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FINAL REPORT

CONFIRMATION STUDY OF FORMER ATLAS MISSILE SITES
FOR POTENTIAL
TOXIC AND HAZARDOUS WASTE CONTAMINATION

FORMER ATLAS SITE S-4
ESSEX, NEW YORK
CONTRACT NUMBER DACW41-86-D-0115

RECEIVED

Prepared for:

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May, 1987

The conclusions and recommendations contained in this report are solely those of Law Environmental Incorporated and do not necessarily reflect the position of the United States Government or any of its departments or agencies.

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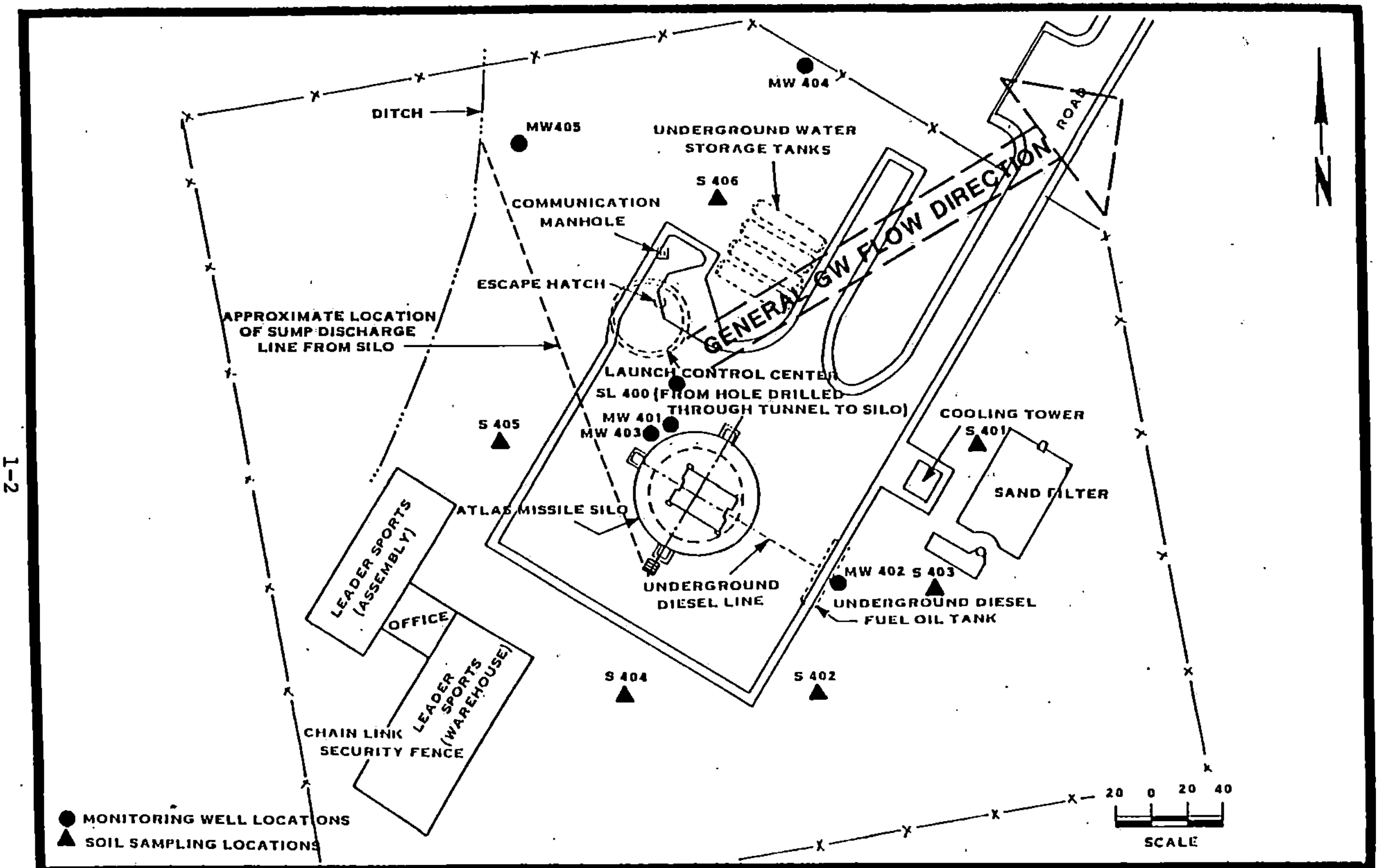
SECTION 1.0 - EXECUTIVE SUMMARY

The Department of Defense (DOD) is investigating former Atlas Missile sites throughout the United States for potential toxic and hazardous waste contamination. This report documents the Confirmation Study performed at Atlas Missile Site S-4, which is located just west of the Town of Essex, New York. The field investigation involved installation and sampling of five shallow ground-water monitoring wells, the silo water, and shallow soils. Field investigations were performed on two separate occasions, November 7-20, 1986, and April 16-28, 1987. Figure 1-1 shows the monitoring well, silo, and soil sampling locations. In order to detect a variety of potential contaminants, the samples were analyzed for purgeable halocarbons, petroleum hydrocarbons, purgeable aromatics, total and dissolved metals. The analytical data for this study are summarized in Section 4.0 of the report.

The analytical tests performed on ground water, silo water, and soil samples were selected by the USACE. These analytical parameters represent likely contaminants from Atlas Missile site operations. A number of those substances were found in the water and soil on the site in low concentrations. Chemical tests performed to identify potential contaminants at the site included:

Contaminant	Matrix
Purgeable Aromatics	Soil & Water
Purgeable Halocarbons	Soil & Water
Petroleum Hydrocarbons	Soil & Water
Metals Total Analyses	Soil
Total & Dissolved Analyses	Water

Arsenic
Barium
Cadmium
Chromium
Lead
Mercury
Selenium
Silver



ATLAS SITE S-4
ESSEX, NEW YORK

LAW ENVIRONMENTAL SERVICES

MARIETTA, GEORGIA

SITE LAYOUT AND
SAMPLING LOCATIONS

SAMPLED 11/19/86, 4/28/87

FIGURE 1-1

Atlas Site S-4 was acquired between 1960 and 1961 as part of the USAF's Plattsburgh Atlas Missile Complex. The site was deactivated in July 1965. There was no housing at the site, and it was not subject to use other than by the Department of the Air Force during its activation.

The Town of Willsboro obtained the site by Quitclaim Deed dated July 11, 1967. During the same year, the Township sold the site to Mr. Lyle Mason. In 1983 Mr. Mason conveyed the site to Leader Sports, Incorporated. Leader Sports, Inc. manufactures sporting equipment for wholesalers and retailers and is the current owner of the site.

1.1 PRELIMINARY DETERMINATION AND RECOMMENDATIONS

Field work was performed at Atlas Site S-4 on two separate occasions: November, 1986 and April, 1987. During November, 1986, three shallow ground-water monitoring wells and one deep well were installed, the wells were developed and sampled, soil samples were collected, and the soil, ground-water, and silo water samples were analyzed. During April, 1987 another shallow ground-water monitoring well was installed, and the four shallow monitoring wells were resampled and analyzed. Analytical results from both sampling episodes were compared to State and Federal criteria and used to prepare the preliminary determination and the recommendations.

Based upon field investigations and analysis of laboratory results, the following preliminary determination and recommendations are made:

(1) Based upon the ground-water samples and analyses, operation of Atlas Site S-4 in the Essex area of New York may have contributed to elevated levels of purgeable halocarbon compounds in the ground water at the site. The purgeable halocarbon compound of particular interest is trichloroethene (TCE). Ground-water samples from monitoring

wells MW403 and MW404 exceeded New York State Department of Environmental Conservation (NYSDEC) standards for TCE.

(2) The missile silo doors at this site were sealed, however samples were taken from a borehole drilled into the tunnel connecting the flooded Launch Control Center (LCC) to the silo. This water sample also tested positive for trichloroethene (TCE).

(3) Based on the soil samples and analyses, operation of Atlas Site S-4 most likely did not contribute significant levels of contaminants in the soil at the site. The existing levels of constituents in the soil appear so low, that it is not thought to be a significant health hazard.

(4) It is recommended that a preliminary baseline Public Health Assessment be performed to determine if the site presents an imminent and substantial danger to public health or welfare.

1.2 OVERVIEW OF THE ATLAS MISSILE SYSTEM

1.2.1 Background

The Atlas Missile System was the foundation for the United States Intercontinental Ballistic Missile (ICBM) and space launch vehicle programs during the late 1950's and early 1960's. The Atlas Missile Program began in 1946 under the code name Project MX774. The program evolved through several phases of improved engines, modified fuels, strategic missile deployment, varied launch configurations, and a space launch vehicle. The phase which influences the Defense Environmental Restoration Program involves the deployment of Atlas missiles at operational sites within the continental U.S.

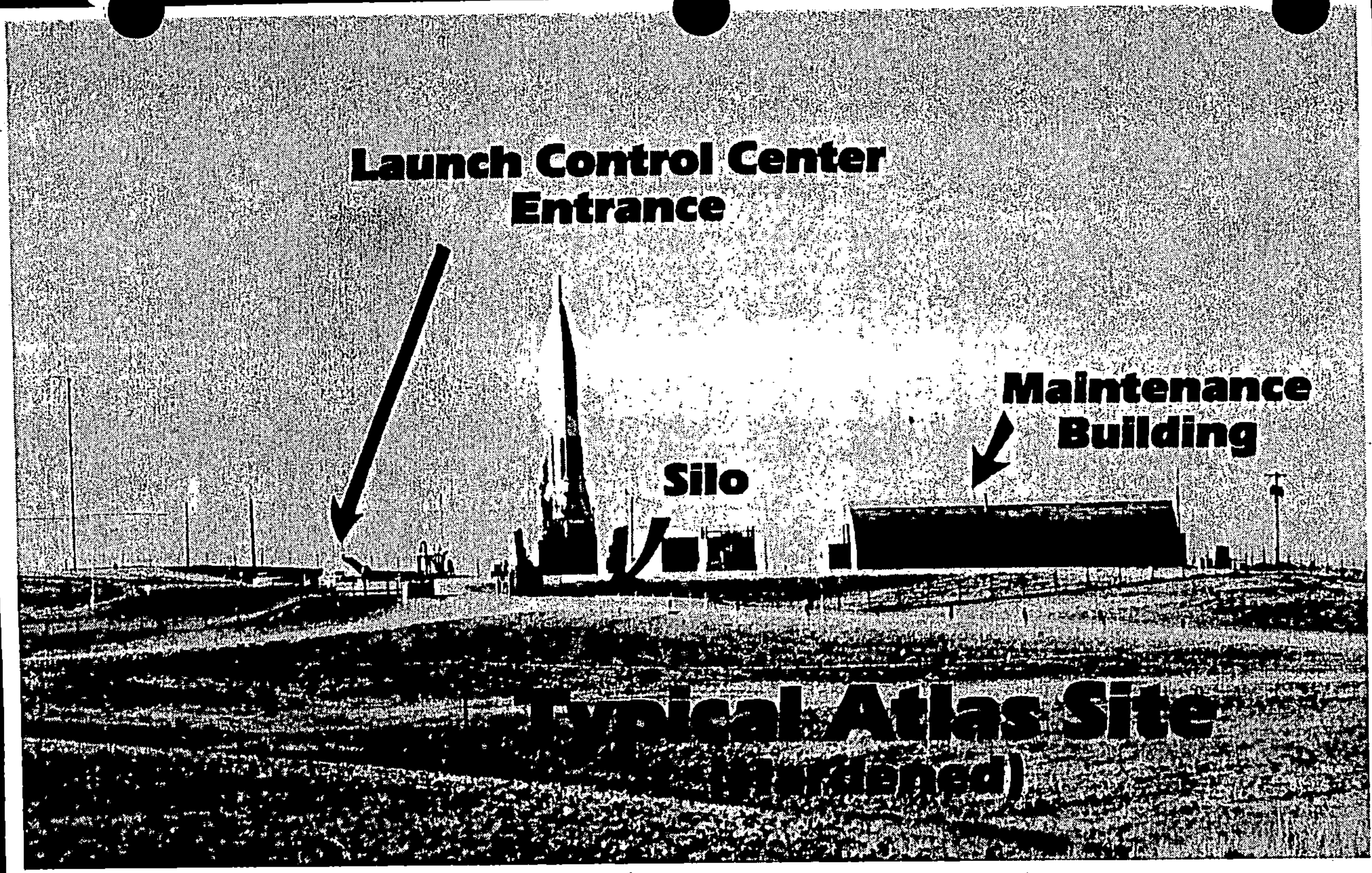
The Research and Development (R&D) phase of the Atlas Missile Program was conducted at Cape Canaveral, Florida. The most memorable event associated with Atlas during R&D was the December 18, 1958 launch into orbit, and radioing back to earth a Christmas message from President Eisenhower. At that time Atlas was on a high priority track to become an operational part of the ICBM Program. The first two versions of the missile Atlas A and Atlas B were produced during this R&D phase.

Atlas D was the first operational version of the missile; it was deployed at Vandenberg AFB, California; Warren AFB, Wyoming, and Offutt AFB, Nebraska. The subsequent versions (E and F) were also deployed at operational units in the U.S. Figure 1-2 shows typical above-ground facilities of an Atlas Missile site.

During the evolution of Atlas versions D, E, and F, the launch mode for the missile was also evolving. The R&D versions of Atlas had stationary launch facilities at Cape Canaveral and Vandenburg. However, the operational missile had to be deployed at remote sites where it was not feasible to provide the stationary launch facilities. Therefore, Atlas D was designed to be moved to the launch pad by a transporter, which subsequently erected the missile to its vertical launch position and then arched away from the missile at launch. The installations which deployed Atlas D's were above ground facilities and provided no protection from attack.

The next improvement for Atlas was the E version, designed to survive a nearby nuclear explosion, which would produce up to 25 PSI overpressure to the launch facility. This criteria resulted in enclosing the missiles in "coffin like" vaults and redesigning the lifting truss to position the missile for launch. The missile vaults were partially buried, with protective doors that retracted from above the missile for launching. The launch operations were conducted from a buried control structure. Atlas E sites were considered "semi-hard" sites.

The final improvement to the Atlas Missiles System was to harden the facilities to provide protection for 100 PSI overpressure



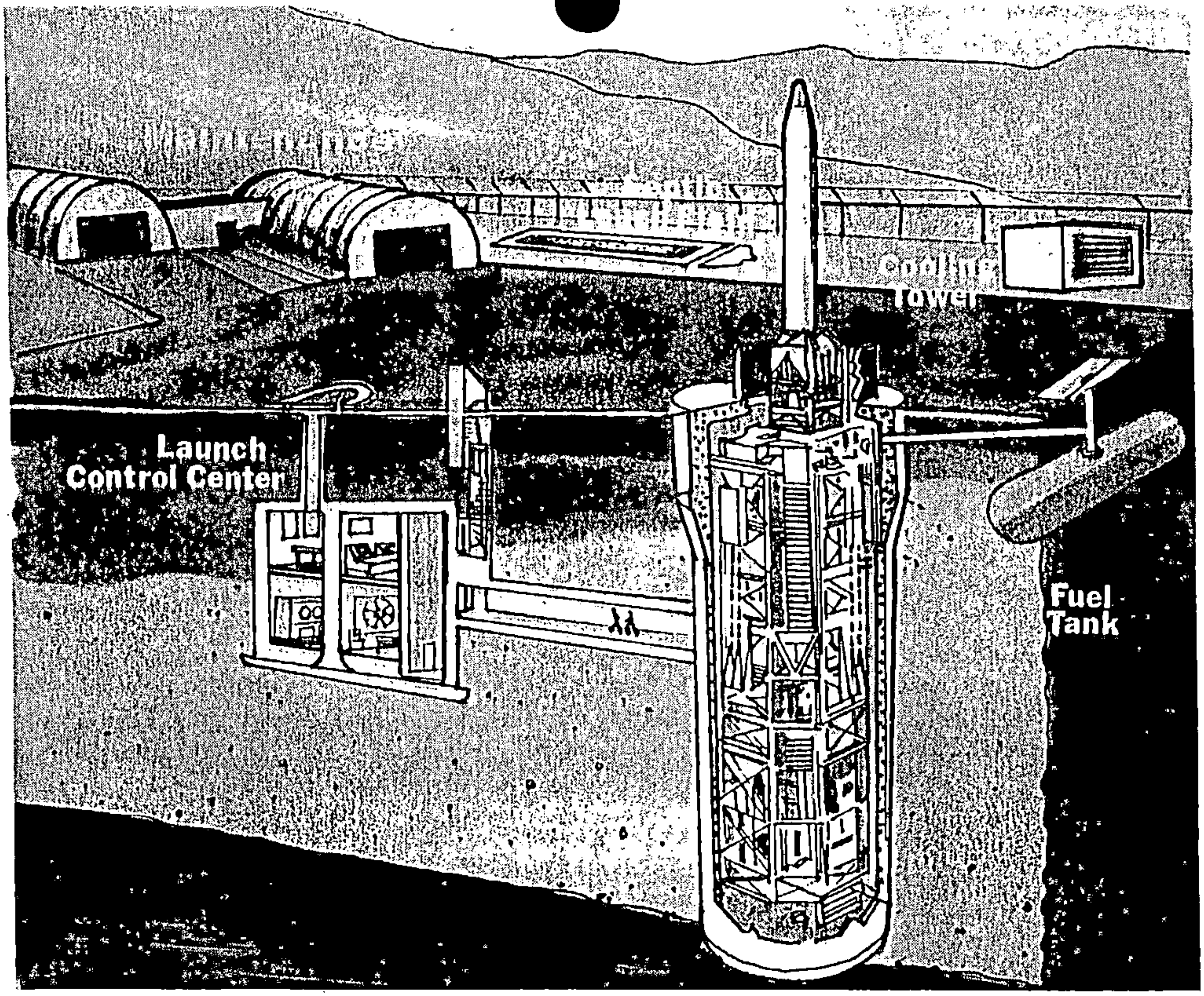
TYPICAL ATLAS MISSILE SITE	LAW ENVIRONMENTAL INC. GOVERNMENTAL SERVICES DIVISION	TYPICAL ATLAS SITE FIGURE 1-2

which would be produced by a nearby nuclear explosion. This resulted in emplacing the missile vertically in underground silos, and isolating the missile from the silo within a spring mounted crib. The silo was 174 feet deep and 69 feet in diameter. Figure 1-3 is an artist's sketch of the above ground and below ground facilities at Atlas sites. The silo top was enclosed by heavy doors which were opened for missile launch (Figures 1-4 and 1-5). The Atlas F version was deployed at the hard sites. The launch mode was to elevate the missile above the silo door (top). Integrated Atlas F facilities such as control rooms, crew quarters, propellant storage were buried below ground.

The Atlas D, E and F versions were deployed at 13 squadrons located near 11 Air Force bases. The Atlas deployments are summarized below:

		Number of Missiles		
Air Force Base	Location	D Model	E Model	F Model
Vandenberg	Lompoc, CA	6		
Warren	Cheyenne, WY	6	9	9
Offutt	Omaha, NE	9		
Fairchild	Spokane, WA		9	
Forbes	Topeka, KS		9	
Schilling	Salina, KS			12
Lincoln	Lincoln, NE			12
Altus	Altus, OK			12
Dyess	Abilene, TX			12
Walker	Roswell, NM			12
Plattsburgh	Plattsburgh, NY			12

In addition to locating the Atlas missile squadrons at scattered Air Force bases, each squadron dispersed its missiles to improve system survivability; except for early "soft" operational units at Vandenberg AFB and Warren AFB, which were not dispersed. The non-dispersed sites allowed multiple (3) missiles to be



TYPICAL ATLAS MISSILE SITE

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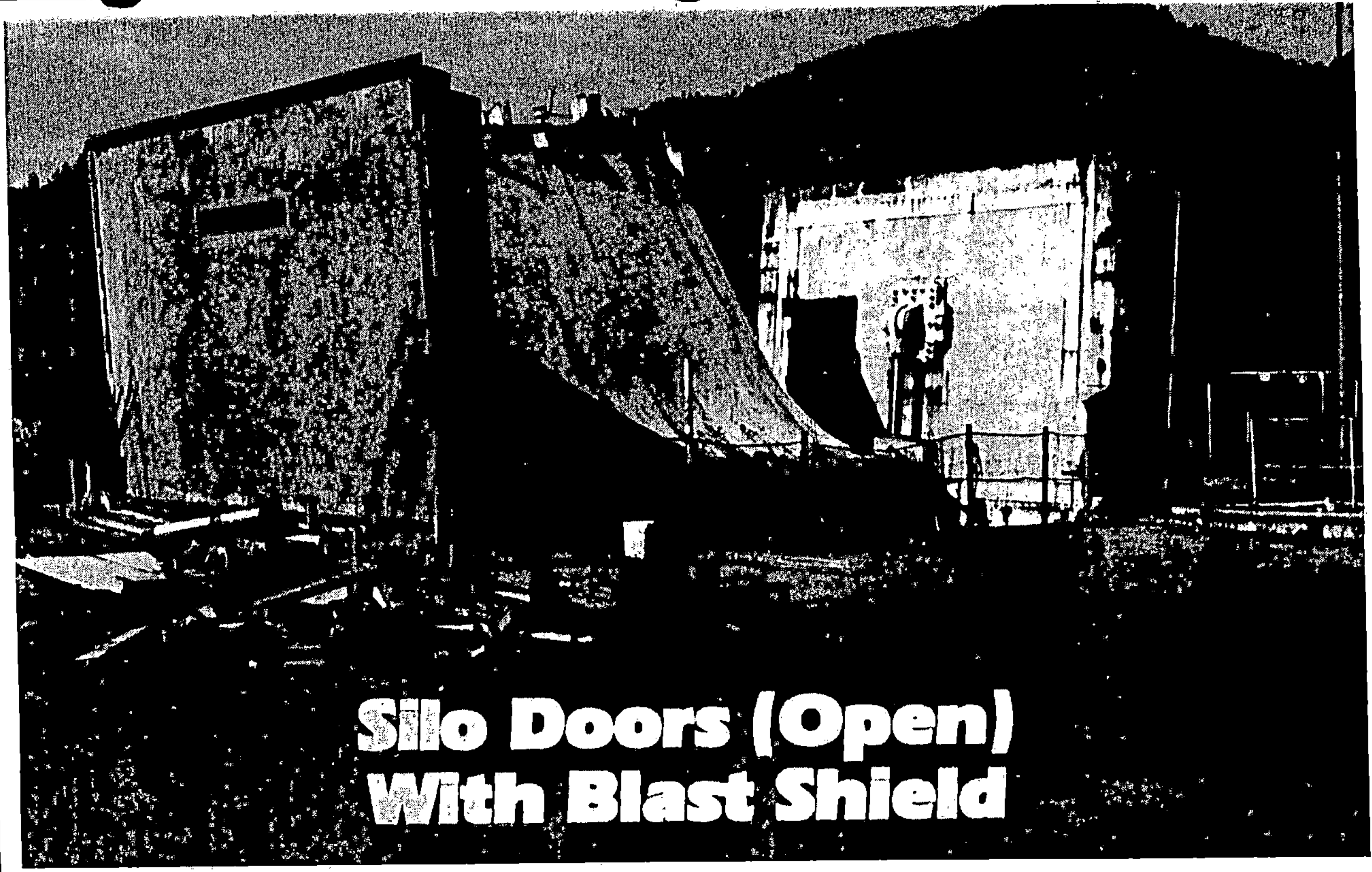
ATLAS GENERIC SITE

FIGURE 1-3

TYPICAL ATLAS MISSILE SITE	LAW ENVIRONMENTAL INC. GOVERNMENTAL SERVICES DIVISION	SILO DOORS (CLOSED) FIGURE 1-4



TYPICAL ATLAS
MISSILE SITE

LAW ENVIRONMENTAL INC.
GOVERNMENTAL SERVICES DIVISION

SILO DOORS (OPEN)
WITH BLAST SHIELD

FIGURE 1-5

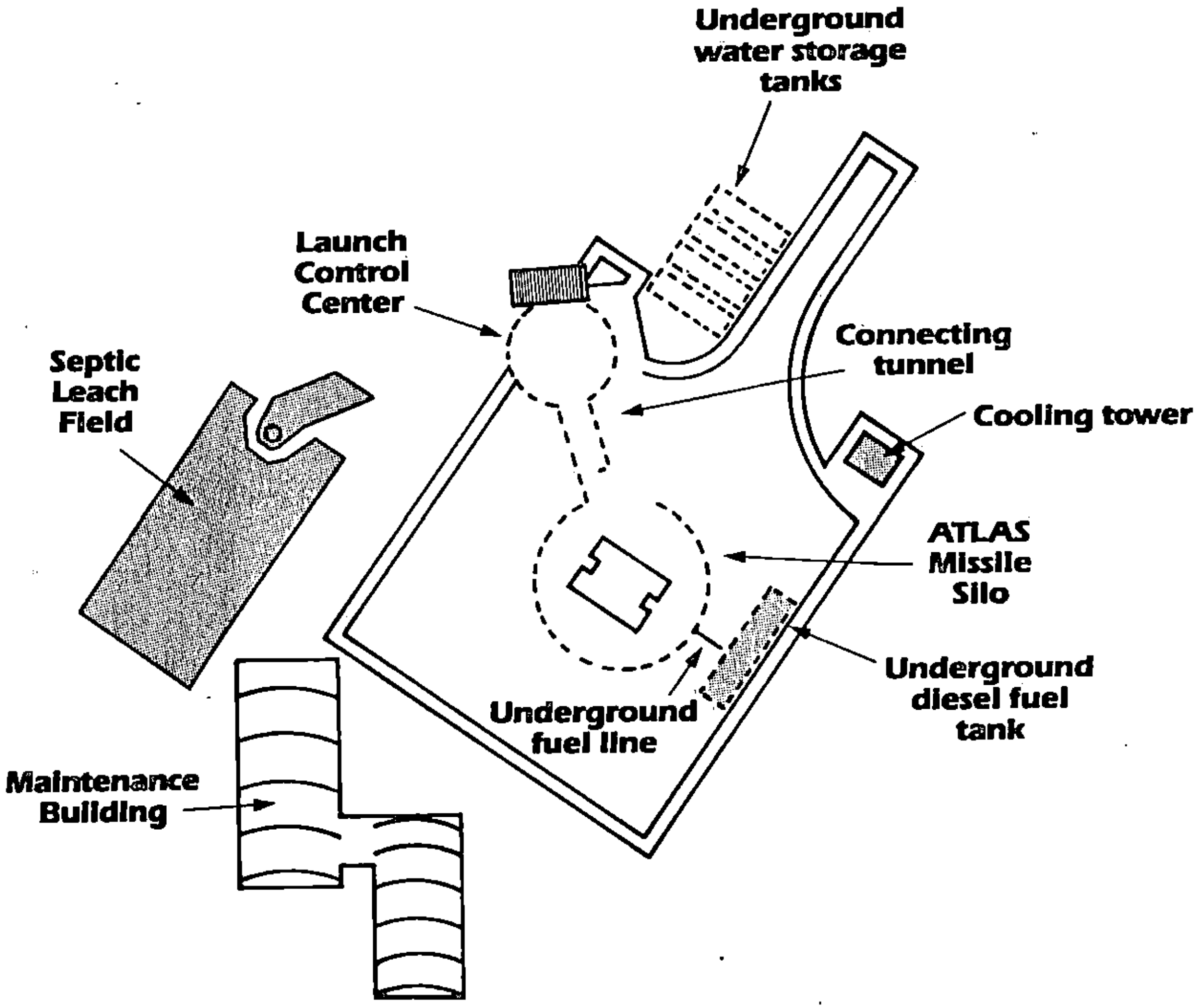
controlled by a single control room. Subsequent semi-dispersed sites also allowed multiple missile control from a single control room. Extensive communications systems were involved with the semi-dispersed sites. The Fairchild AFB communications system for Atlas incorporated a microwave system that was hardened to withstand 25 PSI overpressure and linked 9 sites dispersed over 8,000 square miles. The preponderance of Atlas sites were Atlas F's which were hardened and dispersed. These "hard" sites each had individual control functions.

The Atlas used liquid propellants - kerosene and oxygen. These were generally stored in below ground tanks remote from the launcher or silo. The Atlas F version utilized a unitary concept of deployment, wherein the missile would use storable propellants which could be stored in its onboard tanks or transferred from adjacent storage in minimal time. The missile also required that a positive pressure be maintained interior of the missile to enhance structural rigidity both in prelaunch and during flight. This positive pressure was provided by helium which was stored in the Atlas F silo and on-board the missile.

1.2.2 Atlas Missile System Operations

An Atlas F site generally consisted of about 10 acres within the security fence (Figure 1-6). The major facility at the site was the underground silo which was 174 feet deep x 69 feet diameter. The silo was constructed of thick reinforced concrete walls and the missile was supported by a crib that was suspended inside the silo. The missile was 82 1/2 feet long and 10 feet in diameter. The silo space below the missile was used for propellant storage, missile support and fuel loading equipment. The silo also contained seven operations levels adjacent to the missile: lifting system, hydraulic power and air handling, launch control electronics, HVAC, diesel generator/fuel tank, diesel generator, propellant loading. The silo configured in this manner comprised a unit where all critical elements were contained within the silo.

TYPICAL ATLAS SITE PLAN



TYPICAL ATLAS MISSILE SITE

LAW ENVIRONMENTAL INC.
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TYPICAL ATLAS SITE PLAN

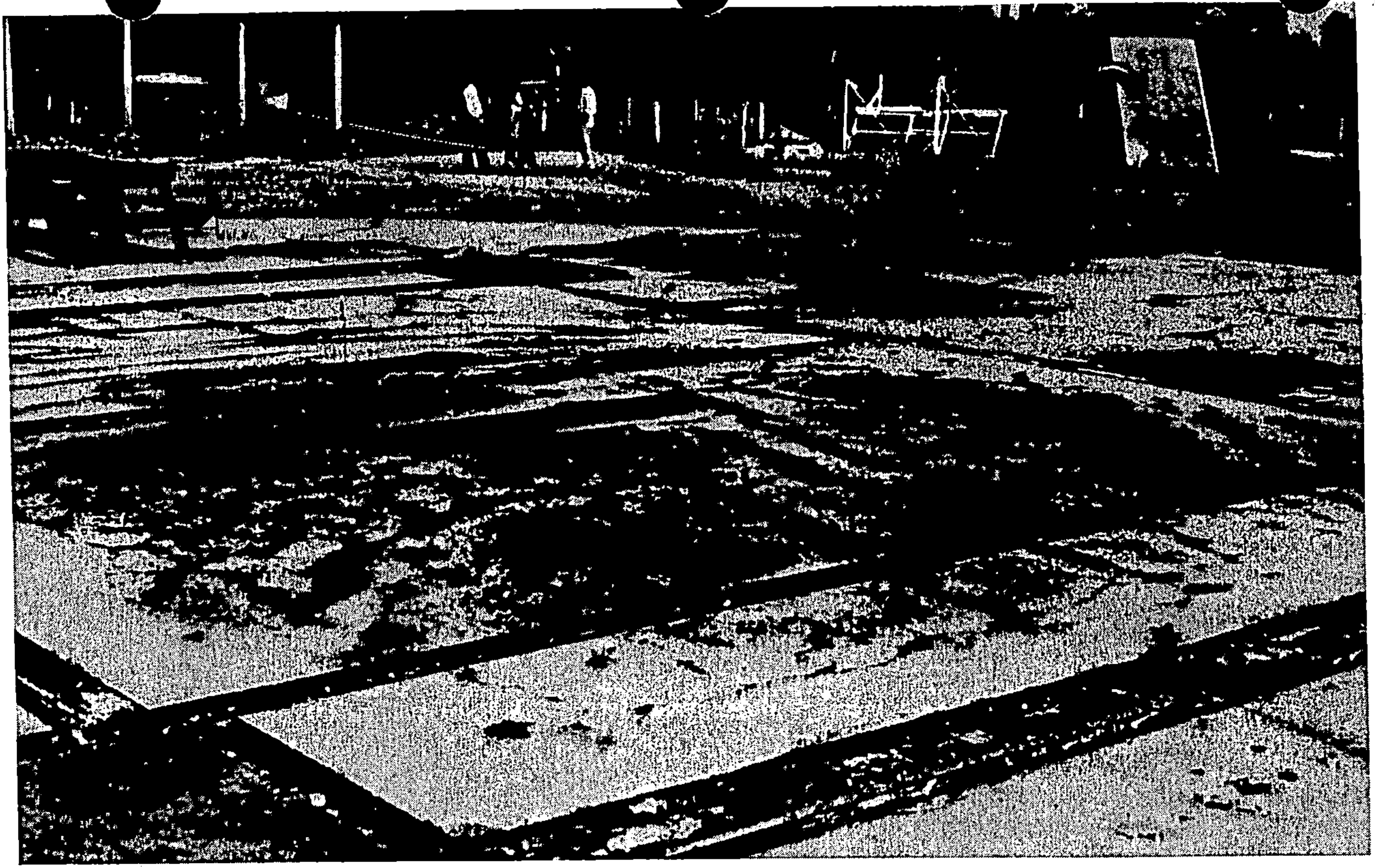
FIGURE 1-6

About 150 feet away from the silo, an Atlas F site contained a below-grade Launch Control Center (LCC). The LCC was a 2 story structure approximately 40 feet in diameter. It provided personnel quarters and communications to the missile and to the command and control centers. Figure 1-7 shows the silo doors and LCC entrance at Atlas Site S-4.

The Atlas F sites included facilities and equipment to maintain the missiles. The maintenance facility (Figure 1-8) was a steel structure located at grade, near the silo. During site operations, missile components could be removed from the silo and maintained within this facility. The maintenance building, security systems, and waste treatment facilities were the only above-grade facilities at a site.

The waste treatment facilities varied depending on site locations. Spray fields and percolation basins were used in areas where soil and climate was appropriate for sanitary waste treatment.

The unitary silo provided a means for fuel storage within the silo. However, there are indications that fuel may have also been stored in underground tanks remote from the silo at some sites. Another below-grade facility was diesel fuel storage for the diesel generators. Generally, steel tanks were provided within about 100 feet of the silo for this purpose.



ATLAS MISSILE SITE S-4
ESSEX, NEW YORK

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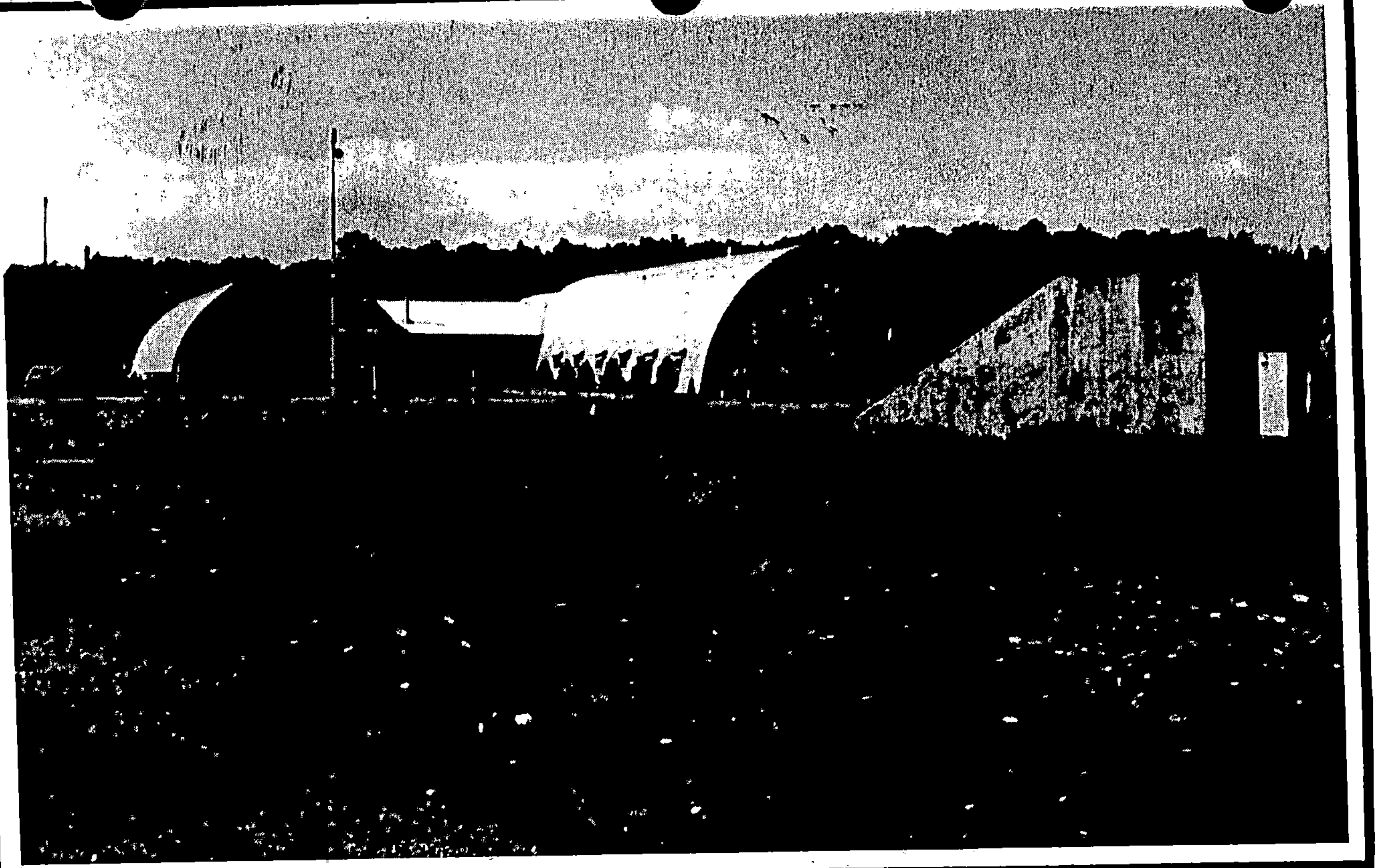
SILO DOORS,
LCC ENTRANCE

FIGURE 1-7



ATLAS MISSILE SITE S-4
ESSEX, NEW YORK

LAW ENVIRONMENTAL INC.
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LAUNCH CONTROL CENTER
ENTRANCE & MAINTENANCE BLDG.

FIGURE 1-8

1.2.3 Waste Generation

The Atlas operational site activities which produced wastes or potential contaminants included:

propellant storage
diesel fuel storage
hydraulic systems
maintenance: petroleum, oil, lubricants, solvents, equipment operations, personnel, sanitary systems

The propellant storage included below-grade tanks for kerosene and liquid oxygen. The duration of the Atlas as an operational system was limited to three to five years. Therefore, underground tank leakage due to deterioration was improbable. The most likely contamination mode from storage was probably spillage during tank filling and possibly faulty connections in conveyance lines. The liquid oxygen was stored in cryogenic conditions and spillage or leakage was very improbable. Furthermore, loss of oxygen would not have produced a toxic or hazardous condition. Propellants were also stored on board the Atlas F's and in their silos. As such, spillage of kerosene inside the silo would have been discharged to the silo exterior from the silo discharge system. Kerosene could persist in the environment as contaminant.

Diesel fuel was stored in below-grade tanks for all of the deployed Atlas F sites. Diesel fuel was used by the on-site generator, which supplied power for control room and launch activities. On-site generators supplied normal operating power as well as emergency power at the most remote Atlas F sites when public electric power was not available. Leakage from underground tanks, spillage during tank filling and escape of fuel during maintenance or repairs of generators could have produced contamination at the diesel storage tank location or adjacent to the silo.

Each Altas F silo contained an enormous hydraulic lift system to move the missile from its cold storage position in the bottom of the silo, to the hot launch configuration at the surface. When the Atlas system was decommissioned, some of the hydraulic fluid may have remained in the storage tanks, pressure lines, pumps and rams. Subsequent deterioration of the system may allow remnant hydraulic fluid to leak into the silo, and ultimately the environment.

Maintenance of the missile and equipment at the launch sites was the most probable source for contamination. The sites contained hydraulic systems, pumps, generators, electronics, heating, ventilating, air conditioning, refrigeration, etc.; systems that required absolute reliability and thus continued maintenance. Maintenance activities undoubtedly used solvents and produced the normal accumulation of petroleum, oil, lubricants (POL) and solvents attendant to maintenance operations. The release of these potential contaminants could have resulted from normal maintenance clean-up activities when floor accumulations were discharged adjacent to the support buildings or from the silo sump discharge line. It is also possible that some POL accumulations which were retained for routine proper disposal were accidentally spilled or intentionally dumped within the site boundaries.

The lowest level in the Atlas F silo was the "Sump Level". Two automatically actuated 100 GPM capacity pumps were located in sumps at this level and were the means of pumping all fluid discharge from the silo. The liquids discharged by the pumps were routed up the silo wall through a discharge line which exited through the silo wall at Level 2. The ultimate disposition of the silo effluent appears to have been to a drainage ditch, which was located far enough away from the silo to avoid interaction with the silo backfill and the launch control center. The USAF Operational Readiness Training Manual designates the Atlas F complex into 4 quadrants with Quad I containing the cooling tower and water plant, Quad II containing the launch control center, Quad III containing the electrical and communication stub-ups and Quad IV containing the sump discharge areas. Quad II and IV are diagonally opposite each other. Therefore, it appears that the silo discharge usually occurs on the silo quadrant opposite the launch control center. This discharge may have been integrated with the area storm water management system and carried off-site by surface channels or allowed to infiltrate into dry, permeable soils.

The support crew for the remote sites consisted of about 20 people. Therefore, waste water from sanitary facilities was produced. The Atlas site had a spray field or aeration basin to treat and discharge sanitary sewage. Typically, waste water treatment fields do not result in hazardous or toxic materials that persist in the shallow subsurface zones. Therefore, it is unlikely that this waste stream produced contamination. Figure 1-9 shows the septic tank leach field area at Atlas Site S-4.

1.2.4 Summary

The Atlas Missile Program provided an important element of the U.S. defense system during a period of rapid evolution in ICBM systems. However, this evolutionary period was short lived. The first operational Atlas system was at Vandenberg in September 1959. The last operational squadron was at Plattsburgh in December 1962. By 1965, the Plattsburgh squadron was dismantling their silos and the records indicate the silo equipment was sold for salvage. By 1966, the Atlas F's were obsolete and were returned to Air Force System Command boosters for the military space program. Therefore, the missile system was in place for only 3 to 5 years. During operational status the Atlas sites could have contributed to environmental contamination from fuel storage and maintenance activities.

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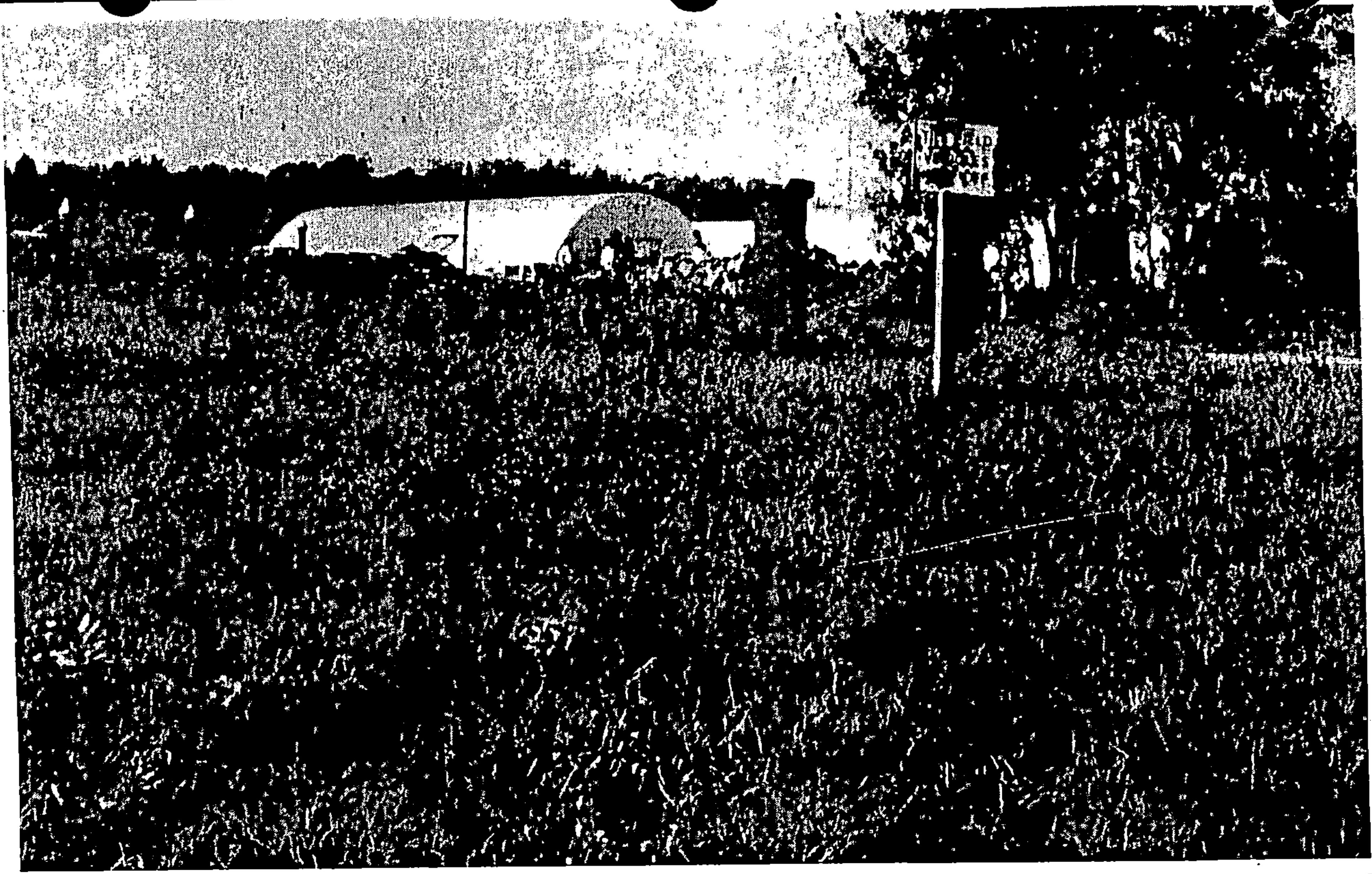

ATLAS MISSILE SITE S-4
ESSEX, NEW YORK

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GOVERNMENTAL SERVICES DIVISION

SEPTIC TANK
LEACH FIELD

FIGURE 1-9

SECTION 2.0 - GENERAL

2.1 INTRODUCTION

The Department of Defense (DOD) conducts a number of industrial processes and manufacturing operations that are similar to private industry. In the late 1970's, DOD became aware of the negative impacts of what were previously considered acceptable disposal practices of waste materials associated with these processes and operations. In response to that knowledge, programs were developed between 1975 and 1978 by each service component to identify and assess potential contamination on active military installations. Authority to address problems of other than active installations was lacking since funds could not be spent on sites not owned by DOD.

The passage of the 1984 Defense Appropriations Act changed this situation. Specific language in the Act directed DOD to extend its efforts to include sites formerly used by DOD. The Act also broadened the definition of "hazard" to include structures and debris which were to be abandoned or had been abandoned upon termination of the site's military use.

The Act directed that the Secretary of Defense assume overall management of the program to assure consistent approach and adequate resource allocation. A Defense Environmental Restoration Account (DERA) was established, which provides the resources for the evaluation and characterization of potential chemical contamination at former Atlas Missile Sites. The work performed relative to this study falls within the jurisdiction of the DERA program.

2.2 PROGRAM COMPARISON

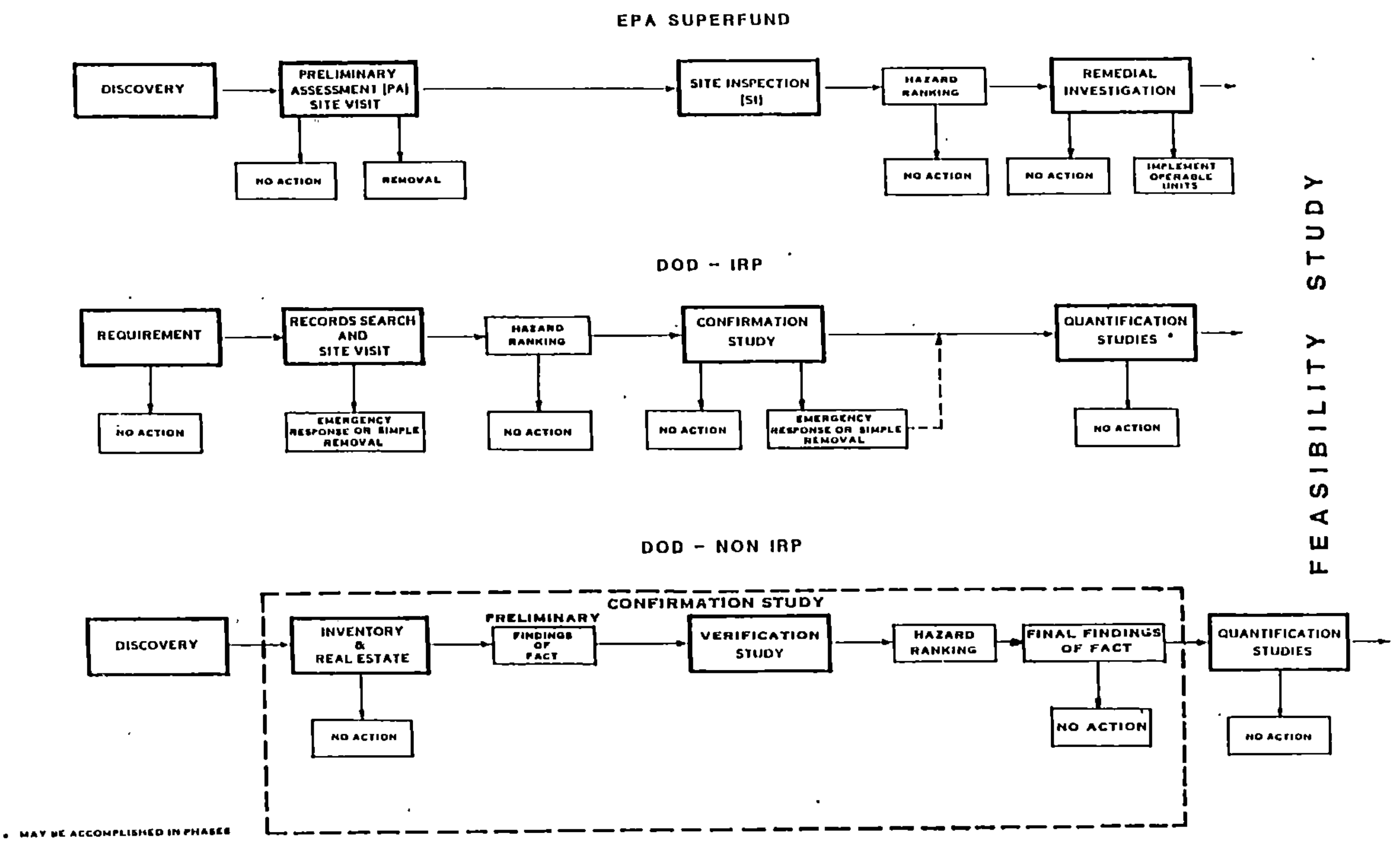
Sites located on active DOD installations are being investigated under the Installation and Restoration Program (IRP). Sites either previously or presently owned by DOD, not located on active DOD installations, are handled separately from the IRP effort. In order to present a perspective of the formerly used (non-IRP) site investigation program, it is necessary to compare such efforts to the EPA's Superfund program and the DOD's IRP.

Figure 2-1 presents a block diagram of the following investigative programs presently being conducted by various Federal agencies.

- EPA Superfund
- DOD/IRP
- DOD Non-IRP

As seen on Figure 2-1, during a Phase 1 effort, comparable investigations are conducted, i.e. preliminary assessments, real estate survey and record searches. For Superfund, the Preliminary Assessment (PA) is conducted. It consists of a desk-top study and site visit which leads to a Site Inspection (SI). The SI usually includes limited sampling activities. After completion of the SI, a Hazard Ranking is performed and if the site scores above a certain number, it becomes a candidate for the NPL (National Priority List). Additional site investigations are conducted during the Remedial Investigation (RI), which is a comprehensive study to determine the extent of contaminants and their rate of movement.

The DOD's IRP Phase I study consists of a records search and site visit to establish a potential list of sites possibly contaminated at an active installation. A Hazard Ranking System (HRS) is utilized to determine which sites will be investigated in order of environmental and/or public health importance.



* MAY BE ACCOMPLISHED IN PHASES

ATLAS SITE CONFIRMATION STUDY
USACE KANSAS CITY DISTRICT

LAW ENVIRONMENTAL SERVICES
MARIETTA, GEORGIA

COMPARISON OF GOVERNMENT
ENVIRONMENTAL PROGRAMS

FIGURE 2-1

The Non-IRP effort, under which the Atlas sites are categorized, also has a Phase 1 Inventory Study. Unlike the IRP and Superfund programs, it is a real estate oriented effort to determine ownership of the site. In addition, certain studies are performed dealing with demolition of structures previously used by the DOD.

A similar relationship is evident for each phase of the three programs; e.g. the Site Inspection (EPA); the Confirmation Study (IRP) and the Confirmation Study (NON-IRP). All of these studies are similar in terms of investigative depth. Some sampling is accomplished and a few monitoring wells may be installed. The main purposes for the study, however, may be somewhat different. For example, the purpose of a Non-IRP Confirmation Study is to determine if contamination exists and if it was caused by DOD operations. However, the Remedial Investigation (RI) under the Superfund Program is by far the most complex field investigation effort. It correlates with to the Qualifications Studies under IRP and Non-IRP efforts.

In summary, the scope of effort for a Confirmation Study of a Non-IRP Site is shown on Figure 2-1 surrounded by the dotted lines. It can easily be seen that this type of study is very preliminary and in no way can be compared with the project requirements for an RI, especially one with an NPL rating.

The objective of this project is to assess the potential existence of toxic or hazardous contamination at former Atlas Missile sites located in northern New York State. To fulfill this objective, a multi-phase program was initiated by the Corps of Engineers. Phase I of this program involved the performance of a title search, site survey and an estimate of remedial actions at all CONUS Atlas Sites. This phase has been completed and the DERP Findings of Fact and Determination of DOD Responsibility for this site has been issued. This report is included herein as Appendix F for continuity.

Phase II of this program involves the verification of contamination and preparation of a preliminary HRS at specific Atlas sites. This Confirmation Study is unique in terms of both breadth and complexity as compared with Remedial Investigations (RI) under CERCLA and Confirmation Studies under the IRP (Installation Restoration Program). Although many technical requirements apply, especially in the sampling and analysis area, some latitude is logical because of the preliminary nature of the effort.

This Confirmation Study involved installing and sampling ground-water monitoring wells, collecting silo water samples and soil samples. The samples were then chemically analyzed so the site could be assessed for potential contamination. This report describes the specific Confirmation Study performed at former Atlas Missile Site S-4 near Essex, New York.

2.3 PROJECT OBJECTIVES

The objective of this investigation is to make a preliminary determination of whether DOD-caused contamination exists at Atlas Site S-4, and if so whether or not it presents an imminent and substantial danger to the public health or welfare. To fulfill this objective, the contractor performed the following work elements for Atlas Site S-4:

- conducted site visit to collect background information;
- prepared work and safety plans;
- installed five shallow ground-water monitoring wells;
- collected and analyzed ground-water, silo, and soil samples;
- evaluated physical and chemical data;
- prepared an engineering report including a hazard ranking system (HRS) report.

These work elements are described in the following sections of this report. Detailed descriptions of field and laboratory procedure are presented in the Work Plans, (under separate cover.) The text of this report contains background information, brief descriptions of field and laboratory activities, and assessment of the analytical data. The final section of the report describes conclusions reached from the site and analytical investigations and recommendations for any additional studies.

2.4 SITE VISIT SUMMARY

LEGS personnel visited Site S-4 on two separate occasions prior to beginning actual field work. The first site visit occurred with representatives from the USACE Kansas City District (MRKED) and Plattsburgh AFB during October 1986. A visual inspection around the site was made and the condition of the existing facilities and the grounds were observed by the inspection team.

In general, the fence, buildings, silo and LCC access appeared to be in good condition. Two igloos (quonset huts) were in good condition, and are currently being used by Leader Sports for offices and storage. Behind the igloo, Leader Sports stores drums of methylene chloride and methyl ethyl keytone (MEK).

The tile field and septic tank were observed halfway between the silo and the west fence line. The highest elevation appeared to be in the southwest corner of the site near this tile field. The silo area appeared to include about 12 feet of fill material over the original grade. The site appeared to drain to the southwest, discharging ultimately to Lake Champlain.

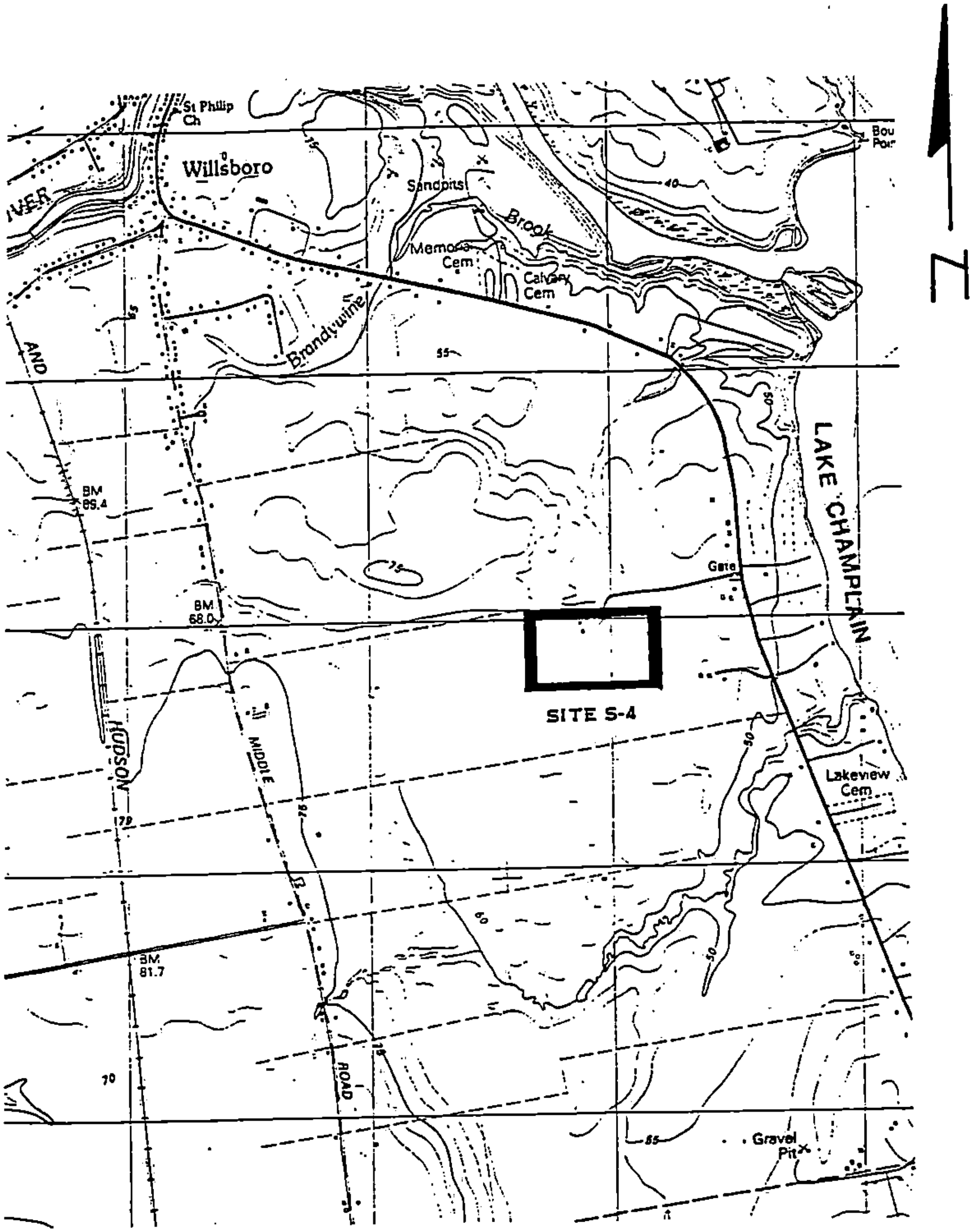
The second site visit was conducted by the LEGS Project Manager, Site Manager, the Health and Safety Officer, and a representative from Leader Sports. The field team walked around the site and identified monitoring well locations and checked the access to the silo for silo water sampling. The silo was not directly accessable for sampling, due to the flooding of the silo and LCC.

2.5 SITE LOCATION AND PHYSIOGRAPHY

Site S-4 is located in the Champlain Section of the Saint Lawrence Valley Physiographic Province, a broad lowland underlain by early Paleozoic strata, Figure 2-2 shows the site location. The regional site area is a lowland of the Adirondack Mountains. This lowland area is associated with rifting and is underlain by a sequence of sedimentary rocks of Cambrian and Ordovician age. The rock sequence includes beds of sandstone, quartzite, shale, slate, phyllite, limestone, and dolomite. These strata consist of hard, indurated rocks which were originally soft sediments deposited in Cambrian and Ordovician seas that covered the eroded surface of the Pre-Cambrian igneous and metamorphic basement rock complex.

This regional area was greatly affected by the advance and retreat of the Wisconsin ice sheet during the close of the Pleistocone epoch. As the glaciers advanced and finally retreated, various unconsolidated deposits identified as tills, outwash, ice contact, and glacio-lacustrine sediments were left behind. A late Pleistocene inland sea inundated the area around the present day Lake Champlain and the Saint Lawrence Valley. Because the earth's crust did not rebound as fast as the ice sheet melted, areas were left below sea level by the retreating glacier and inundated by the sea.

Groundwater at the site was encountered in all the wells at depths between 3 feet and 9 feet below the ground surface. Ground-water flow appears to be from the southwest to the northeast.



1 CENTIMETER ON THE MAP REPRESENTS 250 METERS ON THE GROUND

ELEVATIONS ARE IN METERS.

ATLAS SITE S-4

ESSEX, NEW YORK

LAW ENVIRONMENTAL SERVICES

MARIETTA, GEORGIA

SITE LOCATION MAP

FIGURE 2-2

Typographically, the area is characterized by relatively low elevations with relief on the order of 50 feet or less. Relief at the site is approximately 5 feet. The general slope of the topography at the site is from the west to the east towards Lake Champlain.

Hydraulic conductivities measured in the shallow wells, which were screened in the surficial sand were between 7.0 x 10^{-4} and 2.3 x 10^{-3} centimeters per second (cm/sec). The conductivity measured for the surficial material is consistent for silty, poorly-graded sands such as these glacial deposits. The deep well, open in rock, had a hydraulic conductivity of 1.9 x 10^{-3} cm/sec. This rather high conductivity may indicate that limestone is either jointed or contains numerous permeable cavities. (Hydraulic conductivity test results are contained in Appendix E.)

2.6 OWNERSHIP AND PRIOR USE

Plattsburgh Atlas Missile Complex Site S-4 contains approximately 9 acres. The site was purchased for military purposes in the early 1960's. Site S-4 was one of twelve sites scattered throughout the region collectively known as the Plattsburgh Atlas Missile Complex. These 12 sites were designated as auxiliary sites of the Plattsburgh Air Force Base. All twelve sites were equipped with one subsurface concrete and steel missile silo (174 feet deep, with 12 foot thick walls), one subsurface concrete Launch Control Center, two corrugated steel quonset huts (20 feet by 40 feet by 100 feet) for maintenance, and two smaller steel block pumphouses. Their construction was a National Defense effort to store, maintain and to potentially launch an Atlas Intercontinental Ballastic Missile (ICBM). By September, 1965 all Atlas ICBM sites were deactivated in the Plattsburgh Complex. The USAF conveyed the site to the Town of Willsboro in 1967. Subsequently, the Town of Willsboro sold the site to Mr. Lyle Mason, who sold it to Leader Sports, Incorporated, in 1983.

Leader Sports, Inc. is in the business of manufacturing and selling sports equipment to sports supply wholesalers and retailers. They use Site S-4 to manufacture sports equipment.

According to the USACE assessment at the facility, (Appendix F), Site S-4 is located in a mixed rural industrial/residential neighborhood. There are no future plans for any portion of the site, other than the continued use of the property as a manufacturing facility for Leader Sports, Inc.

2.7 LOCAL WATER SUPPLY

Leader Sports, Inc. is on the southernmost boundary serviced by water from the Town of Willsboro. This water is produced from Lake Champlain. Approximately 800-900 people are serviced by the Town of Willsboro. South of Leader Sports, the Town of Essex services their population, also from Lake Champlain. People outside the jurisdiction of these cities rely on private wells for drinking water purposes.

*****

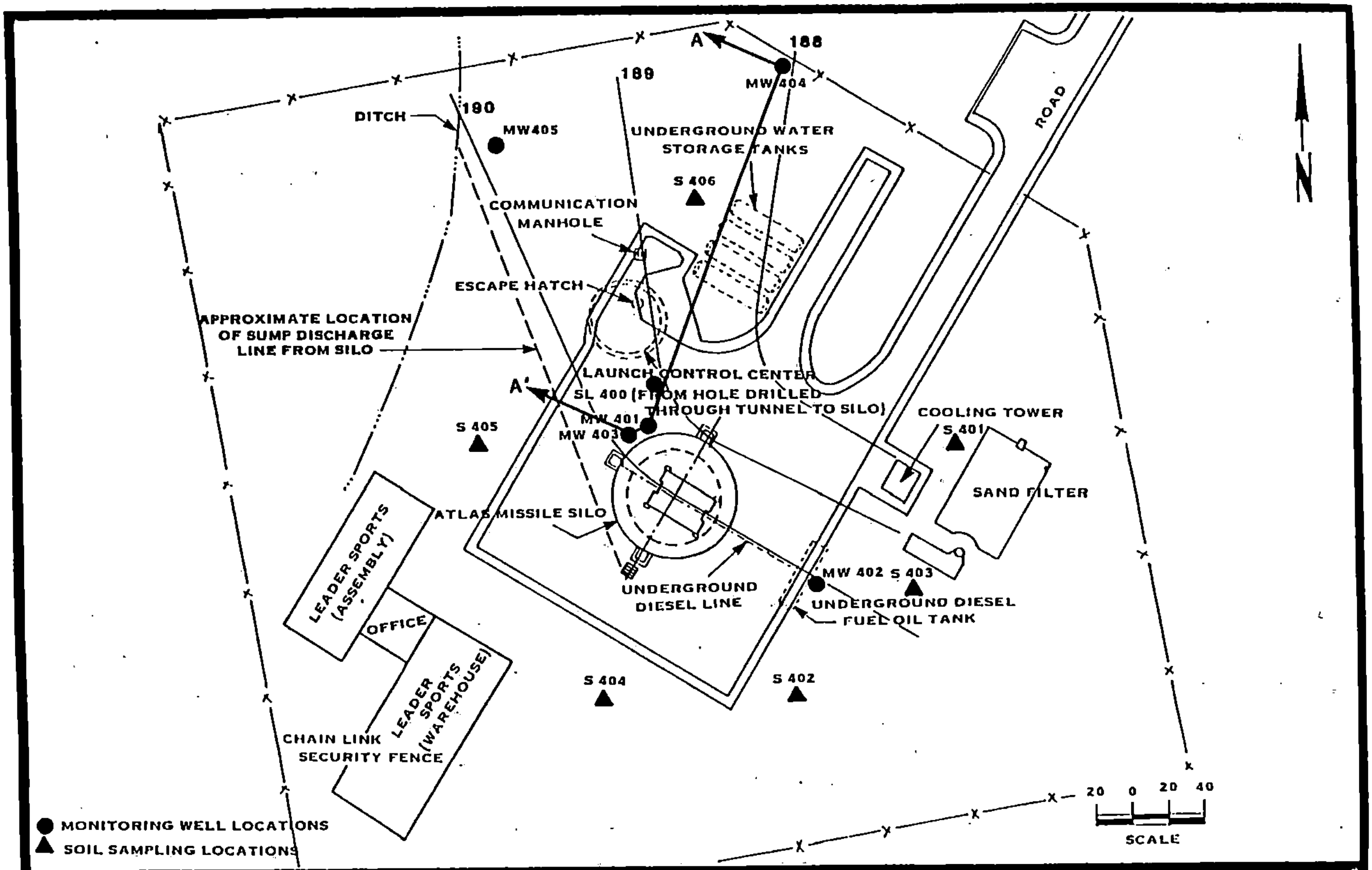
3.0 SITE INVESTIGATION

3.1 INTRODUCTION

The objective of the Atlas Site S-4 (hereafter referred to as the SITE) field investigation program was to determine if DOD activities caused contamination in the soil and ground water. In order to accomplish this objective, Law Environmental, Inc. collected representative samples of the site media for analysis. The sampling program provided a methodical and controlled procedure for collecting and handling media samples at the SITE. Included are subsections that discuss sample site selection, sampling procedures and preservation, sample shipping, and the chain-of-custody. Analytical methods and results are discussed in Section 4.0.

Media sampled at the SITE included soil, silo water and ground water. Figure 3-1 shows the sampling locations. The samples were environmental (dilute) rather than hazardous (or concentrated) samples. Both grab and composite sampling techniques can be used to collect environmental samples. However, the overall objective of this SITE investigation program is to assess the SITE to determine if DOD contamination exists. Therefore, grab samples were collected from the soil and ground water at the SITE. Table 3-1 shows the number and types of field samples collected at the SITE.

Quality control samples, consisting of duplicates and field controls, were transported in the same container and handled in the same manner as the field samples. The number of QC duplicates and QC field controls for each matrix type (water and soil) is specified in Table 3-1. Field controls for water samples were travel blanks and sampling blanks. Travel blanks were containers filled with deionized water, transported to the SITE and handled like a sample. Travel blanks were opened at the site each day of sampling. Deionized water was added to



ATLAS SITE S-4
ESSEX, NEW YORK

LAW ENVIRONMENTAL SERVICES
MARIETTA, GEORGIA

SITE LAYOUT AND
SAMPLING LOCATIONS

SAMPLED 11/19/86, 4/28/87

FIGURE 3-1

compensate for any loss. Sampling blanks were reagent water which was passed through the sampling equipment and transferred to sample containers. These quality control samples were analyzed for all parameters specified in Section 4.0.

Quality Assurance samples consisted of duplicates and field controls for each matrix type (water and soil) taken in the same sample containers and handled in the same manner as the field samples. The number of QA duplicates and QA field controls (travel and sampling blanks) for each matrix type is specified in Table 3-1.

The following table stipulates the number and types of samples collected at the SITE:

TABLE 3-1

Number and Types of Samples

Sample Type	Field Samples	Control Samples		Total Samples
		QC (AE lab)	QA (USACE)	
A. Ground Water	8 *	1 (duplicate)	1	9
B. Silo Water	1	1 (duplicate)	1	3
C. Soil	6	1 (split)	1	8
D. QA/QC (field blanks)				
1) travel blank (water)	---	3 *	2	5
2) sampling blank (water)	---	3 *	2	5

* Includes samples from April, 1987

3.2 MONITORING WELL INSTALLATION

Monitoring wells were installed in a manner to accomplish the following objectives: to collect representative ground-water samples; to prevent contamination of the aquifer by the drilling equipment; to prevent inter-aquifer contamination; and to prevent vertical seepage of surface water into the monitoring well water-intake zone. The Monitoring Well Installation Plan (under separate cover) discusses the equipment, procedures and personnel that were used at the SITE to accomplish these objectives.

3.2.1 Drilling Procedures

Prior to setting up the drilling rig on a monitoring well location, the site was checked with appropriate authorities for underground utilities. Drilling only proceeded where no service lines crossed well locations. After the initial site survey, the drill rig was set up on the selected location. Once the drill rig was in position, the following protocol was followed for each well:

- Collect split-spoon sample (ASTM-D 1586-84) from the ground surface to 1.5 feet using standard penetration procedures, i.e., 140 pound weight falling 30 inches to drive 1.375 inch I.D., 2 inch O.D., split-spoon sampler.

- Begin augering and collect split-spoon samples continuously to 10 feet (i.e., standard penetration tests shall bottom at depths of 1.5, 3.0, 4.5, 6.0, 7.5, 9.0, 10.5 feet). From the 10 foot depth, split-spoon samples collected every 5 feet thereafter.

- A soil test boring log was completed during drilling by a qualified geologist or engineer. It recorded the following data:

- Sample number and depth
- Standard penetration test blow counts per 6 inch advance
- Percentage recovered
- Soil classification, color, consistency or density, and moisture content
- Depth of boring
- Boring refusal
- Water losses, if applicable
- Method of advancing boring

- Soil samples were collected from each split-spoon sample, placed in glass jars, and labeled. Records of each sample were entered into a bound field notebook with prenumbered pages and written in ink. Section 3.3.1.2 discusses the details of soil sample handling and shipping for analysis.

- The depth of first encountered free water was indicated on the drilling log. When the appropriate depth was reached, a groundwater monitoring well was installed in the borehole. Test boring records are located in Appendix A. Appendix B contains well construction diagrams.

3.2.2 Rock Coring Procedures

Bedrock encountered during monitoring well drilling was cored by standard diamond core drilling methods. The following protocol was followed for each well:

- The core barrel used for advancing the boring was "NX" size or larger. The coring apparatus was pre-cleaned with live steam prior to use.

- Only clean, potable water or formation water from the well being drilled was used as drilling fluid. No drilling fluid additives were used.

analyzed ?

- All rock core recovered was logged by a qualified geologist or engineer. The rock recovered was black dense limestone. The core was photographed with 35 mm color slides and stored in wooden core boxes. Duplicate slides will be submitted to the CO as part of the completed boring logs. The cores will be stored until the project is completed.

Need when?

3.2.3 Rationale for Monitoring Well and Other Sampling Locations

The monitoring wells were installed at Site S-4 at specific locations. These locations were chosen as the most likely places for potential contamination. The following discussion gives the rationale for the selected locations:

- Monitoring Well MW401

  This well extends 200 feet below the surface. It was located adjacent to the silo to detect any contamination which may have leaked from the silo at depth. Initially the well was located over the tunnel leading from the silo to the launch control center. Drilling proceeded into the tunnel. Steel casing and a well cap were installed and the "well" was used to sample the water flooding the silo and tunnel. The MW401 was then relocated to its present position.

  Discuss geol & hydrol influence per Sec. 7.4.1.5.1 SOW

- Monitoring Well MW402

  This well is a shallow (18 foot) well near an underground diesel fuel oil tank located on the east side of the Site. The well was located on the southeast side of the underground tank to monitor any leakage from the tank.

  Screen W.T.?

- Monitoring Well MW403

  Well MW403 is 19 feet deep and located just west of MW401 on the outside of the silo. This well was located here to monitor any potential surficial leaks from the silo or other upgradient buildings (quonset huts).

- Monitoring Well MW404

Located on the north side of the site along the fenceline, well MW404 was expected to provide added downgradient ground-water flow and contamination information. Corroding tanks could contribute metals to the ground water. The well is 14 feet deep.

- Monitoring Well MW405

Well MW405 was installed in April, 1987. The well is located on the north side of the site in the area of the silo sump-pump discharge. This discharge area was discovered after the initial wells were installed when more site information became available. The sump-pump discharge line runs from the southwest corner of the silo to the area of well MW405. (See Figure 3-1). This area contains a ditch where the silo discharge was released. Well MW405 should monitor any contamination from the sump-pump discharge.

available up-front

3.2.4 Results of Monitoring Well Installation Program

Drilling at the SITE was initiated during November, 1986. The monitoring wells were installed with an Ingersol-Rand TH-55 air-rotary drill rig and two auger rigs (Mobile B-61 and CME-55). The depth of each monitoring well was as follows: MW401 - 200 feet (air rotary drill rig); MW402 - 18 feet; MW403 - 19 feet; MW404 - 16 feet and MW405 - 14 feet. The deep well was constructed with a 4-inch schedule 80 PVC inner casing grouted inside a 6-inch steel outer casing. The steel outer casing was set to a depth of 18 feet in bedrock. Below the steel casing, a 6-inch open borehole was drilled to 200 feet. The shallow

fd
3 rigs
4 wells

monitoring wells were constructed with 2-inch schedule 80 PVC riser and screen, according to the Monitoring Well Installation Plan.

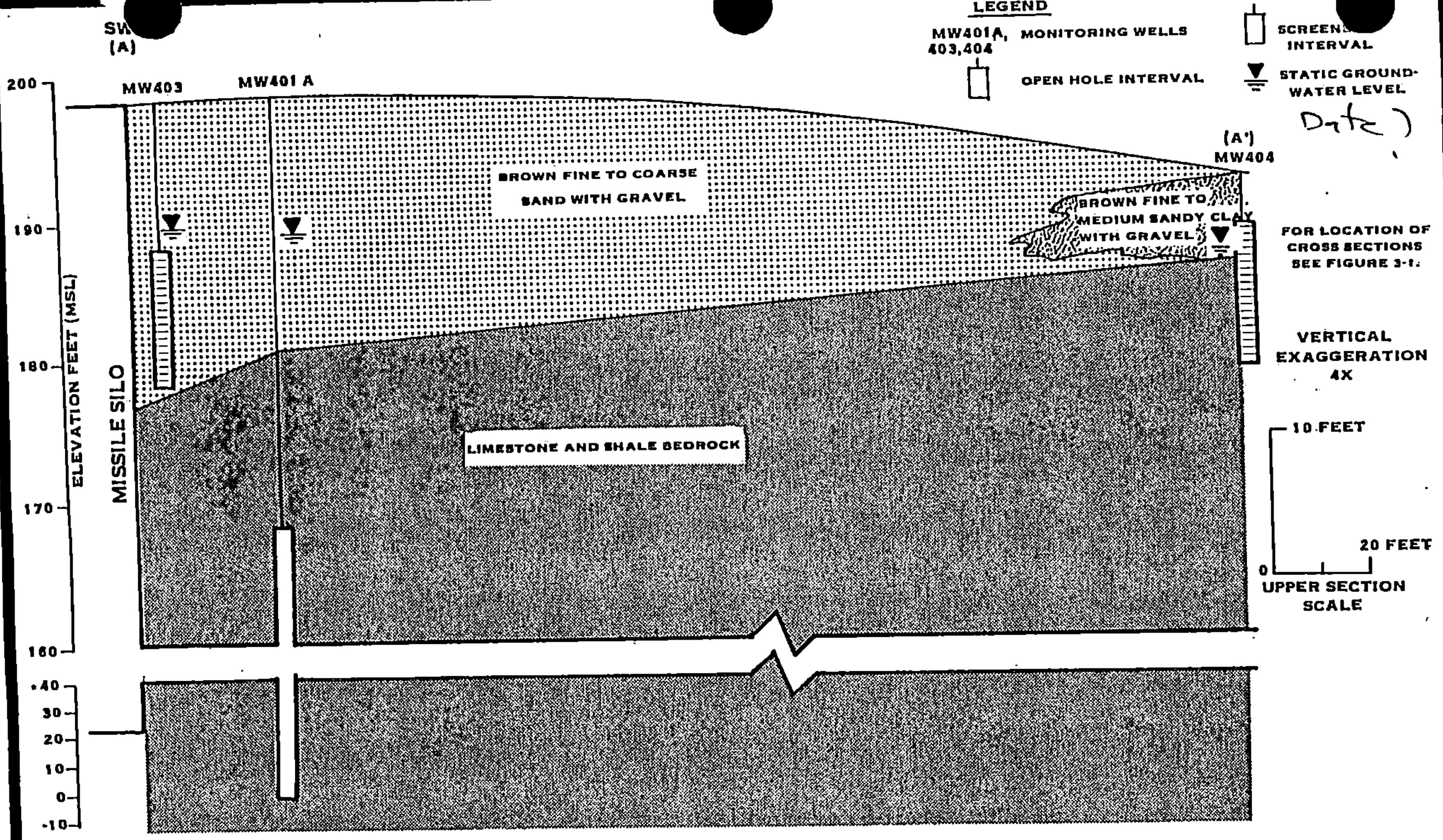
A first attempt at well MW401 was air-rotary drilling through the LCC tunnel. Drilling brought up sand, gravel, and metal shavings (rebar). At about 20 feet depth, the tunnel was drilled through. This hole was completed with a steel casing. Water in the "well" was sampled as silo water.

3.2.4.1 Site Geology

A cross-section of the geology encountered at the SITE is shown in Figure 3-2. It consists of glacial deposits including clayey, silty, poorly graded sands with some gravel. Underlying these deposits, approximately 8-10 feet below the ground surface, is a dense, shaly limestone with numerous light-colored calcite stringers. The limestone is massively-bedded and contains shale partings. The cross-section shows the site in relation to the missile silo.

Ground water beneath the SITE occurs predominantly within the surficial deposits. In the surficial material, it ranges in depth from about 5 to 12 feet below the ground surface. For example, in monitoring wells MW401 and MW403, the water depth exceeds 10 feet below the ground, and in monitoring well MW404 the water table is about 6 feet below the surface. Water at MW405 is at about 5 feet in depth. Elevations of the water table in the shallow wells are presented in Table 3-2. These water-table elevations show that ground water in the surficial aquifer generally moves across the site from the southwest toward the northeast, as expected, (i.e., it is a subdued replica of the surface topography). If the ground water continues in a northeasterly direction, it would discharge into Lake Champlain less than a mile east of the SITE.

vert. grad.?



Date)

*NOTE: VERTICAL EXAGGERATION FOR THE INTERVAL 40 TO -10 IS 1.7X.

ATLAS SITE S-4 ESSEX, NEW YORK	LAW ENVIRONMENTAL SERVICES MARIETTA, GEORGIA	ATLAS SITE S-4 GEOLOGIC CROSS SECTION FIGURE 3-2

TABLE 3-2

WATER LEVEL ELEVATIONS

Well No.	TOC [1] (feet, msl)	November 18, 1986[2] (feet, MSL)	April 28, 1987[3] (feet, MSL)
MW401	201.02	188.74	--
MW402	199.72	190.22	190.74
MW403	200.88	189.48	190.00
MW404	194.07	187.87	188.29
MW405	194.94		189.78

NOTES: (1) TOC - Top of Casing

(2) Static Water Level measurements from slug tests performed 11/18/86 (Appendix E)

(3) Static water level measurements from well sampling 4/28/87.

3.2.4.2 Geotechnical Samples

Two soil samples were chosen from wells MW402, MW403, and MW404 for geotechnical analysis. Percent moisture, grain size analysis, and Atterberg Limits tests were performed on each sample. Appendix D contains the results.

Geotechnical samples from monitoring well MW402 were taken at 1.5 - 3 feet depth and 9 - 10.5 feet depth. Both samples were non-plastic. The shallow sample was a brown poorly graded sand with silt (SP-SM). At 9-10.5 feet depth, the silt is absent and the soil is classified (SP).

At monitoring well MW403 the sample from 1.5 - 3 feet depth showed a non-plastic brown silty sand with gravel (SM). At 19 - 20.5 feet depth the sample was brown poorly graded sand, with silt and gravel (SP-SM).

Well MW404 at 1.5 - 3 feet depth was a slightly plastic, brown clayey sand with gravel (SC). The liquid limit was 27.0 and the plasticity index 11.1. At 7.5 - 9 feet depth a medium plastic gray brown lean clay (CL) was revealed with a liquid limit of 37.4 and a plasticity index of 17.5.

3.2.4.3 Hydraulic Conductivity

The hydraulic conductivity of the shallow wells, which were screened in the surficial sand and limestone, and shallow bedrock, ranged from approximately 7.0 x 10^{-4} to 2.3 x 10^{-3} centimeters per second (cm/sec). The range of measured conductivities is typical for a medium sand. The hydraulic conductivity of the deep well, which as set in rock, was approximately 1.9 x 10^{-3} cm/sec. Results of the slug tests performed at the site are contained in Appendix E.

rock greater hyd. cond. than sand

3.3 SAMPLING PROGRAM

The first sampling episode at Site S-4 occurred in November, 1986. Four wells (MW401, MW402, MW403, and MW404), and the silo (through the casing into the LCC tunnel) were sampled. Six surficial soil samples were also taken from around the site (see Figure 3-1 for all sampling locations). In April, 1987 Well MW405 was installed and sampled along with wells MW402, MW403, and MW404. (MW401 and the silo were not resampled). No soil samples were taken in April, 1987.

3.3.1 ?

3.3.2 Specific Sampling Procedures

Different sample matrices require specific sampling procedures, as described in the Work Plan (under separate cover). Care was taken to determine the best practical sampling procedure that would result in obtaining representative samples. Care was taken to maintain the integrity of the original sample medium through collection, transportation and delivery to the analyst. The SITE samples were collected and packaged as described in the Work Plan. A summary of the specific sampling procedures is presented in the following paragraphs.

3.3.1.1 Ground Water

The subsurface is a unique heterogeneous environment. Gas exchange, biological and other chemical reactions and conditions are different from the surface environment. Ground water is somewhat insulated from surface temperature and pressure variations. Rapid and significant changes can occur in ground-water samples upon exposure to the surface (sunlight, temperature and pressure). Therefore, ground-water sampling was conducted in a manner to minimize interaction of the sample and the surface environment.

3.3.1.1.1 Sampling Equipment

Many variations of ground-water sampling equipment are available depending upon the objective of the program. For the SITE, ground-water samples were obtained with pre-cleaned Teflon bailers. Pre-cleaning was performed in accordance with recommended EPA procedures. Precleaning consisted of: (1) removing gross contamination from the bailer using scrapers, (2) washing the bailer with a brush in a bucket filled with an Alconox soap solution, (3) rinse in a second bucket containing tap water and a brush, (4) spray bailer with a 10% nitric acid rinse, (5) repeat step 3, (6) spray the bailer with methanol, (7) rinse with deoxidized water, and (8) air dry.

3.3.1.1.2 Sampling Protocol

The sampling protocol at the SITE was as follows:

a. Measure Water Level - Using clean, non-contaminating equipment, (i.e., an electronic level indicator, or a fiberglass tape) determine the water level in the well and calculate the fluid volume in the casing and screen.

b. Purge Well - Remove at least 5 well volumes with a Teflon (which bailer, or by pumping.

c. Collect Sample - Lower the Teflon bailer slowly until it contacts the water surface and allow the bailer to sink to the desired depth and fill with a minimum of surface disturbance. Slowly withdraw the bailer, being careful to prevent contact of the bailer line with the ground. Tip the bailer and slowly discharge the contents into the appropriate containers. Repeat the process as necessary to fill each container to the required volume. Samples for volatile organics should be completely filled leaving no air space above the liquid portion (to minimize volatilization). Check that a Teflon-liner is present in the cap and secure the cap tightly. All samples are taken as quickly as possible once the sampling process begins.

what is th

d. Label Sample - Once the sample is collected, label each container providing the following data: site name, sample identification number, project number, date, time, and person sampling. Record the information in the bound field note book, and complete all chain-of-custody and request for analysis documents. The bound field note book has prenumbered pages and entries are made in indelible ink.

e. Custody, Handling and Shipping - Place the properly labeled sample bottle in the appropriate carrying container and maintain the sample at 4°C throughout sampling and transportation period. The shipping container will be a metal cooler. "This Side Up" and "Fragile" labels will be placed on the cooler. Mark liquid level with grease pencil for liquid samples. All sample containers should have sample tags and labels with transparent tap covering each label. The properly marked and tagged bottle should then be sealed in a "ziplock" type bag, closed and placed in a cooler. All writing should be in indelible ink. The lid of the cooler will be taped shut with the custody seals provided with each cooler. Samples are shipped on the day collected from the SITE directly to the laboratory by overnight courier. Chain-of-custody and request for analysis documents are shipped in air-tight plastic bags in each container (taped to the inside of the lid) with applicable samples. The laboratory is notified by phone of the sample shipment.

3.3.1.2 Soils

Soil samples for chemical analysis were obtained at six different locations around the SITE using a hand auger. Split-spoon sampling techniques were used to collect samples for geotechnical classification during drilling. The following sections present a discussion of equipment, procedures, and protocol for soil sampling at the SITE.

3.3.1.2.1 Hand Auger Sampling Equipment

Soil samples for chemical analysis were collected from borings drilled by a stainless steel hand auger. Each piece of stainless steel soil sampling equipment was pre-cleaned before use to minimize potential cross-contamination. Pre-cleaning consisted of: (1) removing gross contamination from the auger using scrapers, (2) washing the auger with a brush in a bucket filled with an Alconox soap solution, (3) rinse in a second bucket containing tap water and a brush, (4) spray auger with a 10% nitric acid rinse, (5) repeat Step 3, (6) spray the auger with methanol, (7) rinse with deoxidized water, and (8) air dry.

3.3.1.2.2 Hand Auger Boring Procedures

At each specified hand auger boring location the following steps were followed:

- A polyethylene sheet was laid down adjacent to the boring location

- The cleaned, stainless-steel hand auger was placed on the ground and augering begun.

- The contents of each full auger was emptied onto the polyethylene sheet

- After completion of the boring and sampling procedures, the boring location was backfilled with soil.

3.3.1.2.3 Hand Auger Sampling Protocol

a. Collect Sample

- The samples were collected with the hand auger at depths of approximately 2 feet.

- Augering proceeded from the sampling depth until sufficient soil was collected to satisfy sampling requirements. Soil was mixed in a stainless steel bowl and transferred to an appropriate sample container with a spoon. Mixing of soil was minimized as much as possible during sample collection. The only exception was when it was necessary to collect a duplicate sample for quality control and quality assurance. The sampler checked that a Teflon liner was present in the cap and secured the cap tightly. After each sample was collected, all of the sampling equipment, hand auger, mixing bowl, and spoon, was cleaned to prevent cross contamination.

b. Label Sample

- Each sample bottle was labeled with the appropriate sample tag, carefully and clearly, addressing all the categories, or parameters. All chain-of-custody documents were completed and the sampling event was recorded in the bound field notebook in ink.

3.3.1.2.4 Split-Spoon Sampling Equipment

Soil samples for geotechnical classification were collected using split-spoon samplers, in borings drilled with a hollow-stem auger. Specific use of these tools depended upon the sampling location and technique. Each piece of soil sampling equipment was pre-cleaned before use to minimize potential cross-contamination. Pre-cleaning consisted of washing the split spoon in detergent and rinsing in tap water.

3.3.2 Field Characterization of Samples

Certain parameters regarding ground-water samples can vary considerably with time. Those parameters of primary interest regarding the SITE are pH, temperature and conductivity. Therefore, these parameters were measured in the field during well development and when the samples were obtained. Well development sheets in Appendix B contain these parameters.

- Field pH was measured with an Orion pH meter. The instrument will be field calibrated with pH 4 and pH 7 buffer solutions at the beginning, middle and end of each days' use. The pH probe was rinsed with deoxidized water between each use.

- Temperature and specific conductance were measured with a portable YSI (Yellow Springs Instruments) S-C-T (Salinity, Conductivity, Temperature) meter. Calibration of the instrument is performed at the factory periodically. The instrument probe was rinsed with reagent water between each use and set to zero at the beginning of each day use.

Actually?

3.4 SAMPLE CONTAINERS

Samples for chemical analysis were collected and placed in containers provided by Ecology and Environment (E&E). Appropriate containers for the media under investigation at the SITE are in accordance with the Work Plans. All container caps had Teflon liners. Each container was labeled giving the site name, sample identification number, date, sampler and project number.

Prior to use at the SITE the containers and caps were cleaned by the following procedure: hand-washing in Alconox or equivalent water solution at 150^{o}F, rinse with hot tap water; rinse with cold tap water, and rinse with distilled water. In addition, containers used for collection of samples to be analyzed for EPA organic priority pollutants were cleaned in a manner appropriate to the test procedure. Specific sample bottle preparation procedures are found in the Work Plan for the site.

3.5 SAMPLE PRESERVATION METHODS

All of the samples were stored and shipped on ice to maintain the temperature at approximately 4^{o}C. Additionally, monitoring well samples analyzed for dissolved metals were filtered in the field. Total and dissolved metal samples (water) were acidified to $pH< 2$ with two milliliters (ml) of nitric acid (HNO_3) per liter of sample. Silo water samples for dissolved metals were filtered and acidified in the field with two milliliters (ml) of nitric acid (HNO_3) per liter of sample. Filtration was accomplished using a stainless steel barrel filter placing a positive pressure on the sample water and forcing it through the filter into the sample bottle at 1 atmosphere. Samples for total recoverable petroleum hydrocarbon analysis (water samples) were preserved with HCl to $pH<2$. Table 3-2 lists the containers, preservatives, and holding times used.

3.6 SAMPLE SHIPPING

Ecology and Environment, Inc. (E&E) provided coolers to transport the samples from the Site to their lab in Buffalo, NY. These coolers were of metal construction and in good condition.

3.6.1 Chain-of-Custody Record.

Chain-of-Custody records were provided in each sample cooler. The custody record (see Appendix G) was fully completed in duplicate, by the field technician responsible for sample handling. The information specified on the chain-of-custody record contained the same level of detail found in the site logbook, with the exception that the on-site measurement data was not recorded. The custody record included, among other things, the following information: name of person collecting the samples; date samples were collected; type of sampling conducted (composite/grab); location of sampling station; number and type of containers used; analysis required, and signature of the E&E person relinquishing samples to a non-E&E person, such as a Federal Express agent, with the date and time of transfer noted.

TABLE 3-3 (1 of 2)

CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

Analytical Test	Container	Preservative or Sample Handling	Holding Time
Purgeable Aromatics			
(water)	2-40 ml glass VOA vials (Teflon-lined lids), no headspace	Cool to 4°C	Analyze within 14 days
(soil)	2-40 ml glass VOA vials (Teflon lined lids)	Cool to 4°C	Analyze within 14 days
Total-Recoverable Petroleum Hydrocarbons			
(water)	1-liter amber glass bottle, filled (Teflon-lined lids)	HCl to pH <2 and cool to 4°C	To hold more than 48 hours, cool to 4°C
Dissolved Metals			
(water)	1-liter high density polyethylene bottle, (with Teflon-lined lids) (filter on-site through .45 um membrane filter)	HNO_3 to pH <2	*6 months

* 28 days for Mercury

TABLE 3-3 Cont'd (2 of 2)

Analytical Test	Container	Preservative or Sample Handling	Holding Time
Total Metals			
(water)	1-liter high density polyethylene bottle (Teflon-lined lids)	HNO_3 to pH <2	*6 months
(soil)	8 oz. wide mouth glass jars, at least 3/4 full (Teflon-lined lids)	none	*6 months
Purgeable Halocarbons			
(water)	2-40 ml glass vials, filled (Teflon-lined lids)	Cool to 4°C	14 days
(soil)	2-40 ml glass vials, filled (Teflon-lined lids)	Cool to 4°C	6 months

* 28 days for Mercury

SECTION 4.0 - ANALYTICAL RESULTS

4.1 INTRODUCTION

This section presents the results of the laboratory analysis of ground-water, silo and soil samples collected at the Atlas Site S-4, Essex, New York.

The soil samples, silo sample, and the ground-water samples were collected by Law Environmental, Inc., Government Services Division (LEGS) personnel and its subcontractors. The sample collection and analysis procedures used were approved by the U.S. Army Corps of Engineers (USACE). Sample identification and location was provided by LEGS. Samples with the prefix "SL"" identify the silo water samples, "MW" indicates the monitoring well samples, and "S" indicates soil samples.

The laboratory results for ground-water are compared to New York State and U.S. Environmental Protection Agency (EPA) quality standards, ground-water classifications, quality standards, and effluent standards and/or limitations developed by the New York State Department of Environmental Conservation (NYSDEC), Part 703. The NYSDEC criteria establish Class GA (potable water) as the best usage of ground-water. These are fresh ground-waters found in the saturated zone. Class GSA waters are used as a source of potable mineral waters, for conversion to fresh potable waters, or as raw material for the manufacture of sodium chloride or its derivatives of similar products. The quality standards for Class GA and Class GSA waters are contained in Appendix H, as developed by the NYSDEC.

The laboratory results for soil samples are compared to U.S. Environmental Protection Agency (EPA) 1983 hazardous waste land treatment criteria found in EPA manual, SW-874 (revised), (Tables 6.47 and 6.46, respectively), and the Total Threshold Limit Concentrations (TTLC) set forth by the California Department of

Health Services (DOHS). The TTLC values are concentrations above which uncontrolled disposal of wastes containing constituents could potentially pose a threat to human health or the environment. (See Appendix H for these references).

Laboratory analysis results and quality control for both ground-water and soil samples are presented in Tables 4-2 to 4-8. Quality Control data is included in Appendix G. Ground-water standards and criteria, and soils criteria are presented in Appendix H.

For each analytical method there is a specific method detection limit. Below this value, an amount cannot be quantified. E&E laboratory convention includes referencing the detection limit by the less than symbol. That is, a value reported a "<0.12 ug/L" means the amount detected was not quantified - but was below 0.12 ug/L. This value was the method detection limit for that specific test.

4.2 GROUND-WATER SAMPLE ANALYSIS RESULTS

The following subsections discuss the analytical results of the ground-water sample testing and compare the results to established NYSDEC and other environmental criteria. Table 4-1 provides a summary of analytical results for all water samples that had any concentrations of purgeable organic compounds and metals. A water quality standard is also shown in the table for comparison. References for each standard or criteria used are included in this table.

4.2.1 Purgeable Halocarbons

Purgeable halocarbons were analyzed by EPA Method 601. (November sampling) and EPA Method 624 (April sampling). These parameters include the chlorinated ethane and ethene hydrocarbon series. This test should detect the presence of solvent residues and degradation by-products.

TABLE 4-1

Summary of Ground-Water Contaminant Levels Compared to Current Standards and Criteria

Atlas Site S-4
Essex, New York

Parameter	GW Conc.	MCL[1]	NYSDEC[2]
<u>Purgeable Halocarbons</u> (ug/L)			
chloroform	7.1**	100	
trichlorethene	20.0	5	10
trans-1,2-dichloroethene	18.0	70	
<u>Metals</u> (mg/L)			
arsenic (total)	0.009	0.05	0.025
arsenic (dissolved)	<0.005	0.05	0.025
barium (total)	0.262	1.000	1.000
barium (dissolved)	0.072	1.000	1.000
chromium (total)	0.04	0.05	0.050
chromium (dissolved)	0.01	0.05	0.050
lead (total)	0.03	0.05	0.025
lead (dissolved)	0.02	0.05	0.025

*detected but not quantifiable
**trip blank

NOTES: (1) MCL -- proposed Maximum Contaminant Level, or MCLG -- Maximum Contaminant Level Goal

(2) NYSDEC -- New York State Department of Environmental Conservation, Class GSA waters

Trichloroethene was detected in silo sample SL 400 and four monitoring well samples MW401, MW402, MW403, and MW404. The following concentrations were found - numbers in parenthesis are duplicate sample results: (ppb):

Sample	Nov '86	April '87
SL400 (silo)	5.7	-
MW401	6.8	-
MW402	9.7	6.0
MW403	6.5 (15)	20
MW404	11	15
MW405	-	<10

The resampling in April 1987 confirmed the presence of trichloroethene. The GA and GSA criteria for trichloroethene is 10 ppb, which was exceeded in well MW403. The proposed Maximum Contaminant Level (MCL) FOR TCE is 5 ppb.

Monitoring well MW404 contained 3.6 ppb of chloroform in November 1986. No chloroform was detected in any well during resampling, but the sampler rinsate (April 1987) contained 5.9 ppb and the trip blank contained 7.1 ppb. This is most likely due to contaminated deionized water used for the rinsate and trip blank. Methylene chloride was detected during November 1986 in monitoring well sample MW403 and the trip blank at concentrations of 8.1 ug/L and 14 ug/L, respectively. No concentrations of this chemical were found in April 1987. This compound has no criterion at present in the NYSDEC water quality regulations under Part 703. Methylene chloride in MW403 may be a result of residual contamination from laboratory preparation of the sample bottle as evident by the trip blank. The trip blank concentration is due to the fact that methylene chloride is used in the procedure for preparing laboratory sample bottles.

All other purgeable halocarbons tested for, if present, were below detectable limits. These purgeable results are contained on Tables 4-2 and 4-3.

4.2.2 Purgeable Aromatics

Purgeable aromatics were analyzed by EPA Method 602 for the November, 1986 sampling event, and Method 624 for the April, 1987 sampling event. The parameters include benzene, toluene, ethylbenzene, and three chlorinated benzenes. Gasoline derivatives, diesel fuel constituents, and propellant constituents and their by-products would be detected by this test.

Purgeable aromatic compounds were not detected in ground-water samples taken from the site during either sampling event. Tables 4-2 and 4-3 verify all results.

4.2.3 Petroleum Hydrocarbons

Petroleum hydrocarbons were analyzed by EPA Method 418.1. Localized spills of petroleum, oil, or lubricants could be indicated by positive results of this test.

Petroleum hydrocarbons were not detected in ground-water samples taken from the site during either sampling event. Tables 4-4 shows petroleum hydrocarbon results.

4.2.4 Total Metals

Total metals were analyzed by EPA Method 200.7 (ICAP) and Methods 206, 270, 272, and 245 (AA). (Results for dissolved metals are discussed in Section 4.2.5). The suite of metals analyzed for included arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver. Metals contamination could have resulted from the following sources: battery electrolyte, pesticides, metal corrosion, paints, electrical equipment and fuel products.

TABLE 4-2

RESULTS OF WATER ANALYSIS FOR PURGEABLE HALOCARBON COMPOUNDS BY GC
(all results in ug/L)

U-4503.2

Dup of 403

Compound	E & E Lab. No. 86-	9929	9930	9931	9932		
	Sample Identity	SL-400	MW-400	MW-401	MW-402		
carbon tetrachloride		<0.12	<0.60	<0.12	<0.60		
1,2-dichloroethane		<0.03	<0.15	<0.03	<0.15		
1,1,1-trichloroethane		<0.05	<0.15	<0.03	<0.15		
1,1-dichloroethane		<0.07	<0.35	<0.07	<0.35		
1,1,2-trichloroethane		<0.02	<0.10	<0.02	<0.10		
1,1,2,2-tetrachloroethane		<0.03	<0.15	<0.03	<0.15		
chloroethane		<0.52	<2.6	<0.52	<2.6		
2-chloroethylvinyl ether		<0.13	<0.65	<0.13	<0.65		
chloroform		<0.05	<0.25	<0.05	<0.25		
1,1-dichloroethene		<0.13	<0.65	<0.13	<0.65		
trans-1,2-dichloroethene		<0.10	<0.50	<0.50	<0.50		
1,2-dichloropropane		<0.04	<0.20	<0.04	<0.20		
trans-1,3-dichloropropene		<0.34	<1.7	<0.34	<1.7		
cis-1,3-dichloropropene		<0.20	<1.0	<0.20	<1.0		
methylene chloride		<0.25	<1.2	<0.25	<1.2		
chloromethane		<0.08	<0.40	<0.08	<0.40		
bromomethane		<1.18	<5.9	<1.18	<5.9		
bromoform		<0.20	<1.0	<0.20	<1.0		
bromodichloromethane		<0.10	<0.50	<0.10	<0.50		
fluorotrichloromethane		<2.0	<10	<2.0	<10		
dichlorodifluoromethane		<1.81	<9.0	<1.81	<9.0		
chlorodibromomethane		<0.09	<0.45	<0.09	<0.45		
tetrachloroethene		<0.03	<0.15	<0.03	<0.15		
trichloroethene		5.7	15	6.8	9.7		
vinyl chloride		<0.18	<0.90	<0.18	<0.90		
chlorobenzene		<0.25	<1.2	<0.25	<1.2		
1,3-dichlorobenzene		<0.32	<1.6	<0.32	<1.6		
1,2-dichlorobenzene		<0.15	<0.75	<0.15	<0.75		
1,4-dichlorobenzene		<0.24	<1.2	<0.24	<1.2		

TABLE 4-2

RESULTS OF WATER ANALYSIS FOR PURGEABLE HALOCARBON COMPOUNDS BY GC
(all results in ug/L)

U-4503.3

Compound	E & E Lab. No. 86-	9933	9934	9935	9936		
	Sample Identity	MW-403	MW-404	Trip Blank	Sample Rinsate		
carbon tetrachloride		<0.60	<0.12	<0.12	<0.12		
1,2-dichloroethane		<0.15	<0.03	<0.03	<0.03		
1,1,1-trichloroethane		<0.15	<0.03	<0.03	<0.03		
1,1-dichloroethane		<0.35	<0.07	<0.07	<0.07		
1,1,2-trichloroethane		<0.10	<0.02	<0.02	<0.02		
1,1,2,2-tetrachloroethane		<0.15	<0.03	<0.03	<0.03		
chloroethane		<2.6	<0.52	<0.52	<0.52		
2-chloroethylvinyl ether		<0.65	<0.13	<0.13	<0.13		
chloroform		<0.25	3.6	<0.05	<0.05		
1,1-dichloroethene		<0.65	<0.13	<0.13	<0.13		
trans-1,2-dichloroethene		<0.50	<2.0	<0.10	<0.10		
1,2-dichloropropane		<0.20	<0.04	<0.04	<0.04		
trans-1,3-dichloropropene		<1.7	<0.34	<0.34	<0.34		
cis-1,3-dichloropropene		<1.0	<0.20	<0.20	<0.20		
methylene chloride		8.1	<0.25	14	<0.25		
chloromethane		<0.40	<0.08	<0.08	<0.08		
bromomethane		<5.9	<1.18	<1.18	<1.18		
bromoform		<1.0	<0.20	<0.20	<0.20		
bromodichloromethane		<0.50	<0.10	<0.10	<0.10		
fluorotrichloromethane		<10	<2.0	<2.0	<2.0		
dichlorodifluoromethane		<9.0	<1.81	<1.81	<1.81		
chlorodibromomethane		<0.45	<0.09	<0.09	<0.09		
tetrachloroethene		<0.15	<0.03	<0.03	<0.03		
trichloroethene		6.5	11	<0.12	<0.12		
vinyl chloride		<0.90	<0.18	<0.18	<0.18		
chlorobenzene		<1.2	<0.25	<0.25	<0.25		
1,3-dichlorobenzene		<1.6	<0.32	<0.32	<0.32		
1,2-dichlorobenzene		<0.75	<0.15	<0.15	<0.15		
1,4-dichlorobenzene		<1.2	<0.24	<0.24	<0.24		

TABLE 4-3

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT PURGEABLE AROMATIC COMPOUNDS BY GC

(all results in ug/L as received)

U-4503.4

Compound	E & E Lab. No. 86-	9929	9930	9931	9932	
	Sample Identity	SL-400	MW-400	MW-401	MW-402	
chlorobenzene		<0.20	<0.20	<0.20	<0.20	
1,2-dichlorobenzene		<0.40	<0.40	<0.40	<0.40	
1,3-dichlorobenzene		<0.40	<0.40	<0.40	<0.40	
1,4-dichlorobenzene		<0.30	<0.30	<0.30	<0.30	
benzene		<0.20	<0.20	<0.20	<0.20	
total xylenes		<1.0	<1.0	<1.0	<1.0	
toluene		<0.20	<0.20	<0.20	<0.20	
ethylbenzene		<0.20	<0.20	<0.20	<0.20	

TABLE 4-3

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT PURGEABLE AROMATIC COMPOUNDS BY GC

(all results in ug/L as received)

U-4503.5

Compound	E & E Lab. No. 86-	9933	9934	9935	9936	
	Sample Identity	MW-403	MW-404	Trip Blank	Sample Rinsate	
chlorobenzene		<0.20	<0.20	<0.20	<0.20	
1,2-dichlorobenzene		<0.40	<0.40	<0.40	<0.40	
1,3-dichlorobenzene		<0.40	<0.40	<0.40	<0.40	
1,4-dichlorobenzene		<0.30	<0.30	<0.30	<0.30	
benzene		<0.20	<0.20	<0.20	<0.20	
total xylenes		<1.0	<1.0	<1.0	<1.0	
toluene		<0.20	<0.20	<0.20	<0.20	
ethylbenzene		<0.20	<0.20	<0.20	<0.20	

TABLE 4-3

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT PURGEABLE ORGANIC COMPOUNDS BY GC/MS

(all results in ug/L)

Date Analyzed: 5/1 and 5/6

U-5396.5

	E & E Lab. No. 87-	3328	3329	3330	3331	
Compound	Sample Identity	402	403	404	405	
chloromethane		<10	<10	<10	<10	
bromomethane		<10	<10	<10	<10	
vinyl chloride		<10	<10	<10	<10	
chloroethane		<10	<10	<10	<10	
methylene chloride		<5	<5	<5	<5	
1,1-dichloroethene		<5	<5	<5	<5	
1,1-dichloroethane		<5	<5	<5	<5	
trans-1,2-dichloroethene		<5*	8.7	18	<5	
chloroform		<5	<5	<5	<5	
1,2-dichloroethane		<5	<5	<5	<5	
1,1,1-trichloroethane		<5	<5	<5	<5	
carbon tetrachloride		<5	<5	<5	<5	
bromodichloromethane		<5	<5	<5	<5	
1,2-dichloropropane		<5	<5	<5	<5	
trans-1,3-dichloropropene		<5	<5	<5	<5	
trichloroethene		6.0	20	15	<5	
chlorodibromomethane		<5	<5	<5	<5	
1,1,2-trichloroethane		<5	<5	<5	<5	
benzene		<5	<5	<5	<5	
cis-1,3-dichloropropene		<5	<5	<5	<5	
2-chloroethylvinyl ether		<5	<10	<10	<10	
bromoform		<5	<5	<5	<5	
tetrachloroethene		<5	<5	<5	<5	
1,1,2,2-tetrachloroethane		<5	<5	<5	<5	
toluene		<5	<5	<5	<5	
chlorobenzene		<5	<5	<5	<5	
ethylbenzene		<5	<5	<5	<5	

*Compound present below measurable detection limit.

TABLE 4-3

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT PURGEABLE ORGANIC COMPOUNDS BY GC/MS

(all results in ug/L)

Date Analyzed: 5/1 and 5/6

U-5396.7

Compound	E & E Lab. No. 87-	3334	3335	Method Blank		
	Sample Identity	Trip Blank	Sample Blank			
chloromethane		<10	<10	<10		
bromomethane		<10	<10	<10		
vinyl chloride		<10	<10	<10		
chloroethane		<10	<10	<10		
methylene chloride		<5	<5	<5		
1,1-dichloroethene		<5	<5	<5		
1,1-dichloroethane		<5	<5	<5		
trans-1,2-dichloroethene		<5	<5	<5		
chloroform		7.1	5.9	<5		
1,2-dichloroethane		<5	<5	<5		
1,1,1-trichloroethane		<5	<5	<5		
carbon tetrachloride		<5	<5	<5		
bromodichloromethane		<5	<5	<5		
1,2-dichloropropane		<5	<5	<5		
trans-1,3-dichloropropene		<5	<5	<5		
trichloroethene		<5	<5	<5		
chlorodibromomethane		<5	<5	<5		
1,1,2-trichloroethane		<5	<5	<5		
benzene		<5	<5	<5		
cis-1,3-dichloropropene		<5	<5	<5		
2-chloroethylvinyl ether		<10	<10	<10		
bromoform		<5	<5	<5		
tetrachloroethene		<5	<5	<5		
1,1,2,2-tetrachloroethane		<5	<5	<5		
toluene		<5	<5	<5		
chlorobenzene		<5	<5	<5		
ethylbenzene		<5	<5	<5		

TABLE 4-4

RESULTS OF WATER ANALYSIS
FOR METALS AND PETROLEUM HYDROCARBONS
(all results in mg/l)

U-4503

Job No.:	U-4503	RE:	LW-1000
Sample Date:	11/19/86	P.O. No.:	
Date Received:	11/20/86	Sampled By:	E & E, Inc.
Sample Type:	Water	Delivered By:	Federal Express

E & E Lab. No. 86-	9929	9930	9931	9932	9933	9934
Customer No.	SL-400	MW-400	MW-401	MW-402	MW-403	MW-404
Sample Identity						
	Results in: mg/L unless noted					
Petroleum Hydrocarbons	<1	<1	<1	<1	<1	<1
Total Arsenic	<0.005	0.008	<0.005	0.009	0.006	<0.005
Total Barium	0.037	0.170	0.073	0.262	0.170	0.094
Total Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Total Chromium	<0.01	0.032	<0.01	0.042	0.039	<0.01
Total Lead	0.005	0.021	0.007	0.032	0.021	<0.005
Total Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Total Selenium	<0.005	<0.05	<0.005	<0.05	<0.05	<0.05
Total Silver	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dissolved Arsenic	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Dissolved Barium	0.032	0.040	0.072	0.072	0.038	0.066
Dissolved Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Dissolved Chromium	0.011	<0.01	0.010	<0.01	0.010	0.010
Dissolved Lead	<0.005	0.020	<0.005	<0.005	<0.005	<0.005
Dissolved Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Dissolved Selenium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Dissolved Silver	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical References:
"Methods for the Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March 1983.

TABLE 4-4

U-4503.1

Job No.: U-4503			RE: LW-1000			
Sample Date: 11/19/86			P.O. No.:			
Date Received: 11/20/86			Sampled By: E & E, Inc.			
Sample Type: Water			Delivered By: Federal Express			
E & E Lab. No. 86-	9935	9936				
Customer No.						
Sample Identity	Trip Blank	Sample Rinsate				
	Results in: mg/L unless noted					
Petroleum Hydrocarbons	<1	<1				
Total Arsenic	<0.005	<0.005				
Total Barium	<0.01	<0.01				
Total Cadmium	<0.005	<0.005				
Total Chromium	<0.01	<0.01				
Total Lead	<0.005	<0.005				
Total Mercury	<0.0002	<0.0002				
Total Selenium	<0.005	<0.005				
Total Silver	<0.01	<0.01				
Dissolved Arsenic	<0.005	<0.005				
Dissolved Barium	<0.01	<0.01				
Dissolved Cadmium	<0.005	<0.005				
Dissolved Chromium	<0.01	<0.01				
Dissolved Lead	<0.005	<0.005				
Dissolved Mercury	<0.0002	<0.0002				
Dissolved Selenium	<0.005	<0.005				
Dissolved Silver	<0.01	<0.01				

Analytical References:
"Methods for the Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March 1983.

TABLE 4-4

RESULTS OF WATER ANALYSIS
FOR METALS AND PETROLEUM HYDROCARBONS
(all results in mg/l)

U-5396.1

Job No.:	U-5396		RE:			
Sample Date:	4/27-28/87		P.O. No.:	16878		
Date Received:	4/29/87		Sampled By:	Client		
Sample Type:	Water		Delivered By:	Federal Express		
E & E Lab. No. 87-	3328	3329	3330	3331		
Customer No.	402	403	404	405		
Sample Identity					Date Analyzed	
	Results in: mg/L unless noted					
Petroleum Hydrocarbons	<1	<1	<1	<1	5/5/87	
Arsenic	<0.005	<0.005	<0.005	<0.005	5/13/87	
Barium	0.130	0.110	0.069	0.038	5/7/87	
Cadmium	<0.005	<0.005	<0.005	<0.005	5/7/87	
Chromium	0.026	<0.01	<0.01	<0.01	5/7/87	
Lead	<0.005	<0.005	<0.005	<0.005	5/13/87	
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	5/11/87	
Selenium*	<0.1	<0.005	<0.025	<0.025	5/13-14/87	
Silver	<0.01	<0.01	<0.01	<0.01	5/7/87	

*Elevated detection limits due to matrix interferences.

Analytical Reference

"Methods for the Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March 1983.

TABLE 4-4

RESULTS OF WATER ANALYSIS FOR METALS AND PETROLEUM HYDROCARBONS
(all results in mg/l)

U-5396.3

Job No.:	U-5396		RE:				
Sample Date:	4/27-28/87		P.O. No.:	16878			
Date Received:	4/29/87		Sampled By:	Client			
Sample Type:	Water		Delivered By:	Federal Express			
E & E Lab. No. 87-	3334	3335					
Customer No.	Trip Blank	Sample Blank					
Sample Identity			Date Analyzed				
	Results in: mg/L unless noted						
Petroleum Hydrocarbons	<1	<1	5/5/87				
Arsenic	<0.005	<0.005	5/13/87				
Barium	<0.01	<0.01	5/7/87				
Cadmium	<0.005	<0.005	5/7/87				
Chromium	<0.01	<0.01	5/7/87				
Lead	<0.005	<0.005	5/13/87				
Mercury	<0.0002	<0.0002	5/11/87				
Selenium	<0.005	<0.005	5/13-14/87				
Silver	<0.01	<0.01	5/7/87				

Analytical Reference

"Methods for the Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March 1983.

The following concentrations of total metals were found in ground water (numbers in parenthesis are duplicate results): (ppb):

Arsenic	Nov '86	April '87
MW402	0.009	<0.005
MW403	0.006 (0.008)	<0.005
Barium		
SL400 (silo)	0.037	-
MW401	0.073	-
MW402	0.262	0.130
MW403	0.170 (0.170)	0.110
MW404	0.094	0.069
MW405	-	0.038
Chromium		
MW402	0.042	0.026
MW403	0.039 (0.032)	<0.01
Lead		
SL400 (silo)	0.005	-
MW401	0.007	-
MW402	0.032	<0.005
MW403	0.021 (0.005)	<0.005

The only metal exceeding any criteria is lead at 0.03 ppb in well MW402. However, the value was not verified in the later sampling. (The NYSDEC criteria is 0.025 ppb for Class GA and 0.005 ppb for Class GSA waters). All other total metals tested for, if present, were below detectable limits. All total metals results are shown on Table 4-4.

4.2.5 Dissolved Metals

Dissolved metals were analyzed by EPA Method 200.7 (ICAP) and Methods 206, 270, 272, and 245 (AA). The same dissolved metals as total metals were analyzed (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver.)

Dissolved metals in all groundwater samples taken from this site were present at detectable levels but below the NYSDEC criteria. Dissolved metals detected included barium, chromium, and lead. All other dissolved metals tested for, if present, were below detectable limits. Table 4-4 shows all dissolved metals results.

4.2.6 Conclusions

Based on the above results, the greatest concern at this site is the fact that four wells contain trichloroethene. Wells MW403 and MW404 had concentrations that exceed the NYSDEC criteria value (10 ug/L) for use as a potable water source, (both sampling events). Based on these analyses, it is concluded that the ground-water at site is contaminated by trichloroethene.

All other parameters analyzed were found at concentrations below standards or criteria, or at non-detectable levels.

4.3 SILO WATER SAMPLE ANALYSIS RESULTS

The silo at Atlas Site S-4 was sampled through a boring drilled through the tunnel connecting the silo to the Launch Control Center. Silo samples were designated "SL400" and the analytical results are discussed in the ground water section (Section 4.2).

In summary, the only parameter of concern found was trichloroethene at 5.7 ug/L (above the proposed MCL for drinking water, but below the NYSDEC criteria). The silo is not considered, or used as a drinking water source.

4.4 SOIL SAMPLE ANALYSIS RESULTS

The following subsections discuss the analytical results of the soil sample testing, and compare the results to established NYSDEC and other environmental criteria.

4.4.1 Purgeable Halocarbons

Purgeable halocarbons were analyzed by EPA Method 8010. Chlorinated ethanes and ethenes, solvent residues, and degradation by-products could be indicated by positive results of this test.

Analysis for purgeable halocarbons showed levels of 1.9 ug/L, 1.9 ug/L, and 1.8 ug/L for methylene chloride only in samples S404, S405, and S406, respectively (Table 4-5). These levels are just slightly above the detection limit of 1.0 ug/L, and are caused by laboratory contamination. All other purgeable halocarbons, if present, were below detection limits.

4.4.2 Purgeable Aromatics

Purgeable aromatics were analyzed by EPA Method 8020. The parameters include benzene, toluene, ethylbenzene, and three chlorinated benzenes. Gasoline derivatives, diesel fuel constituents, and propellant constituents and their degradation by-products may be detected by this test.

Purgeable aromatics were not detected in samples taken from this site above the detection levels for these compounds (Table 4-6).

4.4.3 Petroleum Hydrocarbons

Petroleum hydrocarbons were analyzed by EPA Method 418.1. Localized fuel spills (petroleum, oil, etc.) could be indicated by positive results of this test.

TABLE 4-5

RESULTS OF SOIL ANALYSIS FOR
PURGEABLE HALOCARBON COMPOUNDS BY GC
(all results in mg/kg as received)

U-4519.8

Compound	E & E Lab. No. 86-		10051	10052	10053	10054
	Sample Identity		S400	S401	S402	S403
carbon tetrachloride			<1.0	<1.0	<1.0	<1.0
1,2-dichloroethane			<1.0	<1.0	<1.0	<1.0
1,1,1-trichloroethane			<1.0	<1.0	<1.0	<1.0
1,1-dichloroethane			<1.0	<1.0	<1.0	<1.0
1,1,2-trichloroethane			<1.0	<1.0	<1.0	<1.0
1,1,2,2-tetrachloroethane			<1.0	<1.0	<1.0	<1.0
chloroethane			<1.0	<1.0	<1.0	<1.0
2-chloroethylvinyl ether			<1.0	<1.0	<1.0	<1.0
chloroform			<1.0	<1.0	<1.0	<1.0
1,1-dichloroethene			<1.0	<1.0	<1.0	<1.0
trans-1,2-dichloroethene			<1.0	<1.0	<1.0	<1.0
1,2-dichloropropane			<1.0	<1.0	<1.0	<1.0
trans-1,3-dichloropropene			<1.0	<1.0	<1.0	<1.0
cis-1,3-dichloropropene			<1.0	<1.0	<1.0	<1.0
methylene chloride			<1.0	<1.0	<1.0	<1.0
chloromethane			<1.0	<1.0	<1.0	<1.0
bromomethane			<1.0	<1.0	<1.0	<1.0
bromoform			<1.0	<1.0	<1.0	<1.0
bromodichloromethane			<1.0	<1.0	<1.0	<1.0
fluorotrichloromethane			<1.0	<1.0	<1.0	<1.0
dichlorodifluoromethane			<1.0	<1.0	<1.0	<1.0
chlorodibromomethane			<1.0	<1.0	<1.0	<1.0
tetrachloroethene			<1.0	<1.0	<1.0	<1.0
trichloroethene			<1.0	<1.0	<1.0	<1.0
vinyl chloride			<1.0	<1.0	<1.0	<1.0
chlorobenzene			<1.0	<1.0	<1.0	<1.0
1,3-dichlorobenzene			<1.0	<1.0	<1.0	<1.0
1,2-dichlorobenzene			<1.0	<1.0	<1.0	<1.0
1,4-dichlorobenzene			<1.0	<1.0	<1.0	<1.0

TABLE 4-5

RESULTS OF SOIL ANALYSIS FOR
PURGEABLE HALOCARBON COMPOUNDS BY GC
(all results in mg/kg as received)

U-4517.9

Compound	E & E Lab. No. 86-	10056	10057	10053			
	Sample Identity	S404	S405	S406			
carbon tetrachloride		<1.0	<1.0	<1.0			
1,2-dichloroethane		<1.0	<1.0	<1.0			
1,1,1-trichloroethane		<1.0	<1.0	<1.0			
1,1-dichloroethane		<1.0	<1.0	<1.0			
1,1,2-trichloroethane		<1.0	<1.0	<1.0			
1,1,2,2-tetrachloroethane		<1.0	<1.0	<1.0			
chloroethane		<1.0	<1.0	<1.0			
2-chloroethylvinyl ether		<1.0	<1.0	<1.0			
chloroform		<1.0	<1.0	<1.0			
1,1-dichloroethene		<1.0	<1.5	<1.0			
trans-1,2-dichloroethene		<1.0	<1.0	<1.0			
1,2-dichloropropane		<1.0	<1.0	<1.0			
trans-1,3-dichloropropene		<1.0	<1.0	<1.0			
cis-1,3-dichloropropene		<1.0	<1.0	<1.0			
methylene chloride		1.9	1.9	1.8			
chloromethane		<1.0	<1.0	<1.0			
bromomethane		<1.0	<1.0	<1.0			
bromoform		<1.0	<1.0	<1.0			
bromodichloromethane		<1.0	<1.0	<1.0			
fluorotrichloromethane		<1.0	<1.5	<1.0			
dichlorodifluoromethane		<1.0	<1.0	<1.0			
chlorodibromomethane		<1.0	<1.0	<1.0			
tetrachloroethene		<1.0	<1.0	<1.0			
trichloroethene		<1.0	<1.0	<1.0			
vinyl chloride		<1.0	<1.0	<1.0			
chlorobenzene		<1.0	<1.0	<1.0			
1,3-dichlorobenzene		<1.0	<1.0	<1.0			
1,2-dichlorobenzene		<1.0	<1.0	<1.0			
1,4-dichlorobenzene		<1.0	<1.0	<1.0			

TABLE 4-6

RESULTS OF SOIL ANALYSIS FOR PRIORITY POLLUTANT PURGEABLE AROMATIC COMPOUNDS BY GC

(all results in mg/kg as received)

U-4519.16

Compound	E & E Lab. No. 86-			10,051	10,052	10,053
	Sample Identity			S400	S401	S402
chlorobenzene				<1.0	<1.0	<1.0
1,2-dichlorobenzene				<1.0	<1.0	<1.0
1,3-dichlorobenzene				<1.0	<1.0	<1.0
1,4-dichlorobenzene				<1.0	<1.0	<1.0
benzene				<1.0	<1.0	<1.0
total xylenes				<1.0	<1.0	<1.0
toluene				<1.0	<1.0	<1.0
ethylbenzene				<1.0	<1.0	<1.0

TABLE 4-6

RESULTS OF SOIL ANALYSIS FOR PRIORITY POLLUTANT
PURGEABLE AROMATIC COMPOUNDS BY GC

(all results in mg/kg as received)

U-4519.17

Compound	E & E Lab. No. 86-	10,054	10,056	10,057	10,058	
	Sample Identity	S403	S404	S405	S406	
chlorobenzene		<1.0	<1.0	<1.0	<1.0	
1,2-dichlorobenzene		<1.0	<1.0	<1.0	<1.0	
1,3-dichlorobenzene		<1.0	<1.0	<1.0	<1.0	
1,4-dichlorobenzene		<1.0	<1.0	<1.0	<1.0	
benzene		<1.0	<1.0	<1.0	<1.0	
total xylenes		<1.0	<1.0	<1.0	<1.0	
toluene		<1.0	<1.0	<1.0	<1.0	
ethylbenzene		<1.0	<1.0	<1.0	<1.0	

No petroleum hydrocarbons were detected above detection levels in samples taken from this site (Table 4-7).

4.4.4 Total Metals

Total metals were tested for by EPA Method 6010. They are the same metals tested for in water samples. Soils normally contain metals concentrations at various background levels. Natural background levels and range values for metals are taken from Linsay, 1979 (Appendix H).

Arsenic was detected in soil samples S40D (S403 duplicate), S406, S403, and S406 taken from this site (Table 4-8). These levels are within the natural background range of 1 to 50 mg/kg and below the average of 5 mg/kg as set forth in the soil guidelines criteria (Appendix H).

Barium was detected in all soil samples taken from this site. These concentrations were below the common range of 100 to 3,000 mg/kg, except in sample S403, which showed a concentration of 113 mg/kg (Table 4-8). This level is within the common range and below the average value of 430 mg/kg (Appendix H).

Chromium was detected in all of the samples taken from the site at concentrations within the common range of 1 to 1,000 mg/kg. All levels were below the average concentration of 100 mg/kg (Appendix H).

Lead was detected in all of the soil samples taken from the site. Samples S401, S404, and S405 showed lead levels of 11.7 mg/kg, 20.5 mg/kg, and 18.5 mg/kg, respectively (Table 4-8). These levels are above the average of 10 mg/kg as set forth in the soil guidelines criteria (Appendix H), but within the natural background range of 2 to 200 mg/kg.

Mercury was detected in samples S40D (S403 duplicate) and S401 at concentrations of 0.24 mg/kg and 0.28 mg/kg, respectively. These

TABLE 4-7

RESULTS OF SOIL ANALYSIS FOR PETROLEUM HYDROCARBONS (all results in mg/kg)

U-4664.1

Job No.: U-4664	RE: LW-1000
Sample Date: 11/18-21/86	P.O. No.:
Date Received: 11/22/86	Sampled By: E & E, Inc.
Sample Type: Soil	Delivered By: Federal Express

E & E Lab. No. 86-		10051	10052	10053	10054	10056
Customer No.		S400	S401	S402	S403	S404
Sample Identity						
	Results in: mg/kg as received unless noted					
Petroleum Hydrocarbons		<50	<50	<50	<50	<50

Note: All samples analyzed beyond holding time due to the delayed request for analysis.

Analytical References:

"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Second Edition, U.S. EPA, 1982.

TABLE 4-7

RESULTS OF SOIL ANALYSIS FOR PETROLEUM HYDROCARBONS
(all results in mg/kg)

U-4664.2

Job No.:	U-4664	RE:	LW-1000
Sample Date:	11/18-21/86	P.O. No.:	
Date Received:	11/22/86	Sampled By:	E & E, Inc.
Sample Type:	Soil	Delivered By:	Federal Express

E & E Lab. No. 86-	10057	10058				
Customer No.	S405	S406				
Sample Identity						
	Results in: mg/kg as received unless noted					
Petroleum Hydrocarbons	<50	<50				

Note: All samples analyzed beyond holding time due to the delayed request for analysis.

<u>Analytical References:</u>

"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Second Edition, U.S. EPA, 1982.

TABLE 4-8
RESULTS OF SOIL ANALYSIS FOR METALS
(all results in mg/kg)

U-4519.1

Job No.: U-4519		RE: LW-1000			
Sample Date: 11/18-21/86		P.O. No.:			
Date Received: 11/22/86		Sampled By: E & E, Inc.			
Sample Type: Soil		Delivered By: Federal Express			
E & E Lab. No. 86-		10051	10052	10053	10054	10056
Customer No.		S400	S401	S402	S403	S404
Sample Identity						
	Results in: mg/kg as received unless noted					
Arsenic		1.37	<3.0	3.33	2.53	<3.0
Barium		39.1	52.8	113	27.7	25.6
Cadmium		<0.5	<0.5	<0.5	<0.5	<0.5
Chromium		5.94	11.2	21.8	5.96	6.25
Lead		6.11	11.7	8.47	9.09	20.5
Mercury		0.24	0.28	<0.1	<0.1	<0.1
Selenium		<5.0	<2.5	<2.5	<2.5	<2.5
Silver		<1.0	<1.0	<1.0	<1.0	<1.0

Analytical References:

"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Second Edition, U.S. EPA, 1982.

TABLE 4-8

RESULTS OF SOIL ANALYSIS FOR METALS
(all results in mg/kg)

U-4519.2

Job No.:	U-4519	RE:	LW-1000
Sample Date:	11/18-21/86	P.O. No.:	
Date Received:	11/22/86	Sampled By:	E & E, Inc.
Sample Type:	Soil	Delivered By:	Federal Express

E & E Lab. No. 86-	10057.	10058				
Customer No.	S405	S406				
Sample Identity						
	Results in: mg/kg as received unless noted					
Arsenic	<3.0	2.80				
Barium	12.3	21.8				
Cadmium	<0.5	<0.5				
Chromium	4.25	5.16				
Lead	18.5	5.91				
Mercury	<0.1	<0.1				
Selenium	<5.0	<5.0				
Silver	<1.0	<1.0				

Analytical References:

"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Second Edition, U.S. EPA, 1982.

levels are within the natural background range of 0.01 to 0.3 mg/kg and well above the average of 0.03 mg/kg (Appendix H). These levels appear to be elevated with respect to the rest of the site, since mercury was not detected in other soil samples collected at the site.

Cadmium was not detected in any of the soil samples taken from the site. All other metals tested for at this site, if present, were below detection limits.

4.4.5 Conclusions

The barium and chromium levels detected in sample S402 seem slightly elevated with respect to other soil samples collected at the site. The barium concentration recorded in sample S406 appears to be slightly elevated with respect to other soil samples collected at the site. However, none of the metals concentrations exceeded maximum acceptable concentrations and, therefore, the site is not considered to be contaminated by heavy metals.

Also, since no evidence of petroleum hydrocarbons or purgeable aromatic compounds was found and only slightly elevated levels of methylene chloride (probably due to laboratory contamination) were found, it is concluded that the soils at site are not contaminated by these constituents.

4.5 QUALITY ASSURANCE AND SAFETY CONSIDERATIONS

Quality assurance and safety for this project was controlled by a Work Plan, which contained three separate but related volumes:

- Volume I: Sampling/Analysis -- QC/QA Plan
- Volume II: Safety, Health and Emergency Response Plan
- Volume III: Monitoring Well Installation Plan

These plans were prepared before initiating any field activities and were approved by the Corps of Engineers. The field work was conducted in accordance with Work Plan, and any exceptions to the Work Plan were approved by the Corps of Engineers prior to making the changes. The following paragraphs discuss QA/QC and safety procedures as they were observed during field and laboratory activities.

4.5.1 Quality Assurance

Quality assurance for the project, in addition to preparing and following the Work Plan, consisted of several elements: project organizational responsibility, document control and quality assurance samples in the laboratory. Each element is discussed below.

4.5.1.1 Project Organizational Responsibility

The two primary firms involved in performing the field and laboratory programs are Law Environmental, Inc., and Ecology and Environment. Law Environmental, Inc. was responsible for management of the entire project including QA considerations. Law Environmental was also responsible for seeing that the monitoring wells were properly installed according to approved protocols. This was accomplished by assigning a Site Manager to oversee the entire field operation, and a geologist or geotechnical engineer to oversee drilling operations on each drilling rig. Experienced professional staff was assigned by Law Environmental to accomplish these tasks. The following personnel were utilized by Law Environmental: Site Manager - Mr. S.L. Shugart, P.G.; Geologists or Engineer - Mr. J.G. LaBastie, P.E.; Ms. C.F. Zauner; and Mr. S.W. Hart, P.G. These persons have a combined experience record of about 50 years.

Ecology and Environment (E&E) was responsible for collecting and analyzing the samples from the SITE. E&E provided two experienced field sampling personnel to collect and ship the samples to the laboratory. The sampling was performed under the oversight of Law Environmental's Ms. Zauner, a geochemist.

4.5.1.2 Document Control

Chain-of-custody were completed by the field sampling team. Chain-of-custody reports were maintained for all samples that were shipped to the laboratory. The reports were initiated by the field sampling team and completed by the laboratory scientist that received the samples. A copy of the chain-of-custody documents received by the laboratory is attached in Appendix G of this report. The documents indicate that all the samples were received by the laboratory in satisfactory condition for the requested tests.

An important fact of laboratory analysis is the sample holding time. Samples must be analyzed within a specific time period after they are taken in the field. The analytical tests were performed within the established holding time for each parameter. Below is a comparison of the date sampled and analysis performed for the samples.

Sample No.	Parameter	Sampled	Analyzed
SL 400, MW 401	Metals	11/19/86	12/4-12/29/86
through	Volatiles	11/19/86	11/27-12/2/86
MW 404	Petroleum Hydrocarbons	11/19/86	12/8/86
MW 405	Metals	4/28/87	5/7-5/14/87
	Volatiles	4/28/87	5/1-5/6/87
	Petroleum Hydrocarbons	4/28/87	5/5/87
S 401	Metals	11/18/86	12/19-12/31/86
through	Volatiles	11/18/86	11/25-12/3/86
S 406	Petroleum	11/18/86	12/24-12/26/86

Daily logs were kept in bound log books by the Site Manager and by the field sampling team. These logs are a part of the project file and are available for review upon request.

4.5.1.3 Quality Assurance Samples

Five types of quality assurance samples were analyzed by the laboratory: duplicates, trip blanks, samples are in addition to other analytical QA samples that the E&E laboratory normally analyzes for method controls, instrument calibration, and internal QA procedures.

Duplicate water and soil samples were collected at the SITE during the November 1986 sampling. For the water sample, the duplicate sample was number MW40D. It was a duplicate of sample number MW403. The duplicate data are fairly consistent for the purgeable halocarbons and metals with a few exceptions. The benzene duplicate sample did not show the same concentration as the sample MW103. For substances which showed concentrations of purgeable halocarbons, purgeable aromatics, and metals, the following comparisons were observed:

Parameter	MW403	MW40D
trichloroethene	6.5	15
methylene chloride	8.1	<1.2
total arsenic	0.008	0.006
total barium	0.170	0.170
total chromium	0.039	0.032
total lead	0.021	0.021
dissolved barium	0.038	0.040
dissolved chromium	0.01	<0.01
dissolved lead	<0.005	0.020

The soil duplicate sample was number S40D. It was a duplicate of sample number S403. No purgeable halocarbons, purgeable aromatics or hydrocarbon was detected in the soil samples. Duplicate analyses for metals were slightly variable. This is not unexpected due to the non-homogeneity of soil both vertically and horizontally.

A trip blank consisting deionized water was analyzed for purgeable halocarbons and purgeable aromatics. The only substance detected in the trip blank sample was methylene chloride at 14 ug/L. Measurement of this quantity of methylene chloride in the trip blank does not indicate that contamination of the samples occurred enroute to the laboratory. Methylene chloride is a solvent that is typically utilized in analytical laboratories and can slow up in blanks as a laboratory contaminant.

A sample rinsate was collected to monitor the field cleaning techniques. The sample rinsate showed all parameters to be below the detection levels, indicating good field cleaning procedures.

Replicate analyses and spiked samples were also analyzed for QA. The results are presented in Appendix G. Both analyses show good reproducibility and recovery rates. These samples verify the analytical laboratory techniques for accuracy and precision.

4.5.2 Safety

The site investigation was performed in accordance with the Safety, Health and Emergency Response Plan (SHERP). Specific safety procedures implemented during the field work included monitoring the geotechnical borings during well installation, wearing appropriate safety clothing and monitoring the wells during sampling. No substance was detected during the safety monitoring procedures that necessitated greater safety precautions than those initially used during the field work.

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SECTION 5.0 - CONCLUSIONS AND RECOMMENDATIONS

Site S-4 is a former Atlas Missile Site which was operated for approximately two years during the early 1960's. The USAF conveyed the site to the Town of Willsboro in 1967. Subsequently, the Town of Willsboro sold the site to Mr. Lyle Mason, who in-turn sold it to Leader Sports, Inc., in 1983.

Leader Sports, Inc. manufactures and sells sports equipment to sports supply wholesalers and retailers.

5.1 CONCLUSIONS

The only constituent exceeding NYSDEC criteria on Site S-4 was trichloroethene (TCE), which was measured at 5.7 ppb, 6.8 ppb, 9.7 ppb, 6.5 ppb and 11.0 ppb in the silo water sample SL400 and groundwater monitoring wells MW401, MW402, MW403 and MW404, respectively. Wells MW402, MW403 and MW404 verified TCE during the resampling in April, 1987. The levels were 6.0 ppb, 20 ppb, and 15 ppb respectively. Well MW405 did not show TCE or any other chemical constituent. The NYSDEC criteria for TCE is 10.0 ppb for Classes GA and GSA ground water.

This ground-water contamination may be the result of initial site construction, Atlas Missile operations, post-operational DOD contamination, prior owner or current owner activities.

How do you propose to determine ?

5.2 RECOMMENDATIONS

A preliminary baseline Public Health Assessment is recommended for Atlas Site S-4. This Public Health Assessment would evaluate the public health risk posed by Atlas Site S-4. Follow-on investigations, if required, should be tailored to characterize the extent of TCE contamination.

3.10.1 specific documentation of presence

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