ANL/ESD/TM-111

Contamination Source Review for Building E3162, Edgewood Area, Aberdeen Proving Ground, Maryland

Energy Systems Division
Argonne National Laboratory

Operated by The University of Chicago,
under Contract W-31-109-Eng-38, for the
United States Department of Energy

Argonne National Laboratory

Argonne National Laboratory, with facilities in the states of Illinois and Idaho, is owned by the United States Government, and operated by the University of Chicago under the provisions of a contract with the Department of Energy.

This technical memo is a product of Argonne's Energy Systems (ES) Division. For information on the division's scientific and engineering activities, contact:

Director, Energy Systems Division
Argonne National Laboratory
Argonne, Illinois 60439-4815
Telephone (708) 252-3724

Presented in this technical memo are preliminary results of ongoing work or work that is more limited in scope and depth than that described in formal reports issued by the ES Division.

Publishing support services were provided by Argonne's Information and Publishing Division (for more information, see IPD's home page: http://www.ipd.anl.gov/).

Disclaimer

ANL/ESD/TM-111

Contamination Source Review for Building E3162, Edgewood Area, Aberdeen Proving Ground, Maryland

G.A. Miller, A.K. Draugelis, J. Rueda, and R.E. Zimmerman

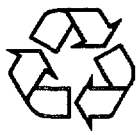
Center for Environmental Restoration Systems, Energy Systems Division,
Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439

Published as

Contamination Source Review Edgewood Area, Aberdeen Proving Ground, Maryland — Building E3162

September 1995

Work sponsored by United States Department of Defense, United States Army, Aberdeen Proving Ground, Maryland



This report is printed on recycled paper.

Contents

Contents (Cont.)

Contents (Cont.)

Figures

Contamination Source Review for Building E3162, Edgewood Area, Aberdeen Proving Ground, Maryland

by

G.A. Miller, A.K. Draugelis,
J. Rueda, and R.E. Zimmerman

Summary

This report was prepared by Argonne National Laboratory (ANL) to document the results of a contamination source review for Building E3162 at the Aberdeen Proving Ground (APG) in Maryland. The report may be used to assist the U.S. Army in planning for the future use or disposition of this building. The review included a historical records search, physical inspection, photographic documentation, geophysical investigation, and collection of air samples. The field investigations were performed by ANL during 1994 and 1995.

Building E3162 (APG designation) is part of the Medical Research Laboratories Building E3160 Complex. This research laboratory complex is located west of Kings Creek, east of the airfield and Ricketts Point Road, and south of Kings Creek Road in the Edgewood Area of APG. The original structures in the E3160 Complex were constructed during World War II. The complex was originally used as a medical research laboratory. Much of the research involved wound assessment. Building E3162 was used as a holding and study area for animals involved in non-agent burns. The building was constructed in 1952, placed on inactive status in 1983, and remains unoccupied.

A physical inspection and photographic documentation of Building E3162 were completed in November 1994. This report includes photographic documentation of exterior and interior walls and the condition of the building. At the time of the inspection, part of the south wall and roof of Building E3162 had collapsed, but the major portion of the building was still standing. This single-story, rectangular structure contains six animal holding pens along each of the north and south walls and a walkway through the middle of the building that ends in a large work area at the building's east end. The 32-ft by 16-ft building is constructed of wood on a concrete slab with a gable roof. The exterior walls and roof are wood, covered with asphalt sheeting. The interior walls and ceiling are exposed wood. Evidence of plumbing, heating, electrical connections, and floor drains was observed inside the building during the ANL inspection.

In December 1994, ANL staff conducted geophysical surveys in the immediate vicinity of Building E3162 by using several nonintrusive methods. Survey results suggest the presence of some underground objects near Building E3162, but they do not provide conclusive evidence of the source of the geophysical anomalies observed during the surveys.

During November 1994, ANL staff collected air quality samples upwind, downwind, and in Building E3162. Analytical results from these air samples revealed no distinguishable difference in hydrocarbon and chlorinated solvent levels between the two background samples and the sample taken inside Building E3162. These results indicate that Building E3162 is not a source of volatile organic compound contamination.

No information on underground storage tanks associated with Building E3162 was available.

On the basis of the information collected and reviewed by ANL for Building E3162, it is the authors' judgment that no significant air contamination is associated with this building. The geophysical surveys revealed some anomalies in the vicinity of Building E3162 that warrant further investigation and evaluation. Suspected asbestos-containing materials observed on the piping and on the hot water tank inside the building should be evaluated and properly disposed of.

1 Introduction

The U.S. Army Aberdeen Proving Ground (APG) commissioned Argonne National Laboratory (ANL) to conduct a contamination source review to identify and define areas of toxic or hazardous contaminants and to assess the physical condition and accessibility of various APG buildings. The information obtained from this review may be used to assist the U.S. Army in planning for the future use or disposition of the buildings. The contamination source review consisted of the following tasks: historical records search, physical inspection, photographic documentation, geophysical investigation, and collection of air samples. This report provides the results of the contamination source review for Building E3162.

Located on Chesapeake Bay in Harford and Baltimore counties, Maryland, APG occupies approximately 30,000 acres. The facility is divided into the Aberdeen and Edgewood areas (Figure 1). The primary mission at APG has been the testing and evaluation of U.S. Army warfare materials. Since its beginning in 1917, the Edgewood Area of APG has been the principal location for chemical warfare agent research, development, and testing in the United States. APG was also used for producing chemical warfare agents during both world wars and has been a center for the storage of chemical warfare material (Nemeth 1989).

Many of the APG facilities constructed between 1917 and the 1960s are no longer used because of obsolescence and their poor state of repair. Because many of these buildings were used for research, development, testing, and/or pilot-scale production of chemical warfare agents and other military substances (such as incendiary materials or munitions containing these materials), the potential exists for portions of the buildings to be contaminated with these substances, their degradation products, and other laboratory or industrial chemicals. These buildings, and associated structures or appurtenances (e.g., underground or aboveground storage tanks, pipes, sumps), may contribute to environmental concerns at APG.

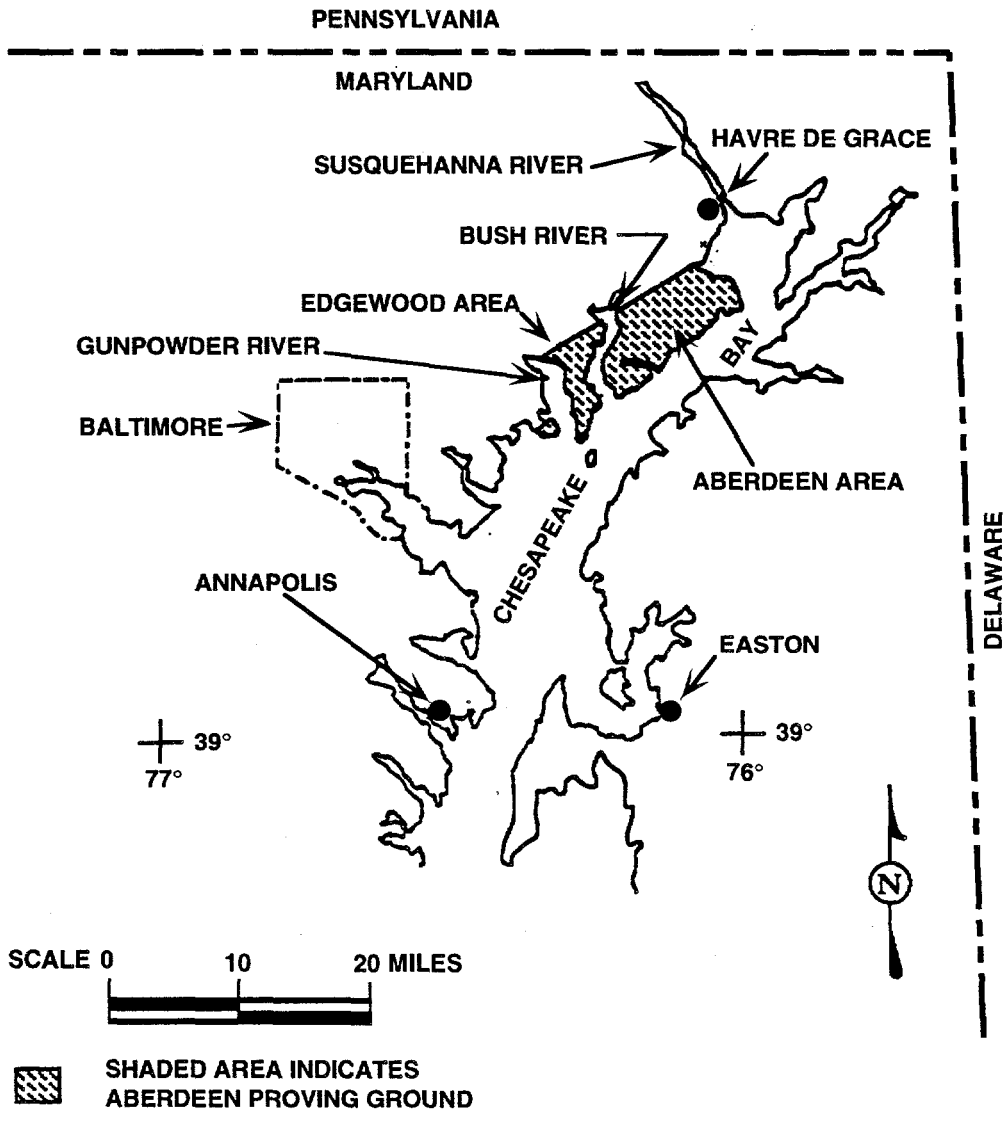


FIGURE 1 Map of Aberdeen Proving Ground Location

2 Methodology

Before the detailed building inspection, ANL personnel made a preliminary site visit to locate the building and obtain building records from APG, identify potential issues to be addressed in the health and safety plan, resolve any access restriction issues, and identify required support services.

Photographs were taken of the building's exterior and interior surfaces during the building inspection in November 1994. The photographs followed a set sequence whenever possible. The exterior was photographed starting on the north side and continuing clockwise around the building; walls were photographed starting in the north or northwest corner of each room and continuing clockwise until reaching the starting point. The ceiling and floor of each room were also photographed.

The area around Building E3162 was examined during December 1994 using several nonintrusive geophysical survey methods, including total field magnetics, electrical conductivity (EM-31), time-domain electrical induction (EMF or EM-61), and ground-penetrating radar (GPR) techniques.

ANL staff collected air quality samples upwind, downwind, and inside of Building E3162 during November 1994. Organic compounds from 24-liter samples trapped in a sorbent polymer cartridge were thermally desorbed and analyzed by using a gas chromatograph equipped with a mass spectrometer. Compounds were identified on the basis of mass spectral interpretation and a computer search of the 140,000 compounds in the Wiley spectral library.

Detailed descriptions of the methodologies used for the geophysical investigation and air quality monitoring are provided in the appendices to this report.

3 Historical Record Search

Building E3162 (APG designation) is part of the Medical Research Laboratories Building E3160 Complex. This research laboratory complex is located west of Kings Creek, east of the airfield and Ricketts Point Road, and south of Kings Creek Road in the Edgewood Area of APG. The original structures in the Building E3160 Complex were constructed during World War II. The complex was originally used as a medical research physics laboratory. Much of the research involved wound assessment. Building E3162 was used as a holding and study area for animals involved in non-agent burn (wound ballistics) testing. The building did not house agents or animals involved in agent testing; no chemicals or explosives have been found in the building (EAI Corporation 1989). On the basis of the activities that occurred at Building E3162, suspected sources of contamination are limited to merthiolale and wash-down detergent. Suspected asbestos-containing insulation materials were observed on piping and on the hot water tank inside the building (EAI Corporation 1989).

Building E3162 was constructed in 1952, and placed on inactive status in 1983. The level of activity in the area is currently low; most of the smaller structures have either been abandoned or are used only for storage (Nemeth 1989). Upon completion of the non-agent burn testing in 1983, the building was vacated. The building has been inactive since 1983, and was empty at the time of this field investigation.

4 Building Description

This section provides a physical description of Building E3162 and the surrounding site as they appeared during the ANL inspection in November 1994. This physical description includes an account of the condition of the exterior walls, roof, interior walls, ceiling, and floor of the building. At the time of the inspection, part of the south wall and roof of Building E3162 had collapsed, but the major portion of the building was still standing. Evidence of plumbing, heating, electrical connections, and floor drains was observed inside the building during the ANL inspection.

4.1 Site Description

4.1.1 Location

Building E3162 is part of the Building E3160 Complex of the Medical Research Laboratories (Figure 2). This research laboratory complex is located west of Kings Creek, east of the airfield and Ricketts Point Road, and south of Kings Creek Road in the Edgewood Area of APG. Building E3162 is approximately 350 ft south of Kings Creek Road.

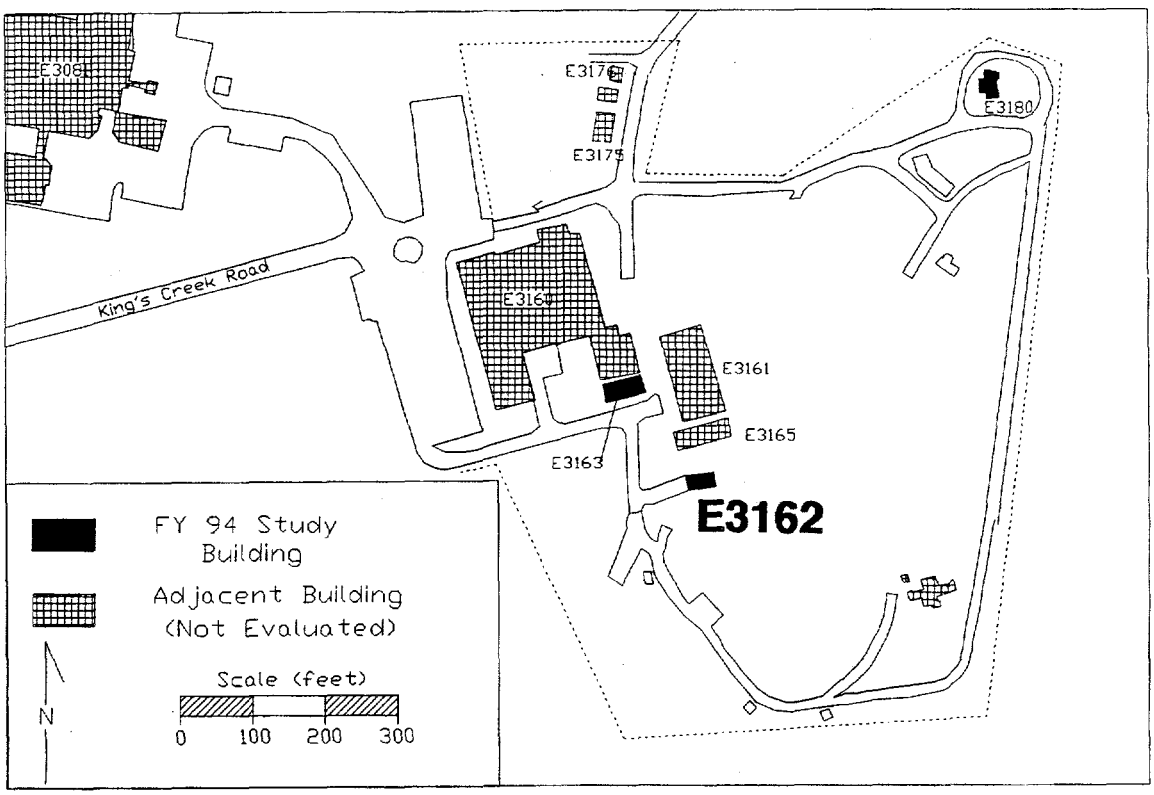


FIGURE 2 Map of Building E3162 Location

4.1.2 Proximity to Other Buildings

Building E3162 is about 50 ft south of Building E3165, approximately 150 ft southeast of Building E3163, and approximately 200 ft southeast of the Building E3160.

4.1.3 Building Structure

Building E3162 is a single-story structure oriented east to west. The exterior walls are made of 2-in. by 4-in. wooden framing with asphalt sheeting. The floor is exposed concrete. A sloped roof covered by asphalt sheeting is supported by wooden rafters. The exterior walls of the building extend from the floor slab to the roof line. The building has five windows, each measuring 3 ft 6 in. wide by 3 ft 4 in. high, and one exterior double door that measures 5 ft wide by 7 ft high. Building E3162 contains 12 animal enclosures. The enclosures are made of 4-ft high, 4-in.-diameter metal posts at the corners. The walls that form the sides and the back of the enclosures are 2-in. by 6-in. wooden planks that fit between the corner posts. In the front of each enclosure is a metal door frame with a chain-link door. The enclosures are 5 ft 6 in. long by 3 ft 6 in. wide. Figure 3 presents a floor plan of the building developed during the ANL inspection and from historical documentation (EAI Corporation 1989). Figure 4 provides photographs of the building exterior.

4.1.4 Exterior Dimensions

The exterior horizontal dimensions of Building E3162 are 32 ft (north wall) by 16 ft (east wall). Building E3162 measures 7 ft 10 in. vertically along the north wall.

4.1.5 Topography

The area directly surrounding Building E3162 is flat and dry.

4.1.6 Vegetation in the Immediate Vicinity

Vegetation in the vicinity of Building E3162 consists of lawn (cut grass), with large trees to the west, east, and south.

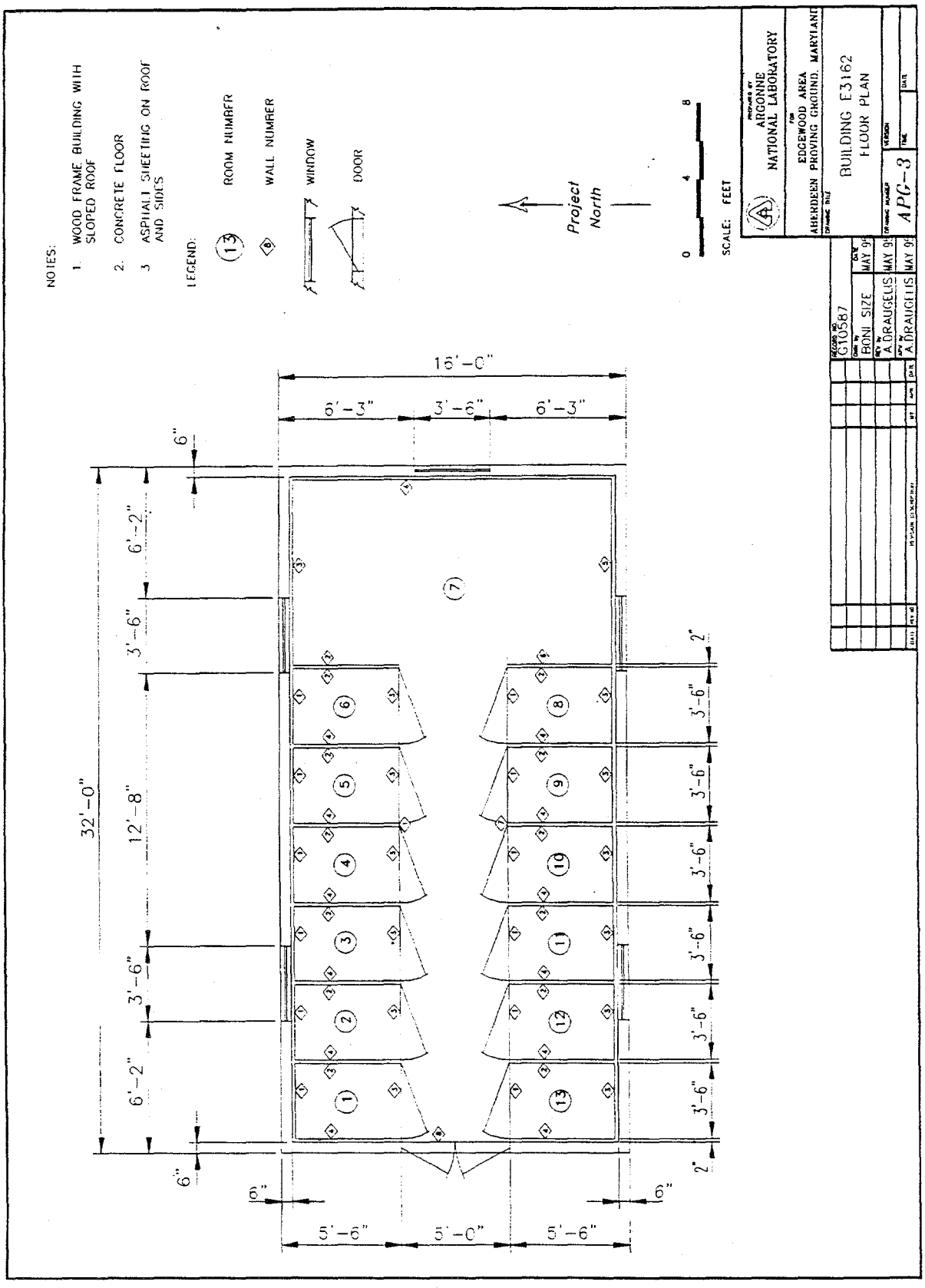
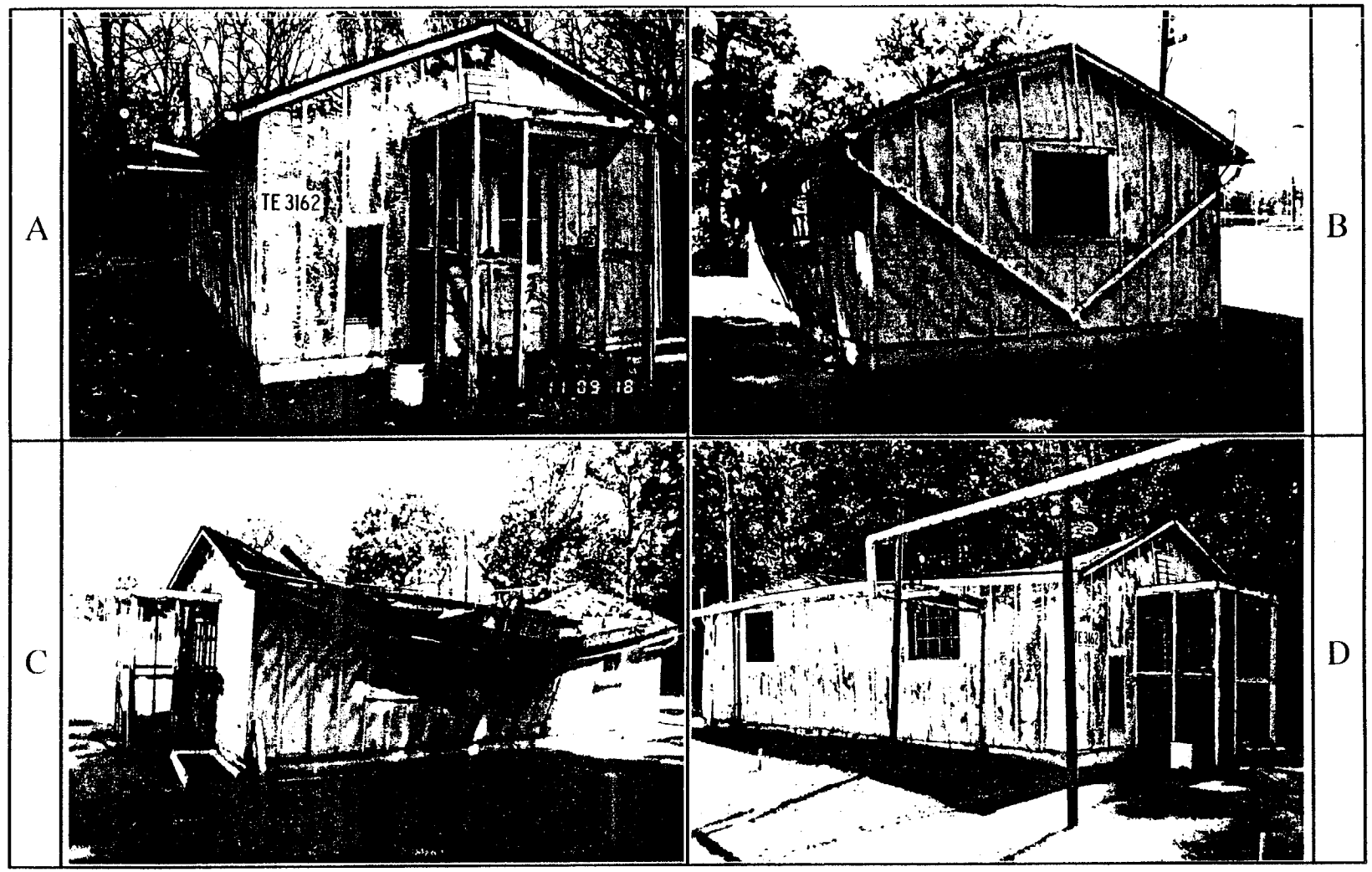


FIGURE 3 Building E3162 Floor Plan



A	North & West Elevation
C	West & South Elevation

South & East Elevation	B
North & West Elevation	D

FIGURE 4 Photographs Building E3162 Exterior

4.1.7 External Aboveground Structures or Equipment

Disconnected electrical lines from a wooden pole and steam pipes were observed on the north side of the building.

4.1.8 Connections with Adjacent Buildings

None.

4.1.9 Underground Structures

None.

4.1.10 Surface Drainage System

None.

4.1.11 Utility Access Points

Disconnected electrical lines from a wooden pole and steam pipes were observed along the north wall of the building.

4.1.12 Exterior Piping

Disconnected steam pipes run along the north side of the building.

4.1.13 Nearby Roads and Sidewalks

Kings Creek Road extends from east to west approximately 350 ft north of the building. A gravel road leading to Kings Creek Road runs north to south directly west of Building E3162.

4.2 North Exterior Elevation

4.2.1 Dimensions

The north exterior elevation of Building E3162 measures 7 ft 10 in. high by 32 ft long (Figures 3 and 4).

4.2.2 Construction Materials

The north exterior wall of Building E3162 is constructed of 2-in. by 4-in. wooden framing covered by asphalt sheeting.

4.2.3 Doors and Windows

There are no doors in the north elevation. There are two windows: each measures 3 ft 6 in. wide by 3 ft 4 in high.

4.2.4 Piping

Two steam pipes enter Building E3162 along the north wall, approximately 5 ft 6 in. from the west end of the building, and approximately 6 ft 6 in. above the ground.

4.2.5 Utility Connections

Electrical power lines enter Building E3162 along the north wall, from a wooden pole that extends beyond the roof approximately 6 ft from the east end of the building. Electrical lines running to the pole have been disconnected.

4.2.6 External Equipment or Structures

A rain gutter was observed along the roof line.

4.2.7 Vegetation

To the north of Building E3162 is an area of lawn (cut grass).

4.2.8 Overall Condition

Because of a lack of building maintenance, the north elevation shows signs of deterioration and weathering.

4.3 East Exterior Elevation

4.3.1 Dimensions

The east exterior elevation of Building E3162 measures 7 ft 10 in. high by 16 ft long (Figures 3 and 4).

4.3.2 Construction Materials

The east exterior wall is constructed of 2-in. by 4-in. wooden framing covered by asphalt sheeting.

4.3.3 Doors and Windows

There are no doors in the east elevation. One window in the east wall measures 3 ft 6 in. wide by 3 ft 4 in. high.

4.3.4 Piping

One plumbing pipe extends from the roof and into the wall on the east side of the building and one 1-in.-diameter utility pipe extends downward into the ground from 1 ft above the roof line on the building's northeast corner. The gutters that run along the north and south sides of Building E3162 connect into a single gutter in the middle of the east side of the building, below the window.

4.3.5 Utility Connections

None.

4.3.6 External Equipment or Structures

None.

4.3.7 Vegetation

The area directly east of Building E3162 is covered by lawn (cut grass) and large trees.

4.3.8 Overall Condition

Because of a lack of building maintenance, the east elevation shows signs of deterioration and weathering.

4.4 South Exterior Elevation

4.4.1 Dimensions

The south exterior elevation of Building E3162 measures 7 ft 10 in. high by 32 ft long (Figures 3 and 4).

4.4.2 Construction Materials

The south exterior wall of Building E3162 is constructed of 2-in. by 4-in. wooden framing covered by asphalt sheeting.

4.4.3 Doors and Windows

There are no doors in the south elevation of this building. There are two windows: each measures 3 ft 6 in. wide by 3 ft 4 in high.

4.4.4 Piping

None.

4.4.5 Utility Connections

None.

4.4.6 External Equipment or Structures

A rain gutter runs along the roof line.

4.4.7 Vegetation

The area directly to the south of Building E3162 consists of lawn (cut grass) and large trees.

4.4.8 Overall Condition

Because of a lack of building maintenance, parts of the south wall and the roof have collapsed.

4.5 West Exterior Elevation

4.5.1 Dimensions

The west exterior elevation of Building E3162 measures 7 ft 10 in. high by 16 ft long (Figures 3 and 4).

4.5.2 Construction Materials

The west exterior wall of Building E3162 is constructed of 2-in. by 4-in. wooden framing covered by asphalt sheeting.

4.5.3 Doors and Windows

One set of double doors in the west elevation measures 5 ft wide by 7 ft high. There are no windows in the west elevation.

4.5.4 Piping

None.

4.5.5 Utility Connections

An overhead electrical line has been disconnected from the west wall.

4.5.6 External Equipment or Structures

A screened entry area, 4 ft deep by 6 ft wide by 8 ft high, is associated with the entrance to Building E3162.

4.5.7 Vegetation

To the west of Building E3162 is an area of lawn (cut grass).

4.5.8 Overall Condition

Because of a lack of building maintenance, the west elevation shows signs of deterioration and weathering.

4.6 Roof

4.6.1 Type and Dimensions

Building E3162 is covered by a gabled roof measuring 16 ft wide by 32 ft long (Figures 3 and 4).

4.6.2 Height

The top of the gable roof is 12 ft high and the bottom of the roof is 7 ft 10 in. above ground level (Figure 4).

4.6.3 Surface Materials

The roof of Building E3162 is covered by rolled asphalt sheeting.

4.6.4 Support System

The roof is supported by wooden rafters.

4.6.5 Condition

The roof was collapsing and leaking at the time of the investigation.

4.6.6 Equipment Located on the Roof

There was a sprinkler system along the roof of the building.

4.6.7 Chimneys, Roof Vents, or Vent Stacks

None.

4.6.8 Piping

Piping associated with the sprinkling system was observed on the roof.

4.7 Interior Floor Plan

4.7.1 Room Number and Dimensions

Building E3162 is a single-story, 13-room, rectangular-shaped building with interior dimensions of 31 ft long by 15 ft wide (Figures 3 and 5).

4.7.2 Walls

The walls of room 7 that coincide with the exterior and interior walls of the building are constructed of 2-in. by 4-in. wooden framing. These walls extend from the floor to the roof line of the building. The interior walls of the animal cages (rooms 1 through 6, and 8 through 13) extend from the floor of the building to a height of approximately 4 ft.

4.7.3 Floor

The concrete floor in Building E3162 is in good condition. There is no evidence that the floor of this building was ever modified. No major cracks were identified (Figure 6).

4.7.4 Floor Penetrations

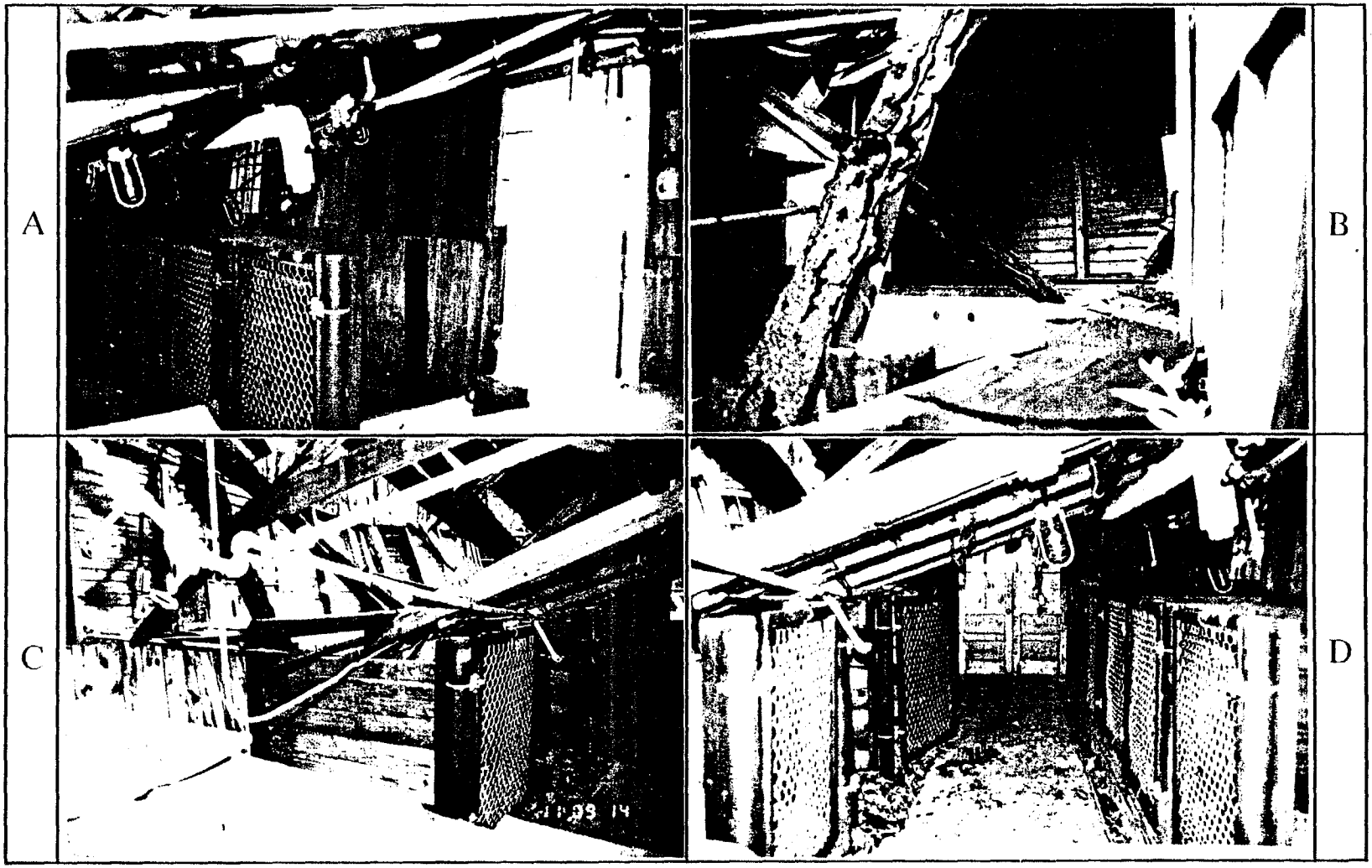
Floor drains in the building lead to two trenches that run along the front of the animal cages.

4.7.5 Interior Partitions

The 4-ft-high interior partitions in Building E3162 are shown in the floor plan (Figure 3). The interior partitions separating the rooms consist of 2-in.-thick wood walls (Figure 5). Rooms 1 through 6 and 8 through 13 also have chain-link gates.

4.7.6 Equipment or Supplies

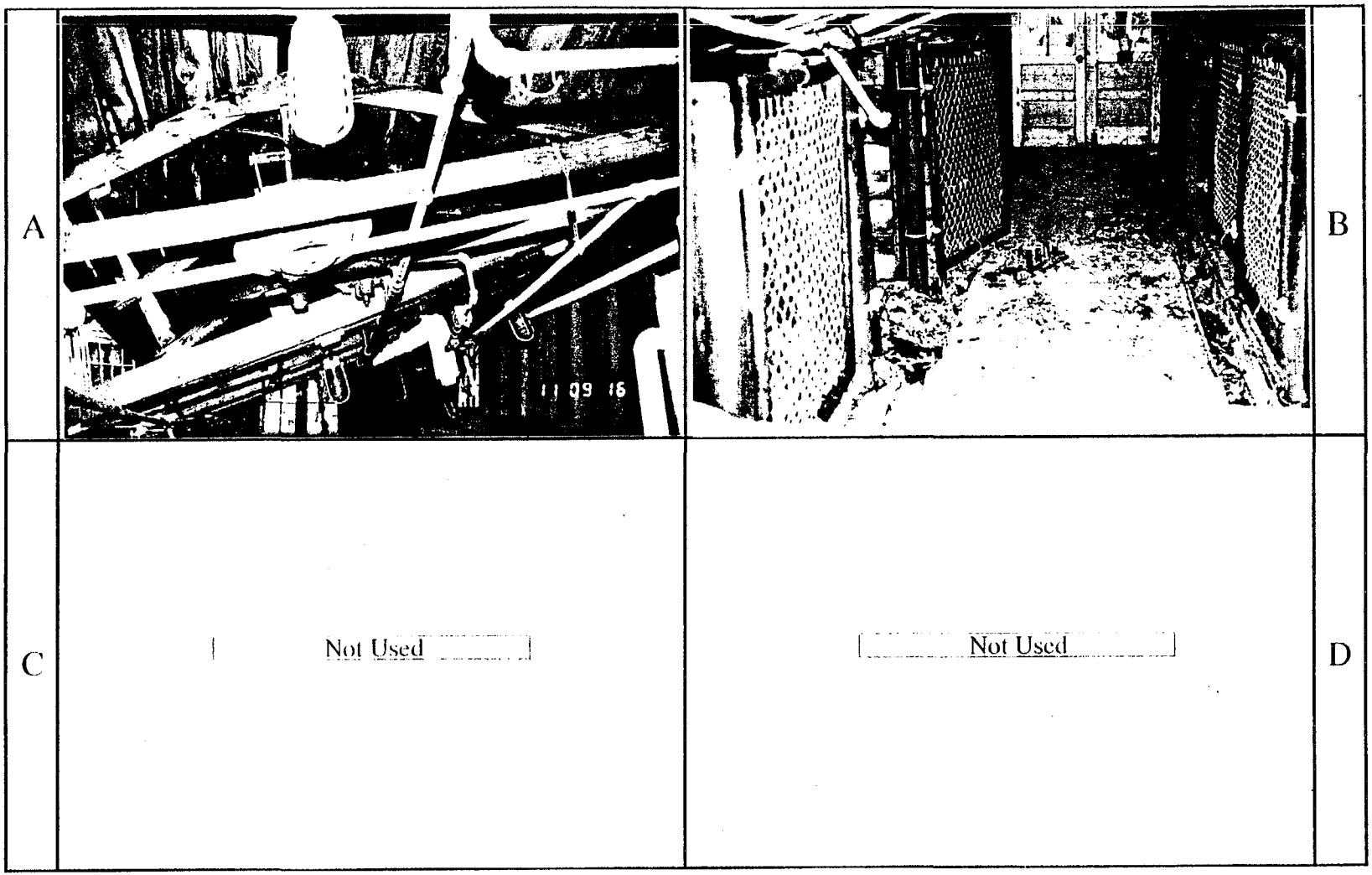
Several incandescent light fixtures and heaters were observed on the ceiling. The building also contains a hot water heater, a heat exchanger, tables, and an electrical fuse box on the north wall.



A	Walls 1, 2, 3
C	Walls 5, 6, 7, 8

Walls 4, 5	B
Walls 7, 8, 1	D

FIGURE 5 Photographs of Building E3162 Interior — Walls



A	Ceiling
C	Not Used

Floor	B
Not Used	D

FIGURE 6 Photographs of Building E3162 Interior — Ceiling and Floor

4.8 Rooms 1 through 6

4.8.1 Walls

The exterior walls are constructed of 2-in. by 4-in. wooden framing covered by asphalt sheeting. The interior walls are 2-in.-thick wooden planks approximately 4 ft high. The east and west interior walls of each room measure 5 ft 6 in. wide, while the north wall measures 3 ft 6 in. wide. The south wall of each room consists of a chain-link gate that measures 3 ft 6 in. wide.

4.8.2 Finish Materials

None.

4.8.3 Piping

Pipes covered with suspected asbestos-containing insulation extend along the walls and through the middle of the building.

4.8.4 Equipment

Electrical conduit and lights are associated with rooms 1 through 6.

4.8.5 Doors and Windows

There are chain-link gates for each animal holding room. Two windows are associated with rooms 1 through 6.

4.8.6 Ceiling and Floor

The floor is concrete. The ceiling is exposed, unpainted wood.

4.9 Room 7

4.9.1 Walls

The exterior walls are constructed of 2-in. by 4-in. wooden framing covered by asphalt sheeting. The interior walls are 2-in.-thick wood. The east wall and west wall each measure 16 ft wide, while the north wall and south wall each measure 32 ft wide.

4.9.2 Finish Materials

Walls in the room are unpainted.

4.9.3 Piping

Piping covered by suspected asbestos-containing insulation is attached to or associated with the walls in room 7.

4.9.4 Equipment

There are several incandescent light fixtures on the ceiling. The room also contains a hot water heater, two space heaters, a heat exchanger, and an electrical fuse box on the north wall.

4.9.5 Doors and Windows

A double exterior door on the west wall measures 5 ft wide and 7 ft high. There is one window on the east wall that measures 3 ft 6 in. wide by 3 ft 4 in. high.

4.9.6 Ceiling and Floor

The floor is concrete. The ceiling is exposed, unpainted wood.

4.10 Rooms 8 through 13

4.10.1 Walls

The exterior walls are constructed of 2-in. by 4-in. wooden framing covered by asphalt sheeting. The interior walls are 2-in.-thick wood approximately 4 ft high. The east and west interior walls of each room measure 5 ft 6 in. wide, while the south wall measures 3 ft 6 in. wide. The north wall of each room consists of a metal chain-link gate that measures 3 ft 6 in. wide.

4.10.2 Finish Materials

The walls in the room are unpainted.

4.10.3 Piping

Pipes covered by suspected asbestos-containing insulation extend along the walls and through the middle of the building.

4.10.4 Equipment

Electrical conduit and lights are associated with rooms 8 through 13.

4.10.5 Doors and Windows

There are chain link gates for each animal holding room. Two windows are associated with these rooms.

4.10.6 Ceiling and Floor

The floor is concrete. The ceiling is exposed, unpainted wood.

5 Geophysical Investigation

The area immediately surrounding Building E3162 was examined during December 1994 using several nonintrusive geophysical survey methods, including total field magnetics, electrical conductivity, time-domain electrical induction (EMF), and GPR techniques. The geophysical investigation report is provided in Appendix A.

Magnetic and time-domain EMF data provided the best overall indicators of potential subsurface features at Building E3162. Conductivity data were dominated by a northwest/southeast-trending anomaly, approximately 40 ft in width, that bisected the geophysical survey area. Subtle anomalies in the conductivity data were fairly consistent with magnetic and EMF data sets. Strong GPR reflections were generally absent in profiles conducted at Building E3162. While GPR data were probably the least useful geophysical data collected at the site, subtle GPR reflections were useful in locating the potential sites of buried objects.

6 Air Quality Monitoring

ANL staff collected air quality samples upwind, downwind, and inside of Building E3162 during November 1994. Analytical results from these air samples showed no distinguishable difference in hydrocarbon and chlorinated solvent levels between the two background samples and the sample taken inside Building E3162. These results indicate that Building E3162 is not a source of volatile organic compound contamination. The air monitoring report is provided in Appendix B.

7 Underground Storage Tanks

No information on underground storage tanks associated with Building E3162 is available.

8 Conclusions

Based on the information collected and reviewed by ANL for Building E3162, it is the authors' judgment that no significant air contamination is associated with this building. The building did not house agents or animals involved in agent testing. Because no work with toxic or explosive materials was conducted within the building, no significant contamination is evident. Potential contaminants consist of wash-down detergent and merthiolate. Suspected asbestos-containing materials observed on piping and on the hot water tank inside the building (EAI Corporation 1989) should be evaluated and properly disposed of. Results of the geophysical surveys indicate some anomalies in the vicinity of Building E3162 that warrant further investigation and evaluation.

9 References

EAI Corporation, 1989, *Historical Records Search and Site Survey of the Edgewood Area Building — Final Report*, prepared for U.S. Army Chemical Research, Development, and Engineering Center, Aberdeen Proving Ground, Maryland, under contract no. DAAIS-87-D0021.

Nemeth, G., 1989, *RCRA Facility Assessment Report, Edgewood Area, Aberdeen Proving Ground, Maryland*, unnumbered report prepared for Aberdeen Proving Ground, Maryland.

Appendix A:

Interim Progress Report — Environmental Geophysics: Building E3162 Decommissioning, Aberdeen Proving Ground

Interim Progress Report — Environmental Geophysics: Building E3162 Decommissioning, Aberdeen Proving Ground

by

C.R. Daudt, L.D. McGinnis, M.D. Thompson, C.A. Padar,
S.F. Miller, M.A. Glennon, and M.A. Benson

Center for Environmental Restoration Systems
Energy Systems Division
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439

February 1995

Sponsored by

United States Department of Defense, United States Army,
Aberdeen Proving Ground, Maryland

Preface

This report is one of a series on environmental geophysical studies around perimeters of buildings in the Edgewood Area of Aberdeen Proving Ground. The series was initiated in 1991 at Building E5032, where techniques were evaluated and a design for the surveys was established. Studies continued in 1992 and 1993, when surveys of Buildings E5190, E5282, E5375, E5440, E5476, E5481, E5485, E5487, E5489, E5974, E5978, and the Building E103 Dump were completed. In 1994, geophysical surveys were completed around Buildings E1489, E2370, E3162, E3163, E3180, E3236, E3613, E3640, E6891, and E7995, and Building E5032 was resurveyed; newer, continuously recording equipment was used in all 1994 surveys. Deeper insight into the magnetic, electrical, and radar imagery characteristics of the Canal Creek and Kings Creek Areas has been gained from the completion of each geophysical survey. Subsequent improvements in survey design and data acquisition, processing, and interpretation have been realized at more recent sites, including Building E3162.

Contents

Table

Figures

Interim Progress Report — Environmental Geophysics: Building E3162 Decommissioning, Aberdeen Proving Ground

by

C.R. Daudt, L.D. McGinnis, M.D. Thompson, C.A. Padar,
S.F. Miller, M.A. Glennon, and M.A. Benson

Abstract

The immediate vicinity of Building E3162, a potentially contaminated site in the Edgewood Area of Aberdeen Proving Ground, was examined by using several noninvasive geophysical methods, including total-field magnetic, electrical conductivity, time-domain electrical induction (EMF), and ground-penetrating-radar techniques. The most pronounced anomalous feature observed was a northwest-southeast trend approximately bisecting the geophysical survey area in all of the potential-field data sets. Magnetic data also suggest an anomalous feature at the northeast corner of Building E3162. Several other point anomalies and anomaly trends were observed in two or more data sets. Point anomalies coincident with a surface depression were observed in the south-central portion of the site. Anomalous trends in the data were observed at the place where a PVC pipe protrudes from the ground surface near the former site of Building E3164. Point anomalies were also observed without any visible surface expression at locations in the southeastern and eastern edges of the survey area. The EMF data were useful for indicating near-surface metallic debris at the northern edge. Magnetic and EMF techniques provided the best overall indicators of buried metallic objects.

1 Introduction

Aberdeen Proving Ground (APG), in the state of Maryland, is managing a comprehensive installation restoration program involving more than 360 solid-waste-managing units contained within 13 study areas. The Edgewood Area of Aberdeen Proving Ground appears on the National Priority List under the Comprehensive Environmental Response, Compensation, and Liability Act. Therefore, APG has entered into an interagency agreement with the U.S. Environmental Protection Agency to address the listed areas.

The Kings Creek portion of the Edgewood Area (Figure 1) requires a Source Definition Study because the potential exists for release of volatile organic compounds into the aquifer system. A report prepared by the EAI Corporation included a list of 29 potentially contaminated

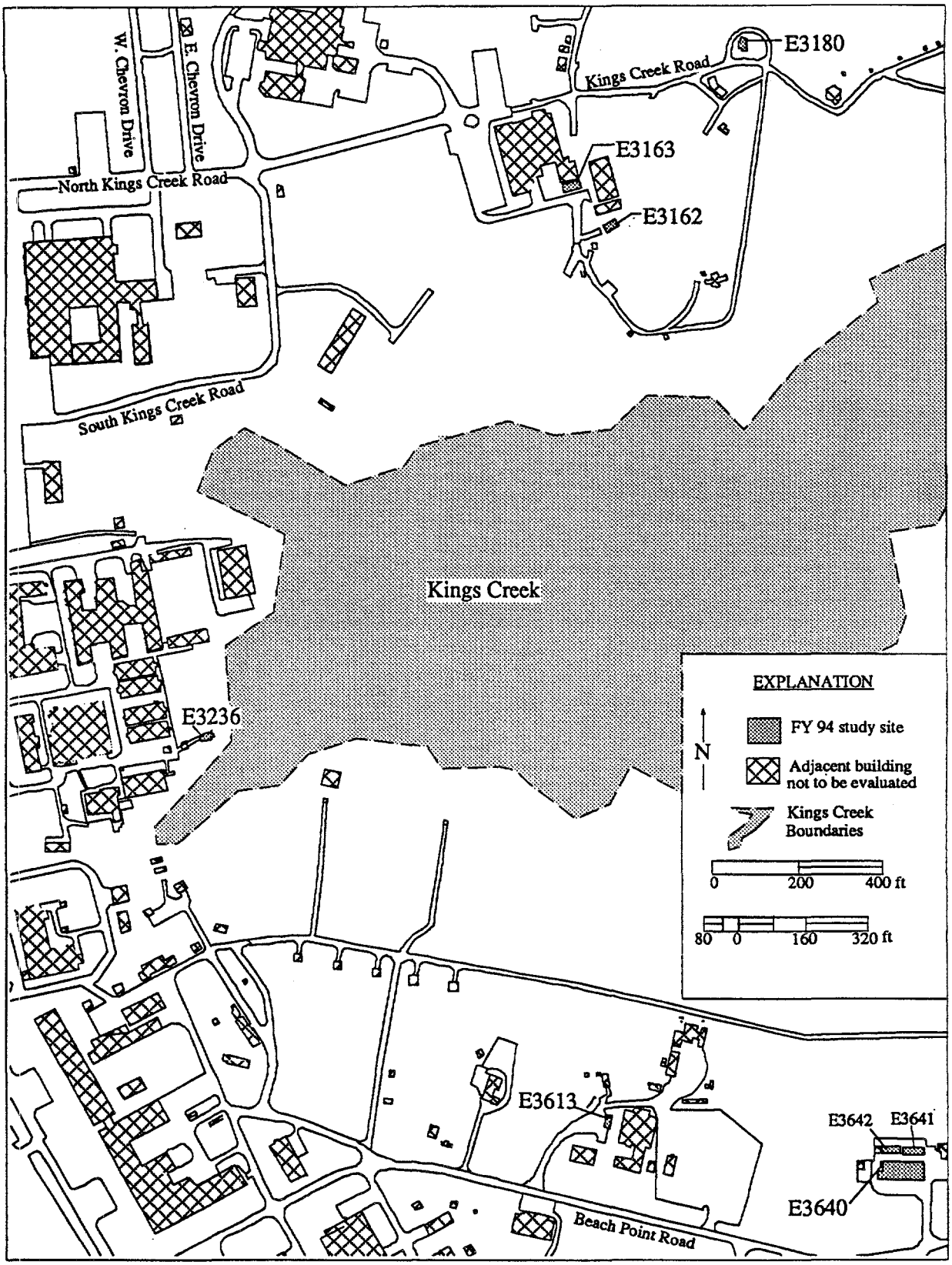


FIGURE 1 General Site Map of the Kings Creek Area, Aberdeen Proving Ground, Md

buildings in the Edgewood Area (1989). The buildings have been abandoned and operations have ceased, but processing equipment, incinerators, sumps, drains, ventilation systems, and underground storage tanks remain. These appurtenances may contain liquid, solid, or vapor contaminants of unknown nature. Sixteen of the buildings contain known contaminants, nine buildings contain unknown contaminants, and four of the buildings are potentially clean. The EAI report recommended that a sampling and monitoring program be established to verify contamination levels in and around each building. Most of the effort thus far has been in the western Canal Creek Area.

Six of the potentially contaminated buildings, including Building E3162, are in the drainage basin of Kings Creek. Aberdeen Proving Ground is proceeding with a program to decommission the buildings, which will eliminate the actual or potential release of contaminants into the environment. Argonne National Laboratory (ANL) has been assigned the task of developing a plan and scope of work for the proposed decommissioning. Argonne has determined that the first step in this decommissioning process, where it is technically feasible, should be a noninvasive geophysical survey around building exteriors.

1.1 History of Building E3162

According to a report prepared by the EAI Corporation on construction records of buildings at APG, Building E3162 was constructed in 1952 and used as temporary housing for animals involved in nonagent-burns (wound-ballistics) testing (1989). The building was part of a cluster of structures informally referred to as the "old Bio Physics Lab." In 1983, activity at the building ceased, and the building has remained unoccupied to the present day.

Building E3162 was constructed with wooden walls on a concrete foundation that measures 16 ft × 32 ft. The EAI report indicates the presence of a 6-in. storm drain and states that no toxic sumps or drainage systems were used at this site (1989). On the basis of the activities that occurred at Building E3162 and the construction materials used, suspected sources of contamination are limited to asbestos and Merthiolate.

An additional structure, Building E3164, was located immediately adjacent to and southwest of Building E3162 (see Figure 2). This building was demolished at some time after the 1991 site reconnaissance. The RCRA Facility Assessment indicated that Building E3164 was also used as temporary housing for animals (Nemeth 1989). Examination of photographs taken of the site suggests that the building was a screened structure with a concrete floor.

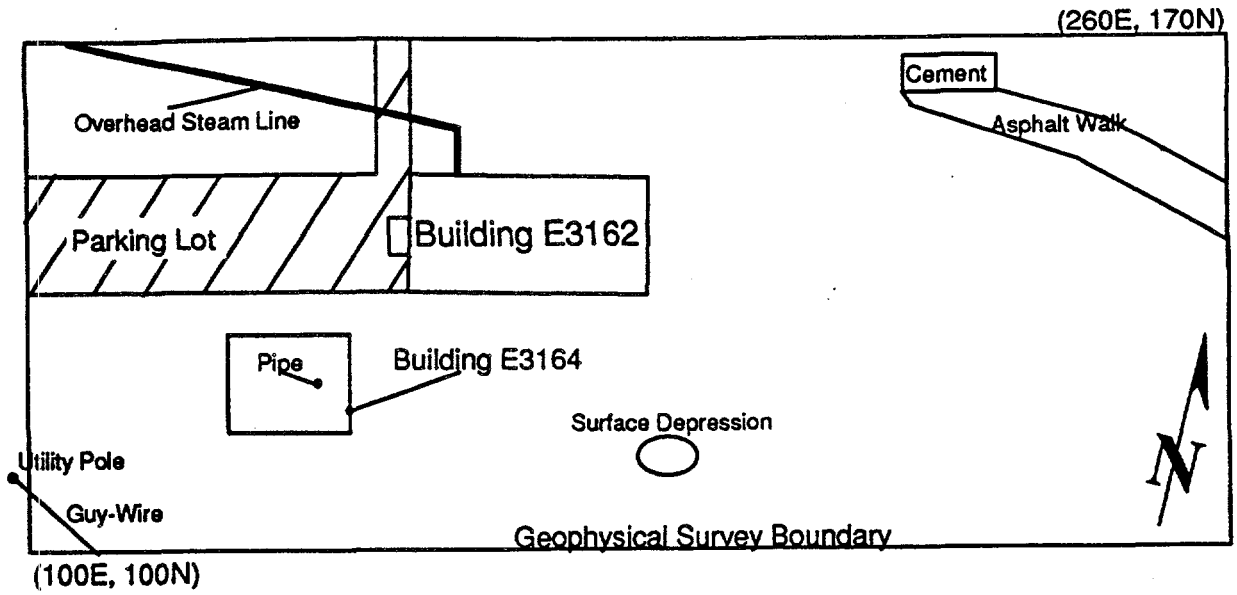


FIGURE 2 Detailed Location Map of Building E3162

1.2 Site Reconnaissance

A geophysics program was initiated, in conjunction with decommissioning Building E3162, that was based upon similar programs conducted by ANL personnel at APG since 1991 (McGinnis and Miller 1991; L.D. McGinnis et al. 1992a,b, 1994; M.G. McGinnis et al. 1992a,b; Miller et al. 1992a,b; Thompson et al. 1992a,b, 1994, 1995; Benson et al. 1995). The initial evaluation was enhanced by a November 1991 site visit and by inspection of aerial photos available to Argonne personnel. The building is located on level terrain adjacent to a forested area that borders the western margin of Kings Creek. The site is accessible from all sides and is covered with grass on the north, east, and south areas around the building.

In addition to surface conditions at the site, subsurface characteristics were considered in planning the geophysics survey. Surficial sediments consist of estuarine sands, silts, and clays that are nonmagnetic and have electrical properties that vary both horizontally and vertically due to natural conditions or excavation and building effects. Such multiple sources as iron-rich magnetized objects, nonmagnetic objects, and subsurface channels containing contaminants may be present in the subsurface.

1.3 Geology and Physiographic Setting

The Kings Creek Area is contained in topographically low and flat terrain of the Coastal Plain physiographic province, where alluvial and estuarine sands, silts, and clays underlay the region. A thin veneer of sediments of the Talbot Formation of Pleistocene age overlies unconsolidated sediments of the Potomac Group of Cretaceous age (Oliveros and Gernhardt 1989).

Lithologies at the site were determined from the four wells (sites #8, #104, #117, and #136) located in the vicinity of Building E3162. Of these, only well #8 had lithologic samples for the upper 40 ft of sediment. This relatively shallow depth range is critical to the geophysical interpretation because the penetration of the geophysical techniques used at Building E3162 does not generally exceed 40 ft. Borehole #8 was drilled approximately 750 ft west of Building E3162. The descriptive log for borehole #8, given in Table 1, was part of a hydrogeologic study of the Canal Creek Area performed by the U.S. Geological Survey (Oliveros and Gernhardt 1989).

Facies represented include a 3-ft layer of silty soil, followed by a clay zone with thin silt and sand lenses. A thick layer of sand starts at 54 ft in depth. The upper 30 ft of the sedimentary section consists primarily of clay units. Inspection of the ground surface around Building E3162 indicates that some excavation and backfilling must have occurred during construction; thus, the upper 5 ft of material is most likely construction fill.

1.4 Surveys

Geophysical data were acquired during two days of field operations during late June and early July 1994. On-site personal computers, interactive software, and field equipment designed specifically for APG building studies were used to expedite data acquisition and processing. After an initial scan with a magnetic gradiometer, surveys were conducted to measure total-field magnetics, electrical conductivity, induced electromagnetic field (EMF), and ground-penetrating-radar (GPR) profiles.

1.5 Survey Grid and Locations of Observations

Prior to geophysical data acquisition, the limits of a rectangular survey area surrounding the building were established by marking with wooden stakes. The dimensions of the rectangular area were 160 ft × 70 ft, with the long side of the survey area (x-direction) parallel to the long side of the building (Figure 2).

Throughout this report, grid coordinates of specific locations shown in Figure 2 and later figures are specified as (x,y), where x and y refer to approximately easterly and northerly directions, respectively. Relative coordinate values are in feet. Grid coordinate values of (100, 100) were assigned to the southwest corner of the survey area, and coordinates of (260, 170) were assigned to the northeast corner. The geophysical profiles that are presented in this report were traversed in both x and y directions, generally with a profile spacing of 5 ft.

TABLE 1 Lithologic Log of Well at Site No. 8

Description[a]	Depth (ft)	Thickness (ft)
Silty soil	3.0	3.0
Clay, red, yellow and gray mottled, plastic, dense	19.0	16.0
Clay, red, plastic, dense; with irregular white, silty zones	40.1	21.1
Clay, gray, friable, micaceous; mixed with red clay as above	42.7	2.6
Clay, red, plastic, dense; with irregular, white silty zones and an olive green, mineralized front at the contacts	48.4	5.7
Sand, silty, light gray, poorly sorted, micaceous	52.5	4.1
Clay, red, plastic, dense; with irregular white zones and green mineralization as above	54.0	1.5
Sand, gray, well-sorted (fU-mL); with alternating lenses of dark gray, plastic clay	64.0	10.0
Sand, gray to tan, well-sorted (mU)	66.7	2.7
Sand, silty, gray, lignitic	67.1	0.4
Sand, gray, well-sorted (mL)	69.0	1.9
Sand, silty, wet, brown; with red-black concretions	71.4	2.4
Sand, clayey, white, (fU); with yellow and lavender laminae	72.0	0.6
Sand, silty, multicolored, micaceous	74.7	2.7
Sand, brown, clean, well-sorted (mU); with multicolored laminae and gravel (1-4 in.)	89.0	14.3
No sample	168.4	79.4
Sand, gray (mL) clean	168.7	0.3
Clay, gray and tan mottled, plastic, dense, micaceous	170.8	2.0
No sample	188.1	17.4
Clay, sandy, dark gray, lignitic	190.1	2.0
No sample	199.1	9.0
Clay, gray, micaceous, lignitic; with some floating gravel up to 0.5 in.	199.8	0.7

[a] Codes enclosed in brackets at selected horizons refer to color designations as specified in the *Munsell Soil Color Charts* (1975).

Source: Oliveros and Gernhardt (1989).

2 Instrumentation

2.1 Magnetic Gradiometer and Cable Locator

The Schonstedt MAC-51B magnetic gradiometer and cable locator is a dual-mode instrument designed for detecting shallow buried iron and steel objects and tracing underground cables and pipes. The system consists of a transmitter and a dual-function receiver designed to detect anomalous magnetic gradients. The MAC-51B is an audio device used only for rapid detection of magnetic materials for further analysis with complementary instrumentation.

Maps or models are not constructed from observations made with this instrument because it is not a calibrated system and it does not have digital data recording. Anomalies are identified by changes in sound amplitude and frequency and are marked on the ground surface prior to the initiation of other surveys. If anomalies detected with the MAC-51B cannot be verified with the magnetometer (see Section 2.2), the anomaly is assumed to be insignificant.

Application of the MAC-51B in its receiver mode is the first geophysical operation following establishment of survey limits. A qualitative description of the site with 100 percent ground coverage is achieved by using the gradiometer, whereas the results obtained with the other techniques, although more quantitative, are spatially limited to single-point survey-grid observations or to continuous readings along spaced profiles.

2.2 Total-Field Magnetics Meter G-822L

Magnetometer surveys were conducted to identify such ferromagnetic objects as tanks, drums, drain pipes, water lines, and small ferrous objects. An EG&G Geometrics G-822L cesium-vapor magnetometer was used to measure the total magnetic field around Building E3162. The G-822L was operated in a continuously recording mode and acquired magnetic measurements at intervals of approximately 0.3 ft.

Because of the dipolar field, a magnetic anomaly due to a source having a simple physical shape exhibits a characteristic signature consisting of a positive magnetic peak and at least one negative magnetic trough. If a symmetrically-shaped body of iron-rich waste is buried in the northern hemisphere and becomes magnetized in the Earth's field, a large positive anomaly with a weak negative offset to the north will occur. The horizontal distance between the paired peak and trough is proportional to the depth of burial, the size, and the shape of the source, whereas, the amplitude of the anomaly is inversely proportional to the depth of burial. Metallic debris at or just below the ground surface produces strong, closely spaced, magnetic peaks and troughs, separated by high-gradient areas.

When using the G-822L magnetometer, the sign of magnetic anomalies must be viewed with extreme caution, because in a region of high gradients, the magnetometer becomes untuned and provides zero readings. Contouring software for the G-822L has been designed to bridge the zero gap with mean values taken from the last readable data along the profile. Thus, because of the bipolarity of magnetic anomalies and the variability of gradients, it is possible for an isolated anomaly or a lineament to change from a positive to a negative feature along the trend. For the

purpose of our study, the polarity of the anomaly is unimportant. The absolute strength of the magnetic anomaly and whether the anomaly appears as a "point" source or a linear feature are more important to the geophysical interpretation.

2.3 Conductivity Meter EM-31

Mean conductivities were obtained with the Geonics EM-31, an electromagnetic (EM) induction instrument that measures terrain conductivity to depths of approximately 20 ft. The induction coil of the EM-31 transmits an EM field into the ground, and a receiver measures the secondary magnetic field caused by the low-intensity eddy currents induced in the subsurface. The secondary magnetic currents are almost linearly proportional to the electrical conductivity of the surrounding sediment.

Data were collected at 0.5-s intervals with the EM-31 and were stored on the OMNI 720 data logger, which can log quad-phase electrical conductivity data and in-phase inductive data for metals simultaneously, as well as store survey geometry. Data for this survey were recorded in quad-phase only. Internal software permits downloading directly into an on-site computer. Conductivity contouring is incorporated into the field acquisition procedure, so that daily map outputs can be available for observation and interpretation. EM methods have been used extensively in the Edgewood Area at Beach Point, J-Field, and various buildings surveyed by ANL staff.

2.4 Time-Domain Millivolt Meter EM-61

Field data were obtained in millivolts with a Geonics EM-61, a portable, time-domain, electrical induction instrument that transmits an electrical pulse into the ground and measures secondary EMFs caused by metallic objects beneath the instrument. As a consequence of its coil arrangement, the EM-61 is relatively insensitive to surface interference but more sensitive to deeply buried metallic targets. Data are recorded on three channels, including the response from an upper coil, a lower coil, and a coil difference.

The lower coil, because of its spatial positioning, responds to signal from all depths within the instrument range. According to the manufacturer's claims, the lower coil can detect an anomaly of 2 mV caused by a 55-gal metal drum buried at a depth of about 9 ft. Inspection of the data sets acquired at Building E3162 and at other APG sites surveyed by ANL personnel indicate that the measurements obtained from the lower coil are sufficient to identify buried metallic sources within the gridded area.

Data were collected at a rate of three readings per second and were stored on the OMNI 720 data logger. Internal software permits downloading directly into an on-site computer. Contouring of data in millivolts is incorporated into the field acquisition procedure, so that daily map outputs can be available for observation and interpretation.

2.5 Ground-Penetrating-Radar System

Ground-penetrating-radar surveying and data processing were accomplished using a Geophysical Survey Systems, Inc., SIR-3 radar system and Radan III software (Galinovsky and Levin 1990). A 300-MHz monostatic-transceiver-antenna system was tethered to the SIR-3 with a 100-ft cable. Data were recorded on a digital audio tape to permit playback. The SIR-3 control unit/graphic recorder was located in the transport vehicle. A computer was located in a field office, so that the radar operator could download, check data quality, and do preliminary processing after a day's run.

Wave-velocity characteristics of near-surface materials were derived from known positions of buried objects. Internal calibration was run at least twice each day to ensure that the graphic record of the range setting was consistent. Studies conducted during the 1991, 1992, and 1993 field seasons indicate GPR travel times of 7-9 ns/ft for near-surface sediment (Geophysical Survey Systems, Inc. 1987). However, conditions vary with the heterogeneity of the subsurface.

Ground-penetrating radar is the best method available to determine depth and geometry of objects buried near the surface. The weakness of the method is its limited depth of exploration, caused by wave-propagating constraints imposed by the electrical properties of soils. The recorded range of GPR data at Building E3162 was 70 ns, which corresponds to an approximate depth range of 0-10 ft below the ground surface. The actual sensitivity of the GPR recording system is probably less than half of the 0-10 ft depth range. Depths are calculated from known travel times through earth materials found at APG.

3 Geophysical Measurements and Surveys

Color contour maps of the total magnetic field, terrain conductivity, and time-domain EMF data presented in this report were constructed using software developed at ANL (Thompson, 1994). The data set comprises 10,630 magnetic measurements, 2,165 conductivity measurements, and 3,280 EMF measurements. Profile plots of selected GPR transects are also presented and represent a data set comprising 4,290 linear feet of profiling.

On each color contour plot, the following coloring convention is maintained: Building E3162 is depicted as a solid, white polygon; cement structures or pads as solid gray rectangles; an overhead steam line as a gray polygon, and a driveway/parking area as a diagonally striped feature. Where possible, a descriptive name was also overlain onto the color diagram.

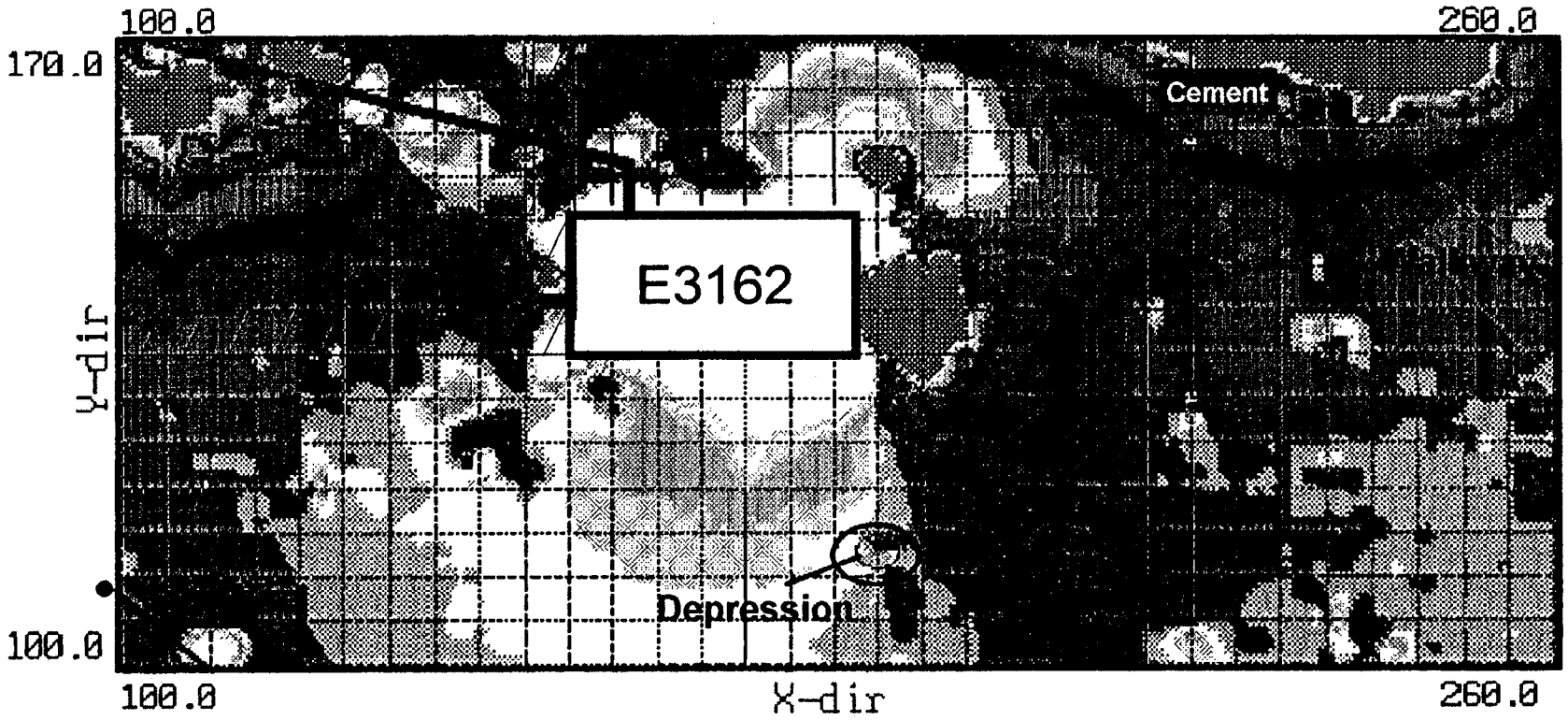
Gridding of data was accomplished with a minimum curvature technique using one of two computer programs: MINC, produced by the U.S. Geological Survey (Cordell et al. 1992); and SURFER, produced by Golden Software, Inc. (1991). Documentation supplied with the MINC program suggests that grid intervals from one-half to one-fifth the profile spacing should yield adequate gridding results for data acquired along profiles. A grid interval of 1.0 ft, representing a grid interval of one-fifth the profile spacing (5 ft), was used for each set of grid data.

3.1 Total-Field Magnetics

A color map of total-field magnetic data is shown in Figure 3. Dashed lines in both x and y directions show the traverses along which magnetic data were collected.

The central part of the figure is dominated by magnetic anomalies associated with Building E3162. A circular magnetic high in the southwest corner of the survey area is probably caused by a metallic anchor stake for the utility pole's support wire. Magnetic anomalies between the northwest corner of the building and the northwest corner of the survey area are caused by metal poles supporting the overhead steam line.

The 10-ft wide magnetic low located immediately east of the building may be caused in part by a pair of rain gutters on the east-facing wall of the structure. However, another magnetic low anomaly is centered at grid coordinates (208, 110), and the two low anomalies are connected by a northwest-southeast magnetic trend. A buried metallic linear feature (e.g., a metal pipe) is a possible cause for the trend, which runs from the east side of Building E3162 in a southeast direction and continues south of the geophysical survey area. A high/low magnetic anomaly pair is located at the northeast corner of Building E3162, centered at grid coordinates (185, 157). The anomaly might be a continuation of the linear trend described above, or it might be caused by another, unrelated, buried metal-bearing object.



Building E3162: Magnetics (nT)

Color Scale

51250 nT 56000 nT

FIGURE 3 Total Magnetic Field Anomaly Map

The northeastern edge of the survey area contains a broad magnetic low that is immediately adjacent to a 12 ft × 4 ft concrete pad and north of an asphalt walkway. The anomaly is probably caused by interference from Building E3165, which is located immediately to the north.

Scattered isolated magnetic anomalies are observed to the southwest and to the southeast of Building E3162. The anomalies to the southwest, in the vicinity of a vertical PVC pipe, approximately outline the relic foundation for Building E3164, which was torn down after the 1991 site reconnaissance. The anomalies southeast of Building E3162 do not have associated surface features and are interpreted to represent buried metallic debris.

A relatively small magnetic anomaly is associated with a subtle surface depression located at grid coordinates (185, 113). There is also a strong, positive EMF counterpart to this anomaly, suggesting the presence of a buried metallic object. The anomaly appears to have a south-southeast trend.

3.2 Terrain Conductivity Measurements

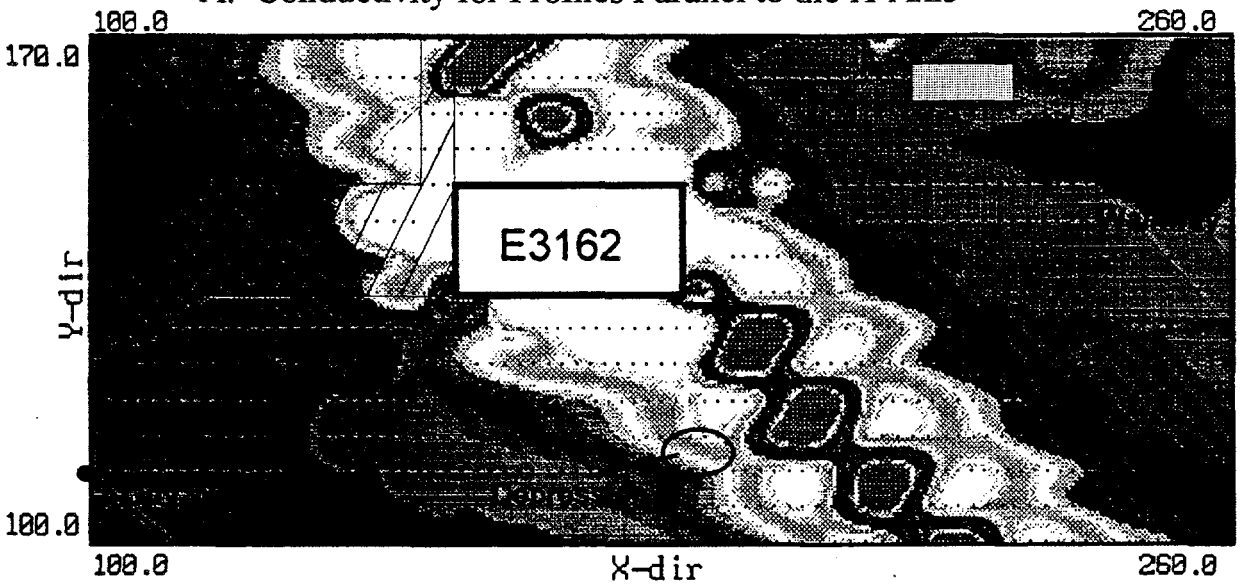
Figure 4 shows the mean electrical conductivity for the upper 20 ft of sediment around Building E3162. Figure 4A shows a color map derived from profiles parallel to the x-axis, while Figure 4B shows a color map derived from profiles parallel to the y-axis. A northwest- to southeast-trending conductivity anomaly, approximately 40 ft wide, bisects the survey area and dominates both maps in the figure. The linear center of the conductivity anomaly is nearly collinear with the magnetic anomaly that extends southeast from Building E3162 (described in Section 3.2), also suggesting the presence of a buried, highly conductive object. To the northwest, the linear anomaly continues north of Building E3162 to the north edge of the survey area. The conductivity anomalies in the northeastern corner of the survey area, east of x = 230 ft and north of y = 160 ft, in both Figures 4A and 4B are probably caused by metallic materials on Building E3165 (located immediately to the north).

3.3 Induced-EMF Measurements

A map constructed from EMF data measured with the lower coil of the Geonics EM-61 meter is shown in Figure 5. Strong positive EMF anomalies associated with the overhead steam line and with Building E3162 dominate the central part of the figure.

Two broad positive EMF anomalies are located at the northeast and northwest corners of the survey area. The anomaly in the northwest corner is probably caused by the overhead steam line. The anomaly in the northeast corner is probably caused by Building E3165, which is located immediately north of the survey area.

A: Conductivity for Profiles Parallel to the X-Axis



B: Conductivity for Profiles Parallel to the Y-Axis

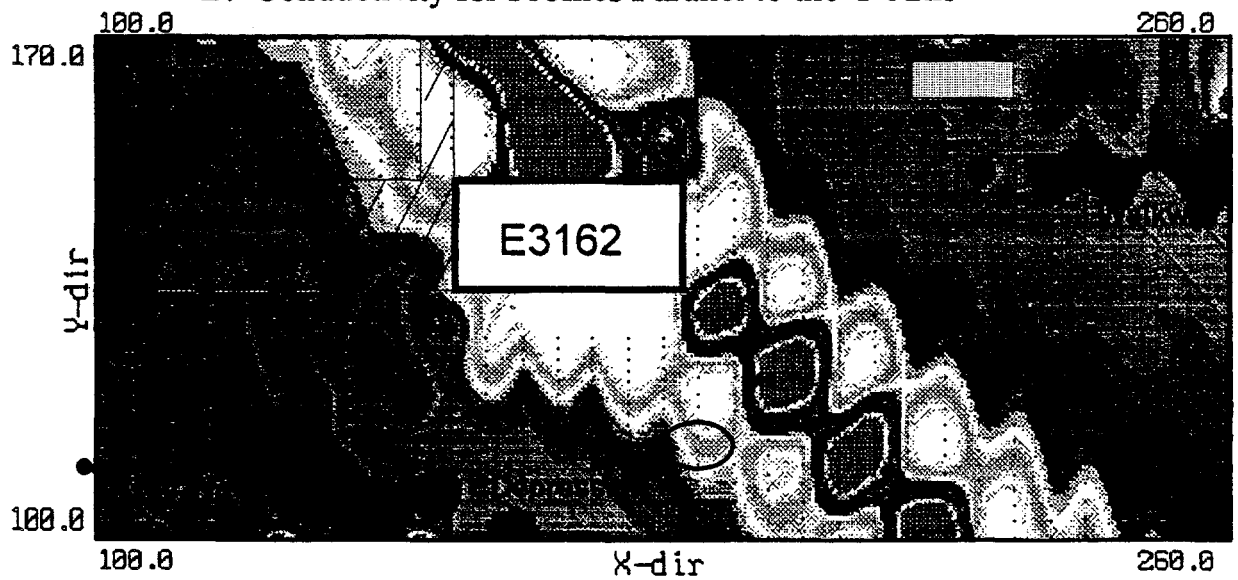


FIGURE 4 Terrain Conductivity Anomaly Map

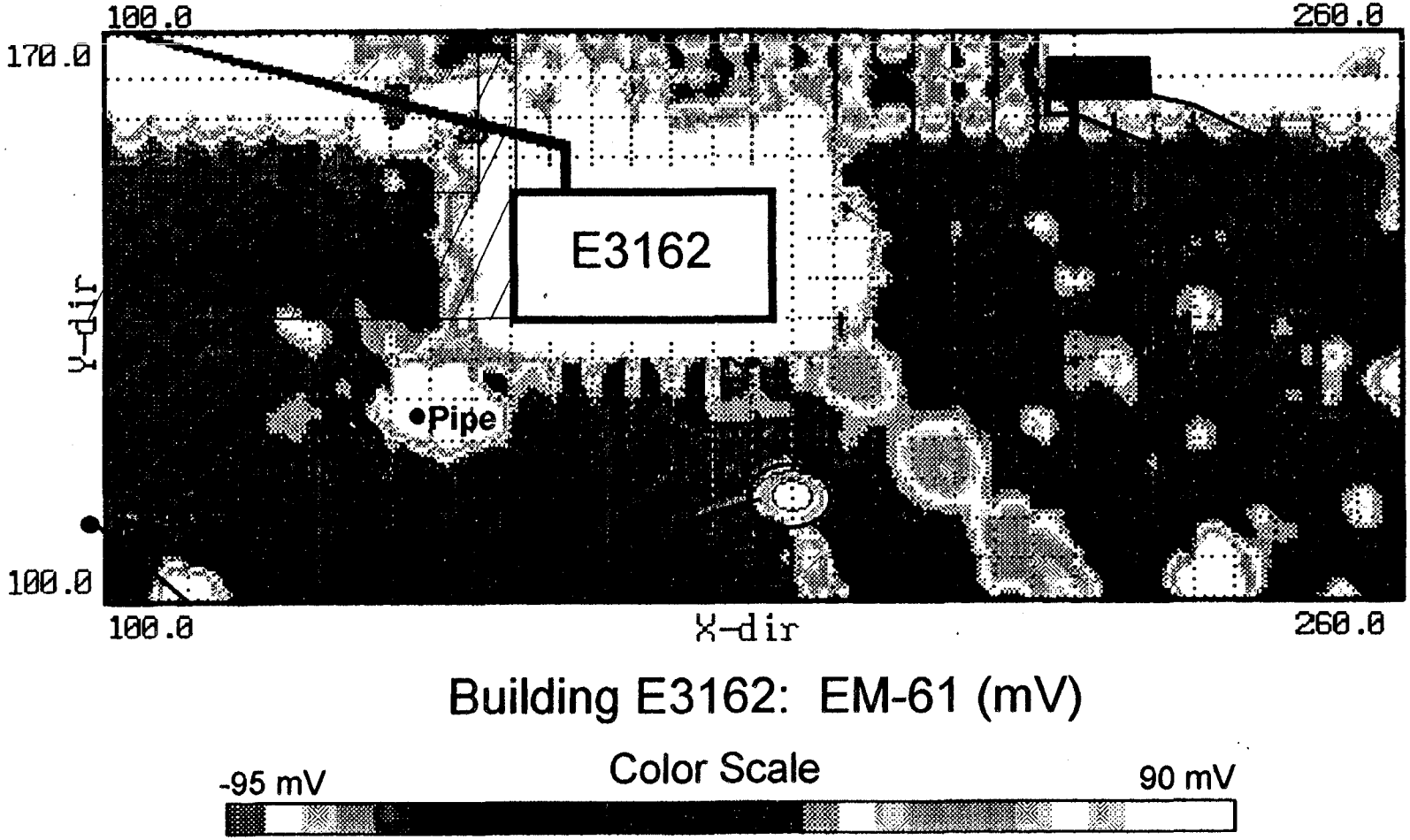


FIGURE 5 EMF Anomaly Map

A northwest-southwest trend is indicated southwest of Building E3162 by EMF anomalies located at (220, 100); (215, 105); (204, 116); and (193, 127). The linear trend may also continue north of the building. The anomaly, which has no surface expression, coincides with magnetic and conductivity anomalies at the same locations.

A 10-ft wide east-west-trending zone of scattered EMF positive anomalies is located along the northern edge of the survey area. The source of the anomalies is apparently buried, since no surface features or structures are present in the area. However, the anomalies appear to be a collinear extension of the anomalies caused by a series of vertical steel poles that support the steam pipe in the northwest portion of the survey area. While the suspended steam pipe angles into the building from the northwest corner of the survey area, the vertical steel support poles are parallel to the east-west grid lines. The vertical poles are located on both north and south sides of the steam pipe, approximately along y = 170 ft and y = 150 ft, respectively. The anomalies west of the place where the steam pipe enters Building E3162 may be caused by buried remnants of a former continuation of the steam line. Whatever the cause of the anomaly, the source is probably relatively shallow, because neither magnetic nor conductivity data show a similar anomaly across the length of the survey area.

Three isolated EMF positive anomalies can be associated with observed features. The first anomaly, at grid coordinates (110, 100), is probably caused by a metal anchor for the guy-wire supporting the utility pole. The second anomaly, 10 ft × 15 ft wide, centered at grid coordinates (140, 125), is next to a vertical pipe constructed of PVC, and it is coincident with the former site of Building E3164.

The third EMF anomaly, with center at grid coordinates (185, 114), has an associated surface depression that is roughly the same dimensions as the anomaly. A weak magnetic anomaly is also observed at this location. A related EMF anomaly continues south beyond the boundary of the survey area. The metallic source of the anomalies is not visible at the surface. The anomalies suggest the presence of a south-southeast trending metal object below the surface.

A 5-ft diameter EMF anomaly, located at grid coordinates (237, 103), does not coincide with any observed structure or feature on the surface. This anomaly has a magnetic equivalent, and it is spatially located on the eastern flank of a 40-ft wide electrical conductivity anomaly. Another EMF anomaly of similar size and shape is located at grid coordinates (260, 127). The latter anomaly has both a small magnetic anomaly and a conductivity anomaly associated with it. The character of the anomalies at these two locations suggests the presence of buried metal objects.

3.4 Ground-Penetrating-Radar Measurements

Coordinates of GPR lines taken at Building E3162 are shown in the Attachment. The lines are numbered in sequence along with the beginning and ending positions relative to the grid. Prior to running the production lines for the survey, replicate runs were made over the same line to determine which of the three transceivers, the 80-, 300-, or 500-MHz antenna was best suited to study the terrain surrounding the site. The transceiver providing the best penetration and resolution of buried objects was the 300-MHz unit. Different range settings were also tested over the same

transect to determine the optimum resolution and depth of penetration. A range setting of 70 ns at a scan rate of 32 scans per second was used for the entire survey.

For the most part, GPR anomalies at Building E3162 were surprisingly subtle and inconclusive, considering the presence of several striking potential-field anomalies as described in the preceding sections. A few strong GPR anomalies were observed at single-point locations; for example, an anomaly was observed at grid coordinates (188, 100) in GPR profile #2 (Figure 6A), which coincides with the southeast-trending magnetic and conductivity anomalies near the surface depression and also at the south edge of the survey area. No similar anomalies were observed along the adjacent parallel GPR profiles #3 and #4 (Figures 6B and 6C, respectively), nor are they observed along perpendicular profiles (not shown). The absence of GPR anomalies for most profiles near the surface depression at grid coordinates (185, 114) suggests that the metallic object causing southeast-trending anomalies in magnetic and EMF data is too small in diameter (for example, a small diameter pipe) to cause observable GPR reflections.

Another set of strong GPR reflections was observed at grid coordinates (187, 155) along profile 13 (not shown). Other strong reflections were observed in proximity to buildings or other surface features. Most GPR reflections, however, were subtle, such as is shown in Figure 7 for profiles in close to grid coordinates (120, 120). Individually, the anomalies are not strong enough to conclude any information about the subsurface. Either the Building E3162 site lacks buried debris of substantial size that would result in GPR reflections or the soil conditions at the site are not conducive to penetrating radar signals. The anomalies described by the potential-field data discussed in previous sections may be caused by pipes and other small-diameter objects that are too narrow to produce GPR reflections.

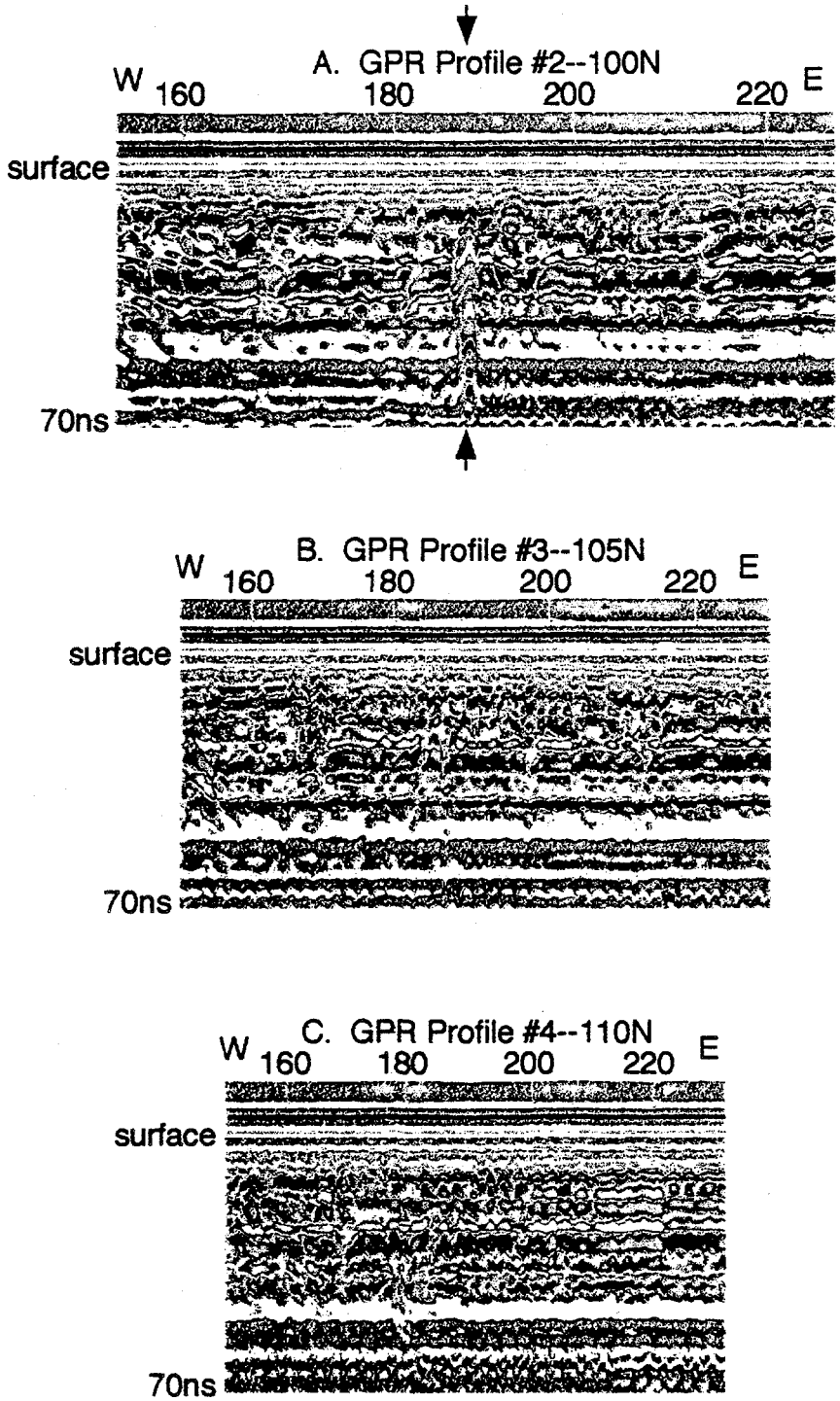


FIGURE 6 Ground-Penetrating-Radar Profiles #2-#4

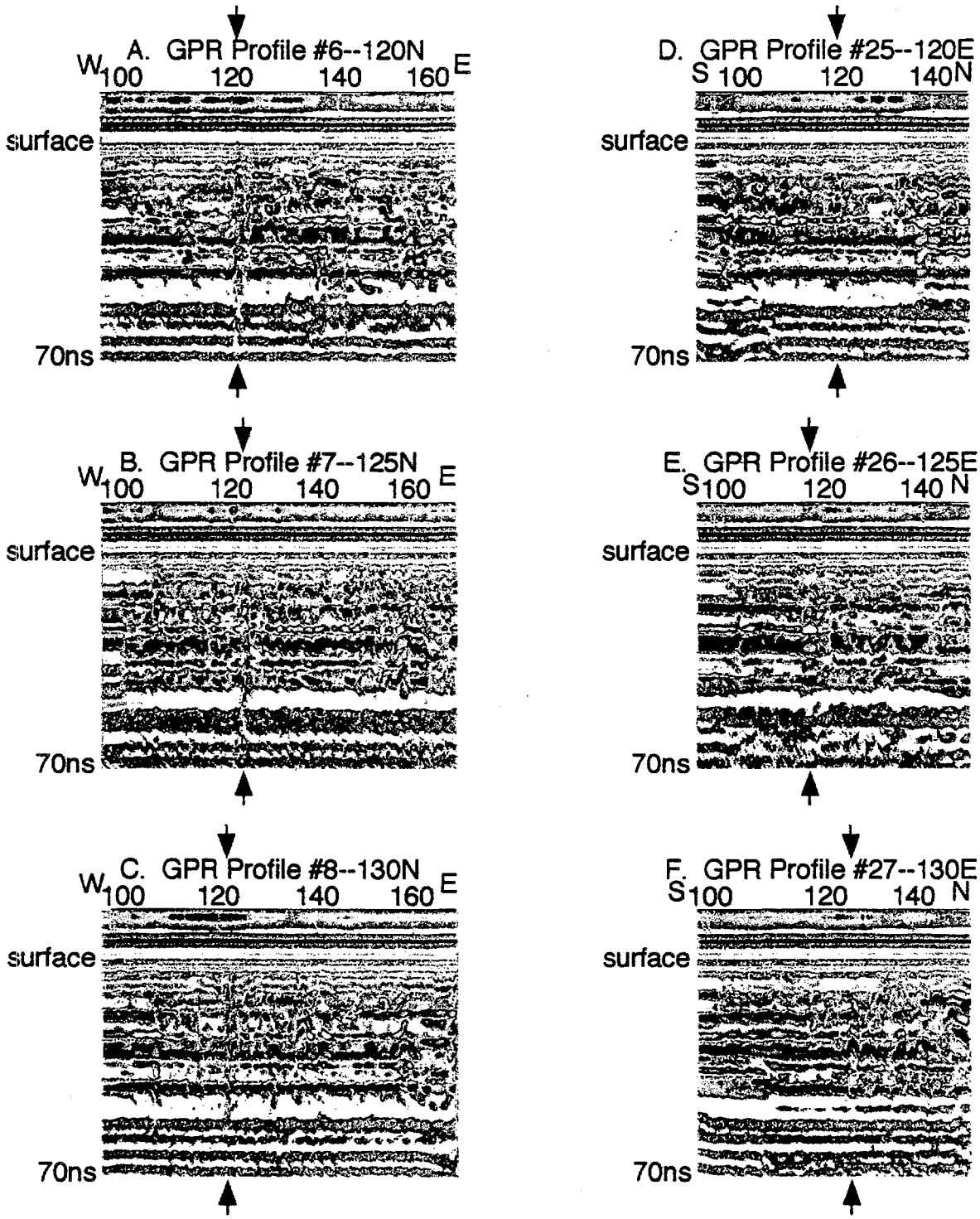


FIGURE 7 Ground-Penetrating-Radar Profiles #6-#8 and #25-#27

4 Discussion

Several anomalous trends were delineated by two or more techniques during the geophysical survey at Building E3162. Probably the most pronounced anomaly was the northwest-southeast trend that intersects with the low magnetic anomaly at grid coordinates (208, 110) and continues to the east side of the building (Figure 3). Time-domain EMF data also show a pronounced trend, and terrain conductivity data are saturated by the same trend (Figures 5 and 4, respectively). Only GPR data do not show a similar characteristic trend of anomalies, perhaps for the reasons stated at the end of Section 3.4. Conductivity and EMF data suggest that the northwest trend may continue north of the building. Magnetic data suggest a related anomalous feature immediately northeast of the building at grid coordinates (186, 157).

Another feature supported by all of the potential-field data was a point anomaly and a weaker south-southeast trending linear anomaly coincident with a surface depression located at grid coordinates (185, 113). The GPR data were inconclusive in identifying the feature, although subtle GPR reflections were observed in the vicinity, and a strong GPR reflection was observed on the trend at grid coordinates (190, 100).

Signatures in potential-field data were generally subtle southwest of the building. An exception is the point anomaly at the former site of Building E3164, where a PVC pipe protrudes from the surface at grid location (138, 123). The anomaly is particularly strong in the EMF data (Figure 5). Anomalies in conductivity, EMF, and GPR data suggest a continuation of a subsurface feature to the west of the pipe, particularly near grid coordinates (120, 120). These anomalies are also probably associated with the former site of Building E3164, although subtle GPR reflections are suggestive of a southwest trend to the southwest corner of the survey area.

The overhead steam pipe in the northwest corner of the survey area causes strong anomalies in magnetic, conductivity, and EMF data. Evidence for a former eastward continuation of the steam line along the north edge of the survey area is provided by the EMF data. Data from the other techniques do not show a similar pattern of anomalies, perhaps because the methods were more sensitive to other features in the area or subject to interference from the building. The EMF data are nevertheless conspicuous indicators of shallow-buried metallic debris along the entire width of the survey area north of y = 160 ft.

Two other point anomalies are observed with the EMF and magnetic data, and more subtly with the conductivity and GPR data. The anomalies, located at grid coordinates (237, 103) and (260, 127), do not coincide with observed structures at the surface and are probably caused by the presence of buried metal objects.

5 Conclusions

Magnetic and time-domain EMF data provided the best overall indicators of potential subsurface features at Building E3162. Conductivity data were dominated by a northwest-southeast-trending anomaly, approximately 40 ft in width, that bisected the geophysical survey area. Subtle anomalies in the conductivity data were fairly consistent with magnetic and EMF data sets. Strong GPR reflections were generally absent in profiles conducted at Building E3162. While GPR data were probably the least useful geophysical data collected at the site, subtle GPR reflections were useful in locating potential sites of buried objects. All geophysical data sets contributed to the identification of suspected buried objects.

6 References

Benson, M.A., et al., 1995, unpublished information, Argonne National Laboratory, Argonne, Ill.

Cordell, L., J.D. Philips, and R.H. Godsen, 1992, *Potential Field Geophysical Software: Version 2*, U.S. Geological Survey Open-File Report 92-18.

EAI Corporation, 1989, *Historical Records Search and Site Survey of Edgewood Area Buildings, Final Report*, prepared for U.S. Army Chemical Research, Development, and Engineering Center, Aberdeen Proving Ground, Md., under contract No. DAA15-87-D0021.

Galinovsky, L., and K. Levin, 1990, *Radan III*, Geophysical Survey Systems, Inc., North Salem, N.H.

Geophysical Survey Systems, Inc., 1987, *Operations Manual for Subsurface Interface Radar (SIR System-3)*, North Salem, N.H.

Golden Software, Inc., 1991 *SURFER Version 4*, Golden, Colo.

McGinnis, L.D., and S.F. Miller, 1991, *Interim Progress Report — Geophysics: Building E5032 Decommissioning, Aberdeen Proving Ground*, ANL/ESD/TM-20, Argonne National Laboratory, Argonne, Ill.

McGinnis, L.D., et al., 1992a, *Interim Progress Report — Geophysics: Building E5440 Decommissioning, Aberdeen Proving Ground*, ANL/ESD/TM-42, Argonne National Laboratory, Argonne, Ill.

McGinnis, L.D., et al., 1992b, *Geophysical Study of the Building 103 Dump, Aberdeen Proving Ground*, ANL/ESD/TM-51, Argonne National Laboratory, Argonne, Ill.

McGinnis, L.D., et al., 1994, *Environmental Geophysics: Buildings E5485, E5487, and E5489 Decommissioning — The "Ghost Town" Complex, Aberdeen Proving Ground, Maryland*, ANL/ESD/TM-78, Argonne National Laboratory, Argonne, Ill.

McGinnis, M.G., et al., 1992a, *Interim Progress Report — Geophysics: Building E5375 Decommissioning, Aberdeen Proving Ground*, ANL/ESD/TM-37, Argonne National Laboratory, Argonne, Ill.

McGinnis, M.G., et al., 1992b, *Interim Progress Report — Geophysics: Decommissioning of Buildings E5974 and E5978, Aberdeen Proving Ground*, ANL/ESD/TM-47, Argonne National Laboratory, Argonne, Ill.

Miller, S.F., et al., 1992a, *Interim Progress Report — Geophysics: Building E5190 Decommissioning, Aberdeen Proving Ground*, ANL/ESD/TM-33, Argonne National Laboratory, Argonne, Ill.

Miller, S.F., et al., 1992b, *Interim Progress Report — Geophysics: Building E5476 Decommissioning, Aberdeen Proving Ground*, ANL/ESD/TM-43, Argonne National Laboratory, Argonne, Ill.

Munsell Soil Color Charts, 1975, Macbeth, a division of Kollmorgen Corp., Baltimore, Md.

Nemeth, G., 1989, *RCRA Facility Assessment Report, Edgewood Area, Aberdeen Proving Ground, Maryland*, prepared by U.S. Army Environmental Hygiene Agency.

Oliveros, J.P., and P. Gernhardt, 1989, *Hydrogeologic Data for the Canal Creek Area, Aberdeen Proving Ground, Maryland, April 1986-March 1988*, U.S. Geological Survey Open-File Report 89-387.

Thompson, M.D., 1994, COLMX software, unpublished.

Thompson, M.D., et al., 1992a, *Interim Progress Report — Geophysics: Building E5282 Decommissioning, Aberdeen Proving Ground*, ANL/ESD/TM-36, Argonne National Laboratory, Argonne, Ill.

Thompson, M.D., et al., 1992b, *Interim Progress Report — Geophysics: Building E5481 Decommissioning, Aberdeen Proving Ground*, ANL/ESD/TM-44, Argonne National Laboratory, Argonne, Ill.

Thompson, M.D., et al., 1994, *Interim Progress Report Addendum — Environmental Geophysics: Building E5032 Decommissioning, Aberdeen Proving Ground, January 1994 Resurvey,* ANL/ESD/TM-85, Argonne National Laboratory, Argonne, Ill.

Thompson, M.D., et al., 1995, unpublished information, Argonne National Laboratory, Argonne, Ill.

Attachment:

Coordinates of Ground-Penetrating-Radar Profiles at Building E3162

Attachment:

Coordinates of Ground-Penetrating-Radar Profiles at Building E3162

	Coordinates (ft)			
	Start		End	
Line No.	X	Y	X	Y
1	Calibration line (begin W→E lines)			
2	100	100	260	100
3	100	105	260	105
4	100	110	260	110
5	100	115	260	115
6	100	120	260	120
7	100	125	260	125
8	100	130	260	130
9	100	135	260	135
10	185	140	260	140
11	185	145	260	145
12	185	150	260	150
13	100	155	260	155
14	100	160	260	160
15	100	165	260	165
16	100	170	215	170
17	100	140	145	140
18	100	145	145	145
19	100	150	145	150
20	Calibration line (begin S→N lines)			
21	100	100	100	170
22	105	100	105	170
23	110	100	110	170
24	115	100	115	170
25	120	100	120	170
26	125	100	125	170
27	130	100	130	170
28	135	100	135	170
29	140	100	140	170
30	145	100	145	170

	Coordinates (ft)			
	Start		End	
Line No.	X	Y	X	Y
31	150	155	150	170
32	155	155	155	170
33	160	155	160	170
34	165	155	165	170
35	170	155	170	170
36	175	150	175	170
37	180	150	180	170
38	150	100	150	130
39	155	100	155	130
40	160	100	160	130
41	165	100	165	130
42	170	100	170	130
43	175	100	175	130
44	180	100	180	130
45	185	100	185	170
46	190	100	190	170
47	195	100	195	170
48	200	100	200	170
49	205	100	205	170
50	210	100	210	170
51	215	100	215	170
52	220	100	220	160
53	225	100	225	160
54	230	100	230	160
55	235	100	235	160
56	240	100	240	160
57	245	100	245	160
58	250	100	250	160
59	255	100	255	160
60	260	100	260	160

Appendix B:

Air Quality Monitoring Report

ARGONNE NATIONAL LABORATORY

INTRA-LABORATORY MEMO

April 6, 1995

TO: Eric Zimmerman

FROM: John Schneider JFS

SUBJECT: **Building 3162 Air Monitoring for Volatile Organic Compounds Results**

Building E3162 at the Aberdeen Proving Ground (APG) was constructed in 1952 for use as temporary housing of animals involved in pre- and post-testing of non-agent burns (wound ballistics). The building was used from 1952 to 1983 and has been unoccupied since 1983.

Air samples were collected and analyzed on-site at APG by ANL during the week of November 14, 1994. Samples were collected by drawing ambient air through a Tenax TA sorbent polymer sampling cartridge (4 mm I.D. × 11.5 cm) traps. at the rate of 200mL for 120 minutes, yielding a 24 L sample volume. The cartridges were analyzed by thermally desorbing the trapped organic compounds with a Dynatherm model 900 ACEM thermal desorption unit on to a Hewlett-Packard 5890 series II gas chromatograph (GC) equipped with a Hewlett-Packard 5972 mass spectrometer (MS).

The MS was used for detecting and identifying organic compounds desorbed from the Tenax traps. Spectra were obtained by scanning from 45 to 400 atomic mass units at a rate of two scans every second. Identifications were based on mass spectral interpretation and computer searching of the 140,000 compound Wiley spectral library. A standard mixture of volatile organics containing toluene at 200 ng/uL and other aromatic hydrocarbons, was run daily to assure that the instrument was operating properly. All quantitations are estimates, using the assumption that analyte response factors should be similar to toluene in the standard mixture of volatile organics.

The majority of the volatile organic compounds found during the ANL air monitoring are commonly found in any building (hydrocarbons and chlorinated solvents). The following compounds were the major components found in the air samples:

Compound	E3162	Outside SW	Outside NE
Benzene	0.15 ng/L	0.16 ng/L	0.15 ng/L
Toluene	0.28 ng/L	0.36 ng/L	0.27 ng/L
Hexanal	0.02 ng/L	ND	ND
Tetrachloroethene	0.06 ng/L	0.08 ng/L	0.06 ng/L
Ethyl Benzene	0.07 ng/L	0.08 ng/L	0.06 ng/L
Xylenes	0.26 ng/L	0.32 ng/L	0.23 ng/L
Alpha Pinene	0.07 ng/L	0.09 ng/L	0.07 ng/L
Benzaldehyde	0.28 ng/L	0.49 ng/L	0.46 ng/L
Phenol	0.03 ng/L	0.07 ng/L	0.08 ng/L
Beta Pinene	0.06 ng/L	0.08 ng/L	0.06 ng/L
Methyl Phenyl Ketone	0.16 ng/L	0.38 ng/L	0.36 ng/L

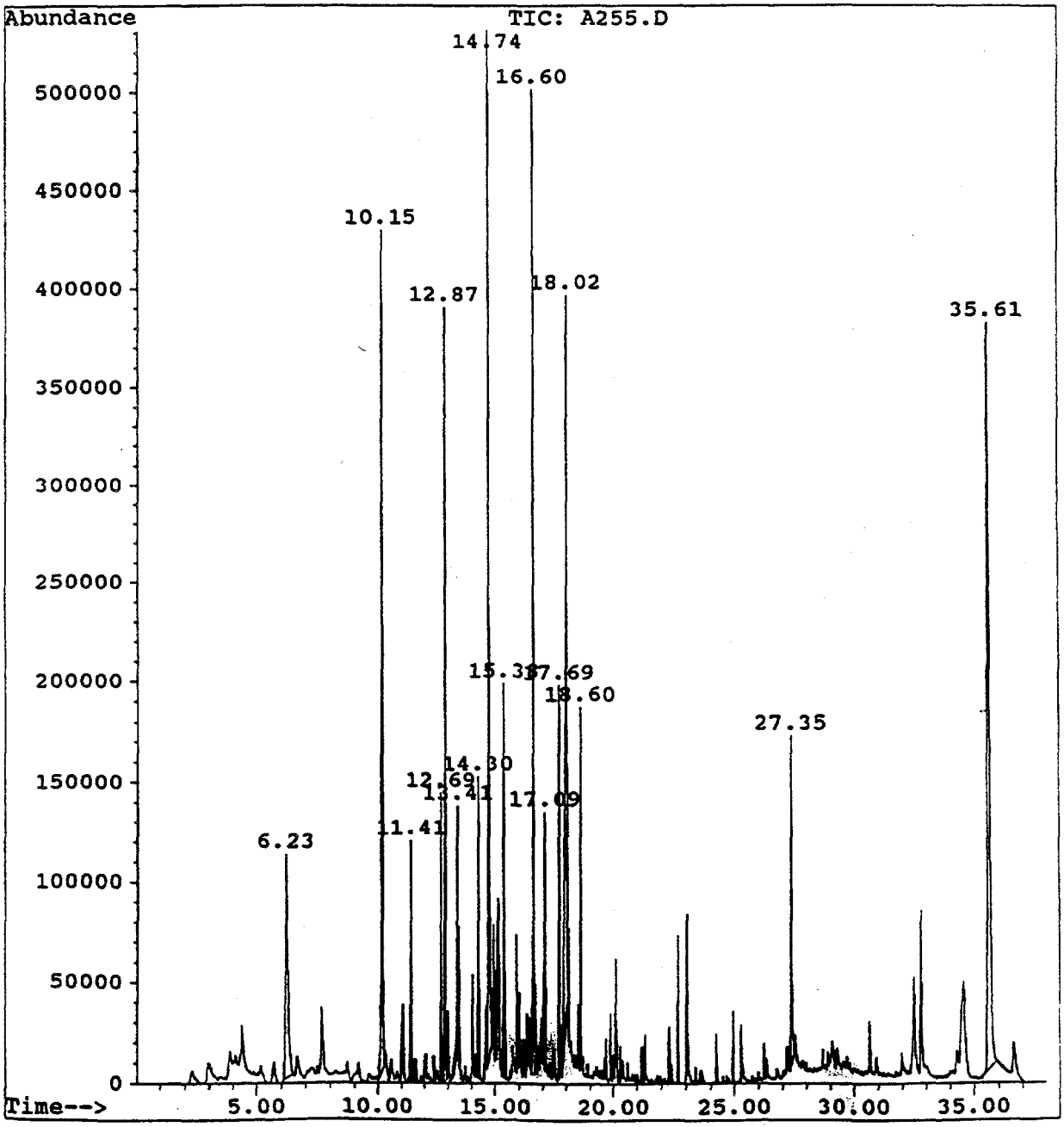
Figure 1 is a total ion chromatogram (TIC) of the air sample taken in E3162. Figures 2 and 3 are TICs of the outside air samples. Table 1 is the air sampling data sheet.

The analysis indicates that Building E5978 is not a source of volatile organic compound contamination.

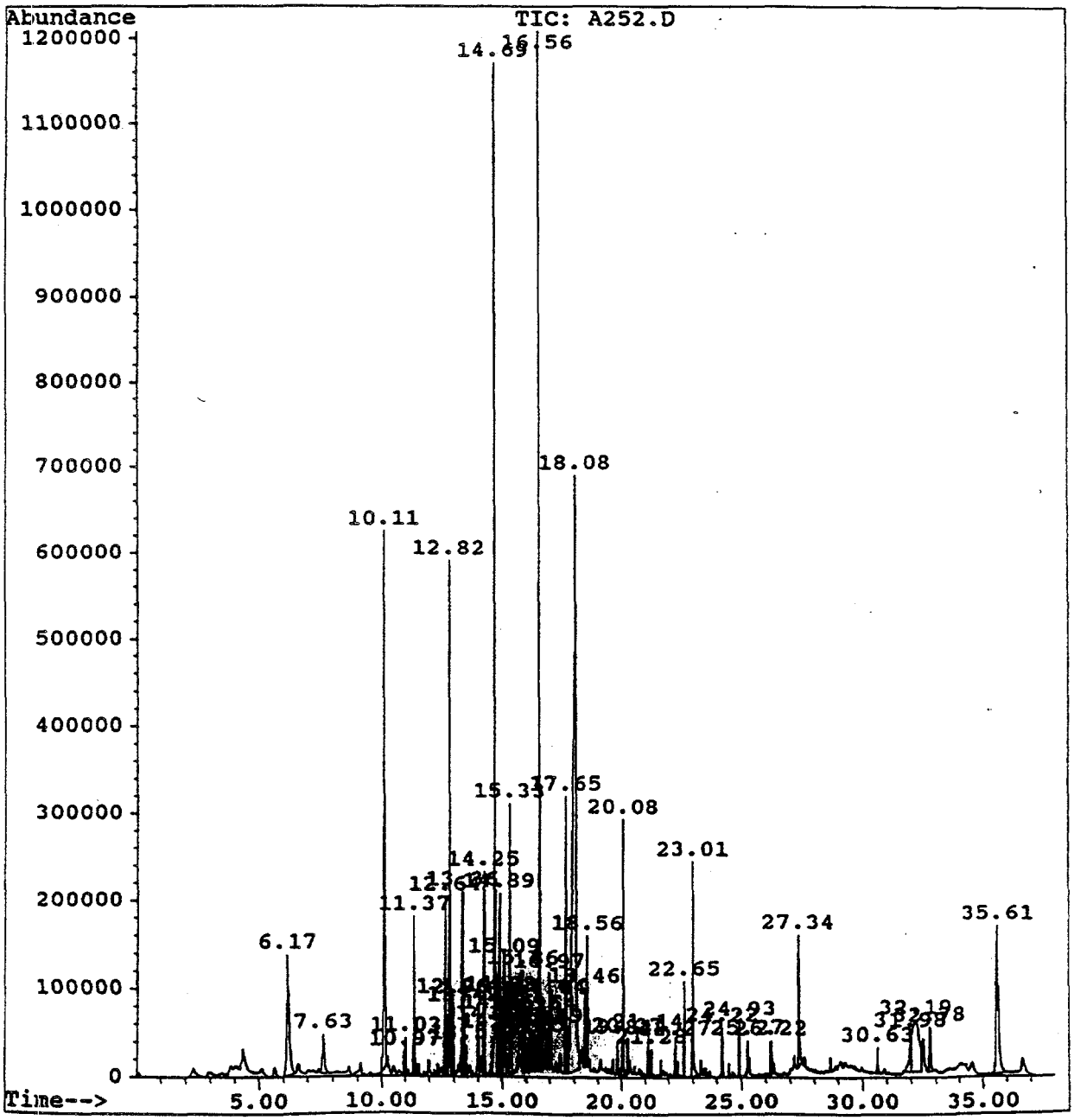
JS:ls
Attachments

cc: D.E. Edgar

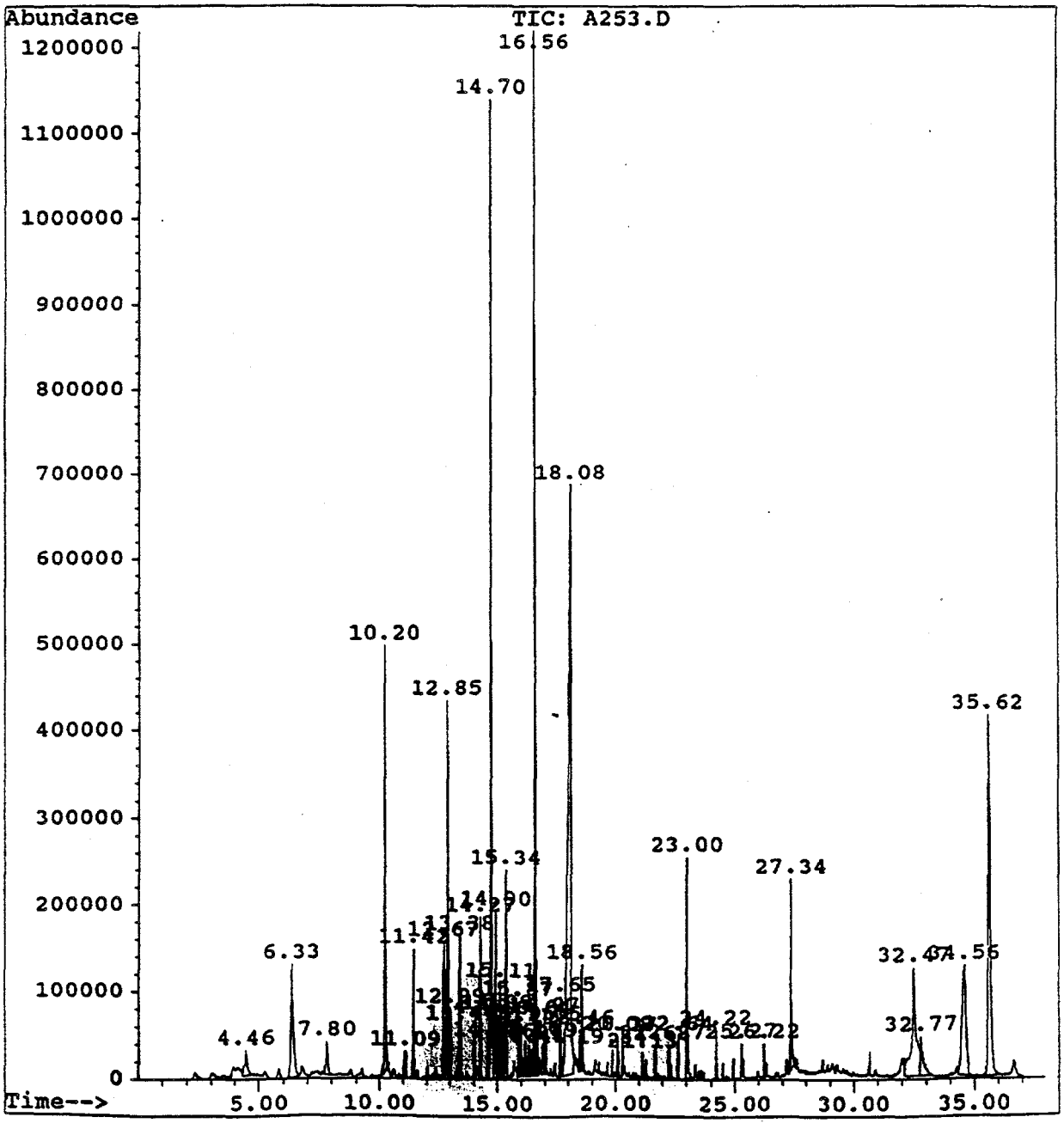
File : A:\A255.D
Operator : lar
Acquired : 18 Nov 94 5:50 pm using AcqMethod PILOT
Instrument : 5972 - In
Sample Name: 255(52) E3162 inside 10:15-12:15 200mL/min
Misc Info : start, 200mL/min end NE corner facing NE
Vial Number: 1



File : A:\A252.D
Operator : lar
Acquired : 18 Nov 94 3:19 pm using AcqMethod PILOT
Instrument : 5972 - In
Sample Name: 252(48) E3162 outside 10:02-12:02 200mL/min
Misc Info : start, 300mL/min end SW corner facing SW
Vial Number: 1



File : A:\A253.D
Operator : lar
Acquired : 18 Nov 94 4:08 pm using AcqMethod PILOT
Instrument : 5972 - In
Sample Name: 253(47) E3162 outside 10:02-12:02 200mL/min
Misc Info : start, 300mL/min end NE corner facing NE
Vial Number: 1



Air Sampling Data Sheet

Date: 11/18/14 **Site:** Aberdeen **Researchers:** H. Coba, L. Raphael, J. Taylor, J. Odell

Sample			Sampling Specifications							Location				Ambient Conditions		
			Sampling Time		Flow Rate		Pump							Temp-		
Number	Building	Room	Start	End	Initial	Final	Setting	Pump ID #	Manifold	Height	Distance #1	Distance #2	Facing	erature	Pressure	Humidity
Tube 49 252	E3162	[illegible]		12:02	[illegible]	300 mL/min	P-100	4	1B	16"	15' S.W. Corner		S.W.	64	–	99
Tube 47 253	E3162	Outside		12:02 p.m.	[illegible]	3	P-100	1	5B	16"	N.E. [illegible]		N.E.	64	–	90%
Tube 51	[illegible]	[illegible]	[illegible]	12:15 pm	[illegible]	200 mL/min	[illegible]	[illegible]	[illegible]		N.E. Wall		N.E.	64	–	90%
Tube 52	[illegible]	[illegible]	[illegible]	12:15 p.m.	[illegible]	200 mL/min	[illegible]				N.E. Wall		N.E.	64	–	90%
Tube 256 43	E5625	Outside	8:30 AM	12:30	200ml	300 mL/min	P-100	5	2B	16"	NE of E5625			60°F		54%
(45) [illegible]	E3180	Dormant Outside	1:40 p.m.	3:40 p.m.	200 mL/min	200 mL/min	P-100	#3	2B	16"	5' From S.W. Corner	8' Building	Ceiling	71°F		93%
(58) A67 258	E3180	main Room inside	1:45 p.m.	3:45 p.m.	200 mL/min	200 mL/min	P-100	2	4A	16"	4' From S. wall	7' From the corner	Ceiling	71°F		93%
(53) [illegible] 259	E3180	main Room inside	1:45 p.m.	3:45 p.m.	200 mL/min	200 mL/min	P-100	2	4B	16"	4' From S. wall	7' From W. wall	Ceiling	71°F		93%