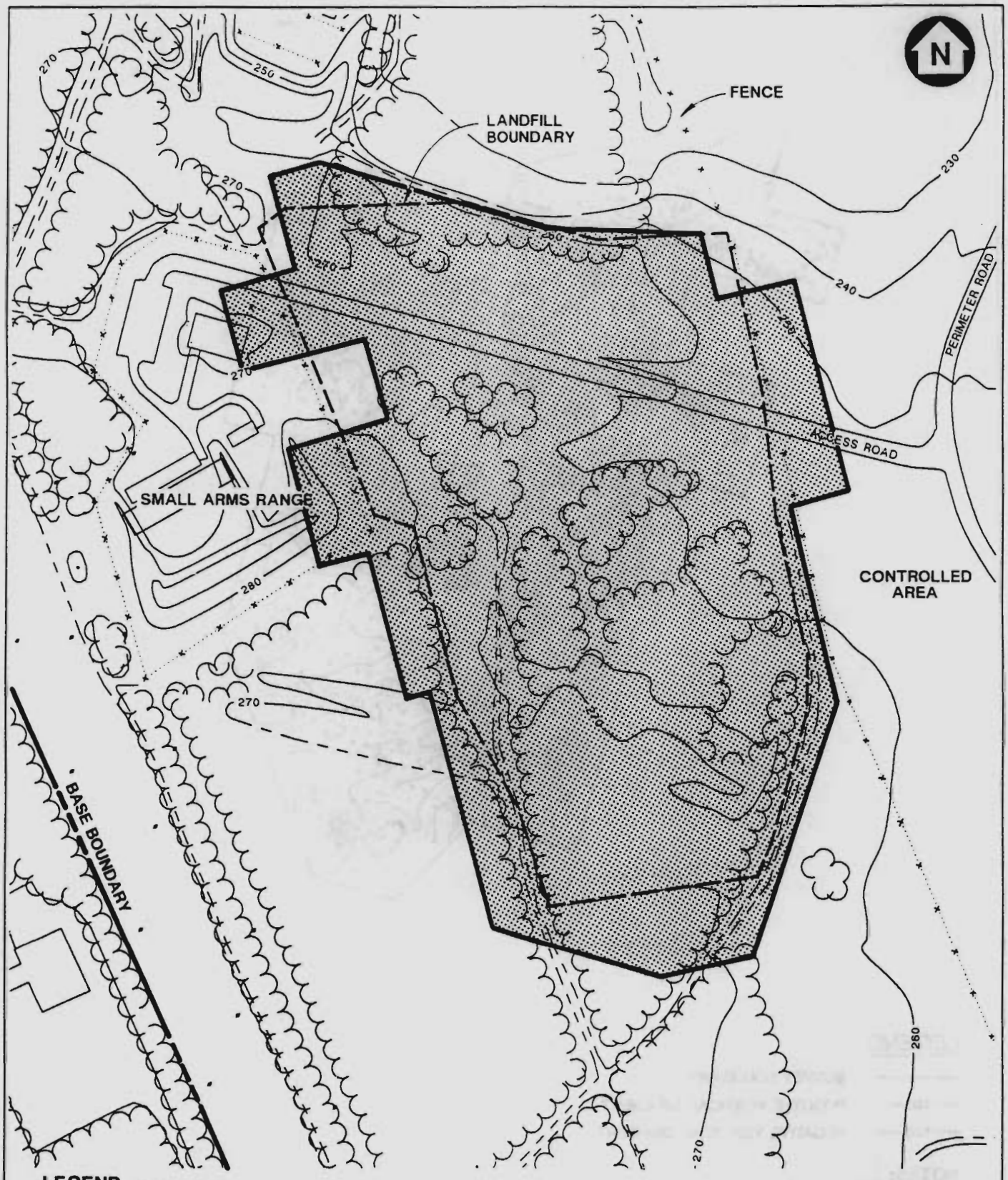
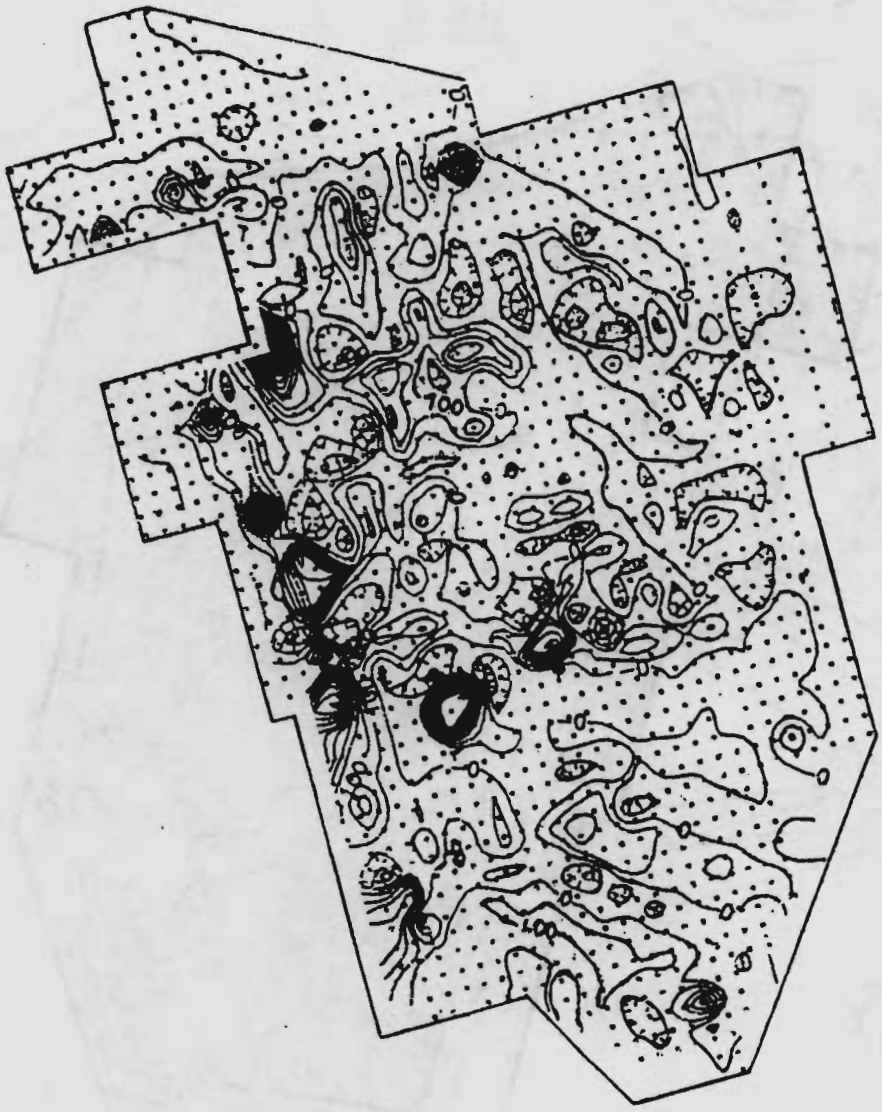


FIGURE 3-9
AREA OF LF-022 COVERED BY MAGNETOMETER SURVEY
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
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6091-10



LEGEND

- SURVEY BOUNDARY
- —100— POSITIVE VERTICAL GRADIENT
- -----100----- NEGATIVE VERTICAL GRADIENT

NOTES:

CONTOUR INTERVAL = 100 GAMMAS PER METER
EACH DOT REPRESENTS A DATA POINT.

SCALE IN FEET

0 200 400

FIGURE 3-10
LF-022 MAGNETOMETER SURVEY
LF-022/LF-023
REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
E.C. JORDAN CO.

anomalies detected during the survey were used to determine the locations of test pits. Test pits were dug to evaluate magnetic anomalies and provide information on the types of waste and depth of the landfill. Test pits were not dug within the boundaries of D-7 because of the general health and safety consideration of the contractor, and given the data from the Preliminary Assessment and SI, no further investigation was needed. Material uncovered during test pitting indicates that a majority of the wastes were household trash that had been burned prior to burial under at least 1 foot of sandy fill. Fifty-five-gallon drums, 5-gallon pails, and a variety of other items were encountered. All drums and pails uncovered by test pit operations were rusty and empty. Test pits dug around the small area used as a munitions dump uncovered no buried munitions and confirmed that dumping of spent munitions was confined to the area shown on Figure 3-1.

Site contaminants identified in the samples of waste collected at LF-022 are: carbon tetrachloride, chloroform, acetone, BEHP, aluminum, cadmium, chromium, copper, iron, lead, silver, zinc, and sodium. The distribution of contaminants in the waste are described in more detail in the following subsections.

3.2.2.1 Types of Wastes. Fourteen test pits were dug at various locations throughout the landfill during the SI to investigate the types of wastes disposed at the site (Figure 3-11). Wastes were encountered in all the test pits with the exception of TP-22-004, TP-22-007, TP-22-011, and TP-22-014.

Five samples of soils containing waste were collected from pits TP-22-001, TP-22-002, TP-22-005, and TP-22-012. The sample from TP-22-001 was analyzed for Target Compound List (TCL), VOCs, TCL SVOCs, and Target Analyte List (TAL) inorganics. Samples from TP-22-002, TP-22-005, and TP-22-012 were analyzed for TCL VOCs, PHCs, and TAL inorganics. In addition to the test pit samples, two samples were collected of small amounts of wastes found on the ground surface near TP-22-014. These were approximately 1 kilogram (kg) of white powder found in a 5-gallon pail uncovered during construction of the small arms range access road and an oily substance found in an exposed 10-gallon drum. A summary of analytical results from the waste samples is shown in Table 3-3.

> **Organics**: A single VOC was detected in only one of the waste samples collected from the test pits. 2-Butanone was detected at 20 micrograms per kilogram (μg/kg) in one of the duplicate samples collected at 7 feet bgs in TP-22-012. Because 2-butanone is a common sampling remnant and

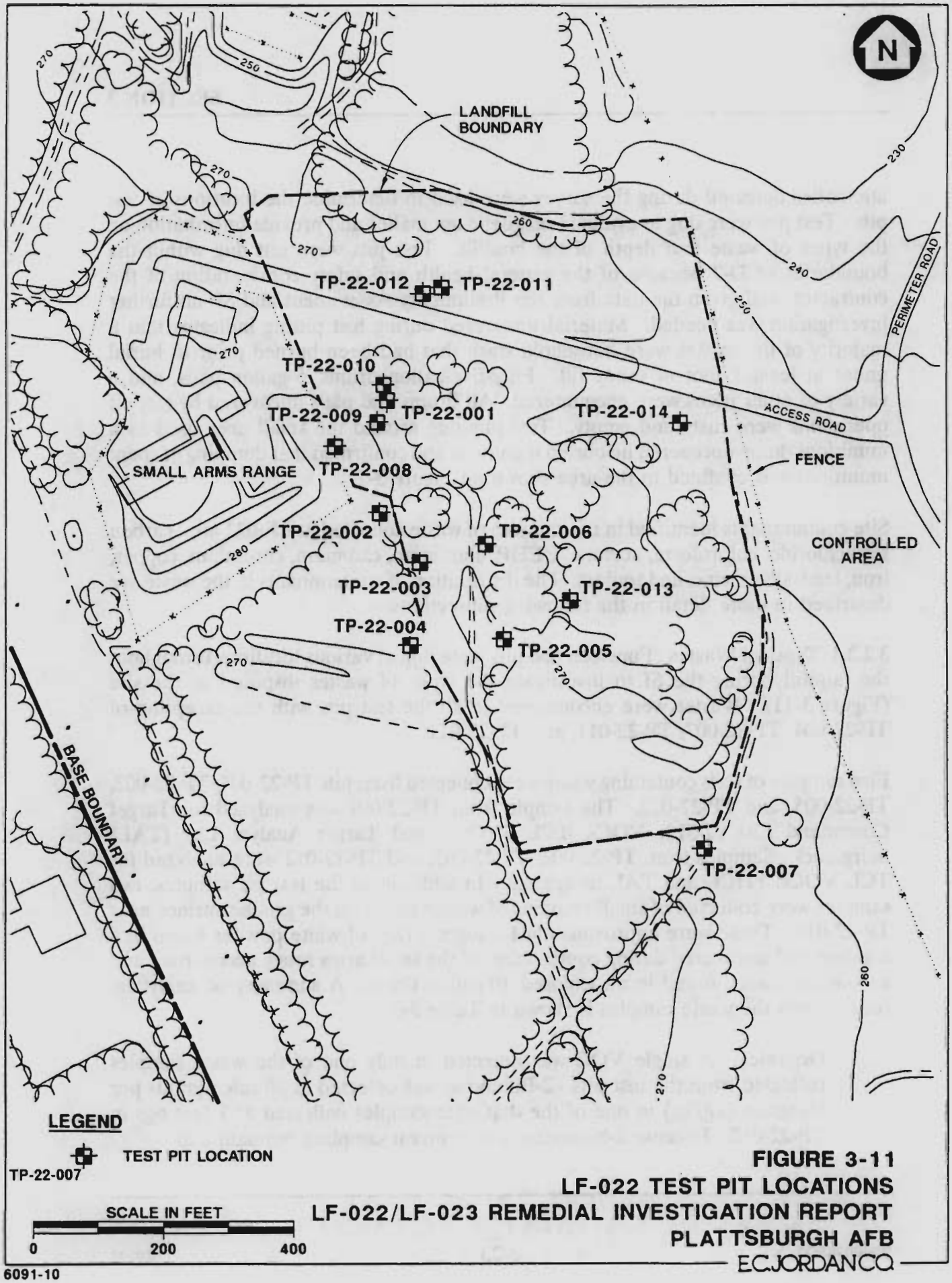


FIGURE 3-11
LF-022 TEST PIT LOCATIONS
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
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TABLE 3-3
LF-022 WASTE SAMPLE ANALYSIS SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		TP-22-001	TP-22-002	TP-22-005	TP-22-005
DEPTH (feet):		11	13	2	13
DATE SAMPLED:		11/04/87	11/04/87	11/04/87	11/04/87
MATRIX:		SOIL/WASTE	SOIL/WASTE	SOIL/WASTE	SOIL/WASTE
SAMPLE ID:		D3XTP11011	D3XTP11113	D3XTP11402	D3XTP11413
VOLATILE ORGANIC COMPOUNDS					
UNITS: ug/kg	CRQL				
Carbon Tetrachloride	5	-	-	-	-
Chloroform	5	-	-	-	-
SEMIVOLATILE ORGANIC COMPOUNDS					
UNITS: ug/kg	CRQL				
bis(2-Ethylhexyl)Phthalate	330	1700	NR	NR	NR
METHOD 418.1					
UNITS: mg/kg	DL				
Petroleum Hydrocarbons	1	NR	62	50	1100
INORGANICS					
UNITS: mg/kg	CRQL				
Aluminum	40	15200	1720	128000	3350
Cadmium	1	16	-	4.3	5.6
Chromium	2	53	2.8	36	14
Copper	5	658	9.3	5150	106
Iron	20	51200	4720	3740	9730
Lead	1	974	20	273	183
Manganese	3	523	137	360	175
Silver	2	18	-	-	3.1
Sodium	1000	1960	-	-	-
Zinc	4	1650 E	44	480 E	301 E

All waste samples were collected during the SI. SI results were not validated.

TABLE 3-3
(Continued)
LF-022 WASTE SAMPLE ANALYSIS SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		TP-22-005	TP-22-012	TP-22-012
DEPTH (feet):		13	7	7
DATE SAMPLED:		11/04/87	11/09/87	11/09/87
MATRIX:		SOIL/WASTE	SOIL/WASTE	SOIL/WASTE
SAMPLE ID:		D3DTP11413	D3XTP13407	D3DTP13407
VOLATILE ORGANIC COMPOUNDS UNITS: ug/kg	CRQL			
Carbon Tetrachloride	5	-	-	-
Chloroform	5	-	-	-
SEMIVOLATILE ORGANIC COMPOUNDS UNITS: ug/kg	CRQL			
bis(2-Ethylhexyl)Phthalate	330	NR	NR	NR
METHOD 418.1 UNITS: mg/kg	DL			
Petroleum Hydrocarbons	1	3100	170	100
INORGANICS UNITS: mg/kg	CRQL			
Aluminum	40	3320	71000 *	84200 *
Cadmium	1	8.9	94	151
Chromium	2	9.4	300	412
Copper	5	117	1580	2270
Iron	20	8290	118000 *	143000 *
Lead	1	234 *	669	1100
Manganese	3	284	753 N*	891 N*
Silver	2	4.2	4.4	4.5
Sodium	1000	-	3870	3950
Zinc	4	422 E	3250 E*	4290 E*

All waste samples were collected during the SI. SI results were not validated.

TABLE 3-3
(Continued)
LF-022 WASTE SAMPLE ANALYSIS SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		TP-22-014		TP-22-014	
DEPTH (feet):		0		0	
DATE SAMPLED:		11/04/87		11/04/87	
MATRIX:		WASTE (Oily Substance)		WASTE (White Powder)	
SAMPLE ID:		D3XTP1170A		D3XTP1170B	
VOLATILE ORGANIC COMPOUNDS					
UNITS: ug/kg	CRQL				
Carbon Tetrachloride	5	-		18000	
Chloroform	5	-		19000	
SEMIVOLATILE ORGANIC COMPOUNDS					
UNITS: ug/kg	CRQL				
bis(2-Ethylhexyl)Phthalate	330	NR		-	
METHOD 418.1					
UNITS: mg/kg	DL				
Petroleum Hydrocarbons	1	46		NR	
INORGANICS					
UNITS: mg/kg	CRQL				
Aluminum	40	1360		42	
Cadmium	1	-		-	
Chromium	2	6.4		6.1	
Copper	5	12		-	
Iron	20	3070		140	
Lead	1	4.1	*	73	
Manganese	3	112		4.2	
Silver	2	-		-	
Sodium	1000	-		23300	
Zinc	4	18	E	33300	E

All waste samples were collected during the SI. SI results were not validated.

laboratory contaminant and because it was only detected above the CRQL in one of the duplicates, it is not considered to be a site contaminant. VOCs were detected in samples of the white powder collected at the ground surface near TP-22-014. Contaminants include carbon tetrachloride (18,000 μg/kg), and chloroform (19,000 μg/kg). Trace amounts (i.e., concentrations below the Contract Required Quantitation Limit [CRQL]) were reported for benzene, tetrachloroethane, 1,1,2,2-tetrachloroethane, and toluene and are not considered site contaminants.

Two waste samples, TP-22-001 and the white powder, were analyzed for SVOCs. BEHP was the only SVOC detected and it was only detected once at 1,700 μg/kg in a sample of white ash that was collected from 11 feet bgs in TP-22-001. BEHP is common in plastics, which are often present in landfill material.

Samples of waste collected from TP-22-002, TP-22-005, TP-22-012, and TP-22-014 were analyzed for PHCs. PHCs were found in varying concentrations and different depths. Samples from TP-22-002 and TP-22-012 and the sample collected in TP-22-005 at 2 feet bgs contained PHCs at 50 to 200 milligrams per kilogram (mg/kg). The duplicate samples collected in TP-22-005 at 13 feet bgs contained higher concentrations of PHCs (i.e., 1100 mg/kg and 3100 mg/kg). PHCs were detected at a concentration of 46 mg/kg in the sample of waste collected from the 10-gallon drum found at the ground surface near TP-22-014.

Only two samples were analyzed for pesticides and polychlorinated biphenyls (PCBs); the sample of waste from TP-22-001 and the sample of white powder collected from the ground surface near TP-22-014. Neither pesticides nor PCBs were detected in either sample.

Inorganics: All the waste samples collected from the test pits were analyzed for inorganics. No site contaminants were identified in the sample from test pit TP-22-002. Concentrations of several inorganics were detected above background in waste samples TP-22-001, TP-22-005, and TP-22-012. Inorganics detected above background in each pit are described below.

TP-22-001: The metals with concentrations above background were cadmium (16 mg/kg), copper (658 mg/kg), iron (51,200), lead (974 mg/kg), silver (18 mg/kg), and zinc (1,650 mg/kg).

TP-22-005: A sample was collected at 1.5 feet bgs where unidentified blue crystals were found. These crystals are not believed to be naturally occurring. The metals detected with concentrations higher than background were: aluminum (128,000 mg/kg), cadmium (4.3 mg/kg), copper (5,150 mg/kg), lead (273 mg/kg), and zinc (480 mg/kg).

Duplicate samples were collected from the bottom of this pit at 12.5 feet bgs. The metals detected with concentrations higher than background were: cadmium (7.3 mg/kg), lead (209 mg/kg), silver (3.7 mg/kg), and zinc (362 mg/kg). These concentrations represent an average of the duplicate samples.

TP-22-012: Duplicate samples were collected from purple-stained sand at 7 feet bgs. The metals detected at concentrations higher then background were: aluminum (77,600 mg/kg), cadmium (123 mg/kg), chromium (356 mg/kg), copper (1,925 mg/kg), iron (130,500 mg/kg), lead (885 mg/kg), magnesium (7,365 mg/kg), silver (4.5 mg/kg), and zinc (3770 mg/kg). These concentrations represent an average of the duplicate samples.

TP-22-014: Inorganics were also detected at concentrations above background in the sample of white powder collected from the ground surface near TP-22-014: sodium (23,300 mg/kg) and zinc (33,300 mg/kg).

3.2.2.2 Volume Estimates of Fill Material. Information from test pits within the landfill, aerial photographs taken while the landfill was active, and the Preliminary Assessment indicate that solid wastes were disposed of in trenches that vary in depth and length. No consistent trenching pattern was observed; trenches were dug in different directions over the period of time that the landfill was active. It was reported during the Preliminary Assessment that wastes may have been buried as deep as 25 feet bgs in some areas of the landfill. The actual depth of the landfill could not be discerned by the seismic refraction survey.

Based on the results of the magnetometer survey, LF-022 has a surface area of approximately 461,000 square feet. Although the areal extent of the landfill has been defined and its depth is known in some locations, the volume of fill material at the landfill is difficult to estimate because of the non-uniform manner in which wastes were disposed. Based on the areal extent of the landfill and a maximum depth of 25 feet, the maximum volume of fill material in LF-022 is 427,000 cubic yards. This fill material volume estimate has a wide range of error because some soils within the landfill boundaries were not disturbed during landfill operations and the depth of the landfill varies.

3.2.3 Subsurface Soils

Two samples of natural, in-place soils were collected from test pits. No organic site contaminants were identified in the subsurface soil samples; however, lead was detected at concentrations above background in soil collected from just below the waste and is considered a site contaminant.

The two subsurface soil samples were collected from test pits TP-22-003 and TP-22-007 (see Figure 3-11). Landfill wastes were uncovered in TP-22-003 and a soil sample was collected from undisturbed soils just below the waste at a depth of 12 feet. No wastes were uncovered in pit TP-22-007 and a sample was collected at a depth of 8 feet. The sample from TP-22-003 was analyzed for TCL VOCs, TCL SVOCs, TCL pesticides, and TAL inorganics, and the sample from TP-22-007 was analyzed for TCL VOCs, PHCs, and TAL inorganics. No TCL organic chemicals or hydrocarbons were detected in either sample. A summary of analytical results is shown in Table 3-4.

3.2.4 Surface Soils

The surface soil at LF-022 is fill material used as cover for the landfill. The landfill cover is at least 1 foot thick and up to 3 feet thick in some locations. The cover soil appears to be the same as the native soils adjacent to and below the landfill. However, because of the homogeneity of surface soils at Plattsburgh AFB, the origin of cover material cannot be determined. The cover material may have been excavated on site during landfilling operations or may have come from anywhere on base or locally.

TABLE 3-4
LF-022 SUBSURFACE SOIL SAMPLE ANALYSIS SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		TP-22-003	TP-22-003	TP-22-007
DEPTH (feet):		12	12	8
DATE SAMPLED:		11/04/87	11/04/87	11/04/87
MATRIX:		SOIL	SOIL	SOIL
SAMPLE ID:		D3XTP11212	D3DTP11212	D3XTP11608
INORGANICS				
UNITS: mg/kg	CRQL			
Lead	1	116	97	4.1 *

All samples were collected during the SI. SI results were not validated.

A passive SOV survey and surface soil sampling were conducted at LF-022 to investigate potential surface soil contamination. Based of the results of these investigations, the pesticides DDT, DDE, and DDD were identified as site contaminants. The distribution of contaminants is described in more detail in the following subsections.

3.2.4.1 Soil Organic Vapor Survey. A passive SOV survey was conducted at LF-022 to screen for VOCs in the soil. The area covered by the survey and the results are shown in Appendix G. Alkanes were detected in small areas throughout the site without any visible trend. One of the areas with the highest ion counts was located alongside the access road and may be related to vehicle use. Two chlorinated solvents, TCE and perchloroethylene, were detected in independent and isolated areas in the landfill. No distribution pattern or trends were apparent for any of the compounds detected at the site. Numerous locations could not be contoured due to interferences with naturally occurring compounds present at the site.

3.2.4.2 Surface Soil Samples. Surface soil samples were collected during the supplemental RI activities at LF-022. The site was divided into four quadrants, as shown in Figure 3-12, and one sample was collected from each quadrant. Duplicate samples were collected from the southeast quadrant. The sample from each quadrant consisted of a grab sample submitted for TCL VOC analysis and a composite sample submitted for TCL SVOC, TAL metal, pesticide and PCB analysis. Locations for VOC grab samples were based on passive soil organic vapor (SOV) survey results. Composite samples were collected from a grid with nodes at 100-foot intervals; each composite sample consisted of grab samples collected from 15 to 18 grid nodes. Composite samples were collected from 0 to 0.5 feet bgs and the VOC grab samples were collected at 0.5 feet bgs. The results of the laboratory analyses are presented in the following paragraphs. A summary of the analytical results is shown in Table 3-5.

Organics: No VOCs or SVOCs were detected above detection limits in samples of LF-022 surface soils.

The pesticide DDT and associated analogs, DDD and DDE, were detected in surface soil samples from quadrants SS-2 and SS-4, at concentrations ranging from 310 to 16,000 μg/kg. No PCBs were detected in any surface soil samples. DDT, DDD and DDE analytical results were confirmed in all samples by gas chromatography/mass spectrometry (GC/MS).

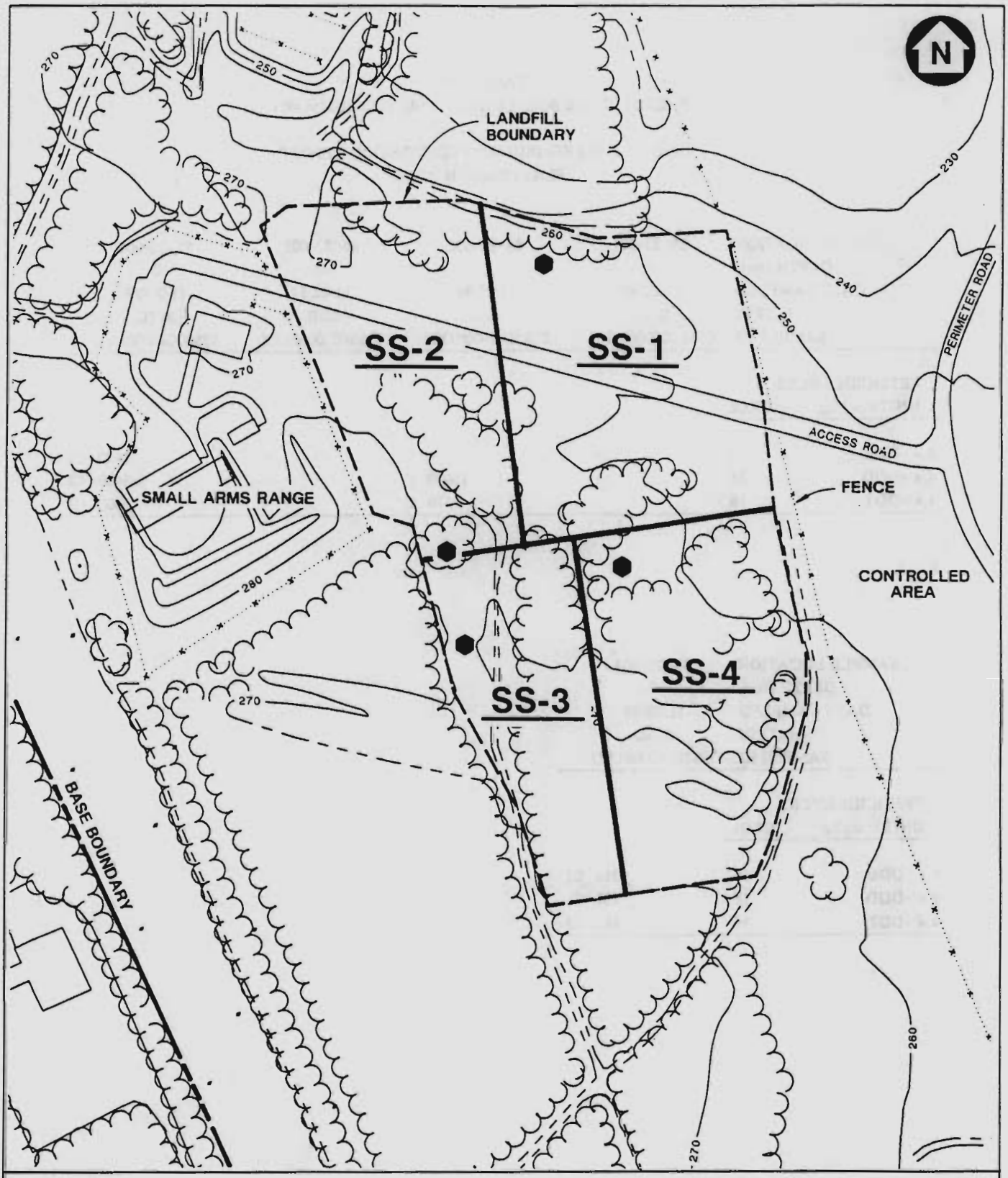


FIGURE 3-12
LF-022 SURFACE SOIL SAMPLE LOCATIONS
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
E.C. JORDAN CO.

6091-10

TABLE 3-5
LF-022 SURFACE SOIL SAMPLE ANALYSIS SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:	SS-22-001	SS-22-002	SS-22-003	SS-22-004
DEPTH (feet):	0	0	0	0
DATE SAMPLED:	11/02/89	11/02/89	11/02/89	11/02/89
MATRIX:	SOIL	SOIL	SOIL	SOIL
SAMPLE ID:	03SS00100001XX	03SS00200001XX	03SS00300001XX	03SS00400001XX
PESTICIDES/PCBS				
UNITS: ug/kg	**CRQL**			
4,4'-DDE	16	-	-	-	1400 CJ
4,4'-DDD	16	-	16000 C	-	3400 CJ
4,4'-DDT	16	-	570 C	-	6600 CJ

SAMPLE LOCATION:	SS-22-004
DEPTH (feet):	0
DATE SAMPLED:	11/02/89
MATRIX:	SOIL
SAMPLE ID:	03SS00400001XD
PESTICIDES/PCBS	
UNITS: ug/kg	**CRQL**	
4,4'-DDE	16	310 CJ
4,4'-DDD	16	720 CJ
4,4'-DDT	16	410 CJ

Inorganics: No inorganics were detected in surface soils at concentrations above background.

The disparity between pesticide concentrations detected in the duplicate samples from quadrant SS-4 suggests that the distribution of pesticides at the site may be heterogeneous. Although the two samples were collected from the same composite, the pesticide analytical results differ by an order of magnitude. However, concentrations of inorganics detected in both samples were nearly identical. The uniformity of the inorganic concentrations suggest that the composite sample was homogeneous and representative of the soil in the southeast quadrant. DDT, DDD, and DDE are expected to be the result of the sorption of pesticides to soil particles. It is impossible to determine if the pesticides detected at LF-022 were disposed of on the landfill after it was covered or if the fill material used as cover already contained the pesticides before it was used on the site.

3.2.5 Groundwater

Groundwater samples were collected from eleven monitoring wells during the RI including two wells installed upgradient from the site (Figure 3-13). All wells were screened within the unconfined aquifer. Iron and manganese were present in the groundwater due to site related conditions. A summary of the analytical results is presented in Table 3-6. SI sampling results for wells MW-22-001 and MW-22-002 are included in Table 3-6 to show any changes in water quality over time. The distribution of contaminants in LF-022 groundwater are discussed in the following subsections.

3.2.5.1 Upgradient Monitoring Wells. Two monitoring wells were installed upgradient and west of the landfill during the RI. These two wells were installed to detect possible contaminants coming from any upgradient areas. This well pair consist of water table well, MW-22-003, which is screened from 40 to 55 feet bgs and a deep well, MW-22-004, which is screened from 52 to 62 feet bgs. The samples were analyzed for TCL VOCs, TCL SVOCs, and TAL inorganics. The analytical results for the samples from these two wells were used to establish the background concentrations for compounds in groundwater at the site.

Organics: No VOCs were reported above CRQLs for either groundwater sample collected. BEHP was the only SVOC detected, but is not considered

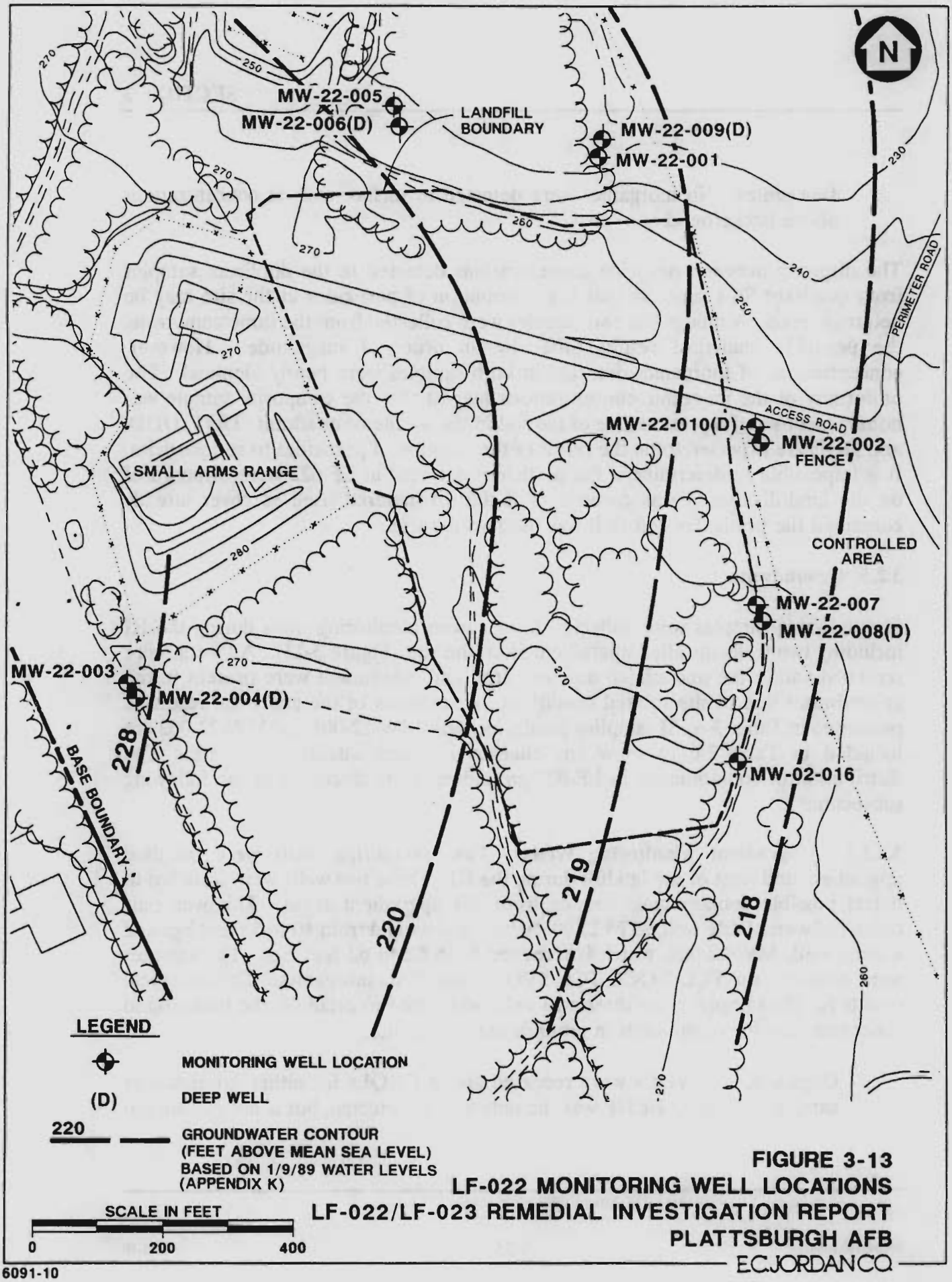


FIGURE 3-13
LF-022 MONITORING WELL LOCATIONS
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
E.C. JORDAN CO.

6091-10

TABLE 3-6
LF-022 MONITORING WELL SAMPLE ANALYSIS SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		MW-22-001 **	MW-22-001	MW-22-002 **	MW-22-002
SCREEN DEPTH (feet):		13	13	37	37
DATE SAMPLED:		12/07/87	01/12/89	12/07/87	01/12/89
MATRIX:		Water	Water	Water	Water
SAMPLE ID:		JMW112XX01	03MW112XXX02XX	JMW139XX01	03MW139XXX02XX
INORGANICS					
UNITS: ug/L	CRQL				
Iron	100	187	-	7180	8760
Manganese	15	-	-	716	877

SAMPLE LOCATION:		MW-22-003	MW-22-004	MW-22-005	MW-22-006
SCREEN DEPTH (feet):		47	57	13	28
DATE SAMPLED:		01/11/89	01/11/89	01/11/89	01/11/89
MATRIX:		Water	Water	Water	Water
SAMPLE ID:		03MW328XXX01XX	03MW329XXX01XX	03MW330XXX01XX	03MW331XXX01XX
INORGANICS					
UNITS: ug/L	CRQL				
Iron	100	-	-	-	-
Manganese	15	-	166	-	229

** Samples collected during the SI. SI results were not validated.

TABLE 3-6
(Continued)
LF-022 MONITORING WELL SAMPLE ANALYSIS SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		MW-22-007	MW-22-008	MW-22-008	MW-22-009
SCREEN DEPTH (feet):		46	87	87	40
DATE SAMPLED:		01/12/89	1/12/89	01/12/89	01/12/89
MATRIX:		Water	Water	Water	Water
SAMPLE ID:		03MW332XXX01XX	03MW333XXX01XX	03MW333XXX01XD	03MW334XXX01XX
INORGANICS					
UNITS: ug/L	CRQL				
Iron	100	3350	147 J	177 J	-
Manganese	15	797	113	114	174

SAMPLE LOCATION:		MW-22-010	MW-02-016
SCREEN DEPTH (feet):		65	48
DATE SAMPLED:		01/12/89	01/17/89
MATRIX:		Water	Water
SAMPLE ID:		03MW335XXX01XX	01MW306XXX01XX
INORGANICS			
UNITS: ug/L	CRQL		
Iron	100	-	NR
Manganese	15	156	NR

** Samples collected during the SI. SI results were not validated.

a site contaminant because it was also detected in the associated laboratory blank (Appendix I).

Inorganics: Sodium was detected at 125,000 μg/L in MW-22-003, which is above what is considered as naturally occurring. U.S. Route 22 and Interstate 87 are within 800 feet of MW-22-003 and MW-22-004. Because MW-22-003 is upgradient from LF-022, the source of the sodium may be attributed to salt applied to adjacent public roads.

3.2.5.2 Downgradient Wells. Two monitoring wells, MW-22-001 and MW-22-002, were installed downgradient from LF-022 during the SI. Seven additional downgradient monitoring wells were installed during the RI (see Figure 3-13). Wells MW-22-006, MW-22-008, MW-22-009, MW-22-010 are screened in the lower portion of the aquifer (i.e., completely below the water table). The remaining wells are screened across the water table. Groundwater samples were collected from all nine downgradient monitoring wells and analyzed for TCL VOCs, TCL SVOCs, and TAL inorganics.

Organics: 2-Butanone was detected in samples from the three wells (MW-22-001, MW-22-002, and MW-22-007) ranging from 47 μg/L to 300 μg/L, and qualified as estimated. 2-Butanone was not detected in the previous SI sampling of MW-22-001 and MW-22-002. 2-Butanone is recognized by USEPA as a common sampling and laboratory contaminant. It is likely that these concentrations represent sampling or laboratory artifacts and are not representative of site contamination.

BEHP was detected in samples from two wells, MW-22-006 and MW-22-008, at concentrations of 13 and 18 μg/L. BEHP is recognized by USEPA as a common sampling or laboratory artifact. Because BEHP was detected at a higher concentration (52 μg/L) in the upgradient well MW-22-003, these BEHP concentrations are believed to represent an upgradient source or sampling or laboratory artifacts, therefore, BEHP is not considered a site contaminant.

Inorganics: Iron and manganese are present in the groundwater due to site related conditions. Calcium is not considered a site contaminant because it is within the naturally occurring range. Both calcium and magnesium may also reflect the geologic composition of the area. Dolomite ($CaMg[CO_3]_2$)

and limestone ($CaCO_3$) are rock materials of this region and both may contribute to high calcium and magnesium concentrations. Sodium and potassium are not considered site contaminants because higher concentrations were detected in the sample from the background well MW-22-003 than in any of the downgradient wells.

3.2.5 Air

An extensive air monitoring survey was not conducted at LF-022. For health and safety reasons, PIDs were used to monitor the air in the vicinity of explorations during the SI and RI. No impacts on air quality were detected by the health and safety monitoring. Modeling techniques were used to evaluate the impacts that contaminants in the soil may have on air quality. The results of the modeling are presented in Subsection 3.3.5.

3.3 Contaminant Fate and Transport

This subsection describes the probable fate of contaminants identified at the site. Contaminant fate will vary depending on several factors, some of which are properties of the contaminant and others that are site dependent. Both general information about site contaminants and specific site-related conditions are presented in the following paragraphs. The transport of contaminants at the site is described in relation to the various potential migration pathways (e.g., surface runoff, and infiltration).

3.3.1 Migration Pathways

Migration pathways are determined by both the physical characteristics of the site and the types of contaminants identified at the site. Potential migration pathways at LF-022 include: surface water runoff (including soil erosion), precipitation percolating through the soil, groundwater, and air (including wind erosion). The potential migration pathways are described in the following subsections with respect to media.

3.3.1.1 Surface Soil. The primary migration pathway for the organochlorine pesticides detected in surface soil (i.e., DDT, DDD, and DDE) is surface water runoff. These contaminants sorb strongly to soil particles which may be eroded and

transported in surface water runoff. Conditions at the site indicate very little surface runoff is occurring (see Subsection 3.1.3); however, the persistence of DDT and its transformation products in the environment increases the likelihood that surface runoff may become an important migration pathway. The extremely slow biodegradability process, limited volatility, and low solubility of these contaminants provide an opportunity for long-term migration by erosion.

A second mechanism for organochlorine pesticide transport is leaching due to infiltration of rainwater. Because these compounds sorb strongly to soil particles and have low water solubilities, this process is expected to be extremely slow. However, the persistence of these compounds makes it possible that this process can be important under current conditions (continued percolation of precipitation) at the landfill.

DDT, DDD, and DDE can volatilize and migrate through the air. Although these pesticides do not readily volatilize, the persistence of the contaminants allows the process to occur over a long period of time. DDT and its transformation products may also be transported on windborne soil particles. The potential for migration of DDT, DDD, and DDE in the air has been evaluated using modeling; the results of this evaluation are presented in Subsection 3.3.5.

3.3.1.2 Wastes. The primary migration pathway available for contaminants in the wastes is the infiltration of rainwater and snowmelt. The infiltration of precipitation is expected to solubilize some of the contaminants in the wastes. The dissolved concentrations of the chemicals are dependent on a number of factors including the pH of the rainwater and soil and soil-water partitioning. The analysis of samples collected from groundwater and soil beneath the waste indicate that downward migration of contaminants in the waste is not readily occurring.

3.3.1.3 Groundwater. The gray color of soil below the water table and the presence of iron and manganese at concentrations above New York State Class GA groundwater quality standards has been interpreted as indicating mild reducing conditions in the groundwater at the site. The mild anaerobic conditions at the landfill increase the solubility of iron and manganese. The age of the landfill, the types of wastes that were disposed, and the practice of burning the wastes have fostered the conditions that exist in the groundwater. No site contaminants appear to have migrated to the groundwater, and the horizontal migration of contaminants appears to be limited.

3.3.2 Fate and Transport of Contaminants in the Waste Material and Subsurface Soil

VOCs, SVOCs, PHCs, and inorganic compounds detected in samples of the waste material from LF-022 were identified as site contaminants. The fate of these contaminants are described in the following subsections.

3.3.2.1 VOCs. The wastes buried in the landfill vary from burned household trash to empty drums and pails. However, one drum (approximately 10 gallons) that was observed at the ground surface during the fall of 1987 contained an oily substance. Analysis of the drum contents revealed that TCL compounds were not present. Road building activities at the landfill in 1987 also exposed a small amount of a white powder (estimated at 1 kg). Carbon tetrachloride, chloroform, and acetone were detected in samples of the powder at concentrations of 18,000, 19,000, and 2,400 μg/kg, respectively.

This powder may have been used as a sorbent for waste solvents as indicated by the variety of solvents detected. Fuel related compounds, chlorinated solvents, and ketones were all present in the powder. The presence of the solvents in the white powder appears to an isolated occurrence since none of the solvents were identified in the soil or groundwater at the landfill.

Using a groundwater model (see Appendix L for assumptions and conditions of the modeling), all of the above VOCs present in the estimated 1 kg of powder were considered as being introduced as an instantaneous slug to the groundwater. Using this worst case scenario, the model predicted less than 1 μg/L of total VOCs in the groundwater approximately 80 feet downgradient from the site. Based on this simulation and the limited nature of the source, VOCs are not considered a concern at the landfill.

3.3.2.2 SVOCs. One SVOC compound, BEHP, a common plasticizer, was detected in a sample of white ash encountered in TP-22-001 at 11 feet. BEHP is found in a variety of plastics and represents a probable component of wastes that were known to be deposited in the landfill.

Uses. BEHP is the primary plasticizer used in PVC. It is easy to process and can be formulated to yield a broad range of physical properties. The only

significant non-plasticizer use for BEHP is as a replacement for PCBs in transformer fluids

Probable Fate and Transport. The BEHP detected in the wastes at the landfill is expected to remain sorbed to the surrounding soils. The high sorption coefficient and low water solubility of BEHP, along with no conclusive evidence that the BEHP detected in groundwater samples can be attributed to LF-022, indicates that migration in the soil column is minimal. However, due to BEHP's resistance to biodegradation, hydrolysis, and volatilization, the importance of solubility with the infiltration of rainwater becomes more important. The BEHP in the subsurface soil is expected to partition between the soil and water and ultimately be transported to the groundwater. This process is expected to be slow with considerable retardation by sorption occurring throughout the vadose zone. The environmental profile for BEHP is contained in Appendix M.

3.3.2.3 Petroleum Hydrocarbons. PHCs were detected in waste samples collected during test pit activities. PHCs are a group of compounds that are defined by the analytical method that is employed. USEPA method 418.1, Total Petroleum Hydrocarbons by Infrared Spectroscopy, is a technique used to measure fuel related compounds with boiling points in the range of gasoline and number two fuel oil. Some of the products that can be measured by this technique include JP-4, kerosene, and most of the components of aviation fuel. Neither the light fractions of gasoline nor the heavier fractions of fuel oils are measured by this analytical technique.

General. PHCs are composed of both straight and branched chain aliphatic and aromatic hydrocarbons. In addition, halogenated hydrocarbons within the boiling point range of the analysis are also detected by this method. It should be noted, however, that the method does not distinguish between types of fuels present, the age of the fuels, whether or not that halogenated compounds are included, or if some of the compounds present are naturally occurring. While PHC values may not correlate to TCL VOA and SVOA results, they are still a good indicator of a large group of unregulated fuel compounds and of active waste disposal areas.

The PHCs detected in the landfill may have been the result of the addition of fuels to burn the wastes that were deposited there. The concentrations of

PHCs detected (not detected to 3,100 mg/kg) are not indicative of widespread use or disposal of fuels in the landfill.

Probable Fate and Transport. The fate processes for PHCs vary with the individual compounds that are present. Because almost all of the compounds are unregulated and may number into the thousands, very little information is available for the individual compounds. In general, the lighter fractions are more susceptible to both volatilization and biodegradation, while the heavier fractions are more persistent.

The absence of TCL volatile compounds at the site indicates that the fuel-related compounds in the landfill have weathered and degraded. The heavier, more resistant fractions of fuels, because of biodegradation and weathering, are less mobile and are expected to undergo only limited migration in the subsurface soils. Because TCL compounds were not detected in conjunction with PHCs, they are not considered to be a major site contaminant and are expected to continue degrading. The environmental profile for PHCs is contained in Appendix M.

3.3.2.4 Inorganics. Ten metals were identified in the waste samples as site contaminants: aluminum, cadmium, chromium, copper, lead, manganese, iron, silver, sodium, and zinc. Each of these metals was detected above background concentrations at the site and is believed to be related to landfill activities.

General. Six of the metals identified in the waste, aluminum, cadmium, chromium, copper, lead, silver, and zinc were not present in the groundwater at concentrations exceeding New York State drinking water standards. Iron, manganese, and sodium were present in the groundwater at concentrations exceeding either background concentrations or the relevant standards.

Iron and manganese in the waste may originate from the native soils, the waste material, or a combination of both. However, there is no indication that metals are leaching to groundwater (e.g., aluminum, cadmium, copper) from the waste material. The presence of iron and manganese in the groundwater does not appear to be related to the waste materials but is instead a result of solubilized iron and manganese within the native soils.

The sodium may originate from its use in the winter salting of nearby roads. The higher concentrations of sodium in the upgradient wells near the roadway supports this as a probable source.

Lead was the only element detected above background concentrations in the native soils below the waste material (TP-22-003). The presence of lead may be related to the application of fuels used to burn the waste during routine operation of the landfill. Lead was not detected in the groundwater beneath the site. Data indicate that lead is not leaching from the soil to the groundwater at the landfill.

Table 3-7 summarizes the predominant species, uses, and probable fate and transport of the elements detected in the wastes. Appendix M contains environmental profiles of the elements detected at LF-022.

3.3.3 Fate and Transport of Contaminants in Surface Soil

Surface soils that were collected and composited during the fall of 1989 contained the TCL pesticide 4,4'-DDT and its metabolites, 4,4'-DDD and 4,4'-DDE. DDT and its degradation products were detected in two of the sample grid quadrants from 310 to 16,000 μg/kg.

DDT is also known as dicophane and chlorophenetane. Commercial mixtures of DDT contain approximately 75 percent of 4,4'-DDT and 25 percent mixed isomers (Verschueren, 1983). Like DDT, DDD is also a commercial product and is composed of different isomers. Alternate names for DDD include TDE and rhothane. DDD is also a product of the anaerobic biodegradation of DDT, and thus is considered one of the transformation products of DDT.

DDE is similar in chemical structure and behavior to DDT, but not manufactured commercially. DDE is strictly an aerobic biodegradation product of DDT.

DDT was used on base before being banned. The presence of DDT and its transformation products at the landfill may be due to waste disposal and/or intentional pesticide applications.

TABLE 3-7
INORGANIC CONTAMINANTS IN THE WASTE AT LF-022

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

INORGANIC CONTAMINANTS IN THE WASTE	EXPECTED PREDOMINANT SPECIES	MAJOR USES	PROBABLE FATE AND TRANSPORT
ALUMINUM	Al^{+3}	• Widely used in metals due to its low density, high electrical conductivity, high reflectivity, and corrosion resistance	• Expected to be precipitated with the silica at the site • Not expected to leach to groundwater
CADMIUM	Cd^{+2}	• Widely used in the electroplating industry • Found in motor oils, fertilizers, and batteries	• Expected to form precipitates • May adsorb to organic materials • Not expected to leach to groundwater
COPPER	Cu^{+2}	• Used in wire, electrical equipment, brass, and electroplating • Used for algae control and in agriculture	• Expected to form precipitates • May adsorb to organic materials • Not expected to leach to groundwater
LEAD	Pb^{+2}	• Used in the manufacture of solders, paints, and pesticides • Component of motor oils, fuel and solvents	• Expected to form precipitates • May form complexes with organic materials • Not expected to leach to groundwater
IRON	Fe^{+2}	• Used in the manufacturing of steel and industrial iron • Used in construction, containers, and coverings	• May form complexes with organic materials • May leach to groundwater under current landfill conditions
MANGANESE	Mn^{+2}	• Used in the manufacturing of steel • Used in dry cell batteries • Used in non-iron alloys	• May adsorb to silicates • Not expected to leach to groundwater
SILVER	Ag^{+}	• Used in the manufacture and development of film • Used in electroplating, jewelry, batteries and coins	• May form complexes with organic materials • Not expected to leach to groundwater
SODIUM	Na^{+}	• Used in glass manufacture, food and gasoline production • Commonly used in winter time salting of roads	• Not expected to form precipitates • Expected to leach with rainwater to the groundwater
ZINC	Zn^{+2}	• Used in the manufacture of brass and bronze alloys • Used in some insecticides, fungicides, and glues	• Expected to form precipitates • Not expected to leach to groundwater

Uses. Produced commercially, DDT and DDD were almost exclusively utilized as insecticides. DDE has not been produced commercially, and is present only as a DDT transformation product.

Occurrence. DDT is not known to exist naturally, but because of widespread use , it is distributed at low concentrations worldwide. DDD and DDE generally occur coincidentally with DDT.

Probable Fate and Transport. After being introduced to the environment, DDT and its transformation products have proven to be very persistent compounds. In the aqueous phase, DDT and its derivatives may evaporate (i.e., volatilize) and photolyze under sunlight. DDT, DDD, and DDE in the surface soils are expected to migrate via mechanical transport away from the site. In addition, sorption and bioaccumulation play important roles in the fate of DDT and its transformation products.

A half life for the decrease of DDT in surface waters is 56 to 110 days, as compared to 1,000 to 5,500 days in soils (USEPA, 1985a). DDD was detected at 16,000 μg/kg in one of the composite samples and may have been as high as 260,000 μg/kg in one component of the composite sample. The worst case value of 260,000 μg/kg could take (based on an assumed half life of 1,000 to 5,500 days) between 50 and 200 years to completely disappear (below the CRQL of 16 μg/kg) from the soils at the landfill. The persistence of DDT and its transformation products increases the likelihood that surface erosion and rainwater runoff may transport DDT away from the site.

Despite their low solubilities, aqueous pathways may become significant for DDT and its derivatives because biodegradation, either in the soil or water, is extremely slow. The biodegradation of these compounds on soil and sediment, although slow, is the primary fate for DDT, DDD, and DDE because most of the contaminants remain adsorbed to the soil.

DDT and its transformation products are also removed from the environment through the bioaccumulation process. Bioaccumulation factors range from 10^3 to 10^6, indicating that concentrations in biota may be up to one million times the concentration in water (Callahan, 1979). The persistence of DDT, DDD, and DDE increases the contact time for biota and the likelihood that these compounds will be bioaccumulated in the food chain. Table 3-8 contains a

TABLE 3-8
CHEMICAL PROPERTIES OF ORGANIC CONTAMINANTS AT LF-022

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

COMPOUND DETECTED	WATER SOLUBILITY (mg/L)	K_{oc} (mg/L)	log K_{ow}	HENRY'S CONSTANT (atm*m^3/mole)	VAPOR PRESSURE (mmHg@20°C)	BCF[1] (L/kg)	SOURCE
Bis-(2-ethylhexyl)phthalate (BEHP)	4.00E+5	62,100	3.98	2.50E-7	--	--	2
4,4'-DDT	5.00E-3	243,000	6.19	5.10E-6	5.50E-6	54,000	USEPA, 1986b
4,4'-DDD	1.00E-1	770,000	6.20	8.00E-4	1.89E-6	--	USEPA, 1986b
4,4'-DDE	4.00E-2	4,400,000	7.00	6.80E-S	6.60E-6	51,000	USEPA, 1986b

NOTES:

[1] Bioaccumulation factor in fish unless otherwise noted

[2] Arthur D. Little, Inc., 1985

listing of the chemical properties of DDT, DDD, and DDE. Appendix M contains environmental profiles of DDT and its transformation products.

3.3.4 Fate and Transport of Contaminants in Groundwater

General. TCL volatile and semivolatile compounds were not detected in the groundwater. Two elements, iron, and manganese, were present in groundwater due to site related conditions. The reported results for iron and manganese (not detected to 8,760 μg/L and not detected to 877 μg/L respectively) exceeded New York State Class GA groundwater quality standards.

Probable Fate and Transport. The results for iron and manganese may be indicative of mild anaerobic conditions in the landfill. Anaerobic conditions in the landfill should slowly dissipate as the degradation cycle reaches completion. If the concentrations of dissolved iron and manganese are the result of anaerobic conditions, concentrations should decrease as the groundwater conditions become similar to the conditions observed in the background wells. The iron and manganese may also be leaching from wastes in the landfill.

The reactions of iron and manganese with regard to the weathering process are dependent on Eh-pH of the environment. The current pH values at the landfill range from 6 to 8 under mild anaerobic conditions. The predominant iron species expected in the groundwater is the ferrous ion (Fe+2), while the manganous ion (Mn+2) is the expected species for manganese. In addition, both iron and manganese oxides may be present in the groundwater. These oxides play an important role as soluble substrates for the sorption of trace metals. The species of iron and manganese in the groundwater that predominate at the landfill varies with the pH and the degree of reducing condition that exist. The presence of reducing conditions at the landfill can reverse the binding of trace metals to soil releasing them back into the groundwater. However, other than iron and manganese, TCL metals were not detected above New York State Class GA groundwater quality standards. Appendix M contains the environmental profiles for both iron and manganese.

3.3.5 Contaminant Transport Modeling

Air quality can be impacted by (1) volatilization of organic contaminants in soil and (2) airborne transport of contaminants sorbed to soil particles. To determine the possible impacts that contaminants may have on air quality at LF-022, organic contaminant emission rates and fugitive particulate concentrations were estimated using concentrations of contaminants present in surface soil at the site. The following subsections describe the processes involved in assessing these air quality impacts.

3.3.5.1 Modeling of Organic Vapor Emissions. NYSDEC defines sites that have not yet been remediated as 'Uncontrolled Sources.' According to NYSDEC "Air Cleanup Criteria" (NYSDEC, 1990), concentrations of contaminants in the air above uncontrolled sources must be compared to the appropriate ambient air quality standards (AAQSs) to determine whether air quality has been affected at a site and if remedial action is necessary. To evaluate the impacts of contaminants on air quality at LF-022 and downwind from the site, modeling was used to estimate the rates at which contaminants in the soil are volatilizing and the dispersion of airborne contaminants.

Data Requirements. Emission rates were estimated based on contaminant concentrations, chemical properties of contaminants, and soil characteristics. Information used in the modeling was collected from SI and RI data and reference manuals.

The pesticides DDD, DDE, and DDT were the only organic compounds detected at concentrations above the CRQL in surface soil at LF-022. The following chemical properties are necessary for the modeling process for each compound: molecular weight, vapor pressure, solubility, diffusivity in air and water, organic carbon partition coefficient (K_{oc}), and Henry's Law constant. Measured values of these chemical properties were obtained from a number of sources including various USEPA resources and chemical handbooks.

The USEPA document entitled "Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF) - Air Emissions Models" (1987) was used as the primary source of information. When a chemical property for a compound was not available in this document, the following references, in order of preference, were used to find the remaining properties: "Superfund Public

Health Evaluation Manual" (USEPA, 1986b), "CERCLA Discharges to POTWs Treatability Manual" (USEPA, 1990d), "CRC Handbook of Chemistry and Physics" (Weast, 1988), "Perry's Chemical Engineers' Handbook" (Perry, 1984), "Handbook of Environmental Data on Organic Chemicals" (Verschueren, 1983), "The Installation Restoration Program Toxicology Guide" (Arthur D. Little, Inc., 1985), "Dangerous Properties of Industrial Materials" (Sax and Lewis, 1989).

Most diffusivity constants could not be found in the literature. These constants were estimated based on similarities in molecular structure between the compound with unknown diffusivity constants and compounds with known diffusivity constants.

Soil characteristics of LF-022 were obtained from a number of resources. Depth of contamination was assumed to be 1 foot; the concentrations of contaminants detected in each sampling quadrant were assumed to be representative of the entire quadrant. Soil porosity was approximated by assuming a value for D_{10}, obtaining a void ratio from the literature, and calculating a range of values. Other soil characteristics were obtained from field and laboratory observations.

Air Emission Rates and Dispersion Modeling. The modeling approach followed USEPA guidance for estimating air emissions from clean-up activities at Superfund Sites (USEPA, 1989a). The approach begins with the estimation of emission rates. The emission rates are then used in dispersion models to estimate air concentrations. The model used to estimate baseline emission rates was the Behavior Assessment Model for Trace Organics in Soil (Jury et.al., 1983).

The model results for several time intervals are presented in Table 3-9. The results shown in Table 3-9 are based on assumptions that conservatively overestimate emission rates. The time of release to the soil is one of the conservative assumptions. Because the actual time the pesticides were released to the soil is unknown, the spill was assumed to have occurred in 1988, which corresponds to the year the LF-022 surface soil samples were collected. Because emission rates decline exponentially from the spill event, present actual emission rates are likely to be significantly lower than those predicted in Table 3-9 because the pesticides may have been released to the

TABLE 3-9
LF-022 ESTIMATED CONTAMINANT EMISSIONS

LF-022/LF023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

LANDFILL QUADRANT	PREDICTED EMISSION RATE (g/s) 2 YEARS	32 YEARS	72 YEARS	AVERAGE EMISSION RATE (g/s) YEAR 2 TO YEAR 32	YEAR 2 TO YEAR 72
4,4'-DDD					
NORTHWEST	4.57E-06	1.42E-07	8.45E-09	7.57E-07	3.43E-07
NORTHEAST	ND	ND	ND	ND	ND
SOUTHEAST	4.27E-07	1.32E-08	7.89E-10	7.07E-08	3.20E-08
SOUTHWEST	ND	ND	ND	ND	ND
4,4'-DDE					
NORTHWEST	5.20E-08	1.75E-09	1.32E-10	8.97E-09	4.08E-09
NORTHEAST	ND	ND	ND	ND	ND
SOUTHEAST	1.99E-07	6.70E-09	5.07E-10	3.43E-08	1.56E-08
SOUTHWEST	ND	ND	ND	ND	ND
4,4'-DDT					
NORTHWEST	1.49E-07	4.87E-09	3.47E-10	2.53E-08	1.15E-08
NORTHEAST	ND	ND	ND	ND	ND
SOUTHEAST	6.49E-07	2.13E-08	1.52E-09	1.11E-07	5.03E-08
SOUTHWEST	ND	ND	ND	ND	ND

NOTES:

4,4'-DDE WAS NOT DETECTED IN NORTHWEST QUADRANT SOILS; EMISSIONS WERE ESTIMATED ASSUMING 4,4'-DDE WAS PRESENT AT HALF THE DETECTION LIMIT

soil over 25 years ago. Additionally, the soil concentrations were assumed to be uniformly distributed throughout the respective landfill quadrant. However, such concentrations are more likely to occur in relatively small areas. Therefore, emissions are likely to be much lower than estimated under this assumption. Conservative emission rates were used because screening dispersion modeling is intended to provide an overestimate of ambient concentrations. If screening modeling can demonstrate that ambient concentrations are acceptable, then the more complex refined dispersion models can be avoided.

Air concentrations were predicted from the estimated emission rates with the screening techniques recommended by USEPA (1988c). The release was first evaluated for density to verify that traditional dispersion models were appropriate for predicting downwind concentrations. Because the density evaluation indicated traditional models could be used, the dispersion model in USEPA (1988c) was used to predict downwind concentrations. The dispersion model recommended in USEPA 1988c is identical to the UNAMAP dispersion model SCREEN. A normalized emission rate of 1 gram per second was input to SCREEN along with the area source's height and length of shortest side. The results for the emission rate of 1 gram per second were then multiplied by the emission rates of each compound which provided predicted 1-hour average concentrations for each compound.

The screening dispersion modeling results are presented in Table 3-10. The eight hour average concentrations were estimated from the predicted 1-hour average concentrations multiplied by a correction factor of 0.9. The annual average concentrations were estimated from the predicted 1-hour average concentrations by applying a correction factor of 0.2.

3.3.5.2 Modeling of Contaminant Particulate Emissions. Contaminants sorbed to soil may be transported in the air when soil particles are carried by the wind. This transport of contaminants is known as fugitive dust emissions. To assess air quality impacts of fugitive dust emissions, airborne concentrations of contaminants resulting from wind erosion of PM_{10} particles were calculated. PM_{10} particles are defined as airborne respirable particulate matter with an aerodynamic diameter equal to or smaller than 10 micrometers.

TABLE 3-10
LF-022 ESTIMATED CONTAMINANT AMBIENT AIR CONCENTRATIONS

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

LANDFILL QUADRANT	ESTIMATED 8-HOUR AVERAGE CONCENTRATION (mg/m^3)			ESTIMATED ANNUAL AVERAGE CONCENTRATION (mg/m^3)	
	2 YEARS	32 YEARS	72 YEARS	YEAR 2 TO YEAR 32	YEAR 2 TO YEAR 72
4,4'-DDD					
NORTHWEST	1.35E-03	4.21E-05	2.50E-06	4.99E-05	2.26E-05
NORTHEAST	--	--	--	--	--
SOUTHEAST	1.05E-04	3.26E-06	1.95E-07	3.88E-06	1.76E-06
SOUTHWEST	--	--	--	--	--
TOTAL	1.46E-03	4.53E-05	2.70E-06	5.37E-05	2.43E-05
4,4'-DDE					
NORTHWEST	1.54E-05	5.19E-07	3.91E-08	5.91E-07	2.69E-07
NORTHEAST	--	--	--	--	--
SOUTHEAST	4.92E-05	1.66E-06	1.25E-07	1.88E-06	8.57E-07
SOUTHWEST	--	--	--	--	--
TOTAL	6.46E-05	2.17E-06	1.64E-07	2.47E-06	1.13E-06
4,4'-DDT					
NORTHWEST	4.42E-05	1.44E-06	1.03E-07	1.67E-06	7.57E-07
NORTHEAST	--	--	--	--	--
SOUTHEAST	1.60E-04	5.26E-06	3.76E-07	6.10E-06	2.76E-06
SOUTHWEST	--	--	--	--	--
TOTAL	2.05E-04	6.71E-06	4.79E-07	7.76E-06	3.52E-06

NOTES:

4,4'-DDE WAS NOT DETECTED IN NORTHWEST QUADRANT SOILS; EMISSIONS WERE ESTIMATED ASSUMING 4,4'-DDE WAS PRESENT AT HALF THE DETECTION LIMIT

ESTIMATED 1-HOUR AVERAGE CONCENTRATIONS WERE MULTIPLIED BY A FACTOR OF 0.9 TO OBTAIN THE 8-HOUR AVERAGE CONCENTRATIONS (USEPA, 1988)

ESTIMATED 1-HOUR AVERAGE CONCENTRATIONS WERE MULTIPLIED BY A FACTOR OF 0.3 TO OBTAIN THE ANNUAL AVERAGE CONCENTRATIONS

THE ESTIMATED TOTAL CONCENTRATION CONSERVATIVELY ASSUMES THE ESTIMATE CONCENTRATIONS FOR EACH QUADRANT ARE ADDITIVE

Depending on the erodibility of surface soil at LF-022, either of two emission factor equations are recommended (USEPA, 1985c). Where erosion potential is low at a site, it is assumed there is a "limited reservoir" of erodible material. Conversely, where site surface soils are mostly composed of fine-grained soil particles, the site is classified as having an "unlimited reservoir" of erodible material. Based on wind erosion research, the cutoff threshold friction velocity between the two erodibility classes is approximately 0.75 meters per second (m/s) (USEPA, 1985c). This division is based on the observation that the soil type of highly erodible surfaces have threshold friction velocities of approximately 0.75 m/s.

Threshold friction velocity can be approximated based on results of a grain size analysis of soil. Based on a relationship described in USEPA, 1985c, if more than 60 percent of the soil particles from a site pass through a 1-mm sieve, the "unlimited reservoir" model would apply. Surface soil from LF-022 was assumed to be composed of Plainfield Loamy Sand with 3 to 8 percent slopes. Typically, 60 percent or more of this soil passes through a 1-mm sieve. Therefore, the "unlimited reservoir" model is appropriate for LF-022.

For estimating fugitive dust particulate emissions from surfaces with an "unlimited reservoir" of erodible particulates, the box model is appropriate. The box model assumes the surface of LF-022 is a rectangular source area. The box is bounded by the surface of the site; the height is defined as the mixing height of the mean vertical displacement of emissions. The width of the box is equal to the width of LF-022. It is assumed that mixing is complete within the boundaries of the box and that the box is aligned so the length is parallel to wind direction (McCarthy and Burbank, 1990).

Airborne particulate concentrations can be estimated by applying this box model. Concentrations are calculated using a three-step process. The first step is to estimate the emission rate of PM_{10} particles (E_{10}) based on site and soil characteristics. In the second step, contaminant emission rates (Q_{10}) are estimated. These results are based on surface soil data and the area of the contaminated surface. The third step is to predict air concentrations (C_{10}).

Based on field measurements of erodible soil for surfaces with an "unlimited reservoir," an emission rate (E_{10}) for PM_{10} particles can be estimated. This estimate is based on site observations such as the fraction of surface with continuous vegetative cover and the type of vegetation present. This calculation also accounts

for mean annual wind speed. Results of these calculations are presented in Appendix L.

Contaminant emission rates are calculated based on PM_{10} emission rates (E_{10}). Surface area of the site and surface soil concentrations of contaminants are considered. Contaminant emission rates (Q_{10}) are listed in Appendix L.

The last step in the box modeling process is to calculate airborne contaminant concentrations (C_{10}). This calculation is based on the contaminant emission rate (Q_{10}) calculated in Step 2, the fraction of a 24-hour day during which activity occurs at the site, and the ventilation rate of the site. It was assumed that activity would occur 24 hours per day at LF-022. The ventilation rate is based on wind speed, the mixing height, and the width of the site perpendicular to the wind. It was assumed that the downwind distance from the edge of LF-022 to a receptor was 1 meter(m); the mixing height (i.e., the mean vertical displacement of emissions) is calculated based on this assumption. These results are presented in Appendix L.

Table 3-11 lists the airborne concentration (C_{10}) 1 m downwind of LF-022 and the contaminant emission rate (Q_{10}) of the pesticides.

3.4 BASELINE RISK ASSESSMENT

A baseline risk assessment was conducted for the LF-022 Landfill to determine if site contaminants pose a risk to human and/or ecological receptors. This assessment consisted of three components: (1) data evaluation, (2) human health risk assessment, and (3) habitat-based environmental risk assessment. The evaluated environmental media included groundwater, surface soil, and subsurface soil/waste. These media were evaluated with regard to potential adverse effects to both human health and the environment.

3.4.1 Data Evaluation

Contaminants associated with the LF-022 site have been detected in groundwater, surface soil, and subsurface soil/waste material. No surface water is associated with this site. The site contaminants identified in Table 3-2 were chosen based on comparisons with New York State or federal standards or background levels. These contaminants were further evaluated for their potential effects on human health and

TABLE 3-11
LF-022 CONTAMINANT PARTICULATE EMISSIONS

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

COMPOUND	Q_{10} (mg/s)	C_{10} (mg/m^3)
4,4'-DDE	3.17E-05	7.26E-08
4,4'-DDD	3.62E-04	8.30E-07
4,4'-DDT	1.49E-04	3.42E-07

the environment. Based on this analysis, contaminants of potential concern were chosen for the baseline risk assessment.

3.4.1.1 Groundwater. The only organic contaminants detected in groundwater were BEHP and 2-butanone, both of which were attributed to laboratory contamination. The only elements considered to be site-related in groundwater were iron and manganese. Neither of these inorganic elements are highly toxic to humans, and both are essential elements in the human diet. However, both elements were detected above their New York State Groundwater Quality Standards (i.e., 300 μg/L). Therefore, they represent contaminants of potential concern.

Other elements detected in groundwater at LF-022 were calcium, magnesium, potassium, sodium, and zinc. None of these elements are considered to be contaminants of potential concern for human health because they all are essential nutrients and are relatively non-toxic. In addition, these elements were not considered to be site-related because, among other considerations, their concentrations downgradient of the landfill were not elevated above upgradient levels. This comparison is illustrated below for all detected elements.

ELEMENT	MAXIMUM DOWNGRADIENT (mg/liter)	MAXIMUM UPGRADIENT (mg/liter)
Calcium	121	97.2
Iron	8.76	ND
Magnesium	21.9	25.9
Manganese	0.877	0.229
Potassium	ND	16.2
Sodium	21.3	125
Zinc	0.037	0.083

3.4.1.2 Subsurface Soil/Waste. Subsurface soil and soil/waste samples were collected from test pits during the 1987 SI (E.C. Jordan Co., 1989). Six inorganic contaminants were detected at concentrations above the expected range for soils in this part of the nation: aluminum, cadmium, copper, iron, lead, manganese, silver, sodium, and zinc. Of these, cadmium, copper, lead, manganese, and silver are of

toxicological concern to human or ecological receptors. Sodium, aluminum, iron, and zinc were not detected at concentrations that are of toxicological concern, therefore, they do not warrant further consideration in this risk assessment. The only organic compound detected in subsurface soil/wastes was BEHP, a probable human carcinogen. Its presence likely results from leaching of waste materials and it is considered a site-related contaminant. Therefore, for subsurface soils/waste, cadmium, copper, lead, manganese, silver, zinc, and BEHP represent contaminants of potential concern.

3.4.1.3 Surface Soil. Composite surface soil samples were collected during a supplemental sampling round in November 1989. The landfill was divided into four quadrants and a composite sample consisting of 15 to 17 discrete samples was taken from each quadrant. These composite samples were analyzed for TCL SVOCs and pesticides/PCBs, and TAL inorganics. In addition, one discrete sample from each quadrant was also analyzed for TCL VOCs.

The only organic contaminants detected above analytical quantitation limits in these samples were DDE, DDD, and DDT at total concentrations up to 16 mg/kg in the northwest quadrant. The mean total concentration of the sum of the three compounds was 6.7 mg/kg. VOCs and SVOCs were not detected. Concentrations of inorganic compounds were within typical background ranges; therefore, they were not considered site-related.

The data for pesticides are summarized in Table 3-12. This table presents both the concentrations detected in each composite and the weighted sitewide average concentration of each pesticide.

Because DDT, DDD, and DDE were the only organic compounds detected in surface soils, and inorganic compounds were not detected above anticipated background concentrations, these three compounds were the only contaminants of potential concern for surface soils at the LF-022 site.

3.4.2 Human Health Risk Assessment

The purpose of the baseline human health risk assessment of the LF-022 site is to determine if contamination at the site poses significant risks to human health, in the absence of any remedial action. The baseline human health risk assessment consists of the following components:

TABLE 3-12
SUMMARY OF SURFACE SOIL PESTICIDE DATA FOR LF-022

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE	LANDFILL QUADRANT	SAMPLES PER COMPOSITE	*DDT* CONCENTRATION (mg/kg)	*DDD* CONCENTRATION (mg/kg)	*DDE* CONCENTRATION (mg/kg)
SS-01	Northeast	16	8.0E-03	8.0E-03	8.0E-03
SS-02	Northwest	16	5.7E-01	1.6E+01	8.0E-03
SS-03	Southwest	17	8.0E-03	8.0E-03	8.0E-03
SS-04	Southeast	15	3.5E+00	2.1E+00	8.6E-01
WEIGHTED AVERAGE			9.7E-01	4.5E+00	2.1E-01

TAB3-12.WK1

- Exposure Assessment
- Toxicity Assessment
- Risk Characterization

Collectively, these components describe (1) the human populations that may come in contact with contaminants at the site and the pathways by which they may be exposed; (2) the site contaminants that pose a potential risk to human health and the potential toxic effects and toxic potency of contaminants; and (3) the potential risks associated with contaminant exposure. This baseline risk assessment was conducted in accordance with USEPA's "Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, Part A" (USEPA, 1989d) and the "Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors" (USEPA, 1991).

3.4.2.1 Exposure Assessment. To estimate risks to human health from exposure to environmental contaminants, an exposure assessment is first necessary. The objective of the exposure assessment is to estimate the amount of contaminants to which individuals may be exposed via multiple exposure pathways. This process involves two steps. The first step is to identify all populations that might come in contact with contaminated media and the pathways through which exposure could occur at the site. The second step is to quantify exposure in terms of the amount of chemical either ingested, inhaled, or absorbed through the skin from all complete exposure pathways. The assessment considers all potential pathways of exposure that might occur, both now and in the future.

An exposure pathway is the process through which humans come in contact with contaminants in the environment. There are four necessary elements to each exposure pathway: (1) a source or mechanism of chemical release to the environment; (2) an environmental transport/retention medium; (3) a point of potential human contact with the contaminated medium; and (4) a route of exposure at the contact point (USEPA, 1989d). In some cases, the source of release may be the point of contact, such as direct contact with a spill area. An exposure pathway is considered complete if elements 1, 3, and 4 are present.

The identification of potentially exposed populations is based on an assessment of the physical characteristics of the site that affect accessibility, which, in turn, are a function of land use at the site. Because land use may change, possibly resulting in

a greater or lesser potential for human exposure, this identification process is performed for both current and foreseeable future site conditions.

Once all populations and pathways are identified, the next step is to quantify exposure for each complete exposure pathway. As described, a complete exposure pathway is one that has a source or mechanism of release, an exposure point where contact can occur, and an exposure route at the point of contact. This quantification process involves developing exposure scenarios to estimate the total amount of contaminants that a hypothetical individual may ingest, inhale, or absorb through the skin, from each exposure pathway.

These exposure scenarios are based on several assumptions about exposure, including frequency, duration, and intensity. In general, these exposure parameters represent best estimates based on knowledge of human behavior and the relative accessibility of the site. However, certain parameters are derived from statistical analyses of human populations (e.g., average body weight and body surface area) or studies of human behavior (e.g., soil ingestion rates) (USEPA, 1989c; 1989d).

The ultimate goal of the exposure assessment, as defined by USEPA guidance, is to identify the combination of exposure parameters that results in the most intense level of exposure that may "reasonably" be expected to occur under current and future site conditions (USEPA, 1989d). This is performed for every complete exposure pathway relevant to the site. The resulting exposure scenarios are referred to as the "Reasonable Maximum Exposure" (RME) for each exposure pathway. The relative "intensity" of exposure for each pathway is a function of the identity of the potentially exposed population (e.g., child, adult, or worker) and the characteristics of exposure, such as frequency and duration.

Identification of Potential Exposure Pathways. There are three media associated with the LF-022 site that could serve as sources of human exposure: groundwater, surface soil, and subsurface soil/waste materials. However, based on current uses of the site, surface soil is the only medium of concern. Individuals may be exposed to contaminants in surface soil either directly through contact at the site or indirectly as a result of the emission of vapors and/or fugitive dusts.

A list of potential exposure pathways relevant to the LF-022 site is in Table 3-13, along with a designation of whether the pathways will be evaluated in this risk

TABLE 3-13
POTENTIAL EXPOSURE PATHWAYS FOR LF-022

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

POTENTIALLY EXPOSED POPULATION	EXPOSURE ROUTE, MEDIUM AND EXPOSURE POINT	PATHWAY SELECTED FOR EVALUATION ?	REASON FOR SELECTION OR EXCLUSION
CURRENT SITE CONDITIONS			
CHILD TRESPASSER	Direct contact with and ingestion of surface soil	Yes	Children may contact surface soil while trespassing on the site
MILITARY PERSONNEL	Inhalation of vapors and fugitive dusts by personnel using the small arms range	No	Low frequency of exposure and duration of event
FUTURE SITE CONDITIONS			
CHILD & ADULT RESIDENT	Ingestion and direct contact with groundwater as a result of domestic use downgradient	Yes	Potential exists for groundwater to be used in the future as a source of potable water
	Incidental ingestion and direct contact with surface soil following residential development nearby	Yes	Future residential development could occur if the base were to close
	Inhalation of vapors and fugitive dust emissions following residential development nearby	Yes	Future residential development could occur if the base were to close

TAB3-13.WK1

assessment. The following paragraphs summarize the rationale for the selection of exposure pathways for each medium.

Groundwater. Groundwater downgradient of LF-022 is not currently a source of potable drinking water on- or off-base, nor is it likely to be used as such anytime in the foreseeable future. However, if Plattsburgh AFB were to close at sometime in the future, a well could be placed downgradient of LF-022. Individuals could then be exposed to groundwater contaminants as a result of ingestion and direct contact during showering and/or bathing. Therefore, this exposure pathway was selected for evaluation. Potential routes of exposure are ingestion and dermal absorption. Because no volatile contaminants were detected, potential inhalation during showering is not a concern. The potentially exposed population is assumed to be children and adult residents living directly downgradient of the landfill at some time in the future.

Surface Soil. Except for military and civilian personnel authorized to travel through the controlled flightline area, the only way for on- or off-site populations to be exposed to surface soils under current site conditions would be to climb over the three wire fence along the west or south side of the landfill. The northern and eastern sides of the landfill are bordered by the controlled-access areas of the flightline and small arms range. The site itself is considered limited access because of its proximity to these areas. The fence will not serve as a deterrent to trespassers. However, this region of the base is marked and is patrolled on a regular basis to control unauthorized access. Access is further discouraged by the fact that all individuals in this area of the base are subject to search.

The landfill's physical features are unremarkable. The surface is covered with grasses and small trees. There are no features, such as pits or mounds, that would tend to attract teenagers or small children for recreational activities such as dirt-biking. The site is somewhat isolated from densely populated areas. As a result, trespassing by both on- and off-site populations is unlikely. Therefore, the potential for exposure of the general public, including on-base children, to surface soil contaminants at LF-022 is low.

The only populations authorized to enter this area are personnel with a controlled area badge. In addition, there are no routine activities conducted at the landfill that would cause personnel to come in contact with contaminated soil. Therefore,

exposure to LF-022 by on-base working populations, including both military and civilian personnel, is unlikely.

Despite the fact that access to the landfill by either on- or off-base populations is unlikely, a hypothetical current exposure scenario has been developed to assess potential health risks associated with the DDT, DDD, and DDE detected in surface soils. Because the site is located along the western base boundary, off-base populations are closest to the site. Therefore, an exposure scenario evaluating off-base children trespassing on the site was developed. Such children could be exposed to surface soil via the ingestion and direct contact exposure routes.

As indicated previously, the LF-022 Landfill is somewhat isolated from population centers. Therefore, small children (younger than 6 years) are not expected to wander onto the site. Children aged 6 to 16 are considered the age group with the greatest potential to trespass on the site. Because actual exposure is considered unlikely, the exposure scenario thus developed is considered to represent a conservative case.

Under future site conditions, the only way for the level of exposure to surface soil to increase would be if the base were to close and residential development were to occur near the landfill following closure. Residential development directly on the landfill is not likely because of problems associated with construction above a landfill. However, residences could be built adjacent to the landfill. Exposures to surface soil that could occur under these circumstances would be similar to residential conditions (i.e., younger children and adults might be exposed to surface soil contaminants). Therefore, a future exposure scenario was developed based on an individual being exposed as a result of nearby residential development. In accordance with USEPA guidance, the default scenario for assessing residential exposure to surface soil was used (USEPA, 1991). This scenario involves evaluating potential risks to the individual from early childhood through early adulthood. For the purposes of estimating intake, the scenario is divided into two components, children 1 to 6 years and older children and adults 7 to 30 years.

Vapors and Fugitive Dusts. In addition to direct contact with surface soil, individuals residing or working near the LF-022 site could also be exposed to surface soil contaminants from inhaling contaminants emitted from the landfill surface. As presented in Subsection 3.3.5, contaminants may be released to the ambient air through volatilization and wind erosion of fugitive dusts. Under current site conditions, the only individuals potentially exposed to vapors and dusts released from

LF-022 are personnel using the adjacent small arms range. However, the frequency of exposure and duration of each exposure event for this population is low. Therefore, this pathway was not selected for quantitative evaluation.

Potential future inhalation exposure to vapors and fugitive dusts could increase if residential development were to occur adjacent to LF-022 at some time in the future. Therefore, the modeled air concentrations corresponding to a distance of 1 m were used to estimate the intake by a hypothetical resident living immediately next to the site some time in the future. This is the same individual that was identified for groundwater and surface soil exposure. Such a person would be exposed to both vapors and fugitive dusts. Therefore, concentrations of compounds resulting from both types of emissions were summed to yield the total inhalation exposure concentrations.

Subsurface Soil/Waste Materials. Various contaminants were identified in subsurface soil and waste materials. However, the only way for individuals to be exposed to these contaminants would be during an invasive activity requiring excavation, such as building construction or utility repair. There are no such activities occurring at the LF-022 site at present, nor are there future plans to build at the site. Therefore, there are no exposure pathways associated with subsurface soils and waste materials. In the event that further construction in this area does take place, a reevaluation of risks associated with subsurface materials would be necessary.

Summary of Exposure Pathways. As a result of this exposure assessment, four complete exposure pathways were selected for quantitative evaluation of current and future site conditions at LF-022:

Current Site Conditions

1. Incidental Ingestion of and Direct Contact with Surface Soil by a Child Trespasser

Future Site Conditions

1. Ingestion of and Direct Contact with Groundwater by a Future Resident

2. Incidental Ingestion of and Direct Contact with Surface Soil by a Future Resident

3. Inhalation of Vapors and Fugitive Dusts by a Future Resident

Quantification of Exposure. Contaminant intake resulting from environmental exposure is calculated for all complete exposure pathways using a series of equations. Within an exposure pathway, various assumptions are made regarding exposure parameters (e.g., frequency and duration of contact, weight of exposed individuals, and quantities contacted). These assumptions describe the nature, duration, magnitude, and frequency of exposure to contaminated media, as well as characteristics of the exposed populations. These equations are described in more detail in Appendix N. The following paragraphs summarize the selection of exposure parameters for each of the identified exposure pathways.

Current Site Conditions

Incidental Ingestion and Direct Contact With Surface Soil - Child Trespasser. The total intake of contaminants from soil for children trespassing on the site is the sum of the intake from incidental ingestion and the amount absorbed through the skin as a result of direct contact. The exposure parameters for this potential exposure pathway are as follows:

Exposed Population = Child Trespasser

CS	=	chemical concentration in surface soil (mg/kg)
IR	=	100 mg/day (USEPA, 1991)
AF	=	1.45 mg/cm^2 (USEPA, 1989d)
SA	=	1,520 cm^2 (hands, forearms, and feet; USEPA, 1989c)
RAF	=	For ingestion: 1.0 (Assumption)
		For direct contact - organics: 0.1 (Assumption)
FI	=	100 percent (Assumption)
EF	=	5 days/year (Assumption)
ED	=	10 years (children age 6 to 16 years)
BW	=	38 kg (USEPA, 1989c)
AT	=	For carcinogens: 70 years x 365 days/year
		For noncarcinogens: 10 years x 365 days/year

The soil ingestion rate (IR) and adherence factor (AF) are default values established by the USEPA (USEPA, 1989d, 1991). The fraction of daily soil intake (FI) associated with LF-022 is assumed to be 100 percent. The exposure duration of 10 years is based on the assumption that children between 6 and 16 years are the potentially exposed population. The surface area represents the average area of the hands, forearms, and feet for children between 6 and 16. An exposure frequency of 5 days per year is based on the assumption that a child may trespass on the site and contact soil 5 times during the time that the ground is not snow covered or frozen. Because of the limited access of the site and the regular patrols, this frequency is likely to be an overestimate. The RAF values presented are discussed further in Appendix O.

The chemical concentrations (CS) used to estimate intake are shown in Table 3-12. Average concentrations of DDT, DDE, and DDD were calculated for the entire site from the four composite samples. Two sets of data were used to estimate intake: (1) the average concentration of each contaminant over the four quadrants, and (2) the concentration of each contaminant in the most contaminated quadrant (northwest). The average over the entire landfill represents the concentration to which children are most likely to be exposed because exposure across the landfill is likely to be random. There are no specific sub-areas of the site where children would preferentially explore. The concentration from the northwest quadrant (sample SS-02) represents a conservative estimate of the exposure concentration if children were to explore only within this area.

Future Site Conditions

Ingestion and Direct Contact With Groundwater - Future Resident. An individual may be exposed to non-volatile groundwater contaminants via ingestion and dermal absorption. The total intake is the sum of the separate intakes from the two exposure routes. As indicated previously, both children and adult residents may be exposed to groundwater contaminants in the future. The exposure parameters for these two future populations are as follows:

Exposed Population	=	Future Resident
CW	=	maximum chemical concentration in drinking water (mg/liter)
RAF_{IG}	=	1.0 (Assumption)
PC	=	For chemicals with log K_{ow} > 2.0: 0.008 cm/hour

		For chemicals with log K_{ow} < 2.0: 0.0008 cm/hour
EF	=	350 days/year (USEPA, 1991)
AT	=	For carcinogens: 70 years x 365 days/year
Child		
IR	=	2 liters/day (USEPA, 1989d)
SA	=	7,220 cm^2 (whole body; USEPA, 1989c)
ED	=	6 years (children 1 to 6 years)
BW	=	16 kilograms (USEPA, 1989c)
AT	=	For noncarcinogens: 6 years x 365 days/year
Adult		
IR	=	2 liters/day (USEPA, 1991)
SA	=	18,150 cm^2 (whole body; USEPA, 1989c)
ED	=	30 years (USEPA, 1991)
BW	=	70 kilograms (USEPA, 1989c)
AT	=	For noncarcinogens: 30 years x 365 days/year

Many of these parameters are default values established by the USEPA for the evaluation of exposure to drinking water. These include the following: exposure frequency (EF), exposure duration (ED) for an adult, body weight (BW), and average daily intake of water (IR). The IR for an adult was also used for children in the absence of a default value. The averaging time (AT) is either the duration of exposure for noncarcinogenic effects, or a lifetime (70 years) for carcinogenic effects. This represents the period over which the intake of chemicals is averaged.

The only parameters that are not default USEPA values are the relative absorption factor (RAF_{IG}), the permeability constant (PC), and the concentration in water (CW). The RAF and PC are discussed further in Appendix O.

The chemical concentration of groundwater contaminants (CW) used to estimate intake was the maximum concentration detected the during RI. Because the location of monitoring wells is not a random process, an average of the water quality results from existing monitoring wells would not represent the potential concentrations in future downgradient wells. Actual concentrations in the future may be lower than those detected because of dilution. However, the true maximum concentration in groundwater downgradient of the landfill may be higher than the maximum detected to date. Maximum concentrations were used, rather than averages, to account for

the uncertainty associated with the concentrations that might be present in a residential well downgradient of the landfill.

Incidental Ingestion and Direct Contact With Surface Soil - Future Resident. The total intake of contaminants from soil for this potentially exposed population is the sum of the intake throughout an exposure period corresponding to the length of residence adjacent to LF-022. In accordance with USEPA guidance, intake for this scenario is estimated by splitting the population into two age groups, a small child 1 to 6 years and an older child/adult 7 to 30 years (USEPA, 1991). The exposure parameters for the two age groups are presented below.

Exposed Population = Future Resident

CS	=	chemical concentration in surface soil (mg/kg)
AF	=	1.45 mg/cm^2 (USEPA, 1989d)
RAF	=	For ingestion: 1.0 (Assumption) For direct contact - organics: 0.1 (Assumption)
FI	=	100 percent (Assumption)
EF	=	175 days/year (Assumption)
AT	=	For carcinogens: 70 years x 365 days/year

Small Child

IR	=	200 mg/day (USEPA, 1991)
SA	=	1,850 cm^2 (hands, arms, and feet; USEPA, 1989c)
ED	=	6 years (children 1 to 6 years; USEPA, 1991)
BW	=	16 kilograms (USEPA, 1989c)
AT	=	For noncarcinogens: 6 years x 365 days/year

Older Child/Adult

IR	=	100 mg/day (USEPA, 1991)
SA	=	2,980 cm^2 (hands, forearms, and feet; USEPA, 1989c)
ED	=	24 years (ages 7 to 30; USEPA, 1991)
BW	=	70 kilograms (USEPA, 1989c)
AT	=	For noncarcinogens: 24 years x 365 days/year

Except for CS, FI, EF and RAF, all of the above parameters are default values established by the USEPA for evaluating residential exposure to surface soil. FI is assumed to be 100%. The EF is based on the USEPA default value of 350 days/year for residential-type exposure (USEPA, 1991). However, this value was

then divided by two to take into account the six months of the year in which the site would not be covered by snow or frozen. The basis for the RAF is described in Appendix O.

The chemical concentrations in soil (CS) used to estimate intake are shown in Table 3-12. Two sets of data were used to estimate intake: (1) the average concentration of each contaminant over the four quadrants, and (2) the concentration of each contaminant in the most contaminated quadrant (northwest). The average over the entire landfill represents the concentration to which children and adults are most likely to be exposed because future exposure across the landfill is likely to be random. There are no specific sub-areas of the site where people would preferentially explore. The concentration from the northwest quadrant (sample SS-02) represents a conservative estimate of the exposure concentration if people were to frequent only one area of the site.

Inhalation of Vapors and Fugitive Dust Emissions - Future Resident. The potentially exposed population evaluated in this scenario is the same as that for the future resident groundwater and surface soil scenarios. Therefore, both children and adult residents may be exposed to airborne contaminants emitted from the landfill in the future. The exposure parameters for this population are listed below.

Exposed Population = Future Resident

CA	=	modeled chemical concentration in air at a distance of 1 m (mg/m^3)
RAF_{IH}	=	For volatile emissions: 1.0 (Assumption) For fugitive dusts: 0.75 (Assumption)
EF	=	175 days/year (USEPA, 1991)
AT	=	For carcinogens: 70 years x 365 days/year
<u>Child</u>		
IR	=	2.0 m^3/hour (USEPA, 1989c)
ET	=	16 hours/day (Assumption)
ED	=	6 years (children 1 to 6 years)
BW	=	16 kilograms (USEPA, 1989c)
AT	=	For noncarcinogens: 6 years x 365 days/year
<u>Adult</u>		
IR	=	1.4 m^3/hour (USEPA, 1989c)

ET	=	16 hours/day (Assumption)
ED	=	30 years (USEPA, 1991)
BW	=	70 kilograms (USEPA, 1989c)
AT	=	For noncarcinogens: 30 years x 365 days/year

All of the above factors are default USEPA values except for CA, IR, ET and EF. It is assumed that inhalation exposure to vapors and dusts occurs outdoors. Therefore, the IR for children 1 to 6 years is the inhalation rate for a child age 6 during moderate activity, such as playing. Similarly, the IR for adults is the average outdoor inhalation rate calculated by USEPA assuming 37 percent of the time is spent at a moderate activity level, 28 percent each at light and resting levels, and 7 percent at a heavy level. The ET for these two age groups of 16 hours/day is based on the expected amount of time an individual might spend at home during the day. The EF of 175 days/year is based on the USEPA default value of 350 days/year for residential exposure (USEPA, 1991). This was divided by two to account for the half of the year in which the ground is snow covered or frozen.

3.4.2.2 Toxicity Assessment. The toxicity assessment weighs available evidence regarding the potential for a chemical to cause adverse effects in exposed individuals and estimates the relationship between the extent of exposure to the chemical and the increased likelihood and/or magnitude of adverse effects. The toxicity assessment is generally accomplished in two steps: hazard identification and dose-response evaluation.

Hazard identification is the process of determining whether exposure to an agent can cause an increase in the incidence of a particular adverse health effect and whether that effect is likely to occur in humans. In this instance, hazard is defined as any chemical, substance, or situation at the site capable of doing harm to human health at detected concentrations.

The object of the dose-response assessment defines the relationship between the dose of a substance and the likelihood that a toxic effect, either carcinogenic or noncarcinogenic (systemic), will result from exposure to that substance. As a result of this assessment, toxicity values are derived that can be used to estimate the incidence of adverse effects as a function of human exposure to an agent. These toxicity values are used in the risk characterization to estimate the likelihood of adverse effects occurring in humans at different exposure levels.

There are two types of toxicity values: cancer slope factors (SF) and reference doses (RfD). The derivation of each value for a particular compound depends on the toxicity of that compound and whether it displays carcinogenic or noncarcinogenic effects. For many compounds, both types of toxicity values have been derived because many compounds produce both carcinogenic and noncarcinogenic effects. In addition, because the toxicity and/or carcinogenicity of a compound can depend on the route of exposure (i.e., oral, inhalation, or dermal), unique toxicity values have been developed for the oral and inhalation exposure routes. In the absence of analogous values for the dermal route, oral values are used.

The derivation of a toxicity value for a particular compound depends on which type of endpoint is being evaluated: cancer formation or systemic effects. The USEPA currently assumes that exposure to any amount of a carcinogen, no matter how small, presents some degree of risk. In other words, carcinogens are considered non-threshold toxicants. Noncarcinogens, however, are thought to have a threshold level of exposure, below which toxic effects are not expected to occur.

Carcinogenic effects are also assumed to be independent of the period over which exposure takes place. That is, the magnitude of the response is proportional only to the amount of carcinogenic substance taken into the body regardless of whether exposure took place over one day or a lifetime. In contrast, the systemic (i.e., noncarcinogenic) toxicity of a compound may vary depending on the length of exposure, which may vary from a few minutes to a lifetime. Based on USEPA guidance, exposure duration for noncarcinogenic effects can roughly be categorized into one of three periods: chronic exposures - seven years to a lifetime; (2) subchronic exposures - two weeks to seven years; and (3) acute exposures - less than two weeks (USEPA, 1989d).

In most cases, both the hazard identification and dose-response steps of the toxicity assessment have been performed by USEPA. That is, USEPA has determined the hazards (carcinogenic versus systemic effects) associated with most chemicals detected at hazardous waste sites (such as LF-022) and has derived appropriate toxicity values that may be used to characterize risks. The purpose of the toxicity assessment for the LF-022 site is to identify the USEPA toxicity values for contaminants of potential concern.

Presented in Tables 3-14 and 3-15 are lists of the relevant oral and inhalation toxicity values for carcinogenic and noncarcinogenic effects. The only compounds considered

TABLE 3-14
ORAL TOXICITY DATA FOR LF-022
CONTAMINANTS OF POTENTIAL CONCERN

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

CARCINOGENIC EFFECTS

COMPOUND	CANCER SLOPE FACTOR (mg/kg-day)-1	SOURCE	STUDY TYPE	WEIGHT OF EVIDENCE	TEST ANIMAL	CANCER TYPE
DDD	0.24	IRIS	Diet	B2	Mouse	Liver and Lung
DDE	0.34	IRIS	Diet	B2	Mouse/Hamster	Liver
DDT	0.34	IRIS	Diet	B2	Mouse/Rat	Liver

NONCARCINOGENIC EFFECTS

COMPOUND	CHRONIC ORAL RfD (mg/kg-day)	SOURCE	STUDY TYPE	CONFIDENCE LEVEL	CRITICAL EFFECT	TEST ANIMAL	UNCERTAINTY FACTOR
INORGANICS							
Iron	NA						
Manganese	0.1	HEAST	Diet		No effect	Human	UF = 1
PESTICIDES							
DDD	0.0005	DDT (1)					
DDE	0.0005	DDT (1)					
DDT	0.0005	IRIS	Diet	Medium	Liver lesions	Rat	UF = 100 H,A

NOTES:

1. The RfD for DDT was used for DDD amd DDE in the absence of chemical-specific RfDs.

IRIS - Integrated Risk Information System, March 1991

HEAST - Health Effects Assessment Summary Tables, 4th Quarter 1990

mg/kd-day = milligrams per kilogram body weight per day

NA - not available

Uncertainty Factors (UF) of 10 are applied for each of the following uncertainties:

H = variation in human sensitivity

A = animal to human extrapolation

TAB3-14.WK1

TABLE 3-15
INHALATION TOXICITY DATA FOR LF-022
CONTAMINANTS OF POTENTIAL CONCERN

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

CARCINOGENIC EFFECTS

COMPOUND	CANCER SLOPE FACTOR (mg/kg-day)-1	SOURCE	STUDY TYPE	WEIGHT OF EVIDENCE	TEST ANIMAL	CANCER TYPE
DDD	0.35	DDT (1)				
DDE	0.35	DDT (1)				
DDT	0.35	IRIS (2)	DIET	B2	Mouse, Rat	Liver

NONCARCINOGENIC EFFECTS

COMPOUND	CHRONIC Oral RfD (mg/kg-day)	SOURCE	STUDY TYPE	CONFIDENCE LEVEL	CRITICAL EFFECT	TEST ANIMAL	UNCERTAINTY FACTOR
DDD	0.0005	DDT (1)					
DDE	0.0005	DDT (1)					
DDT	0.0005	IRIS (3)	Diet	Medium	Liver lesions	Rat	UF = 100 H,A

NOTES:

1. The RfD for DDT was used for DDD amd DDE in the absence of chemical-specific RfDs.
2. The cancer SF for DDT is based on a unit risk of 1E-4 per $\mu g/m^3$.
3. The oral RfD for DDT was used in the absence of an inhalation value.

IRIS - Integrated Risk Information System, March 1991
HEAST - Health Effects Assessment Summary Tables, 4th Quarter 1990
mg/kd-day = milligrams per kilogram body weight per day
NA - not available

Uncertainty Factors (UF) of 10 are applied for each of the following uncertainties:

H = variation in human sensitivity
A = animal to human extrapolation

TAB3-15.WK1

to be potential human carcinogens are the pesticide DDT, and its analogues DDD and DDE. The USEPA has derived cancer SFs for each of these compounds. In terms of noncarcinogenic effects, the USEPA has only derived oral RfDs for manganese and DDT. In the absence of chemical-specific values for DDD and DDE, the oral RfD for DDT was used as a surrogate. This surrogate is reasonable given the similarities in toxicity and chemical structure of the three compounds. A suitable surrogate dose-response value for iron is not available. However, as discussed in the risk characterization, the National Academy of Sciences has developed a recommended daily allowance for iron that can be used to evaluate potential iron intake.

In addition to slope factors and RfD values, these tables also present the source of these values, and the study type used to determine the values. These values will be used with the chemical intake estimates derived in the exposure assessment to estimate potential risks to human health associated with the LF-022 site.

For a more in-depth discussion of the assumptions involved in deriving toxicity values, see Appendix O. This appendix also contains Toxicity Profiles for each contaminant of potential concern at LF-022. Toxicity Profiles describe the inherent toxic properties and contain a discussion of toxicity values for each contaminant of potential concern for LF-022.

3.4.2.3 Risk Characterization. Risk characterization involves the qualitative or quantitative evaluation of potential health risks associated with exposure to chemicals in the environment. For LF-022, quantitative estimates of carcinogenic and noncarcinogenic risks were calculated for each contaminant of potential concern identified in the toxicity assessment and each complete exposure scenario identified in the exposure assessment. The magnitude and type of risks associated with each potential exposure depend on the nature, duration, and frequency of exposure to chemicals, and characteristics of the exposed populations. Carcinogenic risks are estimated by multiplying the estimated chemical intake for each carcinogen (in units of mg/kg-day) by its USEPA cancer SF (in units of $(mg/kg\text{-}day)^{-1}$). The result is a chemical-specific lifetime incremental cancer risk. This value represents the probability of developing cancer over a 70-year lifetime as a result of exposure to this chemical. Within each exposure pathway, cancer risks associated with multiple carcinogenic compounds are summed to yield a pathway-specific lifetime incremental cancer risk for a hypothetical individual within each potentially exposed population. If an individual from the same population could be exposed to contaminants via

more than one pathway, the pathway-specific risks are summed to yield a single risk estimate for each population.

Cancer risks are summed independent of the target organ, the weight-of-evidence for human carcinogenicity, or potential chemical interactions (e.g., antagonistic or synergistic effects). It is current USEPA policy to assume additivity unless adequate information to the contrary is available.

Noncarcinogenic risk estimates are determined by dividing estimated chemical intakes for each noncarcinogen (in units of mg/kg-day) by the appropriate RfD (in units of mg/kg-day). The resulting ratio is termed the hazard quotient. Hazard quotients for individual compounds within an exposure pathway are summed to yield a Hazard Index. As with cancer risks, hazard quotients are summed independent of the critical effect, target organ or mechanism of action. Hazard Indices from multiple pathways are summed if an individual from the same population can be exposed via more than one pathway.

To evaluate the significance of risk estimates, a comparison is made to established target risk levels. The USEPA has established target risk levels for the evaluation of both carcinogenic and noncarcinogenic risks at hazardous waste sites. USEPA's guidelines state that the total incremental carcinogenic risk for an individual resulting from multiple-pathway exposures at a Superfund site should not exceed a range of 10^{-6} to 10^{-4} (USEPA, 1990c). The target risk level for noncarcinogenic effects is a Hazard Index of 1 (USEPA, 1990c).

The significance of an elevated Hazard Index requires evaluation on a case-by-case basis. It is assumed that if this ratio is less than or equal to 1, no adverse health effects are anticipated from the predicted exposure level even in sensitive populations. If the ratio is greater than 1, the predicted exposure level could potentially cause adverse health effects. However, because hazard quotients for chemicals are summed independent of the toxic effect, when a Hazard Index exceeds 1, it may be appropriate to segregate chemicals according to effect and develop effect-specific Hazard Indices. Consequently, Hazard Indices above 1 must be evaluated on a case-by-case basis.

Estimation of Risks. This risk assessment evaluated four potential exposure pathways relevant to current and future conditions at the LF-022 site:

Current Site Conditions

1. Incidental Ingestion of and Direct Contact with Surface Soil by a Child Trespasser

Future Site Conditions

1. Ingestion of and Direct Contact with Groundwater by a Future Resident

2. Incidental Ingestion of and Direct Contact with Surface Soil by a Future Resident

3. Inhalation of Vapors and Fugitive Dusts by a Future Resident

The resulting risk estimates for these scenarios are presented in Tables 3-16 and 3-17. The spreadsheets used to calculate these values are presented in Appendix N.

Current Site Conditions

Incidental Ingestion and Direct Contact with Surface Soil - Child Trespasser. The risks associated with exposure of a child to DDT, DDE, and DDD in surface soil while trespassing on the site are presented in Table 3-16. Two sets of cancer and noncancer risk estimates are presented based on the two sets of surface soil data, site-wide average concentrations and concentrations from the most contaminated quadrant (northwest). As indicated, both sets of cancer risk estimates associated with this potential exposure are below the USEPA's target cancer risk range of 10^{-6} to 10^{-4}. Total site cancer risks range between $2x10^{-8}$ and $7x10^{-8}$. The two sets of total site noncancer hazard indices of 0.001 and 0.004 are also below the USEPA's target of 1.

Future Site Conditions

Ingestion and Direct Contact with Groundwater - Future Resident. Although groundwater immediately downgradient of LF-022 does not serve as a source of drinking water, the potential risks associated with exposure as a result of its use as such were assessed because of the possibility of base closure. The only contaminants detected in groundwater were iron and manganese, neither of which is believed to

TABLE 3-16
SUMMARY OF LF-022 SITE RISK ESTIMATES - CHILD TRESPASSER

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

TYPE OF EFFECT	EXPOSURE ROUTE, MEDIUM AND EXPOSURE POINT	PATHWAY-SPECIFIC CANCER RISK OR HAZARD INDEX	TOTAL CANCER RISK OR HAZARD INDEX
CARCINOGENIC EFFECTS			
Site-wide Average	Direct contact with surface soil	2E-08	
	Ingestion of surface soil	8E-09	2E-08
Northwest Quadrant	Direct contact with surface soil	5E-08	
	Ingestion of surface soil	2E-08	7E-08
NONCARCINOGENIC EFFECTS			
Site-wide Average	Direct contact with surface soil	0.0009	
	Ingestion of surface soil	0.0004	0.001
Northwest Quadrant	Direct contact with surface soil	0.003	
	Ingestion of surface soil	0.001	0.004

be carcinogenic in humans. Therefore, this risk assessment only evaluated potential noncarcinogenic effects. Potential risks were assessed for both children and adults. As indicated in Table 3-17, the Hazard Index associated with exposure of children to the maximum concentration of iron and manganese in groundwater is 1. This value is right at the USEPA target Hazard Index of 1. The analogous Hazard Index for adults is 0.2, which is below the target.

A comparison also can be made between the estimated intake of these compounds that would result from the daily consumption of drinking water at LF-022 to the recommended daily allowances and/or adequate and safe daily intakes for these nutrients developed by the National Academy of Sciences (NAS, 1980). The recommended daily allowance for iron is 10 mg/day for males, and 18 mg/day for females (NAS, 1980). The adequate and safe intake of manganese is 2.5 to 5 mg/day for adults, 1 to 2.5 mg/day for children. The intake of iron resulting from the consumption of 2 liters of water containing the maximum concentration detected (i.e., 8.76 mg/L) at this site would be 17.52 mg/day. The intake of manganese at a groundwater concentration of 0.877 mg/L would be 1.75 mg/day. Consequently, the intake of iron and manganese resulting from ingestion of groundwater downgradient of LF-023 would be within the acceptable intake ranges for these essential nutrients.

Incidental Ingestion and Direct Contact with Surface Soil - Future Resident. The risks associated with exposure of a hypothetical future resident to contaminants in surface soil are presented in Table 3-17. Two sets of cancer and noncancer risk estimates are presented based on the two sets of surface soil data, site-wide average concentrations and concentrations from the most contaminated quadrant (northwest). Potential risks were also assessed separately for children and adults.

As indicated in Table 3-17, the cancer risks associated with a child being exposed to surface soil are $2x10^{-6}$ and $5x10^{-6}$, using the two surface soil data sets. The analogous cancer risks for an adult are also $2x10^{-6}$ and $5x10^{-6}$. These values are within the USEPA target cancer risk range.

The associated hazard indices for a child are 0.2 and 0.5, while the hazard indices for an adult are 0.04 and 0.1. These four risk estimates are all below the USEPA target of 1.

Inhalation of Vapors and Fugitive Dust Emissions - Future Resident. An evaluation of the potential risks of exposure to vapor and fugitive dust emissions on future

TABLE 3-17
SUMMARY OF LF-022 SITE RISK ESTIMATES - FUTURE RESIDENT

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

TYPE OF EFFECT	EXPOSURE ROUTE, MEDIUM AND EXPOSURE POINT	PATHWAY-SPECIFIC CANCER RISK OR HAZARD INDEX		TOTAL CANCER RISK OR HAZARD INDEX	
CARCINOGENIC EFFECTS		CHILD	ADULT	CHILD	ADULT
Site-wide Average	Direct contact with surface soil	1E-06	2E-06		
	Ingestion of surface soil	8E-07	3E-07	2E-06	2E-06
Northwest Quadrant	Direct contact with surface soil	3E-06	4E-06		
	Ingestion of surface soil	2E-06	9E-07	5E-06	5E-06
	Inhalation of vapors and dusts	1E-06	1E-06	1E-06	1E-06
	Total: Site-Wide Average			3E-06	3E-06
	Total: Northwest Quadrant			6E-06	6E-06
	Total: Site-Wide Average			6E-06	
	Total: Northwest Quadrant			1E-05	
NONCARCINOGENIC EFFECTS		CHILD	ADULT	CHILD	ADULT
	Direct contact with groundwater	0.0006	0.0003		
	Ingestion of groundwater	1	0.2	1	0.2
Site-wide Average	Direct contact with surface soil	0.09	0.03		
	Ingestion of surface soil	0.07	0.008	0.2	0.04
Northwest Quadrant	Direct contact with surface soil	0.3	0.1		
	Ingestion of surface soil	0.2	0.02	0.5	0.1
	Inhalation of vapors and dusts	0.09	0.02	0.09	0.02
	Total: Site-Wide Average			1	0.3
	Total: Northwest Quadrant			2	0.3

nearby residential populations was assessed. As presented in Subsection 3.3.6, airborne concentrations of DDD, DDE, and DDT resulting from both vapors and dusts were estimated at a distance of 1 m from the edge of the landfill. Potential risks associated with exposure to these contaminants were assessed using a conservative exposure model represented by children and adults living immediately adjacent to the landfill and inhaling contaminants 16 hours per day.

The risk estimates associated with this potential exposure are presented in Table 3-17. Risks estimates were calculated separately for a child and an adult receptor. The cancer risks for both the child ($1x10^{-6}$) and the adult ($1x10^{-7}$) receptors are at or below the lower limit of the target cancer risk range established by the USEPA. The associated hazard indices for a child (0.09) and an adult (0.02) are below the target hazard index.

Combination of Exposure Pathways. USEPA guidance states that risk estimates should be combined across exposure pathways if (1) the same individuals could reasonably be exposed to more than one pathway, and (2) it is reasonable to assume that the same individuals would consistently experience the RME level estimated in the exposure assessment.

The three exposure scenarios involving a future resident being exposed to groundwater, surface soil, and airborne emissions satisfy these criteria. Therefore, the cancer and noncancer risks associated with the child and adult receptors within these three scenarios were combined. The resulting estimates are presented in Table 3-17. The combination of these three pathways results in a total site cancer risk for a child of $3x10^{-6}$ or $6x10^{-6}$, depending on the surface soil data set used. The total site cancer risks for an adult are also $3x10^{-6}$ or $6x10^{-6}$. All four values are within the USEPA target risk range. If one assumes that the child and adult components of the three future resident scenarios represent the same individual at different stages of development, then the total cancer risks for the child and adult presented above may be combined to yield one total site cancer risk of $6x10^{-6}$ or $1x10^{-5}$ for a future resident population. Both of these values are also within the USEPA target cancer risk range.

The combined hazard indices for the child receptor in these three exposure pathways are 1 and 2. The analogous hazard index for the adult receptor is 0.3 regardless of which data set is used. Of these four values, only the child hazard index associated with the combined exposure to the maximum groundwater concentrations and the

maximum surface soil concentrations from the most contaminated quadrant is above the USEPA target of 1.

The majority of the elevated index for a child is associated with ingestion of manganese in groundwater. As indicated previously, the intake of manganese from groundwater at the maximum concentration detected (0.877 mg/liter) would be within acceptable levels for this essential nutrient. The cause of the elevated hazard index is a moderately low chronic oral RfD of 0.1 mg/kg-day.

The RfD for manganese is based on the absence of observed toxic effects in humans following dietary exposure. Consequently, the RfD was calculated from a NOEL (no observed effect level) according to standard EPA procedures. The implication is that exposure to manganese below 0.1 mg/kg-day is not likely to produce adverse health effects. Exposure above 0.1 mg/kg-day could produce adverse effects. However, because the RfD is based on a NOEL, rather than a NOAEL (no observed adverse effect level), adverse effects may actually not be seen until exposure exceeds an even higher level. There is insufficient toxicity data to determine a more precise level of exposure above which adverse effects will occur.

In a similar manner, the NAS established an adequate and safe daily intake for manganese of 2.5 to 5 mg/day for adults, 1 to 2.5 mg/day for children. This is not a recommended daily allowance. Rather, the level established by NAS represents an estimated safe level of intake based on the lack of observed adverse effects in humans that ingest manganese within these ranges. Consequently, this allowable intake level is analogous to the EPA's RfD in that it implies that intake below this range will not likely produce adverse effects, but intake above this range could produce adverse effects. There is inadequate information to set a recommended daily intake.

Humans are capable of controlling quite well the levels of manganese in the body with variations in diet (IRIS, 1991). There is also evidence to indicate that children are less susceptible to manganese toxicity and may actually require higher levels than do adults (IRIS, 1991). Consequently, the elevated hazard index of 2 for this hypothetical population does not suggest a significant health risk.

Uncertainties and Limitations in Risk Assessment. The interpretation of risk estimates presented here is subject to a number of uncertainties as a result of the multiple layers of conservative assumptions inherent in risk assessment. All

quantitative estimates of risk are based on numerous assumptions, most intended to be protective of human health (i.e., conservative). As such, risk estimates are not truly probabilistic estimates of risk, but rather conditional estimates given a series of conservative assumptions about exposure and toxicity.

In general, sources of uncertainty can be categorized into site-specific factors and toxicity assessment factors. A thorough discussion of all potential sources of uncertainty in this risk assessment is beyond the scope of this report. However, a summary of potential sources relevant to the LF-022 site, and the likely direction of their effect (i.e., to overestimate or underestimate risks), is presented in Table 3-18. Perhaps the most significant source of uncertainty regards the likelihood of exposure pathways. The risk estimates calculated in this report for current site conditions are based on the assumption that children will be able to gain access to LF-022 despite the security measures in place. The likelihood of this actually occurring is low.

The future site risk estimates are based on the combined assumptions of base closure and future residential development. Because of the strategic importance of Plattsburgh AFB, base closure is not likely. Therefore, the risks presented in this report represent conservative estimates. Actual health risks associated with exposure at LF-022 are likely to be lower.

3.4.3 Habitat-Based Environmental Risk Assessment

The purpose of the Habitat-Based Environmental Risk Assessment (ERA) for LF-022 is to define potential ecological effects resulting from chemicals in environmental media at the site. The ERA contains the following elements:

- Ecological Exposure Assessment
- Hazard Identification
- Ecological Risk Characterization
- Uncertainties

Because the ERA must meet the statutory requirements of both federal and state regulations, the ERA was conducted in accordance with federal and state guidance where practicable. Applicable guidance followed in conducting the ERA includes the "Risk Assessment Guidance for Superfund: Environmental Evaluation Manual" (USEPA, 1989b) and the "Habitat-Based Assessment Guidance Document for

TABLE 3-18
POTENTIAL SOURCES OF UNCERTAINTY FOR LF-022

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

Potential Source	Direction of Effect	Justification
Likelihood of exposure pathways	Over-estimate	Pathways may not actually occur (e.g., trespassing, future residential).
Lack of consideration of degradation of chemicals.	Over-estimate	Risk estimates are based on recent chemical concerntations. Concentration will tend to decrease with time as a result of degradation processes.
Exposure assumptions (frequency, duration and intensity).	Over-estimate	Parameters selected are conservative estimates of exposure.
Absorption of soil contaminants through the skin.	Over-estimate	Dermal absorption of chemicals is a function of the length of actual skin contact. Contact at the site may be insufficient to result in the amount of absorption assumed.
Extrapolation of animal toxicity data to humans.	Unknown, probably over-estimate	Animals and humans differ with repect to absorption, metabolism, distribution, and excretion of chemicals. The magnitude and direction of the difference will vary with each chemical. Animal studies typically involve high-dose exposures, whereas humans are exposed to low doses in the environment.
Use of linearized, multi-stage model to derive cancer slope factors.	Over-estimate	Model assumes a non-threshold, linear at low dose relationship for carcinogens. Many compounds induce cancer by non-genotoxic mechanisms. Model results in a 95% upper confidence limit of the cancer risk. The true risk is unlikely to be higher and may be as low as zero.

TAB3-18.WK1

TABLE 3-18, continued
POTENTIAL SOURCES OF UNCERTAINTY FOR LF-022

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

Potential Source	Direction of Effect	Justification
Summation of effects (cancer risks and hazard indices) from multiple substance.	Unknown	The assumption that effects are additive ignores potential synergistic and/or antagonistic effects. Assumes similarity in mechanism of action, which is not the case for many substances. Compounds may induce tumors or other toxic effects in different organs or systems.
Use of uncertainty factors in the derivation of reference doses.	Unknown	Ten-fold uncertainty factors are incorporated to account for various sources of uncertainty (animal to human extrapolation, protection of sensitive human populations, extrapolation from subchronic to chronic data, and use of LOAELS rather than NOAELs). Although some data seem to support the ten-fold factor, its selection is somewhat arbitrary.

Conducting Environmental Risk Assessments at Hazardous Waste Sites" (NYSDEC, 1989a).

Note that potential ecological receptors of chemical contamination at LF-022 are identified in Subsection 3.1.7.

3.4.3.1 Ecological Exposure Assessment. The purpose of the ecological exposure assessment is to evaluate the potential for exposure to site-related chemicals at LF-022. This involves identification of actual or potential exposure routes to receptors (identified in the Description of the Existing Environment in Subsection 3.1.7) and evaluation of the magnitude of exposure to aquatic and terrestrial organisms. In this subsection, exposure concentrations are estimated for each receptor via each pathway. This exposure information is used with toxicological information in Subsection 3.4.3.2 to evaluate ecological risk in the ecological risk characterization (Subsection 3.4.3.3).

Terrestrial organisms may be exposed to chemicals in surface soils (i.e., DDT, DDD, and DDE) through several exposure pathways. No exposure pathways exist for groundwater or subsurface soil at the site because terrestrial organisms are not expected to come into contact with subsurface (i.e., below approximately 2 feet depth) media and no prey exist in subsurface areas. Additionally, because there are no aquatic habitats at the site, there are no exposure pathways for aquatic organisms.

Exposure to constituents in surface soil may occur via direct contact with and ingestion of surface soils, and ingestion of biota with bioaccumulated chemicals in their tissues. Because of the lack of species-specific data concerning uptake of chemicals via dermal contact and the inherent variability in uptake rates among species, this exposure pathway was not evaluated. Five indicator species were selected to represent exposures to terrestrial organisms via ingestion of food and soil:

- White-footed mouse (*Peromyscus leucopus*), small mammal, omnivore
- Wood thrush (*Hylocichla mustelina*), small bird, omnivore
- Garter snake (*Thamnophis s. sirtalis*), herptile, carnivore
- Red fox (*Vulpes*), predatory mammal, omnivore
- Red-tailed hawk (*Buteo jamaicensis*), predatory bird, carnivore

These species were selected because they are representative of exposures to the range of mammals, birds, and herpetofauna (reptiles and amphibians) that may occur

at the site. They are relatively common species in the vicinity of Plattsburgh AFB selected from the species lists in Appendix J (Tables J-1 through J-4) based on the habitats at the site and feeding preferences. Some of these species (e.g., red fox, red-tailed hawk) have been observed at Plattsburgh AFB during the remedial investigation. As shown, these species are used to represent small mammals, small birds, herpetofauna, predatory mammals, and predatory birds. Modeling of exposures to rare species was not performed because no rare, threatened, or endangered species have been identified at Plattsburgh AFB (see Section 3.1.7).

Small mammals and small birds are primary consumers, with the majority of their diet consisting of plants and decomposers (i.e., soil invertebrates). Herpetofauna may also be considered primary consumers, although a greater proportion of their diet may consist of animals. Predatory mammals may be primarily carnivorous, but subsist on plant matter when animal food is lacking. Predatory birds are expected to rely almost entirely on animal matter.

Exposures to these organisms were estimated using spreadsheet food web models, presented in Appendix J (Table J-5). The documentation and derivation of exposure parameters used in these models are presented in Appendix J (Table J-6), while bioaccumulation data for DDT, DDD, and DDE used in the models is presented in Appendix J (Table J-7).

A composite sample of surface soils was collected in each of the four quadrants of LF-022: northeast (NE), northwest (NW), southwest (SW), and southeast (SE). The locations of the NE, NW, SW, and SE quadrants (where surface soil samples SS-01, SS-02, SS-03, and SS-04 were collected, respectively) are shown in Figure 3-12. Each composite sample represents an average concentration of the 15 to 17 subsamples collected in each quadrant.

Modeling of acute and chronic exposures was performed separately for each quadrant based on results of this sampling (see Table 3-12). The concentration reported for each sample was used in the chronic food web models, as each sample represents the average concentration in 15 to 17 subsamples. A theoretical maximum concentration was calculated for each chemical in each sample by multiplying the reported concentration by the number of subsamples; these values were used to represent acute exposure to a "hot spot" in the acute exposure models. Additionally, food web modeling was performed for the entire site using a weighted average concentration (calculated by summing the reported concentration multiplied by the number of

subsamples for each composite sample and dividing by the total number of subsamples from all four composite samples).

Area is important in modeling chronic exposures to ecological receptors because of differences in home range size for different species. Organisms with large home ranges (such as the red fox) will spend less time foraging in contaminated areas than will organisms with small home ranges (such as the white-footed mouse), which may spend most or all their time in contaminated areas. For modeling chronic exposure, the areas of the NE, NW, SW, and SE quadrants (3.4, 4.5, 4.2, and 3.2 acres, respectively) were used. Area was not incorporated into the acute exposure models because, while home range affects the probability of acute exposure, it is not a factor affecting the magnitude of acute exposure. For example, an organism with a large home range (such as a hawk) may have a very low probability of receiving an acute exposure. However, the magnitude of the hawk's exposure may be similar to other organisms with smaller home ranges.

Results of the food web modeling are expressed as a Potential Dietary Exposure (PDE) in mg/kg Body Weight (BW)/day of each chemical for each indicator species under each exposure scenario (see Table J-5 in Appendix J). The PDE for each modeled receptor species is calculated by multiplying each predicted prey species tissue concentration by the proportion of that prey type in the diet, summing these values, and multiplying by the receptor species' Site Foraging Frequency (SFF), represented by the following equation:

$$PDE = [\sum_{1 \rightarrow n} P_1 \times T_1 + P_2 \times T_2 + \ldots P_n \times T_n] \times SFF \times \frac{IR}{BW}$$

where

:

PDE	=	Potential Dietary Exposure (mg/kgBW/day)
P_n	=	Percent of prey item **n** ingested
T_n	=	Tissue concentration in prey item **n** (mg/kg), calculated by multiplying the chemical concentration in soil (or for ingestion of primary consumers, the PDE for the primary consumer) by a bioaccumulation factor

SFF = Site Foraging Frequency; calculated by dividing the area of the site or quadrant (acres) by the species home range (acres). Set equal to 1.0 for acute exposure scenario.
IR = Food Ingestion Rate (kg/day)
BW = Body Weight (kg)

These PDE estimates, which are directly comparable to available toxicological test data, are used with the toxicological data presented in Subsection 3.4.3.2 to evaluate ecological risks in the risk characterization (Subsection 3.4.3.3).

3.4.3.2 Hazard Identification. In the Hazard Identification, the toxicity of each site-related chemical (in this case, DDT, DDD, and DDE) is described. Information necessary to evaluate potential effects to receptors at the exposure concentrations determined in Subsection 3.4.3.1 consists of published laboratory-derived toxicological data and threshold toxicity values developed using extrapolation techniques. Based on these data, Reference Toxicity Values (RTVs) are developed for terrestrial organisms that represent a toxic threshold concentration in soil or food.

Toxicity data for terrestrial receptors consist of acute and chronic ingestion studies. The terrestrial toxicologic data for DDT, DDD, and DDE used in this ERA are presented in Appendix J (Table J-8). From the toxicological data set, the lowest acute or chronic value for each type of receptor (e.g., small mammals and small birds) was selected as the acute or chronic RTV, respectively. Because the lowest toxicity values were selected, the RTVs should be protective of the most sensitive species tested. As insufficient data are available to adequately describe the toxicity of DDT, DDD, and DDE separately, the same RTVs were used for DDT, DDD, and DDE for a given indicator species; this is reasonable given their structural similarity. The RTVs for terrestrial organisms for DDT, DDD, and DDE are indicated as shaded values in Appendix J (Table J-8).

Generally, the Lowest Observed Adverse Effect Level (LOAEL) was used as the chronic RTV. In the case of herpetofauna, a chronic value could not be found in the literature, although an acute study was found. To estimate a chronic RTV for herpetofauna, two factors were applied to the acute LD_{50} (single dose lethal to 50 percent of test organisms). These factors were: (1) a factor of 0.2 for extrapolating from the oral LD_{50} to a value expected to protect 99.9 percent of the population against acute effects (USEPA, 1986d); and (2) a factor of 0.1 for

extrapolating from acute to chronic values (the acute-chronic ratio for many chemicals is approximately 10).

3.4.3.3 Ecological Risk Characterization. This subsection characterizes the risk to terrestrial receptors potentially exposed to DDT, DDD, and DDE in surface soil at LF-022. The magnitude of risk depends on the nature, duration, and frequency of exposure to the chemicals and on characteristics of the exposed populations. This exposure information, detailed in Subsection 3.4.3.1, combined with the appropriate concentration-response toxicity data presented in Subsection 3.4.3.2, is the basis for the risk characterization.

Risks to terrestrial biota at LF-022 were evaluated by comparing the acute (theoretical maximum) and chronic (average) PDEs for each indicator species estimated in exposure scenarios with the acute and chronic RTVs, respectively (see Table J-9 in Appendix J). By dividing the PDE by the appropriate RTV, a Hazard Index is calculated. The Hazard Index for the individual chemicals are then summed to yield a summary Hazard Index. The chronic and acute summary Hazard Indices for each indicator species are presented in Table 3-19.

Adopting a technique developed for the ecological evaluation of pesticides (USEPA, 1986d) yields the following relative Hazard Index ranking:

$HI < 0.1$	No Adverse Effects
$0.1 \leq HI < 10$	Possible Adverse Effects
$HI \geq 10$	Probable Adverse Effects

This ranking scheme applies to ecological risk evaluation, and does not pertain to human health evaluation . The scheme reflects effects to individual organisms, and does not provide an indication of potential population-level effects. In many cases, acute or chronic effects to individuals may occur with little effect on population growth, stability, or structure. However, as the number of organisms experiencing acute or chronic effects increases, so does the probability that population-level effects will occur. Because the number of individuals affected presumably increases with increasing Hazard Index values, the likelihood that population-level effects are occurring is expected to increase as the Hazard Index increases.

Application of this ranking scheme indicates that chronic effects to small mammals, small birds, and herpetofauna are possible in the NW and SE quadrants, as well as

TABLE 3-19
SUMMARY OF ECOLOGICAL RISK ASSESSMENT FOR LF-022

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

INDICATOR SPECIES	CHRONIC SUMMARY HAZARD INDEX BY AREA				
	Entire Site	Northwest	Southeast	Southwest	Northeast
White-footed Mouse	2.9×10^{-1}	8.5×10^{-1}	3.3×10^{-1}	1.2×10^{-3}	1.2×10^{-3}
Wood Thrush	3.4×10^{-1}	9.9×10^{-1}	3.9×10^{-1}	1.4×10^{-3}	1.4×10^{-3}
Garter Snake	1.4×10^{-1}	3.8×10^{-1}	1.1×10^{-1}	5.1×10^{-4}	4.2×10^{-4}
Red Fox	1.6×10^{-2}	1.4×10^{-2}	3.6×10^{-3}	1.8×10^{-5}	1.4×10^{-5}
Red-Tailed Hawk	6.5×10^{-3}	5.6×10^{-3}	1.5×10^{-3}	7.4×10^{-6}	5.9×10^{-6}

INDICATOR SPECIES	ACUTE SUMMARY HAZARD INDEX BY AREA				
	Entire Site*	Northwest	Southeast	Southwest	Northeast
White-footed Mouse	$1.4 \times 10^{+0}$	$1.4 \times 10^{+0}$	4.9×10^{-1}	2.1×10^{-3}	2.0×10^{-3}
Wood Thrush	3.2×10^{-1}	3.2×10^{-1}	1.2×10^{-1}	4.9×10^{-4}	4.6×10^{-4}
Garter Snake	1.4×10^{-1}	1.4×10^{-1}	4.9×10^{-2}	2.1×10^{-4}	2.0×10^{-4}
Red Fox	$1.0 \times 10^{+0}$	$1.0 \times 10^{+0}$	3.8×10^{-1}	1.6×10^{-3}	1.5×10^{-3}
Red-Tailed Hawk	2.0×10^{-1}	2.0×10^{-1}	7.3×10^{-2}	3.1×10^{-4}	2.9×10^{-4}

NOTES:

* Acute summmary HI for entire site is the highest HI of the four quadrants.

RELATIVE HAZARD RANKING (USEPA, 1986d):

$HI < 0.1$	No Adverse Effects
$0.1 \leq HI < 10$	Possible Adverse Effects
$HI \geq 10$	Probable Adverse Effects

from sitewide exposure. Because the summary Hazard Indices for the NW and SE quadrants and the entire site are on the lower end of the 0.1 to 10 range, effects are expected to be limited to a few individuals, with effects on populations unlikely. No effects are predicted for the SW and NE quadrants, and no effects are predicted for predatory birds or mammals exposed to chemicals in any quadrant. Acute effects are possible for all modeled receptors in the NW quadrant, and for small mammals, small birds, and predatory mammals in the SE quadrant.

DDD is the greatest contributor to total chronic risks in the NW quadrant and from site-wide exposure, while DDT is the greatest contributor to risks in the SE quadrant. Again, effects are expected to be limited to a few individuals, with no population-level effects expected. DDT and DDD are the greatest contributors to acute risks in the SE and NW quadrants, respectively.

3.4.3.4 Uncertainties. The prediction of ecological risks involves several uncertainties. These are outlined below:

1) The models used to estimate exposures involve numerous exposure parameters, some of which are values from the literature, and some of which are estimated or assumed. Efforts were made to select exposure parameters representative of a variety of species so that exposure estimates would be representative of more than a single species. Because the parameters selected are generally conservative, risks for most species may be over-estimated; however, risks may still be under-estimated for some species.

2) The exposure models assume that organisms will spend equal amounts of time in all habitats within their home range. In actuality, organisms will spend varying amounts of time in different habitats, which would affect their exposures. The limitation of this assumption is that exposures to the particular species modeled may be under- or over-estimated in the model. The consequences of this assumption at the site are expected to be minor because habitat types at the site are relatively uniform, and chemicals appear to be distributed over relatively large areas, minimizing the extent of variation in exposure.

3) In selecting RTVs, the lowest toxicity value reported was selected as the RTV, meaning that the RTVs may overestimate ecological risk.

4) Dermal contact was not evaluated because of a paucity of information concerning uptake rates for wildlife. Therefore, total exposures may be more than that predicted based on ingestion scenarios and risks may be underestimated by scenarios that do not account for dermal exposure. However, the relative contribution of dermal contact to total risks is expected to be much lower than that of food and soil ingestion due to the fur, feathers, or hardened skin covering most species of terrestrial wildlife.

5) Chronic toxicity to small mammals, small birds, and herpetofauna may result in reduced reproductive success, while acute toxicity may result in mortality in populations of these organisms. If populations of these organisms are significantly reduced, fewer prey items would be available for predatory birds and mammals. Predatory birds and mammals might stop foraging in those areas where populations were reduced, therefore, reducing the risk to predatory species. It is unlikely that populations of wildlife will be significantly reduced given the low hazard indices estimated in the ecological risk assessment.

3.5 SUMMARY AND CONCLUSIONS

Several site contaminants have been identified in various media at LF-022 based on the criteria outlined in Subsection 2.7 (see Table 3-2). The primary source of contamination at LF-022 is the landfill waste. Site contaminants detected in the waste material include: carbon tetrachloride and chloroform detected in a sample of white powder collected from a pail found on the ground surface; BEHP detected in one sample of waste; and aluminum, cadmium, chromium, copper, iron, lead, manganese, silver, sodium and zinc detected in several samples at concentrations above the background range for soil. Neither the VOCs nor SVOCs are considered pervasive contaminants of the landfill. PHCs were also detected in the subsurface waste samples. The PHC results suggest a fuel or hydrocarbon distribution in the waste samples. Although a variety of contaminants are present in the wastes, the only site contaminant identified in the subsurface soils is lead.

Pesticides were identified as site contaminants in the surface soil. DDT and its associated analogs (i.e., DDD and DDE) were detected in two of four surface soil samples. The samples were collected as composites and do not represent the actual distribution of pesticides in the surface soils.

Iron and manganese were present in the groundwater under the landfill due to site related conditions. The absence of other site contaminants indicates that contaminants in the soil/waste are not leaching into the groundwater. The iron and manganese concentrations may be attributable to low oxygen (i.e., anaerobic) conditions in the groundwater.

A baseline risk assessment was conducted for the LF-022 site to determine if contaminants at the site could pose a risk to human health or the environment. This assessment included a human health risk assessment conducted in accordance with USEPA guidance, and a habitat-based environmental risk assessment conducted in accordance with NYSDEC guidance.

Contamination related to the site was identified in groundwater, subsurface soil/wastes, and surface soil. The only site-related contaminants in groundwater were iron and manganese. Various metals and BEHP were determined to be site-related in subsurface soil/wastes. Contaminants considered to be site-related in surface soil were DDT, DDD, and DDE.

The human health risk assessment evaluated four potential exposure scenarios:

Current Site Conditions

(1) Incidental Ingestion of and Direct Contact with Surface Soil by a Child Trespasser

Future Site Conditions

(1) Ingestion of and Direct Contact with Groundwater by a Future Resident

(2) Incidental Ingestion of and Direct Contact with Surface Soil by a Future Resident

(3) Inhalation of Vapors and Fugitive Dusts by a Future Resident

These scenarios were determined to be the only potential exposures that could occur under current and future site conditions. Each of these pathways was evaluated quantitatively to estimate potential carcinogenic and noncarcinogenic risks. Potential

risks associated with subsurface soil/waste material were not assessed quantitatively because of the lack of exposure.

Based on the above three exposure pathways, there are two potentially exposed populations associated with LF-022: (1) a child trespasser under current site conditions, and (2) a future resident under future site conditions. The carcinogenic and noncarcinogenic risks from the three future scenarios were combined to yield total site risks because an individual from this hypothetical population could be exposed via all three pathways. In addition, both a child and an adult receptor were evaluated for the three future scenarios.

Potential risks associated with exposure to surface soil under current site conditions were assessed using a hypothetical child trespasser scenario. The carcinogenic and noncarcinogenic risk estimates calculated for this scenario are presented in Figures 3-14 and 3-15, respectively. Two sets of risk estimates were calculated based on using the two surface soil data sets as exposure point concentrations: (1) the sitewide average from four composite surface soil samples; and (2) the concentrations detected in the most contaminated quadrant (northwest). Only the risks associated with the northwest quadrant are presented geographically. As indicated in Figures 3-14 and 3-15, all of the carcinogenic and noncarcinogenic risks are below the USEPA target risk levels (10^{-6} to 10^{-4} for carcinogenic risks, 1 for hazard index). Therefore, a child trespassing on LF-022 is unlikely to experience adverse health effects as a result of exposure to DDT, DDD or DDE in surface soil.

Total site risks were also estimated for a hypothetical future resident living adjacent to LF-022. Exposure scenarios representing this population were based on the assumption that Plattsburgh AFB will close and homes will be built adjacent to LF-022. Under such conditions, children and adults from these homes could be exposed to site-related contaminants in groundwater, surface soil, and air. Consequently, the risks associated with exposure to these three media were combined. Cancer risks associated with the child and adults receptors were also combined based on the assumption that these receptors represent the same individual at different stages of life. In other words, an individual could be exposed to site-related contaminants in the three media as a child and again as an adult. The resulting risk estimates are presented in Figures 3-16 and 3-17.

The total site cancer risk estimates for a hypothetical future resident (combining all three pathways and the child and adult receptors) are $6x10^{-6}$ and $1x10^{-5}$ using two

FIGURE 3-14

SUMMARY CANCER RISKS FOR LF-022 - CHILD TRESPASSER

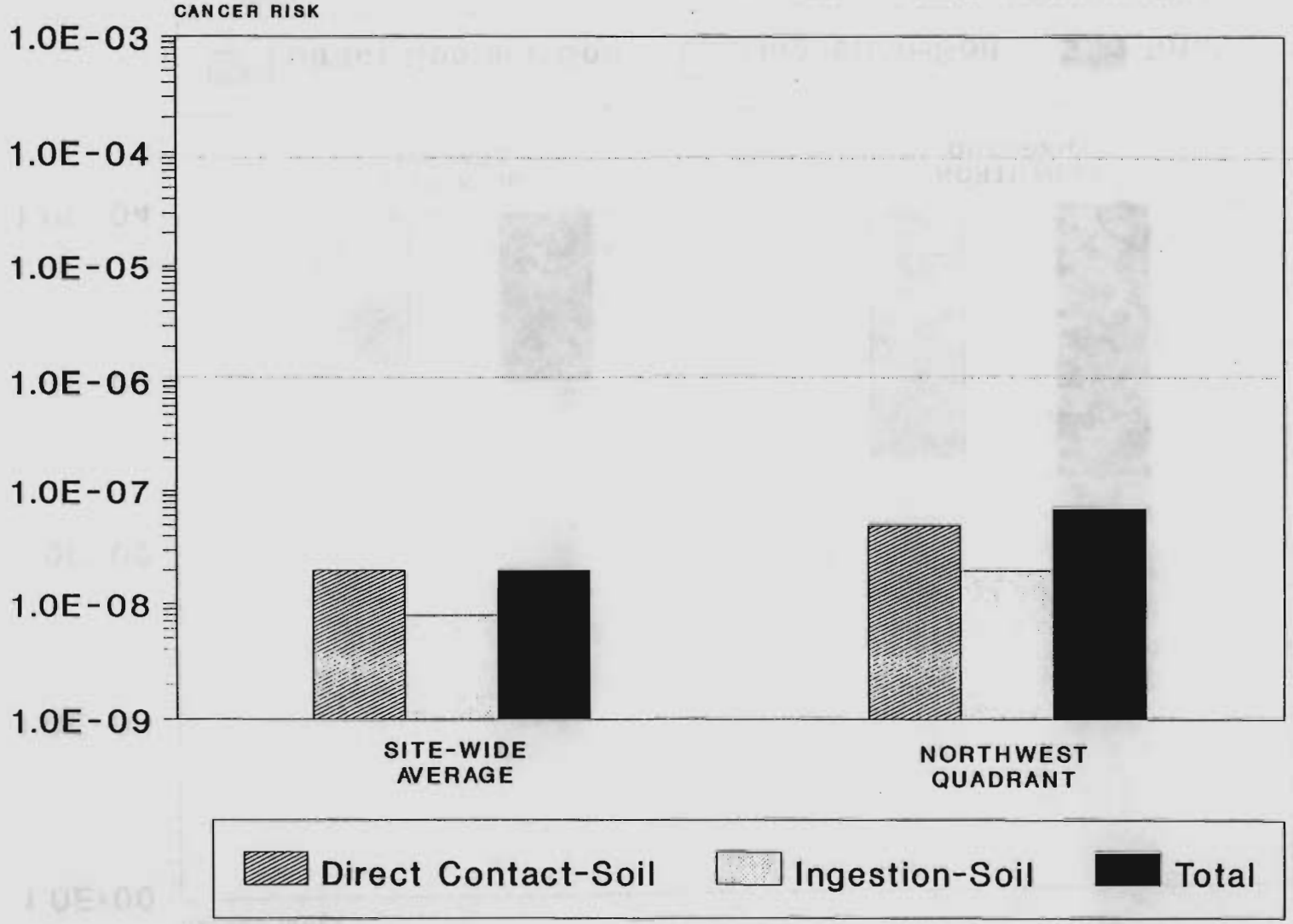


FIGURE 3-15

SUMMARY NONCANCER RISKS FOR LF-022 - CHILD TRESPASSER

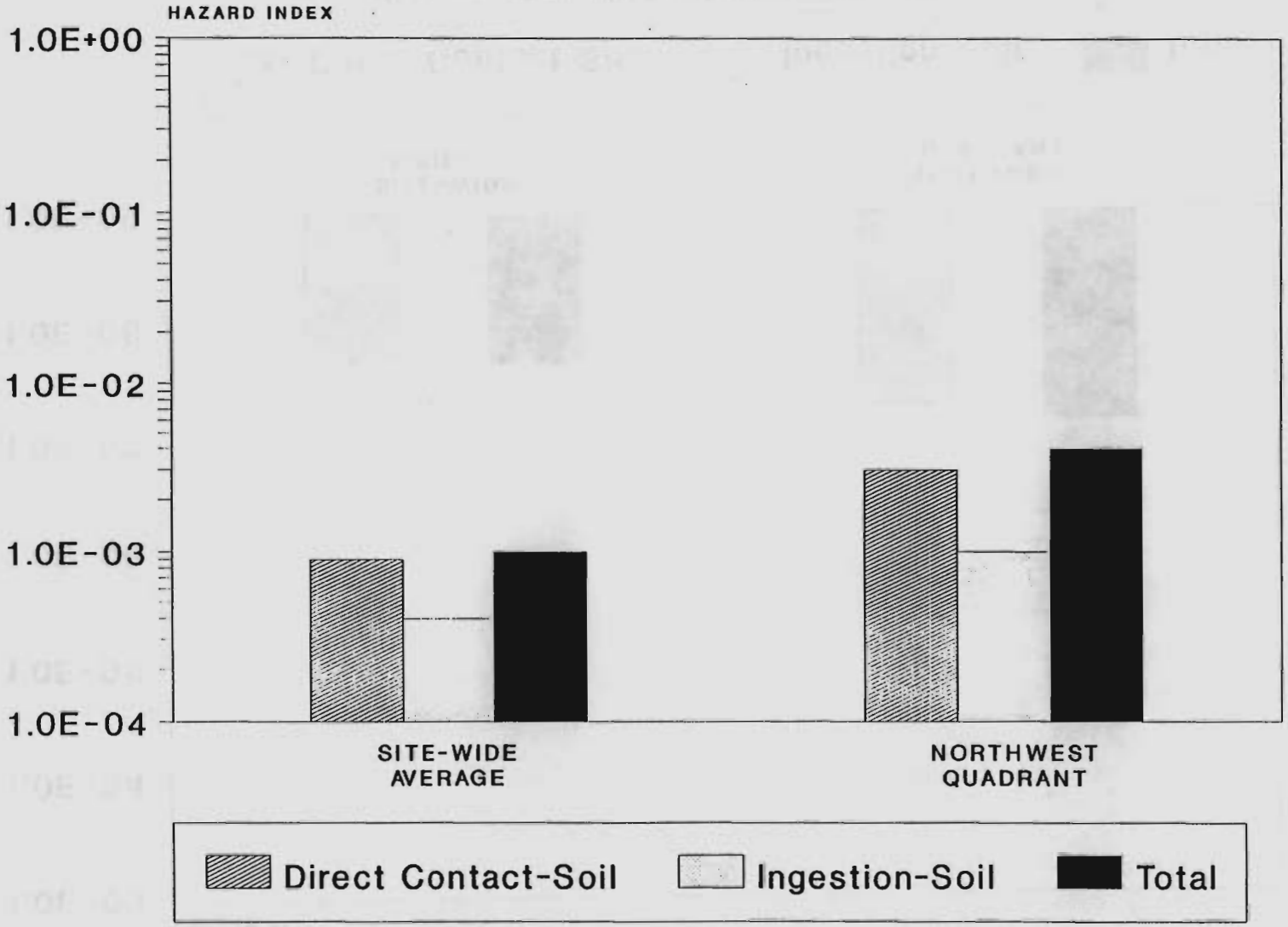


FIGURE 3-16

SUMMARY CANCER RISKS FOR LF-022 - FUTURE RESIDENT

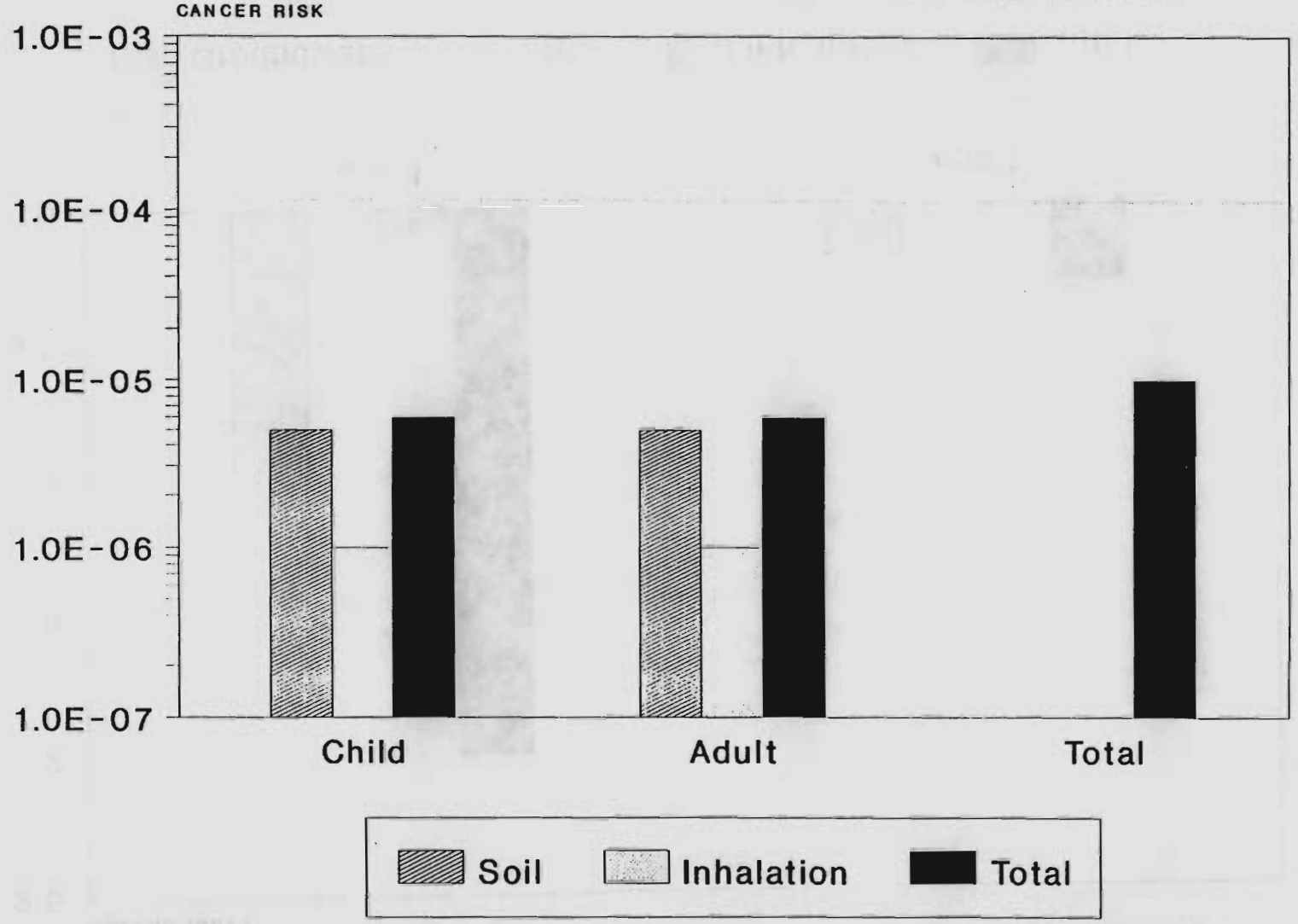
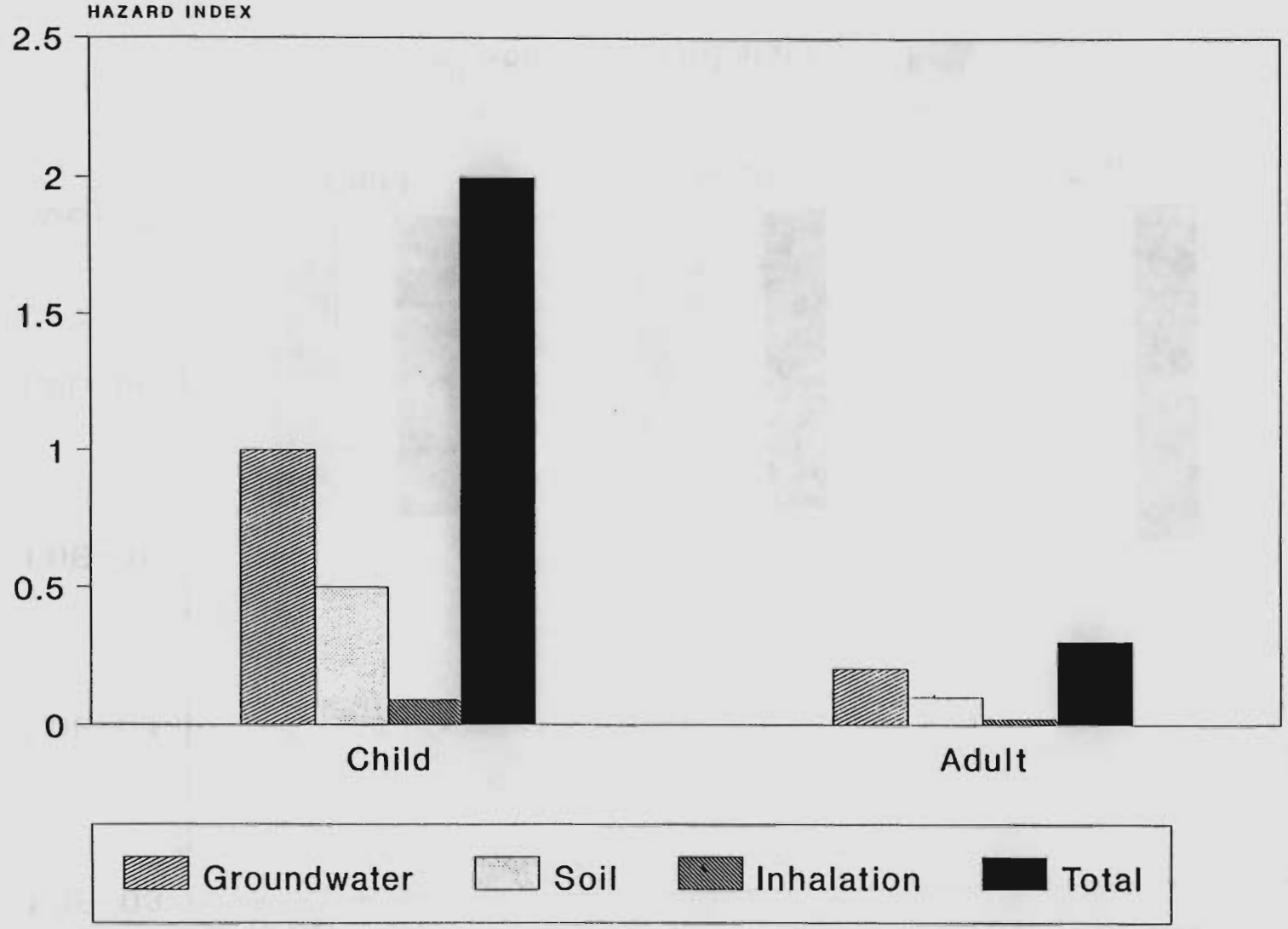


FIGURE 3-17

SUMMARY NONCANCER RISKS FOR LF-022 - FUTURE RESIDENT



data sets previously described (Figure 3-16). These risk estimates are within the USEPA target cancer risk range. Therefore, significant carcinogenic risks are not expected to result from exposure to contaminants at LF-022.

The total site hazard indices for the child receptor in this population are 1 and 2. The corresponding hazard indices for the adult receptor are 0.3 using either surface soil data set. Of these four estimates, only the hazard index incorporating the surface soil exposure scenario based on the most contaminated quadrant is above the USEPA target risk level. At least half of this elevated estimate is attributable to exposure to manganese in groundwater. The intake of manganese from groundwater at the maximum concentration detected downgradient of LF-022 would be within safe levels for this essential nutrient. Consequently, adverse noncarcinogenic health effects are not expected to result from exposure to contaminants at LF-022 even if the base were to close and homes were built nearby. Considering the fact that the future resident exposure pathways are based on the assumption that Plattsburgh AFB will close, these risk estimates represent "worst-case" conditions.

A habitat-based environmental risk assessment was also conducted for LF-022. This assessment evaluated potential risks to five receptor species resulting from exposure to surface soil and food sources:

- white-footed mouse
- wood thrush
- garter snake
- red fox
- red-tailed hawk

Ecological risks associated with exposure to site-related contaminants in surface soils at LF-022 are expected to be minor. Chronic and acute Hazard Indices are in the range of 10^{-6} to 10^{+0}, indicating that effects to some individual organisms are possible. However, population-level effects are unlikely because the number of individual organisms affected (which are limited to small birds, small mammals, and herpetofauna) is expected to be low based on the low Hazard Indices calculated.

3.5.1 Recommended Remedial Action Objectives

Remedial response objectives are media-specific goals established to protect human health and the environment. These objectives are developed based identified risks

associated with site contaminants and media of concern. The following remedial response objectives have been developed for LF-022:

- minimize potential ecological risks associated with direct soil contact
- minimize infiltration of precipitation into waste materials
- minimize potential for contaminant migration from waste material
- minimize erosion of cover soil

3.5.2 Data Limitations and Recommendations for Future Work

The surface soils at LF-022 were characterized by collecting and analyzing four composite samples. While the data from the composite samples was sufficient for the purposes of the risk assessment, they did not delineate the specific areas of concern (i.e., potential hot spots or source areas). This has been identified as a data limitation. Ten discrete soil samples will be obtained in the northwest and southeast quadrants of the landfill, where pesticides are a concern.

Most of the subsurface samples from LF-022 were collected from the waste. There are few samples of natural soil from below the waste because sampling depth was limited by the sampling equipment (i.e. backhoe). Therefore, information about the mobility, in soil, of contaminants detected in the waste is limited and must be inferred from groundwater data.

The compounds 2-butanone and BEHP in groundwater cannot be unequivocally disregarded from consideration at this site, however, based upon the available data it is unlikely that these compounds are site contaminants. These compounds are common sampling and analysis artifacts, and are the only organic compounds associated with groundwater. Because it is unlikely that a plume associated with a landfill would consist of only these two organic compounds, 2-butanone and BEHP, they have not been considered site contaminants at this time, but have been considered data limitations. Additional sampling of groundwater may be required to define the presence or absence of 2-butanone and BEHP.

A Feasibility Study should be conducted to address the remedial action objectives identified in Subsection 3.5.1. If a remedial alternative is selected for LF-022 that requires treatment and/or removal of contaminated surface soil, future sampling will be required.

4.0 LANDFILL LF-023

4.1 PHYSICAL CHARACTERISTICS

The following subsections contain the results of field investigations related to the physical characteristics of the site. LF-023 site features are shown in Figure 4-1.

4.1.1 Physical Geography

Topography across the LF-023 site is relatively flat; the land slopes gradually towards the south and southeast. Elevations range from 230 to 270 feet above sea level with surface gradients between zero and 3 percent.

4.1.2 Surface Features

Landfill operations ceased in 1981. Since then, the landfill area has been utilized as an exercise training course. A dirt road crosses the landfill from north to south. Tall pines border the landfill boundaries. Soils within the landfill boundaries are poorly graded fine to medium sand with trace silt. The soil appears to be native soil mined in the area and used as cover material after landfill operations ceased.

4.1.3 Surface Water

There are no surface water features within LF-023. The relatively low surface relief, highly permeable surface soils, deep water table, and lack of observed erosion or deposition features also indicate that there is no major surface water runoff during storms. However, shallow groundwater discharges to the ground surface downgradient of the landfill in seeps and drainages south of the site.

4.1.4 Geology

LF-023 geology and subsurface conditions were characterized by using information from test pits, borings made during the installation of monitoring wells, laboratory analyses of soil, geophysical surveys, and literature searches. Soil samples collected from borings are representative of Pleistocene marine depositional conditions described by Fisher (1968) and Denny (1974). The stratigraphy in this area consists of four geologic units: sand, clay, till, and carbonate bedrock. The sand unit varies in thickness and thins out towards the southern end of the site. The clay unit was

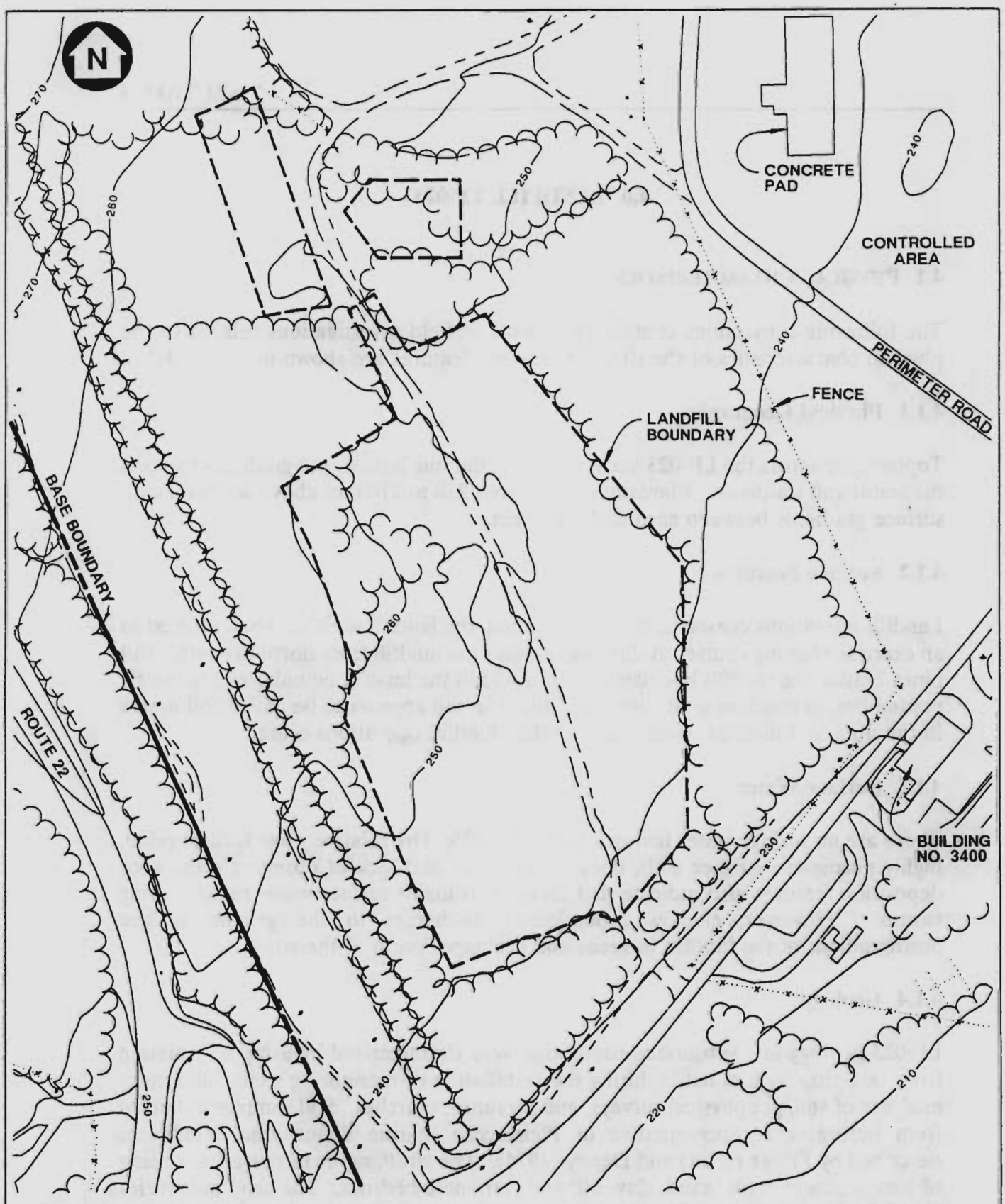


FIGURE 4-1
LF-023 SITE FEATURES
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
E.C. JORDAN CO.

6091-10

not encountered in all of the borings (i.e., MW-23-007 and MW-23-010) and becomes discontinuous toward the west. Geologic information collected during the SI and RI has been used to construct interpretive profiles of the stratigraphy at LF-022. The location of the geologic profiles is shown in Figure 4-2; north to south and east to west profiles are shown in Figures 4-3 and 4-4, respectively. The following descriptions and average depths of strata were interpreted from boring logs and the results of the seismic refraction survey and are summarized in Table 4-1.

4.1.4.1 Sand. The upper sand unit extends from ground surface to an average of 80 feet bgs and is interpreted as deltaic and near shore marine deposits. The particle size is poorly graded, medium to fine with some very fine sand and silt, and occasional silt layers. As with LF-022, the average particle size decreases with depth.

The sand changes from light brown to gray with increasing depth. This change is attributed to the difference between oxidation/reduction conditions above and below the water table.

4.1.4.2 Silt. Below the sand stratum is a silty sand to sandy silt layer at a depth of approximately 80 to 90 feet bgs. This layer ranges in thickness from 3 feet at the southern end of the site to 12 feet at the northern end of the site. This unit is dark gray throughout.

4.1.4.3 Clay. A clay unit underlies the silt unit at 102 feet bgs in MW-23-004, and at approximately 87 feet bgs at MW-23-005. This unit appears to be discontinuous and was not encountered in MW-23-007 and MW-23-010. As shown in the interpretive geologic profile, the clay unit thins out toward the south and west.

4.1.4.4 Till. A gray till was encountered approximately 80 feet bgs. The soil is described as a stiff gray silt with very fine sand (30 percent). The total thickness of the till was not penetrated during the investigation; however, based on borings and seismic survey data, it has been estimated to be approximately 30 feet thick.

4.1.4.5 Bedrock. Based on seismic survey data the bedrock is approximately 110 feet bgs. No rock was cored at Plattsburgh AFB during the SI or RI; however, seismic surveys have indicated depth to bedrock and outcrops in the area have been identified as Ordovician Period carbonate rock (i.e., limestone and dolostone).

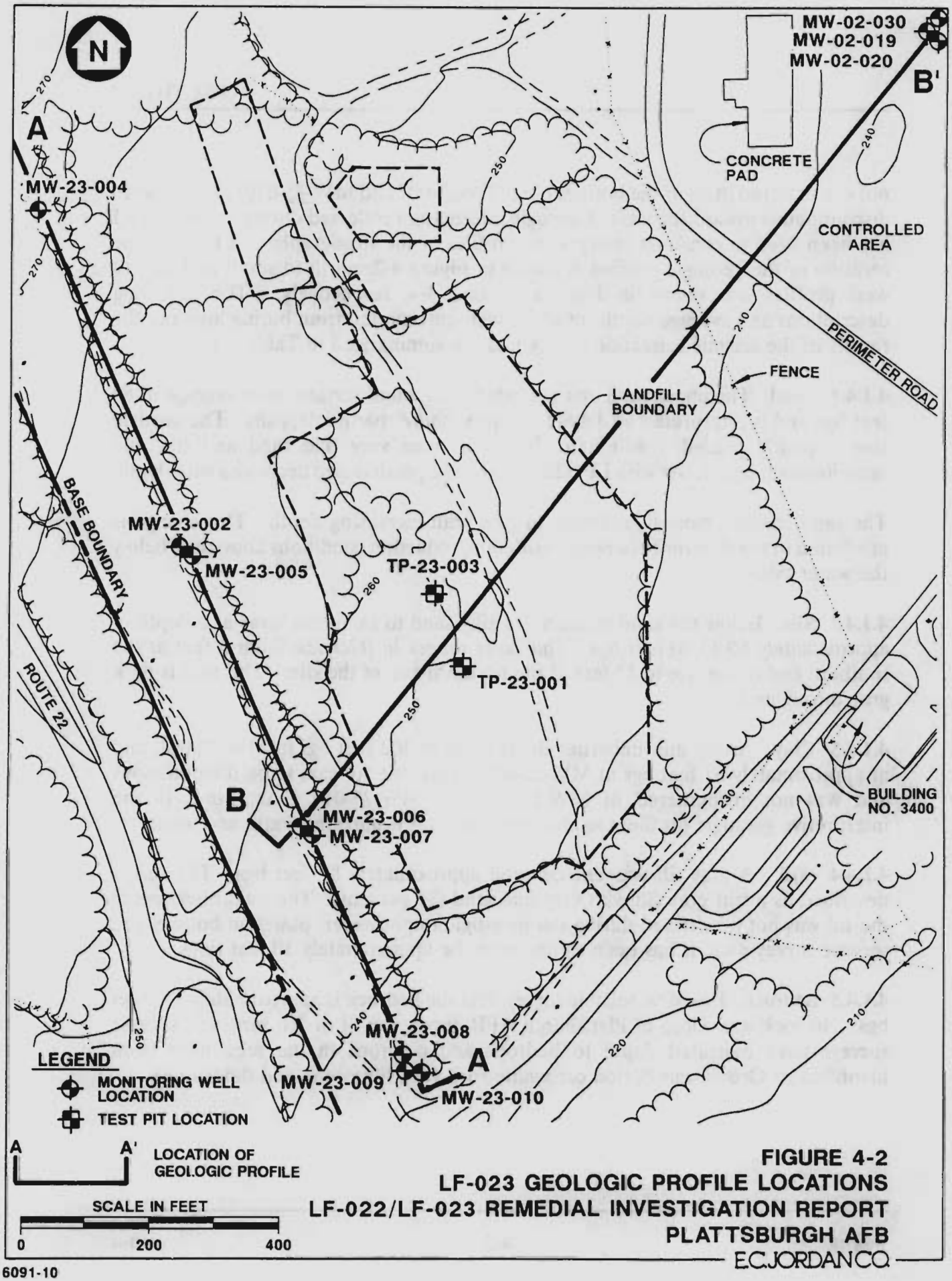


FIGURE 4-2
LF-023 GEOLOGIC PROFILE LOCATIONS
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
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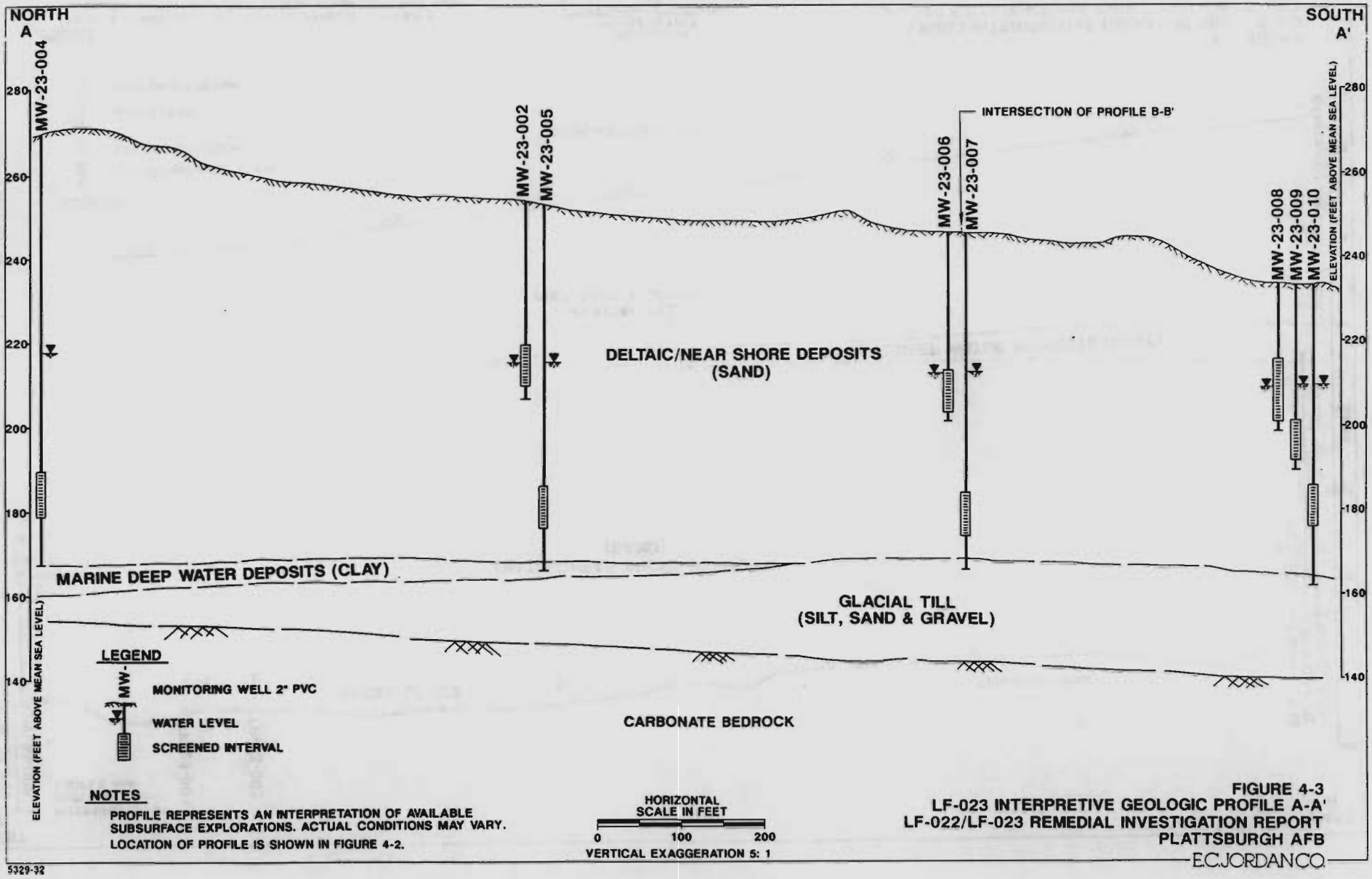


FIGURE 4-3
LF-023 INTERPRETIVE GEOLOGIC PROFILE A-A'
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
E.C.JORDAN CO.

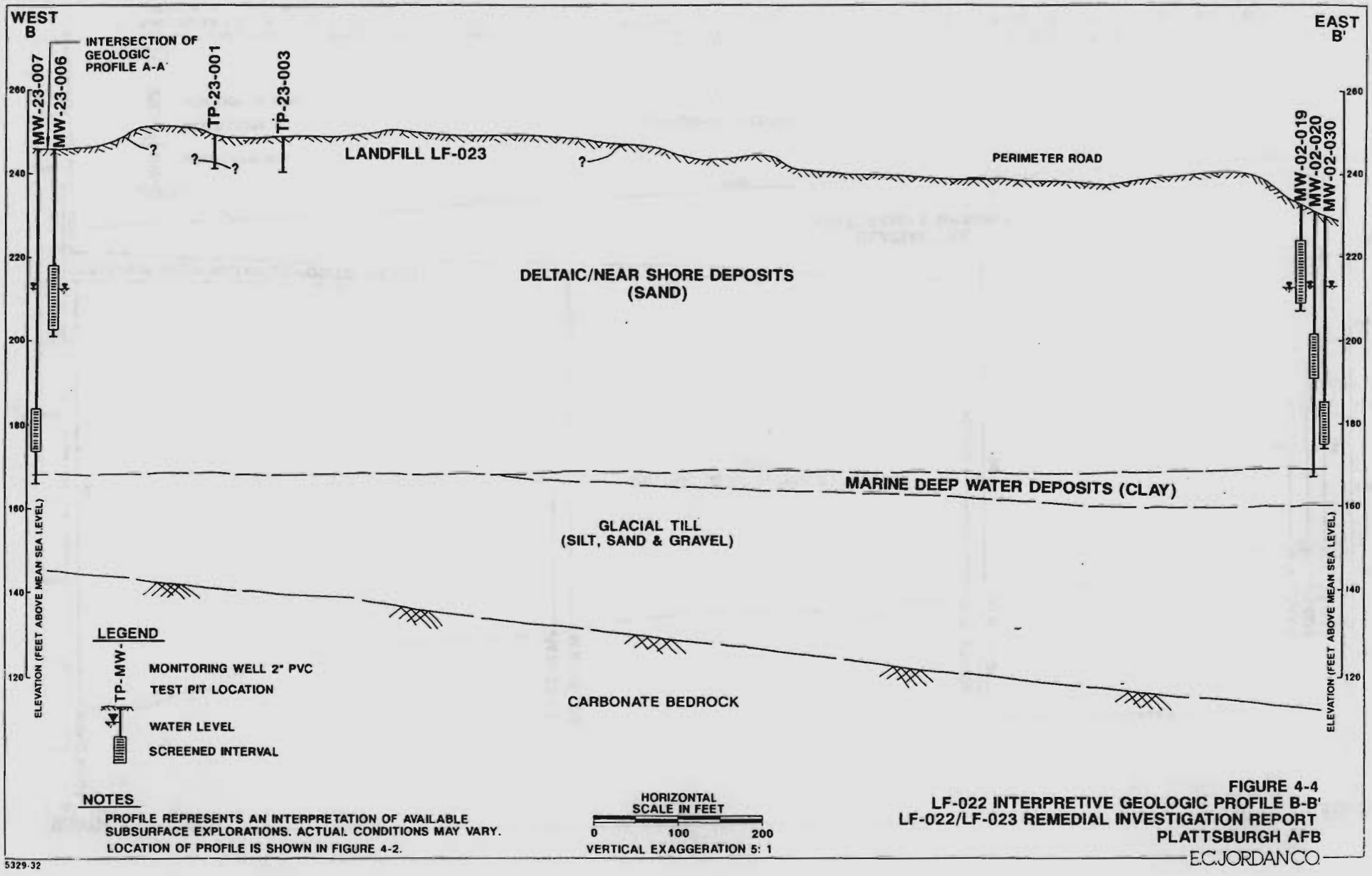


FIGURE 4-4
LF-022 INTERPRETIVE GEOLOGIC PROFILE B-B'
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
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TABLE 4-1
SUMMARY OF LF-023 STRATIGRAPHY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

DEPTH BELOW GROUND SURFACE (feet)	DESCRIPTION AND INTERPRETED DEPOSITIONAL ENVIRONMENT
0 to 80	SAND - Brown to gray, medium to fine with some very fine sand and silt, occasional silt layers, loose, moist to wet.
80 to 85	SILT - Dark gray, some fine sand, trace clay, occasional black mottling.
85 to 95	CLAY - Dark gray, firm, trace silt, discontinuous.
85 to 110	SILT/GLACIAL TILL - Gray, stiff, 3 percent very fine sand.
110	CARBONATE BEDROCK - Limestone or dolostone.

4.1.5 Hydrogeology

Hydrogeologic units in the LF-023 study area can be divided into four distinct units. These units include (1) an unsaturated zone (i.e., vadose zone); (2) a water table aquifer (i.e., unconfined aquifer); (3) a series of aquitards and aquicludes consisting of silts, clays and glacial till (i.e., confining layers); and (4) an aquifer within the carbonate bedrock (i.e., confined aquifer [Giese and Hobba, 1970]).

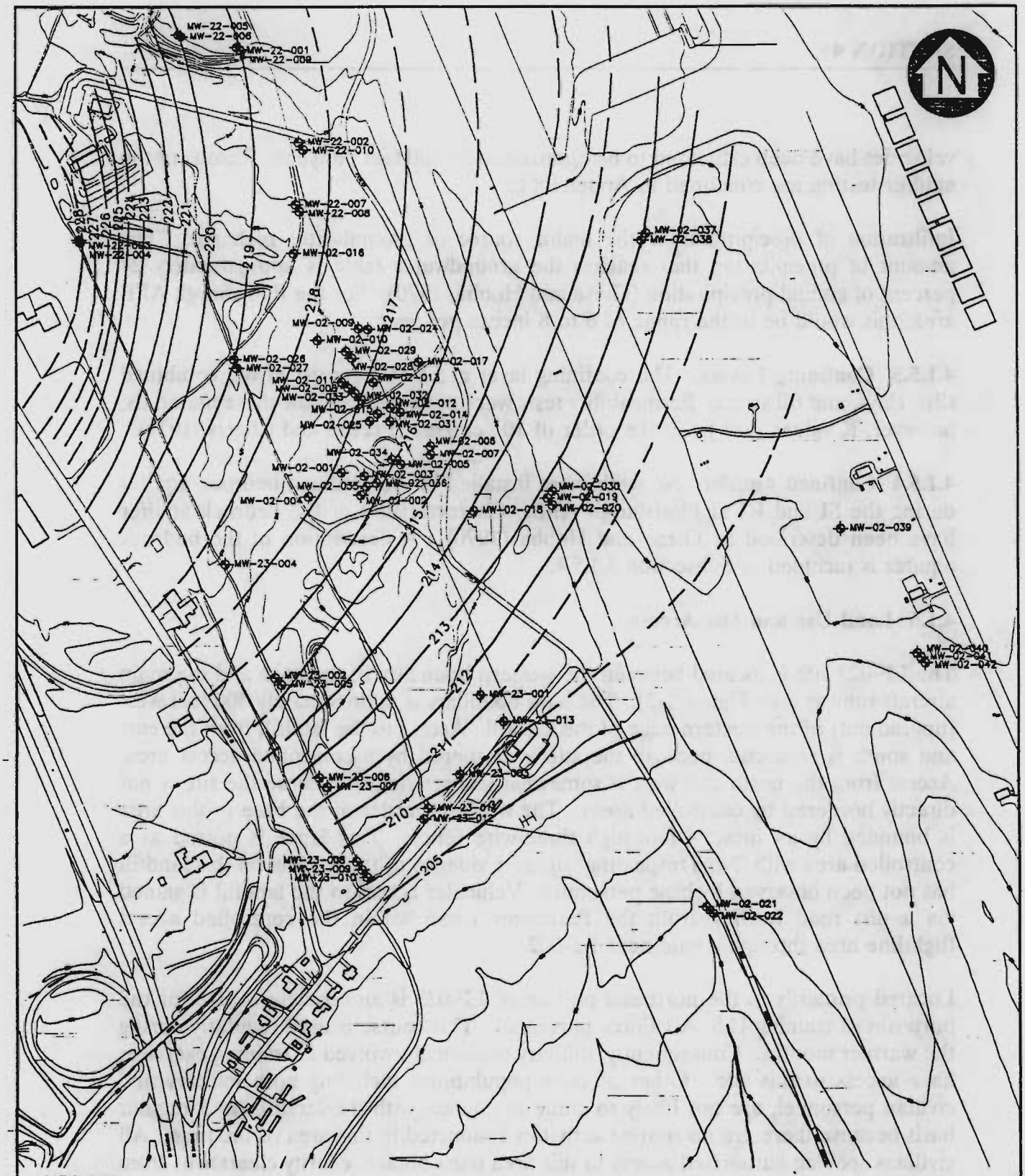
4.1.5.1 Vadose Zone. The vadose zone at LF-023 is approximately 20 to 40 feet thick and consists of medium-to-fine sand. The permeable sands allow precipitation to infiltrate rapidly and reach the groundwater table.

4.1.5.2 Unconfined Aquifer. The aquifer of major concern at Plattsburgh AFB is the water table aquifer, which consists of highly permeable medium-to-fine sand grading to fine sand and sandy silt. This aquifer is bounded by discharge areas (i.e., surface water bodies) on three sides: (1) the Saranac River to the north, (2) Lake Champlain to the east, and (3) the Salmon River to the south. Twelve monitoring wells were installed during the SI and RI field studies at LF-023 to investigate the properties of the unconfined aquifer.

The groundwater table at LF-023 is approximately 30 feet bgs, and the saturated thickness of the water table aquifer ranges from 40 to 50 feet. The regional groundwater flow is from west to east toward Lake Champlain. However, a topographic low south of LF-023, affects local groundwater flow.

Interpretation of head measurements in the area indicate flow in a south-southeast direction in the unconfined aquifer. Flow directions and groundwater table contours are shown in Figure 4-5. Hydraulic gradients at the site range from 0.005 to 0.008. No vertical groundwater gradients have been observed in the water table aquifer. Groundwater levels measured during the SI and RI are listed in Appendix K.

Permeability testing has been conducted in selected monitoring wells screened in the unconfined aquifer at LF-023. To minimize the potential for working in potentially highly contaminated wells, wells outside the suspected zone of contamination that were considered representative of the formation were selected for permeability testing. K values for the water table aquifer are approximately 10^{-2} cm/sec (30 feet/day). K values for the deeper portion of the aquifer (near the clay layer) are approximately 10^{-3} cm/sec (3 feet/day). Principal flow within the water table aquifer occurs in the upper portion where the sand is most permeable. Seepage



LEGEND:

214 — GROUNDWATER ELEVATION CONTOUR

MW-02-010 MONITORING WELL LOCATION

SCALE IN FEET

0 300 600 1200

FIGURE 4-5
LF-023 GROUNDWATER CONTOURS
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

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velocities have been estimated to be approximately 180 feet per year. Results of the aquifer testing are contained in Appendix E.

Infiltration of precipitation is the major source of groundwater recharge. The amount of precipitation that reaches the groundwater table is approximately 24 percent of annual precipitation (Giese and Hobba, 1970). For the Plattsburgh AFB area, this would be in the range of 6 to 8 inches per year.

4.1.5.3 Confining Layers. The confining layer at LF-023 consist of the combined silts, clays, and till strata. Permeability tests were not conducted for these materials; however, K values may be in the order of 10^{-7} cm/sec (Freeze and Cherry, 1979).

4.1.5.4 Confined Aquifer. No wells were installed in the confined bedrock aquifer during the SI and RI at Plattsburgh AFB. Characteristics of the bedrock aquifer have been described by Giese and Hobba (1970). A description of the bedrock aquifer is included in Subsection 3.1.5.4.

4.1.6 Land Use and Site Access

The LF-023 site is located between the western boundary of the base and the main aircraft runway (see Figure 1-2). The base boundary is approximately 300 feet west (upgradient) of the western edge of the landfill. Access to the landfill from the east and south is restricted because the site is bordered by a controlled access area. Access from the north and west is somewhat less restrictive because the site is not directly bordered by controlled areas. The western border of the base in this area is bounded by an intact 4-foot-high three-wire fence. This fence is posted as a controlled area with "No Trespassing" signs. Evidence of trespassing on this landfill has not been observed by base personnel. Vehicular access to the landfill is gained via a dirt road leading from the Perimeter Road within the controlled access flightline area through a gate near FT-002.

Located primarily in the northeast portion of LF-023 is an obstacle course for the purposes of training U.S. Air Force personnel. This course is used regularly during the warmer months. Consequently, military personnel involved in training exercises have access to this site. Other on-base populations, including both military and civilian personnel, are not likely to come in contact with the landfill on a regular basis because there are no routine activities conducted in this area of the base. All civilians seeking authorized access to this area must obtain security clearances from the base before entering the controlled area.

LF-023 is approximately 600 feet northeast (crossgradient) of a small mobile home development on Old NY Route 22, near the interchange with Interstate 87 (see Figures 1-3 and 4-14). An old dirt road used to lead from the mobile home park road to the northeast and onto the base, just south of LF-023. This road intersects with the Perimeter Road on base. Vehicle access via this road from off-base is prevented by an earthen barrier and gate. The area between LF-023 and the mobile home area is mostly wooded. The nearest on-base housing area is more than 6,000 feet east (downgradient) of the site. The light industrial area along Route 22 is approximately 600 feet north (upgradient) of the site.

Although access to the landfill from the west and north is possible, this area of the base is patrolled regularly. Anyone observed trespassing in this area is escorted off-base. Because this area is patrolled regularly and there are other off-base areas nearby where children can play, it is unlikely this site would be a preferred recreational area for children from the housing area on Route 22. Therefore, access to the LF-023 Landfill by off-site populations is unlikely.

A wet area has been observed at the bottom of a small hillside south of the landfill. Although within the base boundary, this area is only about 200 feet east of the mobile home development. Children from this development could more easily explore in this area than on the site itself.

4.1.7 Description of the Existing Environment

In this section potential receptors of contaminants present at LF-023 are described. This information is used to develop exposure scenarios in Section 4.4.3.1 of the ecological risk assessment.

The plant community at LF-023 consists of a pitch pine (*Pinus rigida*) plantation surrounding an open area with sparse weedy vegetation. Wetland habitats are not present on the site itself. The nearest wetland area is located approximately 300 feet to the south of the site, and appears to be a discharge area for groundwater flowing from below LF-023. This wetland, which is primarily red maple (*Acer rubrum*) swamp, is regulated by NYSDEC as wetland unit PB-14 (see Figure J-2 in Appendix J). While red maple is the dominant tree species, wetland PB-14 also contains an understory typical of red maple swamps. These include species such as winterberry (*Ilex verticillata*), arrowwood (*Viburnum recognitum*), cinnamon fern (*Osmunda cinnamomea*), royal fern (*Osmunda regalis*), sensitive fern (*Onoclea*

sensibilis), skunk cabbage (*Symplocarpus foetidus*), jewelweed (*Impatiens capensis*), highbush blueberry (*Vaccinium corymbosum*), and speckled alder (*Alnus rugosa*).

The locations of other wetlands regulated by NYSDEC as of March 1990 at Plattsburgh AFB are illustrated in Figure J-2 in Appendix J. No wetlands regulated by NYSDEC are present on or adjacent to LF-023.

A covertype map of the site and surrounding areas is presented in Figure J-3 in Appendix J. This map indicates New York NHP covertypes specified in Reschke (1990) in accordance with the NYSDEC "Habitat-Based Assessment Guidance Document for Conducting Environmental Risk Assessments at Hazardous Waste Sites" (NYSDEC, 1989a). The map was prepared using aerial photographs, USGS topographic maps, and information from a June 1989 site survey.

Many of the covertypes in the vicinity of the site fall under the broad NHP category of "Terrestrial Cultural". These include landfill/dump (the site itself), unpaved roads, paved roads, rural structure exterior (buildings), and mowed lawns. In addition to the landfill/dump category assigned to the site itself, other NHP covertypes exist on the landfill surface, which are primarily pine plantation and open uplands. Another extensive covertype in the vicinity of the site is the broad category of "Forested Uplands". The wetland area to the south of the site mentioned previously is classified as red maple-hardwood swamp.

Species of birds, mammals, reptiles, and amphibians that occur in the general vicinity of Plattsburgh AFB are listed in Tables J-1 through J-4 in Appendix J, respectively. The plant communities at LF-023 provide food and cover for a subset of the species listed in these tables. Because no aquatic, wetland, or other moist habitats exist on the site, the species of wildlife expected at the site are primarily terrestrial organisms. However, wetland PB-14 may support aquatic invertebrates and is expected to provide habitat for species of birds, mammals, reptiles, and amphibians requiring moist woods or wetland habitats. The wetland is not expected to support fish because it does not contain standing water throughout the year.

Species common in the area of Plattsburgh AFB that may occur at the site based on habitat types present include: white-footed mouse (*Peromyscus leucopus*); meadow vole (*Microtus pensylvanicus*); red fox (*Vulpes vulpes*); wood thrush (*Hylocichla mustelina*); mourning dove (*Zenaida macroura*); gray catbird (*Dumetella carolinensis*); red-tailed hawk (*Buteo jamaicensis*); and eastern garter snake (*Thamnophis sirtalis sirtalis*). Species characteristic of red swamp habitats include salamanders

(*Ambystoma* spp.), black-crowned night heron (*Nycticorax nycticorax*), and red-bellied woodpecker (*Melanerpes carolinus*) (Reschke, 1990). Species such as raccoon (*Procyon lotor*) and leopard frog (*Rana pipiens*) may also use red maple swamp habitat.

The NHP was contacted regarding the presence of rare animals, plants, and natural communities and/or significant wildlife habitats within a 2-mile radius of Plattsburgh AFB. As of March 7, 1991, the NHP database lists no rare species, communities, or significant habitats on the base itself, although nine locations with rare plant species and two rare natural communities are listed within a 2-mile radius of the base. Most of the locations are north of the base, with some near the shore of Lake Champlain. No location appears to be in an area that may be affected by chemical contamination from Plattsburgh AFB or as a result of remedial activities at any site on the base.

The USFWS has also been contacted regarding rare species in the vicinity of Plattsburgh AFB. The USFWS reported that, except for occasional transient individuals, no federally listed or proposed endangered or threatened species under their jurisdiction are known to exist at or within 2 miles of Plattsburgh AFB. Therefore, no Biological Assessment under the Endangered Species Act is required.

4.2 Nature and Extent of Contamination

The following subsections describe the results of the site characterization study at LF-023. The conceptual model that was developed based on the results of the SI and RI is described in the first subsection. The distribution of contaminants in the various media at LF-023 is described in more detail in the subsequent subsections.

4.2.1 Conceptual Model

LF-023 covers an area of approximately 438,000 square feet and became active as a landfill in 1966. The landfill began to close in 1979 when wastes were taken off-base to municipal landfills, however, dumping at the site did not stop completely until 1981. While the landfill was active, domestic wastes were reportedly dumped into trenches and covered with fill. Trenches may extend up to 25 feet bgs in some sections; in other areas of the landfill, soils were relatively undisturbed by disposal operations. Trenches were not excavated in any discernible pattern.

Geologically, the site is located in highly permeable sand and silt deposits. An unconfined aquifer is located in the sand unit and the water table is approximately 15 feet below the deepest reported depth of the landfill. Groundwater in the unconfined aquifer flows to the south and southeast toward Lake Champlain and a topographic low south of the site. Directly below the sand unit is a discontinuous silt unit underlain by a clay unit of low permeability, the clay unit underlies most of the site. Between the clay and the carbonate bedrock is a layer of basal till with low permeability. The low permeability clay and till layers form an apparent hydrogeologic barrier that separates the unconfined aquifer from the confined bedrock aquifer. Groundwater in the confined aquifer flows east towards Lake Champlain. The site conceptual model is shown in Figure 4-6.

Various chemicals have been identified as site contaminants in various media at LF-023 (Table 4-2). The site contaminant identified in the waste material was 1,2-dichlorobenzene. The primary source of contamination at LF-023 is the surface soil. Seventeen SVOCs were identified as site-related contaminants in the surface soil. These SVOCs are all polyaromatic hydrocarbons (PAHs) commonly found in fuels, oil, and their residues suggesting leaks or spills of waste oil at this site. Silver and one PCB, Aroclor 1254, were also identified as site contaminants in the surface soil. No site contaminants were identified in the subsurface soils. Aluminum, arsenic, iron, and zinc were identified as site-related contaminants in the surface water. PHCs were detected in sediment samples and are considered site-related contaminants. No PHCs were detected in the associated surface water samples. The PHC results suggest a general fuel or hydrocarbon base in the sediment samples.

Vinyl chloride, chloroform, chlorobenzene, benzene, ethylbenzene, xylenes (total), aluminum, iron, manganese, and potassium were identified as site contaminants in the groundwater. The halogenated organics are believed to have their origin in the landfill, but a source was not identified. Potential migration pathways for the contaminants and possible receptors are shown in Figure 4-7.

4.2.2 Source Area

Geophysical techniques were used to investigate the depth and areal extent of the landfill. Two seismic refraction survey lines, shown in Figure 4-8, were shot across the landfill during the RI to help determine the maximum depth of the fill materials. However, these lines provided no information on the depth of the landfill or stratigraphy directly below the landfill. The terrain conductivity survey also failed to provide further information about the landfill. The areal extent of the large section

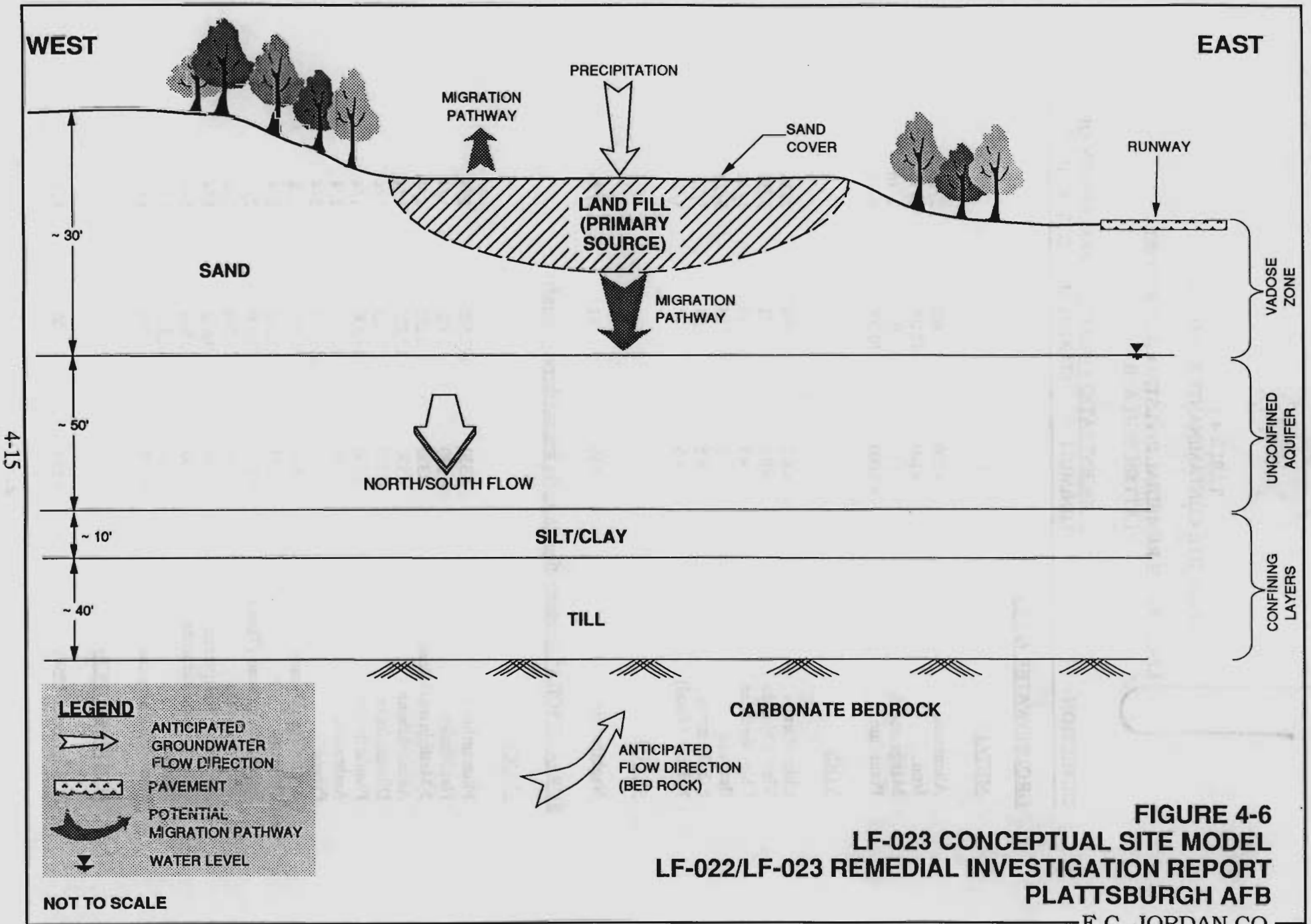


FIGURE 4-6
LF-023 CONCEPTUAL SITE MODEL
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
E.C. JORDAN CO.

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TABLE 4-2
LF-023 SITE CONTAMINANTS BY MEDIA

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

DETECTION	CONCENTRATION RANGE[1] MINIMUM	MAXIMUM	FREQUENCY OF DETECTION[2]
GROUNDWATER (µg/L)			
METALS			
Aluminum	<200	662	2/16
Iron	<100	47,100	3/16
Manganese	<15	954	2/16
Potassium	<5,000	40,000	4/16
VOCs			
Chloroform	<0.2	0.4[4]	2/38
Vinyl Chloride	<0.3	31[5]	3/38
Chlorobenzene	<5	10	1/38
Benzene	<5	14	3/25
Ethylbenzene	<5	54	3/25
Xylenes (Total)	<5	72	4/25
SVOCs			
Naphthalene	<10	11	1/23
SURFACE SOILS[3] (concentrations in µg/kg unless otherwise noted)			
SVOCs			
Fluoranthene	<330	122,500	2/4
Naphthalene	<330	2,725	1/4
2-Methylnaphthalene	<330	2,125	1/4
Acenaphthene	<330	12,825	1/4
Dibenzofuran	<330	7,325	1/4
Phenanthrene	<330	144,000	1/4
Anthracene	<330	25,700	1/4
Pyrene	<330	105,500	2/4
Benzo(a)anthracene	<330	36,500	2/4
Chrysene	<330	35,000	2/4
Benzofluoranthene (Total)	<330	37,000	2/4
Benzo(a)pyrene	<330	21,200	2/4
Indeno(1,2,3-cd)pyrene	<330	4,650	1/4
Dibenzo(a,h)anthracene	<330	2,800	1/4
Fluorene	<330	12,325	1/4
Benzo(g,h,i)perylene	<330	3,850	1/4
PESTICIDES/PCBs			
PCB (Aroclor-1254)	<160	190	1/4

TABLE 4-2
(Continued)
LF-023 SITE CONTAMINANTS BY MEDIA

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

DETECTION	CONCENTRATION RANGE [1] MINIMUM	MAXIMUM	FREQUENCY OF DETECTION [2]
METALS (mg/kg)			
Silver	<2	12.8	2/4
SEDIMENT (mg/kg)			
PHCs	550	1,075	2/2
SURFACE WATER (1g/L)			
Aluminium	<200	1990	1/2
Arsenic	< 10	316	1/2
Iron	<100	672,000	2/2
Zinc	<20	355	1/2
WASTE (1g/kg)			
SVOCs			
1,2-Dichlorobenzene	520	520	1/1

NOTES:

[1] Concentrations of duplicate samples were averaged. When a compound was detected in one duplicate and not the other, an average concentration was calculated by using the detection limit, adjusted for dilution.

[2] Number of samples in which the compound was detected above background concentrations or appropriate standards divided by the total number of samples analyzed for that parameter. Duplicate samples were counted as one sample.

[3] Concentrations detected in composite samples.

[4] Concentrations reported from Method 8010 analyses.

[5] Concentrations reported from CLP-COP and Method 8010 analyses.

VOC Volatile Organic Compound
SVOC Semivolatile Organic Compound
PCB Polychlorinated Biphenyl

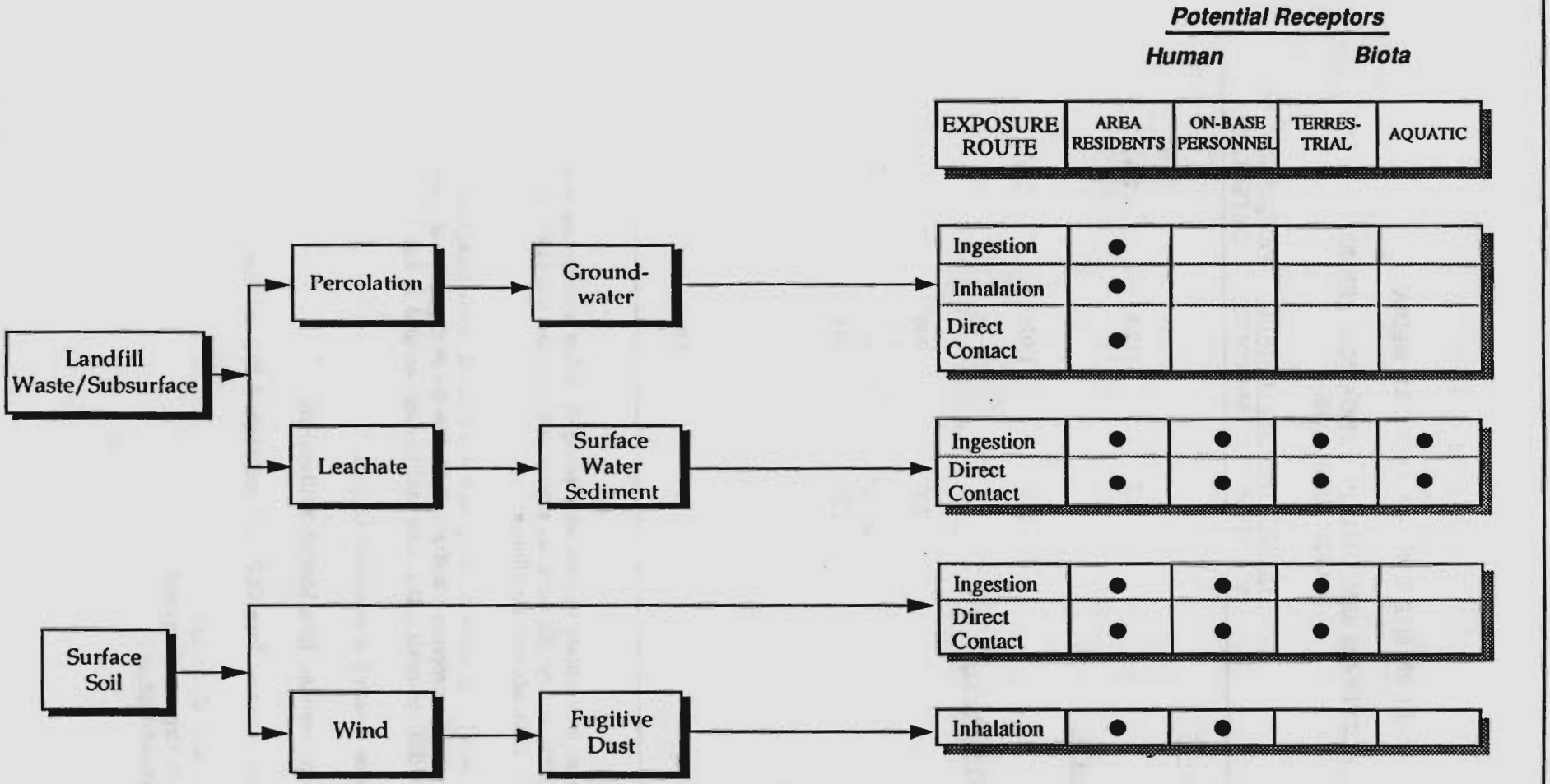


FIGURE 4-7
LF-023 POTENTIAL MIGRATION PATHWAY AND RECEPTORS
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

E.C. JORDAN CO.

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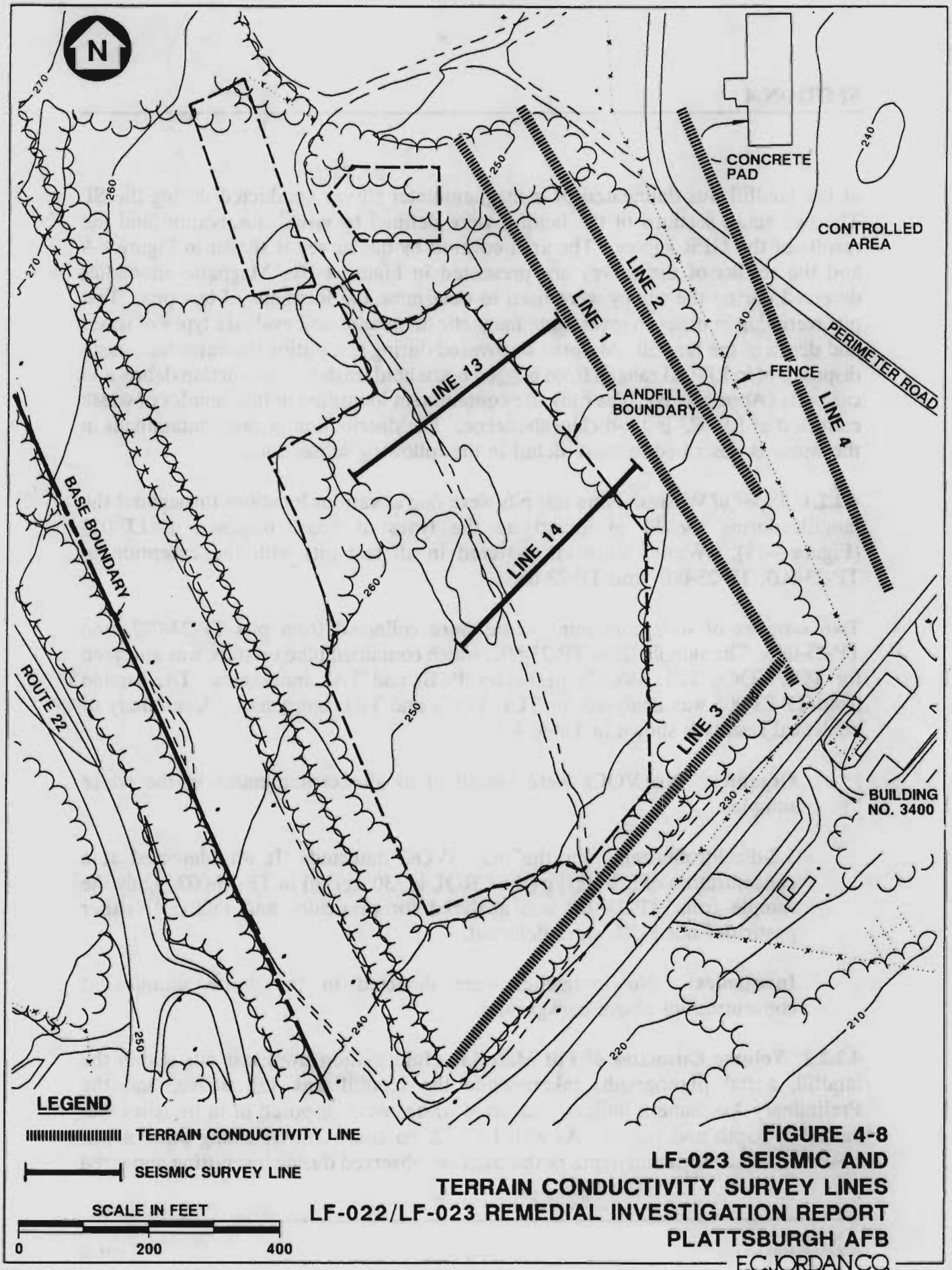


FIGURE 4-8
LF-023 SEISMIC AND TERRAIN CONDUCTIVITY SURVEY LINES
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
E.C. JORDAN CO.

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of the landfill was delineated by a magnetometer survey conducted during the SI. The two small sections of the landfill were defined by visual observation and the results of the GPR survey. The area covered by the survey is shown in Figure 4-9 and the results of the survey are presented in Figure 4-10. Magnetic anomalies detected during the survey were used to determine the locations of test pits. Test pits were dug in order to investigate magnetic anomalies and evaluate types of waste and depth of the landfill. Material uncovered during test pitting indicates that waste disposed of in LF-023 ranged from bagged household trash to construction debris and car parts (Appendix B). The only site contaminant identified in the samples of waste collected at LF-023 is 1,2-dichlorobenzene. The distribution of this contaminant in the waste is described in more detail in the following subsections.

4.2.2.1 Types of Wastes. Nine test pits were dug at various locations throughout the landfill during the SI to investigate the types of waste disposed at LF-023 (Figure 4-11). Wastes were encountered in all test pits with the exception of TP-23-003, TP-23-007, and TP-23-008.

Two samples of soils containing waste were collected from pits TP-23-002, and TP-23-005. The sample from TP-23-002, which contained blue crystals, was analyzed for TCL VOCs, TCL SVOCs, pesticides/PCBs and TAL inorganics. The sample from TP-23-005 was analyzed for TCL VOCs and TAL inorganics. A summary of analytical results is shown in Table 4-3.

Organics: No VOCs were identified as site contaminants in the waste samples.

1,2-dichlorobenzene was the only SVOC detected. It was detected at a concentration of 520 μg/kg (the CRQL is 330 μg/kg) in TP-23-002. Only the sample from TP-23-002 was analyzed for pesticides and PCBs. Neither pesticides nor PCBs were detected.

Inorganics: No inorganics were detected in the waste samples at concentrations above background.

4.2.2.2 Volume Estimates of Fill Material. Information from test pits within the landfill, aerial photographs taken while the landfill was still active, and the Preliminary Assessment indicate that solid wastes were disposed of in trenches that varied in depth and length. As with LF-022, no consistent trenching pattern was observed. The maximum depth of the trenches observed during test pitting appeared

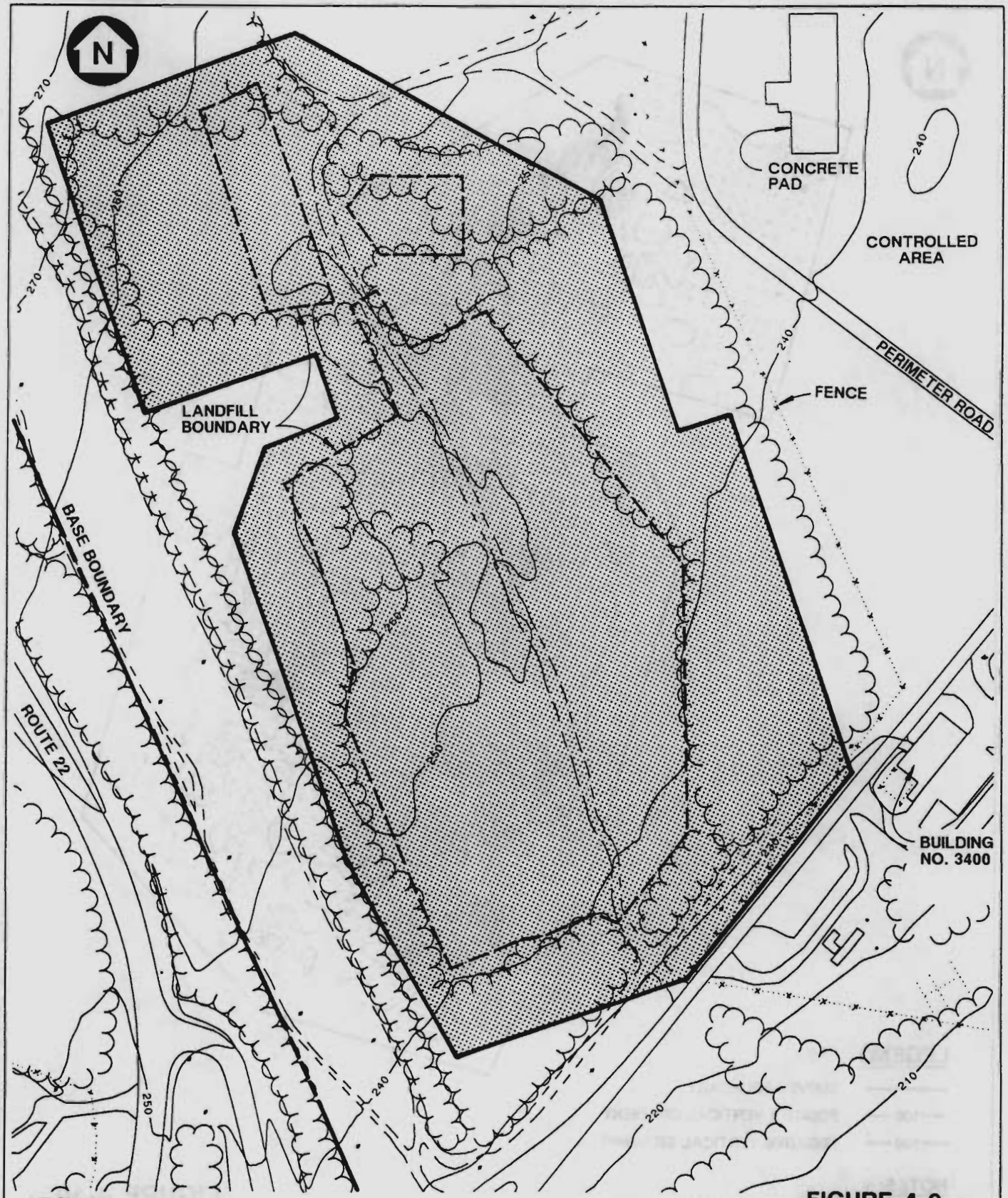
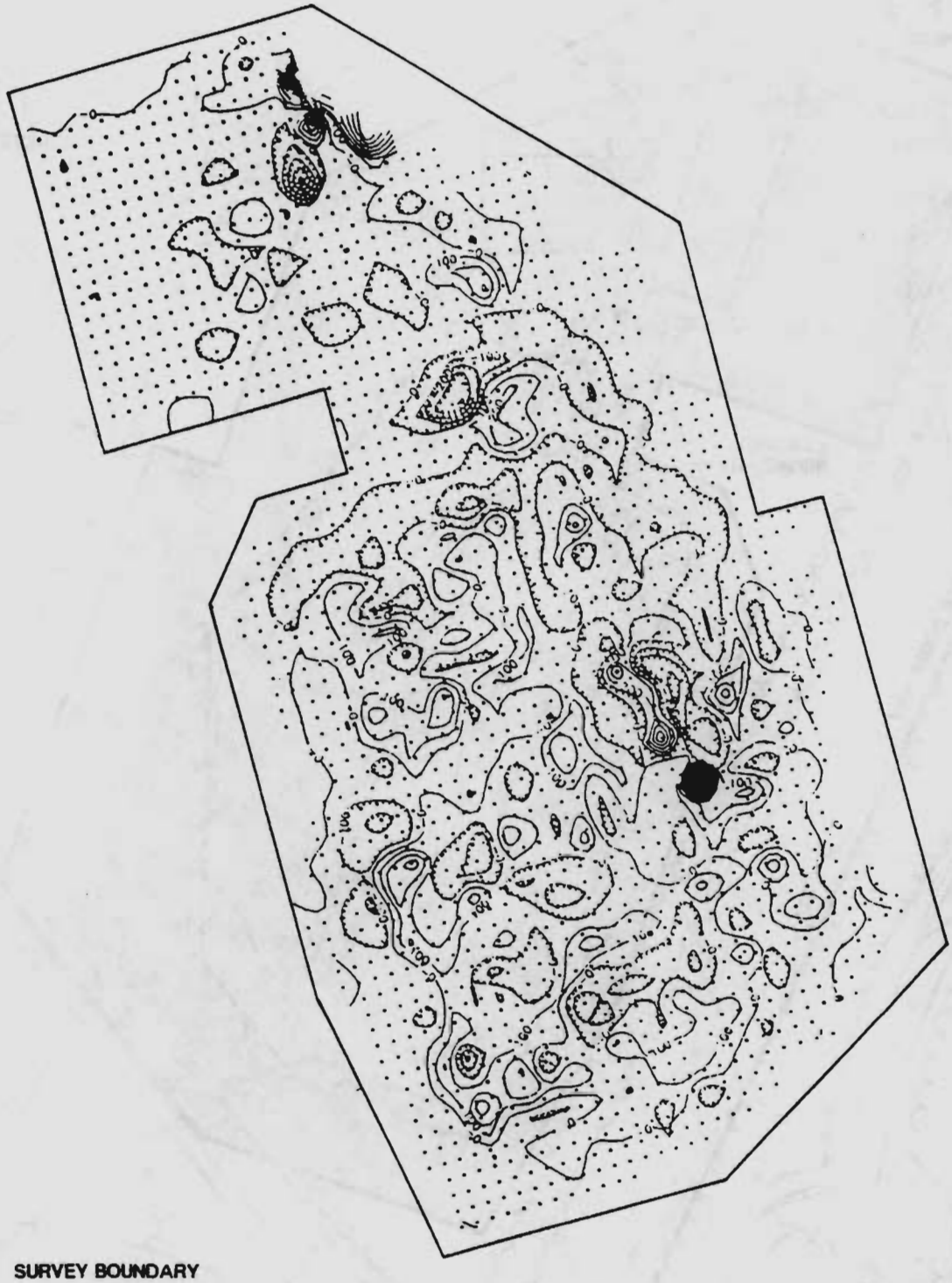


FIGURE 4-9
AREA OF LF-023 COVERED BY MAGNETOMETER SURVEY
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
E.C. JORDAN CO.

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LEGEND

- SURVEY BOUNDARY
- 100 POSITIVE VERTICAL GRADIENT
- 100 NEGATIVE VERTICAL GRADIENT

NOTES:

CONTOUR INTERVAL = 100 GAMMAS PER METER
EACH DOT REPRESENTS A DATA POINT.

SCALE IN FEET

0 200 400

FIGURE 4-10
LF-023 MAGNETOMETER SURVEY
LF-022/LF-023
REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
E.C. JORDAN CO.

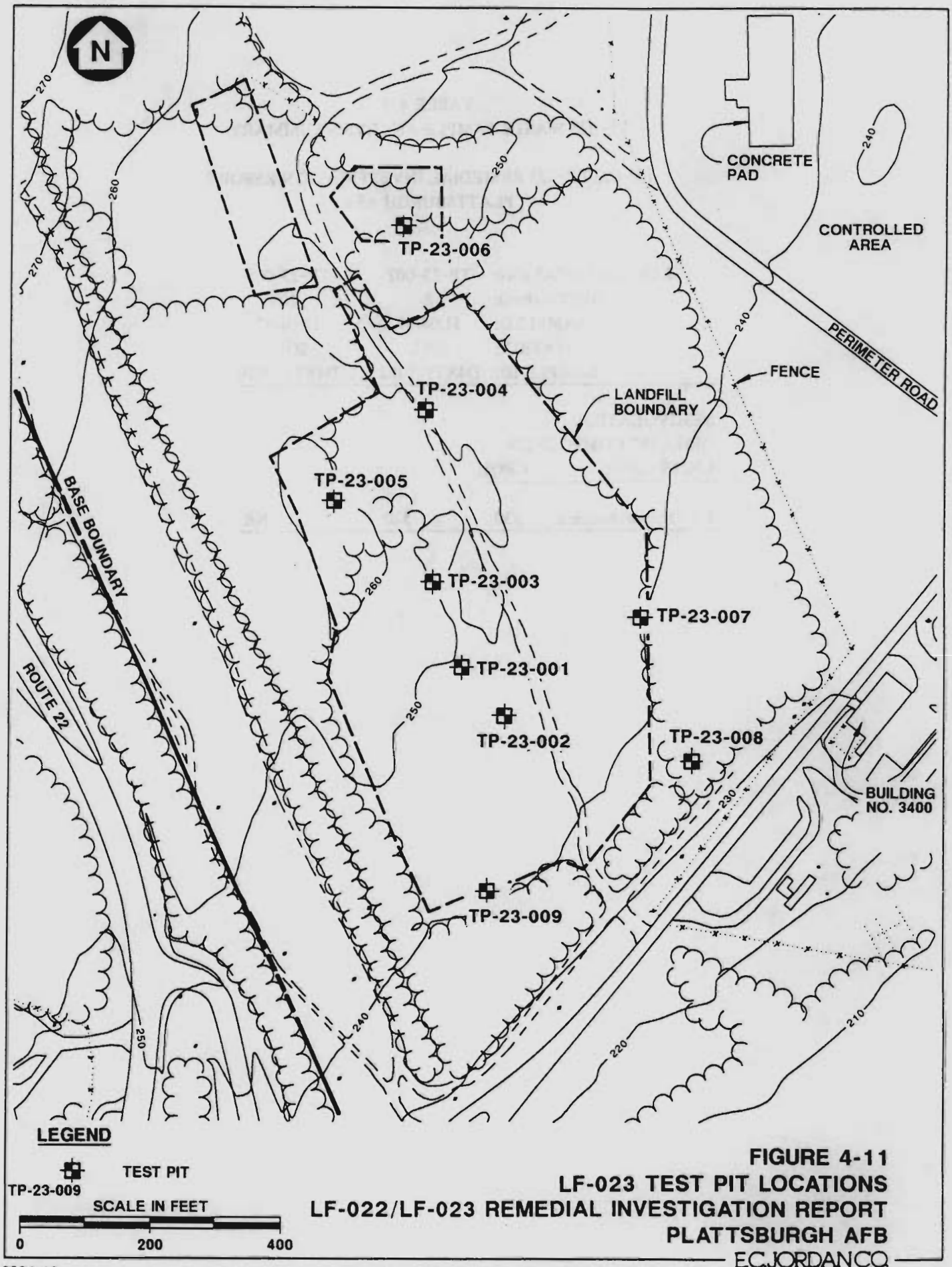


FIGURE 4-11
LF-023 TEST PIT LOCATIONS
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
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TABLE 4-3
LF-023 WASTE SAMPLE ANALYSIS SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:	TP-23-002	TP-23-005
DEPTH (feet):	2	10
DATE SAMPLED:	11/04/87	11/04/87
MATRIX:	SOIL	SOIL
SAMPLE ID:	D4XTP10202	D4XTP10510
SEMIVOLATILE ORGANIC COMPOUNDS UNITS: ug/kg	CRQL	
1,2-Dichlorobenzene	330	520 NR

to be 13 feet; however, information obtained from the Preliminary Assessment indicated that wastes may have been buried as deep as 25 feet bgs in some areas of the landfill.

Based on the results of the magnetometer survey, LF-023 has a surface area of approximately 438,000 square feet. Although the areal extent of the landfill has been defined and its depth is known in some locations, the volume of fill material at the landfill is difficult to estimate because of the non-uniform manner in which wastes were disposed of. Based on the areal extent of the landfill and a maximum depth of 25 feet, the maximum volume of fill material in LF-023 is 406,000 cubic yards. This fill material volume estimate has a wide range of error because some soils within the landfill boundaries were not disturbed during landfill operations and the depth of the landfill varies.

4.2.3 Subsurface Soils

Four samples of natural in-place soils were collected from test pits. No site contaminants were identified in the subsurface soil samples. The four subsurface soil samples were collected from test pits TP-23-006, TP-23-007, TP-23-008, and TP-23-009 (see Figure 4-11). Landfill wastes were uncovered in TP-23-006 and TP-23-009 and soil samples were collected from undisturbed soils just below the waste at 13 feet bgs and 9.5 feet bgs, respectively. The sample from TP-23-007 was collected at 5 feet bgs, and the sample from TP-23-008 was collected at 8 feet bgs. No wastes were uncovered from either TP-23-007 or TP-23-008. The samples from TP-23-006 and TP-23-008 were analyzed for TCL VOCs and TAL inorganics. The samples from TP-23-007 and TP-23-009 were analyzed for TCL VOCs, TCL SVOCs, pesticides/PCBs and TAL inorganics.

Organics: No VOCs, SVOCs or pesticides/PCBs were detected in any of the soil samples.

Inorganics: No inorganics were detected in subsurface soil samples at concentrations above background.

4.2.4 Surface Soils

The surface soil at LF-023 is fill material used as cover for the landfill. The landfill cover ranges in thickness from 1 to 3 feet. The cover soil appears to be the same as

the native soils adjacent to and below the landfill; however, the exact origin of cover material cannot be determined.

A passive SOV survey and laboratory analyses of surface soil samples were conducted at LF-023 to investigate potential surface soil contamination. Based on the results of these investigations, Aroclor 1254, silver and 17 SVOCs were identified as site contaminants. The distribution of contaminants is described in more detail in the following subsections.

4.2.4.1 Soil Organic Vapor Survey. The passive soil gas survey conducted at LF-023 identified two major groups of hydrocarbons, cycloalkanes and alkenes, and simple aromatics. In addition, one chlorinated solvent, TCE was identified at the site.

The soil gas hydrocarbon distribution was fairly uniform and continuous along the access road across the center of the landfill. Additional small pockets of hydrocarbons were detected throughout the site without any apparent pattern. TCE was detected along the roadway just beyond the access point to the site. No other pockets of TCE were detected at the site.

4.2.4.2 Surface Soil Samples. Surface soil samples were collected during the supplemental RI activities at LF-023. The site was divided into four quadrants, as shown in Figure 4-12, and one sample was collected from each quadrant. Duplicate samples were collected from the southeast quadrant. The sample from each quadrant consisted of a grab sample submitted for TCL VOC analysis and a composite sample submitted for TCL SVOC, TAL inorganics, pesticide and PCB analysis. Locations of VOC grab samples were based on passive SOV survey results. Composite samples were collected from a grid with nodes at 100-foot intervals; each composite sample consisted of grab samples collected from 17 to 25 grid nodes. Composite samples were collected from 0 to 0.5 feet bgs and the VOC grab samples were collected at 0.5 feet bgs. The results of the laboratory analyses are presented in the following paragraphs. A summary of the analytical results is shown in Table 4-4.

> **Organics:** No VOCs were detected above detection limits in samples of LF-023 surface soils. SVOCs were detected in surface soil samples from quadrants SS-2 and SS-4. Seven SVOCs were detected in quadrant SS-2 (Sample SS-23-002), and 17 SVOCs were detected in quadrant SS-4 (Sample SS-23-004). Concentrations detected in quadrant SS-2 ranged from 370 to 1,000 μg/kg and concentrations in SS-4 ranged from 1,900 to

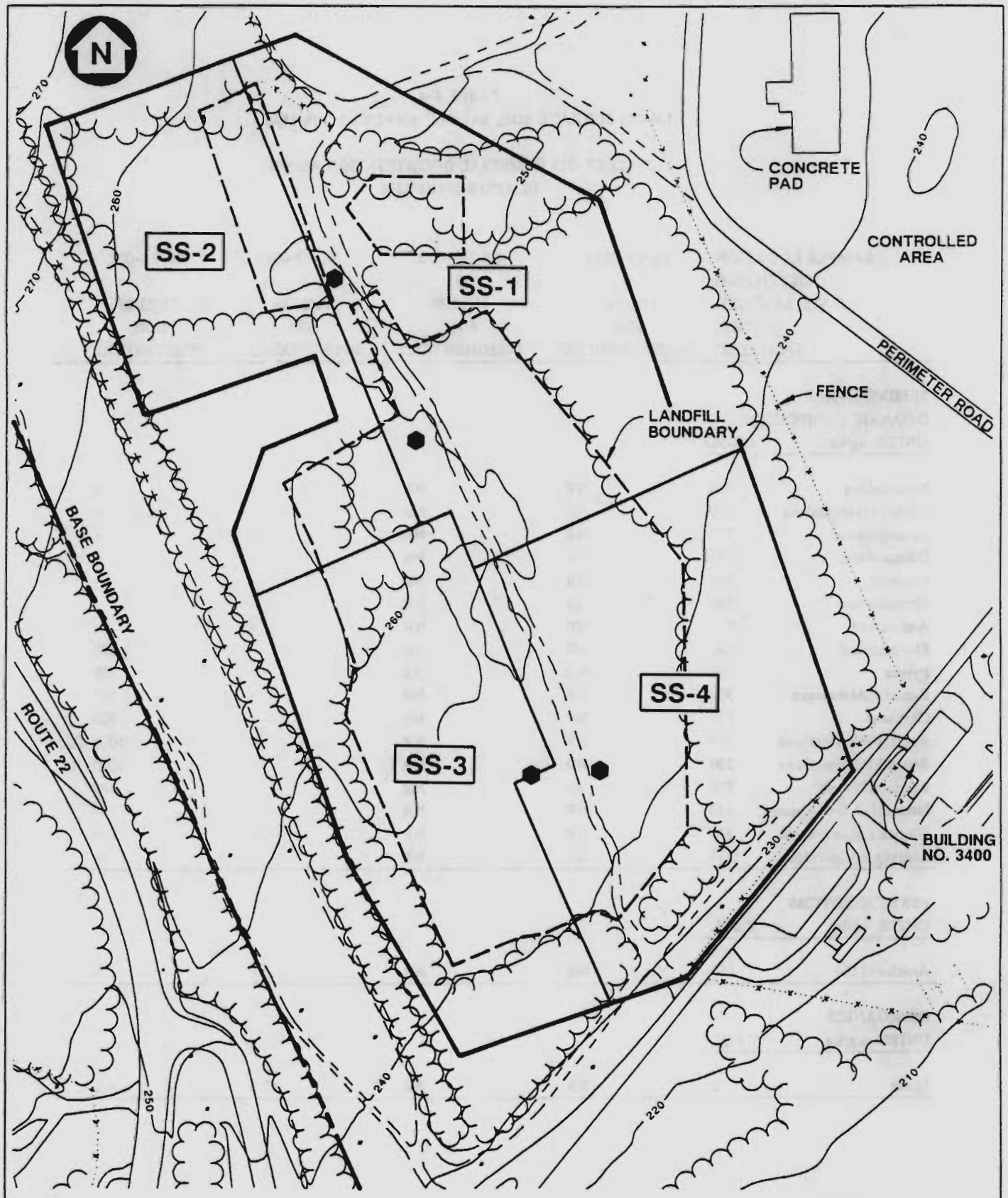


FIGURE 4-12
LF-023 SURFACE SOIL SAMPLE LOCATIONS
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
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TABLE 4-4
LF-023 SURFACE SOIL SAMPLE ANALYSIS SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		SS-23-001A	SS-23-001B	SS-23-001	SS-23-002	
DEPTH (feet):		0	0	0	0	
DATE SAMPLED:		11/03/89	11/03/89	11/03/89	11/03/89	
MATRIX:		SOIL	SOIL	SOIL	SOIL	
SAMPLE ID:		04SS001A0001XX	04SS001B0001XX	04SS0010001XX	04SS0020001XX	
SEMIVOLATILE ORGANIC COMPOUNDS						
UNITS: ug/kg	CRQL					
Naphthalene	330	NR	NR	-	-	
2-Methylnaphthalene	330	NR	NR	-	-	
Acenaphthene	330	NR	NR	-	-	
Dibenzofuran	330	NR	NR	-	-	
Fluorene	330	NR	NR	-	-	
Phenanthrene	330	NR	NR	-	-	
Anthracene	330	NR	NR	-	-	
Fluoranthene	330	NR	NR	-	370	
Pyrene	330	NR	NR	-	730	
Benzo(a)Anthracene	330	NR	NR	-	590	
Chrysene	330	NR	NR	-	620	
Benzo(b)Fluoranthene	330	NR	NR	-	1000	X
Benzo(k)Fluoranthene	330	NR	NR	-	1000	X
Benzo(a)Pyrene	330	NR	NR	-	840	
Indeno(1,2,3-cd)pyrene	330	NR	NR	-	-	
Dibenz(a,h)anthracene	330	NR	NR	-	-	
Benzo(g,h,i,)perylene	330	NR	NR	-	-	
PESTICIDES/PCBS						
UNITS: ug/kg	CRQL					
Aroclor-1254	160	NR	NR	-	-	
INORGANICS						
UNITS: mg/kg	CRQL					
Silver	2	NR	NR	12.8	4.2	

TABLE 4-4
(Continued)
LF-023 SURFACE SOIL SAMPLE ANALYSIS SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		SS-23-003	SS-23-004	SS-23-004
DEPTH (feet):		0	0	0
DATE SAMPLED:		11/03/89	11/03/89	11/03/89
MATRIX:		SOIL	SOIL	SOIL
SAMPLE ID:		04SS00300001XX	04SS00400001XX	04SS00400001DP
SEMIVOLATILE ORGANIC COMPOUNDS				
UNITS: ug/kg	CRQL			
Naphthalene	330	-	3800 J	-
2-Methylnaphthalene	330	-	2600 J	-
Acenaphthene	330	-	24000 JD	-
Dibenzofuran	330	-	13000 EJ	-
Fluorene	330	-	23000 JD	-
Phenanthrene	330	-	270000 JD	18000 J
Anthracene	330	-	47000 JD	4400 J
Fluoranthene	330	-	220000 JD	25000 J
Pyrene	330	-	190000 JD	21000 J
Benzo(a)Anthracene	330	-	62000 JD	11000 J
Chrysene	330	-	58000 JD	12000 J
Benzo(b)Fluoranthene	330	-	61000 JD	13000 JX
Benzo(k)Fluoranthene	330	-	61000 JD	13000 JX
Benzo(a)Pyrene	330	-	35000 JD	7400 J
Indeno(1,2,3-cd)pyrene	330	-	6500 EJ	2800 J
Dibenz(a,h)anthracene	330	-	3700 J	1900 J
Benzo(g,h,i,)perylene	330	-	5000 J	2700 J
PESTICIDES/PCBS				
UNITS: ug/kg	CRQL			
Aroclor-1254	160	-	220 J	-
INORGANICS				
UNITS: mg/kg	CRQL			
Silver	2	-	-	-

270,000 μg/kg. The SVOCs detected were PAHs, which are typical of waste fuel and fuel residue. Five SVOCs, including naphthalene and 2-methylnaphthalene, were only detected in one of the duplicate samples collected from quadrant SS-4. These five compounds are more mobile then the other PAHs detected in quadrant SS-4.

The PCB Aroclor 1254 was detected in only one of the surface soil duplicate samples from quadrant SS-4 at 220 μg/kg. The sample containing the PCBs was the same sample that had the highest concentrations of PAHs (a total of 1,000 parts per million [ppm]). It may be that PCBs were in waste oil spilled in that area of the landfill. The disparity between the PCB and PAH concentrations detected in the duplicate samples from quadrant SS-4 indicates that the distribution of PCBs and PAHs at the site is not homogeneous. No pesticides were detected in any surface soil samples.

Inorganics: Silver was the only inorganic compound detected in LF-023 surface soil samples at concentrations above background. Silver was detected at concentrations of 12.8 mg/kg in quadrant SS-1 (Sample SS-23-001) and 4.2 mg/kg in quadrant SS-2.

4.2.5 Groundwater

Groundwater samples were collected from all of the monitoring wells associated with LF-023 during the RI including three wells installed downgradient from the site (Figure 4-13). Aluminum, iron, manganese, potassium, vinyl chloride, chloroform, chlorobenzene, benzene, ethylbenzene, and xylenes were identified as site contaminants in the groundwater. Wells MW-23-004, MW-23-005, MW-23-007, MW-23-010, MW-23-012 and MW-23-013 are screened in the lower portion of the aquifer. The remaining wells (i.e., MW-23-001, MW-23-002, MW-23-003, MW-23-006, MW-23-008, MW-23-009, and MW-23-011) are screened across the water table. A summary of analytical results is presented in Table 4-5. SI sampling results for wells MW-23-001, MW-23-002, and MW-23-003 are included in Table 4-5 to show changes in water quality over time. The distribution of contaminants in LF-023 groundwater are discussed in detail in the following subsections.

4.2.5.1 Upgradient Monitoring Wells. One monitoring well, MW-23-002, was installed upgradient/side-gradient during the SI. Based on results from the SI, four additional monitoring wells (i.e, MW-23-004, MW-23-005, MW-23-006, and MW-23-007) were installed along the west side of LF-023 during the Supplemental

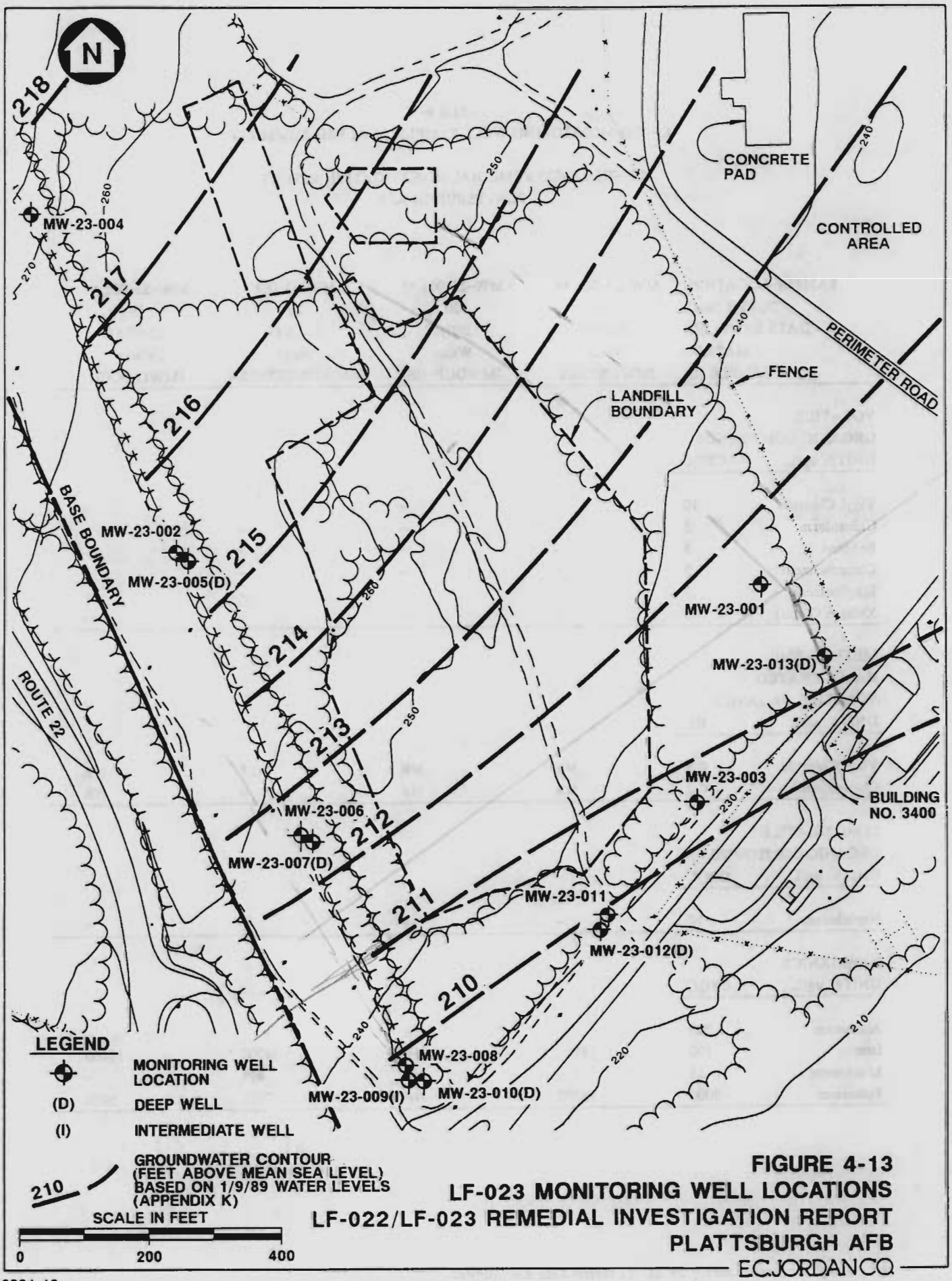


FIGURE 4-13
LF-023 MONITORING WELL LOCATIONS
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
E.C. JORDAN CO.

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TABLE 4-5
LF-023 MONITORING WELL SAMPLE ANALYSIS SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		MW-23-001 **	MW-23-001 **	MW-23-001	MW-23-002 **
DEPTH (feet):		20	20	20	39
DATE SAMPLED:		12/07/87	12/07/87	01/13/89	12/07/87
MATRIX:		Water	Water	Water	Water
SAMPLE ID:		JMW109XX01	JMWDUP-109	04MW109XXX02XX	JMW110XX01
VOLATILE ORGANIC COMPOUNDS					
UNITS: ug/L	CRQL				
Vinyl Chloride	10	-	-	-	-
Chloroform	5	-	-	-	-
Benzene	5	-	-	-	-
Chlorobenzene	5	-	-	-	-
Ethylbenzene	5	-	-	-	-
Xylenes (Total)	5	-	-	-	-
METHOD 8010 HALOGENATED VOLATILE ORGANICS					
UNITS: ug/L	RL				
Vinyl Chloride	0.3	NR	NR	0.8	NR
Chloroform	0.2	NR	NR	-	NR
SEMIVOLATILE ORGANIC COMPOUNDS					
UNITS: ug/L	CRQL				
Naphthalene	10	-	-	-	-
INORGANICS					
UNITS: ug/L	CRQL				
Aluminum	200	-	NR	-	-
Iron	100	18100	NR	14700	18400
Manganese	15	-	NR	895	-
Potassium	5000	15000	NR	7920	5020

** - Samples collected during the SI. SI results were not validated

TABLE 4-5
(Continued)
LF-023 MONITORING WELL SAMPLE ANALYSIS SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		MW-23-002 **	MW-23-002	MW-23-003 **	MW-23-003 **
DEPTH (feet):		39	39	22	22
DATE SAMPLED:		08/10/88	01/10/89	12/07/87	08/10/88
MATRIX:		Water	Water	Water	Water
SAMPLE ID:		JMW110XX21	04MW110XXX02XX	JMW111XX01	JMW111XX21
VOLATILE ORGANIC COMPOUNDS					
UNITS: ug/L	**CRQL**				
Vinyl Chloride	10	-	-	16	29
Chloroform	5	-	-	-	-
Benzene	5	-	-	13	-
Chlorobenzene	5	-	-	-	-
Ethylbenzene	5	-	-	35	-
Xylenes (Total)	5	-	-	63	8
METHOD 8010 HALOGENATED VOLATILE ORGANICS					
UNITS: ug/L	**RL**				
Vinyl Chloride	0.3	NR	-	NR	NR
Chloroform	0.2	NR	-	NR	NR
SEMIVOLATILE ORGANIC COMPOUNDS					
UNITS: ug/L	**CRQL**				
Naphthalene	10	NR	-	-	NR
INORGANICS					
UNITS: ug/L	**CRQL**				
Aluminum	200	NR	-	-	NR
Iron	100	NR	143 J	29200	NR
Manganese	15	NR	-	-	NR
Potassium	5000	NR	-	32100	NR

** - Samples collected during the SI. SI results were not validated

TABLE 4-5
(Continued)
LF-023 MONITORING WELL SAMPLE ANALYSIS SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		MW-23-003	MW-23-004 **	MW-23-004	MW-23-005 **
DEPTH (feet):		22	85	85	72
DATE SAMPLED:		01/13/89	08/10/88	01/10/89	08/10/88
MATRIX:		Water	Water	Water	Water
SAMPLE ID:		04MW111XXX02XX	JMW201XX21	04MW201XXX02XX	JMW202XX21
VOLATILE ORGANIC COMPOUNDS					
UNITS: ug/L	CRQL				
Vinyl Chloride	10	31	-	-	-
Chloroform	5	-	-	-	15
Benzene	5	14	-	-	-
Chlorobenzene	5	-	-	-	-
Ethylbenzene	5	13	-	-	-
Xylenes (Total)	5	72	-	-	-
METHOD 8010 HALOGENATED VOLATILE ORGANICS					
UNITS: ug/L	RL				
Vinyl Chloride	0.3	17	NR	-	NR
Chloroform	0.2	-	NR	-	NR
SEMIVOLATILE ORGANIC COMPOUNDS					
UNITS: ug/L	CRQL				
Naphthalene	10	-	-	-	-
INORGANICS					
UNITS: ug/L	CRQL				
Aluminum	200	-	NR	-	NR
Iron	100	31700	NR	230 J	NR
Manganese	15	176	NR	110	NR
Potassium	5000	28500	NR	-	NR

** - Samples collected during the SI. SI results were not validated

TABLE 4-5
(Continued)
LF-023 MONITORING WELL SAMPLE ANALYSIS SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		MW-23-005	MW-23-006 **	MW-23-006	MW-23-007 **
DEPTH (feet):		72	35	35	67
DATE SAMPLED:		01/10/89	08/10/88	01/10/89	08/10/88
MATRIX:		Water	Water	Water	Water
SAMPLE ID:		04MW202XXX02XX	JMW203XX21	04MW203XXX02XX	JMW204XX21
VOLATILE ORGANIC COMPOUNDS UNITS: ug/L	CRQL				
Vinyl Chloride	10	-	-	-	-
Chloroform	5	-	-	-	-
Benzene	5	-	-	-	-
Chlorobenzene	5	-	-	-	-
Ethylbenzene	5	-	-	-	-
Xylenes (Total)	5	-	-	-	-
METHOD 8010 HALOGENATED VOLATILE ORGANICS UNITS: ug/L	RL				
Vinyl Chloride	0.3	-	NR	-	NR
Chloroform	0.2	-	NR	-	NR
SEMIVOLATILE ORGANIC COMPOUNDS UNITS: ug/L	CRQL				
Naphthalene	10	-	-	-	-
INORGANICS UNITS: ug/L	CRQL				
Aluminum	200	-	NR	-	NR
Iron	100	218 J	NR	104 J	NR
Manganese	15	183	NR	-	NR
Potassium	5000	-	NR	-	NR

** - Samples collected during the SI. SI results were not validated

TABLE 4-5
(Continued)
LF-023 MONITORING WELL SAMPLE ANALYSIS SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		MW-23-007	MW-23-008 **	MW-23-008	MW-23-009 **
DEPTH (feet):		67	25	25	37
DATE SAMPLED:		01/10/89	08/10/88	01/11/89	08/10/88
MATRIX:		Water	Water	Water	Water
SAMPLE ID:		04MW204XXX02XX	JMW205XX21	04MW205XXX02XX	JMW206XX21
VOLATILE ORGANIC COMPOUNDS UNITS: ug/L	CRQL				
Vinyl Chloride	10	-	-	-	-
Chloroform	5	-	-	-	19
Benzene	5	-	-	-	-
Chlorobenzene	5	-	-	-	-
Ethylbenzene	5	-	-	-	-
Xylenes (Total)	5	-	-	-	-
METHOD 8010 HALOGENATED VOLATILE ORGANICS UNITS: ug/L	RL				
Vinyl Chloride	0.3	-	NR	-	NR
Chloroform	0.2	-	NR	-	NR
SEMIVOLATILE ORGANIC COMPOUNDS UNITS: ug/L	CRQL				
Naphthalene	10	-	-	-	-
INORGANICS UNITS: ug/L	CRQL				
Aluminum	200	-	NR	-	NR
Iron	100	103 J	NR	111 J	NR
Manganese	15	72	NR	342	NR
Potassium	5000	-	NR	-	NR

** - Samples collected during the SI. SI results were not validated

TABLE 4-5
(Continued)
LF-023 MONITORING WELL SAMPLE ANALYSIS SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		MW-23-009 **	MW-23-009	MW-23-010 **	MW-23-010
DEPTH (feet):		37	37	53	53
DATE SAMPLED:		08/10/88	01/11/89	08/10/88	01/11/89
MATRIX:		Water	Water	Water	Water
SAMPLE ID:		JMW206XX22	04MW206XXX02XX	JMW207XX21	04MW207XXX02XX
VOLATILE ORGANIC COMPOUNDS UNITS: ug/L	CRQL				
Vinyl Chloride	10	-	-	-	-
Chloroform	5	-	-	11	16
Benzene	5	-	-	-	-
Chlorobenzene	5	-	-	-	-
Ethylbenzene	5	-	-	-	-
Xylenes (Total)	5	-	-	-	-
METHOD 8010 HALOGENATED VOLATILE ORGANICS UNITS: ug/L	RL				
Vinyl Chloride	0.3	NR	-	NR	-
Chloroform	0.2	NR	-	NR	10
SEMIVOLATILE ORGANIC COMPOUNDS UNITS: ug/L	CRQL				
Naphthalene	10	-	-	-	-
INORGANICS UNITS: ug/L	CRQL				
Aluminum	200	NR	-	NR	-
Iron	100	NR	475 J	NR	603 J
Manganese	15	NR	19	NR	169
Potassium	5000	NR	5770	NR	12900

** - Samples collected during the SI. SI results were not validated

TABLE 4-5
(Continued)
LF-023 MONITORING WELL SAMPLE ANALYSIS SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		MW-23-011	MW-23-012	MW-23-013	MW-23-013
DEPTH (feet):		24	60	61	61
DATE SAMPLED:		01/13/89	01/13/89	01/13/89	01/13/89
MATRIX:		Water	Water	Water	Water
SAMPLE ID:		04MW325XXX01XX	04MW326XXX01XX	04MW327XXX01XX	04MW327XXX01XD
VOLATILE ORGANIC COMPOUNDS					
UNITS: ug/L	CRQL				
Vinyl Chloride	10	-	-	-	-
Chloroform	5	-	-	-	-
Benzene	5	10	-	-	-
Chlorobenzene	5	10	-	-	-
Ethylbenzene	5	54	-	-	-
Xylenes (Total)	5	43	-	-	-
METHOD 8010 HALOGENATED VOLATILE ORGANICS					
UNITS: ug/L	RL				
Vinyl Chloride	0.3	3.2	-	-	-
Chloroform	0.2	-	0.4	-	0.5
SEMIVOLATILE ORGANIC COMPOUNDS					
UNITS: ug/L	CRQL				
Naphthalene	10	11	-	-	-
INORGANICS					
UNITS: ug/L	CRQL				
Aluminum	200	367	662	-	-
Iron	100	47100	1260	242	164 J
Manganese	15	385	152	150	149
Potassium	5000	40000	-	-	-

** - Samples collected during the SI. SI results were not validated

SI (see Figure 4-13). The Supplemental SI monitoring wells were installed to further assess the direction of groundwater flow, and to determine if contaminants found during the SI were being transported off-base towards nearby residential wells. The analytical results for the samples from these wells were used to establish the background concentrations for compounds in groundwater at the site. Results of the laboratory analyses are presented in the following paragraphs.

Organics: 2-Butanone was detected at 160 μg/L in a sample collected from MW-23-002 during the Supplemental SI but it was not detected in samples collected from the well during the SI or RI. Because MW-23-002 is upgradient from the site the 2-butanone detected is not site related. There is no pattern over time, therefore, the 2-butanone detected during the Supplemental SI may be a result of laboratory or field contamination and may not represent a source upgradient from the site. BEHP was detected at 14 μg/L in MW-23-002 during the RI but was not detected in either of the previous samples. Because MW-23-002 is upgradient from the site, the BEHP is not site-related. The BEHP may also be a result of laboratory or field contamination, because it was not detected during the SI or Supplemental SI. No pesticides or PCBs were detected in MW-23-002 during the SI.

Chloroform was detected in MW-23-005 only during the Supplemental SI and may also represent laboratory or field contamination.

Inorganics: Potassium was detected in MW-023-010 at a concentration of 12,900 μg/L, which is above naturally occurring concentrations (10,000 μg/L: Dragun 1988).

4.2.5.2 Downgradient Wells. Two downgradient monitoring wells, MW-23-001 and MW-23-003, were installed during the SI. Three downgradient wells, MW-23-008, MW-23-009, and MW-23-010, were installed during the Supplemental SI. Three downgradient wells, MW-23-011, MW-23-012, and MW-23-013, were installed during the RI. Locations of these monitoring wells are shown in Figure 4-13. Results of the laboratory analyses are presented in Table 4-5 and are evaluated below. Groundwater samples were collected from all eight downgradient monitoring wells and analyzed for TCL VOCs, TCL SVOCs, USEPA SW-846 Method 8010, and TAL inorganics during the RI.

Organics: Acetone (170 micrograms per liter [μg/L]) was reported in MW-23-008 during the Supplemental SI sampling event. Results from the

analyses were not validated and acetone was not reported in the RI sampling of the same well. Acetone was not detected in any other well at LF-023. Therefore, it has been attributed to laboratory contamination. 2-Butanone and chloroform, both common laboratory contaminants, were detected sporadically in several of the wells. Chloroform was detected in MW-23-010 during both the Supplemental SI and the RI. Because it was detected at similar concentrations in both rounds, including a sample analyzed by Method 8010, chloroform is considered a site contaminant. However, chloroform was not detected in MW-23-008, and only in one of the duplicate samples collected from MW-23-009 during the Supplemental SI. Using Method 8010, chloroform was detected at 0.4 μg/L in MW-23-012 and at 0.5 μg/L in one of the duplicate samples collected from MW-23-013. These concentrations are below the CRQL for Contract Laboratory Program (CLP) volatile organic analyses (VOA) and were not confirmed by either a second GC/MS identification. From the data it appears that chloroform is a site contaminant at MW-23-010, but may be a laboratory or sampling artifact at the other wells.

2-Butanone was detected sporadically in groundwater samples. Wells MW-23-008 through MW-23-010 were sampled and analyzed during the Supplemental SI and the RI; 2-butanone was not detected consistently in any well. For that reason, 2-butanone is considered a sampling or laboratory artifact in those wells. MW-23-012 and MW-23-013 were only sampled during the RI. 2-Butanone was estimated at 48 μg/L in the sample collected from MW-23-012. Duplicate samples were collected from MW-23-013, and 2-butanone was estimated at 23 and 24 μg/L. There are insufficient data to determine if the 2-butanone detected in samples from MW-23-012 and MW-23-013 is site-related.

Vinyl chloride was detected in three monitoring wells (i.e., MW-23-001, MW-23-003, and MW-23-011) at concentrations ranging from 0.8 to 31 μg/L. Benzene, (10 to 14 μg/L), ethylbenzene (13 to 54 μg/L), and total xylenes (8 to 72 μg/L) were detected at low concentrations in samples from wells MW-23-003 and MW-23-011. Chlorobenzene was detected in MW-23-011 at a concentration of 10 μg/L. Several volatile halogenated organic compounds were detected in MW-23-003 and MW-23-011 using USEPA SW-846 Method 8010, a low detection limit, GC method. Chloroethane (0.7 μg/L), 1,1-dichloroethane (0.6 μg/L), and 1,2-dichloroethane (0.5 μg/L) were detected in MW-23-003 with this method. The identities of these compounds

was not confirmed with a second GC column or MS method and the concentrations are below the CLP CRQL. Vinyl chloride was detected by CLP methods in the sample from MW-23-003. The confirmed presence of vinyl chloride indicates that chloroethane, 1,1-dichloroethane, and 1,2-dichloroethane could be present; however, these compounds have not been identified as contaminants because of the tentative nature of their identification, their low concentrations, and the fact that they were detected only once. Based on the results of these investigations, vinyl chloride, chloroform, chlorobenzene, benzene, ethylbenzene, and total xylenes were identified as site contaminants.

Only two SVOCs were reported above the CRQL in the groundwater at LF-023. Naphthalene (11 μg/L) was detected in MW-23-011. Because naphthalene has been detected in the surface soil and is not usually present in groundwater samples as a laboratory or field contaminant, it has been identified as a site contaminant. BEHP was detected in MW-23-003 (26 μg/L), MW-23-010 (13 μg/L), and MW-23-013 (11 μg/L) during the RI but was not detected in MW-23-003 or MW-23-010 during previous sampling episodes. Because BEHP was detected at similar concentrations in an upgradient well during the RI, it is believed to be a result of sampling or laboratory contamination. BEHP is not considered a site contaminant. No pesticides or PCBs were detected in samples collected from MW-23-001 and MW-23-003.

No pesticides or PCBs were detected in the water samples collected from MW-23-001 or MW-23-003 during the SI and the Supplemental SI. Groundwater samples collected during the RI were not analyzed for pesticides and PCBs.

Inorganics: Aluminum, iron, manganese, and potassium have been identified as potential site contaminants in groundwater samples. Magnesium, calcium, and zinc were detected at concentrations above background, concentrations did not exceed New York State Class GA groundwater standards or Drinking Water Standards. Arsenic was also detected in two downgradient wells at concentrations above background, but below New York State standards.

4.2.6 Surface Water and Sediment

Two surface water and sediment samples were collected approximately 600 feet south of LF-023 during the RI activities (Figure 4-14). These samples were obtained to determine if contaminants have been transported with groundwater and are discharging through seeps in this area. Additional surface water samples were collected from the stream, which is south of LF-023 and west of the Perimeter Road. However, contaminants detected in samples from the stream have been linked to the FT-002 dissolved plume (ABB Environmental Services, Inc., 1991). All the surface water and sediment samples obtained were analyzed for TCL VOCs, TCL SVOCs, TAL inorganics, and PHCs. In addition, all the sediment samples obtained were analyzed for total organic compounds. Duplicate samples were collected from the SW-23-002 and SD-23-002 locations. Based on the results of this investigation, aluminum, arsenic, iron, and zinc have been identified as site contaminants in the surface water. The sediment contaminants are PHCs. The results of the laboratory analyses are presented in the following paragraphs. A summary of the analytical results is shown in Table 4-6.

Organics: No VOCs or SVOCs were reported above the CRQL for any of the surface water or sediment samples collected.

PHCs were not detected in the surface water samples but were detected in the sediment samples at concentrations ranging from 550 to 1,400 mg/kg.

Total Organic Carbon was detected in the sediment samples at concentrations ranging from 19,000 to 210,000 mg/kg. This indicates a high concentration of organic matter and organic carbon in the sediments.

Inorganics: Calcium, iron, magnesium, manganese, and sodium were detected in all the surface water samples. Aluminum, arsenic, barium, lead, and zinc were detected in the samples from SW-23-002. Based on ambient water quality criteria, aluminum (ranging from 1,800 to 2,180 μg/L), arsenic (ranging from 255 to 376 μg/L), iron (4,700 to 792,000 μg/L), and zinc (ranging from 303 to 407 μg/L) were identified as site contaminants. Lead was not identified as a site contaminant because it was detected in one of the duplicate samples from SW-23-002 and was not detected in any of the wells located between LF-023 and the seep. Ambient water quality criteria were not available for barium, calcium, magnesium, manganese, or sodium. Surface water samples were not filtered, therefore, the some of the inorganics

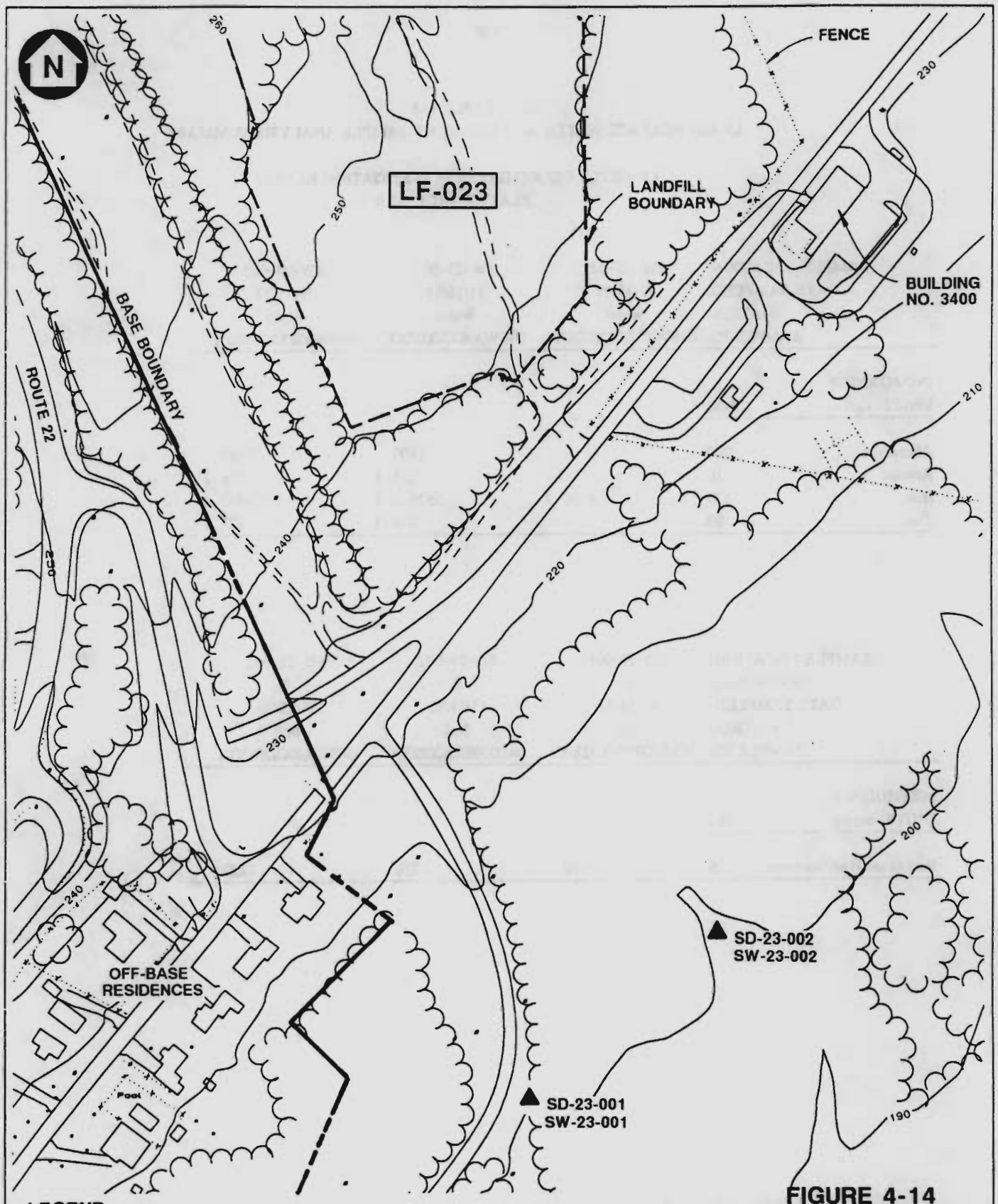


FIGURE 4-14
LF-023 SURFACE WATER/SEDIMENT SAMPLE LOCATIONS
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

ECJORDANCO

6091-10

TABLE 4-6
LF-023 SURFACE WATER AND SEDIMENT SAMPLE ANALYSIS SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		SW-23-001	SW-23-002	SW-23-002
DATE SAMPLED:		11/18/88	11/18/88	11/18/88
MATRIX:		Water	Water	Water
SAMPLE ID:		04SW307XXX02XX	04SW308XXX02XX	04SW308XXX02DX
INORGANICS				
UNITS: ug/L	CRQL			
Aluminum	200	-	1800	2180
Arsenic	10	-	255 J	376 J
Iron	100	4700 J	552000 J	792000 J
Zinc	20	-	303 J	407 J

SAMPLE LOCATION:		SD-23-001	SD-23-002	SD-23-002
DEPTH (feet):		0	0	0
DATE SAMPLED:		11/18/88	11/18/88	11/18/88
MATRIX:		Soil	Soil	Soil
SAMPLE ID:		04SD307XXX02XX	04SD308XXX02XX	04SD308XXX02DX
METHOD 418.1				
UNITS: mg/kg	DL			
Petroleum Hydrocarbons	25	550	750	1400

detected in the surface water samples may reflect inorganics sorbed to suspended particles.

No inorganics were detected above background concentrations in sediment samples.

4.2.7 Air

An extensive air monitoring survey was not conducted at LF-023. For health and safety reasons, PIDs were used to monitor the air in the vicinity of explorations during the SI and RI. No impacts on air quality were detected by the health and safety monitoring. Modeling techniques were used to evaluate the impacts that contaminants in the soil may have on air quality. The results of the modeling are presented in Subsection 4.3.6.

4.3 CONTAMINANT FATE AND TRANSPORT

This subsection describes the probable fate of contaminants identified at the LF-023 site. Contaminant fate will vary with respect to numerous factors, some which are properties of the contaminants and others that are site dependent. Both general information about site contaminants and specific site-related conditions are presented in the following paragraphs. The transport of contaminants at the site is described in relation to the various potential migration pathways (e.g., surface runoff, infiltration, and groundwater migration). The contaminants at former landfill LF-023 are distributed in the surface soils, the wastes that were deposited in the landfill, and the groundwater at the site.

4.3.1 Migration Pathways

Migration pathways are determined by both the physical characteristics of the site and the types of contaminants identified at the site. Potential migration pathways at LF-023 include: surface water runoff (including soil erosion), precipitation percolating through the soil, groundwater, and air (including wind erosion). The potential migration pathways are described in the following subsections with respect to media.

4.3.1.1 Surface Soils. Surface runoff and soil erosion are available mechanisms of transport for surface soil contaminants identified at the site. The group of SVOCs

detected in the surface soils, along with Aroclor 1254, all exhibit low solubilities and strong sorption characteristics. Mechanical transport is the primary mechanism for movement of these compounds in the surface soils.

Another potential migration pathway for contaminants at the landfill is volatilization from the surface and subsurface soils in the unsaturated zone. The processes of infiltration and volatilization are expected to be ongoing in the landfill depending on the contaminants' characteristics (e.g., solubilities, sorption, and vapor pressure).

4.3.1.2 Wastes. Infiltration of precipitation is expected to continue leaching contaminants from the waste materials in the landfill. While only one compound, 1,2-dichlorobenzene, was identified as a contaminant in the waste materials, the limited nature of the subsurface investigation, along with the presence of other contaminants in the groundwater, indicate that the waste materials represent a continuing source of contamination.

4.3.1.3 Groundwater. The primary migration pathway for subsurface contaminants at LF-023 is transport of VOCs and inorganics via groundwater. In addition, groundwater seeps adjacent to the site may be a source to surface water contamination. Three chlorinated solvents, vinyl chloride, chloroform, and chlorobenzene, were detected in the groundwater downgradient and adjacent to the site. In addition, three fuel-related VOCs, benzene, ethylbenzene, and xylene, along with one fuel-related SVOC, naphthalene, were detected in the groundwater. Four metals, aluminum, iron, manganese, and potassium, also had reported values above background concentrations or applicable standards.

4.3.1.4 Surface Water and Sediments. Surface water and sediment samples were collected from seeps adjacent to the site where groundwater is discharged at the surface. The sediment samples contained PHCs, while the unfiltered surface water samples contained aluminum, arsenic, iron, and zinc, at concentrations exceeding surface water criteria. Surface runoff and soil erosion are potential migration pathways for the transport of contaminants in the sediments and surface waters.

4.3.2 Fate and Transport of Contaminants in the Waste Material

The distribution of contaminants within the waste material is not known. The presence of chlorinated solvents, both in the wastes and the groundwater, fuel-related solvents, and metals indicates that the migration of contaminants from the waste

materials to the groundwater is occurring. However, the only compound identified in the wastes as a contaminant was the SVOC, 1,2-dichlorobenzene.

SVOCs. 1,2-dichlorobenzene, was detected in the waste materials during SI test pit operations in the fall of 1987. Dichlorobenzenes are chlorinated solvents that were known to be present at the base (i.e., past storage of mixed dichlorobenzenes at Building 2774).

Uses. The major use of 1,2-dichlorobenzene is in organic synthesis; however, solvent applications account for 8 percent of its use (Arthur D. Little, Inc., 1985). These applications include cleaning and polishing formulations, fumigant and insecticide, industrial odor control, and the carrier solvent for wood preservatives (Verschueren, 1983; Arthur D. Little, Inc., 1985).

Probable Fate and Transport. 1,2-dichlorobenzene was only detected at one location and is not considered a major source of contamination at the landfill. 1,2-dichlorobenzene is moderately soluble (100,000 μg/L at 20°C; Verschueren, 1983) and is expected to migrate downward with rainwater infiltration. 1,2-dichlorobenzene in the wastes may undergo biodegradation; however, this process is expected to be slow as compared to infiltration and dispersion in the groundwater. Chlorobenzene, a possible transformation product of 1,2-dichlorobenzene was detected downgradient of the landfill in the groundwater. In addition, volatilization followed by photolysis is expected to occur for the 1,2-dichlorobenzene in the near surface soils (Arthur D. Little, Inc., 1985). Table 4-7 contains a listing of the chemical properties of 1,2-dichlorobenzene. Appendix M contains an environmental profile for 1,2-dichlorobenzene.

4.3.3 Fate and Transport of Contaminants in the Surface Soils

SVOCs, PCBs, and silver were identified as site contaminants at LF-023. The SVOCs were detected in composite samples collected during the fall of 1989 and the values may range into the hundreds of ppm. One PCB, Aroclor 1254, was also detected in a composite sample collected during the fall of 1989. Silver was detected above background concentrations in two of the composite samples.

4.3.3.1 SVOCs. The SVOCs identified in the surface soils at LF-023 were primarily PAHs. The contaminated surface soils were collected from 15 to 18 grid node composites located in sample grid quadrants SS-2 and SS-4. The PAHs are described

TABLE 4-7
CHEMICAL PROPERTIES OF ORGANIC CONTAMINANTS AT LF-023

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AIR FORCE BASE

COMPOUND DETECTED	WATER SOLUBILITY (mg/L)	K_{oc} (mg/L)	log K_{ow}	HENRY'S CONSTANT (atm*m^3/mole)	VAPOR PRESSURE (mm Hg@20°C)	BCF[1] (L/kg)	SOURCE
Naphthalene	3.17E+01	962	3.30	4.82E-04	5.3E-02	44[3]	2
2-Methylnaphthalene[5]							
Acenaphthene	3.42E+00	4,600	4.00	9.20E-05	1.55E-03	--	USEPA, 1986b
Dibenzofuran[5]							
Fluorene	1.69E+00	7,300	4.20	6.42E-05	7.10E-04	1300	USEPA, 1986b
Phenanthrene	1.00E+00	14,000	4.46	1.59E-04	6.80E-04	2630	USEPA, 1986b
Anthracene	4.50E-02	14,000	4.45	1.02E-03	1.95E-04	--	USEPA, 1986b
Fluoranthene	2.06E-01	38,000	4.90	6.46E-06	5.00E-06	1150	USEPA, 1986b
Pyrene	1.32E-01	38,000	4.88	5.04E-06	2.50E-06	--	USEPA, 1986b
Benzo(a)anthracene	5.70E-031	380,000	5.60	1.16E-06	2.20E-08	--	USEPA, 1986b
Chrysene	1.80E-0	3,200,000	5.61	1.05E-06	6.30E-09	--	USEPA, 1986b
Benzo(b)fluoranthene	1.40E-02	550,000	6.06	1.19E-05	5.00E-07	--	USEPA, 1986b
Benzo(k)fluoranthene	4.30E-03	550,000	6.06	3.94E-05	5.10E-07	--	USEPA, 1986b
Benzo(a)pyrene	1.20E-03	5,500,000	6.06	1.55E-06	5.60E-09	--	USEPA, 1986b
Indeno(1,2,3-cd)pyrene	5.30E-04	1,600,000	6.50	6.86E-08	1.00E-10	--	USEPA, 1986b
Dibenz(a,h)anthracene	5.00E-04	3,300,000	6.80	7.33E-08	1.00E-10	--	USEPA, 1986b
Benzo(g,h,i)perylene	7.00E-04	1,600,000	6.51	5.34E-08	1.03E-10	--	USEPA, 1986b
Benzene	1.75E+03	83	2.12	5.59E-03	9.52E+01	5.2	USEPA, 1986b

TABLE 4-7
(Continued)
CHEMICAL PROPERTIES OF ORGANIC CONTAMINANTS AT LF-023

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AIR FORCE BASE

COMPOUND DETECTED	WATER SOLUBILITY (mg/L)	K_{oc} (mg/L)	log K_{ow}	HENRY'S CONSTANT (atm*m^3/mole)	VAPOR PRESSURE (mm Hg@20°C)	BCF[1] (L/kg)	SOURCE
Chlorobenzene	4.66E+02	330	2.84	3.72E-03	1.17E+01	10	USEPA, 1986b
Chloroform	8.20E+03	31	1.97	2.87E-03	1.51E+02	3.75	USEPA, 1986b
1,2-dichlorobenzene	1.00E+02	1,700	3.60	1.93E-03	1.00E+00	56	USEPA, 1986b
Ethylbenzene	1.52E+02	1,100	3.15	6.43E-03	7.00E+00	37.5	USEPA, 1986b
Vinylchloride	2.67E+03	57	1.38	8.19E-02	2.66E+03	1.17	USEPA, 1986b
Xylene(mixed)	1.98E+02	240	3.26	7.04E-03	1.00E+01	--	USEPA, 1986b
Aroclor1254	3.00E-03	--	--	--	6.8E-06[4]	--	
ERICKSON, 1986							

NOTES:

[1] Bioaccumulation Factor in fish unless otherwise noted.

[2] Arthur D. Little, Inc., 1985.

[3] Blue mussel

[4] 2,3,3'4' - pentachlorobiphenyl

[5] No data available

below as a general contaminant group. The surface soil composite from sample grid quadrant SS-2 had six PAH contaminants, four of which, are carcinogenic. The soil composite from quadrant SS-4 has 16 PAHs, seven of which are carcinogenic. Quadrant SS-2's worst case scenario could potentially consist of a total contaminant concentration of 18 ppm (18 nodes at 1 ppm). Quadrant SS-4's worst-case scenario could potentially consist of a total contaminant concentration of approximately 2,600 ppm (18 nodes at 144 ppm). Table 4-7 lists the chemical properties of the PAHs detected at the landfill. Appendix M contains the environmental profile for PAHs.

General. The PAHs generally refer to hydrocarbons containing two or more fused benzene rings. These compounds are most commonly formed during the incomplete combustion of organic material. These compounds are found in municipal and industrial wastes, urban and surface runoff, ash, and various man-made products, including crude oil products, wood preservatives, paints, sealants, roofing materials, and asphalt. These compounds detected at LF-023 contain two to six rings. As the number of rings increase, the solubility and vapor pressure characteristics decrease, and the Kow values increase (see Table 4-7).

There are 17 PAHs on the USEPA TCL. Included in this group are several compounds that were listed by USEPA as carcinogenic (USEPA, 1986b). Naphthalene is the only noncarcinogenic PAH evaluated by USEPA and assigned a risk criterion for health effects evaluation. Benzo(a)pyrene is recognized as the only PAH with sufficient data to support a human carcinogenic risk. Seven other PAHs are suspected or potential carcinogens: benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(a)pyrene.

Uses. A few of the simpler PAHs are produced commercially. Naphthalene is a common component of fuels (e.g., JP-4) and is used in several chemical manufacturing processes to produce mothballs, pesticides, dyes, wetting agents, synthetic resins, cutting fluids, solvents, and lubricants. Commercial uses of other PAHs, such as anthracene, acenaphthene, and phenanthrene, are minor and limited to dye and plastics manufacturing. PAHs are most commonly associated with fossil fuel sources and incomplete combustion.

Natural Occurrence. PAHs are synthesized by some bacteria, plants, and fungi, and are released by natural processes, such as forest and grass fires and natural oil seeps. However, it is generally accepted that the activity of man

is responsible for the majority of PAHs released to the environment. Near urban and industrial areas, sediment profiles suggest an increase in background PAH levels that correspond to human use of fossil fuels. Background levels of PAHs are believed to result from atmospheric deposition of incomplete combustion of fuels.

Probable Fate and Transport. The ultimate fate of PAHs released to the environment is sorption to soils followed by gradual biodegradation. Other processes such as volatilization, hydrolysis, and photolysis are not as important. PAHs accumulate in plants and animals and this tendency increases with increased molecular weight. The surface soils may act as long-term reservoirs of PAHs, and there may be significant movement of PAH contamination, which is sorbed to suspended sediments, during periods of surface runoff.

Under current conditions at the landfill, the PAH's are expected to remain sorbed to the surface soils. Leaching due to the infiltration of rainwater is not expected to occur due to the high sorption properties for these compounds. While biodegradation is the primary fate for PAHs, this process is expected to be extremely slow (Arthur D. Little, Inc., 1985). As a result of the stability of these compounds and the time available for the process of mechanical transport to occur, the PAHs represent a continuing source of surface soil contamination that may migrate with surface water runoff.

4.3.3.2 PCBs. One PCB, Aroclor 1254, was detected in the surface soils. PCBs were marketed under the trade name Aroclor, a name which has carried over into the analysis and reporting of PCBs. Aroclor 1254 actually represents a group of PCB congeners with an average chlorine content of 54 percent.

General. PCBs represent a group of compounds that can contain from one to ten chlorine atoms in a variety of combinations (209 possible congeners). The higher the number of chlorine atoms, the lower the solubility and volatility, and the greater the propensity to sorb to organic matter and resist biodegradation. Aroclor 1254 falls within this category and is very stable in the environment. Table 4-7 lists some of the chemical properties of Aroclor 1254 and Appendix K contains an environmental profile for PCBs.

Uses. PCBs were produced for a variety of uses, including dielectric fluids in transformers, printing inks, paints, and pesticides (Erickson, 1986).

Probable Fate and Transport. PCBs are very stable in the environment, resist biodegradation, and bioaccumulate in the fat tissue of animals. The occurrence of PCBs in the environment is widespread. PCBs are transported by air, water, snow, fish, and birds, resulting in a fairly uniform global background (Erickson, 1986).

The congeners of Aroclor 1254 are expected to sorb strongly to the surface soils at the landfill. The PCBs are not expected to leach significantly with the rainwater into the subsurface soils. Similar to the SVOCs, the PCBs are expected to migrate via mechanical transport.

Biodegradation and volatilization, while extremely slow, are expected to be the primary fates for the PCB congeners. The rate and degree of both mechanisms are dependent on the amount and positions of the chlorine atoms on the biphenyl rings.

4.3.3.3 Inorganics. Silver was identified in the surface soils above the background concentration. The presence of silver may be related to wastes disposed of at the landfill or as a component in the materials used to cover the wastes.

General. The silver detected in the surface soils was not detected in the waste material or the groundwater above New York State drinking water standards.

The primary use of silver is in the photography industry (used in film manufacture). Silver is also used to make batteries, eating utensils, and jewelry.

Table 3-7 lists the predominant species, the uses, and the probable fate and transport of silver at the landfill. Appendix M contains the environmental profile for silver.

4.3.4 Fate and Transport of Contaminants in the Groundwater

Four chlorinated solvents, vinyl chloride, chloroethane, 1,1-dichloroethene, and chlorobenzene were identified as site contaminants in groundwater. In addition, three fuel-related solvents, benzene, ethylbenzene, and xylene, were also identified as site contaminants in the groundwater. Four elements, aluminum, iron, manganese,

and potassium, were detected at concentrations exceeding applicable standards and are considered site contaminants.

4.3.4.1 Chlorinated Solvents. Three VOCs, vinyl chloride, chloroform, and chlorobenzene, were detected in groundwater at LF-023. These halogenated VOCs are described below as a general contaminant group. Table 4-7 lists the chemical properties of the VOCs detected at the landfill. Appendix M contains environmental profiles for the chlorinated VOCs.

Uses. The major uses of this group of chemicals are industrial solvents for a variety of processes including the manufacturing of PVC and other polymers, as chemical intermediates, decreasing agents, industrial solvent in pesticide production, manufacturing of copolymers for household food wraps and paper coatings for food packages (Arthur D. Little, Inc., 1985).

Probable Fate and Transport. These chlorinated solvents are likely to persist in groundwater. These compounds may volatilize from the groundwater, are weakly adsorbed on soils, and are unlikely to bioaccumulate. Based on solubilities and K_{oc}s, vinyl chloride is expected to be the most mobile in the groundwater followed by chloroform, and chlorobenzene (see Table 4-7). These tendencies, therefore, would suggest whatever solvent is not adsorbed on the soils or volatilized would mobilize to the groundwater (Arthur D. Little, Inc., 1985).

The relatively high solubilities, 466 mg/L for chlorobenzene to 2,670 mg/L for vinyl chloride, low Henry's Law constants, and low K_{oc} values (see Table 4-7) indicate that those solvents already present in the groundwater are expected to migrate in the groundwater by dispersion and diffusion (Arthur D. Little, Inc., 1985). While some of these compounds have high vapor pressures (an indication of volatility), the depth to groundwater along with the relatively high solubilities decreases the likelihood that these compounds will partition and volatilize into the soil pore spaces. For the VOCs that may be present in the near surface soils volatilization is expected to be the predominant migration pathway.

Vinyl chloride is a possible degradation compound of TCE. Its presence could indicate reductive dechlorination biodegradation of the parent(s) compound is occurring. The parent chlorinated aliphatics, tetrachloroethene,

TCE, and 1,1,1-trichloroethane are known to degrade at a more rapid rate in an anaerobic environment (which exist at LF-023), especially in the saturated zone, than an aerobic environment (Arthur D. Little, Inc., 1985).

Chloroform may be present due the reaction of natural or man-made organic materials with chlorine (in the form of bleach). The chlorobenzene detected in the groundwater may be related to the dichlorobenzene detected in the waste (a possible impurity); however, there is no evidence that dichlorobenzenes degrade to chlorobenzene (Arthur D. Little, Inc., 1985).

It is possible that the chloroform detected in MW-23-010 is related to the disposal of chlorine products (e.g., bleach) at the landfill. If chlorine was disposed, the chlorination of organics (natural and manmade) may have produced chloroform. However, other chlorinated compounds that may be the result of chlorination were not detected in MW-23-010. It is also possible that the chloroform may be residual from the monitoring well installation where public water was used during the process. Chloroform has been detected in the public water supply.

4.3.4.2 Fuel-Related Solvents. Three volatile aromatic fuel-related solvents, benzene, ethylbenzene, and xylene, were identified as site contaminants in groundwater. One fuel-related SVOC, naphthalene, was also detected in the groundwater. These aromatic contaminants are described below as a general contaminant group. Table 4-7 lists the chemical properties of the aromatic hydrocarbons detected st the landfill. Appendix M contains an environmental profile for the aromatic VOCs and the SVOC, naphthalene.

Uses. These fuel-related compounds are often found in gasoline, JP-4, oil spills, emissions from the production of petroleum refining, gasoline and diesel engines, and residential wood-burning stoves and fireplaces. Combinations of ethylbenzene, xylene, and naphthalene in petroleum processes and toluene and xylene in gasoline compositions are quite common (Arthur D. Little, Inc., 1985). Benzene, in particular, has been observed as a solvent used for nonferrous metal manufacturing, wood processing, and found as a by-product from cigarette smoke (Howard, 1990).

Probable Fate and Transport. Benzene, ethylbenzene, and xylene, are expected to remain in a soil/groundwater system for months to years (Arthur D. Little, Inc., 1985) if the biodegradation process does not occur. These

contaminants may volatilize from soils and travel through the air filled pores of the unsaturated soil layer. This is of particular interest when the contaminant is located in near surface soils (Arthur D. Little, Inc., 1985). The portions not volatilizing from soil surfaces will be moderately soluble in water, have a moderate potential for bioaccumulation, and migrate to the groundwater where both biodegradation and volatilization may occur.

Naphthalene has a much lower solubility than the other three aromatic compounds along with a higher K_{oc}. Naphthalene in the groundwater is expected to migrate although at a slower rate than the simple aromatics. For naphthalene in the near surface soils, volatilization is expected to be a significant migration pathway. Along with the other aromatics, naphthalene is expected to undergo biodegradation (Arthur D. Little, Inc., 1985).

Aromatic compounds require molecular oxygen to break the ring structure, and, therefore, degrade slowly under anoxic and anaerobic conditions. When these compounds are in a primarily unsaturated zone, an aerobic environment, they will degrade rapidly.

Recent work on the biodegradation has clarified the transfer pathways and kinetics of aromatic compounds in both aerobic and anaerobic surroundings. The transformation exists at a rate measured by the reactivity of the molecule in an ambient environment. Bacterially moderated transfers are likely to have an effect on the solvents found in the groundwater. Ethylbenzene and xylene were noted to completely biodegrade after 192 hours at 13°C when natural flora and the presence of other high-octane compounds of gasoline were present in the groundwater. Ethylbenzene and xylene were originally detected at 1 to 3 parts per billion (ppb) and the other gasoline contaminants at a total concentration of 100 ppb. In some instances, benzene and ethylbenzene are known to be a carbon source for some soil bacteria and microorganisms, respectively (Vershueren, 1983).

In conclusion, biodegradation of aromatic compounds may be a viable fate process that will augment the volatilization fate process.

4.3.4.3 Inorganics. Four elements were identified in groundwater as site contaminants: aluminum, iron, manganese, and potassium. High concentrations of both iron and manganese are expected under the anaerobic conditions at the landfill. Aluminum concentrations may be the result of leaching from the wastes and/or an

increase in the solubility of the native aluminum due to the conditions created at the landfill. Potassium was detected in the upgradient wells (adjacent to the highway) and may be related to road salting activities. Appendix M contains the environmental profiles for the elements detected in the groundwater.

Probable Fate and Transport. The results for iron and manganese may be indicative of anaerobic conditions in the landfill. Anaerobic conditions in the landfill should slowly dissipate as the degradation cycle reaches completion. If the concentrations of dissolved aluminum, iron, and manganese are the result of anaerobic conditions, concentrations should decrease as the groundwater conditions become similar to the conditions observed in the background wells. The iron and manganese may also be leaching from wastes in the landfill.

The reactions of iron and manganese with regard to the weathering process are dependent on Eh-pH of the environment. The current pH values at the landfill range from 6 to 8 under anaerobic conditions. The predominant iron species expected in the groundwater is the ferrous ion (Fe+2), while the manganous ion (Mn+2) is the expected species for manganese. In addition, both iron and manganese oxides may be present in the groundwater. These oxides play an important role as substrates for the sorption of trace metals. The species of iron and manganese in the groundwater that predominate at the landfill varies with the pH and the degree of reducing condition that exist. The presence of reducing conditions at the landfill can reverse the binding of trace metals, releasing them back into the groundwater.

The concentrations of potassium may vary with off-site activities (i.e., road salting) and may remain in the groundwater if road salting activities continue even after the other elements have returned to background concentrations.

4.3.5 Fate and Transport of Contaminants in Surface Water and Sediments

Aluminum, arsenic, iron, and zinc were identified as site contaminants in the unfiltered surface water associated with LF-023. It is important to note that the surface water samples were not filtered. The sediments associated with the surface waters contained PHCs.

4.3.5.1 Surface Water. Elevated concentrations (i.e., above ambient water quality criteria) of aluminum, arsenic, iron, and zinc were detected in the surface water seeps

adjacent to the landfill. The anaerobic conditions at the landfill may be increasing the solubility of these naturally occurring elements. When the groundwater is expressed at the surface the metals undergo oxidation as they come in contact with air, causing them to precipitate. In addition, the unfiltered samples may include particulate materials causing a high bias of the analytical results.

Probable Fate and Transport. The metals detected in the crossgradient surface water do not appear to be related to the landfill. Aluminum, arsenic, iron, and zinc all occur naturally in the environment. Current anaerobic conditions in the groundwater at the site may be increasing the solubility of these native elements. In addition, arsenic was not detected above background at the landfill in the surface soils, wastes, or groundwater. As the landfill matures and anaerobic activity decreases the groundwater conditions should change. As the conditions become more aerobic the amounts of native metals that are currently solubilized should decrease. Appendix M contains environmental profiles for the metals detected in the surface water.

4.3.5.2 Sediments. PHCs were detected in the sediments adjacent to the site and may be related to disposal practices that occurred there.

PHCs. PHCs are a group of compounds that are defined by the analytical method that is employed. USEPA Method 418.1, Total Petroleum Hydrocarbons by Infrared Spectroscopy, is a technique used to measure fuel-related compounds with boiling points in the range of gasoline and number two fuel oil. Some of the products that can be measured by this technique includes JP-4, kerosene, and most of the components of aviation fuel. Neither the light fractions of gasoline nor the heavier fractions of fuel oils are measured by this analytical technique.

PHCs are composed of both straight and branched chain aliphatic and aromatic hydrocarbons. In addition, halogenated hydrocarbons within the boiling point range of the analysis are also detected by this method. It should be noted, however, that the method does not distinguish between types of fuels present, the age of the fuels, whether or not that halogenated compounds are included, or if some of the compounds present are naturally occurring. While PHC values may not correlate to TCL VOA and semivolatile organic analysis results, they are still a good indicator of a large group of unregulated fuel compounds.

Probable Fate and Transport. The fate processes for PHCs vary with the individual compounds that are present. Because almost all of the compounds are unregulated and may number into the thousands, very little fate information is available for the individual compounds. In general, the lighter fractions are more susceptible to both volatilization and biodegradation while the heavier fractions are more persistent.

The presence of TCL volatile compounds at the site indicates that the fuel-related compounds are in the landfill. The heavier, more resistant fractions of fuels, because of biodegradation and weathering, are less mobile and are expected to undergo only limited migration in the subsurface soils. However, the heavier fraction of the PHCs in the surface soils and sediments are expected to undergo mechanical transport and move with the rainwater runoff.

4.3.6 Contaminant Transport Modeling

Air quality can be impacted by (1) volatilization of organic contaminants in soil and (2) airborne transport of contaminants sorbed to soil particles. To determine the possible impacts that contaminants may have on air quality at LF-023, organic contaminant vapor and fugitive particulate emission rates and concentrations were estimated using concentrations of contaminants present in surface soil at the site. The following subsections describe the processes involved in assessing these air quality impacts.

4.3.6.1 Modeling of Organic Vapor Emissions. NYSDEC defines sites that have not yet been remediated as 'Uncontrolled Sources.' According to NYSDEC "Air Cleanup Criteria" (NYSDEC, 1990), concentrations of contaminants in the air above uncontrolled sources must be compared to the appropriate AAQSs to determine whether air quality has been affected at a site and if remedial action is necessary. To evaluate the impacts of contaminants on air quality at LF-023 and downwind from the site, modeling was used to estimate the rates at which contaminants in the soil are volatilizing and the dispersion of airborne contaminants.

Data Requirements. Emission rates were estimated based on contaminant concentrations, chemical properties of contaminants, and soil characteristics. Information used in the modeling was collected from SI and RI data and reference manuals.

SVOCs and one PCB were the organic compounds detected at concentrations above the CRQL in surface soil at LF-023. The following chemical properties are necessary for the modeling process for each compound: molecular weight, vapor pressure, solubility, diffusivity in air and water, organic carbon partition coefficient (K_{oc}), and Henry's Law constant. Measured values of these chemical properties were obtained from a number of sources including various USEPA resources and chemical handbooks.

The USEPA document entitled "Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF) - Air Emissions Models" (1987) was used as the primary source of information. When a chemical property for a compound was not available in this document, the following references, in order of preference, were used to find the remaining properties: "Superfund Public Health Evaluation Manual" (USEPA, 1986b), "CERCLA Discharges to POTWs Treatability Manual" (USEPA, 1990d), "CRC Handbook of Chemistry and Physics" (Weast, 1988), "Perry's Chemical Engineers' Handbook" (Perry, 1984), "Handbook of Environmental Data on Organic Chemicals" (Verschueren, 1983), "The Installation Restoration Program Toxicology Guide" (Arthur D. Little, Inc., 1985), "Dangerous Properties of Industrial Materials" (Sax, 1989).

Most diffusivity constants could not be found in the literature. These constants were estimated based on similarities in molecular structure between the compound with unknown diffusivity constants and compounds with known diffusivity constants. The diffusivity constants for naphthalene were used for 2-methylnaphthalene. The diffusivity constants for benzo(a)anthracene were used for any other compound for which values could not be found.

Soil characteristics of LF-023 were obtained from a number of resources. Depth of contamination was assumed to be 1 foot; the concentrations of contaminants detected in each sampling quadrant were assumed to be representative of the entire quadrant. Soil porosity was approximated by assuming a value for D_{10}, obtaining a void ratio from the literature, and calculating a range of values. Other soil characteristics were obtained from field and laboratory observations.

Air Emission Rates and Dispersion Modeling. The modeling approach followed the USEPA guidance for estimating air emissions from cleanup activities at Superfund Sites (1989b). The approach begins with the

estimation of emission rates. The emission rates are then used in dispersion models to estimate air concentrations. The model used to estimate baseline emission rates was the Behavior Assessment Model for Trace Organics in Soil (Jury et.al., 1983).

The model results for several time dependent emission rates are presented in Table 4-8. The results shown in Table 4-8 are based on assumptions that conservatively overestimate emission rates. The emissions modeling included emissions beginning two years after the SVOCs were release to the soil. Because emission rates decline exponentially from the time of release, present actual emission rates are likely to be significantly lower than those predicted in Table 4-8; this is because the compounds were actually released in the soil approximately 10 years ago. Conservative emission rates were used because screening dispersion modeling is intended to provide an overestimate of ambient concentrations. If screening modeling can demonstrate that ambient concentrations are acceptable, then the more complex refined dispersion models can be avoided.

Air concentrations were predicted from estimated emission rates with the screening techniques recommended by USEPA (1988c). The release was first evaluated for density to verify that traditional dispersion models were appropriate for predicting downwind concentrations. Because the density evaluation indicated traditional models could be used, the dispersion model in USEPA (1988c) was used to predict downwind concentrations. The dispersion model recommended in USEPA 1988c is identical to the UNAMAP dispersion model SCREEN. A normalized emission rate of 1 gram per second was input to SCREEN along with the area source's height and length of shortest side. The results for the emission rate of 1 gram per second were then multiplied by the emission rates of each compound which provided predicted 1-hour average concentrations for each compound.

The screening dispersion modeling results are presented in Table 4-9. The 8-hour average concentrations were estimated from the predicted 1-hour average concentrations multiplied by a correction factor of 0.9. The annual average concentrations were estimated from the predicted 1-hour average concentrations multiplied by a correction factor of 0.2. The predicted concentrations shown in Table 4-9 are based on conservative assumptions used in the assessment. AAQSs have not been established for all of the compounds listed in Table 4-9.

TABLE 4-8
LF-023 ESTIMATED CONTAMINANT EMISSIONS

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

	PREDICTED EMISSION RATE (g/s)			AVERAGE EMISSION RATE (g/s)	
COMPOUND	2 YEARS	32 YEARS	72 YEARS	YEAR 2 TO YEAR 32	YEAR 2 TO YEAR 72
Southeast Quadrant					
Fluoranthene	1.51E-03	1.88E-04	6.41E-05	4.38E-04	2.41E-04
Phenanthrene	7.26E-04	8.38E-05	1.90E-05	1.78E-04	9.61E-05
Anthracene	5.01E-04	2.75E-05	6.49E-06	9.75E-05	4.81E-05
Acenaphthene	1.01E-04	3.70E-06	1.48E-07	1.86E-05	8.38E-06
Benzofluoranthene	9.87E-06	1.52E-06	7.57E-07	2.91E-06	1.79E-06
Fluorene	6.98E-06	2.62E-25	1.41E-29	1.95E-07	8.36E-08
Dibenzofuran	4.11E-06	2.40E-24	4.52E-29	1.15E-07	4.95E-08
Naphthalene	1.96E-06	1.89E-18	5.81E-29	9.59E-09	4.11E-09
Pyrene	7.46E-07	2.65E-24	3.31E-26	1.87E-07	8.02E-08
PCB-1254	5.04E-08	8.41E-09	4.29E-09	1.55E-08	9.68E-09
Chrysene	1.76E-08	1.39E-08	1.13E-08	1.51E-08	1.35E-08
Benzo(g,h,i)Perylene	1.10E-08	7.24E-09	4.96E-09	8.50E-09	6.91E-09
Benzo(a)Anthracene	3.13E-09	2.07E-09	1.43E-09	2.43E-09	1.98E-09
Dibenzo(a,h)Anthrace	2.88E-09	2.20E-09	1.80E-09	2.43E-09	2.15E-09
Benzo(a)Pyrene	4.10E-10	3.38E-10	2.95E-10	3.63E-10	3.32E-10
Indeno(1,2,3-cd)Pyren	1.28E-13	8.74E-14	6.32E-14	1.01E-13	8.39E-14
2-Methylnaphthalene	3.02E-20	3.80E-47	8.88E-84	8.28E-23	3.55E-23
Northwest Quadrant					
Fluoranthene	3.36E-06	4.17E-07	1.43E-07	9.74E-07	5.36E-07
Benzofluoranthene	1.96E-07	3.03E-08	1.51E-08	5.79E-08	3.56E-08
Pyrene	3.80E-09	1.35E-26	1.69E-28	9.54E-10	4.09E-10
Chrysene	2.30E-10	1.81E-10	1.47E-10	1.97E-10	1.76E-10
Benzo(a)Anthracene	3.73E-11	2.46E-11	1.70E-11	2.89E-11	2.35E-11
Benzo(a)Pyrene	1.20E-11	9.87E-12	8.61E-12	1.06E-11	9.69E-12

TABLE 4-9
LF-023 ESTIMATED CONTAMINANT AMBIENT AIR CONCENTRATIONS 1 METER DOWNWIND

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

		ESTIMATED 8-HOUR AVERAGE CONCENTRATION (mg/m^3)			ESTIMATED ANNUAL AVERAGE CONCENTRATION (mg/m^3)	
COMPOUND	QUAD	YEAR 2	YEAR 32	YEAR 72	YEAR 2 TO YEAR 32	YEAR 2 TO YEAR 72
Fluoranthene	SE	2.80E-01	3.49E-02	1.19E-02	1.81E-02	9.94E-03
	NW	8.30E-04	1.03E-04	3.53E-05	5.35E-05	2.94E-05
	Total	2.81E-01	3.50E-02	1.19E-02	1.81E-02	9.97E-03
Phenanthrene	SE	1.35E-01	1.56E-02	3.53E-03	7.34E-03	3.97E-03
Anthracene	SE	9.30E-02	5.11E-03	1.20E-03	4.02E-03	1.98E-03
Acenaphthene	SE	1.88E-02	6.87E-04	2.75E-05	7.67E-04	3.46E-04
Benzofluoranthene	SE	1.83E-03	2.82E-04	1.41E-04	1.20E-04	7.39E-05
	NW	4.84E-05	7.49E-06	3.73E-06	3.18E-06	1.96E-06
	Total	1.88E-03	2.90E-04	1.44E-04	1.23E-04	7.58E-05
Fluorene	SE	1.30E-03	4.86E-23	2.62E-27	8.05E-06	3.45E-06
Dibenzofuran	SE	7.63E-04	4.46E-22	8.39E-27	4.74E-06	2.04E-06
Naphthalene	SE	3.64E-04	3.51E-16	1.08E-26	3.96E-07	1.70E-07
Pyrene	SE	1.39E-04	4.92E-22	6.15E-24	7.72E-06	3.31E-06
	NW	9.39E-07	3.34E-24	4.18E-26	5.24E-08	2.25E-08
	Total	1.39E-04	4.95E-22	6.19E-24	7.77E-06	3.33E-06
PCB-1254	SE	9.36E-06	1.56E-06	7.97E-07	6.40E-07	3.99E-07
Chrysene	SE	3.27E-06	2.58E-06	2.10E-06	6.23E-07	5.57E-07
	NW	5.68E-08	4.47E-08	3.63E-08	1.08E-08	9.67E-09
	Total	3.32E-06	2.63E-06	2.13E-06	6.34E-07	5.67E-07
Benzo(g,h,i)Perylene	SE	2.04E-06	1.34E-06	9.21E-07	3.51E-07	2.85E-07
Benzo(a)Anthracene	SE	5.81E-07	3.84E-07	2.66E-07	1.00E-07	8.17E-08
	NW	9.22E-09	6.08E-09	4.20E-09	1.59E-09	1.29E-09
	Total	5.90E-07	3.90E-07	2.70E-07	1.02E-07	8.30E-08
Dibenzo(a,h)Anthracene	SE	5.35E-07	4.08E-07	3.34E-07	1.00E-07	8.87E-08
Benzo(a)Pyrene	SE	7.61E-08	6.28E-08	5.48E-08	1.50E-08	1.37E-08
	NW	2.97E-09	2.44E-09	2.13E-09	5.82E-10	5.32E-10
	Total	7.91E-08	6.52E-08	5.69E-08	1.56E-08	1.42E-08
Indeno(1,2,3-cd)Pyrene	SE	2.38E-11	1.62E-11	1.17E-11	4.17E-12	3.46E-12
2-Methylnaphthalene	SE	5.61E-18	7.06E-45	1.65E-81	3.42E-21	1.46E-21

4.3.6.2 Modeling of Fugitive Particulate Emissions. Contaminants sorbed to soil may be transported in the air when soil particles are carried by the wind. This transport of contaminants is known as fugitive dust emissions. In order to assess air quality impacts of fugitive dust emissions, airborne concentrations of contaminants resulting from wind erosion of PM_{10} particles were calculated. PM_{10} particles are defined as airborne respirable particulate matter with an aerodynamic diameter equal to or smaller than 10 um.

Depending on the erodibility of surface soil at LF-023, either of two emission factor equations are recommended (USEPA, 1985c). Where erosion potential is low at a site, it is assumed there is a "limited reservoir" of erodible material. Conversely, where site surface soils are composed of mostly fine-grained soil particles, the site is classified as having an "unlimited reservoir" of erodible material. Based on wind erosion research, the cutoff threshold friction velocity between the two erodibility classes is approximately 0.75 m/s (USEPA, 1985c). This division is based on the observation that soil type of highly erodible surfaces have threshold friction velocities of approximately 0.75 m/s.

Threshold friction velocity can be approximated based on the results of a sieve analysis. Based on a relationship described in USEPA, 1985c, if more than 60 percent of the soil particles from a site passes through a 1 mm sieve, the "unlimited reservoir" model would apply. Surface soil from LF-023 was assumed to be composed of Plainfield Loamy Sand with 3 to 8 percent slopes. Sieve analyses of this soil type was plotted on a grain size chart; approximately 65 percent of this soil passes a 1 mm sieve. Therefore the "unlimited reservoir" model is appropriate for LF-023.

For estimating fugitive dust particulate emissions from surfaces with an "unlimited reservoir" of erodible particulates, the box model is appropriate. The box model assumes the surface of LF-023 is a source area rectangular in shape. The box is bounded by the surface of the site; the height is defined as the mixing height of the mean vertical displacement of emissions. The width of the box is equal to the width of LF-023. It is assumed that mixing is complete within the boundaries of the box and that the box is aligned so that the length is parallel to wind direction (McCarthy and Burbank, 1990).

Airborne particulate concentrations can be estimated by applying this box model. Concentrations are calculated using a three-step process. The first step is to estimate the emission rate of PM_{10} particles (E_{10}) based on site and soil characteristics. In the

second step, contaminant emission rates (Q_{10}) are estimated. These results are based on surface soil data and the area of the contaminated surface. The third step is to predict air concentrations (C_{10}).

Based on field measurements of erodible soil for surfaces with an "unlimited reservoir," an emission rate (E_{10}) for PM_{10} particles can be estimated. This estimation is based on site observations such as the fraction of surface with continuous vegetative cover and the type of vegetation present. This calculation also accounts for mean annual wind speed. Results of these calculations are presented in Appendix L.

Contaminant emission rates are calculated based on PM_{10} emission rates (E_{10}). Surface area of the site and surface soil concentrations of contaminants are considered. Contaminant emission rates (Q_{10}) are listed in Appendix L.

The last step in the box modeling process is to calculate airborne contaminant concentrations (C_{10}). This calculation is based on the contaminant emission rate (Q_{10}) calculated in Step 2, the fraction of a 24-hour day which activity occurs at the site, and the ventilation rate of the site. It was assumed that activity would occur at LF-023 24 hours per day. The ventilation rate is based on wind speed, the mixing height and the width of the site perpendicular to the wind. It was assumed that the downwind distance from the edge of LF-023 to a receptor was 1 m; the mixing height (i.e., the mean vertical displacement of emissions) is calculated based on this assumption. These results are presented in Appendix L.

Table 4-10 lists the airborne contaminant concentration (C_{10}) and the contaminant emission rate (Q_{10}) for each compound detected in the surface soil of LF-023. For a distance 1 m downwind of LF-023, the predicted airborne contaminant concentrations are very low even with the conservative assumptions used in this modeling. Exposure due to particulate emissions is not anticipated to be significant.

4.4 BASELINE RISK ASSESSMENT

A baseline risk assessment was conducted for Landfill LF-023 to determine whether contaminants at the site pose a risk to human and/or ecological receptors. This assessment consisted of three components: (1) Data Evaluation, (2) Human Health Risk Assessment, and (3) Habitat-Based Environmental Risk Assessment. The evaluated environmental media include groundwater, surface water, sediment, surface

TABLE 4-10
LF-023 CONTAMINANT PARTICULATE EMISSIONS

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

COMPOUND	Q_{10} (mg/s)	C_{10} (mg/m^3)
Naphthalene	2.18E-04	4.00E-07
2-Methylnaphthalene	1.49E-04	2.74E-07
Acenaphthene	1.38E-03	2.53E-06
Dibenzofuran	7.46E-04	1.37E-06
Fluorene	1.32E-03	2.42E-06
Phenanthrene	1.55E-02	2.84E-05
Anthracene	2.70E-03	4.94E-06
Fluoranthene	1.26E-02	2.31E-05
Pyrene	1.09E-02	2.00E-05
Benzo(a)anthracene	3.56E-03	6.52E-06
Chrysene	3.33E-03	6.10E-06
Benzo(b)fluoranthene	3.50E-03	6.42E-06
Benzo(k)fluoranthene	3.50E-03	6.42E-06
Benzo(a)pyrene	2.01E-03	3.68E-06
Indeno(1,2,3-cd)pyrene	3.73E-04	6.84E-07
Dibenzo(a,h)anthracene	2.12E-04	3.89E-07
Benzo(g,h,i)perylene	2.87E-04	5.26E-07
Aroclor 1254	9.18E-03	1.68E-05
Silver	7.34E-07	1.35E-09

soil, and subsurface soil/waste material. These media were evaluated with regard to potential adverse effects to both human health and the environment. This assessment was conducted in the same manner and according to the same USEPA and NYSDEC guidance as the baseline risk assessment for LF-022.

4.4.1 Data Evaluation

Contaminants associated with the LF-023 site were detected in groundwater, surface water, sediment, surface soil, and subsurface soil/waste material. The site contaminants identified in Table 4-2 were chosen based on comparisons with background levels. These contaminants were further evaluated for their potential effects on human health and the environment. Based on this analysis, contaminants of potential concern were chosen for the baseline risk assessment.

4.4.1.1 Groundwater. Detected groundwater contaminants considered site-related include inorganics (i.e., aluminum, iron, manganese, and potassium), several VOCs (i.e., chloroform, vinyl chloride, chlorobenzene, benzene, ethylbenzene, and xylene), and naphthalene. Of these compounds, the VOCs and naphthalene are of most concern for humans. Vinyl chloride was detected in three of five samples at a maximum concentration of 31 μg/L. None of the inorganic compounds are particularly toxic to humans and all three are essential elements in the human diet. However, these elements were detected above their New York State Groundwater Quality Standards. Therefore, along with the VOCs and naphthalene, they represent contaminants of potential concern for groundwater. A summary of these data is in Table 4-5.

4.4.1.2 Surface Water/Sediment. Two surface water and two sediment samples were collected from seeps located at the northern edge of a red maple swamp located approximately 600 feet south of LF-023. Several metals were detected in these samples. However, the only contaminants determined to be site-related in surface water, and their maximum concentrations, were the following: aluminum (1.99 mg/L), arsenic (0.316 mg/L), iron (672 mg/L), and zinc (0.355 mg/L). The only site-related contaminants in sediment samples were PHCs. No VOCs or SVOCs were identified in either medium.

As discussed in the baseline risk assessment for LF-022, iron is not highly toxic at concentrations detected at this site (672 mg/L maximum). Iron is also an essential nutrient. Similarly, aluminum and zinc are not highly toxic at the detected concentrations. In fact, these compounds were selected as being site-related based

on comparisons with ecologically based Ambient Water Quality Criteria (AWQCs). Drinking water criteria for these compounds are based on aesthetic qualities (e.g., taste) rather than toxicity. Consequently, aluminum, iron, and zinc in the seeps south of LF-023 are contaminants of potential concern for ecological receptors only. Arsenic is the only surface water contaminant of potential concern for human health.

4.4.1.3 Subsurface Soil/Waste. Subsurface soil/waste samples were collected from test pits during the 1989 SI (E.C. Jordan Co., 1989). The only contaminant in subsurface fill considered to be site-related was 1,1-dichlorobenzene, which was detected once at 520 μg/kg.

4.4.1.4 Surface Soil. Composite surface soil samples were collected during a supplemental sampling round in November 1989. The landfill was divided into four quadrants and a composite sample consisting of 17 to 25 discrete samples was collected from each quadrant. These composite samples were analyzed for TCL SVOCs and pesticides/PCBs and TAL inorganics. One discrete sample from each quadrant was also analyzed for TCL VOCs. A summary of the composite surface soil data is in Table 4-11. This table presents the sitewide average concentration of each compound.

Contaminants of potential concern for surface soil are Aroclor-1254 (a PCB), silver, and various PAHs. Aroclor-1254 was detected in one of two duplicate samples from the southeast quadrant (SS-04) at a relatively low concentration (220 μg/kg). Using one-half the detection limit for the non-detect duplicate, a representative concentration of 0.15 μg/kg was calculated for this sample location.

PAHS were detected only in composite samples from the southeast and northwest quadrants. Seventeen separate PAH compounds were identified. The highest total concentration was 612 mg/kg in sample SS-04 from the southeast quadrant. No other SVOCs or VOCs were detected in surface soil.

Silver was the only inorganic compound detected in soil above typical background ranges (maximum of 12.8 mg/kg). Therefore, it represents the only inorganic contaminant of potential concern in surface soil.

4.4.2 Human Health Risk Assessment

The purpose of the baseline human health risk assessment of the LF-023 site is to determine if contamination at the site poses risks to human health, in the absence

TABLE 4-11
SUMMARY OF SURFACE SOIL DATA FOR LF-023

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

	NORTHEAST	*NORTHWEST*	*SOUTHWEST*	*SOUTHEAST*	
CHEMICAL	CONCENTRATION (mg/kg)	CONCENTRATION (mg/kg)	CONCENTRATION (mg/kg)	CONCENTRATION (mg/kg)	WEIGHTED AVERAGE (mg/kg)
Silver	12.8	4.2 *	1 *	1 *	5
Fluoranthene	0.17 *	0.37	0.17 *	120	31.9
Pyrene	0.17 *	0.73	0.17 *	110	29.3
Benzo(a)anthracene	0.17 *	0.59	0.17 *	37	10
Chrysene	0.17 *	0.62	0.17 *	35	9.5
Benzo(b)fluoranthene	0.17 *	1	0.17 *	37	10.1
Benzo(k)fluoranthene	0.17 *	1	0.17 *	37	10.1
Benzo(a)pyrene	0.17 *	0.84	0.17 *	21	5.8
Napthalene	0.17 *	0.17 *	0.17 *	2	0.7
2-Methylnapthalene	0.17 *	0.17 *	0.17 *	1.4	0.5
Acenapthene	0.17 *	0.17 *	0.17 *	12	3.3
Dibenzofuran	0.17 *	0.17 *	0.17 *	6.6	1.9
Fluorene	0.17 *	0.17 *	0.17 *	12	3.3
Phenanthrene	0.17 *	0.17 *	0.17 *	144	38.2
Anthracene	0.17 *	0.17 *	0.17 *	26	7
Indeno(1,2,3-cd)pyrene	0.17 *	0.17 *	0.17 *	4.7	1.4
Dibenz(a,h)anthracene	0.17 *	0.17 *	0.17 *	2.8	0.9
Benzo(g,h,i)perylene	0.17 *	0.17 *	0.17 *	3.9	1.2
Aroclor-1254	0.08 *	0.08 *	0.08 *	0.15	0.1

NOTES:

* - Chemical not detected; value presented is 1/2 CRQL.

** - Values for Southeast Quadrant (SS-04) are averages of duplicate sample results, using 1/2 CRQL for non-detects.

Number of discrete samples per composite sample: Northeast SS-01 = 25; Northwerst SS-02 = 17; Southwest SS-03 = 22; Southeast SS-04 = 23

TAB4-11.WK1

of any remedial action. The baseline human health risk assessment contains the following components:

- Exposure Assessment
- Toxicity Assessment
- Risk Characterization

Collectively, these components describe (1) human populations that might come in contact with contaminants at the site and the pathways by which they could be exposed; (2) site contaminants that pose a potential risk to public health and the potential toxic effects and toxic potency of these contaminants; and (3) potential risks associated with contaminant exposure. This baseline risk assessment was conducted in accordance with the USEPA's "Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A)" (USEPA, 1989d) and the "Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors" (USEPA, 1991).

4.4.2.1 Exposure Assessment. An exposure assessment for LF-023 was conducted according to the procedures described in Subsection 3.4.2.1 of the LF-022 baseline risk assessment. Potential exposure pathways were identified for each contaminated medium and potential intakes were quantified for each complete exposure pathway. This assessment is described in the following paragraphs.

Identification of Potential Exposure Pathways. There are four potential sources of exposure associated with the LF-023 site: groundwater, surface water/sediments, subsurface soil/waste materials, and surface soil. However, based on current site uses, surface soil and surface water/sediments are the only media to which individuals may currently be exposed. A list of potential exposure pathways relevant to the LF-023 site is in Table 4-12, along with a designation of whether they will be evaluated in this risk assessment. The following paragraphs summarize the rationale for the selection of exposure pathways for each medium.

Groundwater. Various volatile contaminants and naphthalene were detected in groundwater downgradient of LF-023. These data are summarized in Table 4-5. Groundwater west of LF-023 is a source of potable water for the nearby mobile home development. However, contaminants related to LF-023 have not been detected in residential wells in this development, nor have contaminants been detected in monitoring wells located between LF-023 and the development. All hydrogeological data indicate that these wells are crossgradient of the site and are

TABLE 4-12
POTENTIAL EXPOSURE PATHWAYS FOR LF-023

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

POTENTIALLY EXPOSED POPULATION	EXPOSURE ROUTE, MEDIUM AND EXPOSURE POINT	PATHWAY SELECTED FOR EVALUATION ?	REASON FOR SELECTION OR EXCLUSION
CURRENT CONDITIONS			
SECURITY POLICE	Direct contact with and ingestion of surface soil	Yes	Security police may contact surface soil during training exercises
CHILD TRESPASSER	Direct contact with and ingestion of surface soil	Yes	Children may contact surface soil while trespassing on the site
CHILD TRESPASSER	Direct contact with and ingestion of surface water/sediment	Yes	Children may contact surface water while exploring in the swamp
NEARBY RESIDENT	Inhalation of volatile and fugitive dust emissions	Yes	Residents of the mobile home park may be exposed to emissions
FUTURE CONDITIONS			
CHILD & ADULT RESIDENTS	Ingestion, direct contact, and inhalation of groundwater contaminants as a result of domestic use downgradient	Yes	Potential exists for groundwater to be used in the future as a source of potable water
CHILD & ADULT RESIDENTS	Incidental ingestion and direct contact with surface soil following residential development nearby	Yes	Future residential development could occur if the base were to close
CHILD & ADULT RESIDENTS	Inhalation of vapors and fugitive dust emissions following residential development nearby	Yes	Future residential development could occur if the base were to close
CHILD RESIDENT	Direct contact with and ingestion of surface water/sediment	Yes	Children may contact surface water while exploring in the swamp

TAB4-12.WK1

unlikely to be affected by site contaminants. The nearest downgradient residential well is south of the Salmon River over two miles south of the site. Therefore, there are no existing exposures to site-related groundwater contaminants.

The likelihood that a future water supply well will be developed on base downgradient of LF-023 is quite remote unless the base were to close. Nevertheless, the potential risks associated with exposure to groundwater contaminants were assessed as a potential future exposure pathway assuming that a well were placed downgradient of LF-023. As such, this scenario represents an extremely conservative exposure scenario. Because the contaminants of potential concern include volatile compounds, potential exposure routes include inhalation of contaminants during showering, as well as ingestion and direct contact. The potentially exposed population is assumed to be children and adult residents living directly downgradient of the landfill in the future.

Surface Soil. LF-023 is located within a controlled access area of the base. Only individuals possessing controlled area badges are allowed into the site. There are three subgroups of base personnel that may come in contact with the LF-023 site under current site conditions: security police, ROTC recruits, and civil engineering personnel. Of these groups, security police and ROTC recruits are the only people likely to come in actual contact with surface soil on a repeated basis. Both subgroups could be exposed to surface soil while involved in training exercises at the obstacle course in the northeast quadrant of the landfill. Civil engineering personnel may travel across the landfill but are unlikely to come in direct contact with soil. At this time, there are no routine activities conducted at the landfill that would cause other base personnel to come in contact with contaminated media. Therefore, exposure of on-base populations to LF-023 other than during training exercises is unlikely.

As noted, both security police and ROTC recruits could be exposed to surface soil contaminants via incidental ingestion and direct contact while participating in training exercises at the obstacle course. Of these two subgroups, the security personnel would be expected to be exposed to a greater extent. ROTC recruits typically train at LF-023 only twice in a year, while security police train three to four days per week for 12 weeks a year. Therefore, a security policeman was selected to represent the potentially exposed adult population associated with surface soil. These individuals may be exposed to surface soil to a greater extent at this site than normally assumed for adults because of the nature of required training activities. Therefore, the

exposure scenario developed to quantitatively estimate intake to this potentially exposed population reflects an increased magnitude of exposure.

As is the case with the LF-022 site, the only way for on-base or off-base civilian populations to access the LF-023 site is to enter from the west by climbing the boundary fence. The other sides of the landfill are bordered by controlled access areas. The site itself is considered limited access because of its proximity to these controlled access areas, and this area of the base is regularly patrolled. All individuals in this area of the base are subject to search. Consequently, trespassing by civilian populations is severely limited.

Of the three sites on the western border of the base (i.e., LF-022, LF-023, and FT-002), access to LF-023 by off-base populations is the easiest, as this site is closest to the nearby mobile home development. The relatively barren landfill surface is surrounded by pine trees. The only feature that would tend to attract teenagers or small children for recreation is the obstacle course. The frequency of trespassing on this site by children and/or teenagers is severely limited by regular patrols. There also are other nearby off-base areas where children can play. Therefore, it is unlikely that this site would be a preferred recreational area. The potential for exposure of the general public to contaminants at LF-023 is considered minimal.

Despite the fact that access to the landfill by either on-base or off-base populations is unlikely, a hypothetical exposure scenario was developed to assess potential health risks associated with surface soil contaminants. Because the site is located along the western boundary of Plattsburgh AFB, off-base populations are closest to the site. Therefore, an exposure scenario was developed (analogous to the trespassing scenario for LF-022) consisting of off-base children playing on the site. These children could be exposed to surface soil via the ingestion and direct contact exposure routes.

Landfill LF-023 is somewhat isolated from population centers and is patrolled regularly. Therefore, small children (younger than six years) are unlikely to wander onto the site. Children ages 6 to 16 are considered to be the age group with the greatest potential to trespass on the site. Because actual exposure is considered unlikely, the exposure scenario thus developed is considered to represent a conservative case.

As was the case for LF-022, the only scenario that might lead to increased exposure to surface soil would be base closure and subsequent residential development.

Therefore, an analogous exposure scenario was developed based on an individual being exposed as a result of living near the site. The USEPA default scenario for assessing residential exposure to surface soil was used, consisting of an individual from early childhood through early adulthood (USEPA, 1991).

Vapors and Fugitive Dusts In addition to direct contact with surface soil, individuals residing or working near the LF-023 site also could be exposed to surface soil contaminants by inhaling contaminants emitted from the landfill surface. As discussed in Subsection 4.3.6, contaminants may be released to the ambient air through volatilization and wind erosion of fugitive dusts.

Under current site conditions, the closest individuals that could potentially be exposed to vapors and dusts released from LF-022 are residents of the mobile home area located approximately 600 feet southwest of the site. Therefore, an exposure scenario was developed to assess potential risks to these individuals. Potential receptors include both children and adults. The concentrations of contaminants to which these individuals may be exposed is the sum of the concentrations resulting from volatile and fugitive dust emissions.

Potential inhalation exposure to vapors and fugitive dusts could increase in the future if residential development were to occur adjacent to LF-023. Consequently, a future residential inhalation scenario was developed analogous to the scenario developed for LF-022. Modeled air concentrations of volatile and fugitive dust emissions at a distance of 1 m were used to estimate the intake to a hypothetical resident living next to the site in the future.

Subsurface Soil/Waste Materials. The only contaminant of potential concern related to subsurface soil and waste materials is 1,1-dichlorobenzene, which was detected once at 520 μg/kg. The only way for individuals to be exposed to subsurface contaminants would be during an invasive operation requiring excavation, such as building construction or utility repair. There are no such activities taking place at the LF-023 site, nor are there plans to build at the site in the future. Therefore, exposure pathways associated with subsurface soils and waste materials were not evaluated. In the event further construction in this area takes place, a reevaluation of risks associated with the subsurface materials would be necessary.

Surface Water/Sediments. There are no surface water bodies on the LF-023 site. However, there is a state-identified wetland, unit PB-14, located south of the landfill. Two seep areas have been identified along the northern edge of this unit. As

indicated in the data evaluation, arsenic is the only contaminant of potential concern in surface water. No specific compounds of concern were detected in sediment at the seeps.

Although within the base boundary, this area is only about 200 feet east of the mobile home development. Therefore, children from this development could enter this area more readily than the site itself. An exposure scenario was developed based on exposure of small children/teenagers, the same population evaluated in the surface soil exposure pathway. These individuals could be exposed to surface water via incidental ingestion and direct contact while exploring in this area.

Potential exposure to surface water could increase in the future if residential development were to occur in the vicinity of the seeps. Therefore, a future exposure scenario was developed in which the same residential population is exposed but at a greater frequency.

Summary of Exposure Pathways. As a result of this exposure assessment, eight complete exposure pathways were identified as being relevant to LF-023 under both current and future site conditions:

Current Site Conditions

1. Incidental Ingestion of and Direct Contact with Surface Soil by a Security Policeman

2. Incidental Ingestion of and Direct Contact with Surface Soil by a Child Trespasser

3. Incidental Ingestion of and Direct Contact with Surface Water by a Child Trespasser

4. Inhalation of Vapors and Fugitive Dusts by a Nearby Resident

Future Site Conditions

1. Ingestion of, Direct Contact with, and Inhalation of Volatile Compounds from Groundwater by a Future Resident

2. Incidental Ingestion of and Direct Contact with Surface Soil by a Future Resident

3. Incidental Ingestion of and Direct Contact with Surface Water by a Future Child Resident

4. Inhalation of Vapors and Fugitive Dusts by a Future Resident

Quantification of Exposure. The intake of contaminants through these eight exposure pathways is calculated using a series of equations. These equations are described in more detail in Appendix N. The following paragraphs summarize the selection of exposure parameters for each identified exposure pathway.

Current Site Conditons

Incidental Ingestion and Direct Contact With Surface Soil - Security Police. While using the obstacle course at LF-023, security police could be exposed to surface soil via both incidental ingestion and direct skin contact. The exposure parameters for the security police using the obstacle course are as follows:

Exposed Population = Security Police

CS	=	chemical concentration in surface soil (mg/kg)
IR	=	200 mg/day (USEPA, 1989d)
AF	=	1.45 mg/cm^2 (USEPA, 1989d)
SA	=	8,620 cm^2 (USEPA, 1989d)
RAF	=	For ingestion: 1.0 (Assumption) For direct contact - organics: 0.1 (Assumption) For direct contact - inorganics: 0.01 (Assumption)
FI	=	100 percent (Assumption)
EF	=	48 days/year (4 days/week, 12 weeks/year)
ED	=	4 years
BW	=	70 kg (USEPA, 1989c)
AT	=	For carcinogens: 70 years x 365 days/year For noncarcinogens: 4 years x 365 days/year

Because security police using the obstacle course may be exposed to surface soil to a greater extent than adults engaged in normal activities, the soil ingestion rate (IR) used for this adult population is greater than that usually used to estimate soil ingestion by an adult. The rate of 200 mg/day is the same as that typically used for

small children. It is also assumed that the fraction of daily soil intake (FI) associated with exposure at LF-023 is 100 percent. The soil-skin adherence factor (AF) is a default value established by the USEPA (USEPA, 1989d).

The exposed surface area is the average total area of the hands, arms, and legs of adults. The exposure duration of four years is based on the average tour of duty for military personnel at Plattsburgh AFB. An exposure frequency of 48 days per year is based on the actual number of days spent on the obstacle course by security police. The RAF values are discussed further in Appendix O.

The chemical concentrations (CS) used to estimate intake by security police are based on the two data sets in Table 4-11: (1) the average concentration of each contaminant over the four quadrants, and (2) the concentration of each contaminant in the most contaminated quadrant (southeast).

The average over the entire landfill represents the concentration to which security police may be exposed if exposure were to occur in a random fashion across the entire landfill. The concentrations from the southeast quadrant (sample SS-04) represent a conservative estimate of the exposure concentration if personnel were to train only in this area. Security police are actually more likely to be exposed to surface soil in the northeast quadrant, the location of the obstacle course. However, except for silver, all contaminants of potential concern in this quadrant were reported as below the detection limit.

Incidental Ingestion and Direct Contact with Surface Soil - Child Trespasser. The other current surface soil exposure pathway evaluated in this risk assessment consists of children trespassing on the landfill. The exposure parameters for estimating intake via incidental ingestion and direct contact for this exposure pathway are as follows:

Exposed Population = Child Trespasser

CS	=	chemical concentration in surface soil (mg/kg)
IR	=	100 mg/day (USEPA, 1989d)
AF	=	1.45 mg/cm^2 (USEPA, 1989d)
SA	=	1,520 cm^2 (hands, forearms, and feet; USEPA, 1989c)
RAF	=	For ingestion: 1.0 (Assumption)
		For direct contact - organics: 0.1 (Assumption)
		For direct contact - inorganics: 0.01 (Assumption)
FI	=	100 percent (Assumption)

EF	=	5 days/year (Assumption)
ED	=	10 years (children age 6 to 16 years)
BW	=	38 kg (USEPA, 1989c)
AT	=	For carcinogens: 70 years x 365 days/year
		For noncarcinogens: 10 years x 365 days/year

These parameters are identical to those used for LF-022 for the trespassing scenario. The chemical concentrations (CS) used to estimate intake are shown in Table 4-11. As with LF-022, two sets of data were used to estimate intake: (1) the average concentration of each contaminant over the four quadrants, and (2) the concentration of each contaminant in the most contaminated quadrant (southeast).

The average over the entire landfill represents the concentration to which children are most likely to be exposed because exposure is likely occur in a random fashion. The only subarea of the site where children would preferentially explore would be the northeast quadrant, which contains the obstacle course. As indicated above, silver was the only contaminant or potential concern detected in this quadrant above the detection limit. The concentration from the southeast quadrant, therefore, represents a conservative estimate of the exposure concentration if children were to trespass only in this area.

Incidental Ingestion and Direct Contact With Surface Water - Child Trespasser. Children may be exposed to surface water via incidental ingestion and direct contact while exploring in the wetland south of LF-023. The following exposure parameters were used to estimate contaminant intake for this hypothetical population:

Exposed Population = Child Trespasser

CW	=	chemical concentration in surface water (mg/L)
IR	=	0.05 liter/hour (USEPA, 1989d)
SA	=	1,520 cm^2 (hands, forearms, and feet; USEPA, 1989c)
PC	=	For inorganics: 0.0008 cm/hour
RAF	=	For ingestion: 1.0 (Assumption)
ET	=	1 hour/day (Assumption)
EF	=	5 days/year (Assumption)
ED	=	10 years (children age 6 to 16 years)
BW	=	38 kg (USEPA, 1989c)
AT	=	For carcinogens: 70 years x 365 days/year
		For noncarcinogens: 10 years x 365 days/year

Most of the above parameters are identical to those used for the surface soil trespasser exposure pathway (i.e., EF, ED, RAF, SA, PC, and BW). The surface water ingestion rate (IR) is based on USEPA guidance (USEPA, 1989d). The exposure time (ET) of 1 hour/day reflects the limited amount of time a child might spend in one small seep area.

Inhalation of Volatile and Fugitive Dust Emissions - Nearby Resident. As indicated previously, the closest individuals that could potentially be exposed to vapors and dusts released from LF-022 are residents of the mobile home area located about 600 feet southwest of the site. The exposure parameters used to estimate inhalation intake for this scenario are listed below.

Exposed Population = Nearby Resident

CA	=	modeled chemical concentration in air at a distance of 200 m (mg/m^3)
RAF_{IH}	=	For volatile emissions: 1.0 (Assumption) For fugitive dusts: 0.75 (Assumption)
ET	=	16 hours/day (Assumption)
EF	=	175 days/year (USEPA, 1991)
AT	=	For carcinogens: 70 years x 365 days/year
<u>Child</u>		
IR	=	2.0 m^3/hour (USEPA, 1989c)
ED	=	6 years (children 1 to 6 years)
BW	=	16 kilograms (USEPA, 1989c)
AT	=	For noncarcinogens: 6 years x 365 days/year
<u>Adult</u>		
IR	=	1.4 m^3/hour (USEPA, 1989c)
ED	=	30 years (USEPA, 1991)
BW	=	70 kilograms (USEPA, 1989c)
AT	=	For noncarcinogens: 30 years x 365 days/year

This scenario is identical to the future residential inhalation exposure scenario developed for the LF-022 site except for the airborne contaminant concentrations. The concentrations in air (CA) used to estimate intake for this population are the modeled concentrations at a distance of 200 meters from the site.

Future Site Conditions

Ingestion of, Direct Contact With, and Inhalation of Volatile Compounds from Groundwater - Future Resident. As a result of the domestic use of groundwater downgradient of LF-023, a future resident could be exposed to contaminants via three exposure routes: (1) ingestion of water or beverages made with water, (2) dermal absorption during showering or bathing, and (3) inhalation of volatile compounds during showering. As indicated previously, both children and adult residents may be exposed to groundwater contaminants in the future. The exposure parameters for these two future populations are as follows:

Exposed Population = Future Resident

CW	=	maximum chemical concentration in drinking water (mg/liter)
CA	=	chemical concentration in air during a shower (mg/m^3)
RAF_{IG}	=	1.0 (Assumption)
RAF_{IH}	=	1.0 (Assumption)
PC	=	For chemicals with log K_{ow} > 2.0: 0.008 cm/hour For chemicals with log K_{ow} < 2.0: 0.0008 cm/hour
ET	=	12 minutes/day (USEPA, 1989d)
EF	=	350 days/year (USEPA, 1991)
AT	=	For carcinogens: 70 years x 365 days/year
<u>Child</u>		
IR_{IG}	=	2 liters/day (USEPA, 1989d)
IR_{IH}	=	0.8 m^3/hour (USEPA, 1989c)
SA	=	7,220 cm^2 (whole body; USEPA, 1989c)
ED	=	6 years (children 1 to 6 years)
BW	=	16 kilograms (USEPA, 1989c)
AT	=	For noncarcinogens: 6 years x 365 days/year
<u>Adult</u>		
IR_{IG}	=	2 liters/day (USEPA, 1991)
IR_{IH}	=	0.6 m^3/hour (USEPA, 1989d)
SA	=	18,150 cm^2 (whole body; USEPA, 1989c)
ED	=	30 years (USEPA, 1991)
BW	=	70 kilograms (USEPA, 1989c)
AT	=	For noncarcinogens: 30 years x 365 days/year

Most of the above parameters are default values established by the USEPA for the evaluation of exposure to drinking water. These include the following: exposure frequency (EF), exposure duration (ED), exposure time (ET; showering), body weight (BW), average daily intake of water (IR_{IG}), and inhalation rate while showering (IR_{IH}). The only parameters that are not default USEPA values are the relative absorption factor (RAF), the permeability constant (PC), and the chemical concentrations in water (CW) and air (CA). The RAF and PC are discussed further in Appendix O.

The maximum concentration of groundwater contaminants (CW) was used to estimate intake rather than the average to account for the uncertainty associated with the concentrations that might be present in a residential well downgradient of the landfill in the future. Groundwater data from the SI was not used in the risk assessment.

The chemical concentration in air (CA) during showering is based on the concentration of volatile compounds in groundwater and is calculated using partitioning equations developed by Foster and Chrostowski (1987). A description of these equations and the parameters involved in the calculations is presented in Appendix P. As with the ingestion and direct contact exposure routes, maximum groundwater concentrations were used as input to the shower model calculations.

Incidental Ingestion and Direct Contact With Surface Soil - Future Resident. This potential exposure pathway is identical to the future residential surface soil pathway developed for LF-022. The exposure parameters for this scenario are as follows:

Exposed Population = Future Resident

CS	=	chemical concentration in surface soil (mg/kg)
AF	=	1.45 mg/cm^2 (USEPA, 1989d)
RAF	=	For ingestion: 1.0 (Assumption) For direct contact - organics: 0.1 (Assumption) For direct contact - inorganics: 0.01 (Assumption)
FI	=	100 percent (Assumption)
EF	=	175 days/year (Assumption)
AT	=	For carcinogens: 70 years x 365 days/year

Small Child

IR	=	200 mg/day (USEPA, 1991)
SA	=	1,850 cm^2 (hands, arms, and feet; USEPA, 1989c)

ED = 6 years (children 1 to 6 years; USEPA, 1991)
BW = 16 kilograms (USEPA, 1989c)
AT = For noncarcinogens: 6 years x 365 days/year

Older Child/Adult
IR = 100 mg/day (USEPA, 1991)
SA = 2,980 cm^2 (hands, forearms, and feet; USEPA, 1989c)
ED = 24 years (ages 7 to 30; USEPA, 1991)
BW = 70 kilograms (USEPA, 1989c)
AT = For noncarcinogens: 24 years x 365 days/year

Incidental Ingestion and Direct Contact With Surface Water - Future Child Resident. The exposure parameters for this scenario are as follows:

Exposed Population = Future Child Resident
CW = chemical concentration in surface water (mg/liter)
IR = 0.05 liter/hour (USEPA, 1989d)
SA = 1,520 cm^2 (hands, forearms, and feet; USEPA, 1989c)
PC = For inorganics: 0.0008 cm/hour
RAF = For ingestion: 1.0 (Assumption)
ET = 1 hour/day (Assumption)
EF = 26 days/year (Assumption)
ED = 10 years (children 6 to 16 years)
BW = 38 kilograms (USEPA, 1989c)
AT = For carcinogens: 70 years x 365 days/year
For noncarcinogens: 10 years x 365 days/year

This potential exposure pathway is identical to the surface water exposure scenario described above for current site conditions except for the frequency of exposure, which is assumed to be greater because of the increased accessibility of the swamp area following base closure. The point of exposure remains a small seep area in the swamp. Therefore, exposure frequency is still expected to be low. For the purposes of this assessment, a frequency of once per week during the warm months of the year was assumed.

Inhalation of Volatile and Fugitive Dust Emissions - Future Resident. The exposure parameters for this future exposure scenario are presented below:

Exposed Population = Future Resident

CA	=	modeled chemical concentration in air at a distance of 1 m (mg/m^3)
RAF_{IH}	=	For volatile emissions: 1.0 (Assumption) For fugitive dusts: 0.75 (Assumption)
ET	=	16 hours/day (Assumption)
EF	=	175 days/year (USEPA, 1991)
AT	=	For carcinogens: 70 years x 365 days/year
Child		
IR	=	2.0 m^3/hour (USEPA, 1989c)
ED	=	6 years (children 1 to 6 years)
BW	=	16 kilograms (USEPA, 1989c)
AT	=	For noncarcinogens: 6 years x 365 days/year
Adult		
IR	=	1.4 m^3/hour (USEPA, 1989c)
ED	=	30 years (USEPA, 1991)
BW	=	70 kilograms (USEPA, 1989c)
AT	=	For noncarcinogens: 30 years x 365 days/year

The parameters used in this scenario are identical to those in the evaluation of future inhalation exposure for LF-022.

4.4.2.2 Toxicity Assessment. A toxicity assessment for LF-023 was conducted according to the procedures described in Subsection 3.4.2.2 of the LF-022 baseline risk assessment. Toxicity values were identified from USEPA guidance for the contaminants of potential concern at LF-023. In Tables 4-13 and 4-14 are lists of the relevant oral and inhalation toxicity values for carcinogenic and noncarcinogenic effects.

The USEPA has derived oral cancer SFs for contaminants of potential concern at LF-023: arsenic, vinyl chloride, chloroform, benzene, benzo(a)pyrene and Aroclor-1254. The cancer SF for benzo(a)pyrene is, in fact, a value no longer officially approved by the USEPA because of concerns regarding the toxicological study upon which the value was based. In fact, some evidence exists to support a lower potency value for benzo(a)pyrene. However, because of the lack of a suitable alternative value, at this time, it is standard practice to use this value. In addition,

TABLE 4-13
ORAL TOXICITY DATA FOR LF-023
CONTAMINANTS OF POTENTIAL CONCERN

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

CARCINOGENIC EFFECTS

COMPOUND	CANCER SLOPE FACTOR (mg/kg-day)-1	SOURCE	STUDY TYPE	WEIGHT OF EVIDENCE	TEST ANIMAL	CANCER TYPE
INORGANICS						
Arsenic	1.75 (1)	HEAST	DW	A	Human	Skin
VOLATILE ORGANICS						
Vinyl Chloride	1.9	HEAST	Diet	A	Rat	Lung
Chloroform	0.0061	IRIS	Drinking Water	B2	Rat	Kidney
Benzene	0.029	IRIS	Occupational	A	Human	Leukemia
SEMI-VOLATILE ORGANICS						
Benzo(a)anthracene	11.5	BaP (2)				
Chrysene	11.5	BaP				
Benzo(b)fluoranthene	11.5	BaP				
Benzo(k)fluoranthene	11.5	BaP				
Benzo(a)pyrene	11.5	SPHEM	Diet	B2	Mouse	Stomach
Indeno(1,2,3-cd)pyrene	11.5	BaP				
Dibenz(a,h)anthracene	11.5	BaP				
Benzo(g,h,i)perylene	11.5	BaP				
PCBS						
Aroclor-1254	7.7	IRIS	Diet	B2	Rat	Liver

NOTES:

1. The cancer SF for arsenic is based on a unit risk of 5E-05 (ug/L)-1.
2. The cancer SF for benzo(a)pyrene was used for all carcinogenic PAHs that lack chemical-specific values.

IRIS - Integrated Risk Information System, March 1991

SPHEM - Superfund Public Health Evaluation Manual, October, 1986

mg/kd-day = milligrams per kilogram body weight per day

TABLE 4-13, continued
ORAL TOXICITY DATA FOR LF-023
CONTAMINANTS OF POTENTIAL CONCERN

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

NONCARCINOGENIC EFFECTS

COMPOUND	CHRONIC ORAL RfD (mg/kg-day)	SOURCE	STUDY TYPE	CONFIDENCE LEVEL	CRITICAL EFFECT	TEST ANIMAL	UNCERTAINTY FACTOR
INORGANICS	0.001	HEAST	DW		Keratosis and hyperpigmentaio	Human	UF = 1
Arsenic							
Silver	0.003	IRIS	Theraputic	Medium	Argyria	Human	UF = 2, L
VOLATILE ORGANICS							
Chloroform	0.01	IRIS	Toothpaste	Medium	Fatty cysts-liver	Dog	UF = 1,000, H,A,L
Vinyl Chloride	0.009	1,1-DCE (1)					
1,1-Dichloroethene	0.009	IRIS	Drinking Water	Medium	Hepatic lesions	Rat	UF = 1,000, H,A,L
Benzene	NA						
Chlorobenzene	0.02	IRIS	Capsule	Medium	Histepathologic changes-liver	Dog	UF = 1,000, H,A,S
Ethylbenzene	0.1	IRIS	Gavage	Low	Liver and kidney toxicity	Rat	UF = 1,000, H,A,S
Xylene	2	IRIS	Gavage	Medium	Hyperactivity, decreased body weight gain, mortaility	Rat	UF = 100, H,A
SEMI-VOLATILE ORGANICS							
Fluoranthene	0.04	IRIS	Gavage	Low	Nephropathy, increased liver weights, hematologic alterations	Mouse	UF = 3,000, H,A,S,D
Pyrene	0.03	IRIS	Gavage	Low	Kidney effects	Mouse	UF = 3,000, H,A,S,D
Benzo(a)anthracene	0.004	Naphthalene (2)					
Chrysene	0.004	Naphthalene					
Benzo(b)fluoranthene	0.004	Naphthalene					
Benzo(k)fluoranthene	0.004	Naphthalene					
Benzo(a)pyrene	0.004	Naphthalene					
Napthalene	0.004	HEAST	Gavage	NA	Decreased body weight gain	Rat	UF = 10,000
2-Methylnapthalene	0.004	Naphthalene					
Acenapthene	0.06	IRIS	Gavage	Low	Hepatotoxicity	Mouse	UF = 3,000, H,A,S,D
Dibenzofuran	NA						
Fluorene	0.04	IRIS	Gavage	Low	Hematologic alterations	Mouse	UF = 3,000, H,A,S,D
Phenanthrene	0.004	Naphthalene					
Anthracene	0.3	IRIS	Gavage	Low	No observed effects	Mouse	UF = 3,000, H,A,S,D

TAB443.WK1

TABLE 4-13, continued
ORAL TOXICITY DATA FOR LF-023
CONTAMINANTS OF POTENTIAL CONCERN

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

NONCARCINOGENIC EFFECTS

COMPOUND	CHRONIC ORAL RfD (mg/kg-day)	SOURCE	STUDY TYPE	CONFIDENCE LEVEL	CRITICAL EFFECT	TEST ANIMAL	UNCERTAINTY FACTOR
SEMI-VOLATILE ORGANICS							
Indeno(1,2,3-cd)pyrene	0.004	Naphthalene					
Dibenz(a,h)anthracene	0.004	Naphthalene					
Benzo(g,h,i)perylene	0.004	Naphthalene					
PCBS							
Aroclor-1254	0.0001	LTHA					

NOTES:

1. The oral RfD for 1,1-dichloroethene (1,1-DCE) was used for vinyl chloride.
2. The oral RfD for naphthalene was used for all PAHs that lack chemical-specific values.

IRIS - Integrated Risk Information System, March 1991

HEAST - Health Effects Assessment Summary Tables, 4th Quarter 1990

LTHA - Long Term Health Advisory, Office of Drinking Water

mg/kd-day = milligrams per kilogram body weight per day

NA - not available

Uncertainty Factors (UF) of 10 are applied for each of the following uncertainties:

H = variation in human sensitivity

A = animal to human extrapolation

S = use of subchronic rather than chronic study

L = use of a LOAEL rather than a NOAEL

An additional UF of 1 to 10 may be applied to account for other uncertainties such as inadequacies in the data base (D) or the severity of the effect.

TABLE 4-14
INHALATION TOXICITY DATA FOR LF-023
CONTAMINANTS OF POTENTIAL CONCERN

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

CARCINOGENIC EFFECTS

COMPOUND	CANCER SLOPE FACTOR (mg/kg-day)-1	SOURCE	STUDY TYPE	WEIGHT OF EVIDENCE	TEST ANIMAL	CANCER TYPE
VOLATILE ORGANICS						
Vinyl Chloride	0.295	HEAST	Inhalation	A	Rat	Liver
Chloroform	0.081	IRIS	Gavage	B2	Mouse	Liver
Benzene	0.035	IRIS (1)	Occupational	A	Human	Leukemia
SEMI-VOLATILE ORGANICS						
Benzo(a)anthracene	6.1	BaP (2)				
Chrysene	6.1	BaP				
Benzo(b)fluoranthene	6.1	BaP				
Benzo(k)fluoranthene	6.1	BaP				
Benzo(a)pyrene	6.1	SPHEM	Inhalation	B2	Hampster	Respiratory tract
Indeno(1,2,3-cd)pyrene	6.1	BaP				
Dibenz(a,h)anthracene	6.1	BaP				
Benzo(g,h,i)perylene	6.1	BaP				
PCBS						
Aroclor-1254	7.7	Oral (3)				

NOTES:

1. Cancer SF for benzene based on a unit risk of 1E-05 per $\mu g/m^3$.
2. The cancer SF for benzo(a)pyrene was used for all carcinogenic PAHs that lack chemical-specific values.
3. The oral cancer SF was used for PCBs in the absence of an inhalation value.

HEAST - Health Effects Assessment Summary Tables, 4th Quarter 1990

IRIS - Integrated Risk Information System, March 1991

SPHEM - Superfund Public Health Evaluation Manual, October, 1986

mg/kd-day = milligrams per kilogram body weight per day

TAB4-14.WK1

it is also standard practice to use this value for the other carcinogenic PAHs: (benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene, because of the lack of suitable chemical-specific values.

The oral cancer SF for arsenic presented in Table 4-13 is based on a drinking water unit risk value of $5x10^{-5}$ $(\mu g/L)^{-1}$. The caveer SF of 1.75 $(mg/kg\text{-}day)^{-1}$ is derived by assuming that the average individual drinks 2 liters of water per day and weighs 70kg.

The oral cancer SF used for Aroclor-1254 is based on a toxicologic study of the carcinogenic effects of Aroclor-1260. Aroclor is a trade name for PCBs, and the associated number denotes the degree of chlorination. The USEPA has recommended the Aroclor-1260 cancer SF be used for all mixtures of PCBs, including single compounds (IRIS, 1990).

The USEPA has derived inhalation cancer SFs for vinyl chloride, chloroform, beuzene, and benzo(a)pyrene. Like the oral value, the inhalation cancer SF for benzo(a)pyrene is also no longer approved by USEPA. However, it remains standard practice to use this value for all carcinogenic PAHs. A similar surrogate inhalation value for Aroclor-1254 is not available. Therefore, the oral cancer SF was used to estimate inhalation toxicity.

In terms of noncarcinogenic effects, oral RfD values could not be identified for many of the contaminants of potential concern at LF-023. Most of these compounds are PAHs. In the absence of chemical-specific values for individual PAHs, it is standard practice to use as a surrogate the RfD for naphthalene, the most toxic of the PAHs for which an RfD has been derived by USEPA.

No oral RfD could be identified for Aroclor-1254. However, a surrogate RfD was derived from the Longer-term Health Advisory (HA) developed by the USEPA Office of Drinking Water. HAs represent concentrations of chemicals in drinking water at which adverse noncarcinogenic health effects would not be expected to occur over a given period of exposure. The Longer-term HA is based on a period corresponding to 10 percent of a lifetime, or 7 years. The Longer-term HA for PCBs is 4 $\mu g/L$. By assuming the average adult ingests 2 liters of water per day and weighs 70 kg, a surrogate RfD of 0.0001 mg/kg-day was derived.

The USEPA has not developed inhalation RfD values for any contaminants of potential concern at LF-023. Therefore, the oral values were used to estimate inhalation toxicity.

In addition to slope factors and RfD values, Tables 4-13 and 4-14 also present the source of these values, and the study type used to determine these values. These values will be used along with the chemical intake estimates derived in the exposure assessment to estimate the potential risks to human health associated with the LF-023 site.

For in-depth discussion of the assumptions involved in deriving toxicity values, see Appendix O. This appendix also contains Toxicity Profiles for each contaminant of potential concern at LF-023. Toxicity Profiles describe the inherent toxic properties of the contaminants of potential concern for LF-023, and also discuss the toxicity values for each contaminant of potential concern.

4.4.2.3 Risk Characterization. Quantitative estimates of both carcinogenic and noncarcinogenic risks were calculated for LF-023 according to the procedures described in Subsection 3.4.2.3 of the LF-022 baseline risk assessment. Risk estimates were calculated for each contaminant of potential concern identified in the toxicity assessment and each complete exposure scenario identified in the exposure assessment.

Estimation of Risks. This risk assessment identified eight complete exposure pathways relevant to current and future conditions at the LF-023 site:

Current Site Conditions

1. Incidental Ingestion of and Direct Contact with Surface Soil by a Security Policeman

2. Incidental Ingestion of and Direct Contact with Surface Soil by a Child Trespasser

3. Incidental Ingestion of and Direct Contact with Surface Water by a Child Trespasser

4. Inhalation of Vapors and Fugitive Dusts by a Nearby Resident

Future Site Conditions

1. Ingestion of, Direct Contact with, and Inhalation of Volatile Compounds from Groundwater by a Future Resident

2. Incidental Ingestion of and Direct Contact with Surface Soil by a Future Resident

3. Incidental Ingestion of and Direct Contact with Surface Water by a Future Child Resident

4. Inhalation of Vapors and Fugitive Dusts by a Future Resident

The resulting risk estimates for each of these scenarios are presented in Tables 4-15, 4-16, and 4-17. The spreadsheets used to calculate these values are presented in Appendix N.

Current Site Conditions

Incidental Ingestion of and Direct Contact with Surface Soil - Security Police. Security policemen could be exposed to surface soil contaminants during training exercises involving the use of the obstacle course at LF-023. As indicated in Table 4-15, the carcinogenic risks associated with exposure to such individuals is estimated at $9x10^{-5}$ and $3x10^{-4}$ depending on the exposure point concentration used. The latter estimate is above the USEPA target risk range while the former is within the range. Virtually 100 percent of each of these risk estimates is attributable to carcinogenic PAHs in surface soil.

The lower of the two estimates is based on the sitewide average concentrations of contaminants. The upper estimate is based on the concentration detected in the southeast quadrant. Most of the obstacle course apparatus is actually located in the northeastern quadrant, in which no PAHs were detected. Therefore, these values represent conservative estimates of potential cancer risk. Of the two values, the most accurate estimate of cancer risk to this population is the value based on the sitewide average, because it is unlikely that the same individual would be exposed repeatedly to soil only in the southeast quadrant.

The Hazard Indices associated with this hypothetical exposure scenario are 0.07 and 0.3. Both of these estimates are below the USEPA target hazard index of 1.

TABLE 4-15
SUMMARY OF LF-023 SITE RISK ESTIMATES - SECURITY POLICE

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

TYPE OF EFFECT	EXPOSURE ROUTE, MEDIUM AND EXPOSURE POINT	PATHWAY-SPECIFIC CANCER RISK OR HAZARD INDEX	TOTAL CANCER RISK OR HAZARD INDEX
CARCINOGENIC EFFECTS			
Site-wide Average	Direct contact with surface soil	8E-05	
	Ingestion of surface soil	1E-05	9E-05
Southeast Quadrant	Direct contact with surface soil	3E-04	
	Ingestion of surface soil	4E-05	3E-04
NONCARCINOGENIC EFFECTS			
Site-wide Average	Direct contact with surface soil	0.06	
	Ingestion of surface soil	0.01	0.07
Southeast Quadrant	Direct contact with surface soil	0.3	
	Ingestion of surface soil	0.05	0.3

TABLE 4-16
SUMMARY OF LF-023 SITE RISK ESTIMATES - CHILD TRESPASSER

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

TYPE OF EFFECT	EXPOSURE ROUTE, MEDIUM AND EXPOSURE POINT	PATHWAY-SPECIFIC CANCER RISK OR HAZARD INDEX	TOTAL CANCER RISK OR HAZARD INDEX
CARCINOGENIC EFFECTS			
Site-wide Average	Direct contact with surface soil	6E-06	
	Ingestion of surface soil	3E-06	9E-06
Southeast Quadrant	Direct contact with surface soil	2E-05	
	Ingestion of surface soil	1E-05	3E-05
	Incidental ingestion of surface water	1E-06	
	Direct contact with surface water	3E-08	1E-06
		Total - Site-wide Average	1E-05
		Total - Southeast Quadrant	3E-05
NONCARCINOGENIC EFFECTS			
Site-wide Average	Direct contact with surface soil	0.002	
	Ingestion of surface soil	0.001	0.003
Southeast Quadrant	Direct contact with surface soil	0.01	
	Ingestion of surface soil	0.003	0.01
	Incidental ingestion of surface water	0.006	
	Direct contact with surface water	0.0001	0.006
		Total - Site-wide Average	0.009
		Total - Southeast Quadrant	0.02

TAB4RISK.WK1

TABLE 4-17
SUMMARY OF LF-023 SITE RISK ESTIMATES - FUTURE RESIDENT

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

TYPE OF EFFECT	EXPOSURE ROUTE, MEDIUM AND EXPOSURE POINT	PATHWAY-SPECIFIC CANCER RISK OR HAZARD INDEX		TOTAL CANCER RISK OR HAZARD INDEX	
CARCINOGENIC EFFECTS		CHILD	ADULT	CHILD	ADULT
	Direct contact with groundwater	4E-07	1E-06		
	Ingestion of groundwater	6E-04	7E-04		
	Inhalation of volatiles - showering	5E-05	4E-05	7E-04	7E-04
Site-wide Average	Direct contact with surface soil	4E-04	6E-04		
	Ingestion of surface soil	3E-04	1E-04	7E-04	7E-04
Northwest Quadrant	Direct contact with surface soil	1E-03	2E-03		
	Ingestion of surface soil	1E-03	5E-04	2E-03	3E-03
	Incidental ingestion of surface water	2E-07			
	Direct contact with surface water	7E-06		8E-06	
	Inhalation of vapors and dusts	2E-04	1E-04	2E-04	1E-04
	Total: Site-Wide Average			2E-03	2E-03
	Total: Northwest Quadrant			3E-03	4E-03
	Total: Site-Wide Average			3E-03	
	Total: Northwest Quadrant			6E-03	
NONCARCINOGENIC EFFECTS		CHILD	ADULT	CHILD	ADULT
	Direct contact with groundwater	0.003	0.002		
	Ingestion of groundwater	0.9	0.2		
	Inhalation of volatiles - showering	0.3	0.06	1.2	0.3
Site-wide Average	Direct contact with surface soil	0.2	0.08		
	Ingestion of surface soil	0.2	0.02	0.4	0.1
Northwest Quadrant	Direct contact with surface soil	0.8	0.4		
	Ingestion of surface soil	1	0.09	2	0.5
	Incidental ingestion of surface water	0.0007			
	Direct contact with surface water	0.03		0.03	
	Inhalation of vapors and dusts	5	0.8	5	0.8
	Total: Site-Wide Average			7	1
	Total: Northwest Quadrant			8	2

Incidental Ingestion of and Direct Contact with Surface Soil - Child Trespasser. Potential risks to older children and teenagers associated with exposure to surface soil while trespassing on LF-023 were assessed despite the fact that trespassing in this area is unlikely. As indicated in Table 4-16, carcinogenic risks associated with this potential exposure pathway are $9x10^{-6}$, and $3x10^{-5}$, depending on the data set used. Each of these estimates is within the USEPA target risk range of 10^{-6} to 10^{-4}. Carcinogenic PAHs are responsible for essentially 100 percent of the risks associated with this surface soil exposure pathway as well.

The most accurate risk estimate for child trespassers is the lower of the two values ($9x10^{-6}$) because this number is based on sitewide average soil concentrations. As indicated in the Exposure Assessment, the average over the entire landfill represents the concentration to which children are most likely to be exposed because random exposure is likely. This value represents the potential cancer risk if children were to trespass on LF-023 for five days per year. Therefore, the estimated potential cancer risk of $9x10^{-6}$ is a conservative estimate.

The Hazard Indices associated with the child trespasser scenario are 0.03 and 0.01 depending on the data set. These values are both below the target Hazard Index of 1.

Incidental Ingestion and Direct Contact With Surface Water - Child Trespasser. In addition to trespassing on the landfill, children may also explore in the swamp south of LF-023. The potential risks associated with exposure to arsenic in seeps were estimated assuming that children would be exposed in this area for five days per year. These risk estimates are presented in Table 4-16.

The estimated cancer risk associated with exposure to arsenic in surface water is $1x10^{-6}$. This value is at the lower end of the USEPA target risk range. The estimated Hazard Index for this scenario is 0.006, which is below the target of 1. Both values represent conservative estimates as this area is somewhat isolated and an exposure frequency of 5 days/year may be an overestimate.

Inhalation of Vapors and Fugitive Dust Emissions - Nearby Resident. An evaluation of the potential risks associated with exposure to vapors and fugitive dust emissions on nearby populations was assessed. As presented in Subsection 4.3.6, airborne concentrations of surface soil contaminants were estimated at a distance of 200 m from the edge of the landfill. This corresponds to the approximate distance between LF-023 and the mobile home development to the southwest. The potential risks

associated with exposure to these contaminants were assessed using a conservative exposure model represented by a child and an adult resident of this mobile home development.

The cancer risk estimates associated with this potential exposure are $2x10^{-6}$ for the child receptor and $2x10^{-6}$ for the adult. The associated hazard indices are 0.04 and 0.006 for the child and adult, respectively. Both cancer risk estimates are within the USEPA target risk range while the two indices are below the target of 1.

Future Site Conditions

Ingestion of, Direct Contact with, and Inhalation of Volatile Compounds from Groundwater - Future Resident. Although groundwater immediately downgradient of LF-023 is not a source of drinking water, groundwater is used to the west (crossgradient) of the site by residents of a mobile home development. Groundwater downgradient of LF-023 is not likely to be used as a drinking water source in the future unless Plattsburgh AFB were to close. Nevertheless, the potential risks associated with exposure to groundwater contaminants as a result of use as a potable supply were assessed to evaluate the VOC contamination detected. Both a child and an adult receptor were evaluated. Because volatile compounds are present in groundwater, there are three potential routes of exposure to contaminants: ingestion, direct contact, and inhalation. These risk estimates are presented in Table 4-17.

As indicated in Table 4-17, the total carcinogenic risks to a hypothetical future resident associated with exposure to the maximum concentrations of groundwater contaminants are $7x10^{-4}$ for both the child and adult receptors. These risk estimates are above the target risk range established by USEPA. Most of these elevated risks are associated with the ingestion route of exposure, 85 percent for the child and 94 percent for the adult. Ninety-nine percent of each of these ingestion estimates is associated with vinyl chloride. In fact, 98 percent of the total cancer risks associated with exposure to groundwater contaminants via the three exposure routes is due to vinyl chloride.

The hazard indices associated with exposure to the maximum concentration of groundwater contaminants for ingestion, direct contact, and inhalation are 1.2 for the child and 0.3 for the adult. The former value is slightly above the USEPA target hazard index of 1.

Incidental Ingestion and Direct Contact with Surface Soil - Future Resident. The risks associated with exposure of a hypothetical future resident to contaminants in surface soil are presented in Table 4-17. Two sets of cancer and noncancer risk estimates are presented based on the two sets of surface soil data, site-wide average concentrations and concentrations from the most contaminated quadrant (southeast). Potential risks were also assessed separately for children and adults.

As indicated in Table 4-17, the cancer risks associated with a child being exposed to surface soil are $7x10^{-4}$ and $2x10^{-3}$, using the two surface soil data sets. The analogous cancer risks for an adult are $7x10^{-4}$ and $3x10^{-3}$. These values are all above the USEPA target cancer risk range. Essentially 100 percent of these elevated cancer risks are attributable to carcinogenic PAHs.

The associated hazard indices for a child are 0.4 and 1, while the hazard indices for an adult are 0.1 and 0.5. Of these four risk estimates, are all below the USEPA target of 1 except the hazard index for a child based on the surface soil concentrations within the southeast quadrant. Seventy percent of this elevated hazard index is attributable to four PAHs, phenanthrene (40 percent), benzo(a)anthracene (10 percent), benzo(b)fluoranthene (10 percent), and benzo(k)fluoranthene (10 percent). As indicated previously, risk estimates based on the concentrations within the most contaminated quadrant represent conservative estimates because is the unlikely that an individual would be exposed to surface soil only within this one quadrant.

Incidental Ingestion and Direct Contact With Surface Water - Future Child Resident. The potential risks associated with exposure to surface water were assessed based on the same older child/teenager population used under current site conditions. The only difference was an increase in the frequency of exposure based on the assumption that the base might close. The cancer and noncancer risk estimates for this exposure pathway are presented in Table 4-17. As indicated, the estimated cancer risk is $8x10^{-6}$. This value is within the USEPA target cancer risk range. The estimated hazard index is 0.03, which is below the target of 1.

Inhalation of Vapors and Fugitive Dust Emissions - Future Resident. An evaluation of the potential risks associated with exposure to vapors and fugitive dust emissions on future populations was assessed assuming the base were to close and houses were built adjacent to LF-023. As presented in Subsection 4.3.6, airborne concentrations of surface soil contaminants were estimated at a distance of 1 m from the edge of the landfill. The potential risks associated with exposure to these contaminants were

assessed using a conservative exposure model represented by a child and an adult resident living immediately adjacent to the landfill.

The cancer risk estimates associated with this exposure pathway are $2x10^{-4}$ for the child and $1x10^{-4}$ for the adult. Both values are above the target risk range established by the USEPA. The corresponding hazard indices for the child and adult receptors are 5 and 0.8, respectively. The former hazard index is above the USEPA target of 1.

Combination of Exposure Pathways. Following USEPA guidance for combining exposure pathways, there are two potentially exposed populations for which exposure pathways may be combined for LF-023: (1) a child trespasser under current site conditions, and (2) a future resident (child and adult).

Two exposure pathways may be combined for the child trespasser population: (1) incidental ingestion of and direct contact with surface soil, and (2) incidental ingestion of and direct contact with surface water. The combined risk estimates are presented in Table 4-16. The combination of these pathways results in a total site cancer risk for the child trespasser population of $1x10^{-5}$ or $3x10^{-5}$, depending on which surface soil data sets are used. These cancer risks are within the USEPA target cancer risk range of 10^{-6} to 10^{-4}. The corresponding total site hazard indices are 0.009 and 0.02, both of which are below the USEPA target hazard index of 1.

There are a total of four exposure pathways that may be combined for a hypothetical future resident: (1) incidental ingestion of, direct contact with, and inhalation of volatiles from groundwater, (2) incidental ingestion of and direct contact with surface soil, (3) incidental ingestion of and direct contact with surface water, and (4) inhalation of vapors and fugitive dusts. With the exception of the surface water pathway, which is applicable only to the child receptor, these pathways may be combined for the child and adult. In addition, if one assumes that the child and adult receptors in these scenarios represent the same individual at different stages of development, as was done for LF-022, then the total site cancer risks for the child and adult may be combined into one estimate for a future resident population. These combined risk estimates are presented in Table 4-17.

Combining the cancer risk estimates for the four child exposure scenarios results in total site cancer risks of $2x10^{-3}$ or $3x10^{-3}$ (based on the two surface soil data sets). The combined cancer risk estimates for the adult are $2x10^{-3}$ and $4x10^{-3}$. Combining these two sets of estimates into a single set results in total site cancer risks for a

hypothetical future resident of $3x10^{-3}$ or $6x10^{-3}$. Both values are above the USEPA target risk range.

All of the cancer risk estimates that were used in these combined values were either above or within the USEPA target risk range. However, the majority of the total site risk may be attributable (about equally) to the groundwater and surface soil pathways. As indicated previously, most of the cancer risk associated with exposure to groundwater is attributable to vinyl chloride while most of the risk associated with surface soil is attributable to carcinogenic PAHs.

The combined total site hazard indices for the child receptor are 7 or 8 depending on which surface soil data set is used. The combined hazard indices for the adult are 1 and 2. Of these, only the hazard index for the adult receptor that incorporates the surface soil scenario based on the site-wide averages is below the USEPA target of 1. All other are above the target hazard index. For the child receptor, the majority of the elevated hazard index is attributable to the inhalation of vapors and dust (71 or 63 percent).

Uncertainties and Limitations in Risk Assessment. The interpretation of these risk estimates is subject to a number of uncertainties as a result of the multiple layers of conservative assumptions inherent in risk assessment. All quantitative estimates of risk are based on numerous assumptions, most intended to be protective of public health (i.e., conservative). As such, risk estimates are not truly probabilistic estimates of risk, but rather conditional estimates given a series of conservative assumptions about exposure and toxicity.

In general, sources of uncertainty can be categorized into site-specific factors and toxicity assessment factors. A thorough discussion of all potential sources of uncertainty in this risk assessment is beyond the scope of this report. However, a summary of potential sources relevant to the LF-023 site, and the likely direction of their effect (i.e., to overestimate or underestimate risks), is presented in Table 4-18.

The most significant source of uncertainty in this risk assessment is the likelihood of exposure pathways. The elevated risks calculated here indicate that future residents of these homes might be at an increased risk of developing cancer or other systemic effects as a result of exposure to contaminants at this site. However, for such individuals to be at an increased risk, Plattsburgh AFB would have to close and residential housing would have to be built adjacent to LF-023. In addition, residents of these homes would have to install private wells as their source of potable water.

TABLE 4-18
POTENTIAL SOURCES OF UNCERTAINTY FOR LF-023

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

Potential Source	Direction of Effect	Justification
Likelihood of exposure pathways	Over-estimate	Pathways may not actually occur (e.g., trespassing, future resident).
Lack of consideration of degradation of chemicals.	Under-estimate	Risk estimates are based on recent chemical concerntations. Concentration will tend to decrease with time as a result of degradation processes.
Exposure assumptions (frequency, duration and intensity).	Over-estimate	Parameters selected are conservative estimates of exposure.
Limited analytical data set	Unknown	Few samples were collected for surface soil and surface water. Concentrations detected may not represe concentrations to which people might be exposed.
Absorption of soil contaminants through the skin.	Over-estimate	Dermal absorption of chemicals is a function of the length of actual skin contact. Contact at the site may be insufficient to result in the amount of absorption assumed.
Extrapolation of animal toxicity data to humans.	Unknown, probably over-estimate	Animals and humans differ with repect to absorption, metabolism, distribution, and excretion of chemicals. The magnitude and direction of the difference will vary with each chemical. Animal studies typically involve high-dose exposures, whereas humans are exposed to low doses in the environment.

TAB4-18.WK1

TABLE 4-18
POTENTIAL SOURCES OF UNCERTAINTY FOR LF-023

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

Potential Source	Direction of Effect	Justification
Use of linearized, multi-stage model to derive cancer slope factors.	Over-estimate	Model assumes a non-threshold, linear at low dose relationship for carcinogens. Many compounds induce cancer by non-genotoxic mechanisms Model results in a 95 % upper confidence limit of the cancer risk. The true risk is unlikely to be higher and may be as low as zero.
Summation of effects (cancer risks and hazard indices) from multiple substance.	Unknown	The assumption that effects are additive ignores potential synergistic and/or antagonistic effects. Assumes similarity in mechanism of action, which is not the case for many substances. Compounds may induce tumors or other toxic effects in different organs or systems.
Use of uncertainty factors in the derivation of reference doses.	Unknown	Ten-fold uncertainty factors are incorporated to account for various sources of uncertainty (animal to human extrapolation, protection of sensitive human populations, extrapolation from subchronic to chronic data, and use of LOAELS rather than NOAELs). Although some data seem to support the ten-fold factor, its selection is somewhat arbitrary.

TAB4-18.WK1

Given the unlikely nature of these events, all risk estimates based on this future resident scenario reflect "worst-case" conditions.

4.4.3 Habitat-Based Environmental Risk Assessment

The purpose of the Habitat-Based ERA for LF-023 is to define potential ecological effects resulting from exposure to chemicals in environmental media at the site. The ERA for LF-023 contains the same elements as the ERA for LF-022:

- Ecological Exposure Assessment
- Hazard Identification
- Ecological Risk Characterization
- Uncertainties

As with LF-022, the ERA for LF-023 was conducted in accordance with federal and state guidance where practicable. Potential ecological receptors of chemical contamination at LF-023 are identified in Subsection 4.1.7.

4.4.3.1 Ecological Exposure Assessment. The purpose of the ecological exposure assessment is to evaluate the potential for exposure to site-related chemicals at LF-023. This involves identification of actual or potential exposure routes to receptors (identified in the Description of the Existing Environment in Subsection 4.1.7) and evaluation of the magnitude of exposure to aquatic and terrestrial organisms. In this subsection, exposure concentrations are estimated for each receptor via each pathway. This exposure information is used with the toxicological information in Subsection 4.4.3.2 to evaluate ecological risk in the ecological risk characterization (Subsection 4.4.3.3).

Terrestrial organisms may be exposed to chemicals present in surface soils through several exposure pathways. No exposure pathways exist for groundwater or subsurface soil at the site because terrestrial organisms are not expected to come in contact with subsurface media (i.e. below approximately 2 feet depth) because no prey exist in subsurface areas. However, terrestrial organisms may be exposed to chemicals in seeps receiving groundwater discharge from the landfill in wetland unit PB-14 south of the landfill. There are no aquatic habitats on the site, and wetland PB-14 is not expected to support fish because standing water is not present throughout the year. However, aquatic invertebrates may live in the wetland and therefore might be receptors of groundwater discharging to the wetland.

Analytical data used in the ecological exposure assessment consist of data for surface soil and seep surface water samples discussed in Subsection 4.4.1. Surface soil data, which consist of four composite samples collected from four quadrants on the site, are summarized by quadrant (see Table 4-11). Additionally, a sitewide weighted average concentration of each chemical is presented.

Surface water and sediment samples were collected from two seep areas south of the site: SW-23-001 and SW-23-002. Sample SW-23-002 is located on the northern edge of wetland unit PB-14, and was the only seep sample used in the exposure assessment because all the site-related contaminants for surface water were detected in it. The only site-related contaminant detected in sample SW-23-001 was iron, present at a much lower concentration than in SW-23-002. The only site-related contaminant detected in sediments, PHCs, was not evaluated in the ecological evaluation because there are no toxicity data available for PHCs.

On-Site Exposures. Exposure to site-related contaminants in surface soil may occur via direct contact with and ingestion of surface soils, and ingestion of biota with bioaccumulated chemicals in their tissues. Because of the lack of species-specific data concerning chemical uptake via dermal contact and the inherent variability in uptake rates among species, this exposure pathway was not evaluated. The following five indicator species were selected to represent exposures to terrestrial organisms via ingestion of food and soil:

- White-footed mouse (*Peromyscus leucopus*), small mammal, omnivore
- Wood thrush (*Hylocichla mustelina*), small bird, omnivore
- Garter snake (*Thamnophis s. sirtalis*), herptile, carnivore
- Red fox (*Vulpes vulpes*), predatory mammal, omnivore
- Red-tailed hawk (*Buteo jamaicensis*), predatory bird, carnivore

These species were selected because they are representative of exposures to the range of mammals, birds, and herpetofauna (reptiles and amphibians) that may occur at the site. They are relatively common species in the vicinity of Plattsburgh AFB selected from the species lists in Appendix J, Tables J-1 through J-4, based on the habitats at the site and feeding preferences. Some of these species (e.g., red fox, red-tailed hawk) have been observed at Plattsburgh AFB during the remedial investigation. As shown, these species represent small mammals, small birds, herpetofauna, predatory mammals, and predatory birds. Modeling of exposures to rare species was not performed because no rare, threatened, or endangered species have been identified at Plattsburgh AFB (see Section 4.1.7).

Small mammals and birds are primary consumers, with most of their diet consisting of plants and decomposers (i.e., soil invertebrates). Herpetofauna may also be considered primary consumers, although a greater proportion of their diet may consist of animals. Predatory mammals may be primarily carnivorous, but subsist on plant matter when animal food is lacking. Predatory birds are expected to rely almost entirely on animal matter.

Exposures to these organisms were estimated using spreadsheet food web models, (see Appendix J, Table J-10). The documentation and derivation of exposure parameters used in these models are presented in Appendix J, Table J-6, while bioaccumulation data for site-related chemicals at LF-023 used in the models is presented in Appendix J, Table J-11.

A composite sample of surface soils was collected in each of the four quadrants of LF-023: northeast (NE), northwest (NW), southwest (SW), and southeast (SE). The locations of the NE, NW, SW, and SE quadrants (where surface soil samples SS-01, SS-02, SS-03, and SS-04 were collected, respectively) are shown in Figure 4-12. Each composite sample represents an average concentration of the 17 to 25 subsamples collected in each quadrant.

Modeling of acute and chronic exposures was performed separately for each quadrant based on results of this sampling (see Table 4-11). The concentration reported for each sample was used in the chronic food web models, as each sample represents the average concentration in 17 to 25 subsamples. A theoretical maximum concentration was calculated for each chemical in each sample by multiplying the reported concentration by the number of subsamples; these values were used to represent acute exposure to a "hot spot" in the acute exposure models. Additionally, food web modeling was performed for the entire site using a weighted average concentration (calculated by summing the reported concentration multiplied by number of subsamples for each composite sample and dividing by the total number of subsamples from all four composite samples).

Area is important in modeling chronic exposures to ecological receptors because of differences in home range sizes for different species. Organisms with large home ranges (such as the red fox) will spend less time foraging in contaminated areas than will organisms with small home ranges (such as the white-footed mouse), which may spend most or all their time in contaminated areas. For modeling chronic exposure, the areas of the NE, NW, SW, and SE quadrants (5.7, 3.9, 5.1, and 5.3 acres, respectively) were used. Area was not incorporated into the acute exposure models

because, while home range affects the probability of acute exposure, it is not a factor affecting the magnitude of exposure.

Off-Site Exposures. Exposure to chemicals detected in wetland seeps may occur via ingestion of seep surface water and sediment and contaminated prey by terrestrial organisms, or by direct contact by aquatic invertebrates. As performed for surface soil exposure, average and maximum surface water concentration data are typically used to assess chronic and acute exposures, respectively. However, in this case, only one sample (SW-023-02) was used in the ecological risk assessment. This sample was used to evaluate chronic and acute effects under two possible scenarios: (1) chronic exposure--if the concentration in SW-023-02 is representative of surface water concentrations along the northern edge of the wetland; and (2) acute exposure--if the concentration in SW-023-02 represents a localized hot spot (which appears likely given that the samples were collected from a seep).

The raccoon (*Procyon lotor*) was chosen as a representative omnivorous organism for modeling of acute and chronic exposures to arsenic and zinc via food, surface water, and sediment ingestion in the wetland. The exposure model includes sediment exposure because, even though they were not selected as site-related contaminant for sediments, arsenic and zinc in sediments will nonetheless contribute to overall exposure. Exposures to aluminum and iron, two of the site-related contaminants, were not modeled because these chemicals are considered essential elements for terrestrial organisms.

Modeling of exposures to aquatic invertebrates was not necessary because the reported concentrations of site-related contaminants in surface water sample SW-023-02 are representative of exposure concentrations for aquatic organisms. The concentration of site-related contaminants used in the exposure assessment, which are an average of the reported values for two duplicates of SW-023-02, are:

Chemical	Concentration (µg/L)
Aluminum	1990
Arsenic	316
Zinc	355

As described previously, these values were used to represent both acute and chronic exposures. Aluminum was included for aquatic organism exposure because it is toxic to aquatic organisms. Iron was not included for two reasons, even though it was

reported at concentrations above the AWQC of 1 mg/L. First, according to the Water Quality Criteria Summary (USEPA, 1986e), swamp waters (such as those in the wetland south of LF-023) may contain iron at concentrations of several mg/L but in a form that has little effect on aquatic life. Second, the samples collected at SW-023-01 were not filtered and were reportedly turbid, indicating that reported iron concentrations may have been due to the presence of suspended sediment or colloidal matter rather than dissolved iron.

The results of the food web modeling are expressed as a PDE in mg/kg body weight (BW)/day of each chemical under each exposure scenario (see Table J-10 in Appendix J). The PDE for each modeled receptor species is calculated by multiplying each predicted prey species tissue concentration by the proportion of that prey type in the diet, summing these values, and multiplying by the receptor species' Site Foraging Frequency (SFF). The PDE is represented by the following equation:

$$PDE = [\sum_{1 \rightarrow n} P_1 \times T_1 + P_2 \times T_2 + \ldots P_n \times T_n] \times SFF \times \frac{IR}{BW}$$

where
:

PDE	=	Potential Dietary Exposure (mg/kgBW/day)
P_n	=	Percent of prey item **n** ingested
T_n	=	Tissue concentration in prey item **n** (mg/kg), calculated by multiplying the chemical concentration in soil (or for ingestions of primary consumers, the PDE for the primary consumer) by a bioaccumulation factor
SFF	=	Site Foraging Frequency; calculated by dividing the area of the site or quadrant (acres) by the species home range (acres). Set equal to 1.0 for acute exposure scenario.
IR	=	Food Ingestion Rate (kg/day)
BW	=	Body Weight (kg)

These PDE estimates, which are directly comparable to available toxicological test data, are used in conjunction with toxicological data in Subsection 4.4.3.2 to evaluate ecological risks in the risk characterization (Subsection 4.4.3.3).

4.4.3.2 Hazard Identification. In the Hazard Identification, the toxicity of each site-related chemical is described. Information necessary to evaluate the potential effects to receptors at the exposure concentrations determined in Subsection 4.4.3.1 consists of published laboratory-derived toxicological data and threshold toxicity values developed using extrapolation techniques. Based on these data, RTVs are developed for terrestrial and aquatic organisms that represent a toxic threshold concentration in soil, water, or food.

Toxicity data for terrestrial receptors consist of acute and chronic ingestion studies. Terrestrial toxicologic data for site-related chemicals used in this ERA are presented in Appendix J, Table J-12. From the toxicological data set, the lowest acute or chronic value for each type of receptor (e.g., small mammal and small bird) was selected as the acute or chronic RTV, respectively. Because the lowest toxicity values were selected, the RTVs should be protective of the most sensitive species tested. The RTVs for terrestrial organisms for are indicated as shaded values in Appendix J, Table J-12.

Generally, the LOAEL was used as the chronic RTV. In cases where no chronic data are available, two factors were applied to the acute LD_{50} (i.e., single dose lethal to 50 percent of the test organisms). These factors are: (1) a factor of 0.2 for extrapolating from the oral LD_{50} to a value expected to protect 99.9 percent of the population against acute effects (USEPA, 1986d); and (2) a factor of 0.1 for extrapolating from acute to chronic values (the acute-chronic ratio for many chemicals is approximately 10).

Information available to evaluate toxicity to aquatic organisms includes AWQC, laboratory-derived toxicity data, and toxicity threshold values developed using extrapolation techniques (acute-chronic ratios and surrogate chemicals). These sources were used to generate acute and chronic RTVs for each site-related chemical in surface water. The RTVs for aquatic organisms are listed in the aquatic risk assessment in Appendix J, Table J-16.

Acute and chronic AWQC are available for all site-related contaminants in surface water (i.e., aluminum, arsenic, and zinc) and were selected as the acute and chronic RTVs, respectively. The AWQC are guidelines developed under the Clean Water Act for use in permitting wastewater discharges to surface water. These criteria specify the concentration of a compound in ambient water which, if not exceeded, should protect most (95 percent) species of aquatic life and their uses. The AWQC are derived from both plant and animal data and are developed to protect the types

of organisms necessary to support an aquatic community. The AWQC consider both acute (short-term) and chronic (long-term) effects. The acute and chronic criteria should not be exceeded by the 1-hour and four-day average chemical concentration, respectively, more than once every three years.

4.4.3.3 Ecological Risk Characterization. This subsection characterizes risks to terrestrial and aquatic receptors potentially exposed to site-related chemicals in surface soil at LF-023 and to surface water in wetland PB-14 south of the site. The magnitude of risk depends on the nature, duration, and frequency of exposure to the chemicals and on the characteristics of the exposed populations. This exposure information, detailed in Subsection 4.4.3.1, combined with the appropriate concentration-response toxicity data in Subsection 4.4.3.2, is the basis for the risk characterization.

The evaluation of risks to terrestrial and aquatic biota is presented in the following Appendix J tables: Table J-13 (risks to terrestrial organisms associated with surface soil exposure); Table J-14 (risks to raccoon ingesting water, sediment, and food from the seep in the wetland); and Table J-15 (risks to aquatic organisms in the wetland). The results of the risk assessment are summarized in Tables 4-19 and 4-20 for surface soil and seep exposures, respectively.

Risks to terrestrial biota exposed to surface soils at LF-023 were evaluated by comparing the acute (theoretical maximum) and chronic (average) PDE for each indicator species estimated in exposure scenarios with the acute and chronic RTVs, respectively (see Table J-13 in Appendix J). By dividing the PDE by the appropriate RTV, a Hazard Index is calculated. The Hazard Index for the individual chemicals are then summed to yield a summary Hazard Indices. The chronic and acute summary Hazard Indexes for each indicator species exposed to surface soil are presented in Table 4-19. Risks to organisms exposed to chemicals in the seep at the northern edge of the wetland (i.e., raccoon and aquatic invertebrates) are summarized in Table 4-20. Summary Hazard Index values were again calculated by dividing the exposure concentration by the appropriate RTV for each chemical and summing the individual Hazard Index values.

Adopting a technique developed for the ecological evaluation of pesticides (USEPA, 1986d) yields the following relative Hazard Index ranking:

$HI < 0.1$	No Adverse Effects
$0.1 \leq HI < 10$	Possible Adverse Effects

TABLE 4-19
SUMMARY OF ECOLOGICAL RISK ASSESSMENT FOR SURFACE SOILS AT LF-023

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

INDICATOR SPECIES	CHRONIC SUMMARY HAZARD INDEX BY AREA				
	Northeast	Northwest	Southwest	Southeast	Entire Site
White-footed Mouse	3.1×10^{-2}	1.9×10^{-2}	7.2×10^{-3}	9.0×10^{-1}	2.5×10^{-1}
Wood Thrush	2.5×10^{-2}	2.2×10^{-2}	1.1×10^{-2}	$1.1 \times 10^{+0}$	3.1×10^{-1}
Garter Snake	1.2×10^{-2}	1.7×10^{-2}	1.1×10^{-2}	$1.4 \times 10^{+0}$	3.8×10^{-1}
Red Fox	8.9×10^{-5}	6.8×10^{-5}	4.3×10^{-5}	5.4×10^{-3}	5.7×10^{-3}
Red-Tailed Hawk	8.1×10^{-5}	5.2×10^{-5}	2.8×10^{-5}	4.2×10^{-3}	4.4×10^{-3}

INDICATOR SPECIES	ACUTE SUMMARY HAZARD INDEX BY AREA				
	Northeast	Northwest	Southwest	Southeast	Entire Site*
White-footed Mouse	7.9×10^{-2}	3.3×10^{-2}	1.6×10^{-2}	$2.1 \times 10^{+0}$	$2.1 \times 10^{+0}$
Wood Thrush	6.2×10^{-2}	3.7×10^{-2}	2.4×10^{-2}	$2.5 \times 10^{+0}$	$2.5 \times 10^{+0}$
Garter Snake	3.0×10^{-2}	3.6×10^{-2}	2.5×10^{-2}	$3.2 \times 10^{+0}$	$3.2 \times 10^{+0}$
Red Fox	9.8×10^{-3}	7.4×10^{-3}	4.6×10^{-3}	6.0×10^{-1}	6.0×10^{-1}
Red-Tailed Hawk	1.8×10^{-2}	1.1×10^{-2}	6.1×10^{-3}	9.3×10^{-1}	9.3×10^{-1}

NOTES:

* Acute summmary Hazard Index for entire site is the highest Hazard Index of the four quadrants.

RELATIVE HAZARD RANKING (USEPA, 1986d):

$HI < 0.1$	No Adverse Effects
$0.1 \leq HI < 10$	Possible Adverse Effects
$HI \geq 10$	Probable Adverse Effects

LF23_SS.TAB

TABLE 4-20
SUMMARY OF ECOLOGICAL RISK ASSESSMENT FOR WETLAND PB-14

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

INDICATOR SPECIES	CHRONIC SUMMARY HAZARD INDEX	
	Acute	Chronic
Raccoon	3.1×10^{-3}	3.1×10^{-2}
Aquatic Invertebrates	$6.5 \times 10^{+0}$	$2.8 \times 10^{+1}$

NOTES:

RELATIVE HAZARD RANKING (USEPA, 1986d):

HI < 0.1	No Adverse Effects
$0.1 \leq$ HI < 10	Possible Adverse Effects
HI $\geq$ 10	Probable Adverse Effects

LF23_WET.TAB

HI ≥ 10 Probable Adverse Effects

This ranking scheme applies to ecological risk evaluation, and does not pertain to human health evaluation. The scheme reflects effects to individual organisms, and does not indicate potential population-level effects. In many cases, acute or chronic effects to individuals may occur with little impact on population growth, stability, or structure. However, as the number of organisms experiencing acute or chronic effects increases, so does the probability that population-level effects will occur. Because the number of affected individuals presumably increases with increasing Hazard Index values, the likelihood that population-level effects are occurring is expected to increase as the Hazard Index increases.

Application of this ranking scheme indicates that chronic effects to small mammals, small birds, and herpetofauna are possible in the SE quadrant, as well as from sitewide exposure (which is primarily attributable to the SE quadrant). Because summary Hazard Indices for the SE quadrant and the entire site are low (maximum summary Hazard Index = 1.4), effects are expected to be limited to a few individuals, with effects on populations unlikely. No effects are predicted for the NE, NW, or SW quadrants, and no effects are predicted for predatory birds or mammals in any quadrant or from sitewide exposure. The greatest contributor to chronic ecological risks is phenanthrene, which is responsible for approximately 60% of the total risk to ecological receptors.

Acute effects are possible for small mammals, small birds, herpetofauna, and predatory birds and mammals in the SE quadrant and from sitewide exposure. Because the acute summary Hazard Indices for the SE quadrant and the entire site are low (maximum summary Hazard Index = 3.2), effects are expected to be limited to a few individuals, with no population-level effects expected. The PAHs phenanthrene and benzo(a)pyrene are the greatest contributors to acute ecological risks at LF-023.

Risks are not predicted for terrestrial organisms in wetland PB-14, as represented by the raccoon, based on acute and chronic summary Hazard Index values of 0.0031 and 0.031, respectively. However, aquatic invertebrates, if present, may be at risk due to exposure to aluminum, arsenic, and zinc in wetland seeps, based on acute and chronic summary Hazard Index values of 6.5 and 28, respectively. If the samples collected at SW-023-02 are representative of long-term surface water concentrations of site-related contaminants in surface waters, the chronic Hazard Index value of 28 would apply. Using the relative ranking scheme described above, probable chronic

effects to aquatic organisms would be predicted. However, if the samples collected at SW-023-02 represent a local hot spot, possible acute effects would be predicted using the ranking scheme. Under either exposure scenario, effects to aquatic invertebrates may occur.

4.4.3.4 Uncertainties. The prediction of ecological risks involves several uncertainties. These are outlined below:

1) The models used to estimate exposures involve numerous exposure parameters, some of which are values from the literature, and some of which are estimated or assumed. Efforts were made to select exposure parameters representative of a variety of species so that exposure estimates would be representative of more than a single species. Because the parameters selected are generally conservative, risks for most species may be over-estimated however, risks may still be under-estimated for some species.

2) The exposure models assume that organisms will spend equal amounts of time in all habitats within their home range. In actuality, organisms will spend varying amounts of time in different habitats, which would affect their exposures. The limitation of this assumption is that exposures to the particular species modeled may be under- or over-estimated in the model. The consequences of this assumption at the site are expected to be minor because habitat types at the site are relatively uniform, and chemicals appear to be distributed over relatively large areas, minimizing the extent of variation in exposure.

3) In selecting RTVs, the lowest toxicity value reported was selected as the RTV, meaning that the RTVs may overestimate ecological risk.

4) Dermal contact was not evaluated because of a paucity of information concerning uptake rates for wildlife. Therefore, total exposures may be more than that predicted based on ingestion scenarios and risks may be under-estimated by scenarios that do not account for dermal exposure. However, the relative contribution of dermal contact to total risks is expected to be much lower than that of food and soil ingestion due to the fur, feathers, or hardened skin covering most species of terrestrial wildlife.

5) Chronic toxicity to small mammals, small birds, and herpetofauna may result in reduced reproductive success, while acute toxicity may result in mortality

in populations of these organisms. If populations of these organisms are significantly reduced, fewer prey items would be available for predatory birds and mammals. Predatory birds and mammals might stop foraging in those areas where populations were reduced, therefore, reducing the risks to predatory species. It is unlikely that populations of wildlife will be significantly reduced given the low hazard indices estimated in the ecological risk assessment.

6) The number of surface water samples collected in the wetland south of LF-023 may not fully characterize the magnitude or extent of surface water contamination. This could affect the risk estimates developed for aquatic and terrestrial organisms.

4.5 SUMMARY AND CONCLUSIONS

Various chemicals have been identified as site contaminants in various media at LF-023 (Table 4-2). The site contaminant identified in the waste material was 1,2-dichlorobenzene. The primary source of contamination at LF-023 is the surface soil. Seventeen SVOCs were identified as site-related contaminants in the surface soil. These SVOCs are all PAHs commonly found in fuels, oil, and their residues suggesting leaks or spills of waste oil at this site. Silver and one PCB, Aroclor 1254, were also identified as site contaminants in the surface soil. No site contaminants were identified in the subsurface soils.

Aluminum, iron, arsenic, and zinc were identified as site-related contaminants in the surface water. PHCs were detected in sediment samples and are considered site related contaminants. No PHCs were detected in the associated surface water samples. The PHCs may not be due to petroleum or fuel-based chemicals in sediments as no PAHs or BTEX chemicals were identified as site-related contaminants in sediments. The reported PHCs may instead be due to the organic material common in many wetland sediments.

Vinyl chloride, chloroform, chlorobenzene, benzene, ethylbenzene, xylenes (total), aluminum, iron, manganese, and potassium were identified as site contaminants in the groundwater. The halogenated organics are believed to have their origin in the landfill, but a source was not identified.

The PAHs and PCBs detected in the surface soil have low solubilities and a strong propensity to sorb to soils. The primary migration pathway for these compounds is mechanical transport. Biodegradation may occur for some of the PAHs and PCB congeners; however, this process is expected to be extremely slow for some of these compounds. Because silver was detected above background concentrations only in the surface soils, it is not expected to migrate to groundwater.

The 1,2-dichlorobenzene detected in one waste sample is moderately soluble and may migrate downward with rainwater infiltration.

The chlorinated solvents, vinyl chloride, chloroform, and chlorobenzene, are expected to persist in the groundwater and undergo only slow biodegradation. The fuel-related solvents, benzene, ethylbenzene, and xylene, and naphthalene will be transported by the same migration pathway (dispersion and diffusion) as the chlorinated solvents; however, the fuel-related compounds are expected to undergo relatively rapid biodegradation.

The high concentrations of iron and manganese are expected in the groundwater because of the anaerobic condition created by the landfill. The elevated aluminum concentration (above background) may be due to leaching from the waste or an increase in the solubility of the native aluminum because of the groundwater conditions. The potassium may be related to winter salting of nearby roads as indicated by the presence of potassium in the upgradient wells.

The aluminum, arsenic, iron, and zinc concentrations in the surface water may be the result of anaerobic conditions at the landfill, which may be increasing the solubility of the native compounds at the site (although this would still be considered a site effect). This is further supported by the fact that arsenic was not identified as a site contaminant in the surface soil, waste, or groundwater. In addition, the surface water samples were unfiltered which may add a high bias to the results.

A baseline risk assessment was conducted for the LF-023 site to determine whether site contaminants could pose a risk to human health or the environment. This assessment was conducted in accordance with USEPA (USEPA, 1989d) and NYSDEC guidance (NYSDEC, 1989a) in the same manner as the baseline risk assessment for LF-022. The risk assessment included a human health risk assessment and a habitat-based environmental risk assessment.

Contamination related to LF-023 has been detected in various media, including groundwater, surface soil, subsurface soil/waste material, surface water, and sediments. The contaminants of concern at LF-023 are VOCs (including vinyl chloride) and naphthalene in groundwater, PAHs in surface soil, and arsenic in surface water seeps south of LF-023. Other contaminants detected at the site include 1,1-dichlorobenzene in subsurface soil, and iron, manganese, and potassium in groundwater.

The human health risk assessment identified eight complete exposure pathways that were relevant to the LF-023 site.

Current Site Conditions

1. Incidental Ingestion of and Direct Contact with Surface Soil by a Security Policeman

2. Incidental Ingestion of and Direct Contact with Surface Soil by a Child Trespasser

3. Incidental Ingestion of and Direct Contact with Surface Water by a Child Trespasser

4. Inhalation of Vapors and Fugitive Dusts by a Nearby Resident

Future Site Conditions

1. Ingestion of, Direct Contact with, and Inhalation of Volatile Compounds from Groundwater by a Future Resident

2. Incidental Ingestion of and Direct Contact with Surface Soil by a Future Resident

3. Incidental Ingestion of and Direct Contact with Surface Water by a Future Child Resident

4. Inhalation of Vapors and Fugitive Dusts by a Future Resident

These scenarios were determined to be the most likely exposures that could occur at LF-023 under current and future site conditions. Each of these pathways was evaluated quantitatively to determine the potential carcinogenic and noncarcinogenic risks. Potential risks associated with subsurface soil and waste materials were not assessed quantitatively because of the lack of exposure to these media.

Based on the above eight pathways, a total of four potentially exposed populations were identified. The carcinogenic and noncarcinogenic risks from multiple pathways were combined to yield total site risks if the same individual could be exposed via more than one pathway. Three populations were identified for current site conditions: (1) Security Police, (2) a Child Trespasser, and (3) Nearby Residents. The only pathways that were combined under current site conditions were the child trespasser surface soil and surface water scenarios. One population was identified under future site conditions: Future Residents. Consequently, the carcinogenic and noncarcinogenic risks from all four future scenarios were combined to yield total site risks. In addition, for scenarios involving residential exposure, both a child and an adult receptor was evaluated.

Carcinogenic and noncarcinogenic risks were estimated for a security police officer engaged in training exercises at LF-023 under current site conditions. These risks are presented in Figures 4-15 and 4-16. Two sets of carcinogenic and noncarcinogenic risk estimates were calculated using the two surface soil data sets as exposure point concentrations: (1) the sitewide average from four composite surface soil samples; and (2) the concentrations detected in sample SS-04 from the southeast quadrant. The cancer risks for this population ($9x10^{-5}$ and $3x10^{-4}$) are near or slightly above the upper end of the USEPA target cancer risk range (Figure 4-15). The most realistic risk estimate for this population is the risk associated with sitewide average concentrations ($9x10^{-5}$). Because this is the only exposure pathway for this population at LF-023, security police are not likely to be at an increased risk of developing cancer over a lifetime.

The Hazard Indices associated with this potentially exposed population (i.e., 0.07 and 0.3) were below the USEPA target hazard index of 1. Therefore, this population is not likely to experience adverse noncarcinogenic effects as a result of exposure to surface soil at LF-023 (Figure 4-16).

Carcinogenic and noncarcinogenic risks associated with exposure of a child trespasser under current conditions were also assessed. Risks associated with exposure to surface soil and surface water at LF-023 were combined because this population

FIGURE 4-15

SUMMARY CANCER RISKS FOR LF-023 - SECURITY POLICE

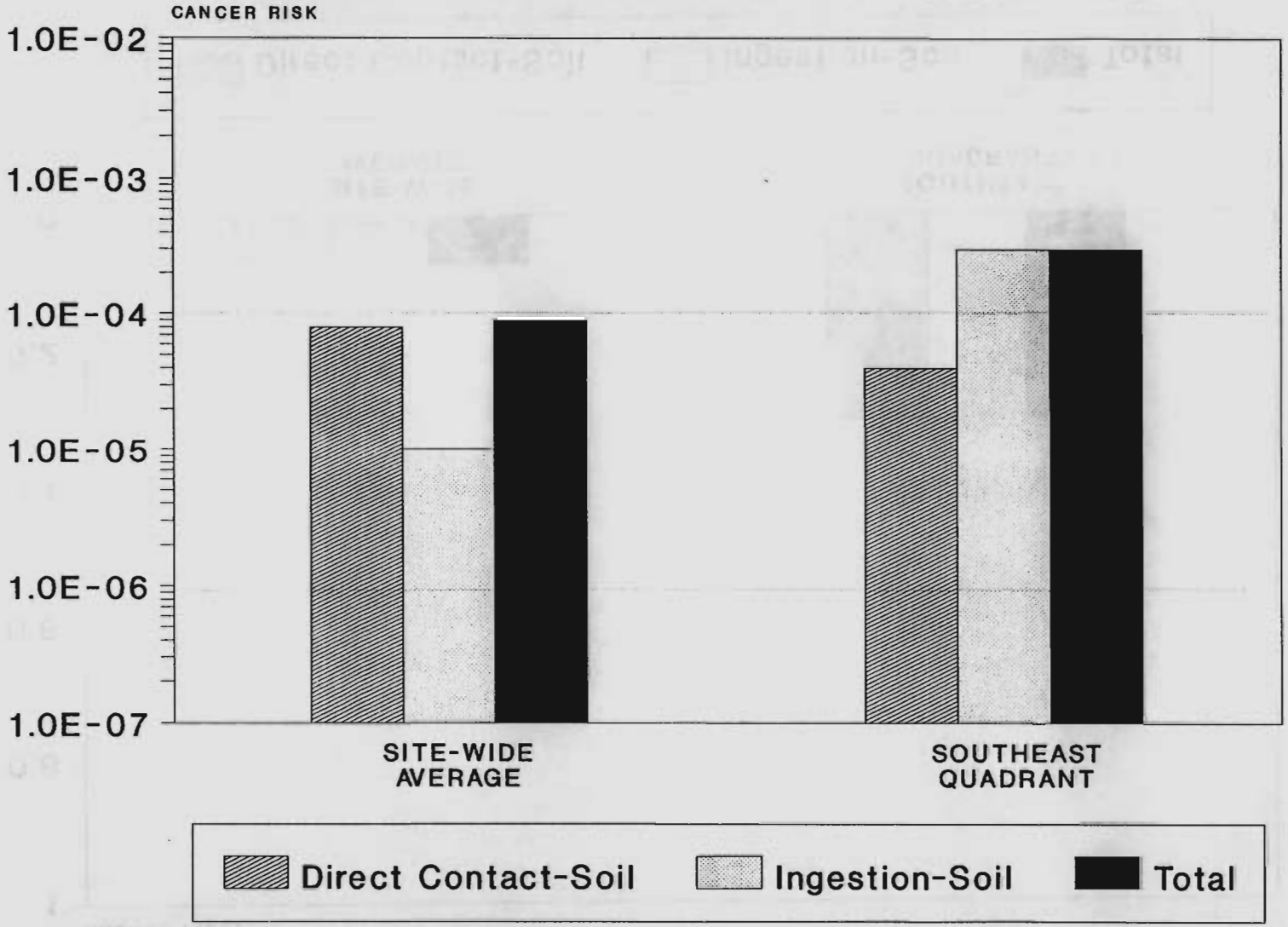
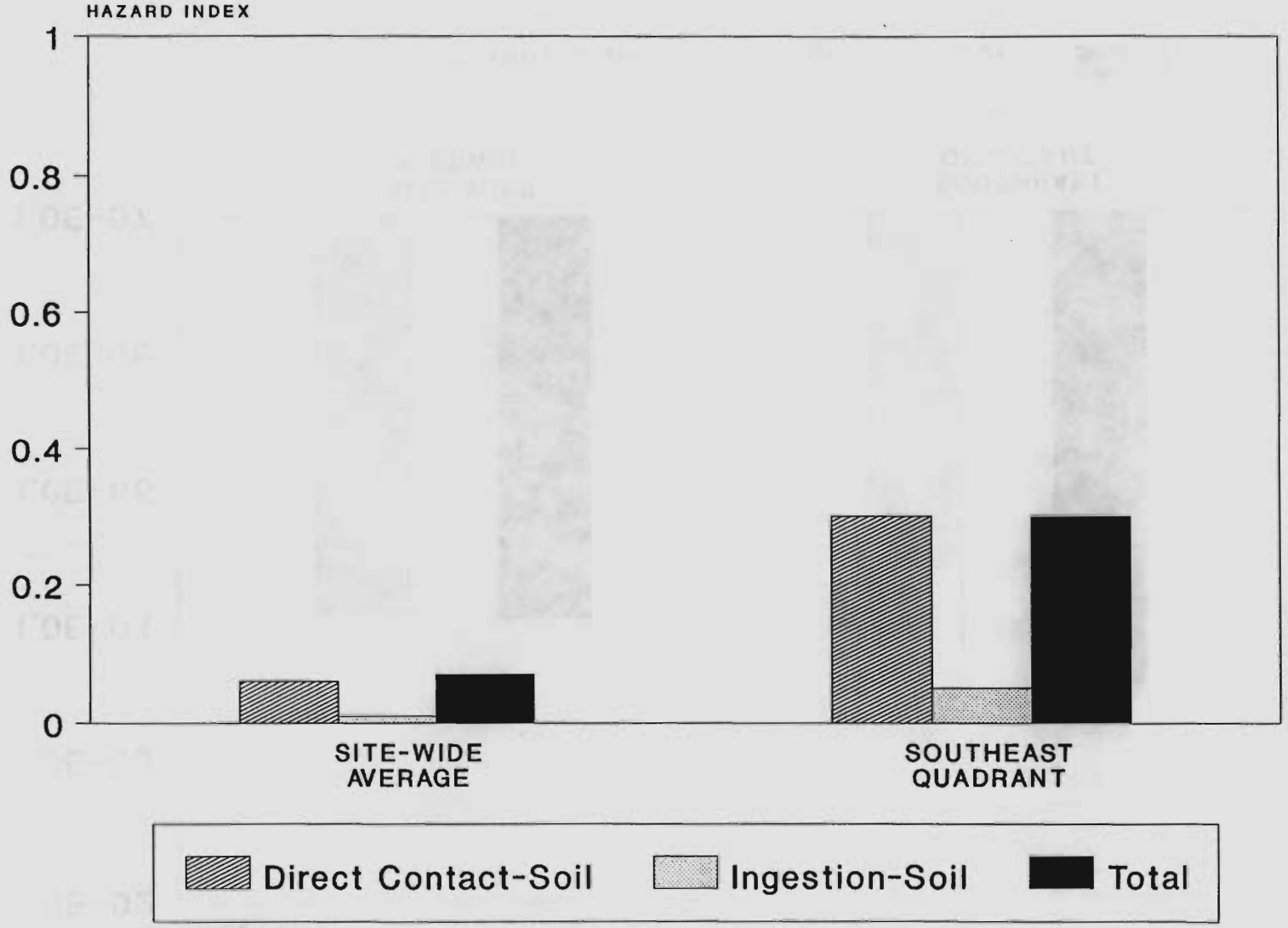


FIGURE 4-16

SUMMARY NONCANCER RISKS FOR LF-023 - SECURITY POLICE



could be exposed via both pathways. The resulting risk estimates for the child trespasser scenario are depicted in Figures 4-17 and 4-18.

As with the Security Police surface soil scenario, two carcinogenic and noncarcinogenic risk estimates were calculated for the surface soil Child Trespasser pathways corresponding to the two different surface soil data sets. The risks associated with the sitewide average represent the most realistic risks for this population because preferential exposure to any one quadrant is unlikely.

As indicated in Figure 4-17, the two combined carcinogenic risks associated with this population ($1x10^{-5}$ and $3x10^{-5}$) are within the 10^{-6} to 10^{-4} target risk range established by USEPA. In the event that a child were to trespass on LF-023, it is unlikely that an individual would repeatedly be exposed to the same area. Therefore, the most realistic estimate of risk is $1x10^{-5}$, which describes the risks based on the sitewide average. This risk is within the acceptable range established by the USEPA. Consequently, an increased risk of cancer is not anticipated for this population.

Both Hazard Indices associated with this population (0.009 and 0.02) were below the USEPA target of 1 (Figure 4-18). This indicates that children trespassing on the site are unlikely to experience adverse noncarcinogenic effects as a result of exposure to surface soil and surface water.

The third potentially exposed population evaluated under current site conditions was a nearby resident of the mobile home development located southwest of LF-023. It was assumed that children and adults living in this area could inhale vapors and fugitive dusts released from the landfill surface. Conservative volatile and fugitive dust emission and dispersion models were used to estimate airborne contaminant concentrations at a distance of 200 m from the landfill. The carcinogenic risks associated with this hypothetical population are $2x10^{-6}$ for both the child and the adult receptor for a total site cancer risk of $4x10^{-6}$. This estimate is within the USEPA target risk range. These risk estimates are considered to be conservative given the conservative nature of the fate and transport models and the exposure scenarios used in the calculations. Therefore, individuals in the mobile home development are not likely to be at an increased risk of cancer as a result of inhaling airborne emissions from LF-023.

The hazard indices associated with this hypothetical exposure are 0.04 for the child receptor and 0.006 for the adult. Both are below the USEPA target of 1. Therefore,

FIGURE 4-17

SUMMARY CANCER RISKS FOR LF-023 - CHILD TRESPASSER

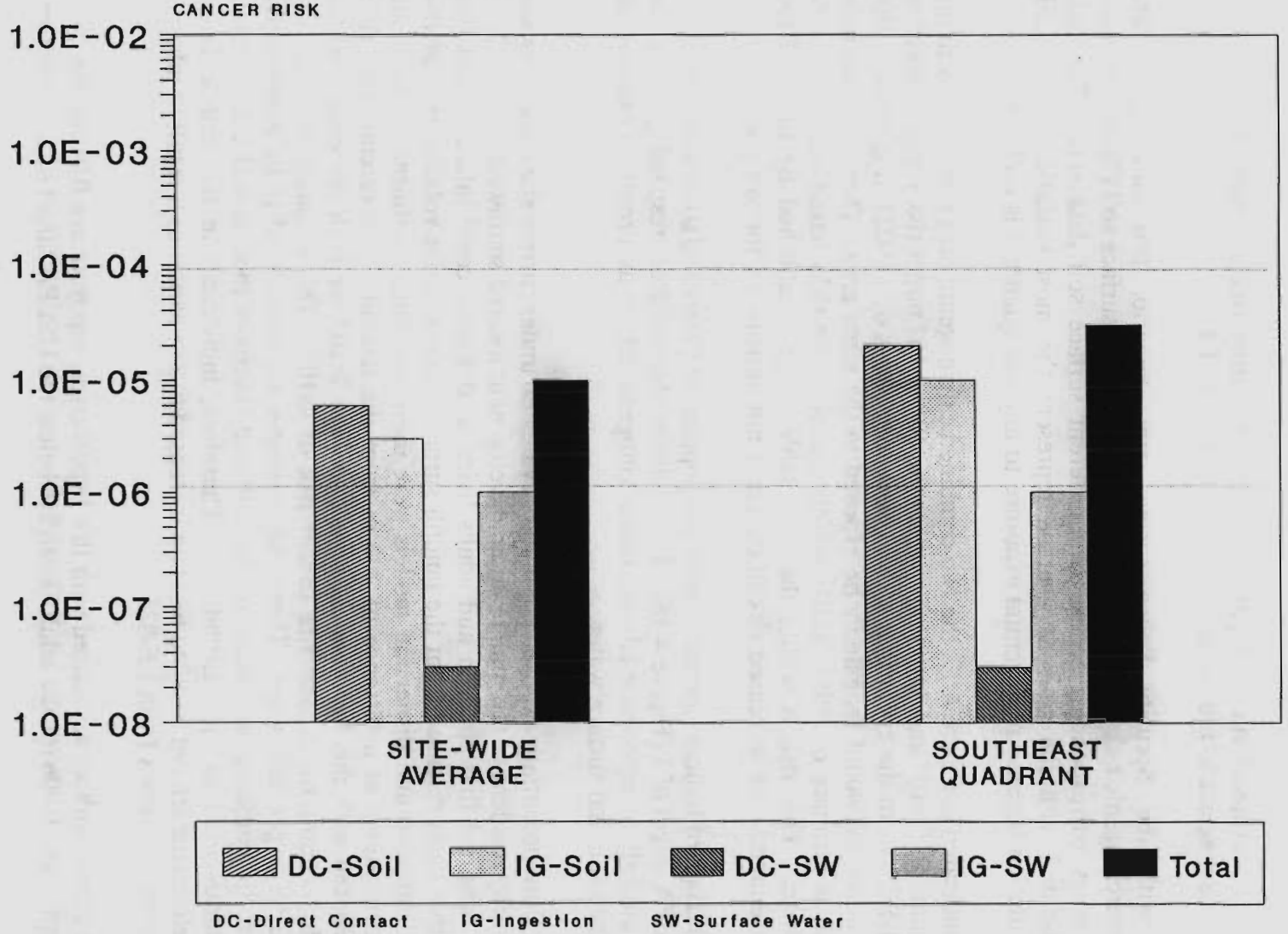
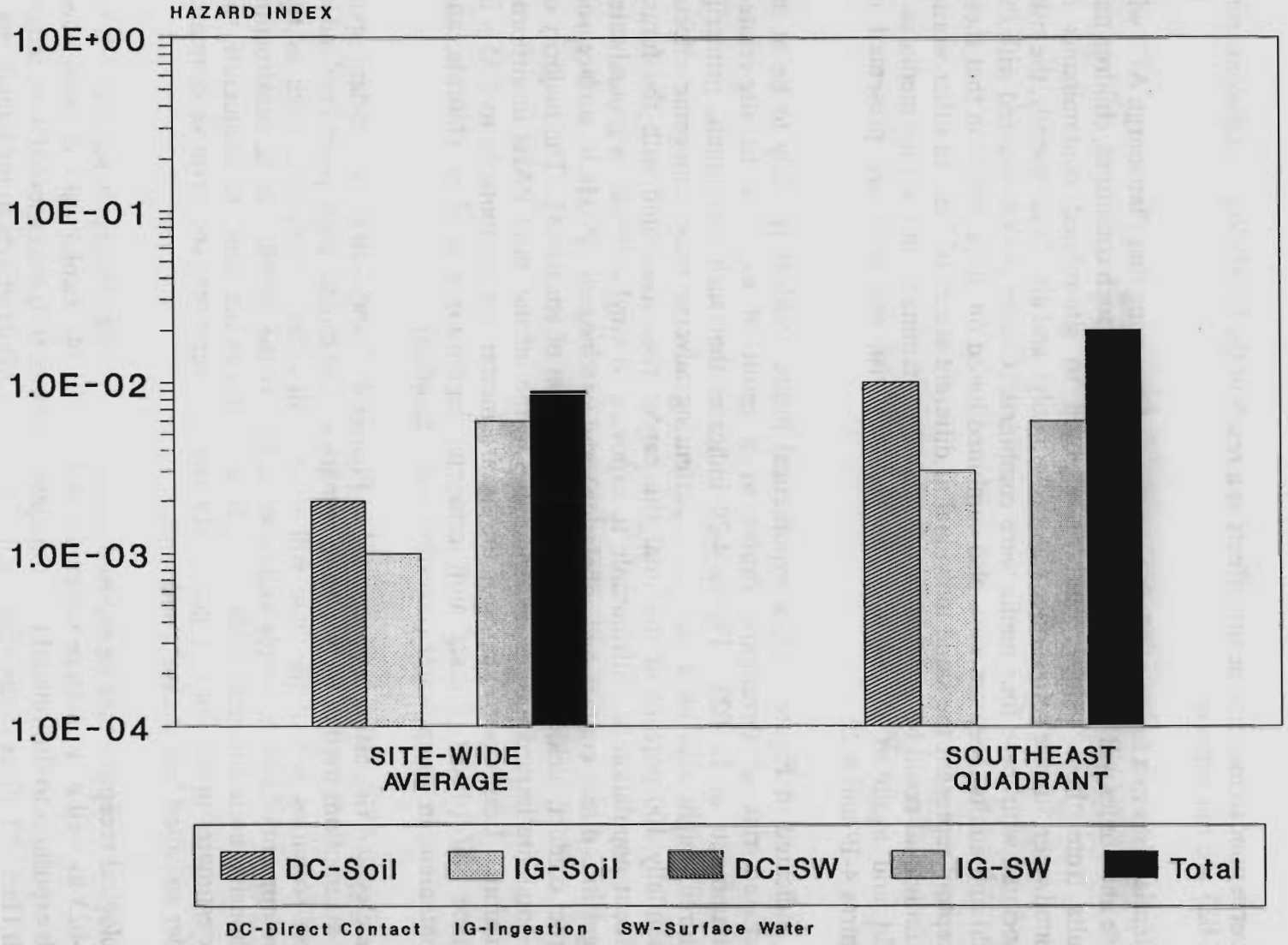


FIGURE 4-18

SUMMARY NONCANCER RISKS FOR LF-023 - CHILD TRESPASSER



adverse noncarcinogenic health effects as a result of the inhalation of emissions from LF-023 are not expected.

Potential risks to a future resident were assessed assuming that Plattsburgh AFB will close and homes will be built adjacent to LF-23. Under such conditions, children and adults from these homes could be exposed to site-related contaminants in groundwater, surface soil, surface water (child only), and air. Consequently, the risks associated with these four media were combined. Cancer risks associated with the child and adults receptors were also combined based on the assumption that these receptors represent the same individual at different stages of life. In other words, an individual could be exposed to site-related contaminants in the four media as a child and again as an adult. The resulting risk estimates are presented in Figures 4-19 and 4-20.

As indicated in Figure 4-19, a hypothetical future resident is likely to be at an increased risk of developing cancer as a result of exposure to site-related contaminants at LF-023. Figure 4-20 indicates that such individuals, primarily children, might also be at risk of experiencing adverse noncarcinogenic effects. Essentially 100 percent of the total site cancer risks associated with the future resident population are attributable to exposure to vinyl chloride in groundwater (ingestion, direct contact and inhalation) and carcinogenic PAHs in surface soil (direct contact, incidental ingestion, and inhalation of emissions). The majority of the total site hazard indices is attributable to the inhalation of PAHs in airborne emissions. Lesser percentages of the hazard indices are attributable to PAHs in surface soil (direct contact and incidental ingestion) and vinyl chloride and naphthalene in groundwater (ingestion and inhalation).

The elevated risk estimates presented in Figures 4-19 and 4-20 are dependant upon the assumptions used in the exposure scenarios. The critical assumption involved in these scenarios is that the base will close. All other assumptions, such as the development of a water supply well downgradient of the landfill and the construction of housing units adjacent to the site, hinge on this assumption. Consequently, the risk estimates presented in Figures 4-19 and 4-20 represent conservative estimates under so-called "worst-case" conditions.

Ecological receptors may be exposed to site-related contaminants in surface soils on LF-023 as well as to surface waters in wetland PB-14. Ecological risks associated with exposures to site-related contaminants in surface soils are expected to be minor, with Hazard Indices in the range of 10^{-5} to 10^{+0}. While effects to individuals may

FIGURE 4-19

SUMMARY CANCER RISKS FOR LF-023 - FUTURE RESIDENT

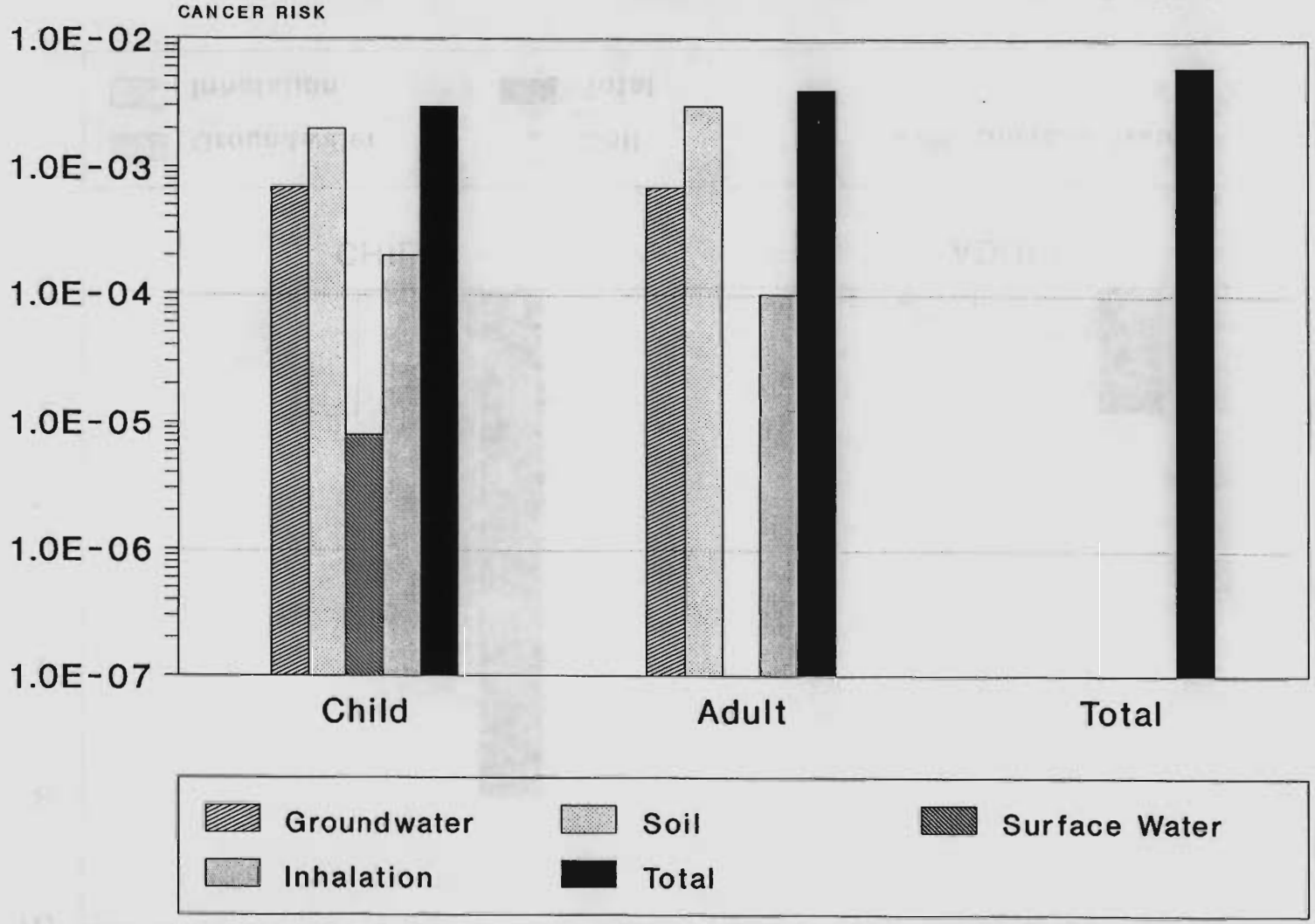
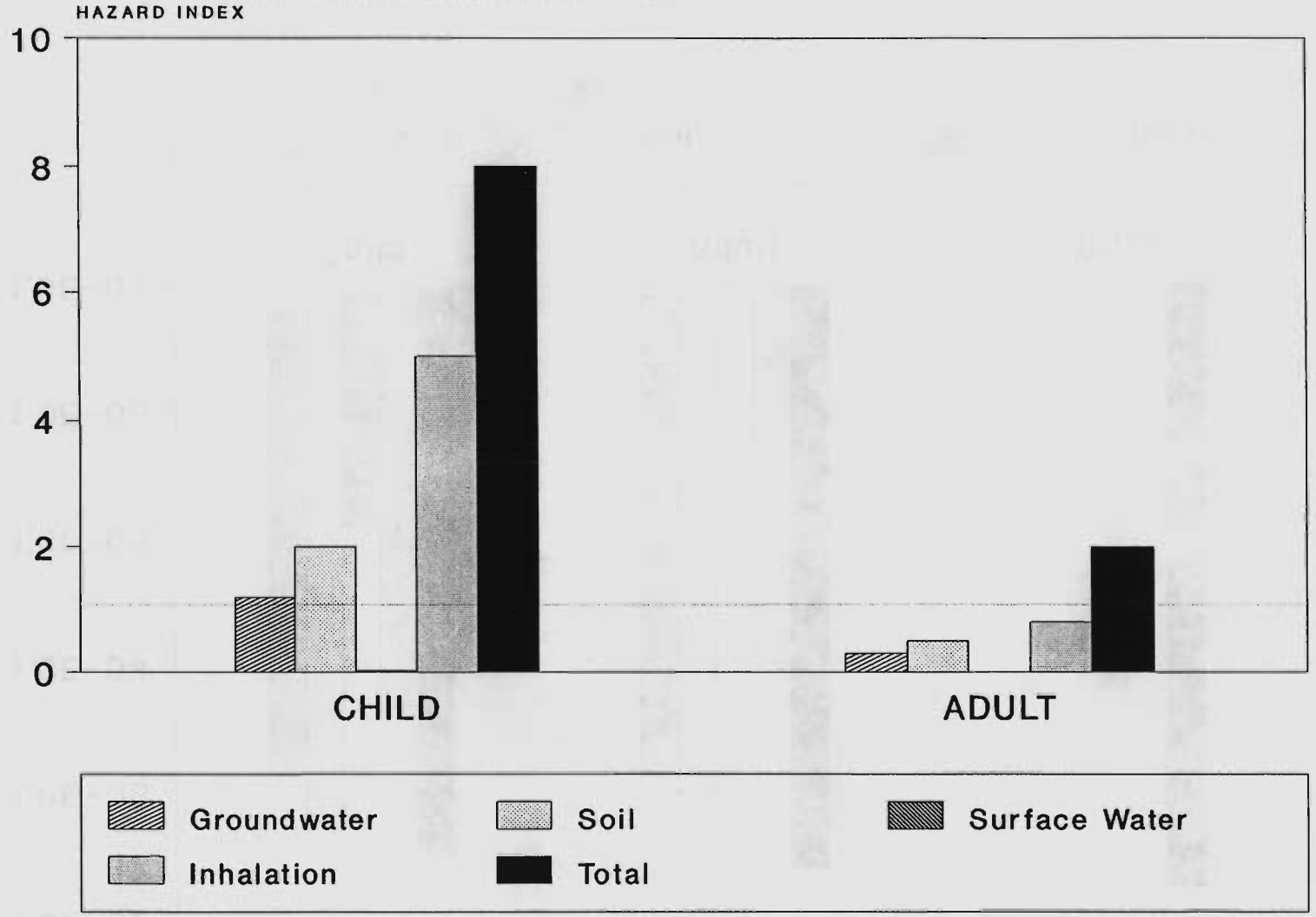


FIGURE 4-20

SUMMARY NONCANCER RISKS FOR LF-023 - FUTURE RESIDENT



occur, population-level effects are unlikely because the number of individuals affected is expected to be low based on the low Hazard Indices calculated.

Effects to terrestrial organisms in the wetland south of LF-023 are not predicted based on Hazard Indices in the range of 10^{-3} to 10^{-2}. However, acute and chronic toxicity to aquatic organisms in the wetland (which are expected to be limited to aquatic invertebrates) may be occurring based on Hazard Indices in the range of 10^{+0} to 10^{+1}.

4.5.1 Recommended Remedial Action Objectives

Remedial response objectives are media-specific goals established to protect human health and the environment. These objectives are developed based on identified risks associated with the site contaminants and media of concern. The following remedial response objectives have been developed for LF-023:

- minimize potential public health and ecological risks associated with direct soil contact
- minimize potential for risks to aquatic organisms associated with surface water exposure in the adjacent wetland
- minimize infiltration of precipitation into waste materials
- minimize potential for contaminant migration from waste material
- minimize erosion of cover soil

4.5.2 Data Limitations and Recommendations for Future Work

The surface soils at LF-023 were characterized by collecting and analyzing four composite samples. While the data from the composite samples was sufficient for the purposes of the risk assessment they did not delineate the specific areas of concern. This has been identified as a data limitation.

Most of the subsurface samples from LF-022 were collected from the waste. There are few samples of natural soil from below the waste because sampling depth was limited by the sampling equipment (i.e. backhoe). Therefore, information about the

mobility, in soil, of contaminants detected in waste is limited and must be inferred from groundwater data.

The 2-butanone in groundwater cannot be unequivocally disregarded from consideration at this site, however, based upon the available data, it is unlikely that this compound is a site contaminant. The compound is a common sampling and analysis artifact, and its association with groundwater has been sporadic without a consistent temporal and spatial relationship, therefore, it has not been considered site contaminants at this time, but has been considered a data limitation. Groundwater from eight downgradient wells will be sampled to define the presence or absence of 2-butanone.

Additional surface water and sediment sampling will also be conducted at the seeps south of LF-023 to determine if groundwater from the site is discharging to the surface and affecting water quality.

A Feasibility Study should be conducted to address the remedial action objectives identified in Subsection 4.5.1. If a remedial alternative is selected for LF-023 that requires treatment and/or removal of contaminated surface soil, future sampling will be required.

5.0 REMEDIAL INVESTIGATION REPORT ADDENDUM

The purpose of this addendum to the LF-022/LF-023 RI Report is to incorporate the results of sampling conducted at the landfills in the fall of 1991, present supplemental risk evaluations, and provide additional historical and physical information to further characterize the landfills.

5.1 ADDITIONAL DATA

In June 1991, the USEPA and NYSDEC requested the following additional sampling and analysis for landfills LF-022 and LF-023:

- collect 10 surface soil samples from LF-022 and analyze for pesticides
- validate pesticide analytical results for groundwater samples collected at LF-022 during the SI
- collect two surface water/sediment samples from the wetland downgradient of LF-023
- collect groundwater samples from LF-023 downgradient wells and analyze for VOCs
- collect additional groundwater samples from new wells or piezometric cone penetrometer borings downgradient from LF-023

The requested additional sampling was conducted at LF-022 and LF-023 in the fall of 1991. Sampling results are presented in the following subsections.

5.1.1 LF-022

During the previous LF-022 RI in 1989, composite samples were collected from each quadrant of the landfill and analyzed for SVOCs, inorganics, pesticides, and PCBs. Each composite sample was composed of soil from 15 to 18 sample points within a quadrant. The pesticides DDT, DDD, and DDE were detected in samples collected

from the northwest and southeast quadrants. The sampling results are discussed in Subsection 3.2.4.2, and sampling locations are shown in Figure 3-12.

To evaluate the possible presence of pesticide "hot spots," 10 discrete surface soil samples were collected from the northwest and southeast quadrants of the landfill in the fall of 1991 (Figure 5-1). The additional sampling points were selected randomly from the sampling points originally used to collect the composite samples. The discrete samples were analyzed for TCL pesticides and PCBs using USEPA Analytical Method 8088. The results of the additional pesticide sampling and analysis are shown in Table 5-1.

In the 1991 samples, DDT and DDE were detected in samples from both quadrants but at lower concentrations than in the 1989 samples. DDD was not detected in the 1991 samples from either quadrant. One PCB, Aroclor 1260, was detected in one sample from the southeast quadrant; no PCBs were detected in the 1989 samples. The analytical results from the 1989 and 1991 samples are compared in Table 5-2.

To evaluate the potential for pesticide migration in groundwater, analytical results from two groundwater samples, JMW112XX01 and JMW139XX01, collected during the SI from wells MW-22-001 and MW-22-002, were fully validated. Validated results did not indicate the presence of any pesticides or PCBs.

5.1.2 LF-023

In the summer and fall of 1991, samples were collected near LF-023 to further evaluate the landfill's potential impact on groundwater, surface water, and sediment.

5.1.2.1 Groundwater. During the LF-023 SI, Supplemental SI, and RI, groundwater samples were collected from monitoring wells next to the landfill. Analytical results for these samples are discussed in Subsection 4.2.5. These samples were analyzed using CLP or equivalent methodology. Because CLP CRQLs for some VOCs are greater than New York State Class GA Groundwater and/or Drinking Water Standards, NYSDEC requested that downgradient wells be sampled and analyzed using CLP low detection limit methodology.

In the fall of 1991, groundwater was collected for laboratory analysis from eight downgradient wells (i.e., MW-23-001, MW-23-003, MW-23-008, MW-23-009, MW-23-010, MW-23-011, MW-23-012, and MW-23-013). Groundwater was also

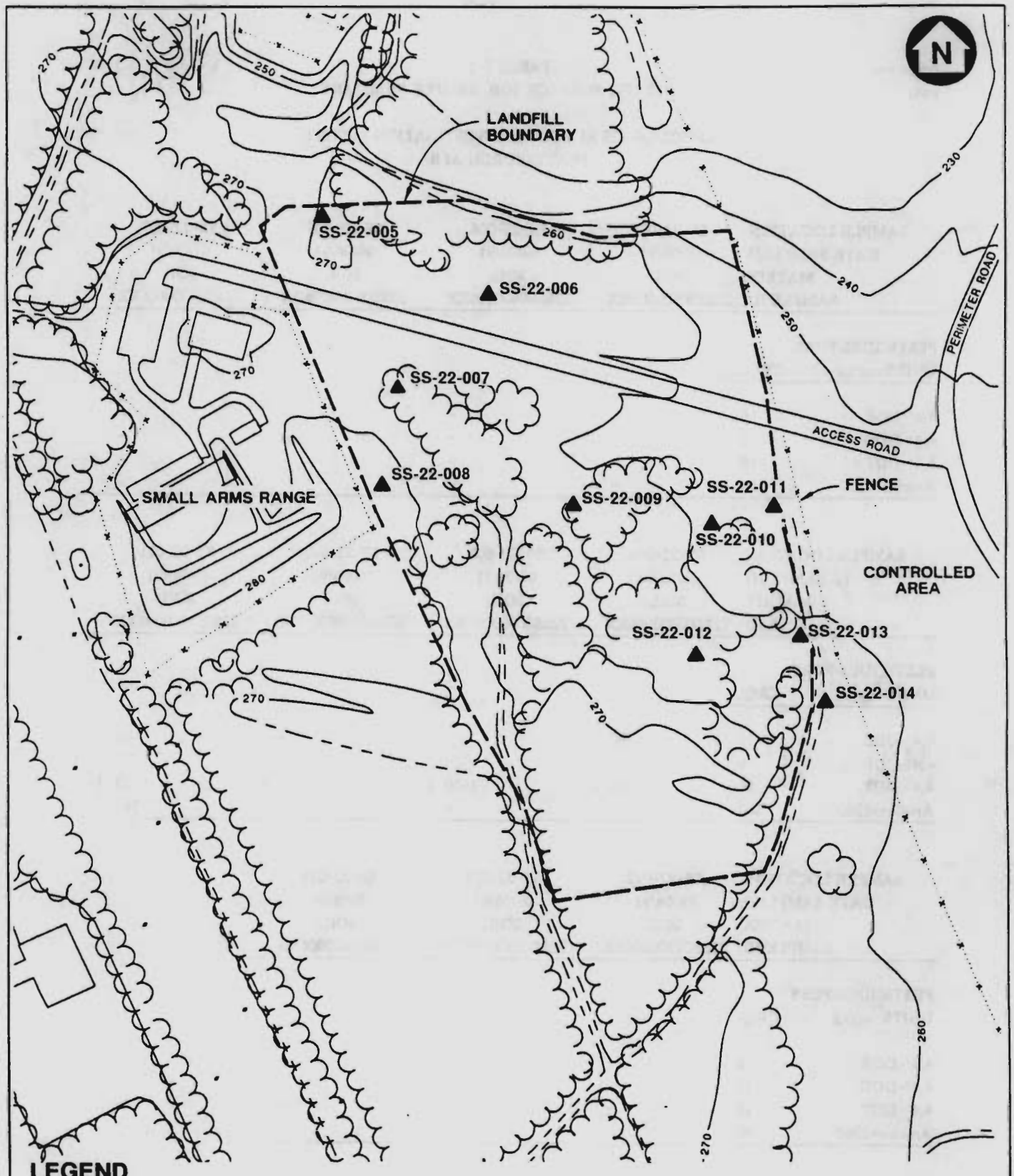


FIGURE 5-1
SURFACE SOIL SAMPLES TAKEN AT LF-022 9/6/91
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
EC JORDAN CO

22PEST.WK1
2/5/92

TABLE 5-1
LF-022 1991 SURFACE SOIL SAMPLE SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		SS-22-005	SS-22-006	SS-22-007	SS-22-007
DATE SAMPLED:		09/06/91	09/06/91	09/06/91	09/06/91
MATRIX:		SOIL	SOIL	SOIL	SOIL
SAMPLE ID:		22SS00500006XX	22SS00600006XX	22SS00700006DX	22SS00700006XX
PESTICIDES/PCBS					
UNITS: ug/kg	CRQL				
4,4'-DDE	16	-	-	-	-
4,4'-DDD	16	-	-	-	-
4,4'-DDT	16	-	-	-	-
Aroclor-1260	160	-	-	-	-

SAMPLE LOCATION:		SS-22-008	SS-22-009	SS-22-010	SS-22-011
DATE SAMPLED:		09/06/91	09/06/91	09/06/91	09/06/91
MATRIX:		SOIL	SOIL	SOIL	SOIL
SAMPLE ID:		22SS00800006XX	22SS00900006XX	22SS01000006XX	22SS01100006XX
PESTICIDES/PCBS					
UNITS: ug/kg	CRQL				
4,4'-DDE	16	190	-	-	25
4,4'-DDD	16	-	-	-	-
4,4'-DDT	16	470 J	1600 J	20 J	20 J
Aroclor-1260	160	-	-	-	360

SAMPLE LOCATION:		SS-22-012	SS-22-013	SS-22-014
DATE SAMPLED:		09/06/91	09/06/91	09/06/91
MATRIX:		SOIL	SOIL	SOIL
SAMPLE ID:		22SS01200006XX	22SS01300006XX	22SS01400006XX
PESTICIDES/PCBS				
UNITS: ug/kg	CRQL			
4,4'-DDE	16	-	-	-
4,4'-DDD	16	-	-	-
4,4'-DDT	16	-	-	-
Aroclor-1260	160	-	-	-

TABLE 5-2
PESTICIDE CONCENTRATIONS DETECTED IN LF-022 SURFACE SOIL SAMPLE

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

	1989 COMPOSITE SAMPLE RESULTS (µg/kg)			1991 SAMPLE RESULTS (µg/kg)		
COMPOUND	MINIMUM	MAXIMUM	FREQUENCY	MINIMUM	MAXIMUM	FREQUENCY
DDD	2,060	16,000	2/4	<16	<16	0/10
DDE	855	855	1/4	25	190	2/10
DDT	570	3,505	2/4	20	1,600	4/10
Aroclor 1260	<160	<160	0/4	360	360	1/10

obtained for laboratory and field screening analysis from four downgradient piezometric cone penetrometer borings (i.e., CP-02-004, CP-02-035, CP-02-36, and CP-02-037). Monitoring well and boring locations are shown in Figure 5-2. The analytical parameters requested for each sample are listed in Table 5-3, the results are presented in Tables 5-4 through 5-6, and comparisons of 1991 results with results from previous samples are shown in Tables 5-7 and 5-8.

VOCs. Five VOCs (i.e., vinyl chloride, benzene, chlorobenzene, ethylbenzene, and xylenes) previously identified as site contaminants were also detected in the 1991 samples. These compounds were detected at concentrations consistent with results of previous sampling rounds.

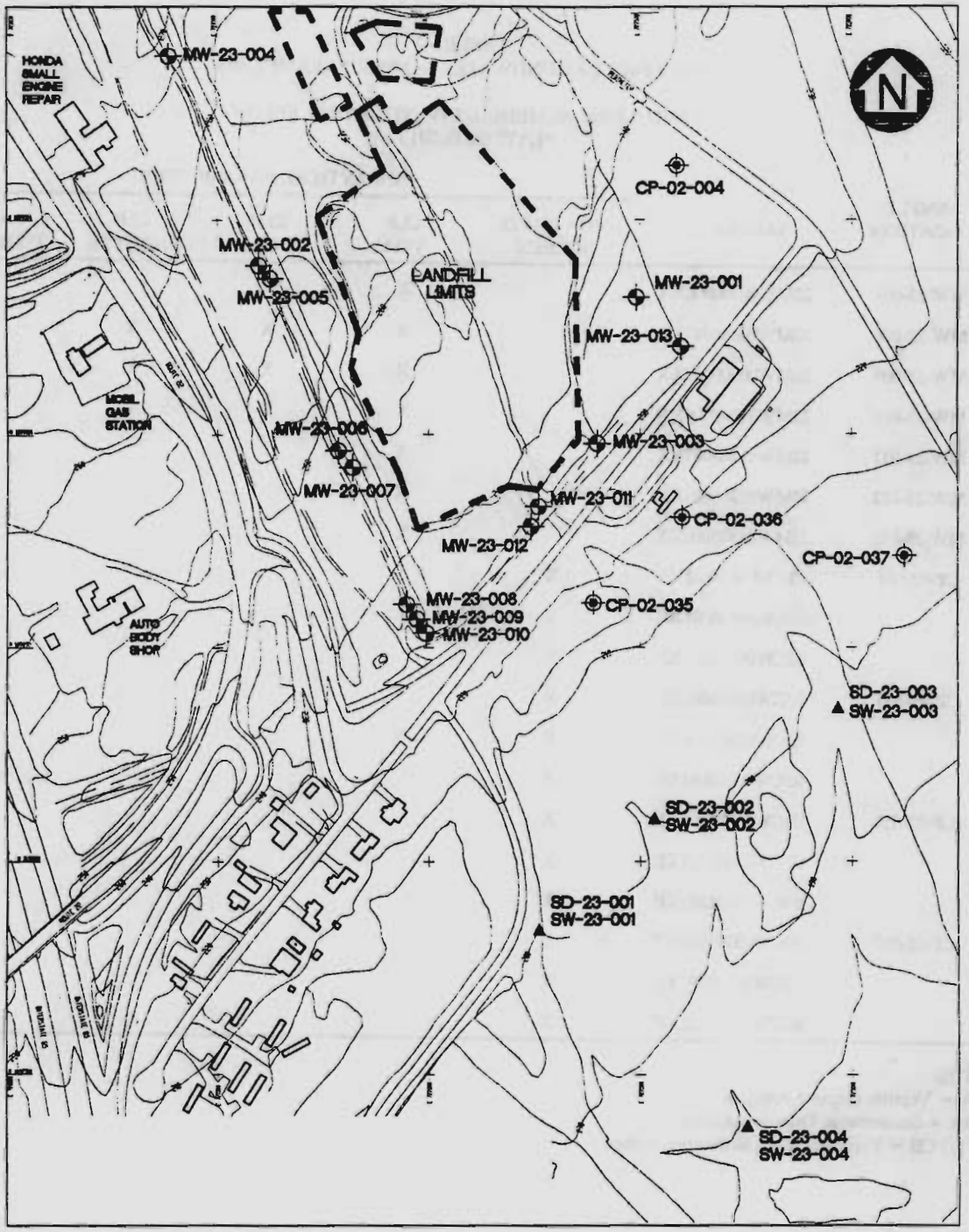
Methylene chloride, toluene, 1,1-dichloroethane, and 1,2-dichloroethene were detected at concentrations at or near the CRQL, but below New York State Class GA Groundwater and Drinking Water Standards. Of these compounds, only 1,1-dichloroethane was detected previously, and it was detected at a low concentration in one sample.

The ketones 4-methyl-2-pentanone and 2-hexanone were detected in well MW-23-008, but had not been detected during previous sampling rounds. Based on groundwater flow in the vicinity of LF-023, it is possible that these compounds are associated with an off-site upgradient source. The concentrations of these ketones are below New York State Class GA Groundwater and Drinking Water Standards.

Carbon disulfide was detected at a low concentration (17 μg/L) in one sample from cone penetrometer boring CP-02-035. This compound was not detected in any previous sampling rounds at LF-023.

TCE was detected by field screening in one sample from CP-02-004. This boring is located at the western edge of a dissolved contaminant plume that originates from the FT-002. The primary constituents of this plume are TCE, 1,2-dichloroethene, and fuel products. Because of the proximity of CP-02-004 to the plume, the TCE detected in this sample has been attributed to the FT-002.

SVOCs, Pesticides, and PCBs. Although naphthalene was detected in one well during previous rounds, no SVOCs, pesticides, or PCBs were detected in groundwater samples collected in 1991.



LEGEND:

- MW-23-007 — MONITORING WELL LOCATION
- SD-23-004 — SURFACE WATER/SEDIMENT SAMPLE LOCATION
- CP-02-037 — CONE PENETROMETER LOCATION
- LANDFILL BOUNDARIES

SCALE IN FEET

0 200 400 800

FIGURE 5-2
SAMPLING LOCATIONS
FOR LANDFILL LF-023
PLATTSBURGH AFB

E.C. JORDAN CO.

6091-21\FIG5-2

TABLE 5-3
1991 LF-023 GROUNDWATER SAMPLE PARAMETERS

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION	SAMPLE ID	ANALYTICAL PARAMETERS				
		VOA FIELD SCREEN	CLP VOA	CLP SVOA	CLP PEST/PCB	CLP INORGANIC
MW-23-003	23MW00300006XX		X			
MW-23-008	23MW00800007XX		X	X	X	X
MW-23-009	23MW00900007XX		X	X	X	X
MW-23-010	23MW01000006XX		X	X	X	X
MW-23-011	23MW01100007XX		X			
MW-23-012	23MW01200006XX		X			
MW-23-013	23MW01300006XX		X			
CP-02-004	02CW00404601XF	X				
	02CW00405601XF	X				
	02CW00406401XF	X				
CP-02-035	02CW03501601XF	X				
	02CW03502901XF	X	X			
	02CW03504001XF	X				
CP-02-036	02CW03602201XF	X				
	02CW03603201XF	X				
	02CW03604201XF	X				
CP-02-037	02CW03701001XF	X				
	02CW03702001XF	X				
	02CW03703201XF	X				

NOTES:
VOA = Volatile Organic Analysis
SVOA = Semivolatile Organic Analysis
PEST/PCB = Pesticides/Polychlorinated Biphenyl

22GWVOA.WK1
2/5/92

TABLE 5-4
LF-023 1991 GROUNDWATER SAMPLE SUMMARY (ORGANICS)

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		MW-23-001	MW-02-003	MW-23-003	MW-02-008
DATE SAMPLED:		09/19/91	09/18/91	09/18/91	11/26/91
MATRIX:		WATER	WATER	WATER	WATER
SAMPLE ID:		3MW00100006XX	23MW00300006DX	23MW00300006XX	23MW00800007XX
VOLATILE ORGANIC COMPOUNDS					
UNITS: ug/L	DL				
Vinyl Chloride	2	2	16	11	-
Methylene Chloride	1	-	-	-	-
Carbon Disulfide	1	-	-	-	-
1,1-Dichloroethane	1	-	1	1	-
1,2-Dichloroethene (total	1	-	1	-	-
Benzene	1	-	13	10	-
4-Methyl-2-Pentanone	2	-	-	-	41
2-Hexanone	2	R	R	R	23
Toluene	1	-	2	1	2
Chlorobenzene	1	-	7	6	-
Ethylbenzene	1	-	28	20	53
Total Xylenes	1	-	35	27	34

SAMPLE LOCATION:		MW-23-009	MW-23-009	MW-23-010	MW-23-011
DATE SAMPLED:		11/26/91	11/26/91	09/13/91	11/26/91
MATRIX:		WATER	WATER	WATER	WATER
SAMPLE ID:		3MW00900007DX	23MW00900007XX	23MW01000006XX	23MW01100007XX
VOLATILE ORGANIC COMPOUNDS					
UNITS: ug/L	DL				
Vinyl Chloride	2	-	-	-	7
Methylene Chloride	1	-	-	-	-
Carbon Disulfide	1	-	-	-	-
1,1-Dichloroethane	1	-	-	-	-
1,2-Dichloroethene (total	1	-	-	-	-
Benzene	1	-	-	-	8
4-Methyl-2-Pentanone	2	-	-	-	-
2-Hexanone	2	-	-	R	-
Toluene	1	-	-	-	1
Chlorobenzene	1	-	-	-	10
Ethylbenzene	1	-	-	-	48
Total Xylenes	1	-	-	-	25

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TABLE 5-4
(Continued)
LF-023 1991 GROUNDWATER SAMPLE SUMMARY (ORGANICS)

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		MW-23-012	MW-23-013	CP-02-035
DATE SAMPLED:		09/18/91	09/19/91	06/29/91
MATRIX:		WATER	WATER	WATER
SAMPLE ID:		3MW01200006XX	23MW01300006XX	02CW03502901XX
VOLATILE ORGANIC COMPOUNDS				
UNITS: ug/L	DL			
Vinyl Chloride	2	-	-	-
Methylene Chloride	1	1	-	-
Carbon Disulfide	1	-	-	17 J
1,1-Dichloroethane	1	-	-	-
1,2-Dichloroethene (total	1	-	-	-
Benzene	1	-	-	3 J
4-Methyl-2-Pentanone	2	-	-	-
2-Hexanone	2	R	R	-
Toluene	1	-	-	-
Chlorobenzene	1	-	-	3 J
Ethylbenzene	1	-	-	-
Total Xylenes	1	-	-	-

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TABLE 5-5
LF-023 1991 GROUNDWATER SAMPLE SUMMARY (INORGANICS)

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		MW-23-008	MW-23-008	MW-23-009	MW-23-009
DATE SAMPLED:		09/18/91	09/18/91	09/18/91	09/21/91
MATRIX:		WATER	WATER	WATER	WATER
FILTERED/UNFILTERED:		FILTERED	UNFILTERED	FILTERED	UNFILTERED
SAMPLE ID:		3MW00800006XX	23MW00800006XX	23MW00900006XX	23MW00900006XX
INORGANICS					
UNITS: ug/L	CRQL				
Aluminum	200	-	-	-	-
Calcium	5000	83500	83800	56600	58500
Chromium	10	44	247	31.3	722
Iron	100	168	4610	-	6020
Lead	3	42.1	-	-	-
Magnesium	5000	24000	23900	24100	24300
Manganese	15	1390	5610	19.4	77.5
Nickel	40	-	142	41.8	68.3
Sodium	5000	109000	109000	76700	76700

SAMPLE LOCATION:		MW-23-010	MW-23-010
DATE SAMPLED:		09/13/91	09/13/91
MATRIX:		WATER	WATER
FILTERED/UNFILTERED:		UNFILTERED	FILTERED
SAMPLE ID:		3MW01000006XX	23MW01000006XX
INORGANICS			
UNITS: ug/L	CRQL		
Aluminum	200	400	-
Calcium	5000	57800	54100
Chromium	10	-	-
Iron	100	707	150
Lead	3	-	-
Magnesium	5000	19100	18000
Manganese	15	223	197
Nickel	40	-	-
Sodium	5000	34400	33500

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TABLE 5-6
LF-023 1991 GROUNDWATER SAMPLE SUMMARY (FIELD SCREENING)

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:	CP-02-004	CP-02-004	CP-02-004	CP-02-035
MATRIX:	WATER	WATER	WATER	WATER
DEPTH (Feet):	46	56	64	16
SAMPLE ID:	02CW00404601XF	02CW00405601XF	02CW00406401XF	02CW03501601XF
VOLATILE ORGANIC COMPOUNDS UNITS: ug/L				
Vinyl Chloride	-	-	-	-
Trichloroethene	20	-	-	-
Benzene	-	-	-	5.6
Ethylbenzene	-	-	-	-
Total Xylenes	-	-	-	-

SAMPLE LOCATION:	CP-02-035	CP-02-035	CP-02-036	CP-02-036
DATE SAMPLED:	WATER	WATER	WATER	WATER
MATRIX:	29	40	22	32
SAMPLE ID:	02CW03502901XF	02CW03504001XF	02CW03602201XF	02CW03603201XF
VOLATILE ORGANIC COMPOUNDS UNITS: ug/L				
Vinyl Chloride	43	35	-	13
Trichloroethene	-	-	-	-
Benzene	1.4	-	9.3	2.6
Ethylbenzene	-	-	-	1.4
Total Xylenes	2.1	-	-	-

	CP-02-036	CP-02-037	CP-02-037	CP-02-037
	WATER	WATER	WATER	WATER
	42	10	20	32
	02CW03604201XF	02CW03701001XF	02CW03702001XF	02CW03703201XF
VOLATILE ORGANIC COMPOUNDS UNITS: ug/L				
Vinyl Chloride	-	-	-	-
Trichloroethene	-	-	-	-
Benzene	-	-	-	-
Ethylbenzene	-	-	-	-
Total Xylenes	-	-	-	-

TABLE 5-7
ORGANIC CONCENTRATIONS DETECTED BY CLP ANALYSIS OF LF-023 GROUNDWATER SAMPLES

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

	1991 SAMPLE RESULTS[1,2] (μg/L)			1987/1988/1989 SAMPLE RESULTS[2] (μg/L)		
COMPOUND	MINIMUM	MAXIMUM	FREQUENCY	MINIMUM	MAXIMUM	FREQUENCY
Vinyl Chloride	2	14	3/9	16	31	3/38
Methylene Chloride	1	1	1/9	-	-	0/25
Carbon Disulfide	17	17	1/9	-	-	0/25
Chloroform	-	-	0/9	0.4	19	6/38
Chloroethane	-	-	0/9	0.7	0.7	1/38
1,1-Dichloroethene	-	-	0/9	0.5	0.5	1/38
1,1-Dichloroethane	1	1	1/9	0.6	0.6	1/38
1,2-Dichloroethene	1	1	1/9	-	-	0/38
1,2-Dichloroethane	-	-	0/9	0.4	0.4	1/38
Benzene	3	12	2/9	10	14	3/25
4-Methyl-2-pentanone	41	41	1/9	-	-	0/25
Toluene	1	2	3/9	-	-	0/25
2-Hexanone	23	23	1/9	-	-	0/25
Chlorobenzene	3	10	2/9	10	10	1/38
Ethylbenzene	24	53	3/9	13	54	3/25
Xylenes	25	34	3/9	8	72	4/25
Naphthalene	-	-	0/9	11	11	1/23

NOTES:
[1] Field screening results are not included in maximums, minimums, or frequencies.
[2] Maximum and minimum concentrations and frequencies of detection represent values above the Contract Required Quantitation Limit.
CLP = Contract Laboratory Program

TABLE 5-8
INORGANIC CONCENTRATIONS DETECTED IN LF-023 GROUNDWATER SAMPLES

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

	1991 FILTERED SAMPLE RESULTS* (µg/L)			1991 UNFILTERED SAMPLE RESULTS* (µg/L)		
COMPOUND	MINIMUM	MAXIMUM	FREQUENCY	MINIMUM	MAXIMUM	FREQUENCY
Aluminum	<200	<200	0/3	400	400	1/3
Calcium	54,100	83,500	3/3	57,800	83,800	3/3
Chromium	31.3	44.0	2/3	247	722	2/3
Iron	150	168	2/3	707	6,020	3/3
Lead	42.1	42.1	1/3	<3	<3	0/3
Magnesium	18,000	24,100	3/3	19,100	24,300	3/3
Manganese	19.4	1,390	3/3	77.5	5,610	3/3
Nickel	41.8	41.8	1/3	68.3	142	2/3
Sodium	33,500	109,000	3/3	34,400	109,000	3/3

	1988/1989 FILTERED SAMPLE RESULTS* (µg/L)		
COMPOUND	MINIMUM	MAXIMUM	FREQUENCY
Calcium	46,200	78,800	3/3
Chromium	80	80	1/3
Iron	111	603	3/3
Magnesium	16,100	24,900	3/3
Manganese	19	342	3/3
Nickel	46	46	1/3
Potassium	5,770	5,770	1/3
Sodium	39,000	75,900	3/3
Zinc	47	47	1/3

NOTES:
* Maximum and minimum concentrations and frequencies of detection represent values above the Contract Required Quantitation Limit.

Inorganics. Both filtered and unfiltered inorganic groundwater samples were collected from three wells at the southwest corner of LF-023 in 1991. Aluminum, calcium, chromium, iron, lead, magnesium, manganese, nickel, and sodium were detected in groundwater samples.

By comparing the filtered and unfiltered results, it can be determined which inorganics are dissolved in the groundwater, and which are associated with suspended particles. Concentrations of calcium, magnesium, and sodium were similar in filtered and unfiltered samples, indicating that these are principally dissolved in the groundwater rather than sorbed to particles. Concentrations of other inorganics were lower in the filtered than in the unfiltered samples, indicating that these compounds are present in both dissolved and suspended (sorbed to particles) forms. There was one anomalous detection of lead; it was detected in a filtered sample, but not the associated unfiltered sample.

Inorganics associated with suspended particles are less likely to be transported by groundwater than are dissolved inorganics because the suspended particles are larger than 0.45 microns (pore size of the filter) and must travel through the pore space in the aquifer. It is possible that the suspended particles in the aquifer were close to the well and were drawn into the well during sampling.

Previous groundwater samples collected at LF-023 for inorganic analysis were filtered. Concentrations of the compounds detected in 1991 filtered samples, with the exception of lead, were similar to those previously detected. Zinc and potassium were detected during the 1987/1988/1989 sampling, but were not detected in the 1991 round.

5.1.2.2 Surface Water and Sediment. Surface water and sediment samples were collected at two locations (i.e., SW-23-003/SD-23-003 and SW-23-004/SD-23-004) in the wetland downgradient of LF-023 (see Figure 5-2). These samples were collected in different locations than the 1988 surface water and sediment samples. Analytical results are listed in Tables 5-9 and 5-10 and a comparison with previous surface water and sediment samples is shown in Tables 5-11 and 5-12.

VOCs. Acetone was detected in one surface water sample (SW-23-004), but no VOCs were detected in the associated sediment sample. Xylenes were detected in one sediment sample (SD-23-003), but no VOCs were detected in the associated

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TABLE 5-9
LF-023 1991 SURFACE WATER SAMPLE SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		SW-23-003	SW-23-003	SW-23-004	SW-23-004
DATE SAMPLED		09/21/91	09/21/91	09/21/91	09/21/91
MATRIX:		WATER	WATER	WATER	WATER
FILTERED/UNFILTERED:		FILTERED	UNFILTERED	FILTERED	UNFILTERED
SAMPLE ID:		23SW00300006XX	23SW00300006XX	23SW00400006DX	23SW00400006DX
VOLATILE ORGANIC COMPOUNDS					
UNITS: ug/L	DL				
Acetone	2	NR	-	NR	58
INORGANICS					
UNITS: ug/L	CRQL				
Aluminum	200	-	271	-	-
Calcium	5000	67300	69300	62300	64300
Iron	100	165	14100	-	433
Magnesium	5000	21300	21100	23300	23900
Manganese	15	187	2620	323	372
Potassium	5000	6370	6010	-	-
Sodium	5000	21400	21100	52300	53300

SAMPLE LOCATION:		SW-23-004	SW-23-004
DATE SAMPLED		09/21/91	09/21/91
MATRIX:		WATER	WATER
FILTERED/UNFILTERED:		FILTERED	UNFILTERED
SAMPLE ID:		23SW00400006XX	23SW00400006XX
VOLATILE ORGANIC COMPOUNDS			
UNITS: ug/L	DL		
Acetone	2	NR	52
INORGANICS			
UNITS: ug/L	CRQL		
Aluminum	200	-	-
Calcium	5000	62900	63800
Iron	100	-	479
Magnesium	5000	23400	23800
Manganese	15	321	389
Potassium	5000	-	-
Sodium	5000	52100	53000

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TABLE 5-10
LF-023 1991 SEDIMENT SAMPLE SUMMARY

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SAMPLE LOCATION:		SD-23-003	SD-23-003	SD-23-004
DATE SAMPLED:		09/21/91	09/21/91	09/21/91
MATRIX:		SOIL	SOIL	SOIL
SAMPLE ID:		23SD00300006DX	23SD00300006XX	23SD00400006XX
VOLATILE ORGANIC COMPOUNDS				
UNITS: ug/kg	CRQL			
Total Xylenes	5	72 J	56 J	-
INORGANICS				
UNITS: mg/kg	CRQL			
Aluminum	40	7030	5920	800
Arsenic	2	28.4	20.8 J	-
Calcium	1000	26300	23100	1580
Chromium	2	34.9	38.4	5.6
Copper	5	-	-	10.7
Iron	20	28800	23200	12700
Lead	0.6	24	18.3	1.2
Manganese	3	1370	2230	357
Vanadium	10	45.8	52.1	-
Zinc	4	44.2	37.7	10.5

TABLE 5-11
INORGANIC CONCENTRATIONS DETECTED IN LF-023 SURFACE WATER SAMPLES

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

	1991 UNFILTERED SAMPLE RESULTS* (µg/L)			1991 FILTERED SAMPLE RESULTS* (µg/L)		
COMPOUND	MINIMUM	MAXIMUM	FREQUENCY	MINIMUM	MAXIMUM	FREQUENCY
Aluminum	271	271	1/2	<200	<200	0/2
Calcium	64,050	69,300	2/2	62,600	67,300	2/2
Iron	456	14,100	2/2	165	165	1/2
Magnesium	21,100	23,850	2/2	21,300	23,350	2/2
Manganese	381	2,620	2/2	187	322	2/2
Potassium	6,010	6,010	1/2	6,370	6,370	1/2
Sodium	21,100	53,150	2/2	21,400	52,200	2/2

	1988 UNFILTERED SAMPLE RESULTS* (µg/L)		
COMPOUND	MINIMUM	MAXIMUM	FREQUENCY
Aluminum	<200	1,990	1/2
Arsenic	<10	316	1/2
Barium	<200	412	1/2
Calcium	85,600	86,700	2/2
Iron	4,700	672,000	2/2
Lead	<5	7	1/2
Magnesium	21,500	26,000	2/2
Manganese	228	3,815	2/2
Sodium	34,500	42,800	2/2
Zinc	<20	335	1/2

NOTES:
* Maximum and minimum concentrations and frequencies of detection represent values above the Contract Required Quantitation Limit.

TABLE 5-12
INORGANIC CONCENTRATIONS DETECTED IN LF-023 SEDIMENT SAMPLES

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

	1991 SAMPLE RESULTS* (µg/L)			1988 SAMPLE RESULTS* (µg/L)		
COMPOUND	MINIMUM	MAXIMUM	FREQUENCY	MINIMUM	MAXIMUM	FREQUENCY
Aluminum	800	6,475	2/2	4,760	4,890	2/2
Arsenic	24.6	24.6	1/2	7	8.6	2/2
Calcium	1,580	24,700	2/2	5,860	16,450	2/2
Chromium	5.6	36.7	2/2	11	32	2/2
Copper	10.7	10.7	1/2	-	-	0/2
Iron	12,700	26,000	2/2	23,000	47,900	2/2
Lead	1.2	21.5	2/2	17	28	2/2
Manganese	357	1,800	2/2	205	404	2/2
Vanadium	49	49	1/2	-	-	0/2
Zinc	10.5	41	2/2	77	80	2/2

NOTES:

NOTES:
* Maximum and minimum concentrations and frequencies of detection represent values above the Contract Required Quantitation Limit.

surface water sample. These compounds were not detected in the two previous surface water or sediment samples.

SVOCs. No SVOCs were detected in the 1991 surface water or sediment samples.

Surface Water Inorganics. Both filtered (using a 0.45-micron filter) and unfiltered surface water samples were collected to evaluate total and dissolved inorganics. Concentrations of aluminum, calcium, iron, magnesium, manganese, potassium, and sodium were detected in 1991 surface water samples.

Concentrations of calcium, magnesium, potassium, and sodium were similar in filtered and unfiltered samples, indicating that these compounds are mostly present in the dissolved form. Concentrations of other inorganics were lower in the filtered than in the unfiltered samples, indicating that these compounds are present in both dissolved and suspended forms.

Because the streams from which the surface water samples were collected do not run through LF-023, and originate at least 600 feet downgradient from LF-023, and surface runoff/erosion has not been observed on LF-023, it is unlikely that the detected inorganics were transported from the landfill by surface runoff. Inorganic compounds from the landfill could be transported to the surface water by groundwater. However, inorganics associated with suspended particles are less likely to be transported by groundwater than dissolved inorganics, because the suspended particles must travel through the pore space in the aquifer where particles can settle out or be filtered out by the sand. It is possible that inorganics associated with suspended particles represent local soil particles introduced to the stream by surface runoff or picked up from the streambed, and are not necessarily a representation of inorganics transported from LF-023 in groundwater.

Surface water samples collected near LF-023 in 1988 were not filtered before analysis. Inorganic concentrations detected in the 1991 unfiltered samples were similar to, or lower than, those detected in the 1988 surface water samples. Arsenic, barium, lead, and zinc were detected in the 1988 samples, but not in the 1991 samples. Potassium was detected in the 1991 samples, but not the 1988 samples.

Sediment Inorganics. Aluminum, arsenic, calcium, chromium, copper, iron, lead, manganese, vanadium, and zinc were detected in the 1991 sediment samples. With the exception of copper and vanadium, which were not detected in the 1988 samples,

the inorganic concentrations detected in the 1991 samples were similar to those detected previously.

For the reasons described in the preceding surface water section, it is unlikely that inorganics sorbed to suspended particles were transported by groundwater to the streams. Therefore, it is not likely that inorganics detected in the sediment are associated with LF-023, but they may represent the composition of the local soil.

5.2 SUPPLEMENTAL RISK ASSESSMENTS AND EVALUATIONS

In the original evaluation of site contaminants at LF-022 and LF-023, some VOCs were not considered site contaminants because sporadic detection or spatial inconsistencies indicated they were not site-related. Inorganics were eliminated from consideration if they were detected at concentrations within background ranges obtained from literature searches. These compounds were not included in risk calculations. Because these compounds were not eliminated based on laboratory blank data or a site-specific background study, USEPA requested that these compounds be included in supplemental risk calculations that could be compared to the results described in Sections 3.0 and 4.0. The results of the supplemental risk calculations are discussed in the following subsections. Supplemental calculations were based on the same exposure assumptions as the original calculations and the same uncertainties apply. In addition to increasing the number of compounds used in the assessment of chronic human health risks, acute risks were evaluated by comparing contaminant concentrations in groundwater to one-day HAs.

Additional samples were collected from LF-022 and LF-023 in 1991 (see Subsection 5.1). A qualitative evaluation of the impacts of 1991 analytical results on the baseline risk assessment is also included in this subsection.

5.2.1 LF-022 Supplemental Risk Assessment

For LF-022, contaminants originally dismissed as laboratory artifacts or naturally occurring background concentrations included chromium, mercury, and vanadium (soil contaminants), and BEHP, 2-butanone, and zinc (groundwater contaminants). BEHP and 2-butanone were detected in both analytical and laboratory blank samples, and the inorganics were detected within background concentrations. To provide a conservative estimate of potential risks at LF-022, both noncarcinogenic

and carcinogenic risks were reevaluated based on exposure to all compounds detected in surface soils and groundwater.

The Hazard Index (HI) of revised noncarcinogenic risks from direct contact and incidental ingestion exposure to soil at LF-022 ranged from 0.003 to 0.005 (child trespasser), a slight increase from the previous range of 0.001 to 0.004; from 0.3 to 0.6 (future residential - adult), an increase from 0.2 to 0.5; and 0.08 to 0.2 (future residential - adult), an increase from 0.04 to 0.1. All noncarcinogenic risks remain below an HI of 1.0. The carcinogenic risks associated with this route of exposure were not reevaluated because the additional compounds (i.e., total chromium, mercury, and vanadium) are not considered to elicit carcinogenic effects. A summary of the revised risk estimates is presented in Tables 5-13 and 5-14.

The noncarcinogenic risks associated with ingestion and direct contact exposure to groundwater increased from 1.0 to 2.0 (future residential - child), and from 0.2 to 0.5 (future residential - adult) with the inclusion of BEHP, 2-butanone, and zinc. The carcinogenic risks associated with exposure to BEHP were estimated at 7×10^{-6} (future residential - child) and 9×10^{-6} (future residential - adult).

Potential risks associated with acute exposure to contaminated groundwater were qualitatively evaluated by comparing the maximum detected contaminant concentrations to the respective one-day HA. The contaminants detected in groundwater associated with LF-022 and their respective HAs are presented in Table 5-15. Of the five contaminants detected, 2-butanone and zinc had appropriate HAs. The maximum detected concentrations of 2-butanone and zinc were approximately two orders-of-magnitude less than their respective one-day HA, indicating no acute risks from exposure to this compound.

5.2.2 LF-023 Supplemental Risk Assessment

For LF-023, contaminants originally not considered groundwater contaminants of concern included chloroethane, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, BEHP, 2-butanone, arsenic, chromium, nickel, and zinc. To provide a conservative estimate of potential risks at LF-023, both noncarcinogenic and carcinogenic risks were reevaluated based on exposure to all compounds detected in groundwater.

TABLE 5-13
SUMMARY OF LF-022 SITE RISK ESTIMATES - CHILD TRESPASSER

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

TYPE OF EFFECT	EXPOSURE ROUTE, MEDIUM AND EXPOSURE POINT	PATHWAY-SPECIFIC CANCER RISK OR HAZARD INDEX	TOTAL CANCER RISK OR HAZARD INDEX
CARCINOGENIC EFFECTS			
Sitewide Average	Direct contact with surface soil	2E-08	
	Ingestion of surface soil	8E-09	2E-08
Northwest Quadrant	Direct contact with surface soil	5E-08	
	Ingestion of surface soil	2E-08	7E-08
NONCARCINOGENIC EFFECTS			
Sitewide Average	Direct contact with surface soil	0.002	
	Ingestion of surface soil	0.0008	0.003
Northwest Quadrant	Direct contact with surface soil	0.003	
	Ingestion of surface soil	0.002	0.005

Revised values are shaded.

TABLE 5-14
SUMMARY OF LF-022 SITE RISK ESTIMATES - FUTURE RESIDENT

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

TYPE OF EFFECT	EXPOSURE ROUTE, MEDIUM AND EXPOSURE POINT	PATHWAY-SPECIFIC CANCER RISK OR HAZARD INDEX		TOTAL CANCER RISK OR HAZARD INDEX	
CARCINOGENIC EFFECTS		CHILD	ADULT	CHILD	ADULT
	Direct contact with groundwater	7E-06	9E-06		
	Ingestion of groundwater	4E-09	1E-08	7E-06	9E-06
Sitewide Average	Direct contact with surface soil	1E-06	2E-06		
	Ingestion of surface soil	8E-07	3E-07	2E-06	2E-06
Northwest Quadrant	Direct contact with surface soil	3E-06	4E-06		
	Ingestion of surface soil	2E-06	9E-07	5E-06	5E-06
	Inhalation of vapors and dusts	1E-06	1E-06	1E-06	1E-06
	Total: Sitewide Average			1E-05	1E-05
	Total: Northwest Quadrant			1E-05	2E-05
	Total: Sitewide Average			2E-05	
	Total: Northwest Quadrant			3E-05	
NONCARCINOGENIC EFFECTS		CHILD	ADULT	CHILD	ADULT
	Direct contact with groundwater	0.001	0.0007		
	Ingestion of groundwater	2	0.5	2	0.5
Sitewide Average	Direct contact with surface soil	0.2	0.06		
	Ingestion of surface soil	0.1	0.01	0.3	0.08
Northwest Quadrant	Direct contact with surface soil	0.4	0.1		
	Ingestion of surface soil	0.3	0.03	0.6	0.2
	Inhalation of vapors and dusts	0.09	0.02	0.09	0.02
	Total: Sitewide Average			2	0.6
	Total: Northwest Quadrant			3	0.7

Revised values are shaded.

TABLE 5-15
COMPARISONS OF ONE-DAY HEALTH ADVISORIES AND
CONTAMINANT CONCENTRATIONS IN GROUNDWATER

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

SITE	COMPOUND	MAXIMUM CONCENTRATION IN GROUNDWATER (mg/L)	ONE-DAY HEALTH ADVISORIES[1] (10kg CHILD) (mg/L)
LF-022	2-Butanone	0.3	80
	BEHP	0.052	Not Available
	Iron	8.76	Not Available
	Manganese	0.877	Not Available[2]
	Zinc	0.083	4
LF-023	Vinyl Chloride	0.031	3
	Chloroform	0.0004	4
	Chlorobenzene	0.01	Not Available
	Benzene	0.014	0.2
	Ethylbenzene	0.054	30
	2-Butanone	0.07	80
	Chloroethane	0.0007	Not Available[2]
	1,1-Dichloroethane	0.0006	Not Available[2]
	1,2-Dichloroethane	0.0004	0.7
	1,1-Dichloroethene	0.0005	2
	Xylenes	0.072	40
	Naphthalene	0.011	0.5
	BEHP	0.014	Not Available
	Arsenic	0.024	Not Available[2]
	Nickel	0.2	1
	Chromium	0.046	1
	Zinc	0.08	4

NOTES:
[1] Reference Document: Drinking Water Regulations and Health Advisories, April 1991
[2] Compound was listed in reference document but no value was given.
BEHP = bis(2-Ethylhexyl)phthalate

Risks associated with future residential exposure to contaminated groundwater downgradient of LF-023 were estimated based on exposure to the maximum detected contaminant concentration, and therefore represent an upper-bound conservative estimate of risk. The total carcinogenic risk for both child and adult was $1x10^{-3}$. These risk estimates exceed the USEPA target risk range of 10^{-4} to 10^{-6}. Most of the risk is attributed to the ingestion of vinyl chloride, which was detected in the groundwater at a maximum concentration of 0.031 mg/L. The noncarcinogenic risks for this route of exposure were 6.0 (child) and 1.0 (adult). The risk for child exposure exceeds the USEPA target HI of 1.0. Most of the noncarcinogenic risks were attributed to the presence of arsenic, chromium, and nickel. A summary of the revised risk estimates is presented in Table 5-16.

Potential risks associated with acute exposure to contaminated groundwater were qualitatively evaluated by comparing the maximum detected contaminant concentrations to the respective one-day HA. The contaminants detected in groundwater associated with LF-022 and their respective HAs are presented in Table 5-15. Of the 17 contaminants detected in the groundwater associated with LF-023, 12 had associated one-day HA values. None of the detected contaminants exceeded their respective HA values, indicating no acute risks from groundwater exposure. In most instances, the maximum detected contaminant concentration was one order-of-magnitude less than the respective HA.

5.2.3 Risk Evaluation of 1991 Additional Data

As discussed in Subsection 5.1, the additional data collected in 1991 were generally consistent with the historical data, including the contaminants and concentrations detected at LF-022 and LF-023. No significant changes were identified in the contaminants or concentrations detected in the various media, and therefore no significant changes were made to the conclusions of the baseline risk assessment. A qualitative evaluation of the additional data is presented here to support the results of the baseline risk assessment.

Additional data collected at LF-022 included soil and groundwater samples. The soil data indicated the presence of DDT and DDE at concentrations lower than those used in the baseline risk assessment, and DDD was not detected in any of the recent samples. Aroclor 1260 was detected in one of 10 samples at a maximum concentration of 0.36 mg/kg.

TABLE 5-16
SUMMARY OF LF-023 SITE RISK ESTIMATES - FUTURE RESIDENT

LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB

TYPE OF EFFECT	EXPOSURE ROUTE, MEDIUM AND EXPOSURE POINT	PATHWAY-SPECIFIC CANCER RISK OR HAZARD INDEX		TOTAL CANCER RISK OR HAZARD INDEX	
CARCINOGENIC EFFECTS		CHILD	ADULT	CHILD	ADULT
	Direct contact with groundwater	7E-07	2E-06		
	Ingestion of groundwater	1E-03	1E-03		
	Inhalation of volatiles - showering	5E-05	4E-05	1E-03	1E-03
Sitewide Average	Direct contact with surface soil	4E-04	6E-04		
	Ingestion of surface soil	3E-04	1E-04	7E-04	7E-04
Northwest Quadrant	Direct contact with surface soil	1E-03	2E-03		
	Ingestion of surface soil	1E-03	5E-04	2E-03	3E-03
	Incidental ingestion of surface water	2E-07			
	Direct contact with surface water	7E-06		8E-06	
	Inhalation of vapors and dusts	2E-04	1E-04	2E-04	1E-04
	Total: Sitewide Average			2E-03	2E-03
	Total: Northwest Quadrant			3E-03	4E-03
	Total: Sitewide Average			3E-03	
	Total: Northwest Quadrant			6E-03	

NONCARCINOGENIC EFFECTS		CHILD	ADULT	CHILD	ADULT
	Direct contact with groundwater	0.03	0.02		
	Ingestion of groundwater	6	1		
	Inhalation of volatiles - showering	0.3	0.06	6	1
Sitewide Average	Direct contact with surface soil	0.2	0.08		
	Ingestion of surface soil	0.2	0.02	0.4	0.1
Northwest Quadrant	Direct contact with surface soil	0.8	0.4		
	Ingestion of surface soil	1	0.09	2	0.5
	Incidental ingestion of surface water	0.0007			
	Direct contact with surface water	0.03		0.03	
	Inhalation of vapors and dusts	5	0.8	5	0.8
	Total: Sitewide Average			12	2
	Total: Northwest Quadrant			13	2

Revised values are shaded.

The lower pesticide concentrations detected in the recent sampling indicate lower risks to human health than estimated based on the previous composite sampling results. The presence of Aroclor 1260 in one of 10 samples, at a concentration of 0.36 mg/kg, does not present a significant health risk. For comparative purposes, cleanup levels for PCBs in soils at Superfund sites have ranged from 1 to 50 mg/kg (USEPA Region I).

No pesticides or PCBs were detected in the groundwater associated with LF-022. Therefore, the risk estimates discussed in Subsection 5.2.1 are representative of the total site groundwater risks.

Additional data collected at LF-023 include groundwater, surface water, and sediment samples. Groundwater data from 1987, 1988, and 1989 sampling episodes are compared with 1991 groundwater data in Table 5-7 and discussed in Subsection 5.1.2.1. The 1991 data is consistent with the previous data for all locations and contaminants except for MW-23-008, where 4-methyl-2-pentanone and 2-hexanone were detected, and CP-02-035, where carbon disulfide was detected. None of these compounds had been detected during previous sampling rounds. All other VOCs were previously detected and at similar concentrations to those reported in the 1991 data.

The concentrations of 4-methyl-2-pentanone and 2-hexanone were below the New York State Class GA Groundwater and Drinking Water Standards, indicating no significant risk to human health. There are no appropriate Drinking Water Standards with which to compare the concentration of carbon disulfide. However, a chronic oral RfD of 0.1 mg/kg-day has been developed by the USEPA and presented in the Health Effects Assessment Summary Tables (USEPA, 1991). This value corresponds to a drinking water concentration of 3.5 mg/L carbon disulfide (assuming a 70 kg adult consumes 2 liters of water per day). The maximum detected concentration of carbon disulfide (0.017 mg/L) was significantly below this value, indicating no significant risk to human health.

Both filtered and unfiltered groundwater samples were collected and analyzed for inorganic compounds. The filtered results were similar to those previously detected. Unfiltered samples had not been previously collected so there was no historical data to compare against. Three inorganic metals were detected in the unfiltered samples in excess of the New York State Class GA Groundwater and Drinking Water Standards: chromium, manganese, and iron. Of these, only chromium is regulated

based on health considerations; iron and manganese are regulated based on aesthetic qualities. Chromium was identified as a contaminant of concern in the baseline risk assessment and the potential risks from exposure to this metal were evaluated.

Surface water and sediment samples were collected at two locations from the wetlands downgradient of LF-023. Acetone and xylene were not previously detected in these media; however, they were detected in surface water and sediment, respectively, in 1991. There are no appropriate federal or state Ambient Water Quality Standards or Guidance Values with which to compare these results.

Both filtered and unfiltered surface water samples were collected and analyzed for inorganic metals. The unfiltered sample results from the 1991 sampling episode were similar in chemical composition and concentration to the 1988 sample results. Calcium, iron, magnesium, manganese, potassium, and sodium were detected in the filtered samples (these metals were also detected in the unfiltered samples). The concentrations of these metals were similar or less than the corresponding concentrations in the unfiltered samples.

As discussed in Subsection 5.1 and the previous paragraphs, analytical results from the 1991 sampling episodes at LF-022 and LF-023 are consistent with previous sampling results. Therefore, the 1991 data support the conclusions of the baseline risk assessments (see Sections 3.0 and 4.0).

5.3 Additional Physical and Background Data

USEPA expressed concern that sufficient data was not available to support Feasibility Studies (FSs) at LF-022 and LF-023. The following subsections contain new data and clarifications of existing data to address these concerns.

5.3.1 LF-022

In January 1992, the USEPA forwarded a technical memorandum to Plattsburgh AFB that contained recommendations for further remedial investigation activities at landfill LF-022. The recommended activities focused on achieving the following six objectives:

- Determine the nature of the waste

- Define the volume of fill material
- Define the areal extent of LF-022
- Determine the effect of the waste on groundwater quality
- Define the direction of groundwater flow beneath LF-022
- Collect information necessary to support the development and screening of alternatives

During a January 1992 regulatory meeting at Plattsburgh AFB, USEPA's concerns were discussed, existing data were clarified, and all parties agreed that the current data were sufficient to support an FS but some work may be required in support of the final design. New data are presented and existing data are clarified in the following subsections.

5.3.1.1 Nature of the Waste. LF-022 was active from 1959 to 1966, and received domestic wastes from Plattsburgh AFB. While the landfill was active, several different disposal methods were available for hazardous waste. Explosive ordnance was deactivated or detonated by the explosive ordnance disposal (EOD) personnel on base; residue was then disposed of in the landfill as nonhazardous waste. Other hazardous wastes were handled by civil engineering service contractors, or taken to the Defense Reutilization and Marketing Office (DRMO) and disposed of recycled off site by hazardous waste contractors. Liquids, such as out-of-specification fuel, waste solvents, and waste oil, were also taken to FT-002 and burned during fire training activities. Because appropriate methods of hazardous waste disposal were available during operation of the landfill, it is unlikely that hazardous wastes were disposed of in LF-022. Landfill workers, interviewed during the Preliminary Assessment and the RI, said that hazardous wastes were not disposed of in LF-022. Workers stated that drums had been received at the landfill but these were empty and unsalvageable.

During the SI and RI, investigations were conducted to evaluate the impact of the landfill on human health and the environment. A magnetometer survey was conducted across the landfill to search for magnetic anomalies that might indicate buried drums. Magnetic anomalies detected by the survey were investigated by digging 14 test pits. Materials uncovered in the test pits included: trash, glass, paper,

plastic, wood, steel objects, steel cable, crushed 5-gallon pails, and a few crushed 55-gallon drums. Samples of discolored soil and material in or around the crushed pails and drums were collected and analyzed. The analytical results for these samples are described in Section 3.0. The sampling results do not indicate that hazardous waste was disposed of at LF-022.

Because hazardous waste is not always associated with metal objects such as drums, other investigations were conducted to evaluate the presence of hazardous waste. Surface soil, groundwater, and soil gas samples were collected. Although some contaminants were detected (see Section 3.0), sampling results did not indicate that LF-022 was used for hazardous waste disposal.

The soil gas survey, conducted at LF-022 during the RI, was performed to screen for potential "hot spots," which may be impacting groundwater and/or posing a risk. Areas of high relative flux values for some compounds were detected across the landfill. Soil gas data were used, in conjunction with groundwater data from monitoring wells and surface soil samples collected from four high flux value locations, to determine the potential for "hot spots." Although there were higher relative flux values in some parts of the landfill, based on a technical evaluation of the data, it was determined that no obvious "hot spot" locations were evident.

In the early 1980s, spent jet engine starter cartridges were piled on the ground at the southwest corner of the landfill. It was reported in the Preliminary Assessment that these starter cartridges gave off hydrogen cyanide gas when used. However, a recent research conducted by base personnel revealed that these cartridges contained only ammonium nitrate. In the mid-1980s, most of the cartridges were removed from the site and disposed of at a municipal landfill.

5.3.1.2 Areal Extent of the Landfill. The LF-022 border is defined by physical features and from explorations. A small arms range is located northwest of the landfill, excavations dug during the construction of the small arms range revealed no waste. Prior to construction of the small arms range, these geotechnical test borings were drilled to a depth of 20 feet. Waste was not encountered in any of these borings. South of the small arms range are former railroad beds that predate Plattsburgh AFB and are truncated by the landfill. The small arms range, the truncated railroad beds, and old growth pines define the west boundary of the landfill. South of the landfill are large pines that predate landfill activities and define the southern boundary. Monitoring wells were installed along the eastern side

of the landfill during the SI and RI. Waste was not encountered during the installation of these wells; therefore, they have been used to define the eastern boundary of the landfill. North of the landfill, large pines and a steep slope define the boundary. Aerial photographs, taken two years after landfill operations at LF-022 ceased, support this interpretation of the landfill boundaries. The features that define the extent of the landfill are shown in Figure 5-3.

The volume of fill material in the landfill was estimated using the areal extent of the landfill and the reported maximum depth of the fill. Landfill workers interviewed during the Preliminary Assessment indicated that the maximum depth of the landfill was 25 feet. These reports are consistent with the depth observed in a landfill cell excavated on the western side of the site but never filled in. Based on groundwater elevations measured in wells surrounding LF-022, groundwater is at least 40 feet below the surface of LF-022; therefore, trenches were not deep enough to expose groundwater-saturated soil. Without an extensive field investigation program, it would not be possible to determine the location and maximum depth of each trench. A more accurate estimate of fill material volume may be required if excavation and treatment were selected as an alternative. However, the excavation/treatment alternative was screened out during the screening of alternatives because the cost of treating the estimated volume of waste in LF-022 is too great. USEPA guidance, *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites*, states that generally landfills with volumes greater than 100,000 cubic yards are too large to consider excavation/treatment. The volume of fill material in LF-022 is estimated at approximately five times this amount. The volume of fill material at LF-022 should not influence the final selection of a remedial alternative.

5.3.1.3 Aquifer Characteristics. Three IRP sites are located in the northwest section of the base. These three sites, LF-022, FT-002, and LF-023, are next to each other, with LF-022 being the northernmost site of the three and LF-023 the southernmost (see Figure 1-3). Investigations at all three sites have been used to evaluate aquifer characteristics in the area. The investigations conducted in the immediate vicinity of the three sites (i.e., west of Perimeter Road) are:

- Sixteen borings that completely penetrated the unconfined aquifer (Appendix C and *Draft FT-002 Soil Remedial Investigation Report* [ABB-ES, 1991])

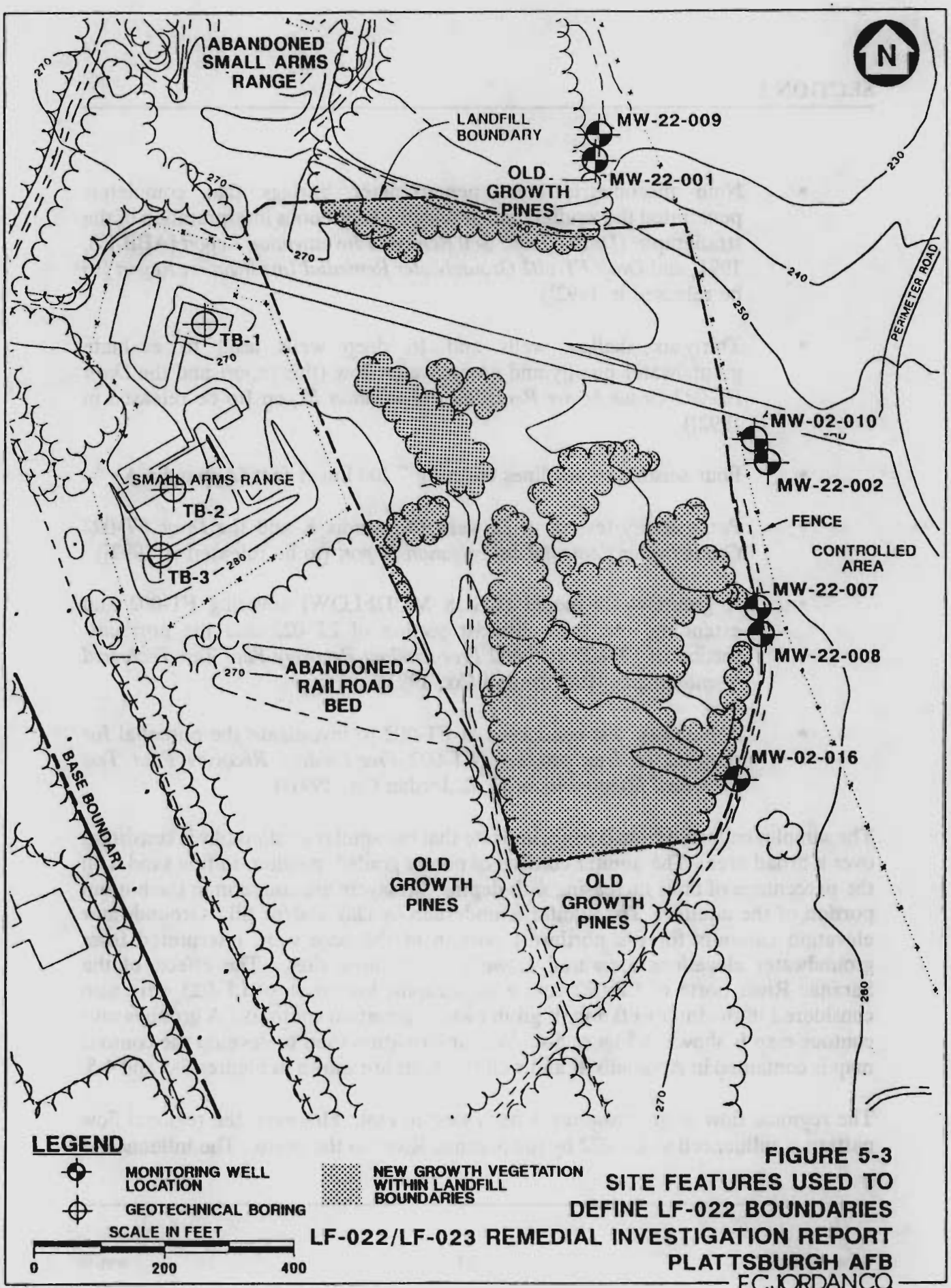


FIGURE 5-3
SITE FEATURES USED TO DEFINE LF-022 BOUNDARIES
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
EC JORDAN CO

- Nine piezometric cone penetrometer borings that completely penetrated the aquifer, and provided a continuous interpretation of the stratigraphy (*Draft FT-002 Soil Remedial Investigation Report* [ABB-ES, 1991] and *Draft FT-002 Groundwater Remedial Investigation Report* [to be released in 1992])

- Thirty-six shallow wells and 16 deep wells used to evaluate groundwater quality and groundwater flow (this report and the *Draft FT-002 Groundwater Remedial Investigation Report* [to be released in 1992])

- Four seismic survey lines covering 7,200 linear feet (Appendix A)

- Permeability testing in 22 wells (Appendix K and the *Draft FT-002 Groundwater Remedial Investigation Report* [to be released in 1992])

- A groundwater model (USGS MODFLOW) covering FT-002 and extending into the southeast section of LF-022 and the northeast section of LF-023 (*FT-002 Free-Product Recovery Pilot Test Technical Memorandum* [E.C. Jordan Co., 1991])

- A pumping test conducted at FT-002 to investigate the potential for removal of free product (*FT-002 Free-Product Recovery Pilot Test Technical Memorandum* [E.C. Jordan Co., 1991])

The samples collected from borings indicate that the aquifer stratigraphy is consistent over a broad area. The aquifer consists of poorly graded, medium-to-fine sand with the percentage of fines increasing with depth. Silt layers are common in the bottom portion of the aquifer. The aquifer is underlain by clay and/or till. Groundwater elevation contours for the northwest portion of the base were interpreted from groundwater elevations measured in wells at all three sites. The effects of the Saranac River north of LF-022, and a topographic low south of LF-023 were also considered in the interpretation of groundwater elevation contours. A groundwater contour map is shown in Figure 5-4. Well information used to develop the contour map is contained in Appendix K and well locations are shown in Figures 3-5 and 4-5.

The regional flow of groundwater is from west to east. However, the regional flow pattern is influenced at LF-022 by the Saranac River to the north. The influence of

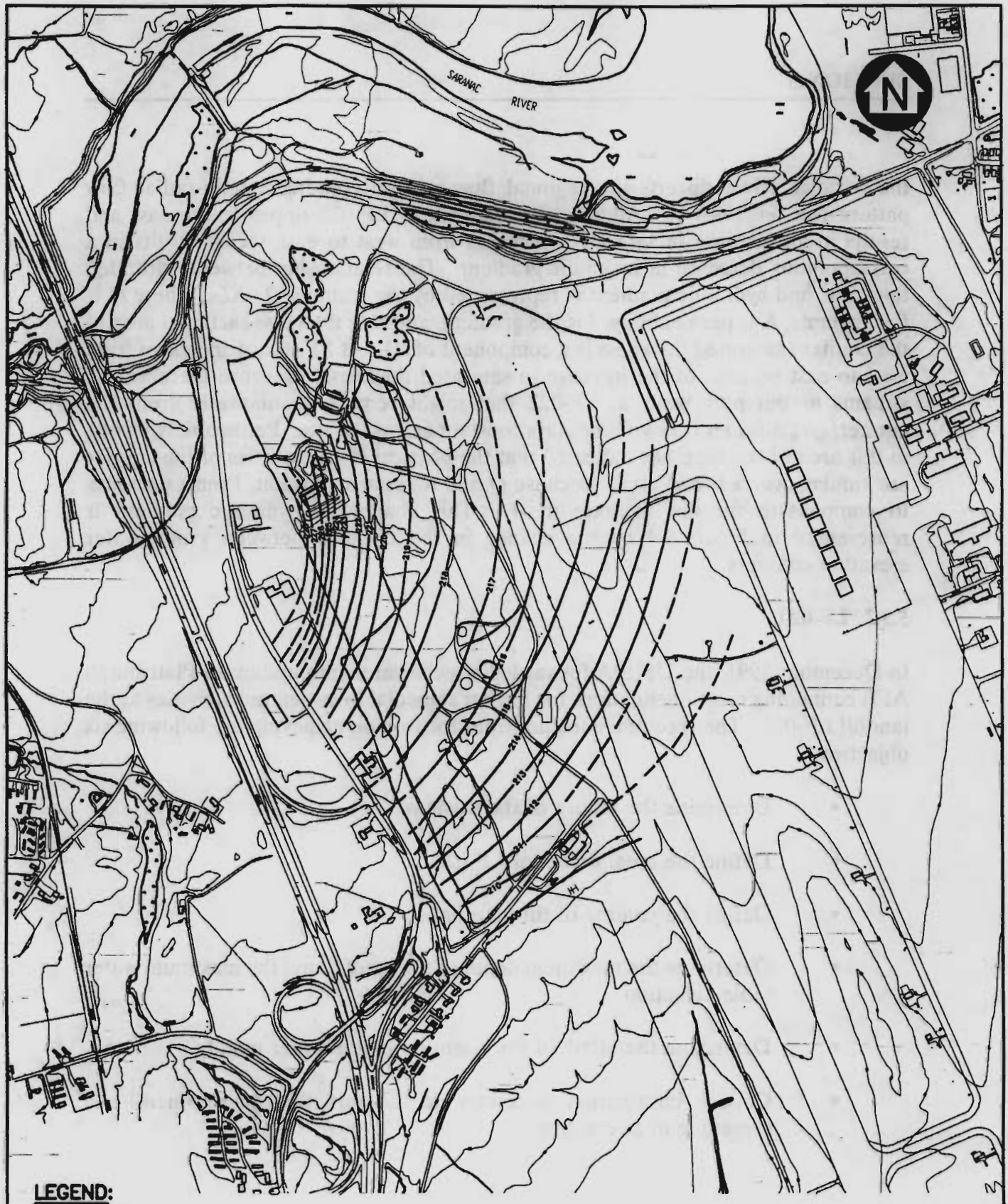


FIGURE 5-4
FT-002/LF-022/LF-023
GROUNDWATER ELEVATION CONTOURS
PLATTSBURGH AFB
EC JORDAN CO.

6091-21\FIG5-4

the Saranac River distorts the regional flow pattern creating a semi-radial flow pattern (see Figure 5-4). Additionally, bedrock at LF-022 slopes to the east and results in an increase in saturated thickness from west to east, which results in a corresponding decrease in hydraulic gradient. The relationship between saturated thickness and hydraulic gradient is represented by the formula $Q=KIA$, where Q is flow volume, K is permeability, I is the gradient, and A is the cross-sectional area of the aquifer (saturated thickness is a component of A). At LF-022, A increases from west to east because of the increase in saturated thickness. Because there are no streams or pumping wells at LF-022 that might remove groundwater from the aquifer, groundwater flow volume stays constant across the site. Permeability testing in this area of the base has indicated that the physical characteristics of the aquifer are similar over a broad area. Because Q and K remain constant, I must decrease to compensate for the increase in A. This change in hydraulic gradient is represented in Figure 5-4 by the change in the distance between groundwater elevation contours.

5.3.2 LF-023

In December 1991, the USEPA forwarded a technical memorandum to Plattsburgh AFB containing recommendations for further remedial investigation activities at the landfill LF-023. The recommended activities focused on achieving the following six objectives:

- Determine the nature of the waste
- Define the areal extent of LF-023
- Define the volume of fill material
- Determine the maximum depth of the landfill and the maximum water table elevation
- Determine the effect of the waste on groundwater quality
- Collect information necessary to support the development and screening of alternatives

During a January 1992 regulatory meeting at Plattsburgh AFB, USEPA's concerns were discussed, existing data were clarified, and all parties agreed that the current data were sufficient to support an FS. Some work may be required in support of the final design. New data are presented and existing data are clarified in the following subsections.

5.3.2.1 Nature of the Waste. LF-023 was active as a domestic waste landfill from 1966 to 1979, after which domestic wastes were taken off site to a municipal landfill. Construction debris was dumped at the site until 1981. Because appropriate methods of hazardous waste disposal were available during the operation of the landfill, it is unlikely that hazardous wastes were disposed of in LF-023. Hazardous waste disposal methods are described in Subsection 5.3.1.1. Landfill workers interviewed during the Preliminary Assessment and the RI said that hazardous wastes were not disposed of in LF-023. Workers reported that drums disposed of at LF-023 were empty and unsalvageable.

During the SI, a magnetometer survey was conducted across the landfill to search for magnetic anomalies that might indicate buried drums. Magnetic anomalies detected by the survey were investigated by digging nine test pits. Materials uncovered in the test pits included trash, glass, plastic, wood, steel objects, and a crushed car. Samples of discolored soil were collected and analyzed. The analytical results for these samples are described in Section 4.0. The sampling results do not indicate that hazardous waste was disposed of at LF-023.

Because hazardous waste is not always associated with metal objects such as drums, other investigations were conducted to evaluate the presence of hazardous waste. Surface soil, groundwater, and soil gas samples were collected. Although some contaminants were detected (see Section 4.0), sampling results did not indicate that LF-023 was used for hazardous waste disposal.

The USEPA guidance, *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites*, identifies containment as generally the most practicable remedial alternative for municipal landfills because these landfills often contain large volumes of heterogeneous waste. The guidance states that "characterization of municipal landfill waste contents is therefore not necessary because containment of the landfill contents do not require such information." Characterization of wastes may be required for sections of landfills that are suspected "hot spots."

The soil gas survey conducted at LF-023 during the RI screened for potential "hot spots," that could be impacting groundwater and/or posing a risk. Areas of high relative flux values for some compounds were detected primarily alongside the dirt road that runs north-south across the landfill. Soil gas data were used with groundwater data from monitoring wells and surface soil samples collected at four high flux value locations to determine the potential for a "hot spot." Based on a technical evaluation of the data, it was determined that no obvious "hot spot" location was evident. Although there were higher relative flux values in some parts of the landfill, these were not considered "hot spots." The landfill ceased operations more than 10 years ago. If "hot spots" were present in the landfill, it is expected that groundwater would be impacted. Low concentrations of fuel-related compounds and solvents were detected in the groundwater, but these concentrations do not suggest the presence of "hot spots".

5.3.2.2 Areal Extent and Depth of Landfill LF-023. Most of the landfill border is defined by large pine trees surrounding the site that predate landfill activities. The areal extent of two small sections of the landfill, which are north of the main portion of the landfill, was defined by a combination of a magnetometer survey conducted during the SI and a ground-penetrating radar survey conducted during the RI. The features defining the areal extent of the landfill are shown in Figure 5-5.

The maximum depth of fill material in LF-023 was reported in the Preliminary Assessment to be 25 feet below ground surface. This information has been further supported by recent interviews with Plattsburgh AFB employees involved with landfill operations at LF-023. Workers reported that trenches were dug with a crane, and a bulldozer spread the trash in the trenches. They also reported that trenches were never deep enough to expose groundwater-saturated soil.

The USEPA guidance, *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites*, states that the depth of waste is used to calculate settlement patterns that are incorporated into a cover system design for a landfill. Because this is a design consideration, this information will not influence the selection of a remedial alternative.

The volume of fill material may be required if excavation and treatment were selected as an alternative. However, the excavation/treatment alternative was screened out during the screening of alternatives because the cost of treating the estimated volume of waste in LF-023 is too great. The USEPA guidance, *Conducting*

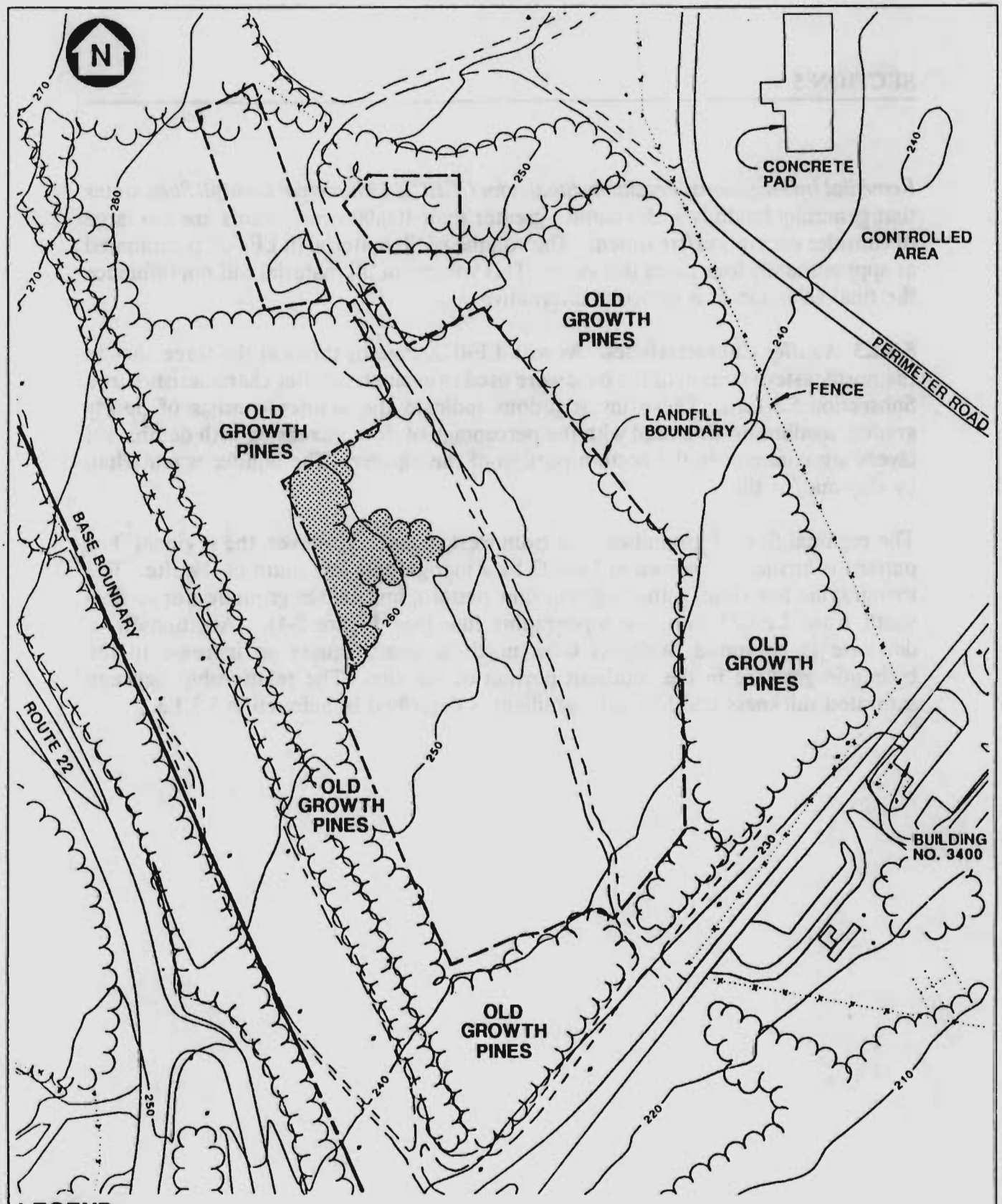


FIGURE 5-5
SITE FEATURES USED TO DEFINE LF-023 BOUNDARIES
LF-022/LF-023 REMEDIAL INVESTIGATION REPORT
PLATTSBURGH AFB
E.C. JORDAN CO.

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Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites, states that generally landfills with volumes greater than 100,000 cubic yards are too large to consider excavation/treatment. The volume of fill material in LF-023 is estimated at approximately four times this value. This volume of fill material will not influence the final selection of a remedial alternative.

5.3.2.3 Aquifer Characteristics. As with LF-022, investigations at the three sites in the northeastern section of the base were used to evaluate aquifer characteristics (see Subsection 5.3.1.3). These investigations indicate the aquifer consists of poorly graded, medium-to-fine sand with the percentage of fines increasing with depth. Silt layers are common in the bottom portion of the aquifer. The aquifer is underlain by clay and/or till.

The regional flow of groundwater is from west to east. However, the regional flow pattern is further influenced at LF-023 by a topographic low south of the site. The topographic low distorts the regional flow pattern, and causes groundwater to flow south from LF-023 into the topographic low (see Figure 5-4). Additionally, a decrease in saturated thickness from north to south causes an increase in the hydraulic gradient in the southern portion of the site. The relationship between saturated thickness and hydraulic gradient is described in Subsection 5.3.1.3.

AAQS	Ambient Air Quality Standard
AFB	Air Force Base
AWQC	Ambient Water Quality Criteria
BEHP	bis(2-ethylhexyl)phthalate
bgs	below ground surface
BW	body weight
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
cm	centimeter
cm/sec	centimeters per second
CRQL	Contract Required Quantitation Limit
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
DOD	Department of Defense
DOE	Department of Energy
DRMO	Defense Reutilization and Marketing Office
EOD	explosive ordnance disposal
ERA	Environmental Risk Assessment
FS	Feasibility Study
GC/MS	gas chromatography/mass spectrometry
GPR	ground-penetrating radar
HA	Health Advisory
HARM	Hazard Assessment Rating Methodology
HAZWRAP	Hazardous Waste Remedial Actions Program
HI	Hazard Index
IRP	Installation Restoration Program
K	hydraulic conductivity
kg	kilogram

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

K_d	partitioning coefficient
K_{oc}	organic carbon partition coefficient
K_{ow}	octanol-water partitioning
LOAEL	Lowest Observed Adverse Effect Level
m	meter
mm	millimeter
m/s	meters per second
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mm	millimeter
MMES	Martin Marietta Energy Systems, Inc.
NYSDEC	New York State Department of Environmental Conservation
PAH	polyaromatic hydrocarbon
PCB	polychlorinated biphenyl
PDE	Potential Dietary Exposure
PHC	petroleum hydrocarbon
PID	photoionization detector
ppb	parts per billion
ppm	parts per million
PVC	polyvinyl chloride
RfD	reference dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
RTV	Reference Toxicity Value
SAC	Strategic Air Command
SARA	Superfund Amendments and Reauthorization Act
SF	slope factor
SFF	Site Foraging Frequency
SI	Site Inspection
SOV	soil organic vapor
SVOC	semivolatile organic compound

TAL	Target Analyte List
TCE	trichloroethene
TCL	Target Compound List
USEPA	U.S. Environmental Protection Agency
VOA	volatile organic analysis
VOC	volatile organic compound
µg/kg	micrograms per kilogram
µg/L	micrograms per liter

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