UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

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MAY 22 1992

REPLY TO THE ATTENTION OF:
HSRM-6J

Department of the Navy
Northern Division, Naval Facilities Command
Building 77 Low, Code 1421
Philadelphia Naval Base
Philadelphia, PA 19112-5094

RE: Approval of the Remedial Investigation (RI) Workplan for the Soils Operable Unit at the Naval Industrial Reserve Ordnance Plant (NIROP), Fridley, Minnesota

Dear Mr. Shafer:

The U.S. EPA has completed the review of Revision 1 RI Workplan for the Soils Operable Unit (operable unit #2), dated January 1992, and NIROP Fridley Soils Operable Unit Responses to Agencies' Comments on the Draft Final RI Workplan, dated March 10, 1992. Documents included in the RI Workplan for the Soils Operable Unit are the Quality Assurance Project Plan (QAPP), Field Sampling and Analysis Plan and the Site Health and Safety Plan.

Within the context of the Federal Facility Agreement for NIROP, Fridley, Revision 1 RI Workplan for the Soils Operable Unit, dated January 1992, and the NIROP Fridley Soils Operable Unit Responses to Agencies' Comments on the Draft Final RI Workplan, dated March 10, 1992, are considered final, as of the date of issue of this notice. Together the afore mentioned documents serve as the final RI Workplan for the Soils Operable Unit.

U.S. EPA understands that if a Project Manager requests field modifications that alter procedures and methods agreed to in the above mentioned documents, the Project Manager will conform to provisions for modifications found in Sections 19.4, 19.5, in the Federal Facility Agreement for NIROP, Fridley.

Sincerely,

Thomas R Bloom

Thomas R. Bloom
Remedial Project Manager

cc: Frank Rollins
Steve Giddings

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U.S. EPA ADMINISTRATIVE RECORD INDEX

ORIGINAL (SOILS OPERABLE UNIT)

NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT

FRIDLEY, MINNESOTA

10/21/92

DOC#	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	01/00/92	Koch, T., Kenoyer, G., & Hicken, L., RMT, Inc.	U.S. EPA	Remedial Investigation Workplan for the Soils Operable Unit (Includes QAPP, Field Sampling Plan, Site Security and Health & Safety Plan)	463
2	03/10/92	Hicken, L., RMT, Inc.	Bloom, T., U.S. EPA	Responses to U.S. EPA & MPCA Comments on Draft Final RI Workplan for the Soils Operable Unit	80
3	05/22/92	Bloom, T., U.S. EPA	Shafer, Dept. of the Navy	Approval of RI Workplan for Soils Operable Unit	1

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REMEDIAL INVESTIGATION WORKPLAN FOR THE SOILS OPERABLE UNIT AT THE NAVAL INDUSTRIAL ORDNANCE PLANT FRIDLEY, MINNESOTA

JANUARY 1992

Thomas E. Koch
Hydrogeologist

Galen J. Kenoyer, Ph.D.
Senior Hydrogeologist

Linda E. Hicken, P.E.
Project Manager

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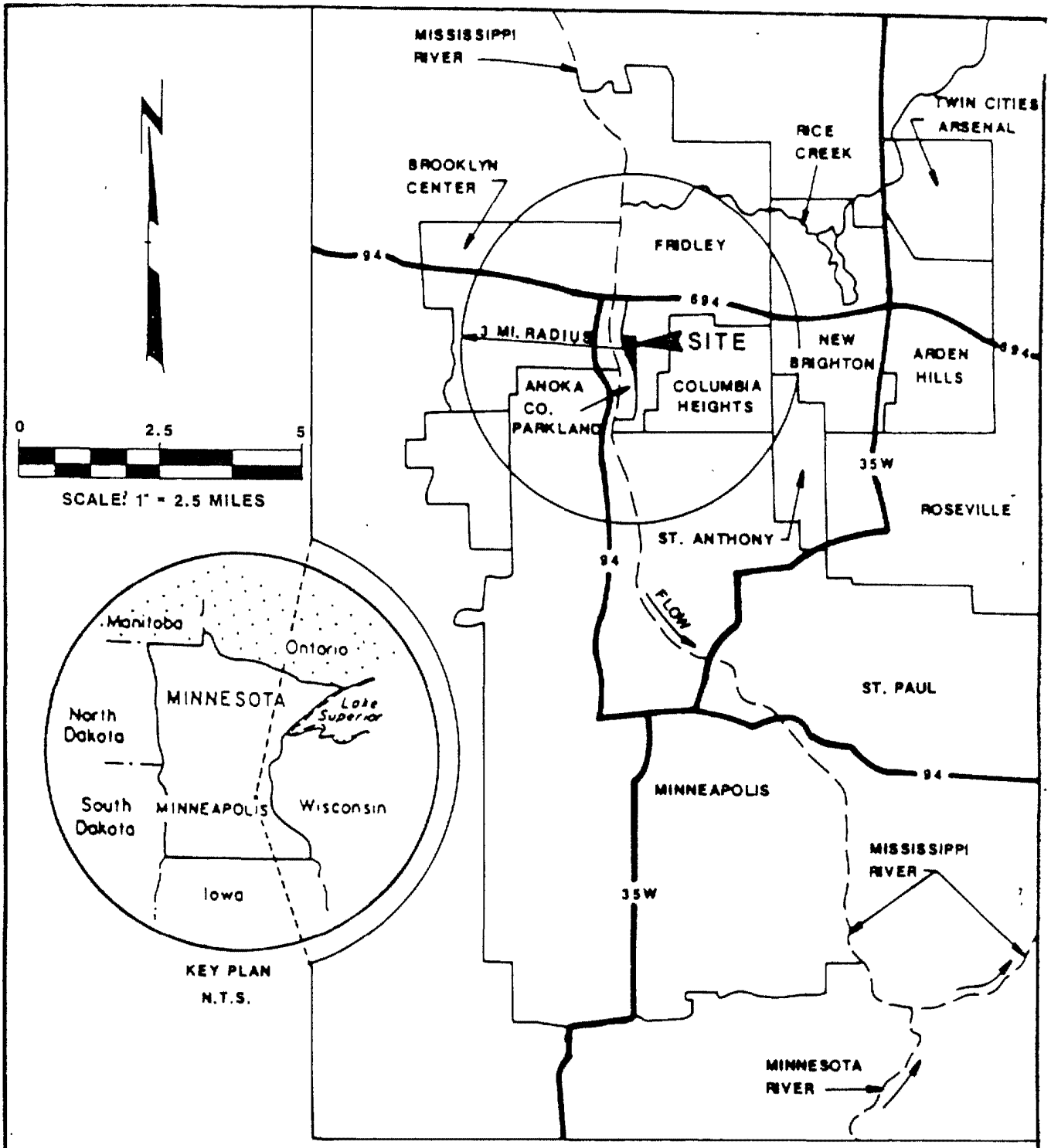
1. INTRODUCTION

RMT, Inc., of Madison, Wisconsin, has been retained by the U.S. Department of the Navy, Naval Facilities Engineering Command (Navy), to develop a workplan for a remedial investigation (RI) of the soils operable unit at the Naval Industrial Reserve Ordnance Plant (NIROP) in Fridley, Minnesota (Figure 1-1). This document has been prepared to partially fulfill the requirements of Section X of the Federal Facility Agreement (i.e., only the workplanning activities, not the implementation and reporting) between the USEPA Region V (Region V), the Navy, and the Minnesota Pollution Control Agency (MPCA) (USEPA, 1991a). Procedures and terminology used in this Workplan adhere to those described in the USEPA's October 1988 Interim Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (OSWER Directive 9355.30).

The Quality Assurance Project Plan (QAPP), included in Appendix A of this Workplan, has been prepared in accordance with the Region V Model QAPP (USEPA, 1991b) that was provided on computer diskette to RMT before Technical Review Committee Meeting 10 for this site, which was held on June 27, 1991. USEPA guidance on CLP protocols as described in a memorandum issued by Charles T. Elly, Region V CRL Director, dated August 16, 1991, has also been incorporated. A site security and health and safety plan (SSHP) is included as Appendix B.

The purpose of this RI is to gather information needed to develop an appropriate remedial action for site soils in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan as described in 40 CFR §300.68. The objectives of this RI include the following:

- To investigate the nature and extent of releases of hazardous substances.
- To evaluate the quality of soils relative to applicable or relevant and appropriate requirements (ARARs).
- To gather data and information to the extent necessary and sufficient to quantify the risk to public health and the environment, and to support development of remedial alternatives in the feasibility study.



SITE LOCATION MAP

RMT INC	DWN. BY: JMM
	DATE: JULY, 1991
	PROJ. # 2313.01

FILE #2313.01WP

FIGURE 1-1

- To identify general response actions that may be appropriate to the soils operable unit at the NIROP Fridley.

Several previous investigations have been performed on the soils at the NIROP Fridley to identify source areas of ground water contamination, and to evaluate the extent of soil contamination. These investigations included a geophysical survey of potential areas of buried drums of wastes conducted in 1983, a soil pore gas survey conducted in 1987, and a preliminary remedial investigation of soils conducted in fall 1990. The results of these investigations have been used to focus the scope of this RI in areas of known or suspected soil contamination.

To the extent practicable, this RI has been designed to be a complete and final investigation of soil contamination outside of buildings and other structures at the NIROP Fridley. A field gas chromatograph will be used to provide a near real-time evaluation of VOCs in the soil headspace so that additional soil borings can be drilled during the same field mobilization to expeditiously complete the assessment of the extent of contamination. While it is recognized that actual field circumstances or laboratory detection of constituents not detectable with the field GC (e.g., saturated hydrocarbons, semivolatile organic compounds, PCB/pesticides, and metals) may require additional fieldwork, the intent of this workplan is to make this a single-phase RI under CERCLA. Although the field GC cannot detect many classes of compounds, it is an appropriate screening method for this project because it can detect the major constituents of concern at this site, specifically dichloroethene (DCE), 1,1-, cis-1,2-, and trans-1,2-; trichloroethene (TCE), and tetrachloroethene.

2. SCOPE OF WORK

The RI of the soils operable unit addresses soil contamination in the vadose zone (i.e., above the water table) in areas of the facility that are not covered by buildings or other surface structures. While it is generally conceded that there may have been sources of ground water contamination emanating from inside of the building(s), and that releases from leaking storm/sewer lines or leaching of contaminants at past tank or disposal areas during periodic increases in the regional water table elevation may still be occurring, these sources pose a less significant threat to ground water quality for two reasons: 1) current operating practices have reduced potentially ongoing uncontrolled releases into the subsurface; and 2) the extensive capping provided by floors and roofs reduces the potential for past releases to the soils to be leached into the ground water. If it becomes important to investigate soil quality beneath the building(s), this will be studied as a separate operable unit.

The investigation and remediation of the ground water operable unit has been addressed separately and is not considered within this workscope. The scope of the soil RI is intended to investigate potential outdoor sources of elevated concentrations of VOCs in ground water. This RI also looks at potential soil impacts at areas of past waste disposal, handling, and storage. The full Target Compound List (TCL) and Target Analyte List (TAL) will be used to evaluate soil impacts during the first portion of this investigation. A modified analytical list has been proposed during the second portion of this investigation to aid in determining the extent of areas found to be of concern.

The objectives of the RI will be met by drilling soil borings and advancing test pits at selected locations to collect representative soil samples for field and laboratory analyses. The soil borings will be drilled to a depth of approximately 20 feet below ground surface. This depth is approximately 3 feet above the water table, and was selected to reduce the effect of measuring VOCs vaporizing from the dissolved constituent plume.

3. PROJECT ORGANIZATION AND PERSONNEL

3.1 Project Organization

The United States Environmental Protection Agency (USEPA), the Minnesota Pollution Control Agency (MPCA), and the U.S. Navy entered into a Federal Facility Agreement (FFA) in March 1991, giving the USEPA the lead role for enforcement of the federal Superfund program at the NIROP Fridley.

The designated Remedial Project Manager for the USEPA is Tom Bloom. The designated U.S. Navy Project Manager is Jim Shafer. The Project Manager for the MPCA is Cynthia Kahrmann, and the Project Manager for RMT, Inc., is Linda Hicken.

An organizational chart for the RI of the soils operable unit is shown on Figure 3-1.

The RMT project team is composed of engineers, hydrogeologists, industrial hygienists, scientists, and support staff. The multi-disciplinary project team provides the resources for completing the Scope of Services in a systematic and comprehensive manner.

3.2 Key Individuals

Key individuals are defined as persons having responsibility for production of major work activities, technical direction, quality assurance, primary coordination with outside parties, and overall project management. The individuals assigned these responsibilities for this project are identified below.

KEY RMT PERSONNEL

Person	RMT Position Title	Project Assignment
Linda Hicken, P.E.	Project Manager	Project Manager
Tom Koch	Senior Hydrogeologist	RI Task Leader
Ron Vaughn	Project Geologist	Site Coordinator/Site Health and Safety Representative
Chris Hansen, C.I.H.T.	Northern Region Health and Safety Coordinator	Health and Safety Coordinator
Galen Kenoyer, Ph.D.	Senior Hydrogeologist	QA - Hydrogeology
Tom Stolzenburg, Ph.D.	Manager Applied Chemistry Department	QA - Chemistry
John Reinhardt	Corporate Health and Safety Director	QA - Health and Safety

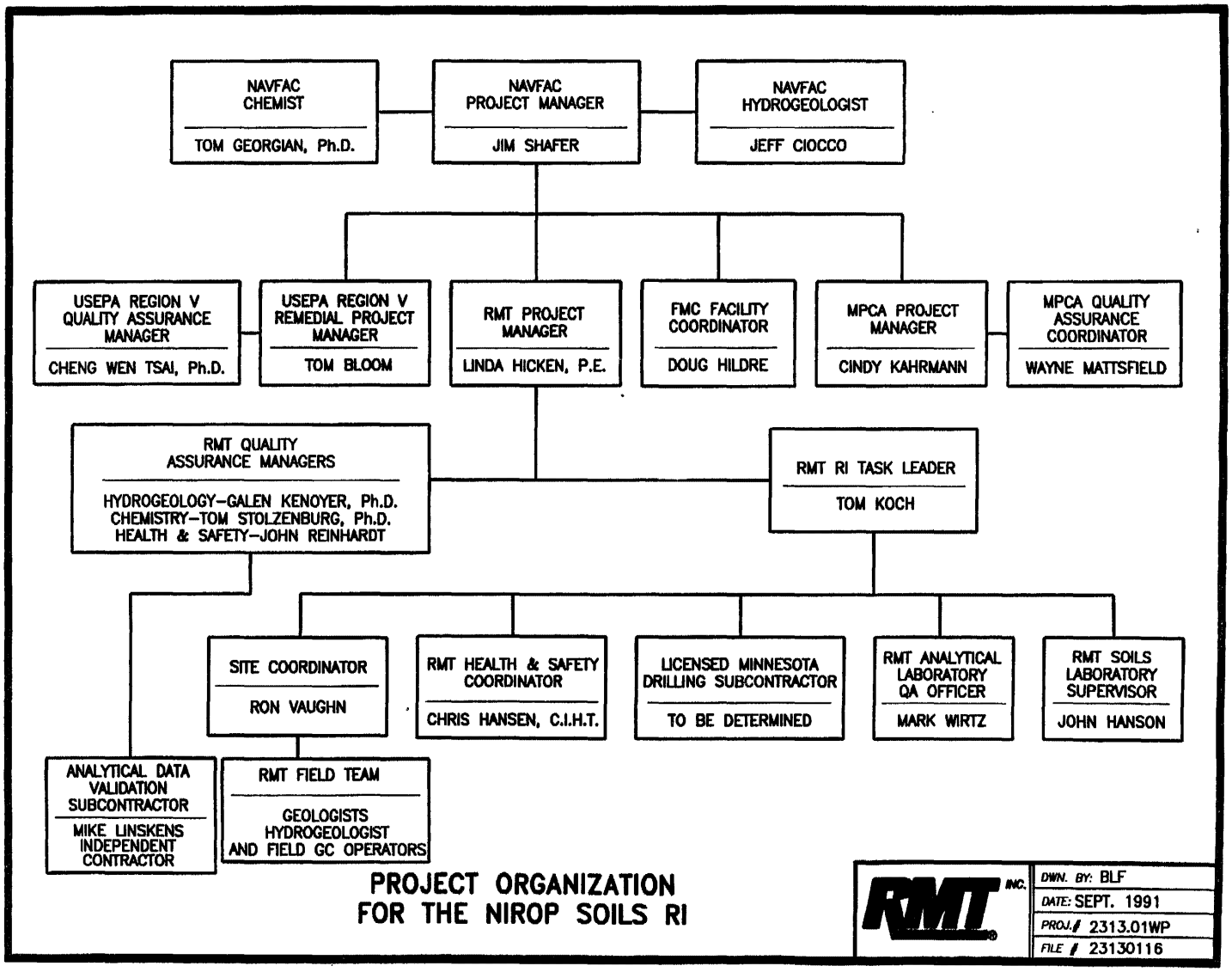

NAVFAC CHEMIST
TOM GEORGIAN, Ph.D.
NAVFAC PROJECT MANAGER
JIM SHAFER
NAVFAC HYDROGEOLOGIST
JEFF CIOCCO
USEPA REGION V QUALITY ASSURANCE MANAGER
CHENG WEN TSAI, Ph.D.
USEPA REGION V REMEDIAL PROJECT MANAGER
TOM BLOOM
RMT PROJECT MANAGER
LINDA HICKEN, P.E.
FMC FACILITY COORDINATOR
DOUG HILDRE
MPCA PROJECT MANAGER
CINDY KAHRMANN
MPCA QUALITY ASSURANCE COORDINATOR
WAYNE MATTSFIELD
RMT QUALITY ASSURANCE MANAGERS
HYDROGEOLOGY–GALEN KENOYER, Ph.D.
CHEMISTRY–TOM STOLZENBURG, Ph.D.
HEALTH & SAFETY–JOHN REINHARDT
RMT RI TASK LEADER
TOM KOCH
SITE COORDINATOR
RON VAUGHN
RMT HEALTH & SAFETY COORDINATOR
CHRIS HANSEN, C.I.H.T.
LICENSED MINNESOTA DRILLING SUBCONTRACTOR
TO BE DETERMINED
RMT ANALYTICAL LABORATORY QA OFFICER
MARK WIRTZ
RMT SOILS LABORATORY SUPERVISOR
JOHN HANSON
ANALYTICAL DATA VALIDATION SUBCONTRACTOR
MIKE LINSKENS INDEPENDENT CONTRACTOR
RMT FIELD TEAM
GEOLOGISTS
HYDROGEOLOGIST
AND FIELD GC OPERATORS
PROJECT ORGANIZATION
FOR THE NIROP SOILS RI
RMT INC.
DWN. BY: BLF
DATE: SEPT. 1991
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FIGURE 3-1

3.3 QA Responsibilities for Key Personnel

Site investigation activities will be performed by RMT. QA responsibilities for key personnel include the following:

- ***Project Manager*** - Responsible for meeting the overall project objectives and identifying and resolving major project issues. Provides QC review and conformance with project plans, and on-going review for logic and reasonableness of interim results. Approves and signs major outputs. Coordinates activities of QA managers and other QC reviewers to provide objective oversight. Serves as the primary point of contact for communications from the USEPA, the MPCA, the U.S. Navy, and other organizations involved in the project.

- ***Quality Assurance Managers*** - Discipline-specific reviewers of portions of the project workplans, progress, problems, and outputs, and of systems audits as appropriate for specified disciplines. Used systematically for some reviews, and when called upon by the project manager for specific problems.

- ***Task Leader*** - Technical coordinator of the overall RI effort. Ensures that RI objectives are met. Understands how all of the technical pieces are interrelated and the factors that affect each. Facilitates communications among discipline-specific coordinators so that interim findings or changes in workscope or schedule are understood by the entire team. Reviews daily progress to ensure that work is proceeding efficiently and that tasks are appropriately sequenced.

- ***Site Coordinator*** - Provides technical supervision, oversight, and review for daily on-site operations. Is responsible for on-site conformance with project plans, schedule, and procedures. Performs daily review and signing of notes and logs. Responsible for initiating corrective action on problems encountered in the field. Maintains ongoing coordination with the RI task leader on work progress, interim results, and problems.

- ***Peer-Level QC Reviewers*** - Ongoing checking in the field and office of calculations, procedures, issues, and logic.

3.4 Analytical Laboratory Qualifications

Soil and Quality Control samples (duplicates, trip blanks, and field blanks) will be analyzed at RMT Laboratories in Madison, Wisconsin. The qualifications of RMT's analytical laboratory, including facilities and equipment, have been audited by Martin Marietta Energy Systems, Inc., for the Department of the Navy and under contract to the Department of Energy, as part of the Navy Installation Restoration Program. The RMT Analytical Laboratory

QA Officer is Mark Wirtz. The QA officer will be responsible for ensuring that contaminant-free sample containers are obtained for the project and for initiating corrective action on problems encountered in the laboratory. Laboratory analytical methods and procedures are described in the QAPP.

In accordance with Navy policy, the validation of the analytical data will be subcontracted. RMT plans to subcontract this task to Mike Linskens, an independent contractor in Madison, Wisconsin. Mike was formerly the laboratory director at Warzyn Engineering, Inc., also in Madison.

4. DESCRIPTION OF CURRENT SITUATION

4.1 Site and Regional Description

The NIROP Fridley is operated by the Northern Ordnance Division of FMC Corporation. The plant has produced naval guns since 1941 and has expanded into the production of guided missile launching systems, torpedo tubes, and hydraulic and electric power drive and control systems.

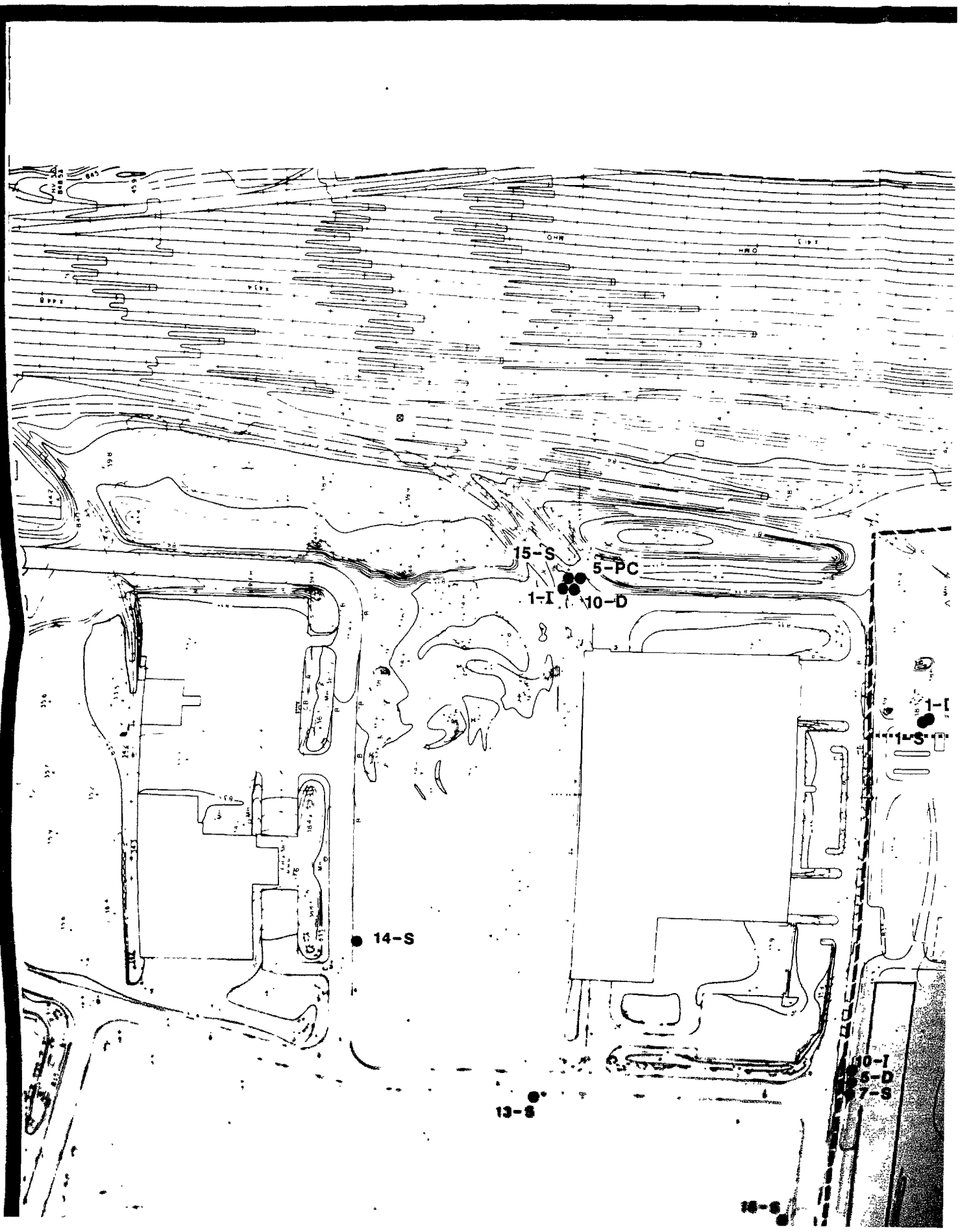
The NIROP Fridley is located in the city of Fridley, on the southernmost tip of Anoka County, Minnesota. The plant is situated approximately one-quarter mile east of the Mississippi River and less than 1 mile south of Interstate 694. The plant is bordered on the west by East River Road and on the east by the Burlington Northern railyard. A site location map is presented on Figure 1-1.

Fridley's population was estimated at 30,000 residents in 1990. Anoka County's population, according to 1990 estimates, was 241,000 people. The NIROP Fridley facility is located near the northern boundary of the metropolitan statistical area (as defined by the U.S. Bureau of Census) for Minneapolis-St. Paul, Minnesota-Wisconsin. The area was estimated to contain a population of 2,464,100 people in 1990.

The government-owned, contractor-operated portion of the plant encompasses 83 acres. The remainder of the facility is owned and operated by FMC Corporation. Figure 4-1 shows the layout of the plant, as well as other site features referred to throughout this document.

The NIROP Fridley site and adjacent properties to the north, east, and south are zoned heavy industrial. The Anoka County Islands of Peace Mississippi Riverfront Park is located between East River Road and the Mississippi River (west of the site). The park is a day-use recreation facility on the river's edge, consisting of approximately 60 acres.

Two significant waterways are in the vicinity of the site: Rice Creek, approximately 2 miles to the north, and the Mississippi River almost directly to the west. The Mississippi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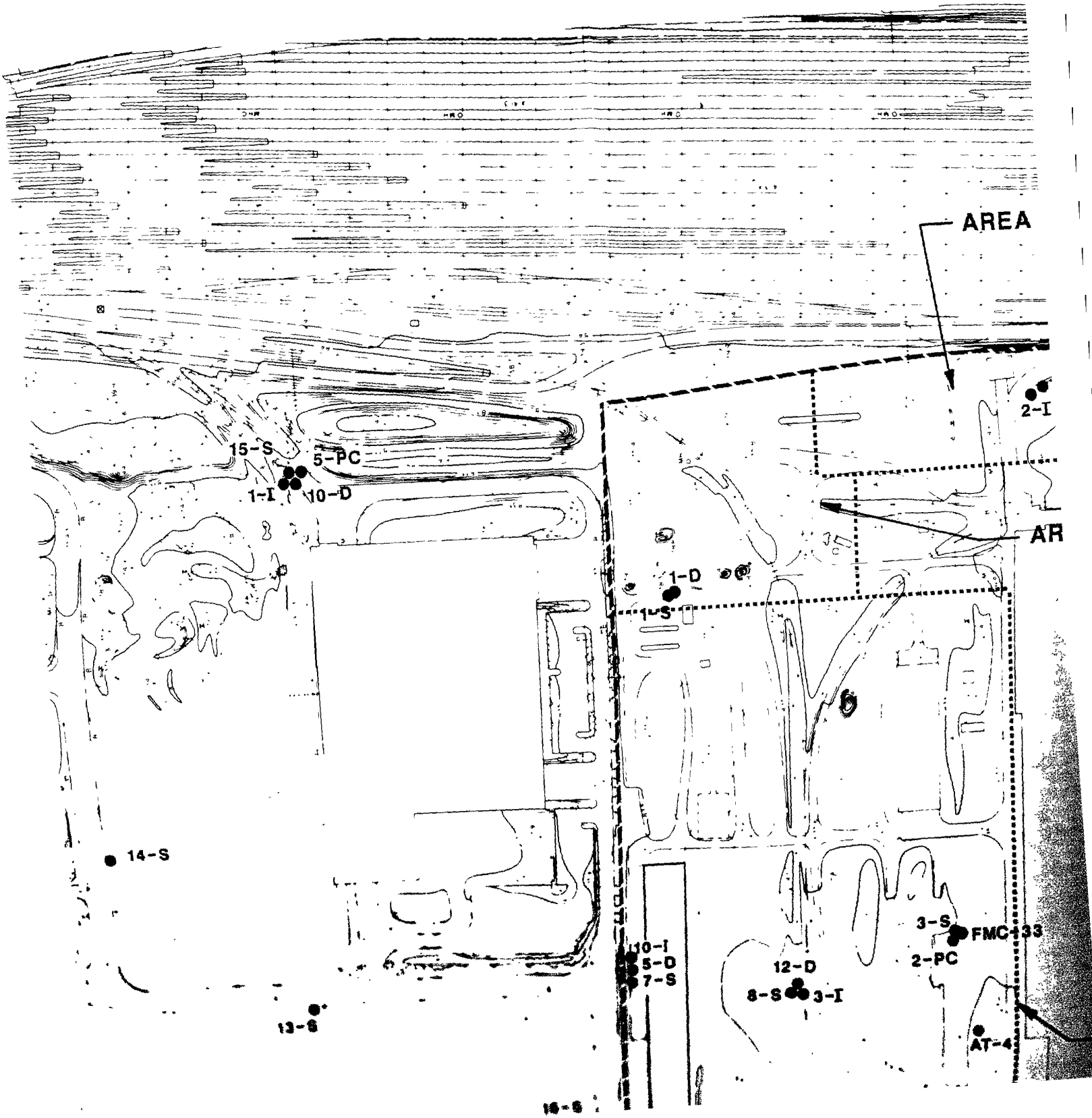
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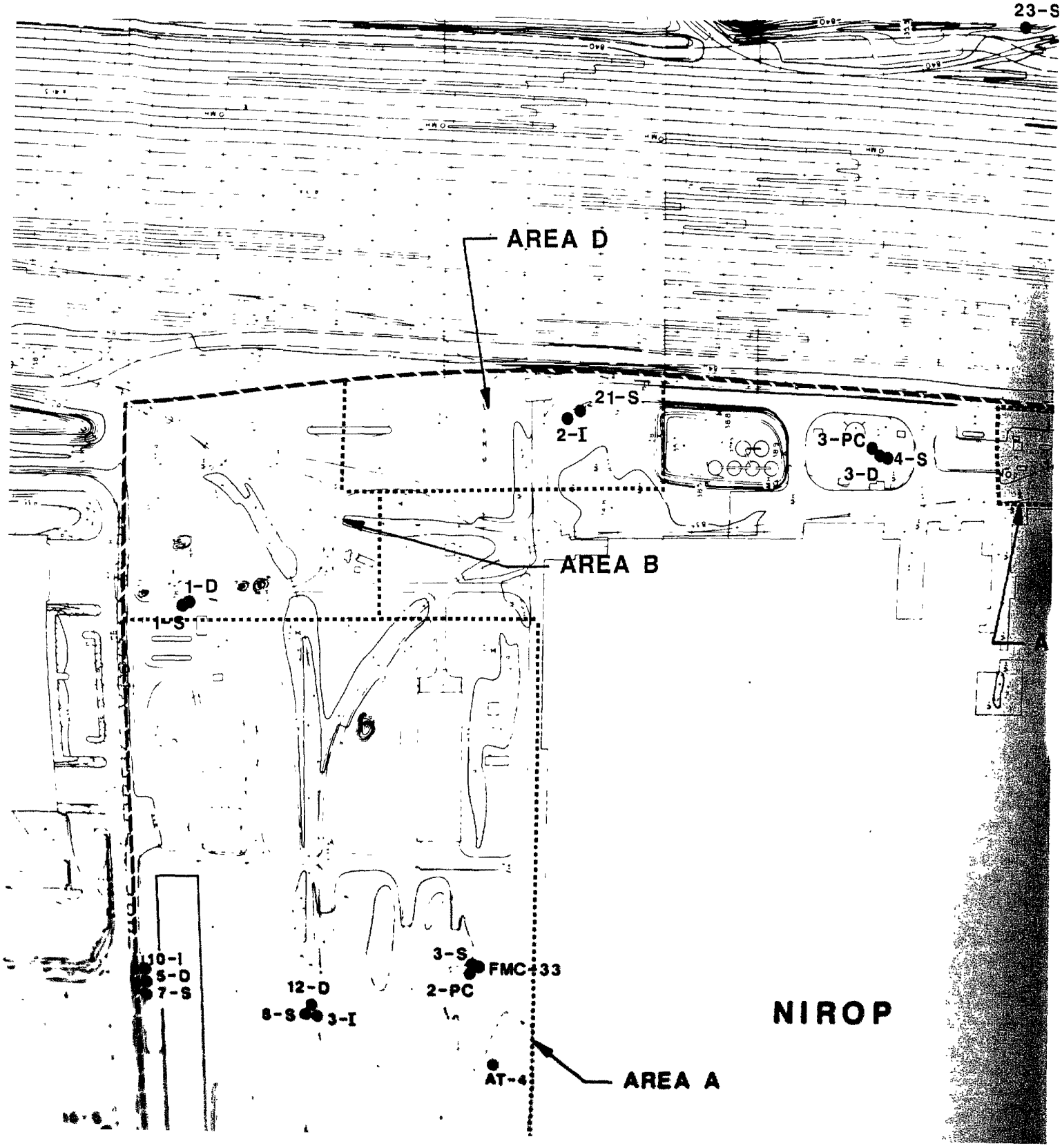
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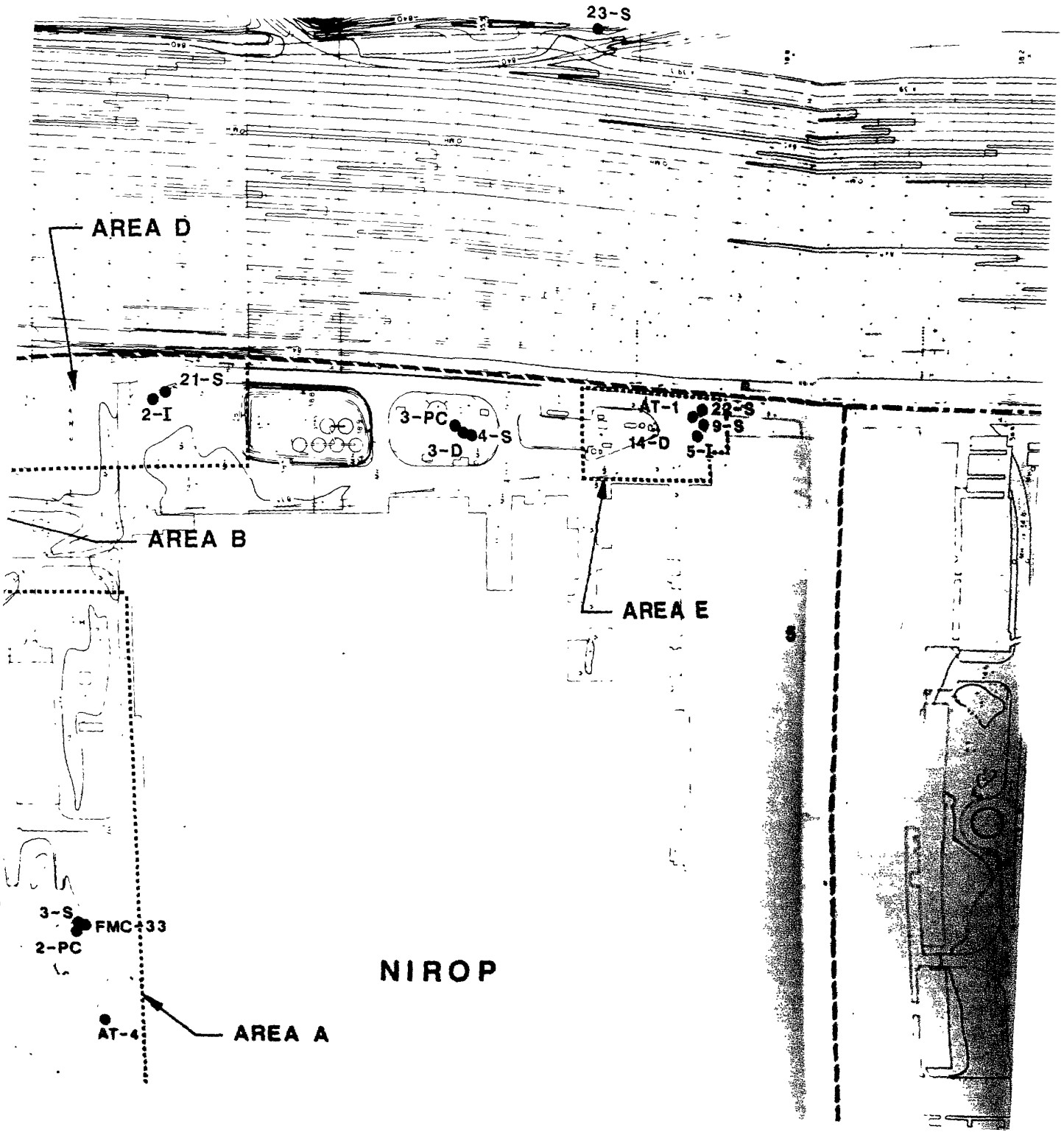
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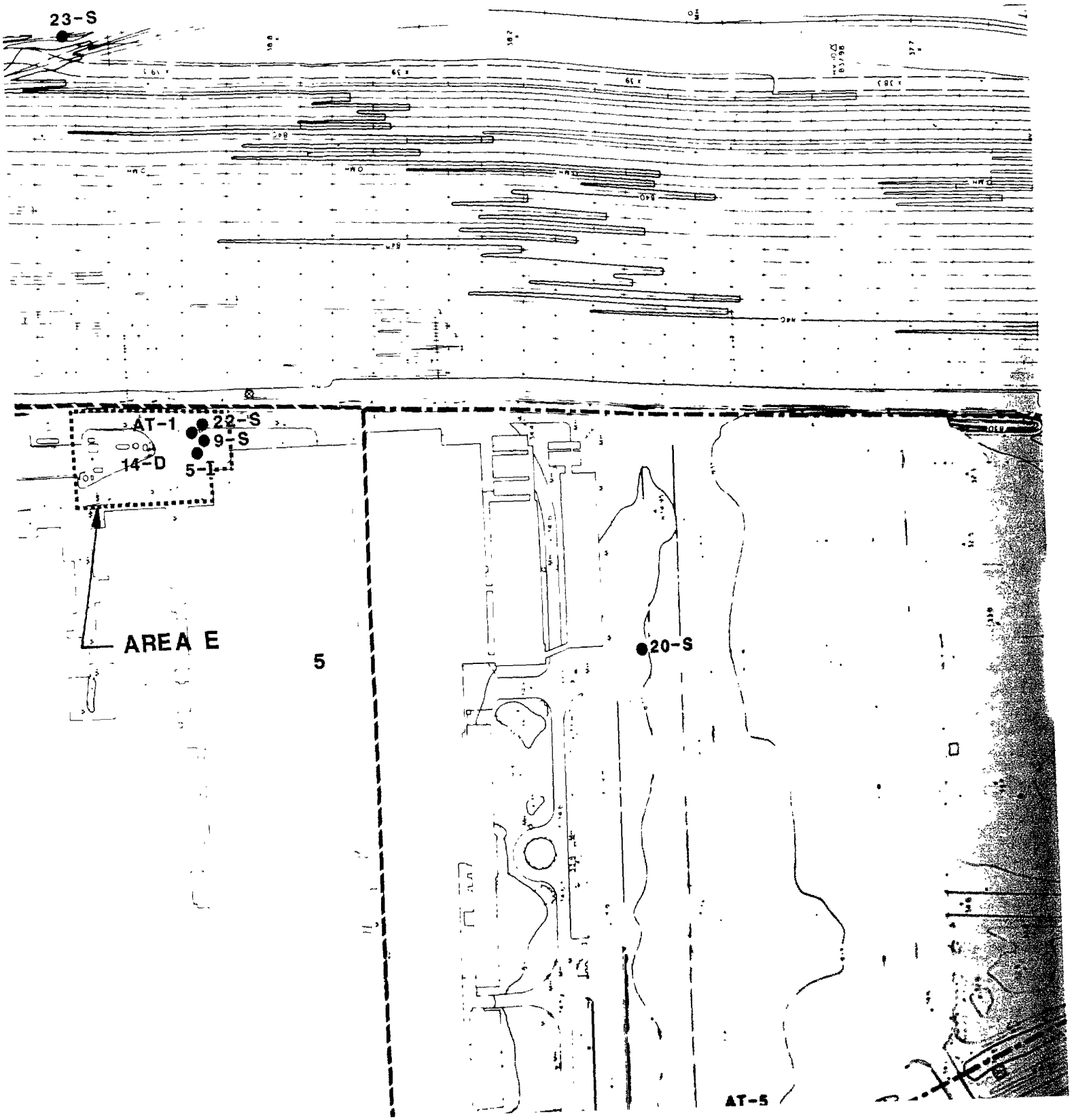
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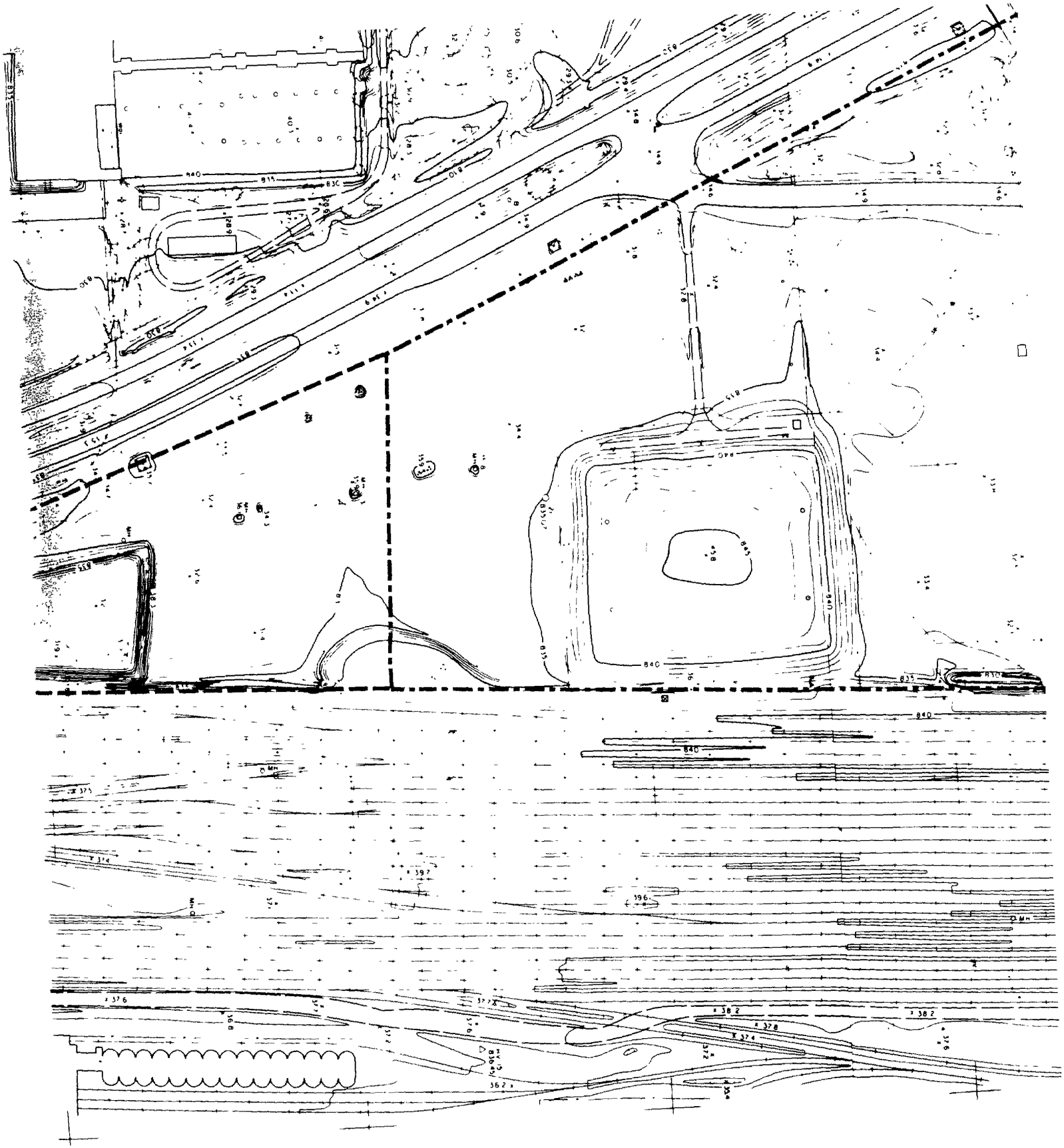

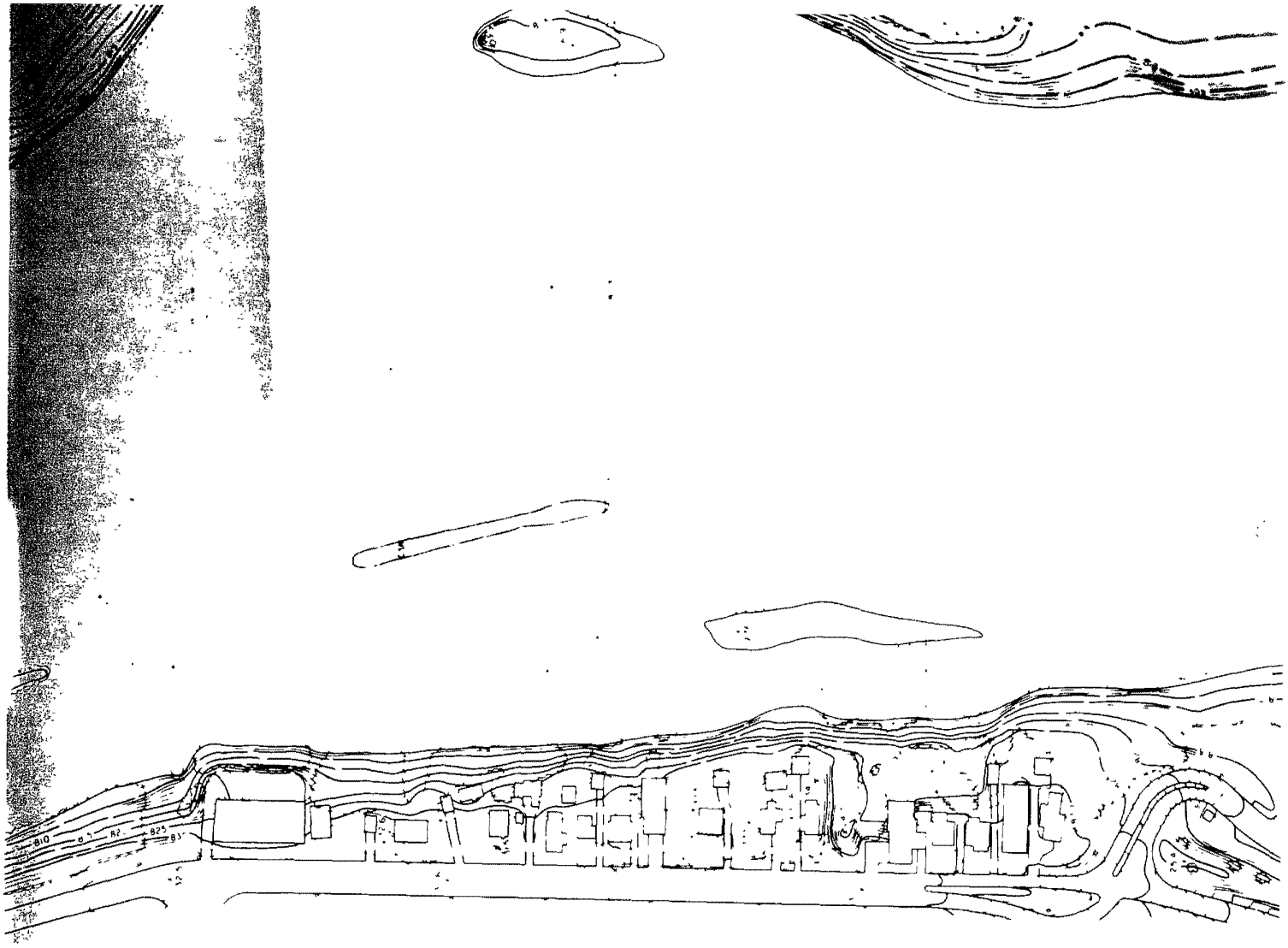

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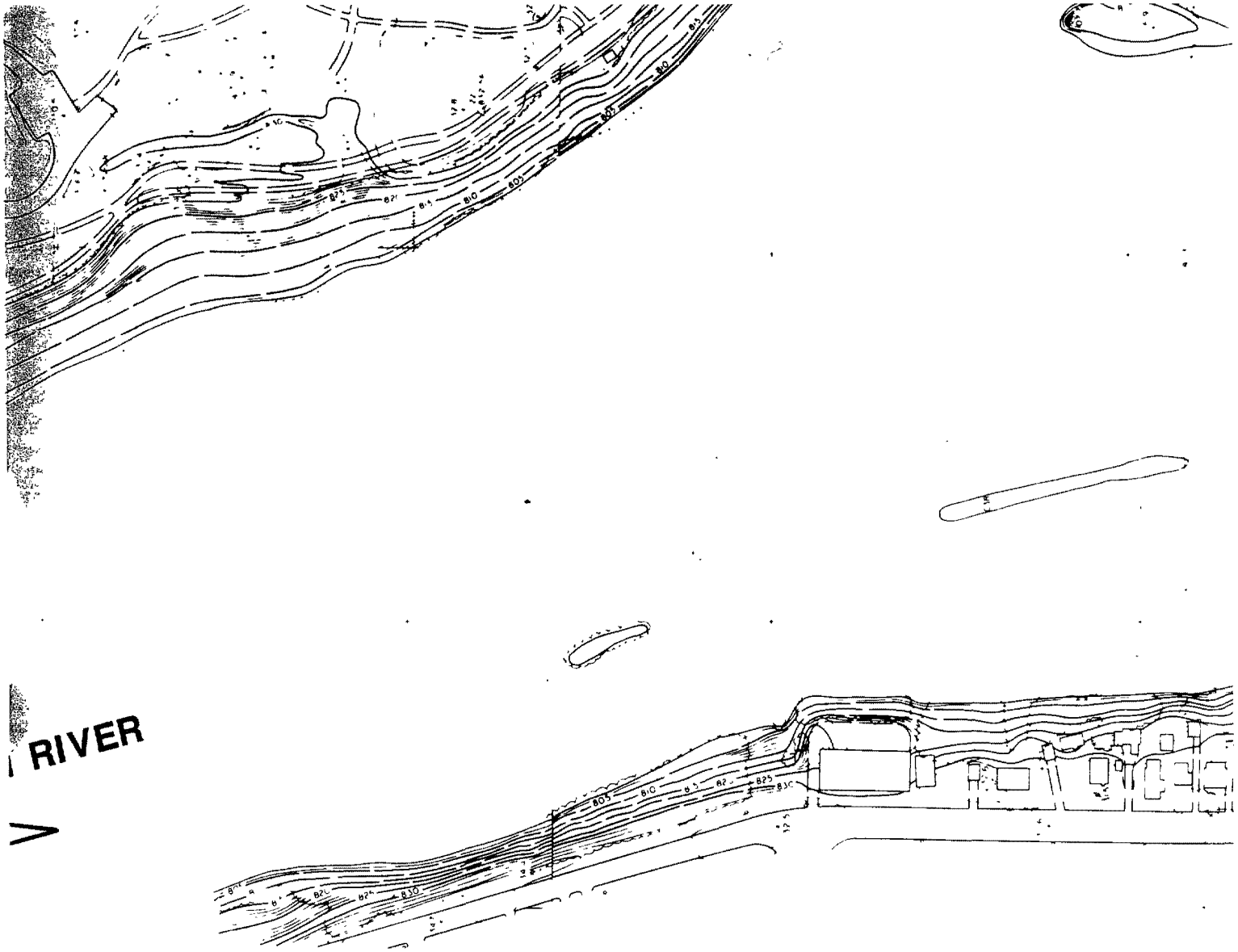

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APPROXIMATE FMC PROPERTY LINE

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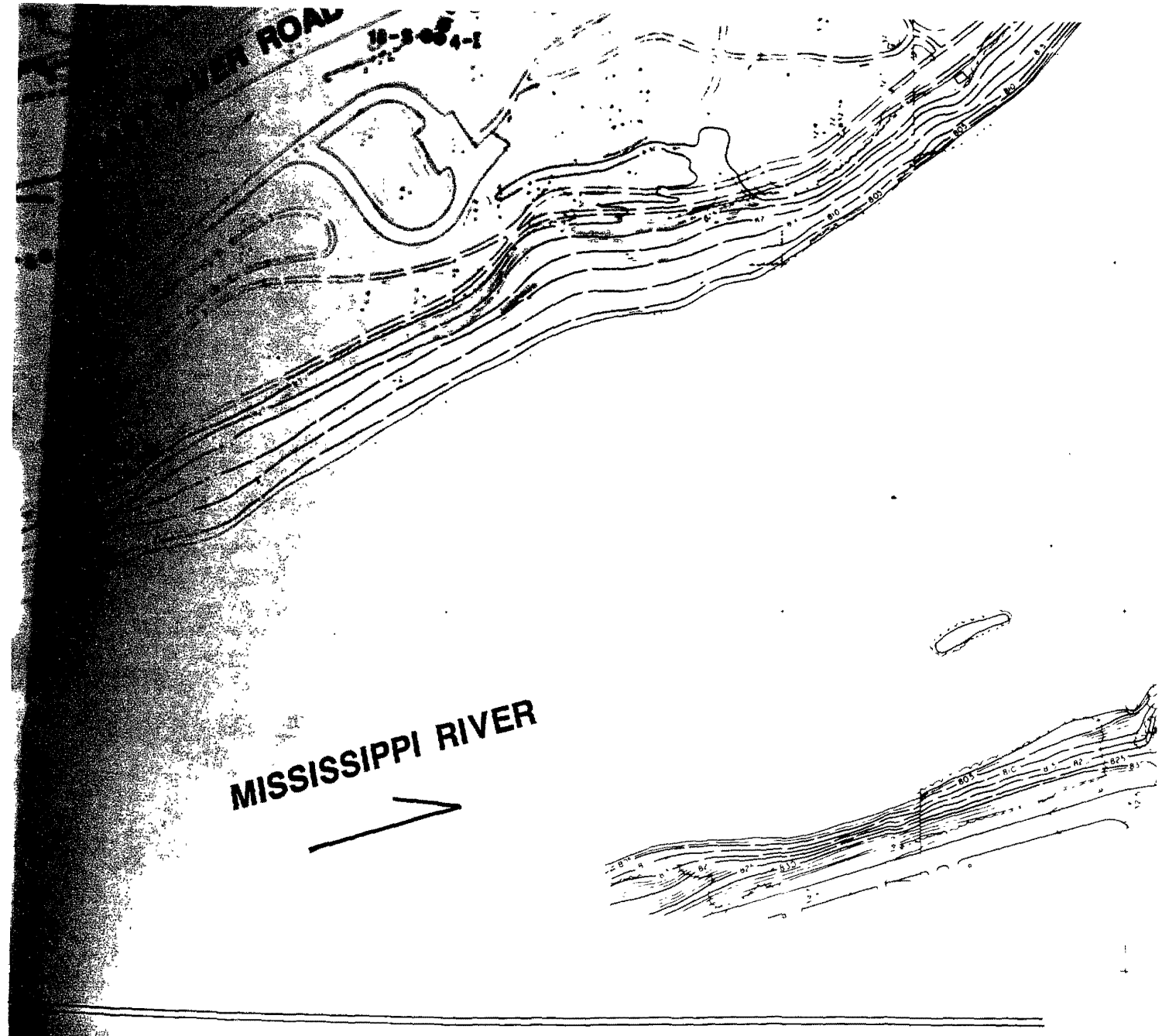

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● 1-D DEEP PIEZOMETER IN UNCONSOLIDATED SEDIMENTS

● 1-PC BEDROCK PIEZOMETER

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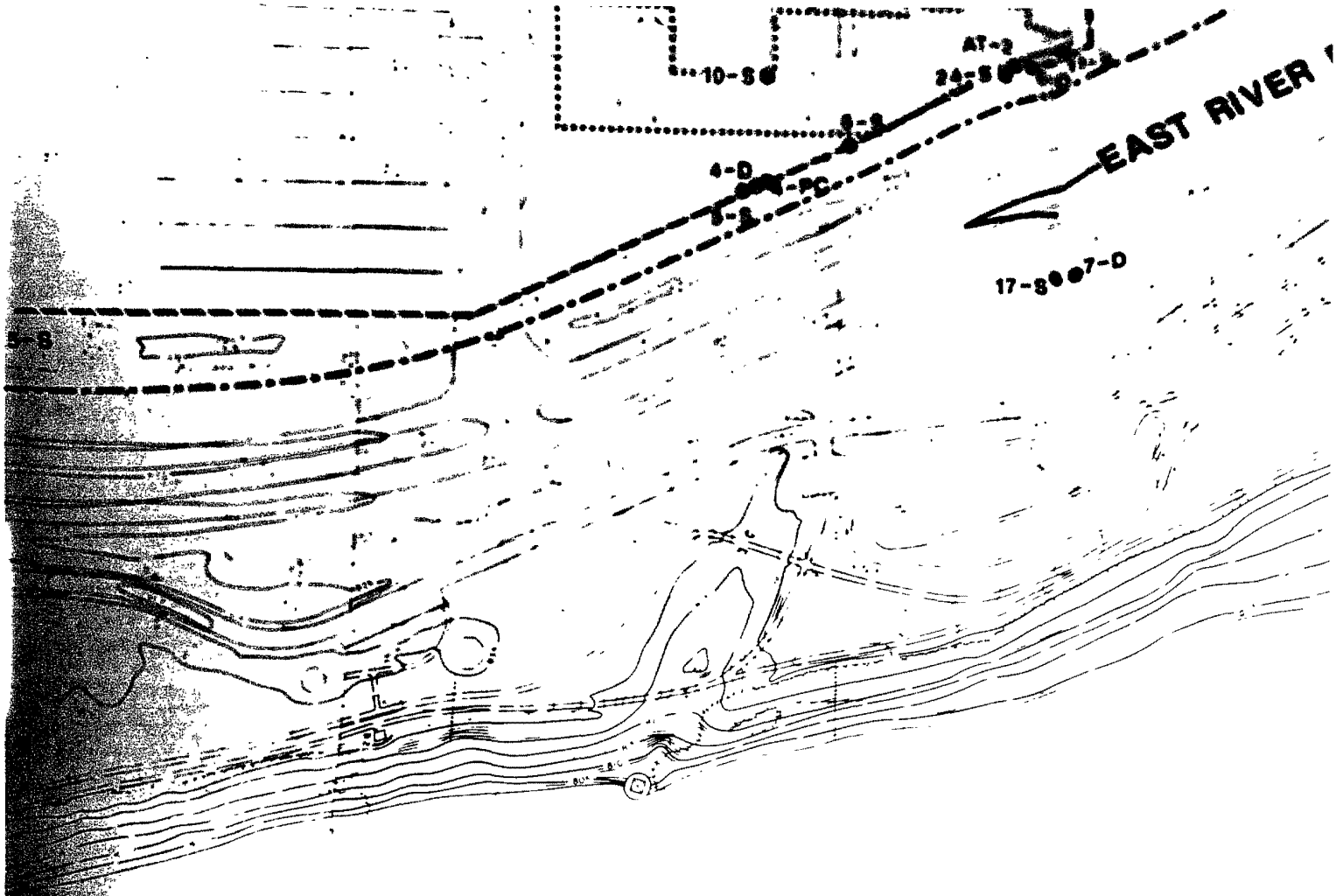
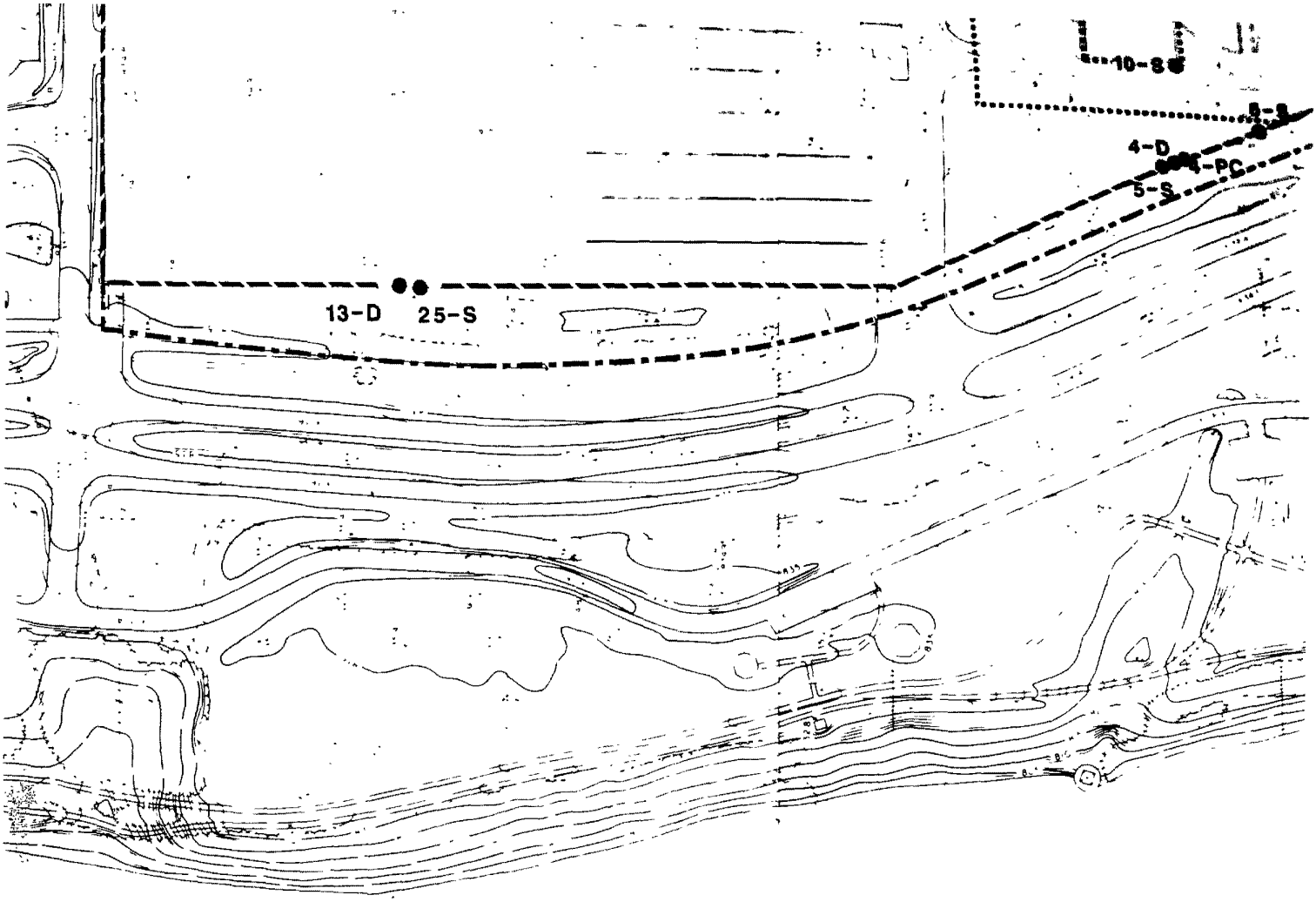


LEGEND

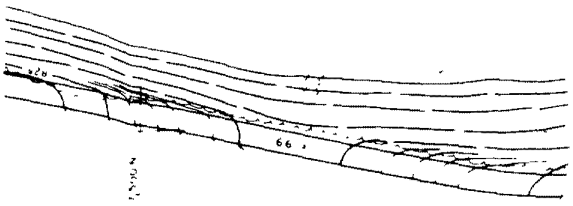
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING BUILDING
- EXISTING FENCE
- 800 — EXISTING 5' CONTOUR
- EXISTING 1' CONTOUR
- x 865.1 — EXISTING SPOT ELEVATION
- TREES AND / OR BRUSH
- EDGE OF WATER
- WET AREA

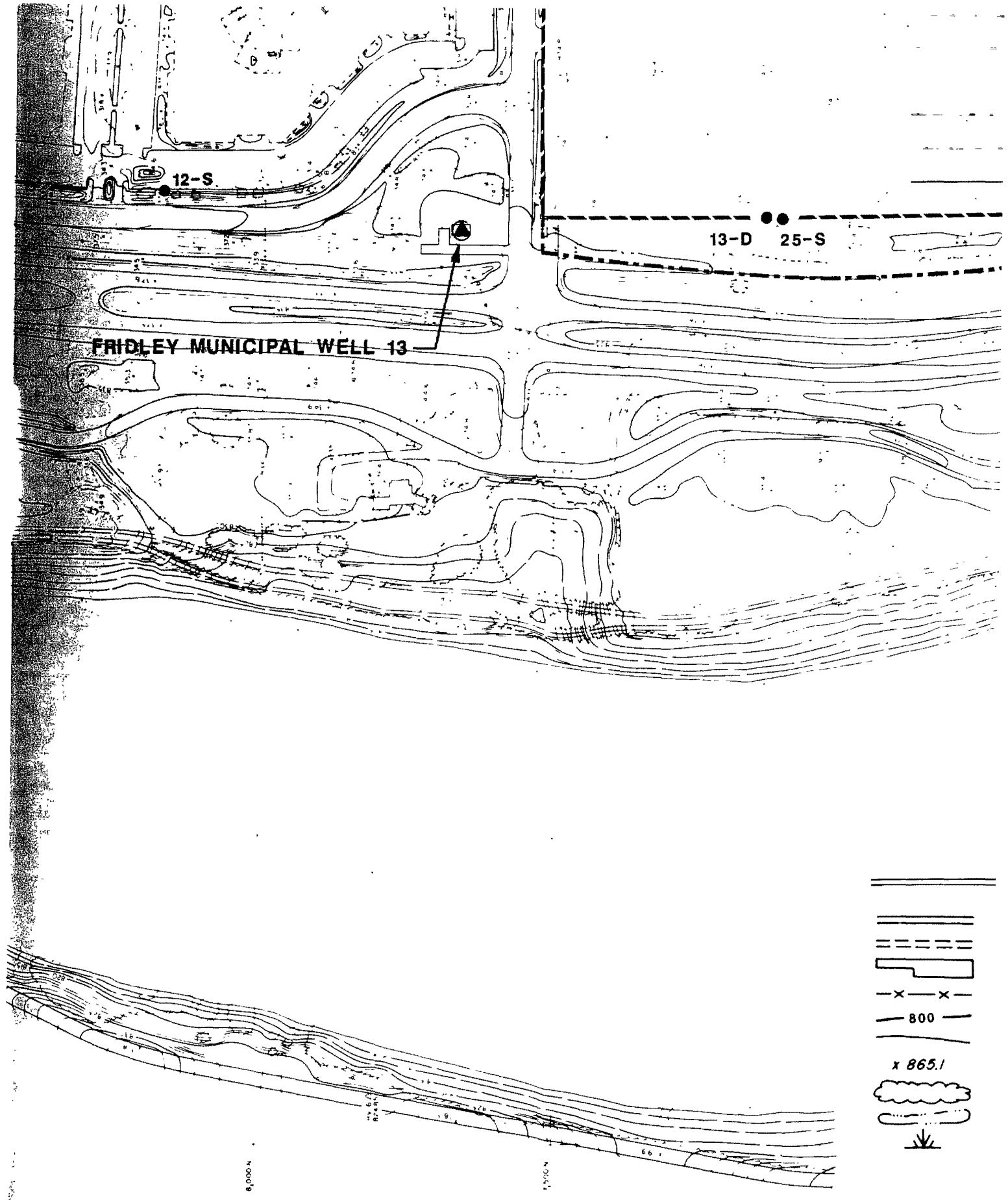
- 1-S — WATER TABLE OBSERVATION WELL IN UNCONSOLIDATED SEDIMENTS
- 1-I — INTERMEDIATE DEPTH PIEZOMETER IN UNCONSOLIDATED SEDIMENTS
- 1-D — DEEP PIEZOMETER IN UNCONSOLIDA' SEDIMENTS
- 1-PC — BEDROCK PIEZOMETER
- AT-1 — PRODUCTION WELL
- MUNICIPAL WELL



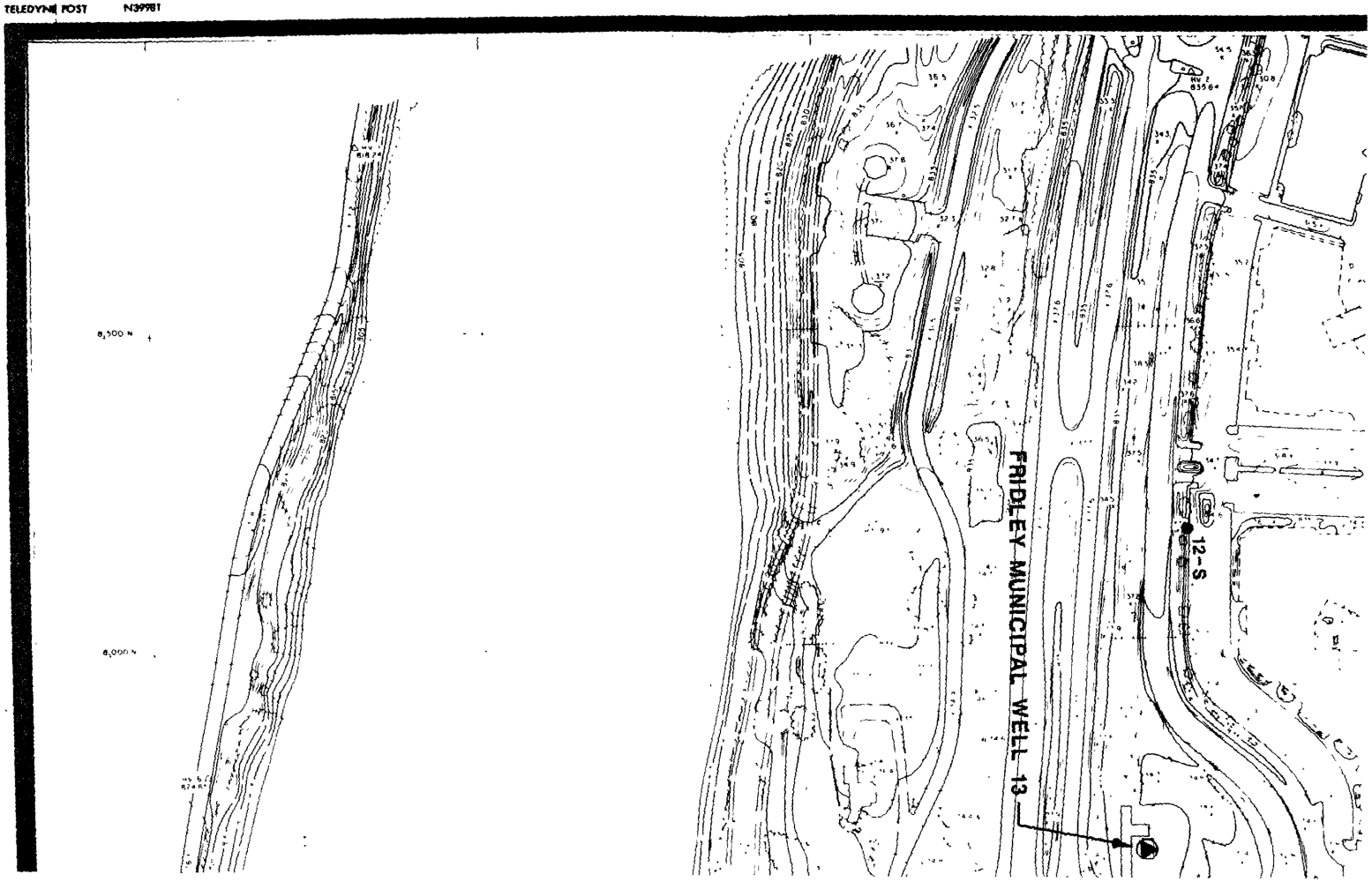
LEGEND

	EXISTING PAVED ROAD	● 1-S
	EXISTING UNPAVED ROAD	
	EXISTING BUILDING	● 1-I
—x—x—	EXISTING FENCE	
—800—	EXISTING 5' CONTOUR	● 1-D
	EXISTING 1' CONTOUR	
x 865.1	EXISTING SPOT ELEVATION	● 1-PC
	TREES AND / OR BRUSH	● AT-1
	EDGE OF WATER	
	WET AREA	




12-S
13-D
25-S
FRIDLEY MUNICIPAL WELL 13
800
x 865.1
8,000 N
7,500 N

TELEDYNE POST N39981



River provides active recreational opportunities to boaters and anglers as well as passive recreation because of its aesthetics and historical significance. The river also serves as a source of public and private drinking water. The City of Minneapolis waterworks facility is located approximately 2,000 feet south (downstream) of the NIROP Fridley's southern property line.

The NIROP Fridley facility is situated over a sand and gravel aquifer capable of yielding significant quantities of water for residential or municipal supplies. The aquifer is generally restricted to the Mississippi River Valley. The sand and gravel aquifer is underlain by the Prairie du Chien/Jordan bedrock aquifer which supplies water for municipal and industrial wells in the metropolitan area. Area geology and ground water use are discussed in detail in Section 5 of the Remedial Investigation Report (ground water unit) prepared by RMT (1987b).

The climate in the area of the NIROP Fridley is characterized by warm summers with average temperatures ranging from the upper 70s°F to the low 80s°F, with moderate rainfall averaging about 17 inches per year. Winter temperatures average between 3° and 7°F for January and February. Winter precipitation (during the months of October through April) averages about 9 inches. Temperature extremes for the area range from - 34° to 104°F (Envirodyne, 1983). Wind directions vary throughout the year. Northwest winds prevail from November through April; southeast winds are dominant in May, June, August, and October; and southern winds dominate in July and September. Wind speeds are fairly constant throughout the year, averaging 10.5 miles per hour (Envirodyne, 1983).

4.2 Summary of Ground Water Contamination Investigation and Remediation

In March 1981, an anonymous telephone call to the MPCA led to the discovery of trichloroethene (TCE) in three NIROP Fridley water supply wells. At that time, grab samples obtained from NIROP Fridley storm sewer outfalls at the Mississippi River also showed

contamination by TCE and other VOCs. Subsequent sampling at the City of Minneapolis Mississippi River water intake (approximately 2,000 feet downstream of the NIROP Fridley) also revealed measurable concentrations of TCE.

Investigation into potential problems at the NIROP Fridley began immediately by FMC Corporation. Two separate areas of concern were identified as the South Study Area (FMC-owned property) and the North Study Area (government-owned property) by Hickok and Associates (Hickok, 1981). FMC has pursued investigation of the South Study Area separately from the government-owned North Study Area.

Investigation of the North Study Area began on March 31, 1982, when Naval officials implemented the Navy Assessment and Control of Installation Pollutants (NACIP) Program to identify and control environmental contamination from past use and disposal practices. An Initial Assessment Study (IAS) was completed in June 1983 by Envirodyne Engineers, Inc. The IAS determined that drummed wastes had occasionally been buried in the northern portion of the NIROP Fridley and, additionally, that the area beneath the NIROP Fridley building may be contributing to ground water problems. As a result of IAS recommendations, the Navy contracted the U.S. Army Corps of Engineers (USACE) to continue investigations.

Ground water monitoring wells have been installed in several phases beginning in June 1983. The current monitoring network consists of more than 50 ground water monitoring wells installed by the USACE and RMT, Inc., one monitoring well installed by FMC, nine proposed ground water monitoring wells, and four containment and recovery wells.

A Record of Decision (ROD) for the ground water operable unit was signed in September 1990. The ROD included the ground water containment and treatment alternative presented in the FS as the selected remedial alternative (RA) for the ground water operable unit. Soils at the NIROP Fridley were identified as a separate operable unit that required further investigation. This document addresses only soils-related activities and their potential as sources of ground water contamination as identified during the ground water RI.

Table 4-1 summarizes a chronology of significant events and activities at the NIROP Fridley with regard to the ongoing ground water remedial investigation and remedial action. The most recent round of ground water sampling was completed in February 1991 and included 52 monitoring wells, the City of Fridley Well No. 13, and one recovery and containment well. The executive summary, introduction, and findings and conclusions from a draft technical memorandum prepared by RMT (1991c) to summarize the February 1991 ground water sampling is included as Appendix D.

Ground water recovery and treatment was selected as the remedial alternative for the ground water operable unit at the site. The installation of ground water recovery and containment wells, as well as the additional ground water monitoring wells, is expected to be completed in late 1991. The recovery system startup and monitoring is anticipated to begin shortly after installation is completed.

4.3 Summary of Previous Soil Investigations

4.3.1 Geophysical Surveys

The investigation of contaminated soils by the U.S. Navy at the NIROP Fridley began following the completion of the Initial Assessment Study (IAS) by Envirodyne Engineers, Inc. (1983). The IAS revealed that, during the 1970s, drums of waste materials were buried in pits and trenches at depths of 8 to 10 feet below ground surface in the area known as the North 40. For purposes of this RI, the North 40 has been subdivided into two smaller areas (A and B) as shown on Figure 4-1.

No records of buried materials were maintained; therefore, the actual amount and location of wastes is unknown. Two hundred or more drums of waste materials were thought to be buried in the pits and trenches (USACE, 1984). The materials disposed in the pits and trenches were thought to include waste oil, plating sludge, paint sludge, cleaning solvents, and degreasing solvents. These waste materials may have contained hazardous substances,

TABLE 4-1

CHRONOLOGICAL SUMMARY OF SIGNIFICANT EVENTS
AND ACTIVITIES AT THE NIROP FRIDLEY

Early 1970s	On-site disposal of paint sludge and chlorinated solvents in pits and trenches reportedly was performed (see Subsection 4.3).
December 1980	Anonymous telephone call is made to the Minnesota Pollution Control Agency (MPCA) concerning past waste disposal practices at the NIROP.
March and April 1981	Trichloroethene (TCE) is detected at concentrations of 35 to 200 µg/L in on-site water supply wells Navy No. 2 and 3 and FMC Well No. 1.
April 24, 1981	On-site water supply wells are shut down.
December 31, 1981	First quantifiable concentrations of TCE are identified at the Minneapolis water treatment plant intake (1.2 µg/L).

In response to these events, the following investigations, remedial actions, and CERCLA enforcement activities have taken place:

September 1980	U.S. Navy implemented the Navy Assessment and Control of Installation Pollutants (NACIP) program.
March 1982	The NACIP program was implemented at the NIROP.
May 1983	U.S. Navy authorized the current Installation Restoration (IR) program.
1983	Initial Assessment Study (IAS) at the NIROP was performed under NACIP. The IAS identified that drummed waste was disposed in the northern portion of the site in 8- to 10-foot-deep trenches or pits. The U.S. Army Corps of Engineers (USACE) conducted geophysical surveys of the suspected disposal areas. Ground water monitoring wells were installed and sampling began.
November 1983 - March 1984	Approximately 1,200 cubic yards of contaminated soil and 43 drums were excavated and disposed off-site in an approved landfill (see Subsection 4.3).
May 22, 1984	The MPCA issued a Request for Response Action at the site to the U.S. Navy and FMC Corporation.

TABLE 4-1 (CONTINUED)

CHRONOLOGICAL SUMMARY OF SIGNIFICANT EVENTS
AND ACTIVITIES AT THE NIROP FRIDLEY

October 1984	Draft Project Report of the hazardous waste cleanup was prepared by the USACE.
June 1986	A ground water Remedial Investigation (RI) and Feasibility Study (FS) was initiated by the USACE, for the U.S. Navy.
March 1987	All use of TCE at the NIROP was discontinued. 1,1,1-Trichloroethane replaced TCE.
June 1987	Final ground water RI report was issued. Additional investigations were recommended.
November 1987 - February 1988	Additional site investigations were performed, including a soil pore gas survey in November 1987.
July 1988	Ground water FS report and an Addendum to the RI report were issued.
August 1988	Addendum to the ground water FS report was issued.
February 8, 1989	The U.S. Navy establishes the Technical Review Committee (TRC) for the project and convenes the first meeting. TRC membership includes the following: USEPA, MPCA, U.S. Navy, U.S. Army Corps of Engineers, Anoka County, City of Fridley, FMC Corp., Metropolitan Waste Control Commission, Minnesota Department of Natural Resources, and RMT, Inc.
April 13, 1989	TRC Meeting 2 was held.
May 22, 1989	Public meeting to present the ground water RI/FS was held in Fridley, Minnesota.
June 15, 1989	TRC Meeting 3 was held.
July 14, 1989	NIROP was proposed for inclusion on the NPL by the USEPA.
September 13, 1989	TRC Meeting 4 was held.
November 21, 1989	NIROP was listed on the NPL by the USEPA.
February 7, 1990	TRC Meeting 5 was held.

TABLE 4-1 (CONTINUED)

CHRONOLOGICAL SUMMARY OF SIGNIFICANT EVENTS
AND ACTIVITIES AT THE NIROP FRIDLEY

May 1, 1990	U.S. Navy issues final Proposed Plan for ground water remediation after review by the MPCA and USEPA.
May 9, 1990	TRC Meeting 6 was held.
May 9, 1990	Public meeting to present the Proposed Plan for ground water was held in Fridley, Minnesota.
May 1, 1990 - May 30, 1990	Public comment period for the proposed ground water remedial action began and ended.
May 22, 1990	Special Notice letter from USEPA was received at the NIROP.
August 23, 1990	TRC Meeting 7 was held.
September 1990	Record of Decision for Ground Water Remediation is signed by the U.S. Navy, the USEPA, and the MPCA.
October - November 1990	Soils investigation was undertaken within three areas of the NIROP (see Subsection 4.3).
	Construction of the ground water containment system begins.
December 6, 1990	TRC Meeting 8 was held.
March 7, 1991	TRC Meeting 9 was held.
June 27, 1991	TRC Meeting 10 was held.
March 1991	Federal Facility Agreement between the USEPA Region V, the MPCA, and the U.S. Navy signed.
September 19, 1991	TRC Meeting 11 was held.

such as cyanide, trichloroethene (TCE), methyl ethyl ketone (MEK), and 1,1,1-trichloroethane (TCA). Wastes were assumed to be liquid, semi-liquid, or solid.

The Navy, through the U.S. Army Corps of Engineers (USACE), began cleanup of the pits and trenches in 1983. USACE personnel conducted geophysical surveys of the suspected disposal areas. Prior to the geophysical survey, Navy and FMC officials arranged to relocate equipment and materials kept in the storage areas to reduce interference with the surveys. The geophysical survey crew completed their task by using both magnetometer and terrain conductivity surveys. Methods and results of the two geophysical surveys are included in the Draft Project Report of the Hazardous Waste Clean-up Site for the United States Navy (U.S. Army Corps of Engineers, 1984; RMT, 1986). Conclusions offered in that report state that results of the magnetometer study roughly corresponded with results of the conductivity study. However, due to interferences, the results of the magnetometer study were not definitive. On the other hand, the results of the electrical conductivity study were found to be much more definitive than those of the magnetometer. As a result of the conductivity survey, 20 conductivity anomalies were identified as potential disposal locations.

The 20 conductivity anomalies were evaluated as to their potential to be indicators of buried wastes, and nine areas were selected for excavation as indicated in Table 4-2. These nine areas were divided into high-, medium-, and low-probability waste sites, as follows:

High-probability - sites 3, 5, 18

Medium-probability - sites 6, 7, 10

Low-probability - sites 15, 17, 19

The criteria for these subdivisions included consideration of aerial photograph analyses and interviews with NIROP Fridley employees. Appendix C contains the USACE conductivity contour map and the text describing both of the geophysical surveys from the Draft Report of the Hazardous Waste Clean-up (USACE, 1984).

TABLE 4-2

SUMMARY OF CONDUCTIVITY ANOMALIES

Magnetic Anomaly Number	Probability as Waste Site	Excavated by USACE	Comments*
1	Potential	No	First of four areas with "no reading[b];" no borings advanced in area; no soil gas survey performed nearby.
2	Potential	No	Second of four areas with "no reading[b];" borings NB21 to NE and NB11 to SW; TCE in NB21 (10 µg/kg) at water table; TCE in NB11 (7 µg/kg) at water table.
3	High	Yes	PCE NB06 (110 µg/kg); PCE NB01, NB04, and NB05 from 9 to 25 µg/kg - TCE NB05 at 380 µg/kg; NB04 at 230 µg/kg; NB01 at 220 µg/kg - removed 41 drums.
4	Potential	No	Third of four areas with "no reading[b];" no borings advanced in area; no soil gas survey performed nearby.
5	High	Yes	No borings done near 5; bottom sample during excavation showed TCE at 50 - 280 µg/kg.
6	Medium	Yes	NB06 showed VOCs - may be due to pit 3, not pit 6.
7	Medium	Yes	No borings near 7; excavation sample near bottom had 1,300 µg/kg TCE.
8	Potential	No	Varying levels of conductivity attributed to rubble, etc. No borings or soil gas survey in vicinity.
9	Potential	No	Varying levels of conductivity attributed to rubble, etc. NB01 had TCE at 45 µg/kg; NB01 had TCE at 220 µg/kg.
10	Medium	Yes	NB13 had several VOC hits; samples 1 foot below bottom during excavation had TCE 50-280 µg/kg.
11	Not Rated	No	Found on conductivity contour map; no boundaries drawn; is <u>not</u> one of four areas where "no reading" was recorded. NE of 5.
12	Potential	No	NB16 had some VOCs.
13	Potential	No	Highest VOCs of soil investigations; metal fragments in cuttings.
14	Potential	No	Fourth of four areas with "no readings[b]."
15	Low	Yes	Covered by soil gas survey; no apparent problem.
16	Not Rated	No	Found on conductivity contour map; no boundaries drawn; is <u>not</u> one of four areas where "no reading" was recorded.

TABLE 4-2 (CONTINUED)

SUMMARY OF CONDUCTIVITY ANOMALIES

Magnetic Anomaly Number	Probability as Waste Site	Excavated by USACE	Comments[a]
17	Low	Yes	Found on conductivity contour map; no boundaries drawn; is not one of four areas where no reading was recorded.
18	High	Yes	Found on conductivity contour map; no boundaries drawn; is not one of four areas where no reading was recorded.
19	Low	Yes	Found on conductivity contour map; no boundaries drawn; is not one of four areas where no reading was recorded.
20	Potential	No	Found on conductivity contour map; no boundaries drawn; is not one of four areas where no reading was recorded.

Notes:

[a] Comments refer to results of previous investigations described in Subsection 4.3.

[b] Four areas found to have "no reading," as reported by the USACE, correlated well with buried asphalt or concrete.

TABLE 4-3
SUMMARY OF COMPOSITE ANALYSES PERFORMED ON DRUM CONTENTS FROM PIT/TRENCH AREA
(Analyses Date, January 1984)

Classification*	Number of Drums	Oil and Grease (% by weight)	Metals	Total (mg/kg)	Leachable** (mg/l)	Volatile Organic Compounds (% by weight)		PCBs (mg/kg)
Empty	4	--		--		--		--
Inert Liquid	4	7.5	As	< 0.07		Isopropanol	0.3	ND
			Ba	5.78		Methyl Ethyl Ketone	0.6	
			Cd	142	7.21	Trichloroethylene	0.2	
			Cr	7,430	2.12	Ethyl Benzene	0.02	
			Cu	15.3		Xylenes	0.07	
			Hg	< 0.005		Hydrocarbons (C_{10}-20)	0.2	
			Ni	6.84				
			Pb	18.9	0.04			
			Se	0.15				
			Zn	2,560	95.7			
Base Solid	1	16	Ag	< 0.22		Methyl Ethyl Ketone	0.06	ND
			As	< 0.07		Trichloroethylene	0.4	
			Ba	119	1.70	Toluene	0.03	
			Cd	8.60	0.01	Ethylbenzene	0.07	
			Cr	427	< 0.01	Xylenes	0.3	
			Cu	71.5		Hydrocarbons (C_6-16)	0.5	
			Hg	< 0.005				
			Ni	22.8				
			Pb	312	< 0.01			
			Se	< 0.07				
			Zn	1,250	3.40			
PCB Waste	6	(a)		(a)		(a)		650 (as 1016)

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TABLE 4-3 (Cont'd)
SUMMARY OF COMPOSITE ANALYSES PERFORMED ON DRUM CONTENTS FROM PIT/TRENCH AREA
(Analyses Date, January 1984)

Classification*	Number of Drums	Oil and Grease (% by weight)	Metals	Total (mg/kg)	Leachable** (mg/l)	Volatile Organic Compounds (% by weight)		PCBs (mg/kg)
Flammable Solid	2	54.4	Ag	0.74		Trichloroethylene	0.06	ND
			As	< 0.08		Toluene	2	
			Ba	44.9		Ethylbenzene	12	
			Cd	2.87	0.01	Xylenes	39	
			Cr	1,020	0.31	Hydrocarbons (C_7-22)	12	
			Cu	24.5		Naphthalene	0.2	
			Hg	< 0.005		C_3 Benzenes	2	
			Ni	8.18		C_4 Benzenes	3	
			Pb	301	< 0.01	C_5 Benzenes	2	
			Se	0.16				
			Zn	32,500	97.3			
Inert Solid	26	6.92	Ag	1.46		Trichloroethylene	0.8	65
			As	1.49		Toluene	0.08	
			Ba	218	2.14	Ethylbenzene	0.2	
			Cd	4.90	0.03	Xylene	1	
			Cr	533	0.16	Hydrocarbons (C_{10}-23)	2	
			Cu	124		Cresols	0.8	
			Hg	0.0202		C_3 Benzenes	0.03	
			Ni	33.1				
			Pb	324	< 0.01			
			Se	< 0.08				
			Zn	1,250	3.16			

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* - Classifications by Chemical Waste Management Corp.
** - Leachable Concentrations by EP Test Procedure
(a) - Constituents Not Reported
ND - Not Detected

Chemical Waste Management of Oakbrook, Illinois, began excavation of the nine from conductivity anomalies in November 1983. A total of 43 drums were recovered (41 drums from Pit 3 and two drums from Pit 17) and stored temporarily on a staging pad until excavation of all of the pits was complete. It is uncertain whether the 200-barrel estimate made by the USACE (1984) was in error, or whether there are still many drums buried in the North 40 storage area.

After excavation, composite samples were obtained from the drums and analyzed. Classification and a summary of the analytical results for the 43 drums are shown in Table 4-3. All empty drums were crushed and disposed with the contaminated soil at the Evergreen Landfill, Northwood, Ohio (USEPA I.D. OHD-68111327). The full or partially filled drums were transported to Emelle, Alabama, and disposed at the Chemical Waste Management Facility (USEPA I.D. ALD-000622464).

The required depth of each excavation was to be determined based on the results of the VOC testing of the soil at the base of the excavations. Guidance from the MPCA staff was that, if the total concentration of VOCs was less than 1 part per million (ppm), backfilling could proceed. The project report of the hazardous waste cleanup (USACE, 1984) stated that all pits, except pits 3 and 6, had VOC concentrations below the 1 ppm (1 mg/kg) guideline at the base of the excavation. During review of data from the excavated areas, it was noted that Pit 7 apparently also exceeded the 1 ppm guideline. The soil in Pit 7 containing more than 1 ppm VOCs was not removed. Pit 3 was also reported to have PCBs in the soil beneath the pit (USACE, 1984).

Upon completion of excavation, five soil sampling locations were identified at the bottom of each excavation. Split-spoon samples were collected at each of the five locations at the bottom of the pit and at 1- and 2-foot depths below the bottom. The range of constituent concentrations detected in soils from pits and trenches upon completion of excavation are shown in Table 4-4.

TABLE 4-4

RANGE OF CONSTITUENT VALUES DETECTED IN SOILS FROM PITS AND TRENCHES UPON COMPLETION OF EXCAVATION*

Constituent	Pit/Trench								
	3	5	6	7**	10	15	17	18	19
Metals (mg/kg)									
Arsenic	< 0.06 - 2.50	< 0.06 - 27.7	< 0.06 - 6.15	< 4 - 6	< 0.7 - 9	< 3.2 - 6.1	< 3 - < 10	< 3.9 - < 16	< 2.7 - 11
Barium	5.01 - 81.8	8.28 - 78.2	7.16 - 169	< 5 - 270	7.5 - 300	(c)	22 - 72	(c)	(c)
Cadmium	0.88 - 2.06	0.90 - 2.91	1.3 - 4.29	< 0.5 - 2	< 0.3 - < 0.6	< 0.4 - 4.3	< 0.3 - < 0.3	< 0.3 - 1	< 0.2 - < 0.4
Chromium (Total)	6.82 - 48.7	9.94 - 16.4	9.00 - 19.3	5.3 - 74	2.2 - 28	(a)	< 2 - 130	(a)	(a)
Copper	5.67 - 314	6.57 - 45.5	5.58 - 80.2	4.1 - 14,000	< 0.7 - 19	1.8 - 4,300	1 - 32	6.4 - 39	7.1 - 36
Lead	12.4 - 48.3	14.3 - 49.4	19.9 - 74.2	< 8 - 550	< 1 - < 2	< 10 - 280	< 2 - 370	< 10 - 22	< 10 - 24
Manganese	(d)	(d)	(d)	< 0.04 - 14,000	39 - 3,000	(d)	100 - 740	(d)	(d)
Mercury	< 0.005 - 0.0363	< 0.005 - 0.0202	< 0.005 - 0.2231	< 0.07 - < 0.1	< 0.03 - < 0.1	< 8.1 - < 0.5	< 0.02 - < 0.8	< 0.1 - 2	< 0.1 - < 0.2
Nickel	9.2 - 18.3	7.98 - 19.2	0.8 - 27.1	7 - 110	< 10 - 25	(e)	4.5 - 37	(e)	(e)
Selenium	< 0.06 - 0.45	< 0.05 - 0.25	< 0.06 - 0.21	< 3.8 - < 6	< 0.8 - < 1	< 2	< 1 - < 2	< 2 - < 8	< 2
Silver	0.23 - 1.36	0.44 - 1.28	0.75 - 1.79	< 0.1 - 3.5	< 1 - 4	< 1	< 1 - < 4	< 1 - < 5	< 0.6 - < 1
Zinc	10.2 - 108	13.4 - 46.5	12.3 - 70.8	8.0 - 890	4.6 - 28	8.4 - 1,200	5.2 - 46	5.1 - 43	16 - 56
Organics (mg/kg)									
Aldrin	< 0.001	< 0.001	< 0.001	< 0.001	< 0.002	< 0.002	ND - < 0.015	< 0.002 - 0.0077	< 0.002
Chlordane	< 0.001	< 0.001	< 0.001	< 0.010	< 0.020	< 0.020 - 0.041	ND - < 0.015	< 0.002 -< 0.020	< 0.020 - 0.028
DDT	< 0.001	< 0.001	< 0.001	< 0.001 - 0.270	0.0025 - .100	0.0024 - 0.130	0.004 - 0.140	< 0.002 - 0.093	0.0048 - 0.126
Dieldrin	< 0.001	< 0.001	< 0.001	< 0.001 - 0.002	< 0.002 - .0063	< 0.002 - 0.0071	ND - 0.015	< 0.002 - 0.012	< 0.002 - 0.022
Endrin	< 0.001	< 0.001	< 0.001	< 0.001 - 0.002	< 0.002 - .0289	< 0.002 - 0.0058	ND - 0.082	< 0.002 - 0.086	< 0.002 -0.0071
Heptachlor	< 0.001	< 0.001	< 0.001	< 0.001	< 0.002 - .0081	< 0.002	0.0048 - 0.0086	< 0.002 - 0.0079	< 0.002
Lindane	< 0.001	< 0.001	< 0.001	< 0.001 - 0.002	< 0.002 - .0023	< 0.002	ND - 0.0025	< 0.002 - 0.0028	< 0.002
Methoxychlor	< 0.001	< 0.001	< 0.001	< 0.005	< 0.010	< 0.002 - < 0.010	< 0.002 -< 0.010	ND	< 0.010
Toxaphene	< 0.005	< 0.005	< 0.005	< 0.020	< 0.050	< 0.050 - 0.280	< 0.050 - 0.280	ND - 0.690	< 0.050 - 0.250
Parathion	< 0.001	< 0.001	< 0.001	< 0.010	< 0.050	< 0.050	ND	< 0.050	< 0.050
PCBs (mg/kg)	< 0.001 - 0.03	< 0.001	< 0.001	< 0.042	< 0.020 - .130	< 0.0055 - 0.077	ND - 1.00	< 0.020	< 0.02 - 0.053
Industrial Solvents (% by weight)	< 1.0	< 1.0	< 1.0	(b)	(b)	< 0.1	(b)	< 0.1	< 0.1

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* Ranges indicated for each pit/trench include values for samples obtained from the surface of the pit bottom; 1 foot below the pit bottom, and 2 feet below the pit bottom. Duplicate sample results have been included in ranges shown where appropriate.

** Pit #7 was excavated and sampled twice due to a surveying error. Values shown represent the second (true) excavation location.

ND - Not Detected

(a) - Total chromium not reported for pits/trenches 15, 18, and 19.

(b) - Industrial solvents not reported for pits/trenches 7, 10, and 17.

(c) - Barium not reported for pits/trenches 15, 18, and 19.

(d) - Manganese not reported for pits/trenches 3, 5, 6, 15, 18, and 19.

(e) - Nickel not reported for pits/trenches 15, 18, and 19.

At the MPCA's request, a modification was made to perform additional pit bottom sampling in order to quantify the presence of 15 VOCs. The previous analyses (Table 4-4) had reported "industrial solvents" on a percent-by-weight basis only. These additional samples were taken 1 foot below the pit bottoms. Additional samples were obtained as follows:

Pit Number		Number of Samples Analyzed
3		6
5		2
6		3
7		3
10		3
15		2
17		3
18		2
19		2
	TOTAL	26

The above testing was performed to detection levels that were 0.01 mg/kg for VOCs. Table 4-5 summarizes the range of concentrations of VOCs from 1 foot below the pit bottom as required by the MPCA.

Pit 3 was lined with plastic sheeting prior to backfilling so that the clean backfill would not come in contact with the trench bottom soil that still contained organic compounds. The remaining eight pits were filled with clean soil without special provisions for segregating the fill from the underlying soil.

In June 1985, at the request of the MPCA, soil from beneath trenches 3 and 6 was resampled. A drill rig was used to obtain split-spoon samples. Samples were obtained at 11 locations in pit 3 and five locations in pit 6. Samples were collected beginning at 10 feet below ground surface to a depth of 20 feet below ground surface. All of the samples were, therefore, collected below the base of the pits. A summary of these soil data is presented as Table 4-6.

TABLE 4-5

SUMMARY OF CONCENTRATION RANGES FOR MPCA-REQUIRED VOLATILE ORGANIC COMPOUND ANALYSES OF SAMPLES FROM ONE FOOT BELOW PIT BOTTOMS

Constituent (mg/kg)	Pit/Trench								
	3*	5	6*	7**	10	15	17	18	19
Ethylbenzene	< 0.010 -< 0.100	< 0.010	NS	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benzene	< 0.010 - < .100	< 0.010	NS	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Methylene Chloride	< 0.005 - 1.200	< 0.010	0.017 -0.033	< 0.005-0.056	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Tetrachloroethylene	0.022 - 6.300	< 0.010	0.042 -0.051	< 0.005-0.078	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
1,1,2-trichloroethane	< 0.010 - < 0.100	< 0.010	< 0.010	< 0.005	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Toluene	0.100 - 12.000	< 0.010	NS	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Chloroform	< 0.010 -< 0.100	< 0.010	< 0.010	< 0.005	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
1,1 dichloroethane	< 0.010 - 5.000	< 0.010	< 0.010	< 0.005	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
cis 1,2-dichloro-ethylene	< 0.010 - NS	< 0.010	< 0.010	< 0.005	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Trans 1,2-dichloro-ethylene	< 0.100 - (> 10.000 - < 100.000)	< 0.010	0.021 -0.064	< 0.005 - 0.057	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
1,1-dichloroethylene	< 0.005 - 1.300	< 0.010	< 0.010	< 0.005	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
1,1,2,2 tetrachloro-ethane	< 0.010 - < 0.100	< 0.010	< 0.010	< 0.005	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
1,1,1,2 tetrachloro-ethane	< 0.010 -< 0.100	< 0.010	< 0.010	< 0.005	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
1,1,1 trichloroethane	< 0.010 - 1.000	< 0.010	< 5.1 - 13	< 0.005-0.014	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Trichloroethylene	0.680 - 3,700	0.050 -0.280	0.160 -1.600	0.045 - 1.300	0.099 - 0.220	< 0.010	< 0.010	< 0.010	< 0.010

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* Due to high concentrations detected in pits/trenches 3 and 6 reanalysis was required by MPCA. Concentrations shown reflect reanalyzed samples.
** Pit #7 was excavated and sampled twice due to a surveying error. Concentrations shown represent the second (true) excavation location.
NS-Data not supplied.

TABLE 4-6

NIROP SOIL SAMPLING RESULTS OF BORINGS ADVANCED AT PITS 3 AND 6
JUNE 1985 (ppm)

Pit #	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Sample # Location	1	1	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7	7
Depth	10.0-11.5	18.5-20.0	10.0-11.5	18.5-20.0	10.0-11.5	14.5-16.0	18.5-20.0	10.0-11.5	14.5-16.0	18.5-20.0	10.0-11.5	12.5-14.0	18.5-20.0	10.0-11.5	14.5-16.0	18.5-20.0	10.0-11.5	14.5-16.0	18.5-20.0
Lead	2.78	3.97	2.43	2.12	1.45	1.64	1.62	1.61	2.35	1.96	1.82	1.63	2.20	2.03	1.82	1.83	2.20	3.04	2.50
Manganese	679	485	328	166	350	194	218	285	340	205	376	357	445	387	226	419	460	390	343
Zinc	11.3	11.7	9.32	11.2	11.3	8.40	11.6	9.03	12.4	11.9	11.1	10.2	11.2	16.2	12.1	13.1	15.8	14.2	8.05
PCB 1242	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002
PCB 1248	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002
PCB 1254	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002
PCB 1260	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002
Methylene Chloride	< .025	< .025	.10	< .025	.035	< .025	< .025	.039	< .025	< .025	< .025	< .025	< .025	< .63	< .63	< .63	< .63	< .025	< .025
1,1-Dichloroethene	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .63	< .63	< .63	< .63	< .025	< .025
1,1-Dichloroethane	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .63	< .63	< .63	< .63	< .025	< .025
Trans 1,2-Dichloroethene	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .63	< .63	< .63	.78	< .025	< .025
1,1,1 Trichloroethane	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	.88	< .63	< .63	1.0	.048	< .025
Trichloroethene	.19	< .025*	< .025*	< .025*	< .025	< .025	< .025	< .025	< .025	.41	< .025	< .025	.042	207	127	78.8	139	6.7	.53
Benzene	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .63	< .63	< .63	< .63	< .025	< .025
Tetrachloroethene	.056	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	.073	< .025	< .025	< .025	16.5	13.0	3.9	13.9	.56	.097
Toluene	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	4.9	7.9	4.6	3.82	.73	.032
Ethylbenzene	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	1.9	10.6	6.4	4.85	2.38	< .025
Chloroform	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .63	< .63	< .63	< .63	< .025	< .025
Bis(2 ethylhexyl) Phthalate	< .0002	< .0002	< .0002	< .0002	.0110	.037	.022	.0085	.016	.022	< .0002	< .0002	.023	< .0002	< .0002	.045	< .0002	< .0002	.033

(1120.05 139:RPT:[illegible])

TABLE 4-6 (Cont'd)
NIROP SOIL SAMPLING RESULTS OF BORINGS ADVANCED AT PITS 3 AND 6
JUNE 1985 (ppm)

Pit #	3	3	3	3	3	3	3	6	6	6	6	6	6	6	6	6	6	6	6	6
Sample # Location	8	8	9	9	10	10	11	1	1	1	2	2	2	3	3	3	4	4	4	5
Depth	12.5-14.0	18.5-20.0	10.0-11.5	18.5-20.0	14.5-16.0	18.5-20.0	18.5-20.0	10.0-11.5	14.5-16.0	18.5-20.0	10.0-11.5	14.5-16.0	16.5-18.0	10.0-11.5	14.5-16.0	16.5-18.0	10.0-11.5	14.5-16.0	16.5-18.0	18.5-20.0
Lead	1.85	2.50	2.47	1.89	1.79	2.78	2.69	1.57	1.81	2.59	1.68	2.10	1.49	1.09	1.86	1.80	1.56	2.27	3.30	2.44
Manganese	192	356	602	394	164	1820	331	357	215	345	1400	526	399	540	266	285	344	196	521	716
Zinc	9.65	10.2	14.2	9.85	9.12	10.7	10.2	9.36	11.8	14.5	11.8	9.10	9.27	11.3	8.27	12.1	12.9	10.1	11.7	12.2
PCB 1242	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002
PCB 1248	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002
PCB 1254	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002
PCB 1260	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002	< .002
Methylene Chloride	< .025	< .025	< .025	< .025	< .025	< .025	.042	.39	.14	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025
1,1-Dichloroethene	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025
1,1-Dichloroethane	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025
Trans 1,2-Dichloroethene	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025
1,1,1 Trichloroethane	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025
Trichloroethene	< .025	.30	.034	< .025*	< .025	< .025*	.15	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	.026	< .025*
Benzene	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025
Tetrachloroethene	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025
Toluene	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025
Ethylbenzene	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025
Chloroform	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025	< .025
Bis(2 ethylhexyl) Phthalate	.0049	.0051	< .0002	< .0002	< .0002	< .0002	< .0002	.031	.037	.0111	.0395	.0247	.0297	.234	.0732	.0200	< .0002	< .0002	< .0002	< .0002

(1120.05 139:RPT:fr1d0718t)

Three organic compounds were detected in 11 of 13 samples collected below pit 6. Methylene chloride was found in two samples (0.39 and 0.14 mg/kg), and bis(2-ethylhexyl)phthalate was found in nine samples (concentrations ranged from 0.234 to 0.020 mg/kg). TCE was detected in two samples: one from boring 4 between the 16.5- and 18-foot depth at 0.026 mg/kg, and one from boring 5 between the 18.5- and 20-foot depth identified as present but not quantifiable. Samples from below pit 3 contained eight organic compounds at concentrations greater than those in pit 6. TCE was detected in 75 percent of the samples, from all depths below pit 3, and in concentrations ranging from present but below detection limits to 207 mg/kg. TCE was most prevalent at the eastern end of pit 3. Other organic compounds detected included tetrachloroethene (PCE) (0.0987 to 16.5 mg/kg), TCA (0.048 to 1.0 mg/kg), methylene chloride (0.10 to 0.039 mg/kg), toluene (0.032 to 7.9 mg/kg), ethylbenzene (1.9 to 10.6 mg/kg), bis(2-ethylhexyl)phthalate (0.0049 to 0.045 mg/kg), and trans-1,2-dichloroethene (DCE) (0.78 mg/kg).

The presence of high concentrations of VOCs below the pits indicated that an unknown quantity of these hazardous constituents was released from the disposal areas. The VOCs are likely to have entered the ground water flow system since the water table is approximately 23 feet below the ground surface (RMT, 1991b) in the area of the pits. The disposal activities in some of the pits and trenches did result in releases of hazardous substances into the environment. The constituents left in the soil (Table 4-6) may also form a continuing source to the ground water as precipitation infiltrates the sandy soils.

Original data for the trench excavation work performed by Chemical Waste Management, and the results of the additional soil sampling, are located in Volume II of the Interim Report for RI/FS (RMT, 1987a) and include the following:

- Analytical results of excavated drum contents and shipping manifests.
- Soils data from pit and trench excavations at the bottom, the 1-foot depth, and the 2-foot depth.
- Results of MPCA-requested VOC analysis 1 foot below pit bottoms.
- Results of soil borings advanced at trenches 3 and 6, June 1985.

4.3.2 Soil Pore Gas Survey

In November 1987, RMT conducted a soil pore gas survey at the NIROP Fridley. The purpose of the survey was to screen and identify areas of shallow, VOC-contaminated soil that may be contributing to ground water contamination. A complete description of the field-sampling and analysis methods, QA/QC procedures, and results are included in the A-E Quality Control Summary Report for the Soil Gas Survey (RMT, 1988a).

The soil gas sampling locations and the results of field gas chromatograph (GC) analyses of the gas samples are shown on Figures 4-2 and 4-3. A summary of the key results, findings, and conclusions is presented below.

Methodology - Two methods were used for collecting soil gas samples for analysis by the field GC: 1) a stainless-steel tube (probe) was driven into the ground, and a gas sample was drawn through this tube by applying a vacuum to the tube; and 2) headspace from a soil sample was collected by hand-augering into the ground. Soil gas samples were collected between 2.5 and 3.5 feet below the ground surface. Both sample collection methods gave comparable results from GC analysis of the samples. Compounds analyzed and the GC associated detection limits were as follows:

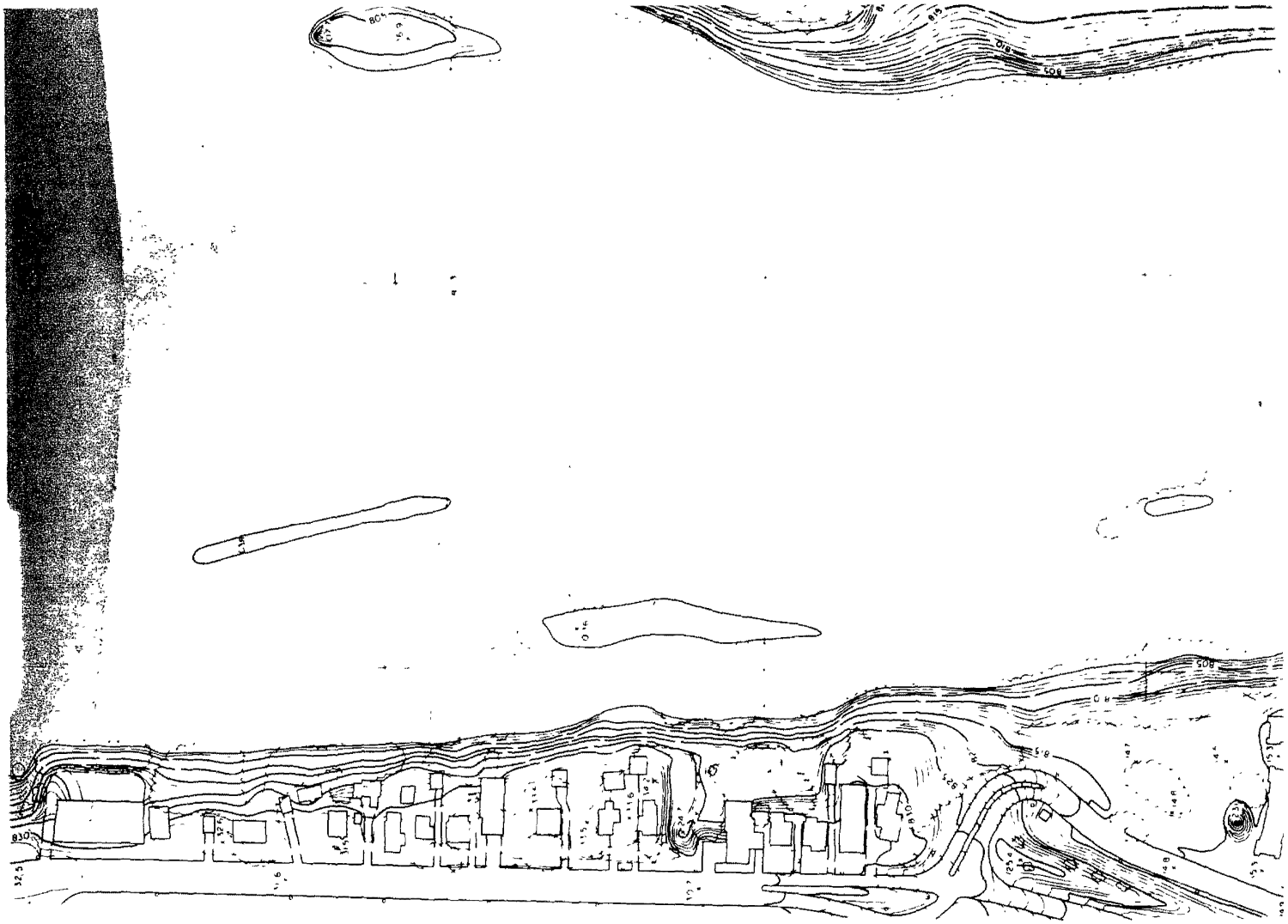
Trichloroethene	0.010 μL/L
cis-1,2-Dichloroethene	0.050 μL/L
trans-1,2-Dichloroethene	0.050 μL/L

Both methods also gave fairly reproducible results. The mean percent difference between replicates was 19.7 percent for headspace samples and 6.1 percent for pore gas samples.

Soil Gas Results - The areas referred to below are shown on Figure 4-2.

<u>Area I (former TCE tank area west of the plant) and Background</u>

- The former TCE tank has been located on Figure 4-2. Although the former tank was located under a building addition, nine soil gas samples were



SCALE: 1" = 200'

200 400 600 FEET

NO.	BY	DATE	REVISION	APP
3.				
2.				
1.				

PROJECT :

REMEDIAL INVESTIGATION
NIROP - FRIDLEY, MINNESOTA

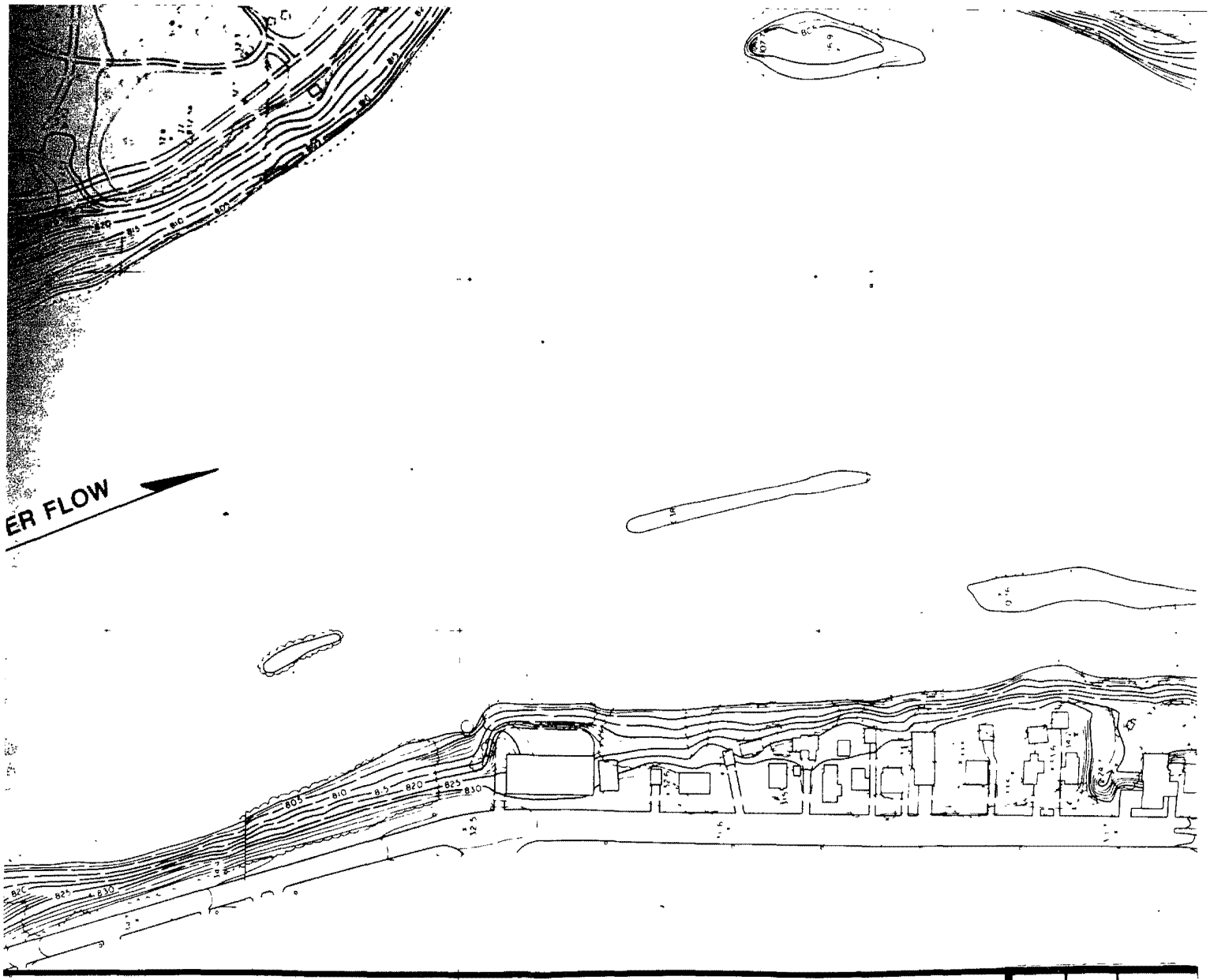
SHEET TITLE :

SOIL GAS SAMPLING LOCATIONS AND TCE + DCE CONCENTRATIONS

DRAWN BY: DPR	SCALE : 1" = 200'	PROJ . NO . 2313.01
CHECKED BY: J. Kral		DRWG . NO .
APPROVED BY: G. Kenoyer	DATE PRINTED :	SHEET **FIGURE 4-2**
DATE : JANUARY 1992		

RMT INC
Suite 124
1406 East Washington Ave
Madison, WI 53703
Phone 608-255-2134

JAN 20 1992



SCALE: 1" = 200'

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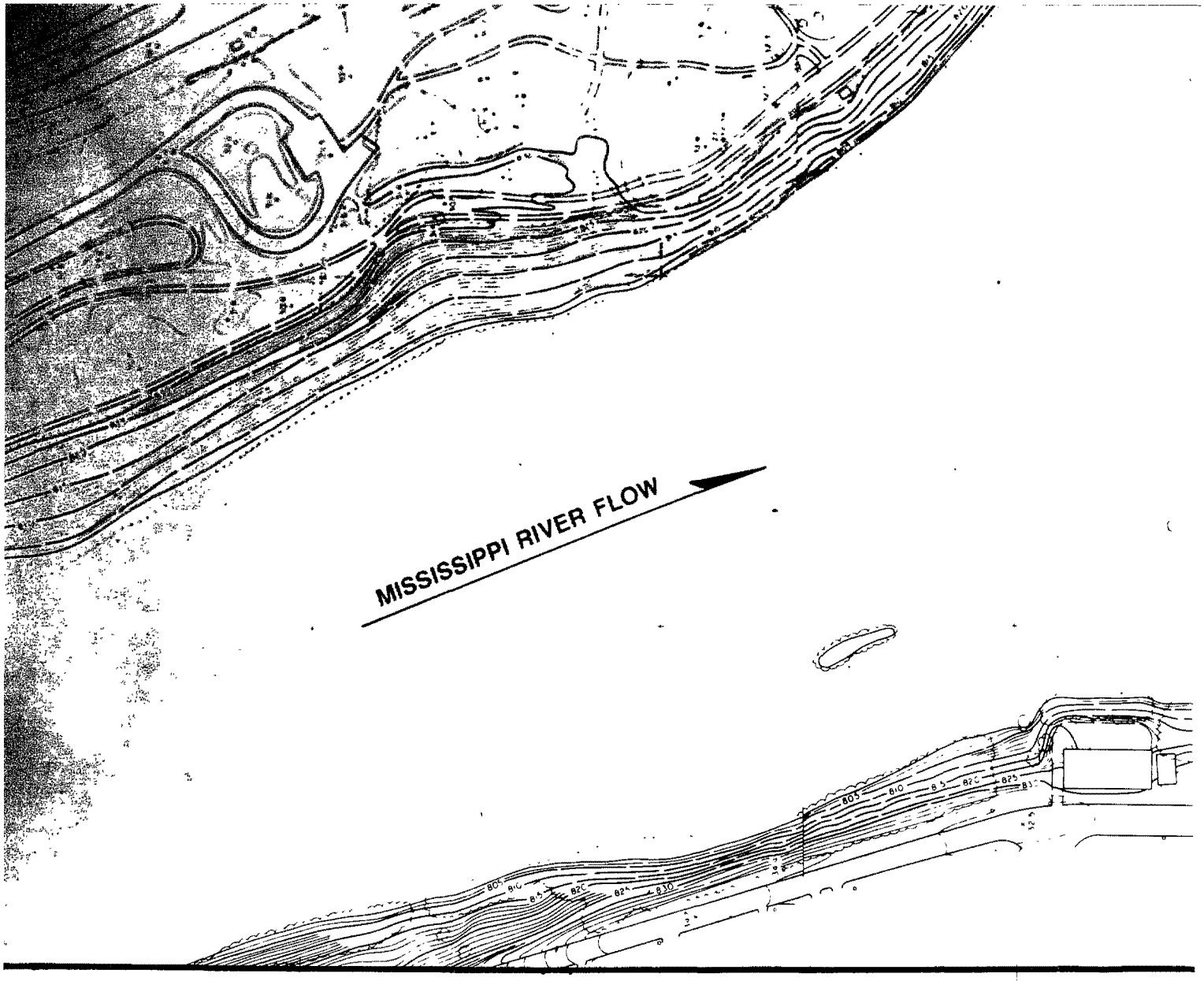


INTENDED LOCATION, NOT SAMPLED

SITE NUMBER

CONCENTRATION OF TCE AND DCE IN SOIL PORE GAS IN PPM (VOLUME/VOLUME BASIS)

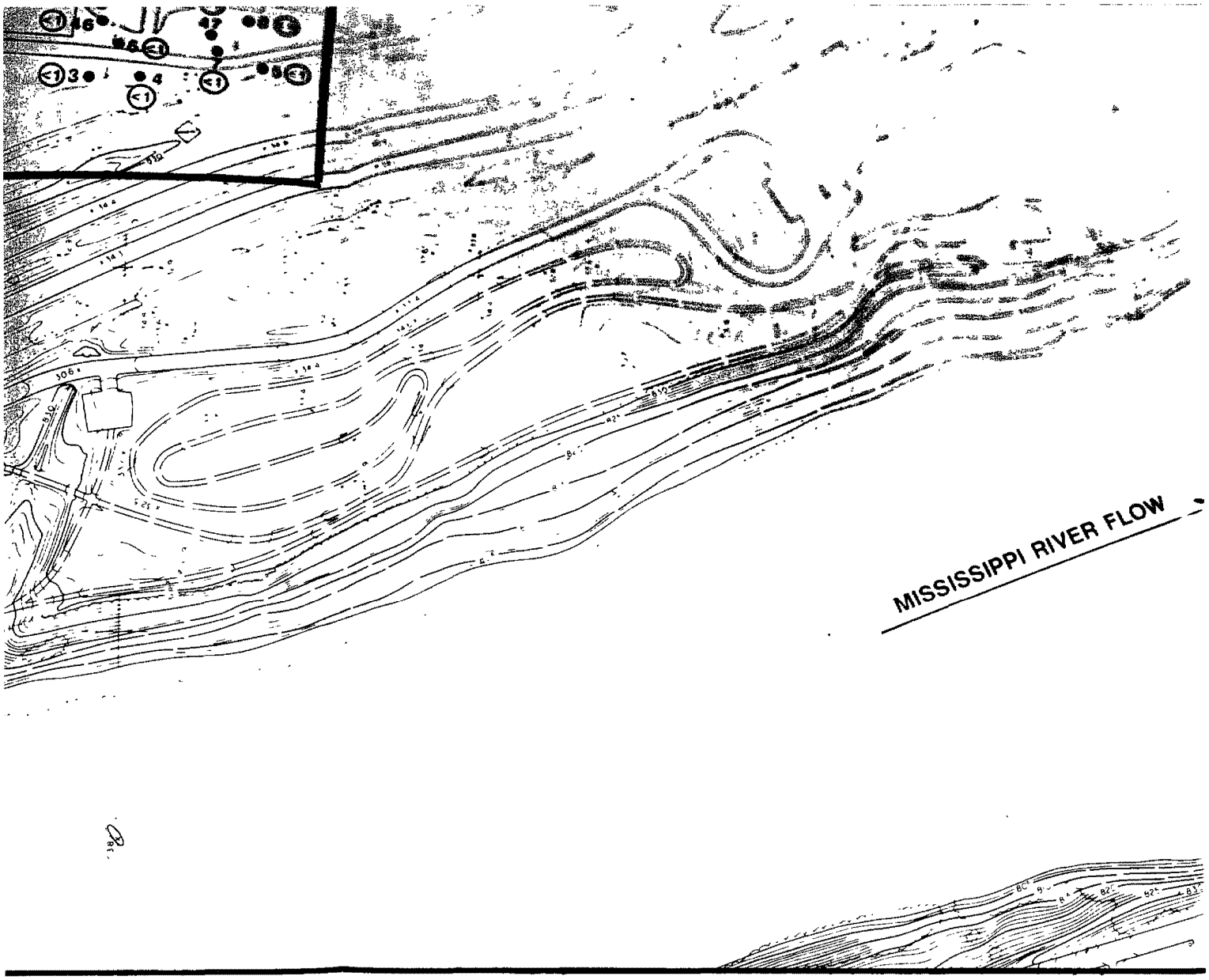
AREA BOUNDARY LINE

ENLARGEMENT BOUNDARY LINE

SCA

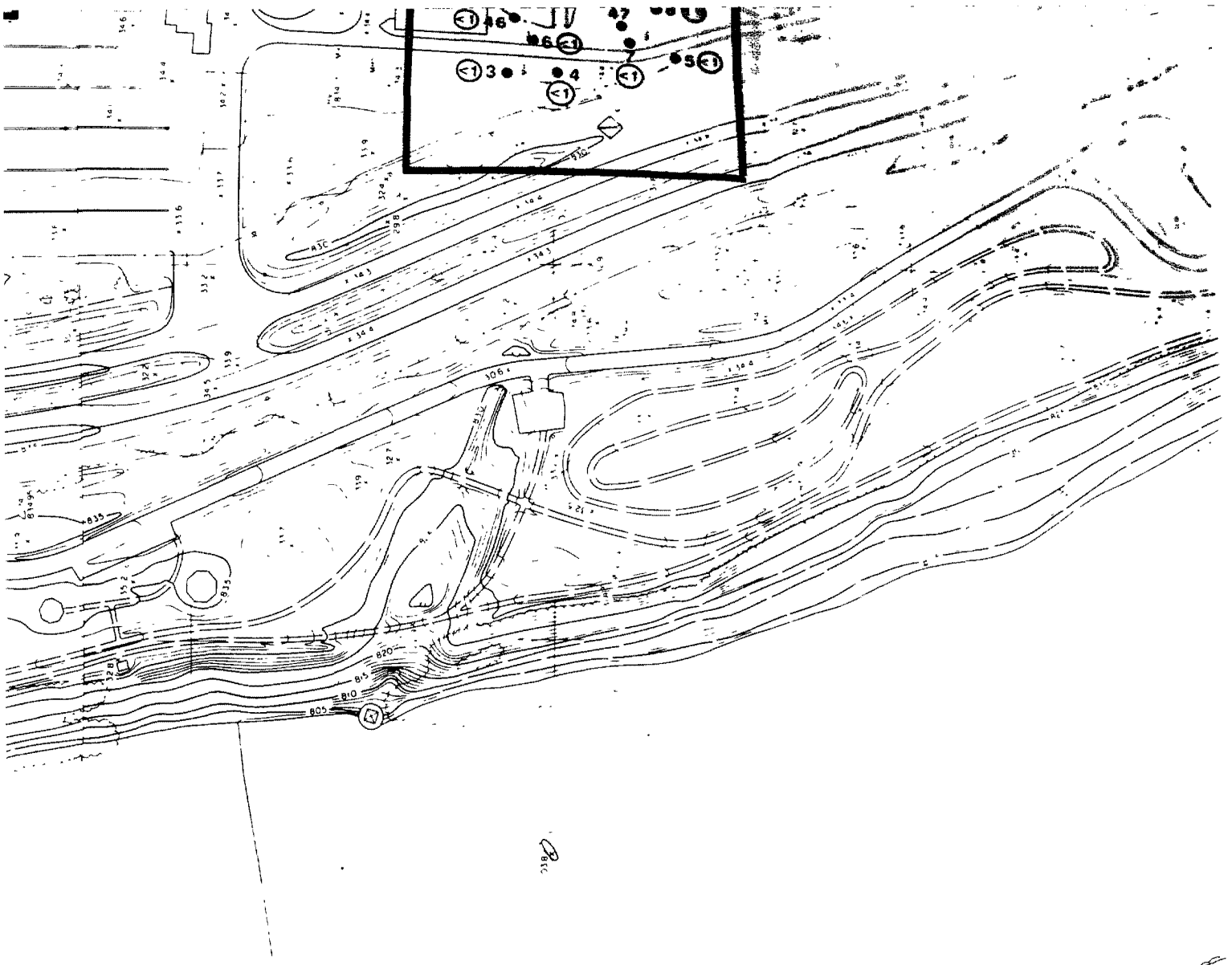
0 200

)N/FEASIBILITY
T. JULY, 1988.



EXISTING PAVED ROAD	(58)	INTENDED LOCATION, NOT SAMPLED
EXISTING UNPAVED ROAD	8●	SITE NUMBER
EXISTING BUILDING	③	CONCENTRATION OF TCE AND DCE IN SOIL PORE GAS IN PPM (VOLUME/VOLUME BASIS)
EXISTING FENCE		
EXISTING 5' CONTOUR		AREA BOUNDARY LINE
EXISTING 1' CONTOUR		ENLARGEMENT BOUNDARY LINE
EXISTING SPOT ELEVATION		
TREES AND / OR BRUSH		
EDGE OF WATER		
WET AREA		

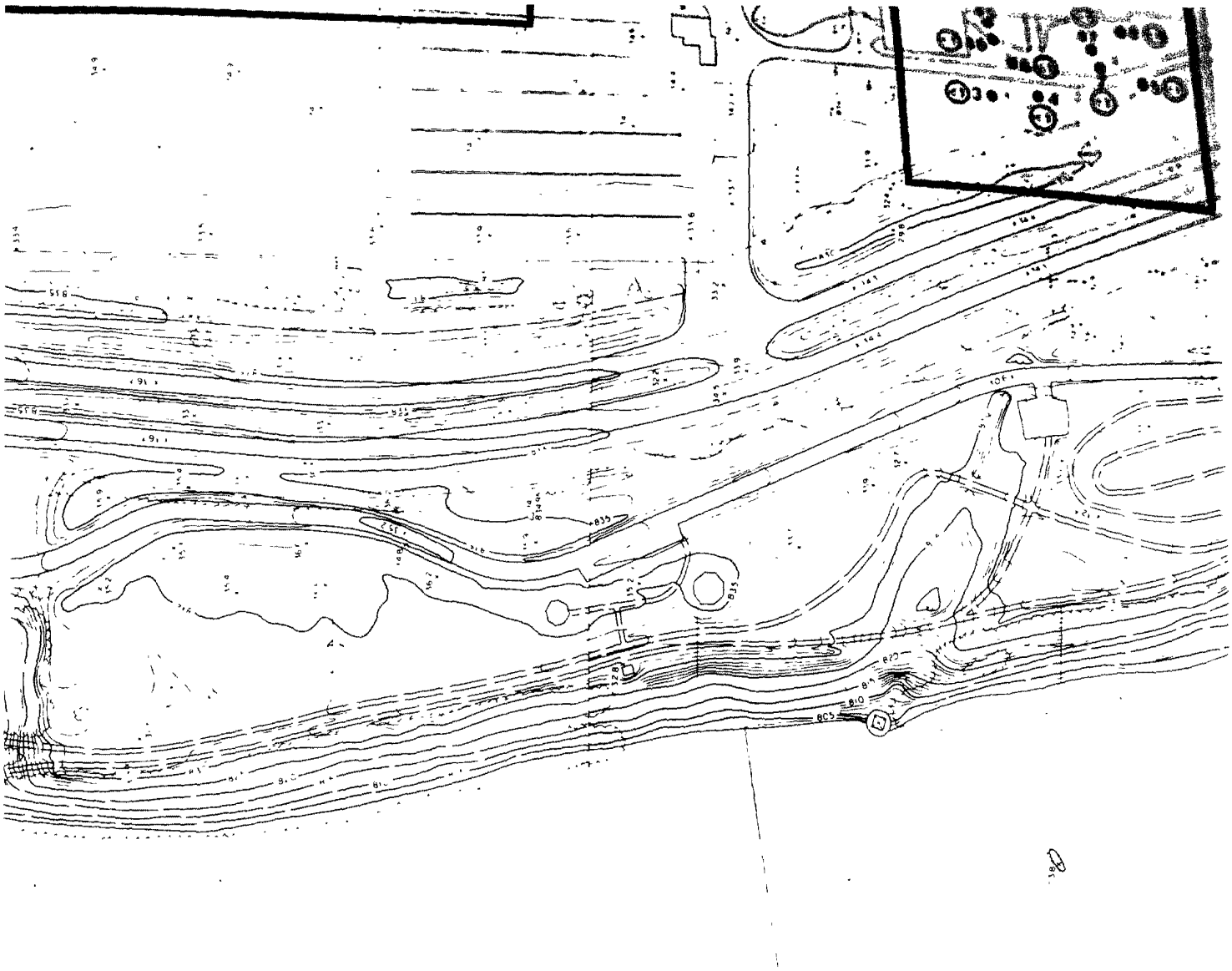
INC., 1988. ADDENDUM TO THE REMEDIAL INVESTIGATION/FEASIBILITY
' AT THE NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT. JULY, 1988.



LEGEND

	EXISTING PAVED ROAD	(58)	INTENDED LOCATION, I
	EXISTING UNPAVED ROAD	8●	SITE NUMBER
	EXISTING BUILDING	③	CONCENTRATION OF PORE GAS IN PPM (VC
—×—×—	EXISTING FENCE		
—800—	EXISTING 5' CONTOUR		AREA BOUNDARY LINI
	EXISTING 1' CONTOUR		ENLARGEMENT BOUNI
x 865.1	EXISTING SPOT ELEVATION		
	TREES AND / OR BRUSH		
	EDGE OF WATER		
	WET AREA		

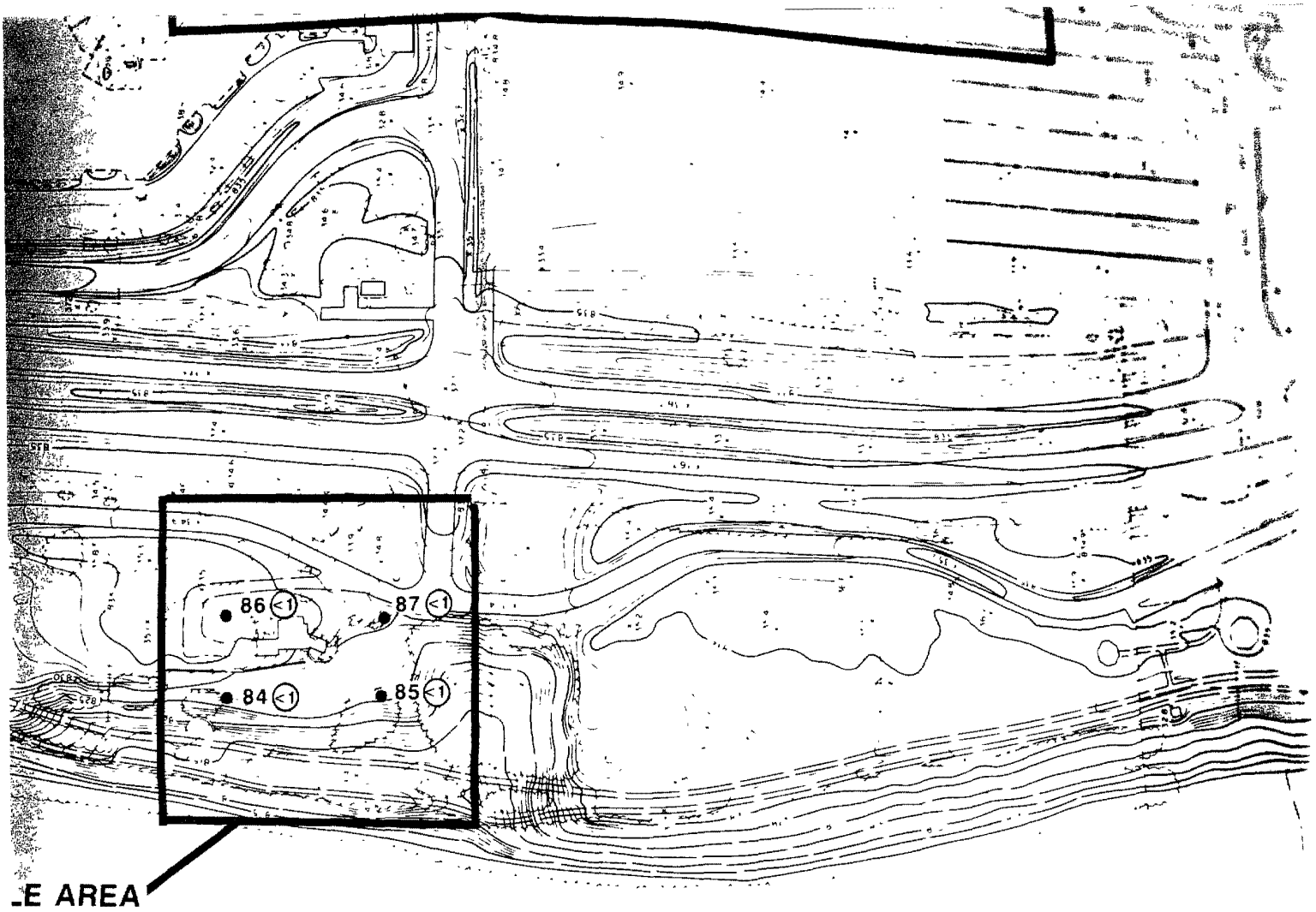
SOURCE: RMT, INC., 1988. ADDENDUM TO THE REMEDIAL INVESTIGATION/FEASIBILITY STUDY AT THE NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT. JULY, 1988.



LEGEND

- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING BUILDING
- EXISTING FENCE
- 800 — EXISTING 5' CONTOUR
- EXISTING 1' CONTOUR
- x 865.1 — EXISTING SPOT ELEVATI
- TREES AND / OR BRUSH
- EDGE OF WATER
- WET AREA

SOURCE: RMT, INC., 1988. ADDENDUM TO TH
STUDY AT THE NAVAL INDUSTRIAL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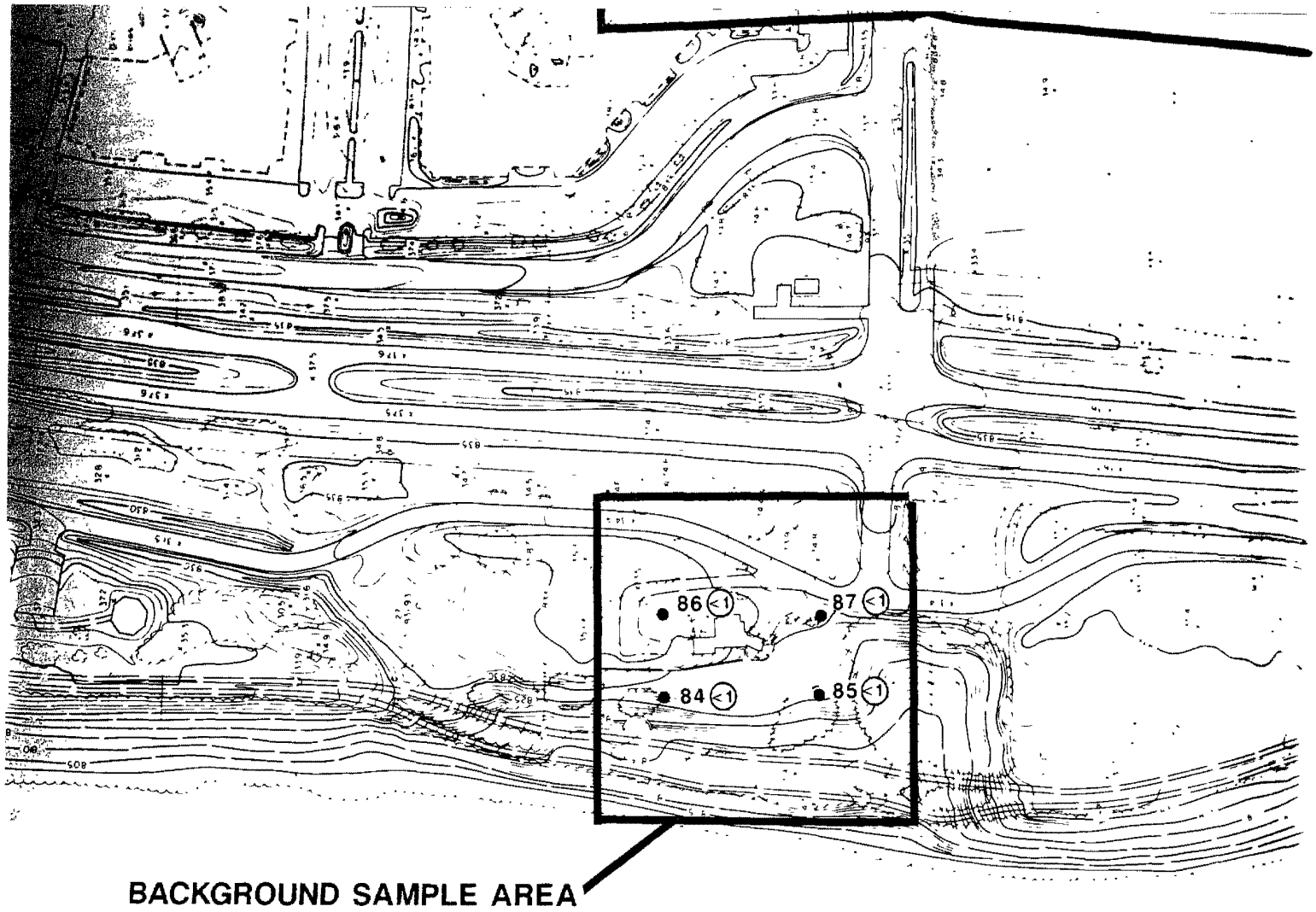
E AREA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87 <1
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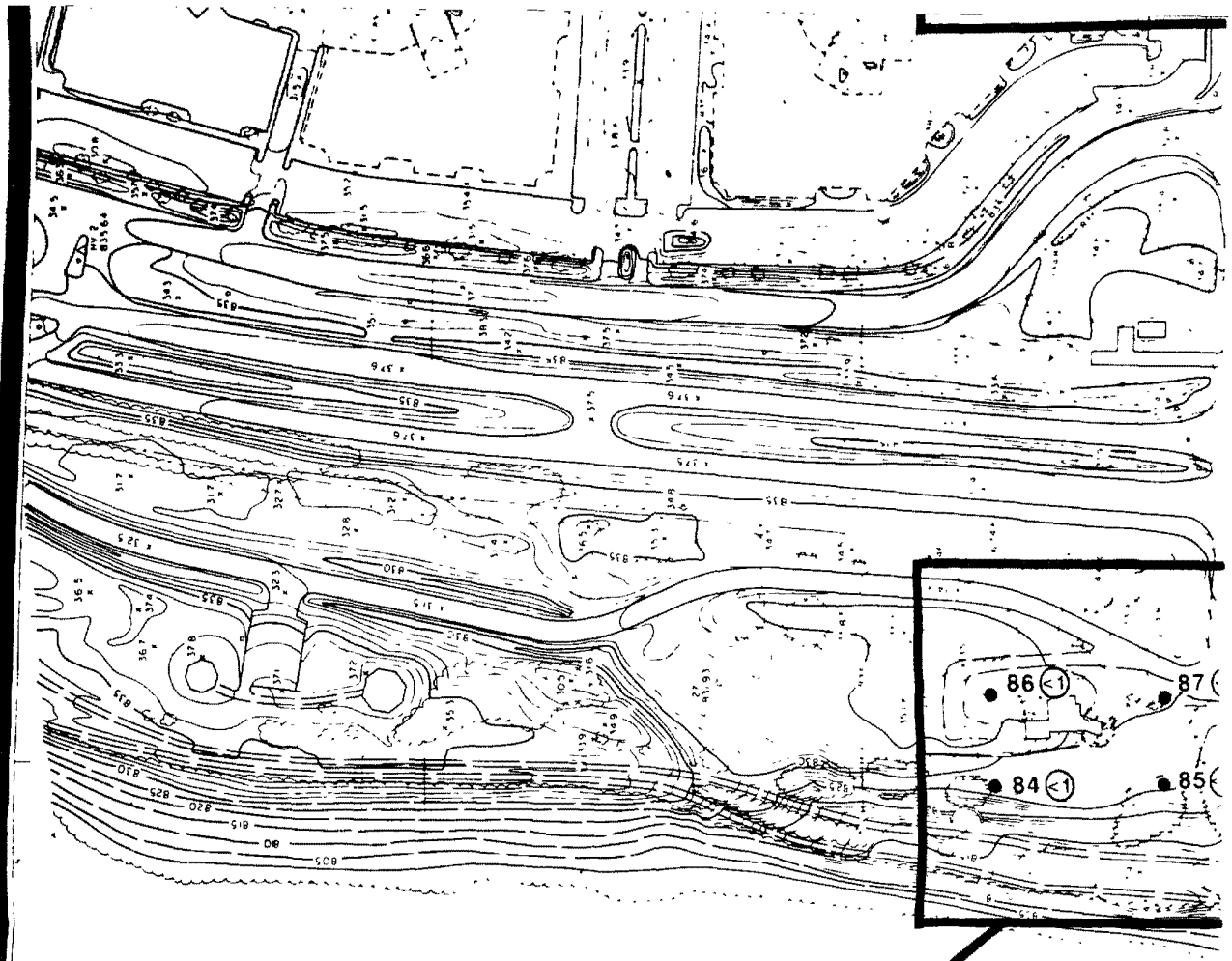
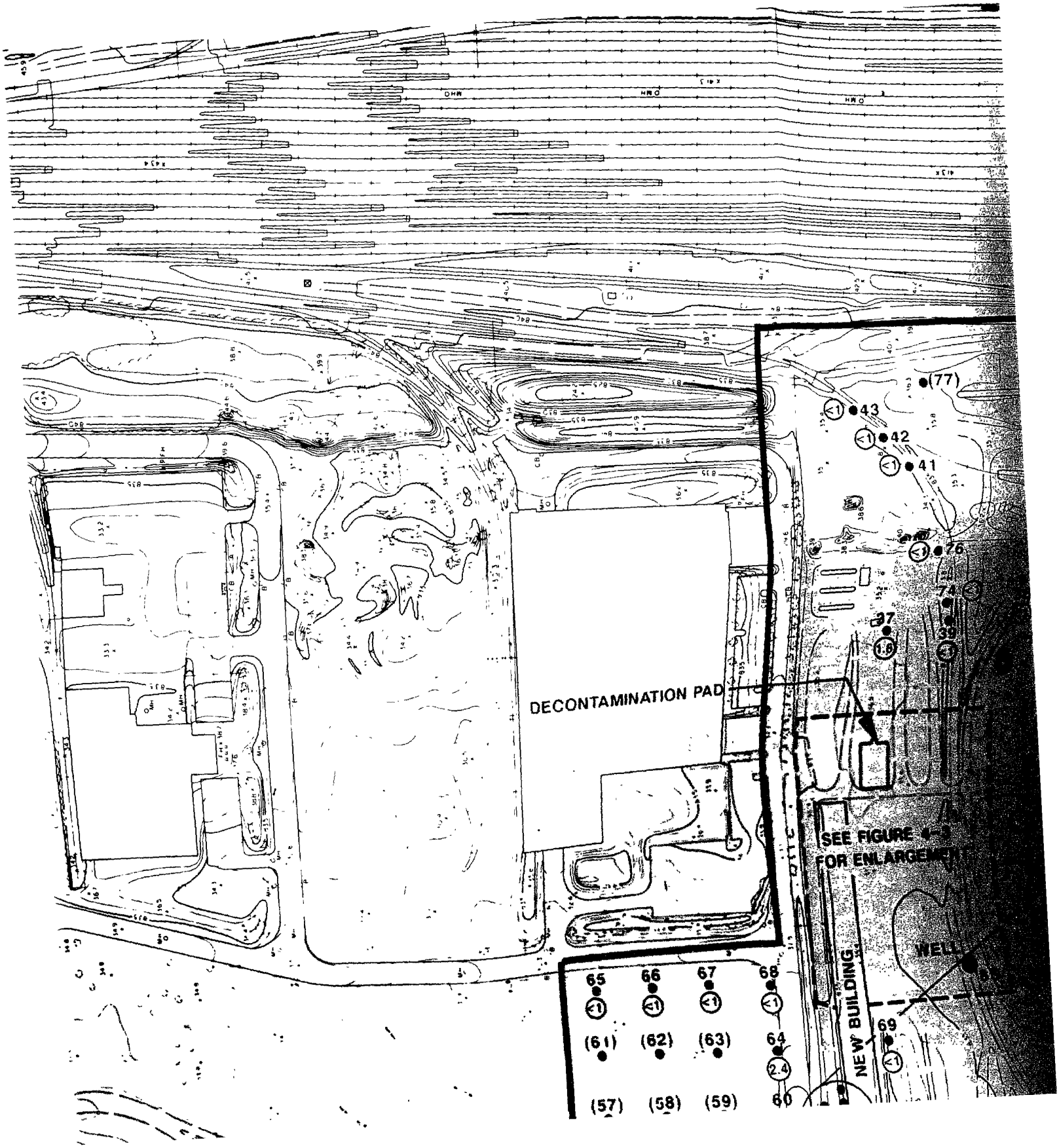
BACKGROUND SAMPLE AREA



TELEDYNE POST N39981


DECONTAMINATION PAD
SEE FIGURE 4-3
FOR ENLARGEMENT
NEW BUILDING
WELL
(77)
43
42
41
76
74
39
37
1.6
65
66
67
68
64
2.4
69
(61)
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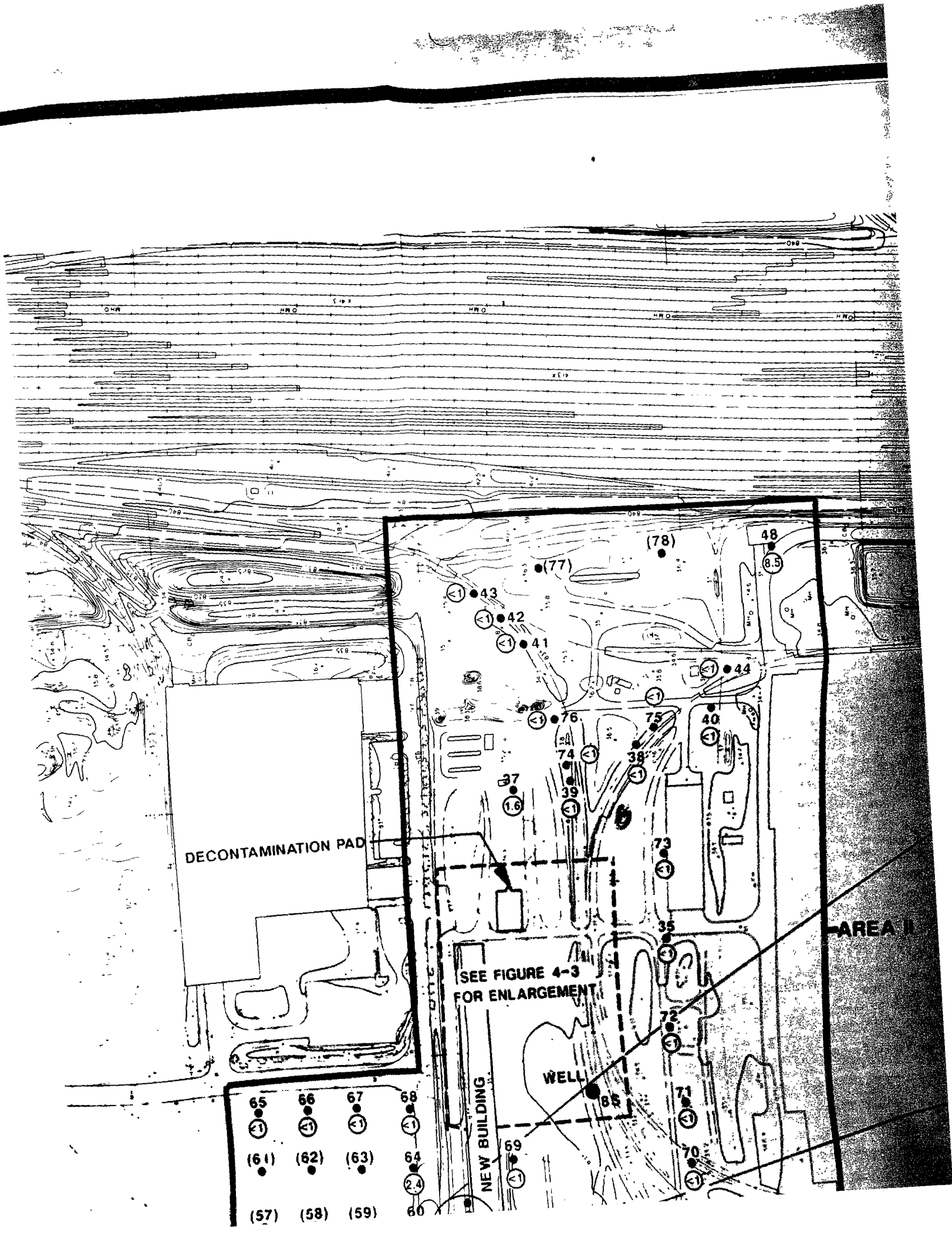
(63)
(57)
(58)
(59)
60


DECONTAMINATION PAD
SEE FIGURE 4-3
FOR ENLARGEMENT
NEW BUILDING
WELL
AREA II
(78)
(77)
48
8.5
43
42
41
44
76
75
40
74
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37
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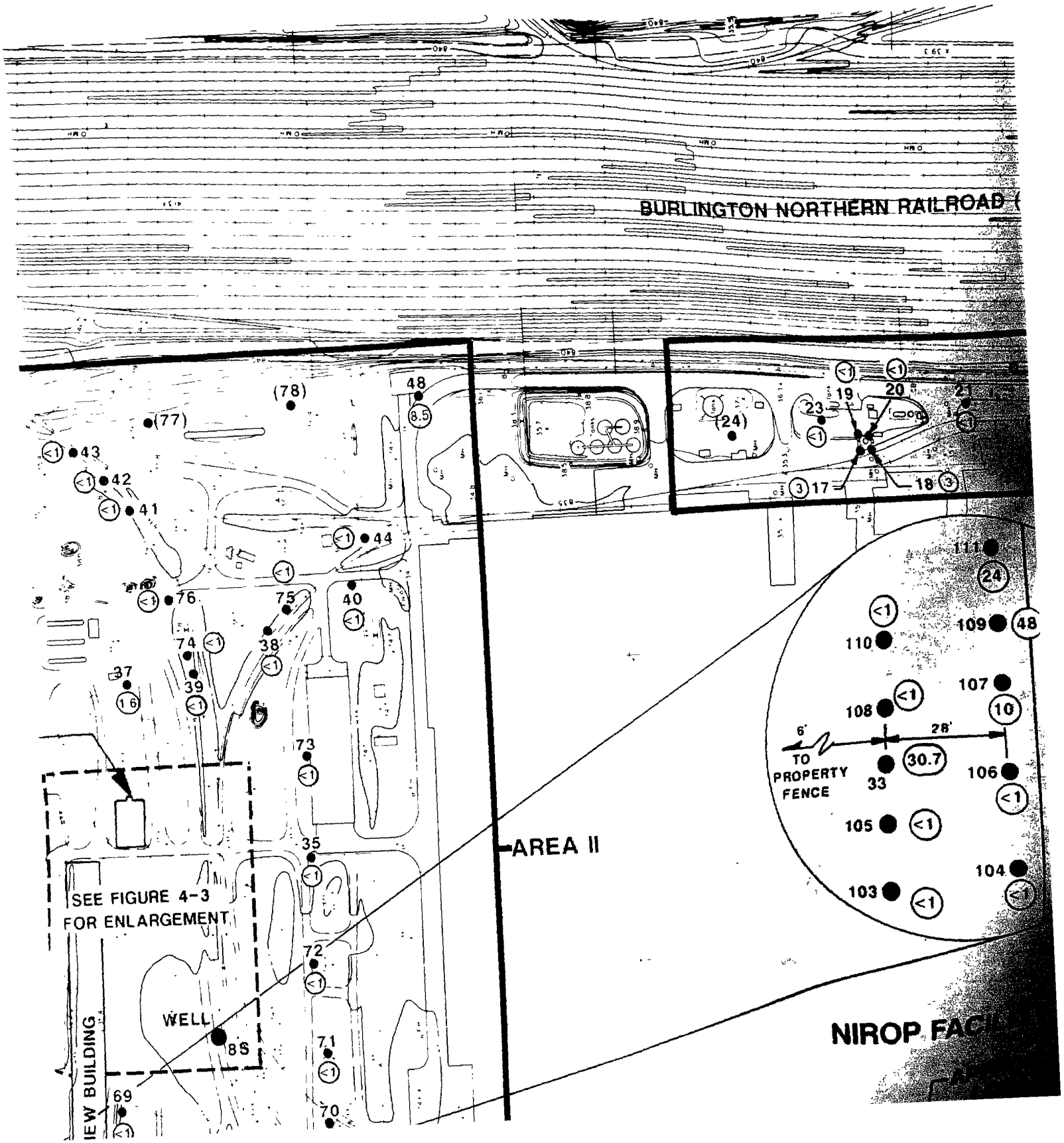
BURLINGTON NORTHERN RAILROAD
AREA II
SEE FIGURE 4-3
FOR ENLARGEMENT
WELL
8S
IEW BUILDING
NIROP FAC
TO
PROPERTY
FENCE
6'
28'
(78)
(77)
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8.5
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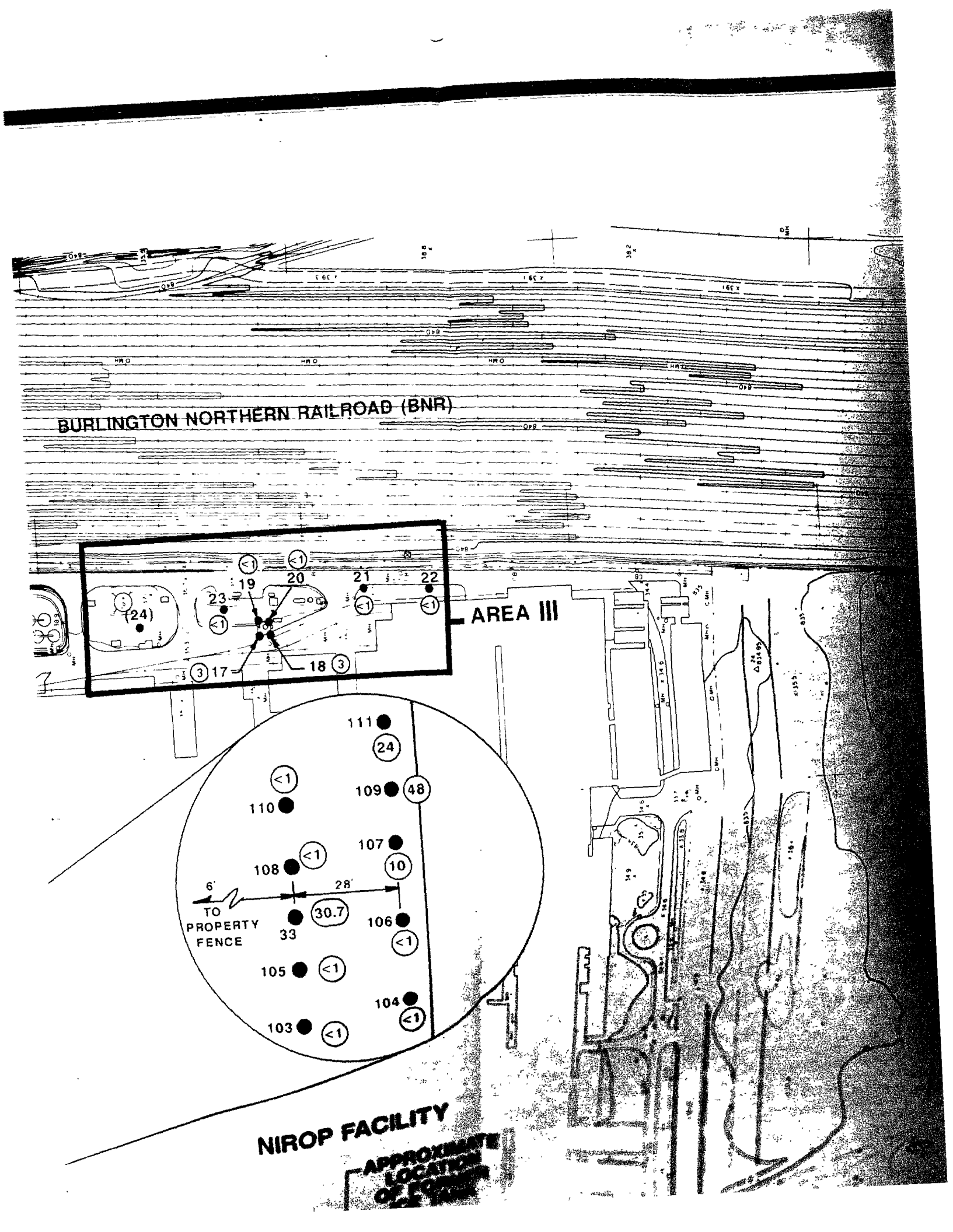
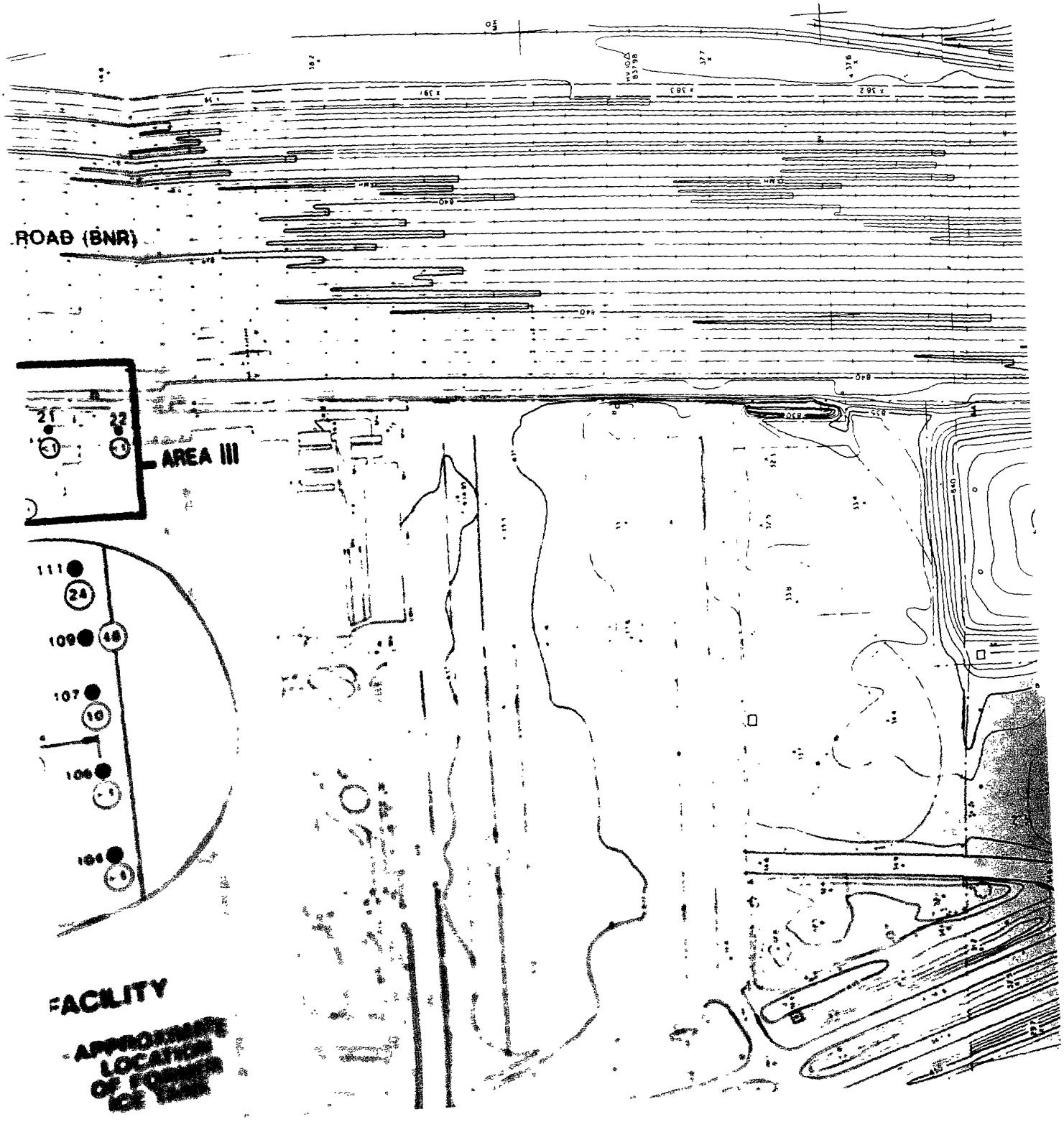

BURLINGTON NORTHERN RAILROAD (BNR)
AREA III
NIROP FACILITY
APPROXIMATE LOCATION OF FORMER OIL TANK
19
20
21
22
23
(24)
17
18
111
24
109
48
110
107
108
10
6'
28'
TO PROPERTY FENCE
33
30.7
106
105
104
103
<1


ROAD (BNR)
AREA III
FACILITY
APPROXIMATE LOCATION OF FORMER ICE TANK

HV 10
837.98
HV 15
836.45
835.07
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840
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830
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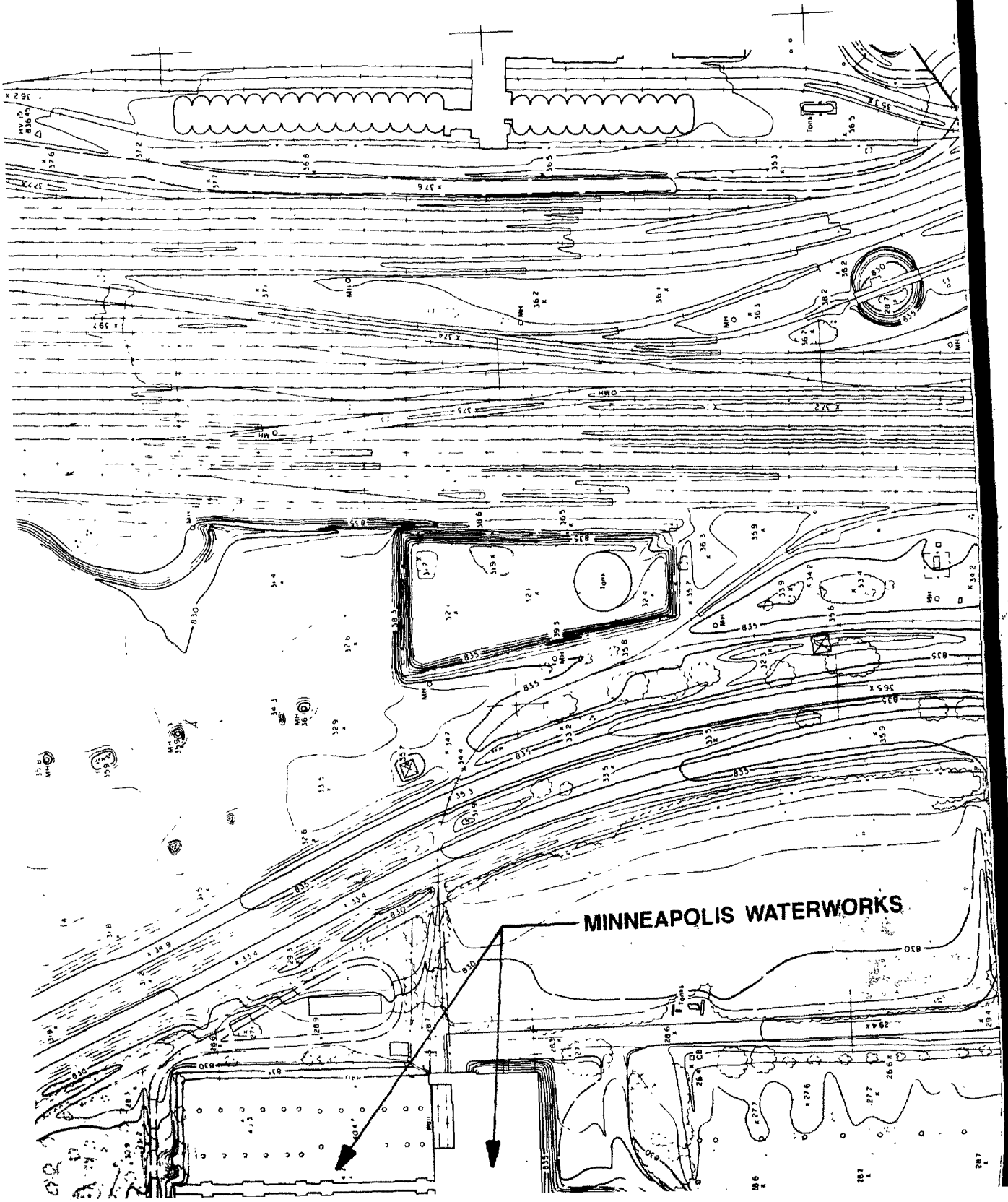

MINNEAPOLIS WATERWORKS

collected in proximity to the tank's former location. All nine Area I samples had relatively low or undetectable concentrations of VOCs in soil gas. The highest concentration was a total of 1.9 ppm of DCE and TCE at sample point SG-8.

- Results of soil gas analyses for the four background samples were less than the method detection limits.

Area II (Trench disposal and storage area north of plant–see Figure 4-3)

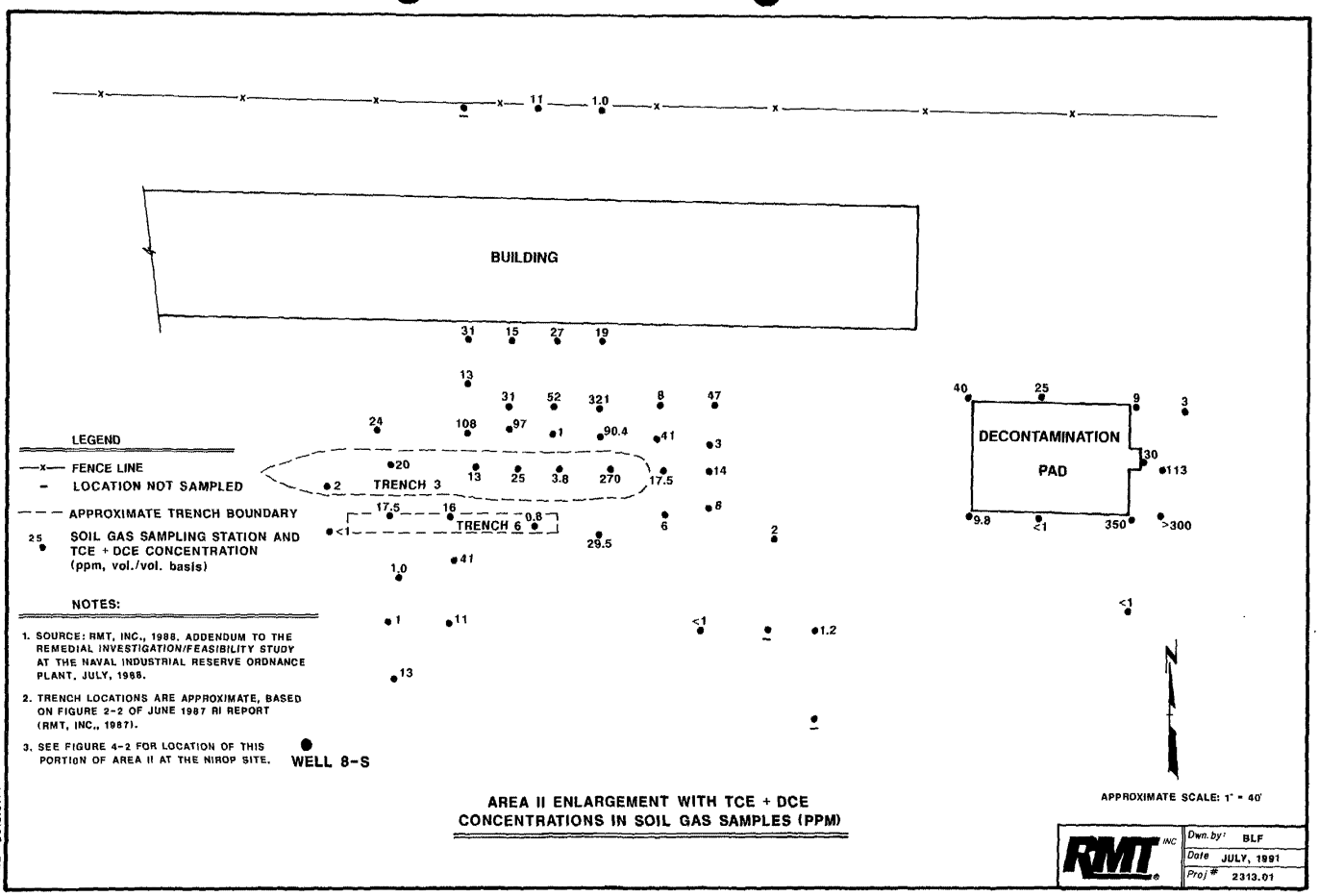
- Three areas of elevated soil gas concentrations were found as follows:
  - Near several of the excavated trenches.
  - Near a newly installed water main at the north edge of the property along the fence.
  - Near the decontamination pad constructed for the drum and soil removal operations in 1983-84.
- Other sections of Area II had low soil gas concentrations.
- Areas with the highest soil gas concentrations (> 100 ppm TCE plus DCE) were south and east of the decontamination pad and in the vicinity of trench 3.
- Concentrations decreased with increasing distance away from trench 3 in the trench area.
- TCE was the predominant soil gas constituent in most areas. However, in the areas of highest contamination, cis-DCE was generally present at the highest concentration. Trans-DCE was generally present at low concentrations, if present at all, and was above 10 ppm in only two samples.
- Other unidentified compounds were detected at three locations: two next to the decontamination pad, and one near trench 3.

Area III (existing TCA tank area east of plant)

- Soil gas concentrations were generally low in Area III samples. Both of the sample points at the west edge of the TCA tank had a total concentration of 3 ppm TCE and DCE. The other five samples had concentrations less than 1 ppm.

Conclusions

- No significant concentration of chlorinated ethenes was found in soil gas from near-surface soils in Area I, suggesting that possible historical surface spills in this area have not contributed to soil contamination in the area sampled.



AREA II ENLARGEMENT WITH TCE + DCE CONCENTRATIONS IN SOIL GAS SAMPLES (PPM)

RMT INC

Dwn. by:	BLF
Date	JULY, 1991
Proj #	2313.01

FILE #2313.01WP

JAN 20 1992

FIGURE 4-3

Possible spills in the immediate vicinity of the former TCE tank would have to be investigated as part of a separate operable unit, if necessary.

- No significant chlorinated ethene contamination of near-surface soil was found in Area III.

- A fairly large portion of Area II was found to have near-surface soil concentrations of chlorinated ethenes in the pore gas. The following three contiguous areas had the greatest concentrations:

  - Former disposal trench area (trench 3)
  - Decontamination pad area
  - New water main trench area (north edge of Area II)

  The highest concentrations of chlorinated ethenes were in the immediate vicinity of trench 3 and near the decontamination pad.

- TCE was the predominant constituent, except in the most contaminated areas where cis-DCE was at higher concentrations. The trans-DCE isomer was a small portion of the total chlorinated ethenes in all but two of the contaminated sites. Both the cis-and trans-DCE isomers are breakdown products of TCE.

4.3.3 Fall 1990 Soil Investigation

A total of 55 soil borings were advanced in October and November 1990 during an investigation to assess the extent of soil contamination at the NIROP Fridley. Boring locations were selected to meet the following objectives:

- Verify elevated soil gas results discussed in the ground water RI Addendum Report (RMT, 1988a).

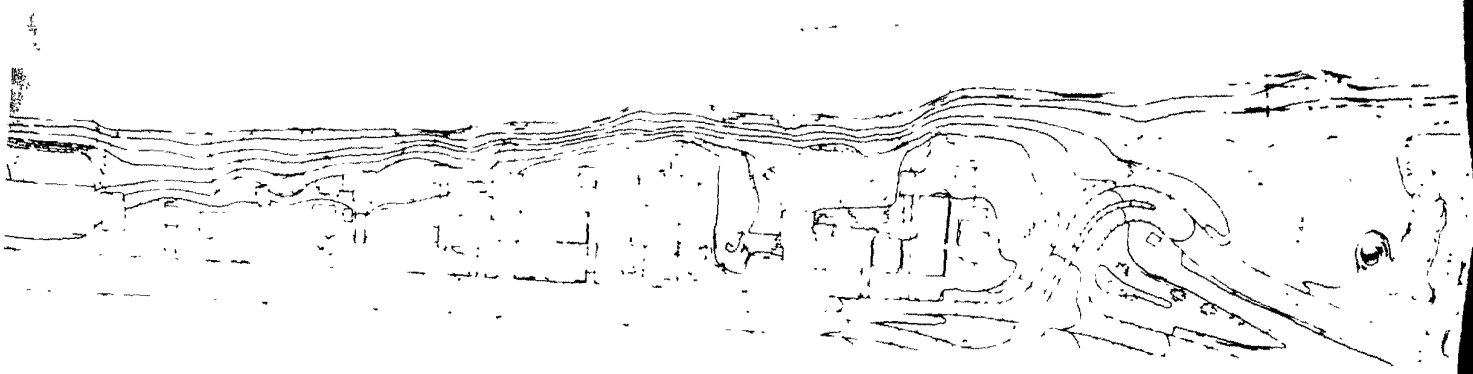
- Determine whether areas near excavated trenches continue to be a source of contamination.

- Determine whether existing and/or former underground storage tanks may be a source of contamination.

- Collect data for closure of former Hazardous Waste Storage Area C.

- Determine background soil chemistry.

The 55 soil borings were advanced to the water table in four areas. The background area consisted of one boring (NB23) as shown on Figure 4-4; the North 40 Area included 22 soil borings, as shown on Figure 4-5; the locations of former Hazardous Waste Storage Area C



NO.	BY	DATE	REVISION	APP'D
3.				
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1.				

PROJECT :

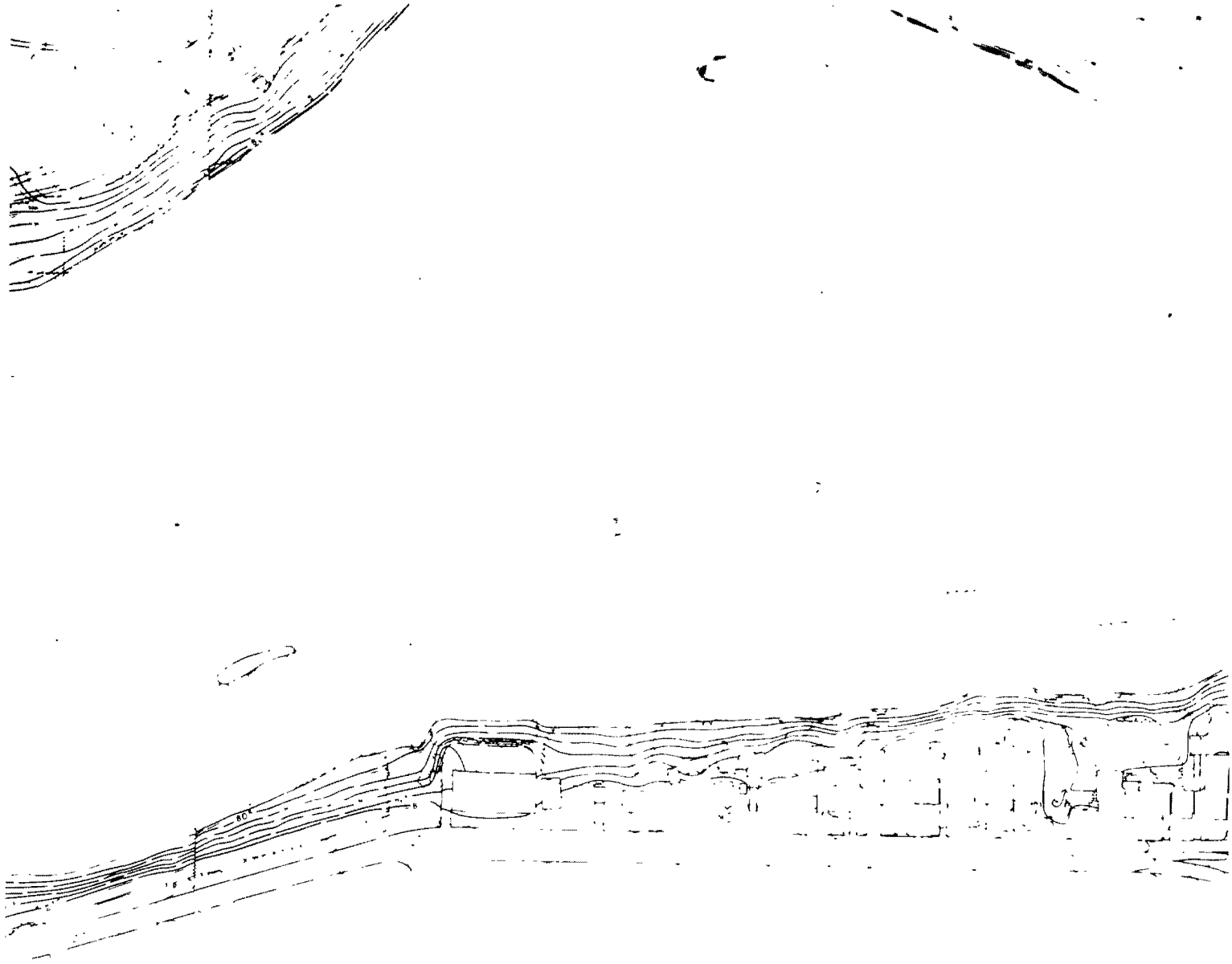
REMEDIAL INVESTIGATION
NIROP - FRIDLEY, MINNESOTA

SHEET TITLE :
FALL 1990 BORING LOCATION MAP AND AREAS OF POTENTIAL CONTAMINATION INDICATED BY PREVIOUS INVESTAGATION

SCALE: 1 = 200'
200 400 600 FEET

DRAWN BY DPR	SCALE . 1"=200'	PROJ . NO . 2313.01WP
CHECKED BY: J. Koch		DRWG . NO .
APPROVED BY: G. Kenoyer	DATE PRINTED :	FIGURE 4-4
DATE : JANUARY 1992		

RMT INC
744 Heartland Trail
P.O. Box 8923
Madison, WI 53708
Phone: 608-831-4444



NIROP PROPERTY LINE

FMC PROPERTY LINE

BNR PROPERTY LINE

ATION AREA

OCATION

SCALE: 1 = 200'

0 200 400 600 FEET

3.			
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REMED
NIROP -

SHEET TITLE :
FALL 1990 BORIN
OF POTENTIAL C
PREVIO

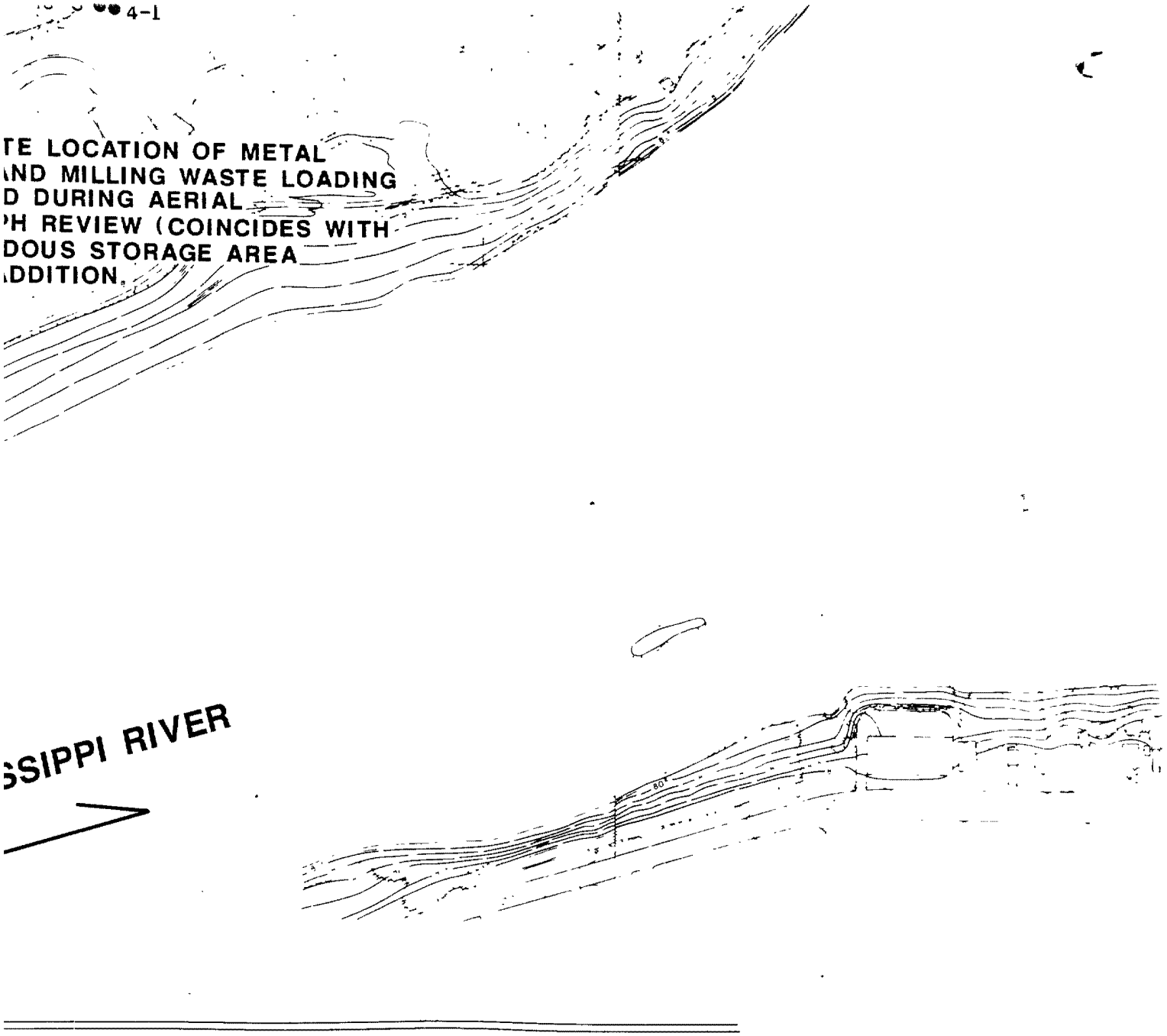
DRAWN BY DPR

CHECKED BY: J. Koeb

APPROVED BY: G. Kenoyer

DATE JANUARY 1992

RMT INC



APPROXIMATE NIROP PROPERTY LINE

APPROXIMATE FMC PROPERTY LINE

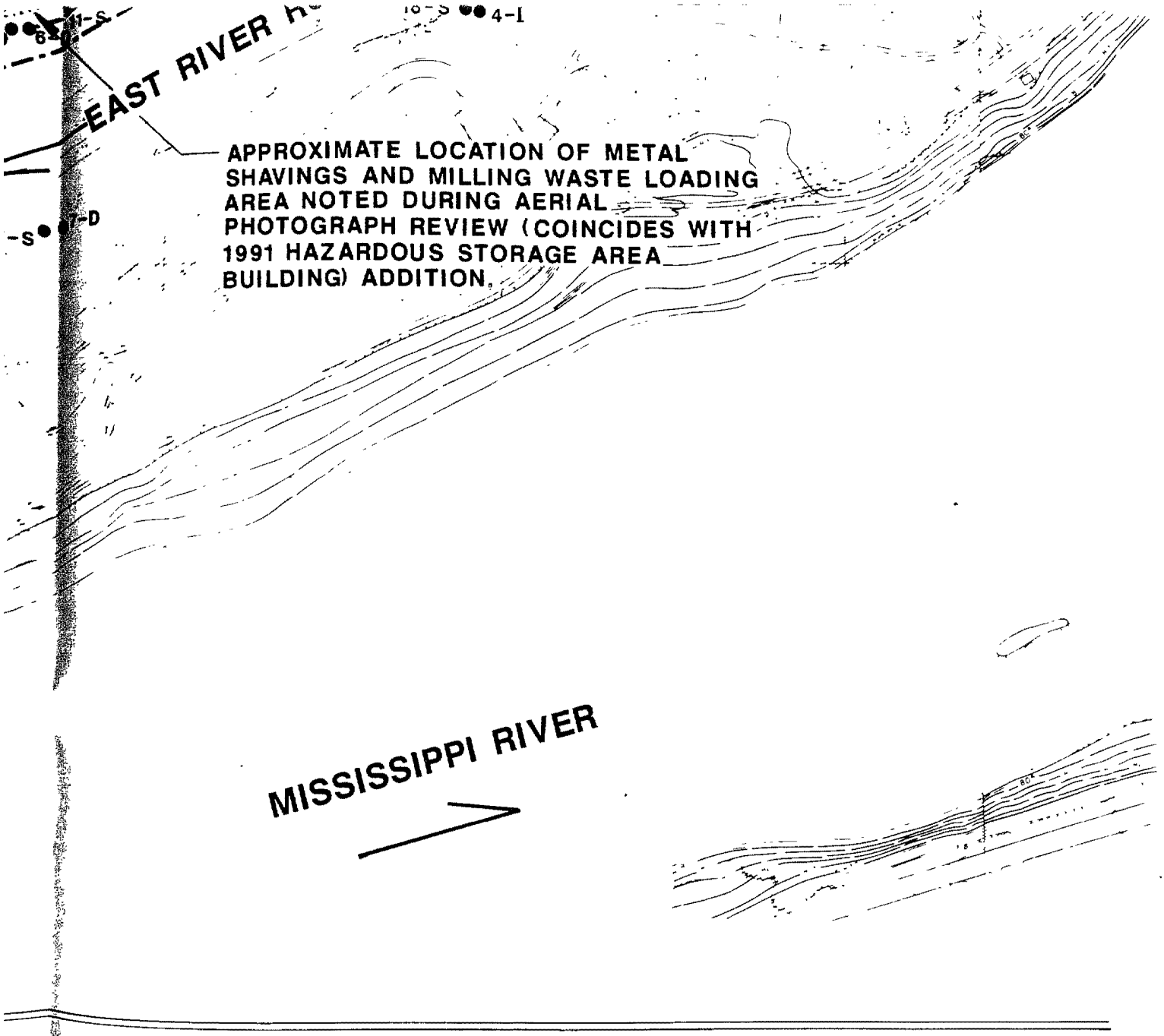
APPROXIMATE BNR PROPERTY LINE

SOIL INVESTIGATION AREA

SOIL BORING LOCATION

SCALE: 1 = 200'

0 200 400



ABLE OBSERVATION WELL IN
OLIDATED SEDIMENTS

DIATE DEPTH PIEZOMETER IN
OLIDATED SEDIMENTS

ZOMETERS IN
OLIDATED SEDIMENTS

PIEZOMETERS

ION WELLS

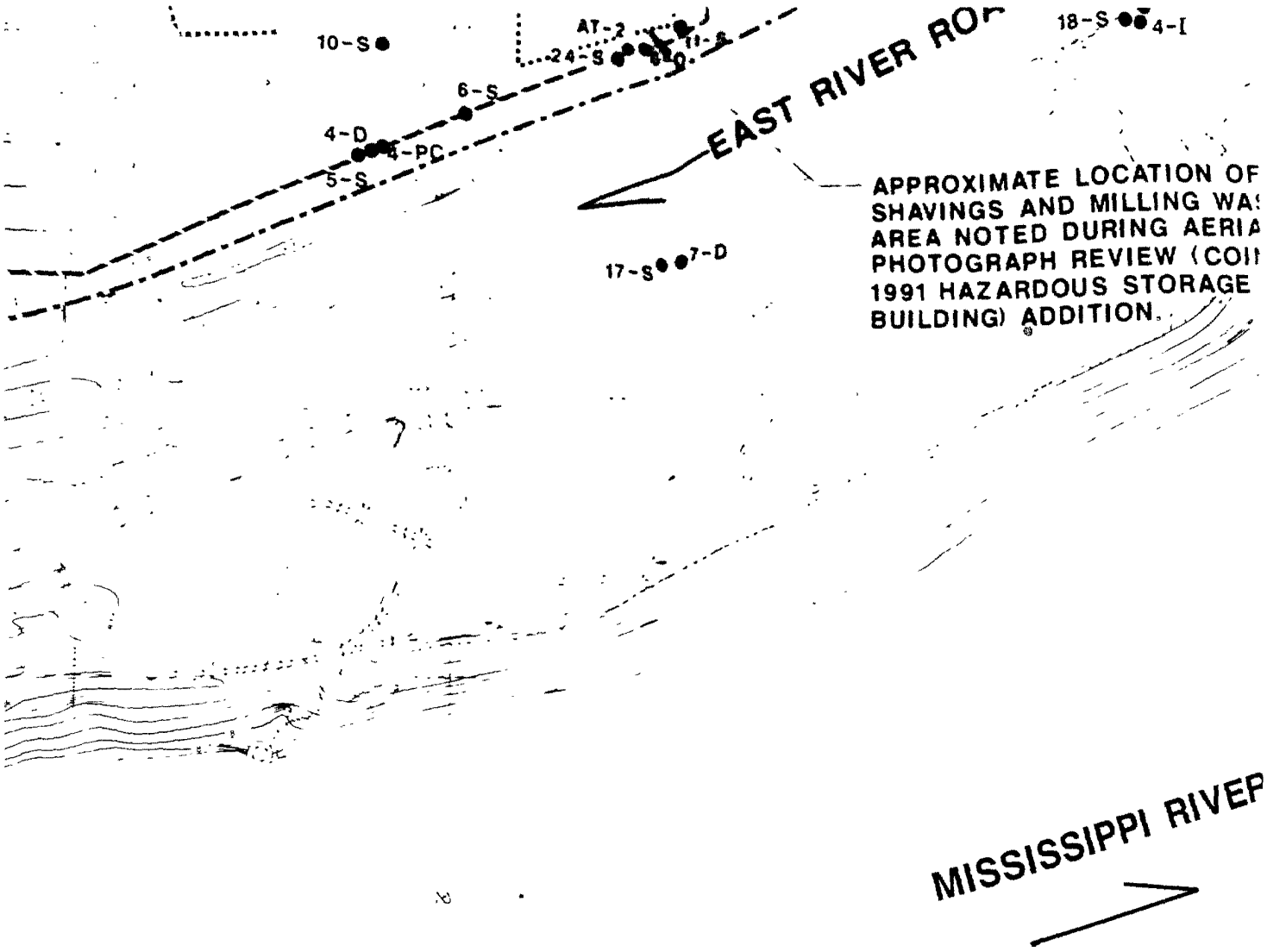
APPROXIMATE NIROP PROPERTY LINE

APPROXIMATE FMC PROPERTY LINE

APPROXIMATE BNR PROPERTY LINE

SOIL INVESTIGATION AREA

SOIL BORING LOCATION



AVED ROAD
NPAVED ROAD
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ENCE
' CONTOUR
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POT ELEVATION
/ OR BRUSH
ATER

● 1-S WATER TABLE OBSERVATION WELL IN UNCONSOLIDATED SEDIMENTS

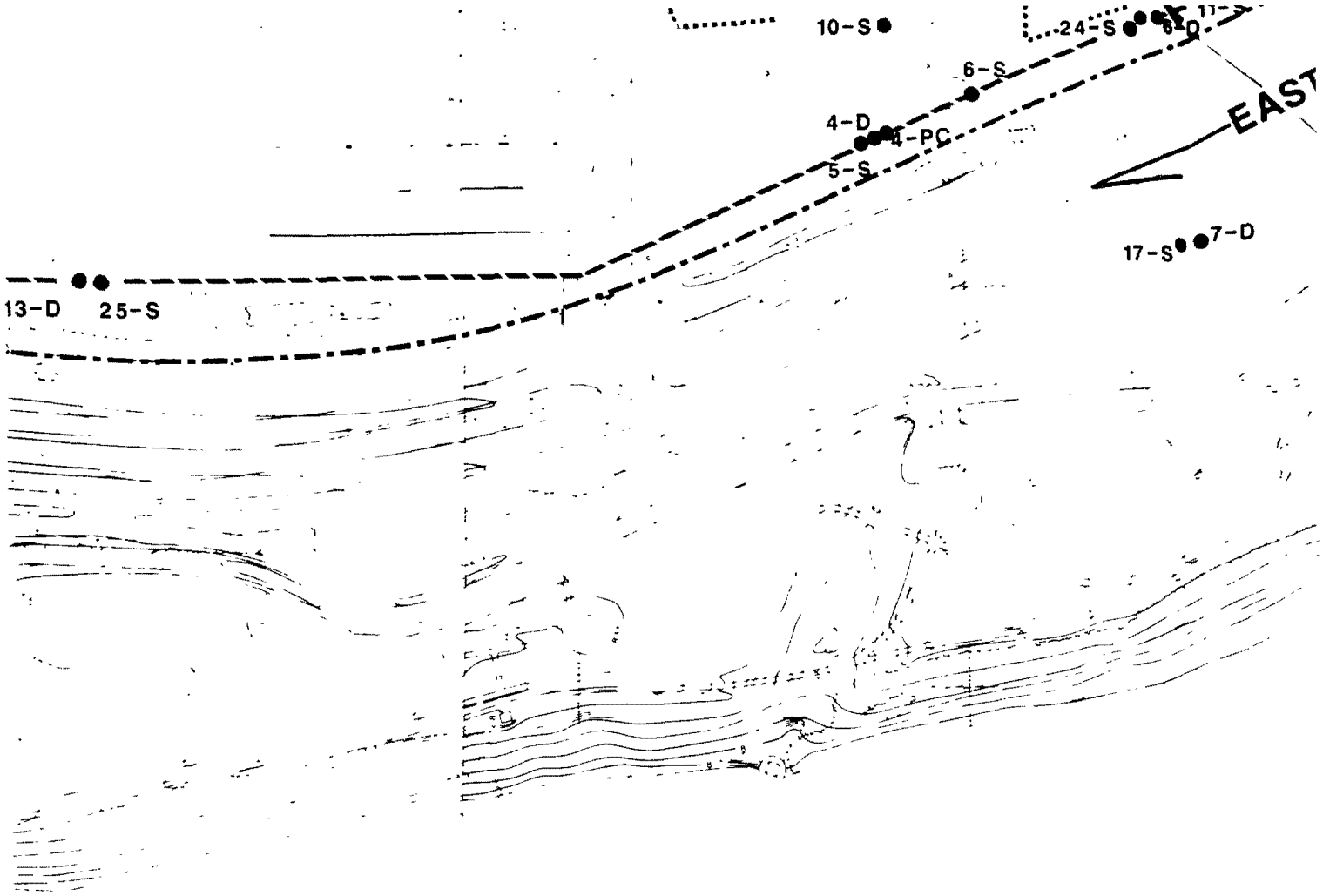
● 1-I INTERMEDIATE DEPTH PIEZOMETER IN UNCONSOLIDATED SEDIMENTS

● 1-D DEEP PIEZOMETERS IN UNCONSOLIDATED SEDIMENTS

●1-PC BEDROCK PIEZOMETERS

● AT-1 PRODUCTION WELLS

HNICAL MEMORANDUM NO. 1 SOIL INVESTIGATION
:LL SAMPLING ROUND AT THE NAVAL INDUSTRIAL
PLANT, FRIDLEY, MINNESOTA. APRIL 1991.

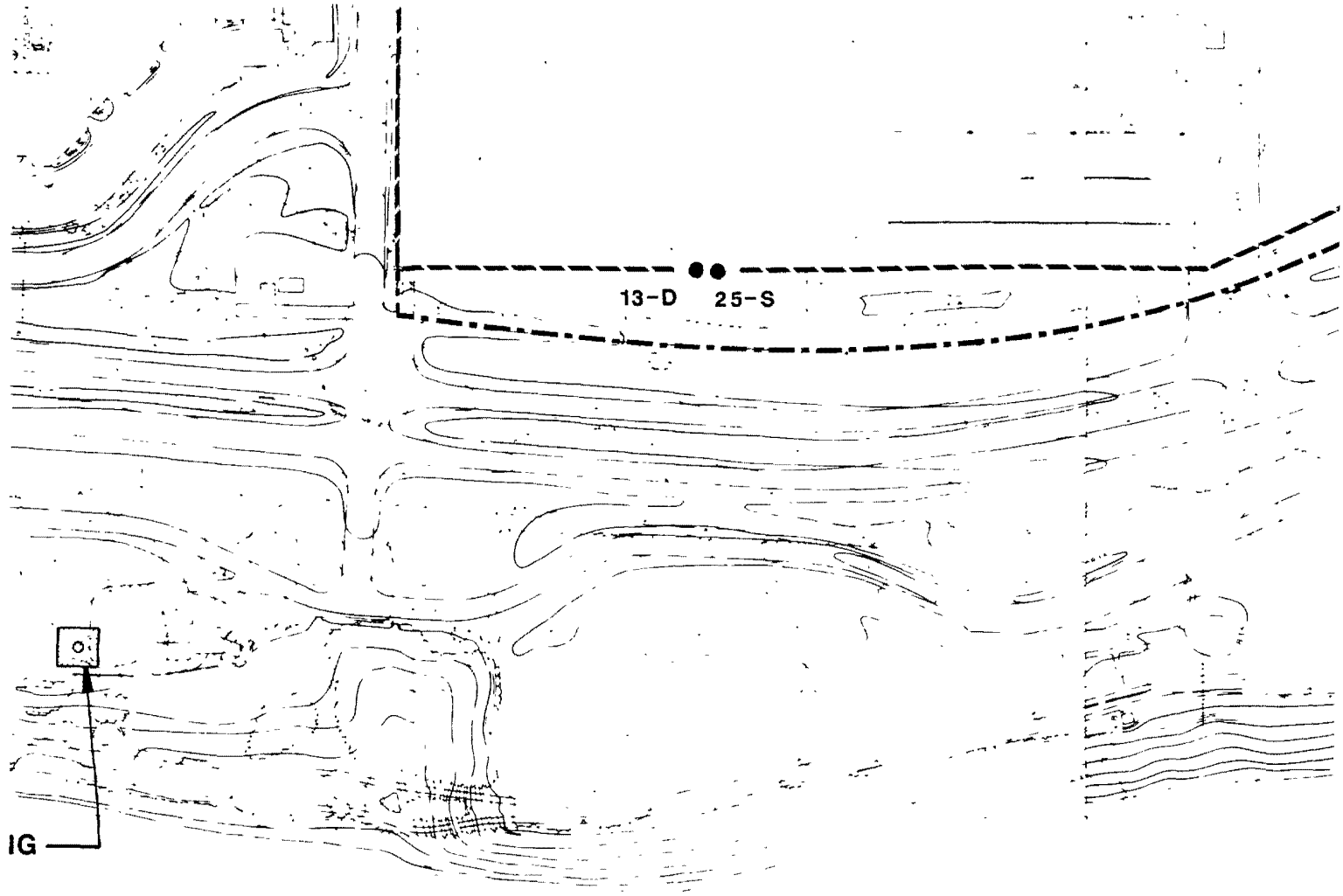


LEGEND

- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING BUILDING
- EXISTING FENCE
- 800 EXISTING 5' CONTOUR
- EXISTING 1' CONTOUR
- x 865.1 EXISTING SPOT ELEVATION
- TREES AND / OR BRUSH
- EDGE OF WATER
- WET AREA

- ● 1-S WATER TABLE OBSEF UNCONSOLIDATED SI
- ● 1-I INTERMEDIATE DEPT UNCONSOLIDATED SE
- ● 1-D DEEP PIEZOMETERS I UNCONSOLIDATED SE
- ● 1-PC BEDROCK PIEZOMETI
- ● AT-1 PRODUCTION WELLS

SOURCE: RMT, INC., 1991. TECHNICAL MEMORANDUM NO. 1 SOIL INVESTIGATION AND MONITORING WELL SAMPLING ROUND AT THE NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT, FRIDLEY, MINNESOTA. APRIL 1991.



LEGEND

- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING BUILDING
- EXISTING FENCE
- 800 — EXISTING 5' CONTOUR
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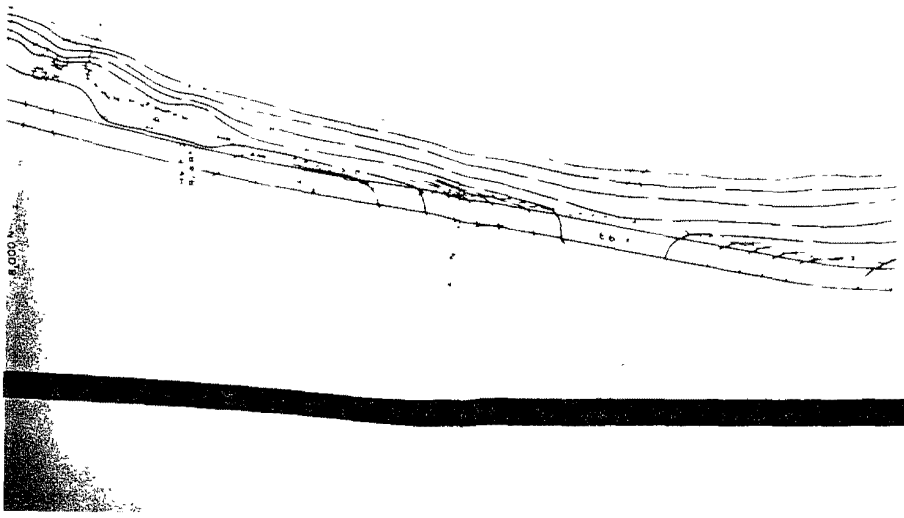
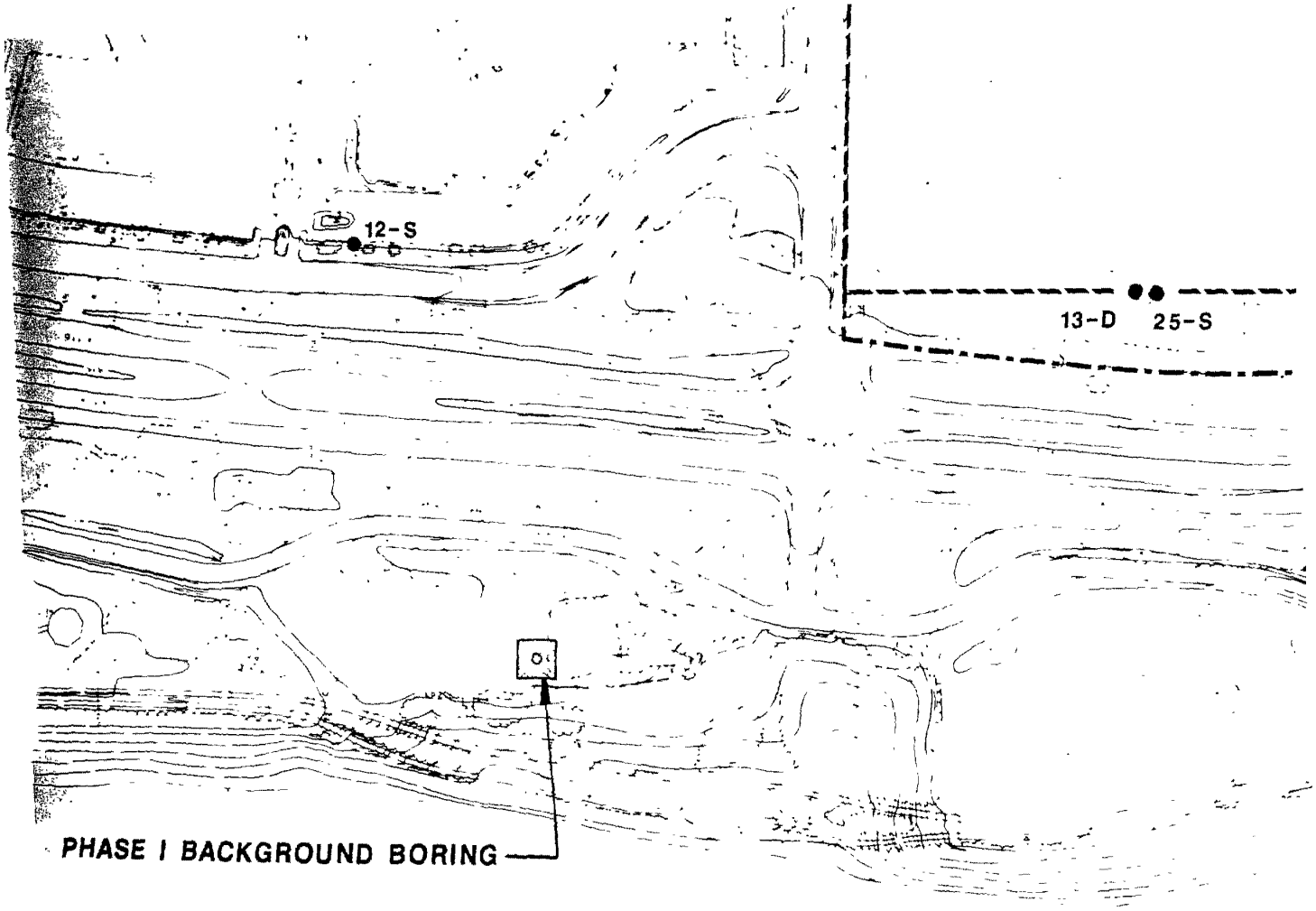
- TREES AND / OR BRUSH
- EDGE OF WATER
- WET AREA



SOURCE: RMT, INC., 1991. TECHNICAL MEMORA
AND MONITORING WELL SAMPLING RC
RESERVE ORDNANCE PLANT, FRIDLEY



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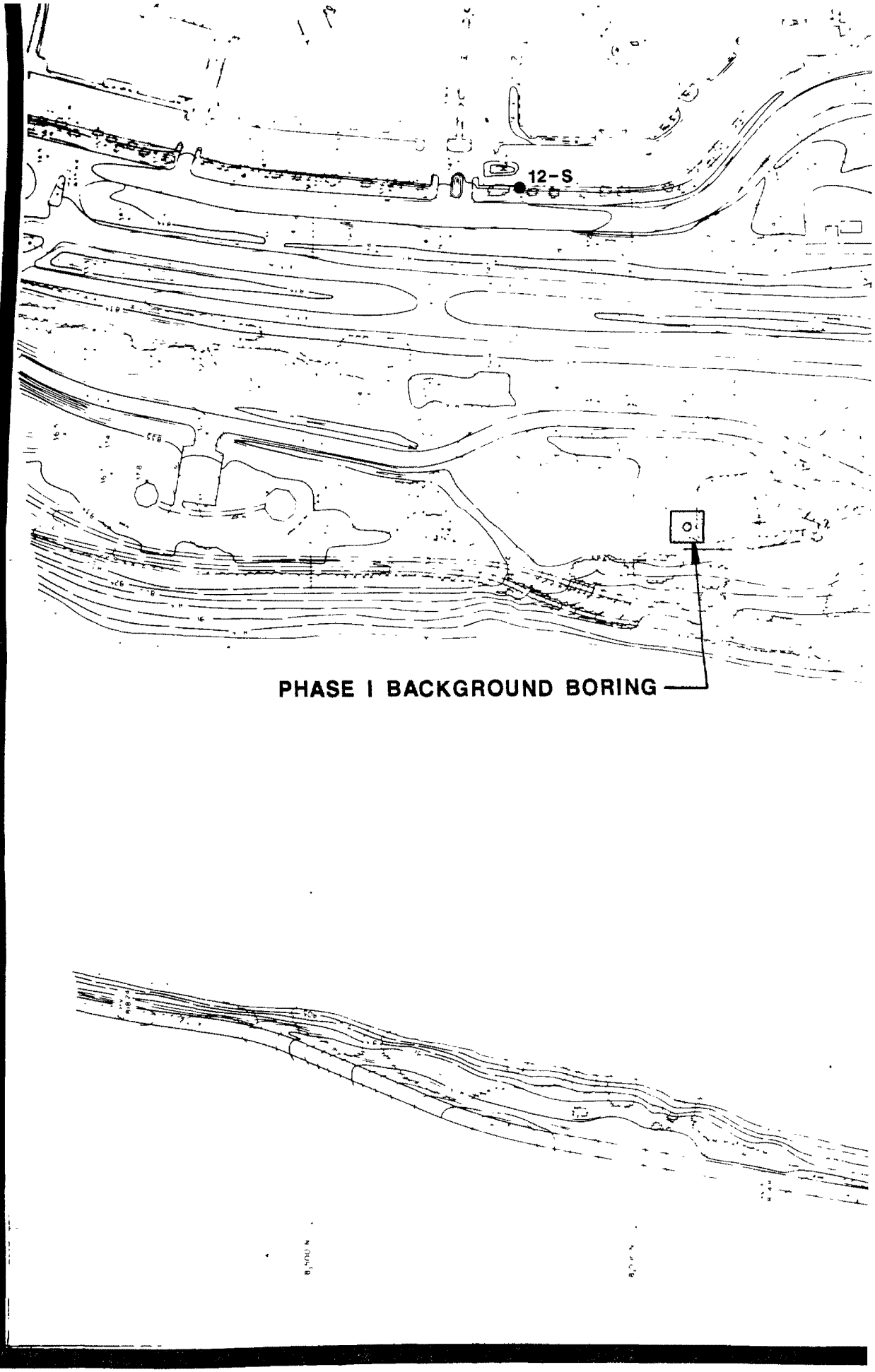

TELEDYNE POST N39981

15-S
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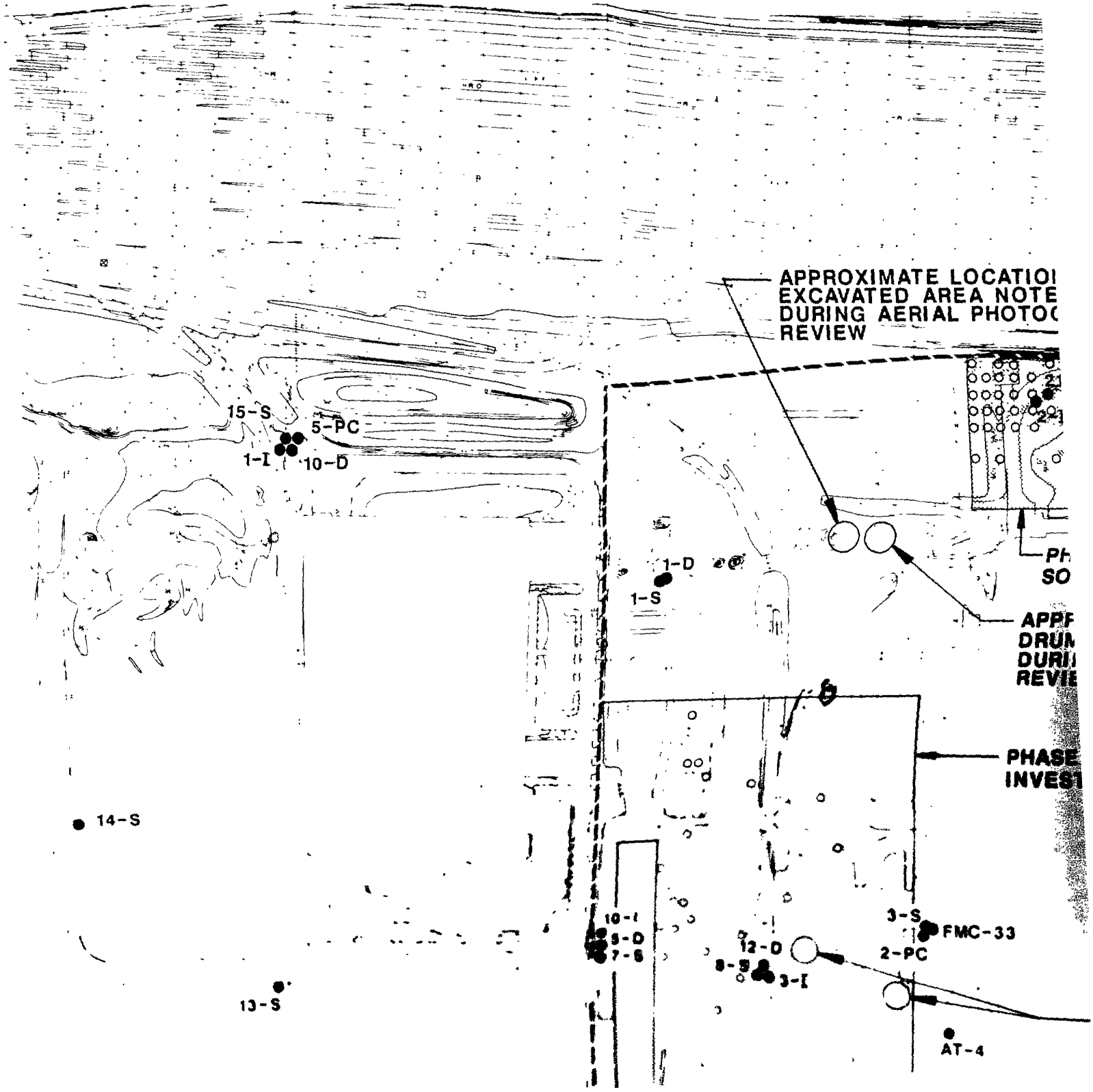
10-D
1-D
1-S
14-S
13-S
16-S


APPROXIMATE LOCATIOI
EXCAVATED AREA NOTE
DURING AERIAL PHOTOC
REVIEW
15-S
5-PC
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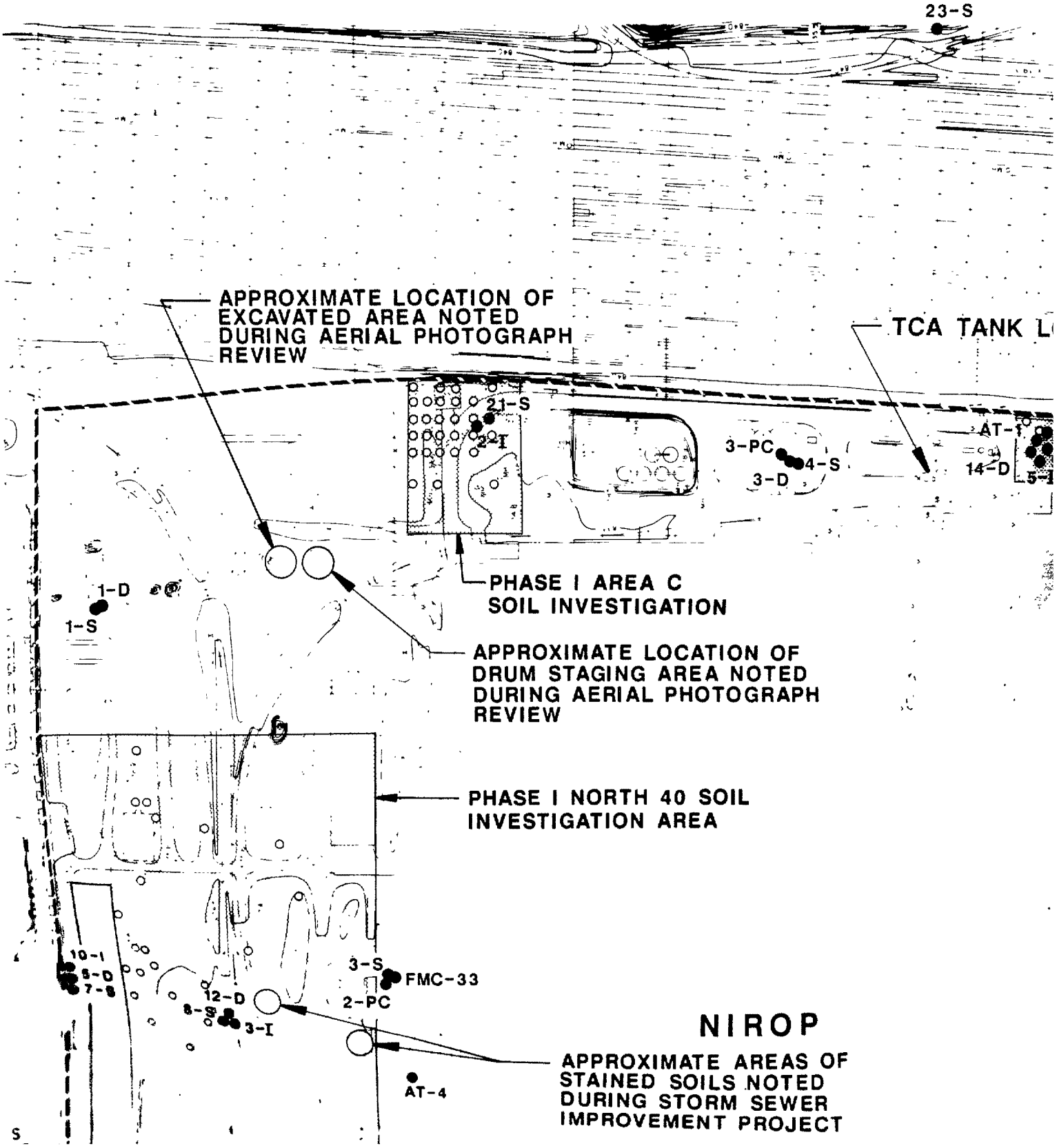
2-PC
AT-4


23-S
APPROXIMATE LOCATION OF EXCAVATED AREA NOTED DURING AERIAL PHOTOGRAPH REVIEW
TCA TANK L
21-S
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3-PC
4-S
3-D
AT-1
14-D
5-I
PHASE I AREA C SOIL INVESTIGATION
1-D
1-S
APPROXIMATE LOCATION OF DRUM STAGING AREA NOTED DURING AERIAL PHOTOGRAPH REVIEW
PHASE I NORTH 40 SOIL INVESTIGATION AREA
10-I
5-D
7-S
12-D
8-S
3-I
3-S
FMC-33
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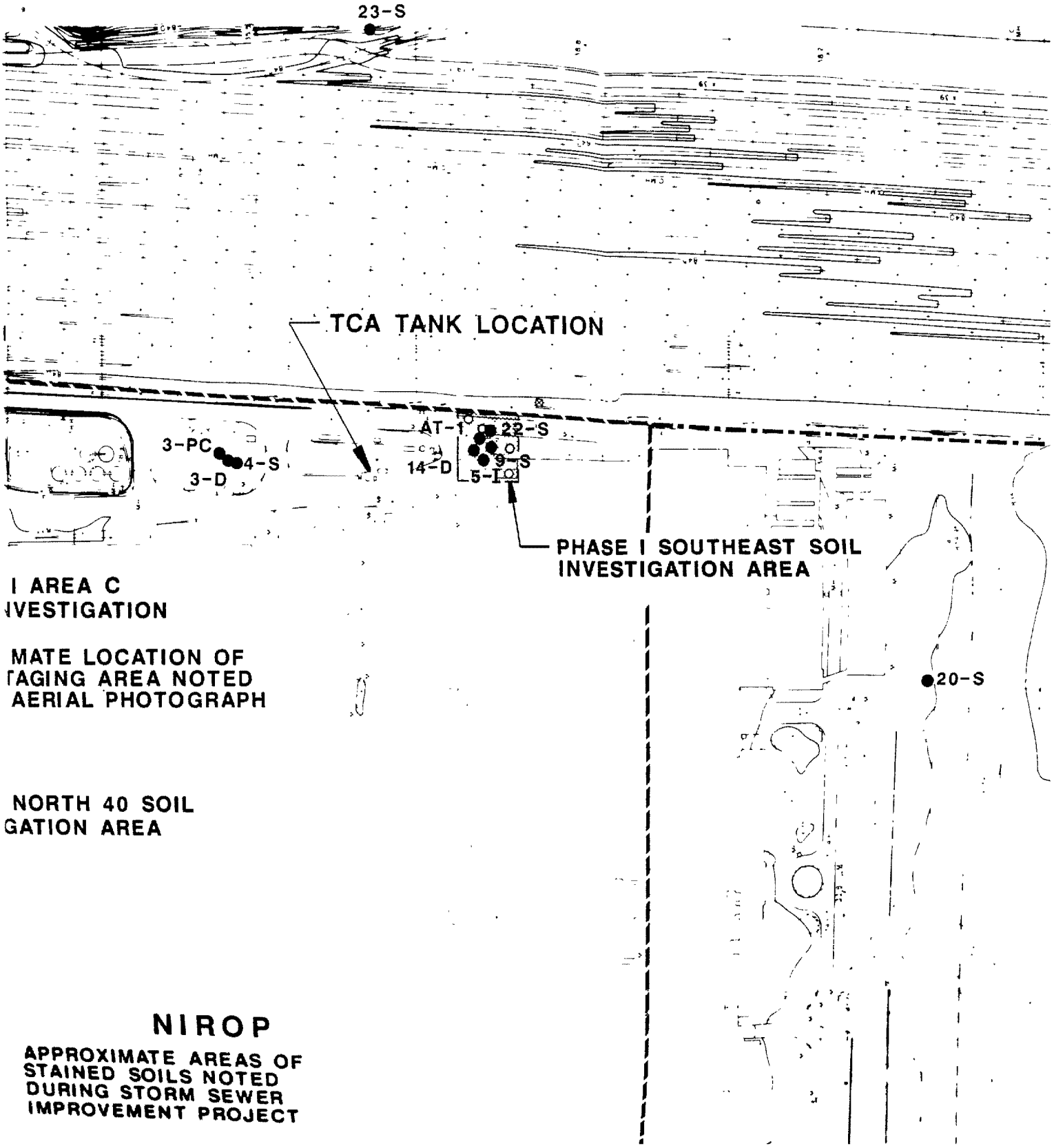
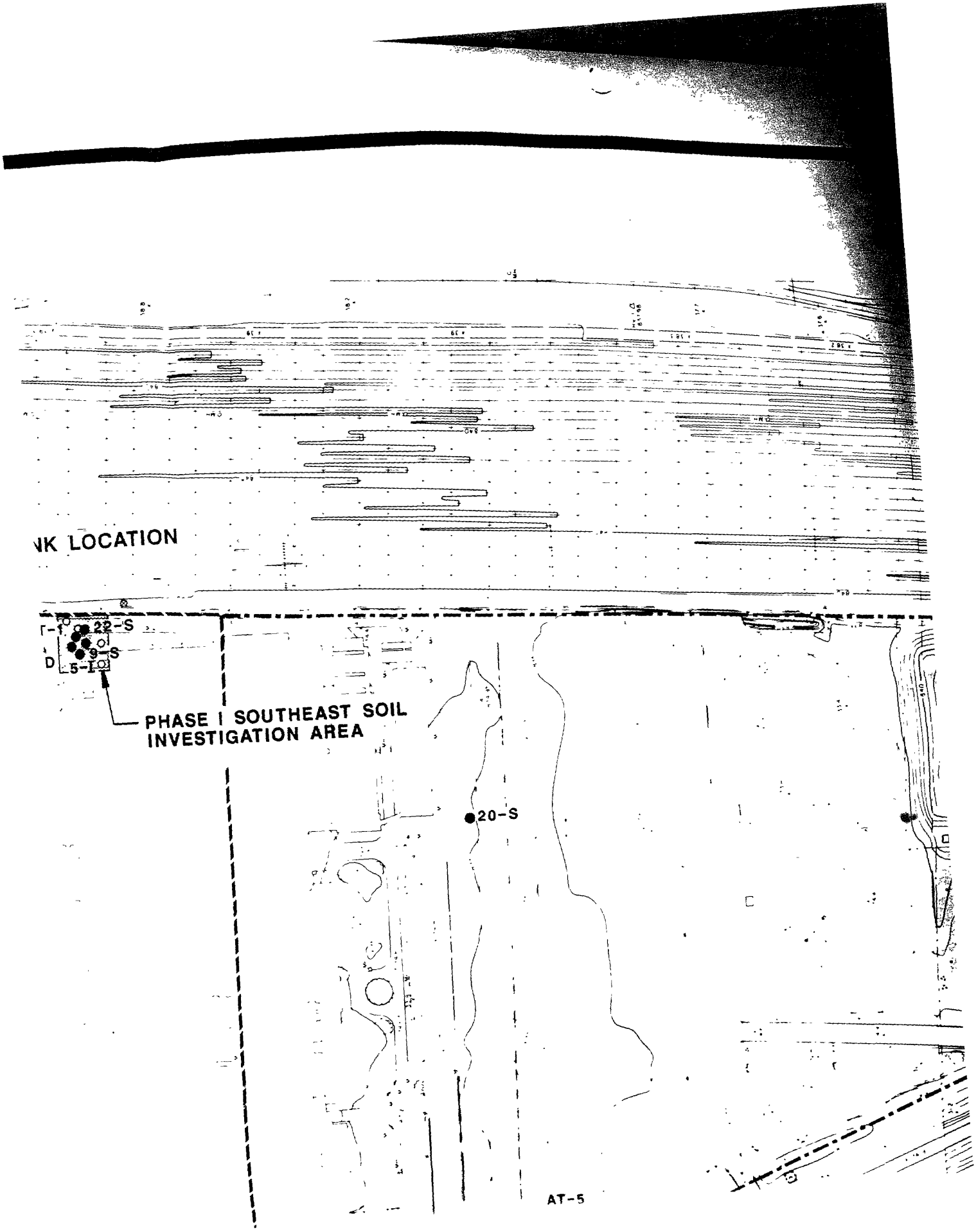
NIROP
APPROXIMATE AREAS OF STAINED SOILS NOTED DURING STORM SEWER IMPROVEMENT PROJECT



NIROP

APPROXIMATE AREAS OF STAINED SOILS NOTED DURING STORM SEWER IMPROVEMENT PROJECT


NK LOCATION
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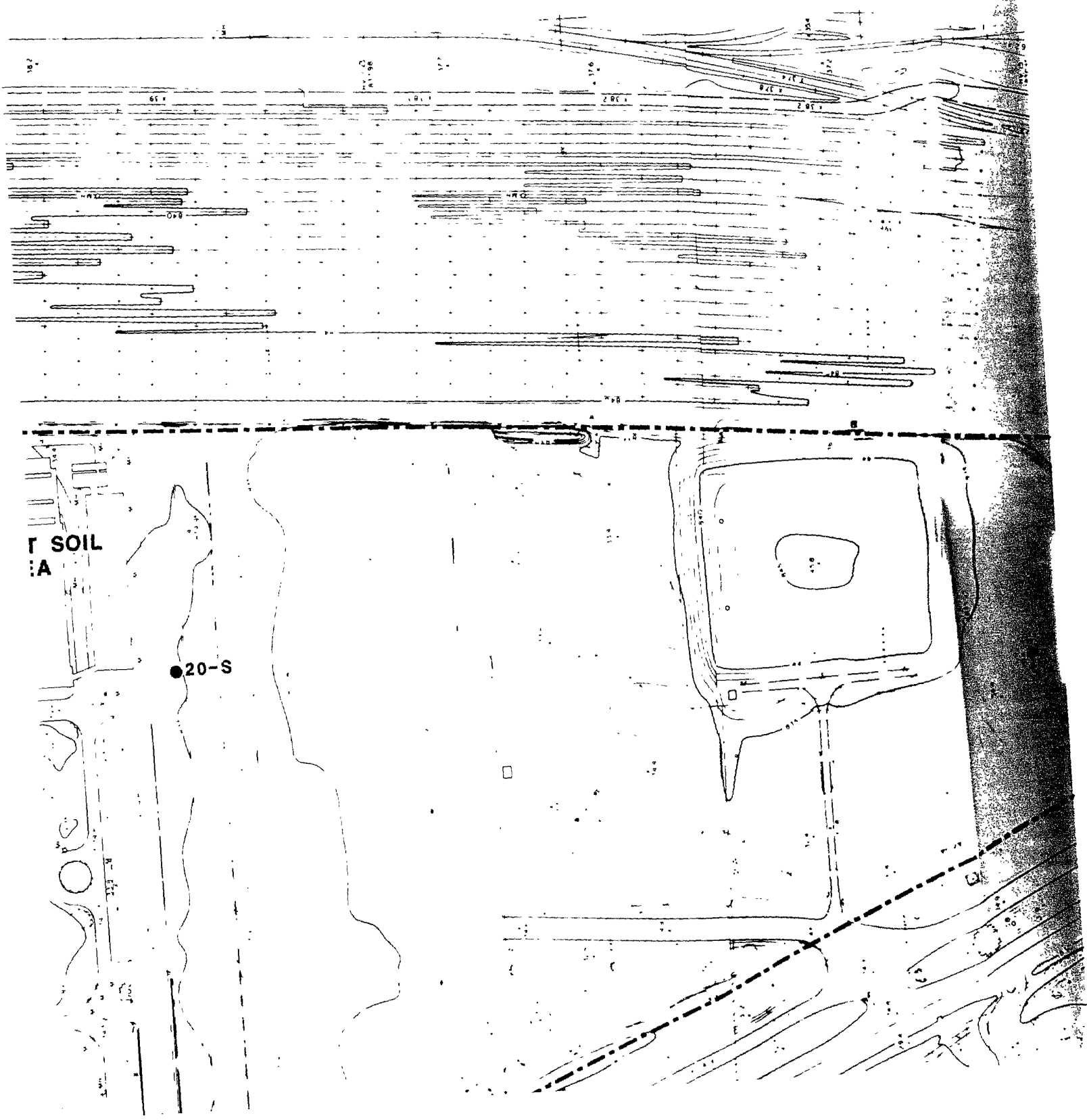
9-S
5-I
PHASE I SOUTHEAST SOIL
INVESTIGATION AREA
20-S
AT-5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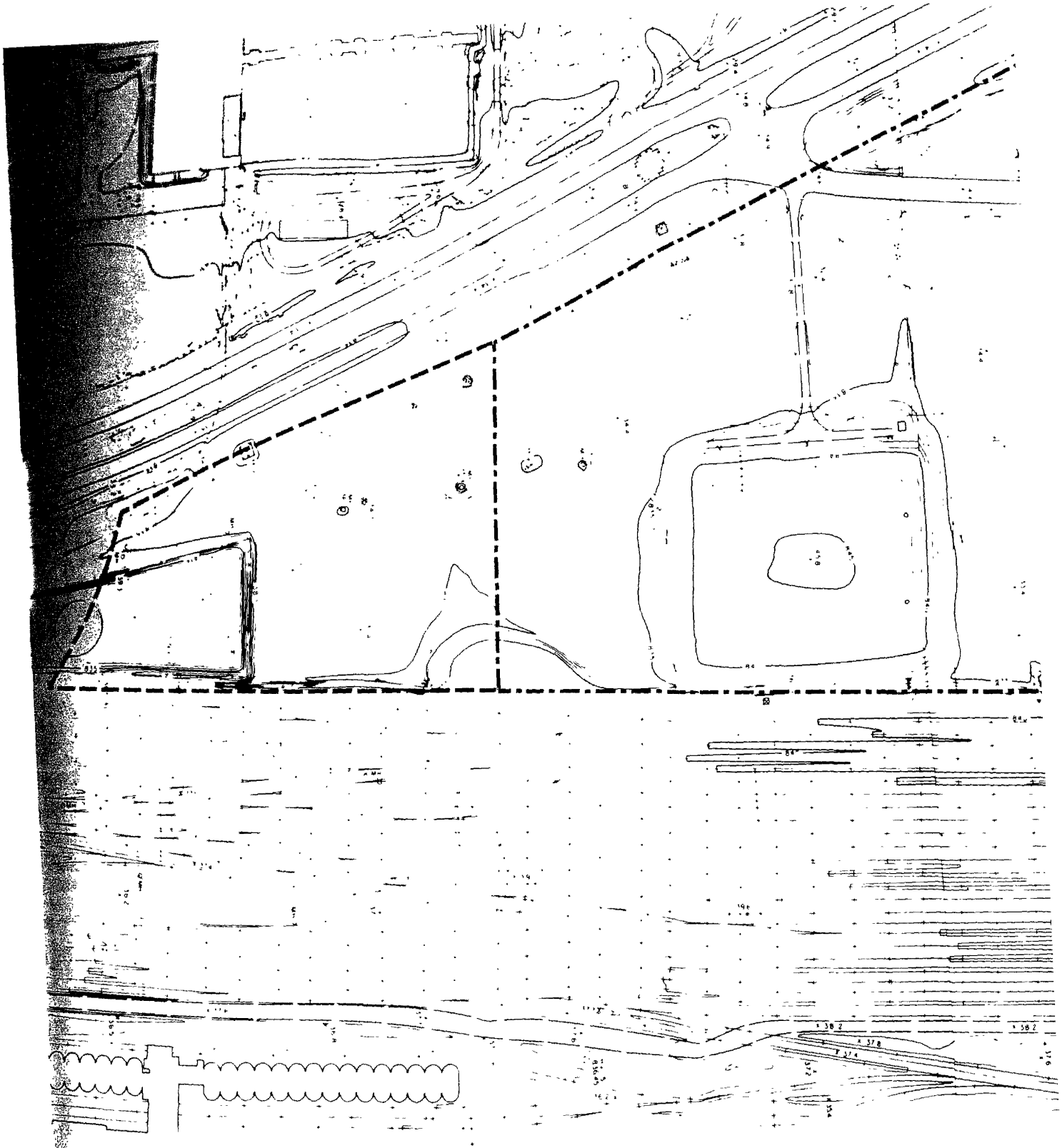

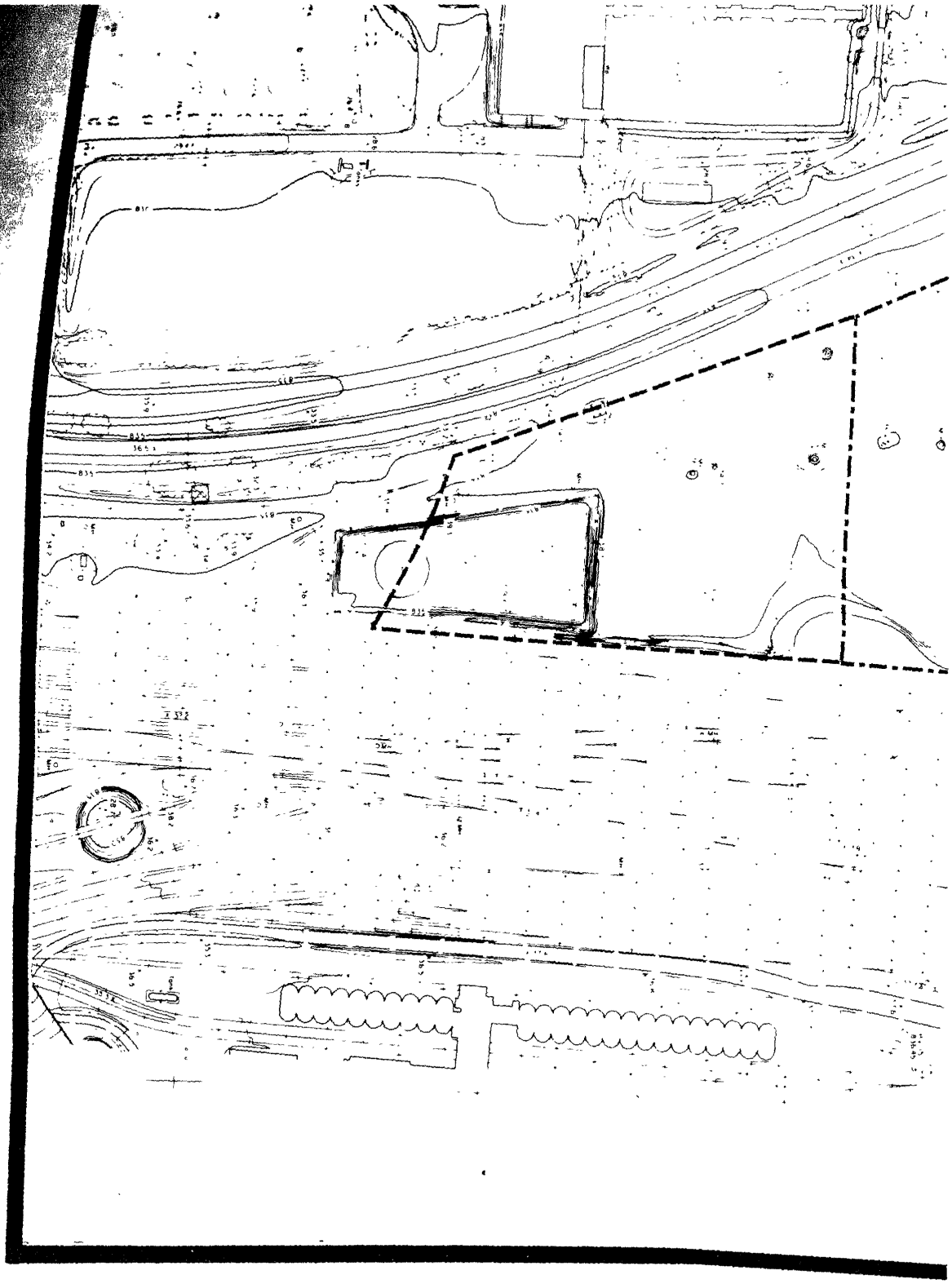

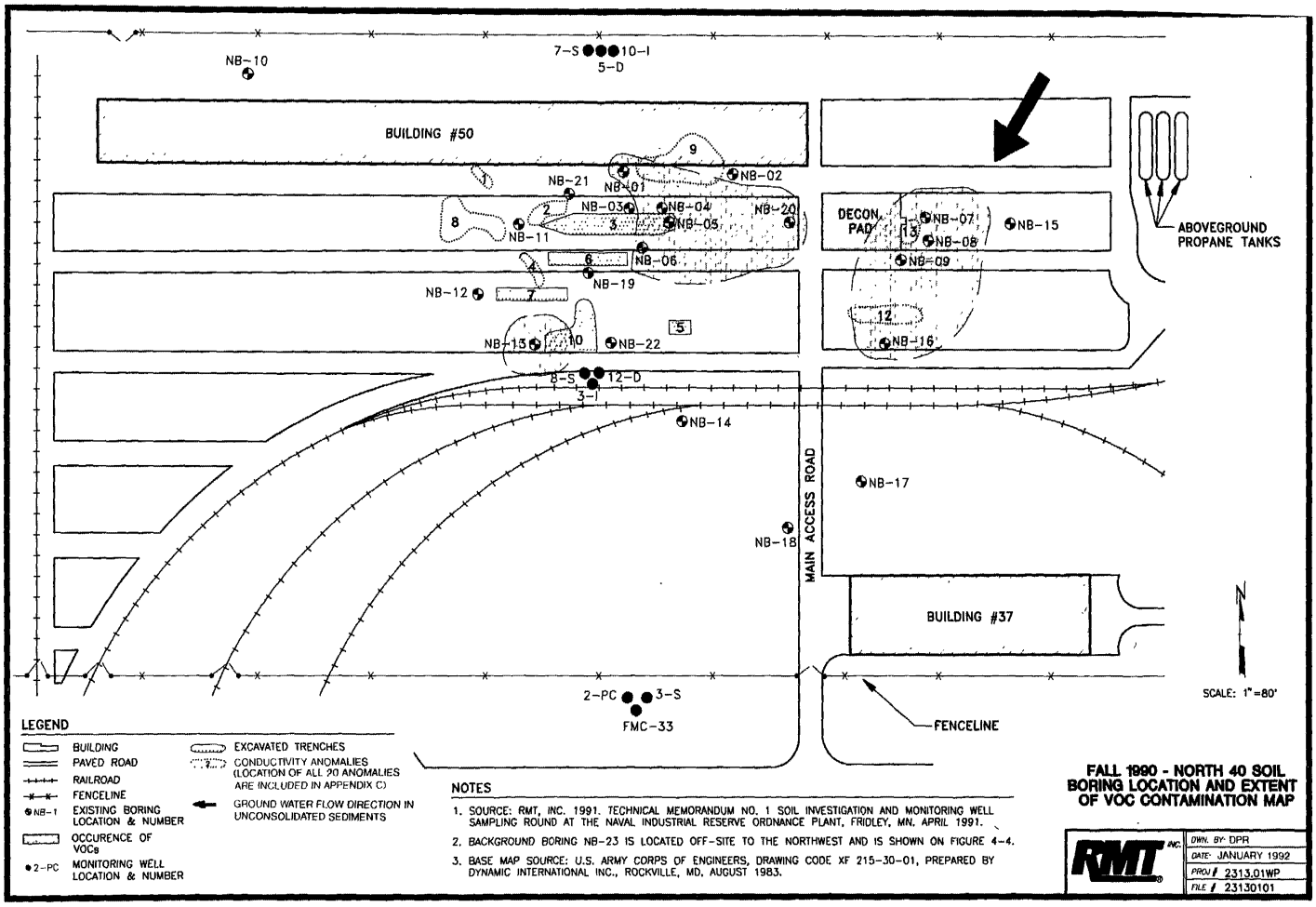

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FIGURE 4-5

included 28 soil borings, as shown on Figure 4-6; and the Southeast Area included four soil borings, as shown on Figure 4-7.

At each boring location, soil samples were collected for chemical and geotechnical analysis. Soil samples for Hnu headspace analysis were collected at 2.5-foot intervals to the top of the water table, which was encountered in most borings approximately 23 feet below ground surface. Soil samples for chemical analysis were collected at 5-foot intervals. The chemical parameter list is shown in Table 4-7. Detailed procedures for drilling and soil sampling are contained in the Draft Quality Control Plan and Sampling Plan (RMT, 1990).

Soil samples were selected for laboratory analysis by field-screening of the headspace of the soil sample jars with an Hnu photoionization detector (PID); results are included in the Quality Control Summary Report (RMT, 1991a). Three soil samples from each boring were selected for laboratory analysis. The soil sample collected from the 5-foot interval with the highest PID value was selected to be analyzed for the full list of chemical parameters shown in Table 4-7. The two soil samples from 5-foot intervals with the second and third highest PID values were selected for analysis of VOCs and four metals (barium, manganese, selenium, and zinc).

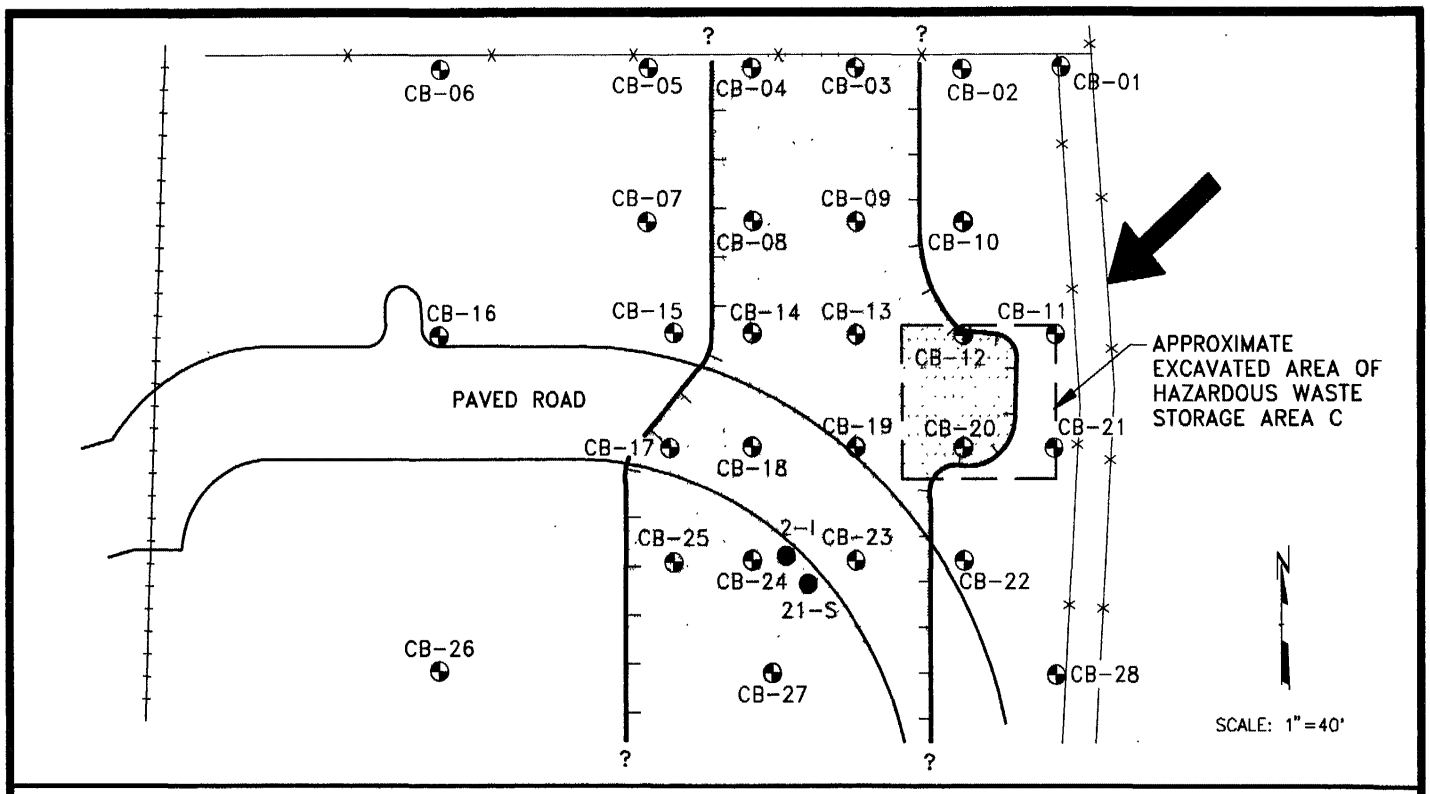
Key results of the Fall 1990 investigation are discussed below.

North 40

Findings and conclusions for the North 40 have been divided into subareas for discussion purposes as follows:

Area Around Decontamination Pad

- Sand and clay fill at borings NB08 and NB20 was found to be mixed with metal slag; the sand and clay fill, which extended to an unusual depth of 12.5 feet at NB08, was also found to contain cloth and large metal fragments.



LEGEND

- PAVED ROAD
- RAILROAD
- FENCELINE
- EXCAVATED AREA
- CB-01 BORING LOCATION AND NUMBER
- GROUND WATER FLOW DIRECTION IN UNCONSOLIDATED SEDIMENTS
- LIMITS OF FILL
- OCCURANCE OF VOC's
- 2-I GROUND WATER MONITORING WELL

NOTE

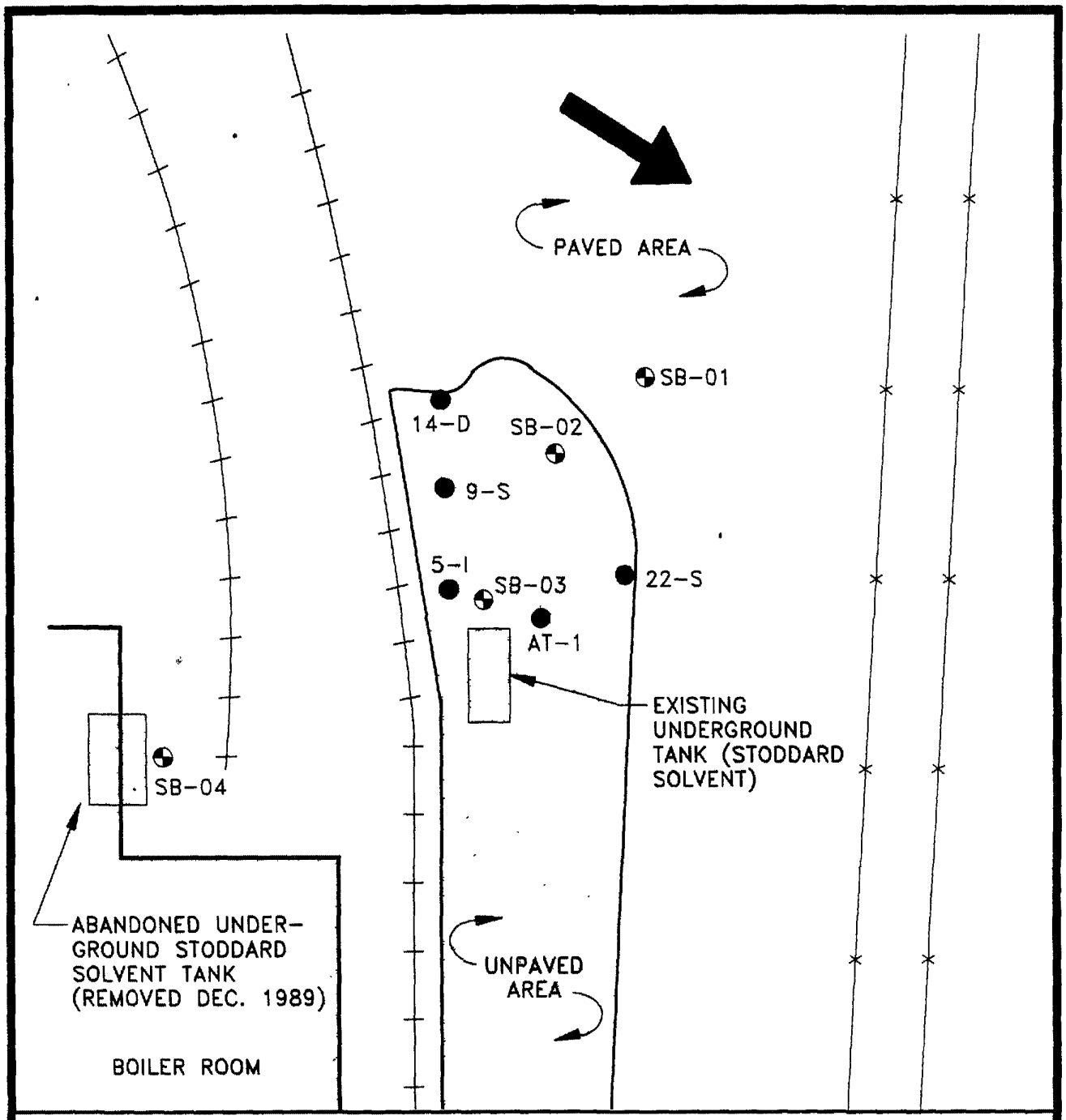
1. BASE MAP SOURCE: DEPARTMENT OF THE NAVY, DRAWING #2000522, PREPARED BY FMC CORPORATION, MINNEAPOLIS, MN, SEPTEMBER 1972.
2. RMT, INC. 1991. TECHNICAL MEMORANDUM NO. 1 SOIL INVESTIGATION AND MONITORING WELL SAMPLING ROUND AT THE NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT, FRIDLEY, MN. APRIL 1991.
3. SEE FIGURE 4-4 FOR AREA C LOCATION.

FALL 1990 - AREA C BORING LOCATION AND EXTENT OF VOC CONTAMINATION MAP

RMT INC.

DWN. BY:	BLF
DATE:	SEPT., 1991
PROJ.#	2313.01WP
FILE #	23130104

JAN 20 1992 **FIGURE 4-6**



LEGEND

- BUILDING
- UNPAVED AREA
- RAILROAD
- FENCELINE
- UNDERGROUND SOLVENT TANK
- SB-03 BORING LOCATION AND NUMBER
- AT-1 WELL LOCATION AND NUMBER
- GROUND WATER FLOW DIRECTION IN UNCONSOLIDATED SEDIMENTS IN OCTOBER, 1990

NOTE

1. BASE MAP SOURCE: DEPARTMENT OF THE NAVY, DRAWING #200520, PREPARED BY FMC CORPORATION, MN, SEPT. 1972.
2. SOURCE: RMT, INC. 1991. TECHNICAL MEMORANDUM NO. 1 SOIL INVESTIGATION AND MONITORING WELL SAMPLING ROUND AT THE NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT, FRIDLEY, MN. APRIL 1991.
3. SEE FIGURE 4-4 FOR SOUTHEAST AREA LOCATION.

N

SCALE: 1" = 10'

FALL 1990 - SOUTHEAST AREA BORING LOCATION MAP

RMT INC.

DWN. BY:	BLF
DATE:	SEPT., 1991
PROJ.#	2313.01WP
FILE #	23130103

TABLE 4-7

CHEMICAL PARAMETERS ANALYZED IN FALL 1990 SOIL SAMPLES

Volatiles (all samples)
(Method 8240)

Trichlorofluoromethane
Vinyl chloride
Chloroethane
Methylene chloride
1,1-Dichloroethene
1,1-Dichloroethane
1,2-Dichloroethene (Total)
Chloroform
1,1,1-Trichloroethane
Trichloroethene
Benzene
Tetrachloroethene
Toluene
Chlorobenzene
Ethylbenzene
Xylenes (total)

Metals (all samples)
(Method 6010, unless otherwise noted)

Barium
Manganese
Selenium (7740)
Zinc

PCBs/Pesticides
(selected samples)
(Method 8080)

Alpha-BHC
Beta-BHC
Delta-BHC
Gamma-BHC (Lindane)
Heptachlor
Aldrin
Heptachlor epoxide
Endosulfan I
Dieldrin
4,4'-DDE
Endrin
Endosulfan II
4,4'-DDD
Endosulfan sulfate
4,4'-DDT
Methoxychlor
Endrin ketone
Alpha-Chlordane
Gamma-Chlordane
Toxaphene
Aroclor-1016
Aroclor-1221
Aroclor-1232
Aroclor-1242
Aroclor-1248
Aroclor-1254
Aroclor-1260

Semivolatiles
(selected samples)
(Method 8270)

Phenol
Bis(2-chloroethyl)ether
2-Chlorophenol
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Benzyl alcohol
1,2-Dichlorobenzene
2-Methylphenol
Bis(2-chloroisopropyl)ether
4-Methylphenol
N-Nitroso-di-n-propylamine
Hexachloroethane
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Dimethylphenol
Benzoic acid
Bis(2-Chloroethoxy)methane
2,4-Dichlorophenol
1,2,4-Trichlorobenzene
Naphthalene
4-Chloroaniline
Hexachlorobutadiene
4-Chloro-3-methylphenol
2-Methylnaphthalene
Hexachlorocyclopentadiene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
2-Chloronaphthalene
2-Nitroaniline
Dimethylphthalate
Acenaphthylene
2,6-Dinitrotoluene
3-Nitroaniline
Acenaphthene
2,4-Dinitrophenol
4-Nitrophenol
Dibenzofuran
2,4-Dinitrotoluene
Diethylphthalate
4-Chlorophenyl-phenylether
Fluorene
4-Nitroaniline
4,6-Dinitro-2-methylphenol
N-nitrosodiphenylamine
4-Bromophenyl-phenylether
Hexachlorobenzene
Pentachlorophenol
Phenanthrene
Anthracene
Di-n-Butylphthalate
Fluoranthene
Pyrene

Semivolatiles (cont.)

Butylbenzylphthalate
3,3'-Dichlorobenzidine
Benzo(A)anthracene
Chrysene
Bis(2-ethylhexyl)phthalate
Di-n-Octylphthalate
Benzo(B)fluoranthene
Benzo(K)fluoranthene
Benzo(A)pyrene
Indeno(1,2,3-CD)pyrene
Dibenz(A,H)anthracene
Benzo(G,H,I)perylene

Inorganics
(selected samples)
(Method 6010 except as noted)

Aluminum
Antimony (7041)
Arsenic (7060)
Barium
Beryllium
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead (7421)
Magnesium
Manganese
Mercury (7471)
Nickel
Potassium
Selenium (7740)
Silver
Sodium
Thallium (7841)
Vanadium
Zinc
Cyanide (Total) (9012)

- Soils from boring NB08 had the highest concentrations of VOCs reported during the investigation. PCE at 10,000 µg/kg, TCE at 52,000 µg/kg, 1,2-DCE at 62,000 µg/kg, TCA at 14,000 µg/kg, and 1,1-DCA at 3,300 µg/kg were all reported in sample NB08C (6 to 8 feet below ground surface). NB08C is the same interval where discarded metal and cloth were noted during drilling.

- VOCs were reported in samples from other borings in this subarea.

- Borings in this subarea are upgradient of ground water monitoring wells 3-S and FMC-33, where the same VOC compounds have been historically reported in ground water samples.

- A total of 12 trace elements were reported at high concentrations in soil samples collected in this subarea. Ten of the 12 high concentrations were from sample NB08C.

Area Around Trench 3

- PCE, TCE, 1,2-DCE, and TCA were reported in several samples from this area. TCE concentrations were approximately 350 µg/kg in some samples from this area.

- Trench 3 is upgradient of ground water well nest 8-S, 3-I, and 12-D where VOCs have been reported in ground water samples from the shallow and intermediate wells.

- High concentrations of trace elements were not found in soils in this subarea.

Area Around Trench 10

- TCE (54,000 µg/kg) and 1,2-DCE (1,300 µg/kg) were reported in sample NB13C.

- Boring NB13 is within 40 feet of ground water monitoring wells 8-S and 3-I where TCE was reported in October 1990 at approximately 2,500 µg/L.

- Thirteen base, neutral, and acid-extractable PAH compounds were reported in one sample at the 0- to 2-foot interval. The presence of PAH compounds may be due to asphalt materials or combustion residue.

- Thirteen trace elements were reported at high concentrations in one shallow sample from this area.

Area South of the Railroad Tracks

- TCE was the only VOC detected in the three borings south of the tracks. It was reported in only one sample at 37 µg/kg (NB14).

Miscellaneous Borings

- Soil samples from the boring advanced for new well 10-I did not contain VOCs above detection limits or elevated concentrations of other compounds.

Area C

Findings and conclusions for Area C have been divided into subareas for discussion purposes as follows:

Location of Former Area C Storage Building

- Four borings were advanced directly into the former building location. PCE (130 µg/kg) and TCE (680 µg/kg) were reported in soils from CB20. These two compounds were the only VOCs reported above method reporting limits.
- Boring CB13, which is immediately west of the former building, contained soils with PCE at 500 µg/kg and TCE at 6,300 µg/kg. However, CB13 is also associated with a possible trench discovered during this investigation.
- Boring CB13 was also observed to contain high concentrations of barium, manganese, and mercury.

It should be noted that the excavated area shown on Figure 4-6 is part of an ongoing RCRA closure activity being conducted by FMC. The closure alternatives study was performed by RMT, Inc., for FMC, and the draft report is under review by FMC. The boundaries of the RCRA unit will be negotiated with the MPCA RCRA group. It is not anticipated that the final delineation of the RCRA closure area will materially affect the scope of this CERCLA investigation based on preliminary discussions with the MPCA.

Location of Previously Unknown Trench

- PCE and TCE were the only two VOCs reported above method reporting limits in this subarea.
- PCE and TCE were reported in the northernmost boring in the trench (CB03) at 16 µg/kg and 100 µg/kg, respectively, and also in the southernmost boring in the trench (CB25) at 25 µg/kg and 88 µg/kg, respectively.
- CB03 was observed to contain the greatest number of anomalous trace elements (12) reported in Area C.

- Ground water monitoring wells 21-S and 2-I are immediately downgradient of both the southern end of the possible trench and the former Area C storage building. TCE was reported in well 21-S at 1,200 µg/L during the October 1990 sampling round.

Southeast Area

- Although cinders were noted in the sand, silt, and clay fill in the Southeast Area, there were no other significant unusual physical features.

- Results of VOC analysis of soils in the Southeast Area show low concentrations of VOCs (< 85 µg/kg TCE) and suggest that this area is the source of ground water contamination observed in area wells.

4.3.4 Aerial Photograph Review

During August 1991, an initial aerial photograph review was conducted by RMT staff which included photographs spanning the period 1945 to 1977. A second review of the same aerial photographs, and additional photographs which were not available for the August review by RMT, was conducted on December 5, 1991, following the quarterly meeting of the RI Technical Review Committee. The second review was performed jointly by representatives of the U.S. Navy, the USEPA, the MPCA, FMC, and RMT. As a result of review and discussions held on December 5, 1991, additional areas of investigation will be included as part of the NIROP Soils RI Workplan, as follows:

- An area near the recent addition to the Hazardous Materials Storage Building (see Subsection 4.3.5) on the southwest side of the plan will be added to the investigation. This area appears to be located where metal shavings and milling wastes were loaded for removal from the plant. Soil staining was noted on several photographs in this area. This area is shown in general on Figure 4-4 of the RI Workplan and in detail on Figure 2-6 of the FSP.

- An area where barrels were stored was observed on several aerial photographs. The area in question is located near the present western entrance near the guard shack, generally as shown on Figure 4-4 of the RI Workplan and in detail as shown on Figure 2-6 of the FSP.

- An area noted on the November 13, 1975, photograph revealed what was apparently a pit-type excavation located approximately 385 feet south of the northern property fence, and approximately 275 feet west of the eastern property fence. The area is shown in general on Figure 4-4 of the RI Workplan and in detail on Figure 2-3 of the FSP.

- An area noted on the 1975 photograph also showed numerous barrels just south of the excavation described above. The area was used to stage empty drums for recycling and is shown in general on Figure 4-4 of the workplan and in detail on Figure 2-3 of the FSP. Neither the barrel staging area nor the apparent excavation area were included within the limits of the geophysical surveys nor the limits of the soil gas survey.

There was no direct evidence in the photographs of the potential trench observed in Area C during the Fall 1990 soils investigation discussed in Subsection 4.3.3. However, photograph N-2461 (June 1, 1941) showed a slightly shaded area in the vicinity of the potential trench. The planned investigation detailed in this workplan will cover portions of the shaded area.

4.3.5 Hazardous Materials Storage Building Addition

In November 1991, FMC Corporation began construction of an addition to the hazardous materials storage area on the west side of the NIROP facility. Soil staining was noted at this location during the aerial photograph review (see Subsection 4.3.4). The location of the addition corresponds with an area where metal shavings and milling wastes were loaded for removal from the plant. Figure 4-4 shows the general location of the building addition and stained soil. Figure 2-6 of the FSP shows details of the area.

Potentially contaminated soils were encountered during construction of the hazardous materials storage building. An excavation documentation report was prepared for FMC by Wenck Associates (1991). The Wenck report presented data for organic vapor analysis performed on excavated soils and analytical data for samples selected for analysis of VOCs and total petroleum hydrocarbons (TPH). The major constituent reported was a cutting oil, "Lubecut." Additionally, four samples were reported as containing ethylbenzene and xylenes. No TCE was reported in soil sampled from the excavation.

4.3.6 Storm Sewer Construction

In November 1991, a storm sewer improvement project was performed in the area north of the NIROP plant building. During excavation of soils for the sewer, an on-site USEPA observer noted stained soils approximately 2 feet below the ground surface. The stained soil areas are noted on Figure 4-4 of the workplan and Figure 2-2 of the FSP. No observations regarding odor were made at the time that the stained soils were noted, nor were samples collected.

4.4 Preliminary Problem Assessment

Results of previous investigations indicate that several areas at the NIROP Fridley may contain soils which have been impacted by site activities. These potentially impacted areas are shown on Figure 4-1. New area designations have been used during this RI to facilitate sample identification which is described in the Field Sampling Plan (Appendix A, Attachment 1). Areas to be further investigated, and the preliminary problem assessment for each, are discussed below.

Area A (referred to as the North 40 in previous investigations).

- Past disposal activities in Area A indicate that wastes containing hazardous substances have been disposed in pits and trenches.
- Results of an electrical conductivity survey indicated 15 conductivity anomalies (potential pits and/or trenches) within Area A.
- Only six of the 15 conductivity anomalies identified in Area A were excavated in 1983.
- Results of a soil pore gas survey performed in November 1987 indicated that potential sources of VOC contamination still existed in Area A, primarily near the decontamination pad and near the northern property line fence.
- Results of the Fall 1990 soil investigation indicated that soils have been impacted within Area A near the decontamination pad, near trench 3, and near trench 10. The area along the northern property fence line did not show elevated concentrations of VOCs above the water table at the one location sampled.

- Observations made during the construction of a storm sewer improvement project indicated potentially contaminated soils within Area A at locations not included in previous investigations.

Based on the results of previous investigations, the following subareas within Area A require additional investigation:

- Subareas near the unexcavated nine conductivity anomalies.
- Subareas near the decontamination pad, trench 3, trench 10, and along the northern property fence.
- Additional investigation to determine the boundaries between clean and contaminated areas (if appropriate).
- Stained soils reported during the construction of a storm sewer improvement project.

Area B

- Past disposal activities in Area B indicate that wastes containing hazardous substances have been disposed in pits and trenches.
- Results of an electrical conductivity survey indicated five conductivity anomalies (potential pits and/or trenches) exist within Area B.
- Only three of the five magnetic conductivity identified in Area B were excavated in 1983.
- Results of the soil pore gas survey performed in November 1987 suggested that the three excavated pits/trenches in Area B were currently not potential sources of VOC contamination.
- Results of the aerial survey review suggest the presence of a previously unreported pit.
- Results of the aerial survey review show a drum staging area.

Based on the results of previous investigations, the following subareas within Area B require additional investigation:

- Subareas near two of the five unexcavated conductivity anomalies.
- Subareas near the three excavated trenches.
- Subarea near the potential pit observed during the aerial photograph review.

- Additional investigation to determine the boundaries between clean and contaminated areas (if appropriate).

Area D

Area D has been added to the RI based on results of the Fall 1990 soils investigation. During that investigation, what was apparently a previously unknown trench was discovered near former Hazardous Waste Storage Area C. Area D has been added to this investigation and includes only the extent of the unknown trench. Former Hazardous Waste Storage Area C is undergoing RCRA closure by FMC and will not be included in this RI. Additional soil investigations are necessary to determine the nature and extent of the apparent trench.

Area E

Area E includes the area around the TCA storage tank located on the east side of the NIROP Fridley plant building, and corresponds to Area III from the soil gas survey. Results of the soil gas survey performed in November 1987 indicated potential impacts on soils in that area by VOCs. Additional soil borings in Area E are necessary to determine if a problem exists in this area. Also included in Area E is the area around soil boring SB04. TCE was reported in soil from SB04 during the fall 1990 investigation.

Area F

Area F includes the area around the new addition to the Hazardous Materials Storage Area on the west side of the NIROP plant building. This area coincides with an area containing stained soils noted during an aerial photograph review. Impacted soils were reported during excavation for the building addition. Additionally, a drum storage area was also identified in Area F during the aerial photograph review.

5. POSSIBLE ALTERNATIVE RESPONSE ACTIONS

The purpose of this section is to identify general response actions that may be appropriate to this site. This initial discussion is intended to focus the scope of the RI so that data necessary for future decision-making can be collected. These general response actions are based on available site data and are subject to change as the RI progresses.

This section should not be considered a list of technologies or alternatives that have been agreed upon by the Navy and the agencies. The selection of a remedy will be made by the Navy during the FS phase of the investigation with subsequent approval by the MPCA and the USEPA Region V.

The Feasibility Study will evaluate the feasibility and effectiveness of implementing alternative response actions at the site. It will contain sufficient information and analysis to make the determination of the appropriate extent of remedy. The FS will use and build upon the information generated by the RI and will consist of an Alternatives Report and treatability studies (as appropriate).

Following the finalization of the RI report, the Navy will develop and submit to the USEPA and the MPCA an Alternatives Report. The Alternatives Report will provide an evaluation of (a) each possible alternative response action identified in the initial screening of possible alternative response actions (a section of the RI Report), and (b) any other reasonable alternative identified by the Navy or the agencies. For each evaluated alternative, the following criteria will be addressed and presented in the Alternatives Report:

1. Compliance with Applicable, Relevant, and Appropriate Requirements (ARARs)
2. Cost
3. Protection of Human Health and Environmental Effects
4. Short-Term Effectiveness
5. Long-Term Effectiveness and Permanence
6. Technical Feasibility and Implementability

7. Toxicity, Mobility, and Volume Reduction

8. State Acceptance

9. Community Acceptance

It is possible that no specific remedial action will be necessary to provide protection. If risk to human health and the environment, as estimated during the baseline risk assessment (described in Subsection 9.3 of the QAPP [Appendix A]), are within acceptable ranges, a "no-action" or "limited-action" response may be appropriate. The no-action alternative would provide for no physical remedial action of soils at the site, with the likely continuation of ground water monitoring.

For those response actions involving remedial activity, various technologies have been identified and are discussed below. Currently available data suggest that some remedial technologies are inappropriate to known site conditions. However, a rather broad range of technologies is presented in the event that new and unanticipated conditions are encountered during the RI. During the FS, these technologies will be screened to eliminate those that are not feasible or impractical based on the RI data base. Technologies that pass the initial screening will form the basis for specific remedial alternatives for the site.

5.1 Containment Technologies

Containment can be used in conjunction with other remedial response actions or as the sole means of remediation.

5.1.1 Cover Systems for Source Materials

The purpose of site capping is, in general, threefold: 1) to eliminate surface transport of waste constituents through erosion processes; 2) to eliminate the potential for direct contact with waste material; and 3) to minimize the introduction of precipitation, and thereby the leaching of constituents from buried waste materials.

Capping is frequently employed as a final method of site stabilization for a variety of waste materials, particularly when waste removal is impractical because of risks due to increased public exposure, the type of constituents present, and/or the cost of waste removal. Capping does not eliminate the risk associated with a waste, but rather reduces the risk of exposure to the waste and/or the potential for migration of waste constituents.

If it is determined during the RI that the existing surface materials do not adequately reduce infiltration of precipitation, a variety of specific options are available. These include the following:

Concrete Pavement - This option involves surface grading to provide contouring for effective surface water runoff, and placement of a granular base course followed by placement of a concrete slab. The slab would provide a durable surface which would permit selective future surface use of the site for storage or parking. The concrete slab has excellent weathering characteristics and excellent water repellency (i.e., low permeability). However, concrete surfaces can be damaged as a result of settlement of underlying materials.

Asphalt Pavement - This option involves surface contouring for effective water runoff and placement of a granular base course and an asphaltic surface course. This surface is specifically designed to reduce infiltration and is similar to highway paving asphalt except that the percentages of mineral filler and asphalt cement are increased, providing a low-permeability surface.

***In-Situ* Soil Admixtures** - This option involves surface grading followed by addition and mixing into the soil of either a liquid asphalt to create soil asphalt, or cement and water to create soil cement. The mixing depth in either case is generally 6 to 12 inches, resulting in physical soil properties (strength, water repellency) greater than the natural soil.

Sprayed-On Caps - This technology involves grading the area for effective surface water runoff, compaction and rolling of the area to obtain a smooth surface, and application of a sprayed-on surface membrane. The membrane material generally used is an asphalt or a rubber and/or plastic latex. The finished membrane generally has a thickness of approximately 0.25 inch.

Soil Caps - This technology involves base preparation consisting of regrading and recompaction followed by placement and compaction of clay to achieve a hydraulic conductivity of less than 1×10^{-7} cm/sec. A typical clay thickness is 2 feet, which is then covered by general soils and topsoil for freeze protection and revegetation, respectively. The clay layer provides a low-permeability barrier which minimizes infiltration of surface waters. Revegetation helps to reduce surface erosion and minimize ground water recharge by evapotranspiration of infiltrated precipitation. Where direct contact is the primary concern, cover soils alone can be utilized. The existing soil cap could be enhanced by placement of additional low-permeability soils if it is shown that the cover is presently inadequate.

Composite Covers - This technology involves placement of a synthetic membrane. A clay layer of less than 1×10^{-7} cm/sec hydraulic conductivity is then placed on top of the synthetic membrane with an overlying sand drainage layer. Fill material to be revegetated is then placed on top of the sand blanket. This technology provides two low-permeability liners to minimize infiltration, as well as sand blankets to cushion the synthetic membrane and serve as a drainage layer. A synthetic membrane could also be added to the existing soil cover to provide an additional barrier to infiltration.

5.1.2 Subsurface Gas Migration Control

Gas that might be migrating from the waste disposal areas may be intercepted by construction of perimeter cutoff trenches. The trenches are filled with coarse material or gravel, and may be vented to the atmosphere through piping. If a higher level of control is needed to protect nearby structures, a synthetic membrane may also be added to the trench.

5.2 Removal Technologies

5.2.1 Soil Excavation

This technology involves the excavation of materials from an identified area followed by disposal or treatment of those materials. The purpose of the excavation is to physically remove the source of the waste constituents to prevent future migration or contact. Excavation work would be performed using conventional equipment, such as backhoes, clamshells, or draglines. For dry materials, dust suppression may be necessary to reduce the release of airborne particulates. In general, the technology is viable and effective in minimizing future migration of waste constituents in air, surface water, and ground water, assuming that significant sources of these constituents are located and removed.

5.2.2 *In-Situ* Soil Vapor Extraction

Vapor extraction consists of removing volatilized organics from the pore spaces of the soil by applying a vacuum to the unsaturated zone through a series of well screens. The technique is highly effective in permeable soils where the water table is greater than 10 to

15 feet deep. It is less effective in tighter soils, or where a shallow water table leads to short-circuiting of ambient air. This latter condition can be overcome by constructing a low-permeable surface, such as asphalt or concrete, over the affected area.

When the off-gas from this process contains low levels of volatiles, it may be vented directly to the atmosphere. Alternatively, where the levels are high, or where ambient air quality concerns exist, it may be necessary to remove the organics from the off-gas. This can be accomplished by air emission controls. Installation of vacuum recovery points and the associated equipment is relatively straightforward and typically not cost prohibitive.

5.3 Treatment Technologies

Several treatment technologies for the treatment of waste and soil are available. New technologies are being introduced at various stages of development, and existing technologies are being applied in alternate ways. Unlike the more conventional technologies for containment and removal, treatment technologies (or process options) are frequently patented and proprietary, and available only through a limited number of vendors. In some cases, technologies exist at a "full-scale" stage of development, but have yet to be permitted for specific applications. In all cases, a treatment technology is specific to a particular chemical compound or class of compounds.

Information on treatment technologies offered through specific vendors, as well as on a generic basis, is contained below.

> **Biological Treatment** - Organic constituents may be amenable to biological treatment under controlled conditions, using naturally occurring or enhanced micro-organisms. Under *in-situ* conditions, existing aerobic microbial populations may be enhanced by introducing nutrients and oxygen to the subsurface via an injection system. Water that is leached to the ground water can be recovered, replenished with appropriate nutrients, and then recirculated. By providing otherwise rate-limiting nutrients, naturally occurring degradation is enhanced. Less- or non-toxic byproducts are produced.

Biological treatment may also be performed in aboveground batch reactors. Excavated solids would be slurried, and the required nutrients would be introduced. Control of oxygen levels and temperature would be required. Treated material would be dewatered prior to backfilling or disposal.

Both *in-situ* and batch treatment processes are somewhat innovative, and they have not been widely applied. Because an extensive body of empirical data does not yet exist, treatment performance under highly variable site and waste conditions cannot be accurately predicted. At a minimum, laboratory and pilot treatability testing would be required.

Chemical Extraction - Chemical extraction, or "soil washing," is the extraction of constituents from bulk soil or solids using water, solvents, or surfactants. The technology may be applicable to heavy metals, halogenated aliphatics, and volatile organics. Soils that are most amenable to extraction are those that contain a limited number of chemically similar constituents, and that have a low organic content and a high permeability. A sandy, porous soil would typically be more easily treated than a silt or clay.

Batch treatment is performed in a series of specially designed mixing vessels, and, in some cases, at elevated temperature or pressure. Extraction fluids used in the process are further treated to destroy or recover the extracted constituents. If solvents are used, they may be recycled for further use.

It may also be possible to remove constituents via *in-situ* flushing. As with *in-situ* biological processes, leachate would be recovered using ground water collection wells. Subsequent treatment would be required to remove the recovered constituents prior to discharge or reinjection of the water. The process is most amenable to high-permeability soils where adequate volumes of water can be applied.

Thermal Destruction - Organic constituents can be thermally destroyed at elevated temperatures (1400 - 3000° F). The end products include carbon dioxide, water vapor, sulfur and nitrogen oxides, acid gases, and particulates. Soil or other inorganic solids pass through the process and are emitted as a dry, ash-like material.

The most common process options include rotary kilns, liquid-injection systems, multiple hearths, and fluidized beds. Innovative process options include infrared units, plasma furnaces, and plasma arcs. Selection of a particular option is based on feed material characteristics, commercial availability, and economics.

Fixed-based commercial facilities exist around the country for the treatment of Resource Conservation and Recovery Act (RCRA) hazardous wastes, Toxic Substances Control Act (TSCA) PCB wastes, and other solids or liquid wastes containing organic constituents. For large volumes of material which cannot be economically transported to a fixed-base facility, transportable units are available for on-site remedial actions. Transportable units require ancillary equipment for treatment of air and wastewater side streams, and may be subject to state and federal permitting.

Thermal Extraction - Thermal extraction is a technology used to remove organics from a waste stream under comparatively low temperature conditions (400° to 800° F). During the extraction process, organics are transferred from the solid matrix to a gaseous matrix. Depending on the process option, the off-gas may be passed through an afterburner for destruction of organic constituents, or may be condensed for organics recovery. Treated soil may be backfilled or otherwise treated/disposed.

This technology is offered commercially in the form of transportable units. Fixed-base facilities have not been developed to date, since the attractiveness of this technology is for cost-effective, on-site applications. Transportable units can provide complete processing capabilities, with the exception of condensate which may require off-site management. Depending on the regulatory classification of the feed material and on local requirements, state or federal permits may be necessary.

Solidification/Chemical Fixation - A variety of proprietary and non-proprietary equipment and additives are available to solidify/chemically fixate soils or solids. The net result of the technology is to reduce the leachability of waste constituents by physical encapsulation, chemical reaction, or a combination of both. The technology can be applied on a batch or continuous basis or by using *in-situ* techniques. When waste is excavated and processed, the treated material may be backfilled or otherwise disposed.

In terms of leaching potential, solidification without chemical alteration of the waste may not provide long-term effectiveness. In addition, materials containing high levels of organics are typically less amenable to solidification than materials with inorganic constituents, when leaching potential is the standard of measure. At the present time, there is no definitive guidance from USEPA headquarters or from the regions concerning the allowable "leachability" of constituents from a solidified material. It is also uncertain as to which leach test protocols should be applied to measure the performance of a solidification technology.

Physical Separation (Preprocessing) - This technology involves the separation of dissimilar materials by mechanical means. A common application is the screening of soils containing bulk debris as a processing step prior to soil treatment. A variety of equipment and techniques are readily available.

In an application where soil is being sorted prior to treatment, bulk items would be managed as a separate waste stream. Depending on site and regulatory conditions, this portion of the waste stream may or may not be classified as a hazardous waste. When this material is considered a regulated material, and cannot be otherwise treated, direct land disposal may be necessary.

5.4 Disposal Technologies

Land disposal of both solid wastes and bulk soil or solids is a proven technology that has been used for many years. The options for disposal of excavated solids include the following:

Off-Site Facility - Excavation of material would be performed by a backhoe or other mechanical means. Excavated material would then be transported by licensed hazardous waste haulers to an off-site, permitted disposal facility. Imported fill material would be required to backfill the excavated areas. This technology permits full future use of the site. Long-term management of the removed material would become the responsibility of a third party; however, the liability associated with the material remains that of the generator.

On-Site Facility - This technology could involve the construction of a disposal facility on-site. A newly constructed landfill would have to meet land disposal design requirements consisting of a base, cap, and sidewalls constructed of low-permeability clay with a second internal synthetic liner. Sufficient land area must be available, and future land use would be restricted.

6. IDENTIFICATION OF DATA GAPS

The objectives of the RI for the NIROP Fridley site are as follows:

- To determine the nature and extent of hazardous substances that may be present in the soils above the water table at the site.
- To evaluate the chemical quality of affected soils relative to applicable or relevant and appropriate requirements (ARARs).
- To gather data and information to the extent necessary and sufficient to quantify risk to public health and the environment and to support the development and evaluation of viable remedial alternatives in the FS.
- To identify general response actions that may be appropriate for the soils at the NIROP Fridley site.

Soils RI activities are planned to be conducted in five on-site areas. Figures showing the locations of these areas and boring locations are included in the Field Sampling Plan, which is Attachment 1 of the QAPP. The five areas of planned activity and their relationship to past site activities are as follows:

RI Area	Past Activity
Area A	Area A coincides with the North 40 Area which has been the subject of the electrical conductivity and magnetometer surveys, the soil pore gas survey, the Fall 1990 Soil Investigation, and the November 1991 storm sewer improvement project.
Area B	Area B is east of the North 40 and has been investigated previously during the electrical conductivity and magnetometer surveys and the soil pore gas survey.
Area D	Area D is located in the general vicinity of former Hazardous Waste Storage Area C. The area has been investigated as part of the soil pore gas survey and the Fall 1990 Soil Investigation. Since former Hazardous Waste Storage Area C is currently undergoing RCRA closure activities, the portion of the area which is not subject to the RCRA closure has been designated as Area D. Currently, the boundaries of the RCRA unit are under discussion.
Area E	Area E includes the location of the aboveground TCA storage tank included in the soil pore gas survey and the southeast area near SB4 from the fall 1990 investigation.
Area F	Area F includes the area around the excavation where the Hazardous Materials Storage Addition has been built. Additionally, it includes an area of potential drum storage, identified during the aerial photograph review.

RI activities (described in Section 7) are planned to fill the following data gaps:

Area A: Soil samples from the area near the decontamination pad (conductivity anomaly 13) were found to contain VOCs, anomalously high concentrations of metals, and pesticides. Additional samples are required to evaluate the extent of contamination.

Fall 1990 soil borings indicated the presence of VOCs in soils around trench 3 and also in the vicinity of trench 10. Additionally, soils near trench 10 were reported as containing anomalously high concentrations of metals. Additional borings are required to characterize these areas.

Only six of 15 conductivity anomalies observed during the electrical conductivity survey have been excavated. The remaining nine anomalies have been attributed as having either a potential to contain wastes or were not rated. Additional investigation at these locations is necessary to verify that the soils associated with these anomalies do not contain additional unexcavated wastes.

High soil gas readings along the northern property fence were investigated with one soil boring during the Fall 1990 investigation. Additional borings are necessary to confirm or deny the presence of VOCs.

Stained soils observed during the November 1991 storm sewer improvement project.

Area B: Only three of five conductivity anomalies observed in Area B during the electrical conductivity survey have been excavated. The remaining two anomalies have been evaluated as having either a potential to contain wastes or were not rated. Additional investigation at these locations is necessary to verify that the soils associated with these anomalies do not contain additional unexcavated wastes.

Additional borings at the three excavated anomalies are necessary to confirm the absence of hazardous substances.

A potential unknown pit or trench was observed during the aerial photograph review at a location not included in previous investigations. Additional investigation is required at the pit location to determine if wastes have been disposed within the pit.

A potential drum storage area was also observed in Area B during the aerial photograph review.

Area D: A potential unknown trench was observed during the Fall 1990 soil investigation. Additional investigation is required to determine the size of the trench to the north and south, and to determine the nature of the constituents present in soils within the trench.

Area E: Results of the soil gas survey reported the presence of low levels of VOCs in soils in the vicinity of the aboveground TCA storage tank. Soil borings near the tank are needed to determine the nature of the source of the VOCs, and to determine the extent of contamination, if appropriate. Additionally, ground water monitoring wells 9-S and 22-S, which are located to the south of the TCA tank, have indicated the presence of TCE, TCA, and other contaminants. Analytical results from soils collected at boring SB4, advanced during the fall 1990 investigation, indicated the presence of TCE in the 3- to 5-foot sample. An additional boring is proposed for this area.

Area F: Results of the aerial photograph review indicated two areas of concern in Area F. The first location is a potential drum storage area, and the second location includes an area of stained soils. The area of stained soils also includes the location of the addition to the Hazardous Materials Storage Area.

Background: The Fall 1990 Investigation included only one background soil boring. The nature of the material encountered in the upper portion of the one background boring was quite different from that of the 54 borings advanced on-site. Additional background data are necessary for comparison with on-site soils, particularly with regard to metals.

7. SAMPLING AND ANALYSIS PLAN

7.1 Soil Sampling

7.1.1 Objectives

The investigation approach outlined below is designed to meet the objectives that were identified in Section 6.

7.1.2 Soil Sampling Plan

The Soils RI will build on the results of previous investigations as described in Section 4 of the RI Workplan. In particular, it will address the issues outlined in the Preliminary Problem Assessment (Subsection 4.4). A combination of soil test pits and soil borings will be used to collect soil samples. Boring and test pit locations, rationale for sample locations, and sampling procedures are presented in the Field Sampling Plan (Appendix A, Attachment 1).

The soil boring program is summarized in Table 7-1. Samples for laboratory analysis of physical properties are also shown in Table 7-1. The overall soils workplan and schedule are illustrated graphically on Figure 7-1.

Soil Boring General Approach

The general approach to the soil borings is to begin by conducting vertical soil sampling at areas of known or suspected contaminated soils. These are designated as "Type 1" borings. An Hnu photoionization detector will be held over eacn split-spoon sample to provide preliminary information about the magnitude of VOC concentrations to aid in running the field gas chromatograph (GC) analysis. Field GC analysis will be conducted on each split-spoon sample, and the results will be used to select samples for laboratory compositional analysis. At many locations, near-surface samples will be submitted for laboratory analysis to evaluate the risk associated with direct contact (see Subsection 9.3 of the QAPP for discussion regarding the baseline risk assessment). The accuracy of the field GC analyses will be assessed qualitatively by comparison with laboratory CLP analyses during

TABLE 7-1

SUMMARY OF PROPOSED SOIL BORING PROGRAM

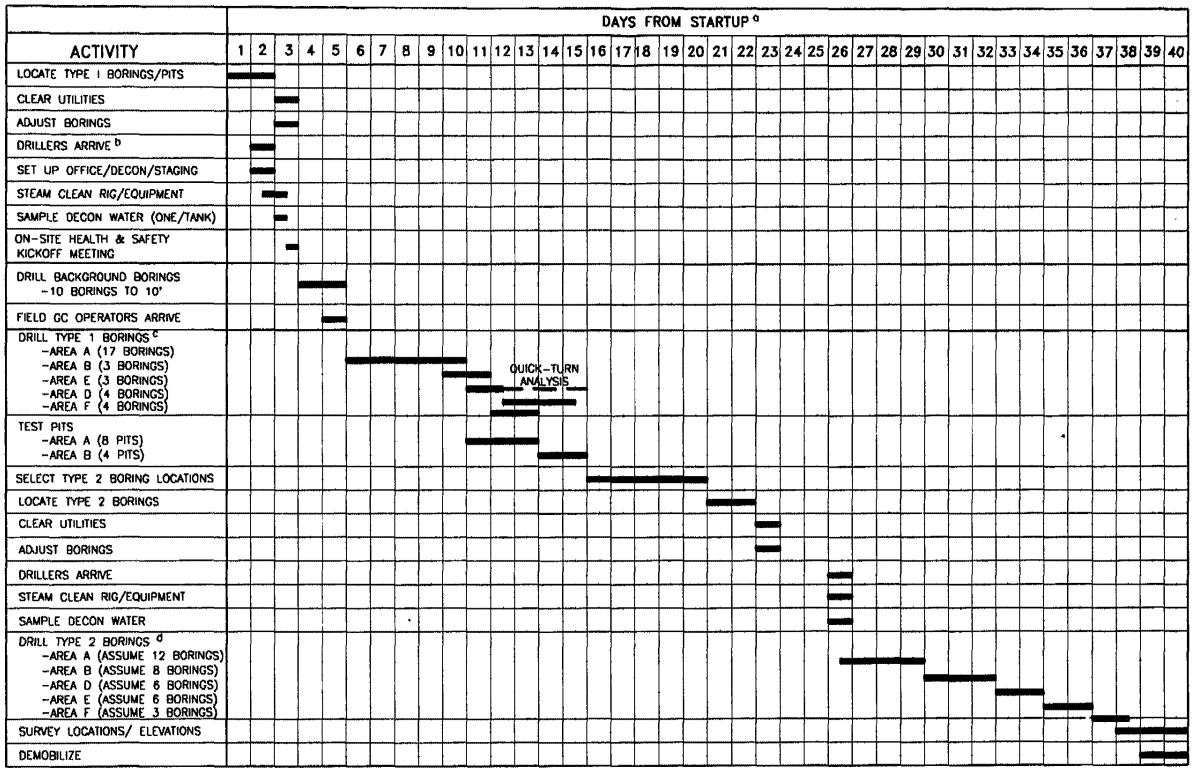
Area	Number of Proposed Type 1 Soil Borings[a]	Number of Proposed Type 2 Soil Borings	Number of Proposed Test Pits	Number of Samples for TCL/TAL and TOC Analysis (Type 1 Borings and Test Pits)	Number of Samples for TCL VOC and TOC Analysis (Type 2 Borings)	Number of Samples for Quick Turn TCA/DCA Analysis	Number of Samples for Physical Testing
A	17	To be determined[b]	8	50	To be determined[b]	0	[c]
B	3	To be determined	4	14	To be determined	0	[c]
D	4	To be determined	0	8	To be determined	0	[c]
E	3	To be determined	0	6	To be determined	16	[c]
F	4	To be determined	0	8	To be determined	0	[c]
Background	10	0	0	20	0	0	20
Total	**41**	**35[b]**	**12**	**106**	**70**	**16**	[c]

Notes:

[a] Background borings will be advanced to 10 feet; all other Type 1 borings will be advanced to 20 feet.

[b] A total of 35 Type 2 borings with analysis for TCL VOCs and TOC have been assumed. The distribution of the 35 borings between the various areas has not been assumed.

[c] One sample per boring will be analyzed for physical properties (moisture content, grain size, hydrometer, and Atterberg limits if appropriate). Samples selected will be from the same intervals selected for chemical analysis or from an adjacent interval of similar composition, if insufficient volume is present.



a - DAYS SHOWN ARE WORKING DAYS FROM STARTUP AND EXCLUDE WEEKENDS. ASSUMES NO DELAYS DUE TO BAD WEATHER OR FACILITY LIMITATIONS.
b - ASSUMES TWO DRILL RIGS ON SITE FROM DAY 2 THROUGH DAY 13; THEN 1 RIG ON SITE FROM DAY 14 THROUGH DAY 15.
c - ONE ADDITIONAL TYPE 1 D TOTAL OF 18 WILL BE ADVANCED IN AREA A BASED ON OBSERVATIONS OF STAINED SOILS MADE DURING COMPLETION OF A STORM SEWER IMPROVEMENT PROJECT. THE LOCATION WILL BE DETERMINED IN THE FIELD UPON COMPLETION OF HAND AUGER HOLES WHICH WILL BE ADVANCED IN AREAS SUSPECTED OF CONTAINING THE STAINED SOILS.
d - ASSUMES TWO DRILL RIGS ON SITE FROM DAY 26 THROUGH DAY 38.

FIELD SCHEDULE

RMT INC.

DWN. BY: DPR
DATE: JANUARY 1992
PROJ.# 2313.01WP
FILE # 23130113

JAN 22 1992 FIGURE 7-1

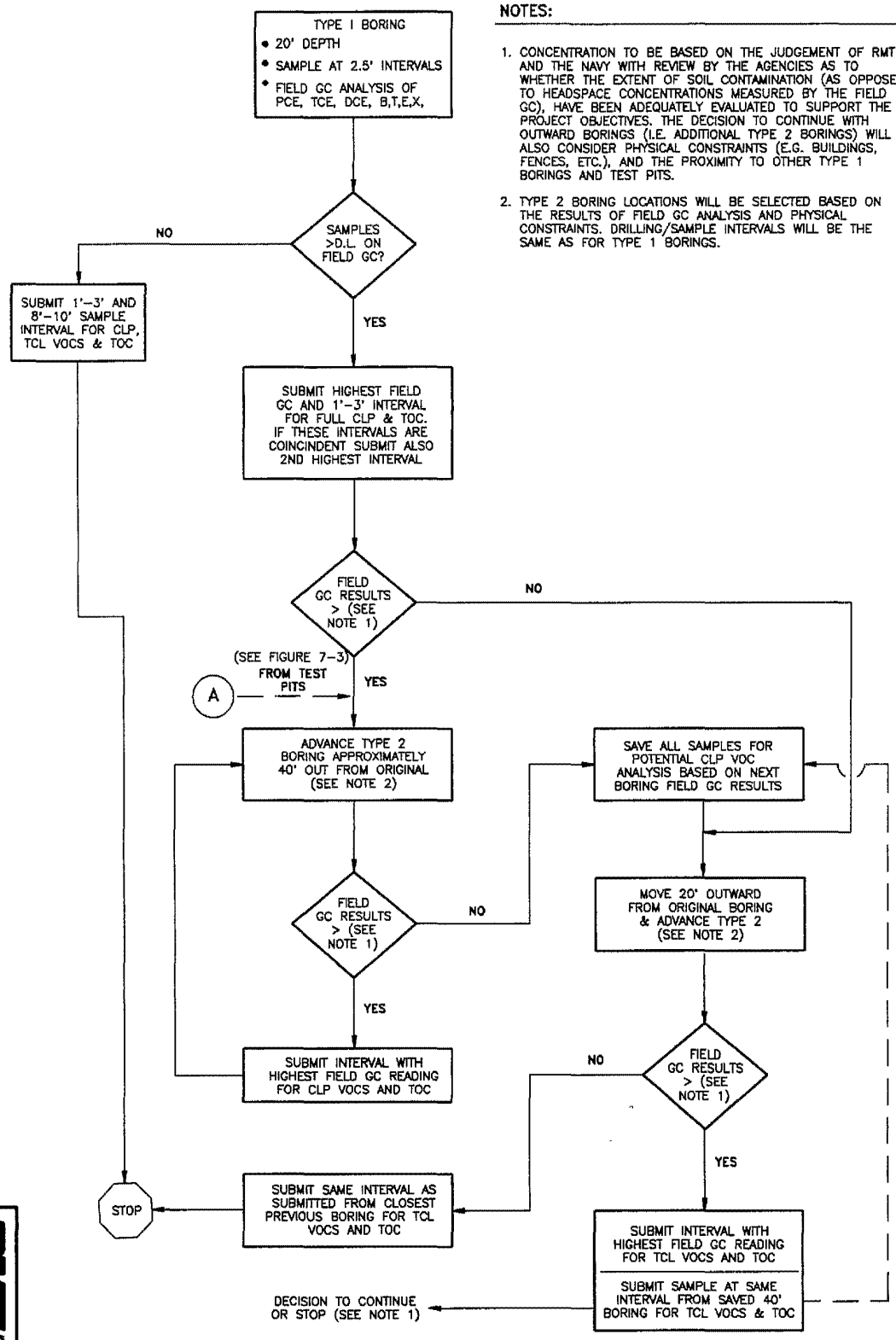
preparation of the RI report. Upon completion of all of the Type 1 borings within a given area, the field data (e.g., GC data, soil boring logs, physical constraints, etc.) will be reviewed to evaluate the need for additional data and determine the locations of additional borings, if necessary. These secondary "step-out" borings are designated as "Type 2" borings. As each Type 2 boring is completed, field data will again be used to evaluate the need for additional borings to characterize the extent of contamination.

Figure 7-2 shows the decision diagram that will be used to complete the boring program. A Type 1 boring will be advanced to a depth of 20 feet and sampled approximately at 2.5-foot intervals, as explained in Subsection 3.1 of the FSP. The 20-foot depth was selected based on results of the Fall 1990 boring program for the following reasons:

- This investigation is focused on soils above the water table, and the water table was encountered in nearly all Fall 1990 borings at a depth of 23 feet.
- Field Hnu headspace results and laboratory analytical results for many of the Fall 1990 soil samples collected immediately above the water table indicated the presence of VOCs (primarily TCE).
- Many of the Fall 1990 soil samples where VOCs were detected immediately above the water table did not contain VOCs in overlying strata, indicating that the source of VOC contamination was due to migrating contaminated ground water, and not due to soil contamination from above.
- Because a Record of Decision has already been signed for the ground water operable unit at the NIROP Fridley, and since one of the primary objectives of this RI is to determine the extent of contaminated soils (not ground water), the depth of 20 feet has been selected.

The parameters selected for field GC analysis include tetrachloroethene (PCE), trichloroethene (TCE), cis– and trans–1,2-dichloroethene (DCE), benzene, ethylbenzene, toluene, and xylenes (BTEX). Selection of these constituents is based on results of eight years of ground water monitoring data.

Upon completion of all Type 1 borings in an area, the field GC data will be reviewed to see if VOCs have been detected. Data reviews will be performed in a timely manner and will be done by U.S. Navy and RMT. If, upon data review, VOCs are detected, the 1- to 3-foot



NOTES:

1. CONCENTRATION TO BE BASED ON THE JUDGEMENT OF RMT AND THE NAVY WITH REVIEW BY THE AGENCIES AS TO WHETHER THE EXTENT OF SOIL CONTAMINATION (AS OPPOSED TO HEADSPACE CONCENTRATIONS MEASURED BY THE FIELD GC), HAVE BEEN ADEQUATELY EVALUATED TO SUPPORT THE PROJECT OBJECTIVES. THE DECISION TO CONTINUE WITH OUTWARD BORINGS (I.E. ADDITIONAL TYPE 2 BORINGS) WILL ALSO CONSIDER PHYSICAL CONSTRAINTS (E.G. BUILDINGS, FENCES, ETC.), AND THE PROXIMITY TO OTHER TYPE 1 BORINGS AND TEST PITS.
2. TYPE 2 BORING LOCATIONS WILL BE SELECTED BASED ON THE RESULTS OF FIELD GC ANALYSIS AND PHYSICAL CONSTRAINTS. DRILLING/SAMPLE INTERVALS WILL BE THE SAME AS FOR TYPE 1 BORINGS.

DECISION DIAGRAM FOR SOIL BORING SAMPLING

RMT INC.

DWN BY: DPR
DATE: JANUARY 1992
PROJ # 2313.01WP
FILE # 23130109

JAN 22 1992 FIGURE 7-2

QUALITY ASSURANCE PROJECT PLAN FOR THE SOILS OPERABLE UNIT AT THE NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT FRIDLEY, MINNESOTA

REVISION 2

APRIL 15, 1992

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for 5/14/92
Valerie J. Jones
USEPA Regional Quality Assurance Manager

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QUALITY ASSURANCE PROJECT PLAN FOR THE SOILS OPERABLE UNIT AT THE NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT FRIDLEY, MINNESOTA

REVISION 2

APRIL 15, 1992

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TABLE 1-1

FIELD QC SAMPLING FREQUENCY FOR PHASE II SOILS RI

Matrix	Test Parameters[1]	Number of Samples to be Analyzed with the Field GC[2] Type 1	Type 2	Number of Samples to be Submitted for Laboratory Analysis Type 1	Type 2	Field Duplicates (1 per 10 samples)	Field (Equipment Rinsate) Blanks[6] (1 per day)	Trip Blanks[5] (1 per cooler)	Matrix Spikes and Matrix Spike Duplicates (1 per 20 samples)	Total Samples (does not include field GC)
Soil Samples										
Soil	TCL-VOCs	332	280	112	72	19	27	27	9	266
Soil	TCL-Semivolatiles	0	0	112	0	12	15	0	6	145
Soil	TCL-PCB/Pesticides	0	0	112	0	12	15	0	6	145
Soil	TAL	0	0	112	0	12	15	0	6	145
Soil	Total Organic Carbon	0	0	112	72	19	27	0	9	239
Soil	1,1,1-TCA, 1,1-DCA	0	0	4	0	1	0	0	0	5
Water	Completed TCL and TAL Parameters	0	0	5[4]	0	1	0	0	1	7

Notes:

[1] VOCs - Volatile Organic Compounds; TCL - Target Compound List; TAL - Target Analyte List; TCA - trichloroethane; DCA = Dichloroethane. All TCL and TAL analyses will be performed following Contract Laboratory Program routine analytical services protocols. TCA and DCA analysis will be performed following modified EPA Method 8010.

[2] Number of samples for field GC analysis is based on eight sampling intervals per boring (34 Type 1 and 36 Type 2 borings) and five sampling intervals per test pit (assumed 12 test pits). The field GC will not be used on the 10 background borings.

[3] Number of samples for laboratory analysis based on two samples per each of the Type 1 borings (44 borings), test pits (12 test pits), and Type 2 borings (36 borings).

[4] Water samples include the drilling/decontamination water source. One sample per truckload will be analyzed. Five truckloads were estimated.

[5] These are water samples that will be analyzed for the same test parameters as the soil matrix samples.

[6] The field GC will be used to analyze the following TCL-VOCs: Tetrachloroethene (PCE), trichloroethene (TCE), cis- and trans-1,2-dichloroethene (DCE), and benzene, toluene, ethylbenzene, and xylenes (BTEX).

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3. QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The Overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide results which are legally defensible in a court of law. Specific procedures for sampling, chain of custody, laboratory instruments calibration, laboratory analysis, reporting of data, internal quality control, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QAPP. The purpose of this section is to address the specific objectives for accuracy, precision, completeness, representativeness, and comparability.

3.1 Level of Quality Control Effort

Source water samples, field blank (equipment rinsate blank), trip blank, field duplicate and matrix spike samples will be analyzed to assess the quality of the data resulting from the field sampling program. Field and trip blanks consisting of laboratory-grade deionized water, will be submitted to the analytical laboratory to provide the means to assess the quality of the data resulting from the field sampling program. Field blank samples are analyzed to check for procedural contamination at the site which may cause sample contamination. Trip blanks are used to qualitatively assess the potential for contamination of samples due to the migration of VOC compounds through the septum of the VOC container during transportation of containers into the field, during sampling and shipment of samples from the field to the laboratory, and during the time samples are held in the laboratory up to analysis. It is recognized that the analytical results for the trip blank samples cannot be used to quantitate cross-contamination because the site and trip blank samples are different matrices. Field duplicate samples are analyzed to check for sampling and analytical reproducibility. Matrix

spikes provide information about the effect of the sample matrix on the digestion and measurement methodology. All matrix spikes are performed in duplicate and are hereinafter referred to as MS/MSD samples. One matrix spike/matrix spike duplicate will be collected for every 20 or fewer investigative samples.

The general level of the QC effort will be one field duplicate and one field (equipment rinsate) blank for every 10 or fewer investigative samples. A minimum of one field (equipment rinsate) blank will be collected per day when soil samples are collected. One trip blank consisting of deionized laboratory-grade water will be included in each cooler containing samples for VOC analysis. Trip blanks will be analyzed for the TCL VOCs.

MS/MSD samples are internal laboratory QC samples. Soil MS/MSD samples require no extra volume for VOCs or extractable organics. One MS/MSD sample will be collected/designated for every 20 or fewer investigative samples per sample matrix (i.e., soil). The number of field duplicate and field blank samples to be collected are listed in Table 1-1. Sampling procedures are specified in the Field Sampling Plan.

Soil samples will be sent to RMT Laboratories, Madison, Wisconsin, which is a U.S. Navy- and USEPA-approved laboratory for this project. The analysis for organic constituents (VOCs, semivolatiles, and pesticide/PCBs) will follow Routine Analytical Service (RAS) Target Compound List (TCL) protocols (Level 4). Analysis for metals will follow RAS Target Analyte List (TAL) protocols (Level 4). Level 3 analyses will be performed on all samples for TOC, moisture content, Atterberg limits, grain-size distribution, and hydrometer analyses. Level 2 analyses will be performed on samples collected for field gas chromatograph analysis of soil vapor headspace and on laboratory quick-turn samples from Area E for analysis of 1,1,1-trichloroethane and 1,1-dichloroethane. The level of laboratory QC effort for RAS analysis

(Level 4) provided by the CLP is specified in CLP SOW/OLM01.0 and the most current revision in effect for organics and SOW/ILM01.0 and the most current revision in effect for inorganics. QC procedures to be used for Level 3 analysis are provided in the Standard Operating Procedures (SOPs) for organics analyses for TOC (Attachment III). QC procedures to be used for Level 2 analysis are provided in the SOPs for operation of the field gas chromatograph (Attachment II) and the SOPs for analysis of 1,1,1-trichloroethane and 1,1-dichloroethane (Attachment II).

Tables 3-1, 3-2, 3-3, and 3-4 contain the quantitation levels for TCL and TAL compounds. Quantitation levels for low- and medium-level quick-turn samples to be analyzed for 1,1,1-trichloroethane and 1,1-dichloroethane are 1 µg/kg and 50 µg/kg, respectively. The quantitation limit for TOC is 100 mg/kg.

The QC level of effort for the field measurement of compounds to be analyzed with the field gas chromatograph are included in Table 8-1 in the FSP.

3.2 Accuracy, Precision, and Sensitivity of Analysis

The fundamental QA objective with respect to accuracy, precision, and sensitivity of laboratory analytical data is to achieve the QC acceptance criteria of the analytical protocols. The accuracy and precision requirements for RAS organics and inorganics analyses from the CLP (Level 4) are specified in CLP SOW/OLM01.0 and the most current revision in effect for organics and SOW/ILM01.0 and the most current revision in effect for inorganics. The accuracy and precision requirements for the Level 3 TOC analysis are included in Attachment III. The sensitivities required for organics and inorganics analyses will be the Contract-Required Limits for Level 4 data, the RMT quantitation limits for Level 3 TOC data

TABLE 3-1

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL) FOR VOLATILE ORGANIC COMPOUNDS

Volatiles	CAS Number	Quantitation Limits* Low Soil µg/kg	Med. Soil µg/kg
1. Chloromethane	74-87-3	10	1,200
2. Bromomethane	74-83-9	10	1,200
3. Vinyl Chloride	75-01-4	10	1,200
4. Chloroethane	75-00-3	10	1,200
5. Methylene Chloride	75-09-2	10	1,200
6. Acetone	67-64-1	10	1,200
7. Carbon Disulfide	75-15-1	10	1,200
8. 1,1-Dichloroethene	75-35-4	10	1,200
9. 1,1-Dichloroethane	75-34-3	10	1,200
10. 1,2-Dichloroethene(total)	540-59-0	10	1,200
11. Chloroform	67-66-3	10	1,200
12. 1,2-Dichloroethane	107-06-2	10	1,200
13. 2-Butanone	78-93-3	10	1,200
14. 1,1,1-Trichloroethane	71-55-6	10	1,200
15. Carbon Tetrachloride	56-23-5	10	1,200
16. Bromodichloromethane	75-27-4	10	1,200
17. 1,2-Dichloropropane	78-87-5	10	1,200
18. cis-1,3-Dichloropropene	10061-01-5	10	1,200
19. Trichloroethene	79-01-6	10	1,200
20. Dibromochloromethane	124-48-1	10	1,200
21. 1,1,2-Trichloroethane	79-00-5	10	1,200
22. Benzene	71-43-2	10	1,200
23. trans-1,3-Dichloropropene	10061-02-6	10	1,200
24. Bromoform	75-25-2	10	1,200
25. 4-Methyl-2-pentanone	108-10-1	10	1,200
26. 2-Hexanone	591-78-6	10	1,200
27. Tetrachloroethene	127-18-4	10	1,200
28. Toluene	108-88-3	10	1,200
29. 1,1,2,2-Tetrachloroethane	79-34-5	10	1,200
30. Chlorobenzene	108-90-7	10	1,200
31. Ethylbenzene	100-41-4	10	1,200
32. Styrene	100-42-5	10	1,200
33. Xylenes (total)	1330-20-7	10	1,200

* Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

TABLE 3-2

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL) FOR SEMIVOLATILE ORGANIC COMPOUNDS

Semivolatiles	CAS Number	Quantitation Limits* Low Soil µg/kg	Med. Soil µg/kg
34. Phenol	108-95-2	330	10,000
35. bis(2-Chloroethyl)ether	111-44-4	330	10,000
36. 2-Chlorophenol	95-57-8	330	10,000
37. 1,3-Dichlorobenzene	541-73-1	330	10,000
38. 1,4-Dichlorobenzene	106-46-7	330	10,000
39. 1,2-Dichlorobenzene	95-50-1	330	10,000
40. 2-Methylphenol	95-48-7	330	10,000
41. 2,2'-oxybis-(1-Chloropropane)**	108-60-1	330	10,000
42. 4-Methylphenol	106-44-5	330	10,000
43. N-Nitroso-di-n-dipropylamine	621-64-7	330	10,000
44. Hexachloroethane	67-72-1	330	10,000
45. Nitrobenzene	98-95-3	330	10,000
46. Isophorone	78-59-1	330	10,000
47. 2-Nitrophenol	88-75-5	330	10,000
48. 2,4-Dimethylphenol	105-67-9	330	10,000
49. bis(2-Chloroethoxy) methane	111-91-1	330	10,000
50. 2,4-Dichlorophenol	120-83-2	330	10,000
51. 1,2,4-Trichlorobenzene	120-82-1	330	10,000
52. Naphthalene	91-20-3	330	10,000
53. 4-Chloroaniline	106-47-8	330	10,000
54. Hexachlorobutadiene	87-68-3	330	10,000
55. 4-Chloro-3-methylphenol	59-50-7	330	10,000
56. 2-Methylnaphthalene	91-57-6	330	10,000
57. Hexachlorocyclopentadiene	77-47-4	330	10,000
58. 2,4,6-Trichlorophenol	88-06-2	330	10,000
59. 2,4,5-Trichlorophenol	95-95-4	800	25,000
60. 2-Chloronaphthalene	91-58-7	330	10,000
61. 2-Nitroaniline	88-74-4	800	25,000
62. Dimethylphthalate	131-11-3	330	10,000
63. Acenaphthylene	208-96-8	330	10,000
64. 2,6-Dinitrotoluene	606-20-2	330	10,000
65. 3-Nitroaniline	99-09-2	800	25,000
66. Acenaphthene	83-32-9	330	10,000
67. 2,4-Dinitrophenol	51-28-5	800	25,000
68. 4-Nitrophenol	100-02-7	800	25,000
69. Dibenzofuran	132-64-9	330	10,000
70. 2,4-Dinitrotoluene	121-14-2	330	10,000
71. Diethylphthalate	84-66-2	330	10,000
72. 4-Chlorophenyl-phenyl ether	7005-72-3	330	10,000

TABLE 3-2 (CONTINUED)

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL) FOR SEMIVOLATILE ORGANIC COMPOUNDS

		Quantitation Limits*	
Semivolatiles	CAS Number	Low Soil µg/kg	Med. Soil µg/kg
73. Fluorene	86-73-7	330	10,000
74. 4-Nitroaniline	100-01-6	800	25,000
75. 4,6-Dinitro-2-methylphenol	534-52-1	800	25,000
76. N-Nitrosodiphenylamine	86-30-6	330	10,000
77. 4-Bromophenyl-phenyl ether	101-55-3	330	10,000
78. Hexachlorobenzene	118-74-1	330	10,000
79. Pentachlorophenol	87-86-5	800	25,000
80. Phenanthrene	85-01-8	330	10,000
81. Anthracene	120-12-7	330	10,000
82. Carbazole	86-74-8	330	10,000
83. Di-n-butylphthalate	86-74-2	330	10,000
84. Fluoranthene	206-44-0	330	10,000
85. Pyrene	129-00-0	330	10,000
86. Butylbenzylphthalate	85-68-7	330	10,000
87. 3,3′-Dichlorobenzidine	91-94-1	330	10,000
88. Benzo(a)anthracene	56-55-3	330	10,000
89. Chrysene	210-81-9	330	10,000
90. bis(2-Ethylhexyl)phthalate	117-81-7	330	10,000
91. Di-n-Octylphthalate	117-84-0	330	10,000
92. Benzo(b)fluoranthene	205-99-2	330	10,000
93. Benzo(k)fluoranthene	207-08-9	330	10,000
94. Benzo(a)pyrene	50-32-8	330	10,000
95. Indeno(1,2,3-cd)pyrene	193-39-5	330	10,000
96. Dibenzo(a,h)anthracene	53-70-3	330	10,000
97. Benzo(g,h,i)perylene	191-24-2	330	10,000

* Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

** Previously known by the name bis(2-Chloroisopropyl)ether.

TABLE 3-3

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL) FOR PESTICIDES/AROCLORS

Pesticides/Aroclors	CAS Number	Quantitation Limits* Soil µg/kg
98. alpha-BHC	319-84-6	1.7
99. beta-BHC	319-85-7	1.7
100. delta-BHC	319-86-8	1.7
101. gamma-BHC (Lindane)	58-89-9	1.7
102. Heptachlor	76-44-8	1.7
103. Aldrin	309-00-2	1.7
104. Heptachlor epoxide	1024-57-3	1.7
105. Endosulfan I	959-98-8	1.7
106. Dieldrin	60-57-1	3.3
107. 4,4'-DDE	72-55-9	3.3
108. Endrin	72-20-8	3.3
109. Endosulfan II	33213-65-9	3.3
110. 4,4'-DDD	72-54-8	3.3
111. Endosulfan sulfate	1031-07-8	3.3
112. 4,4'-DDT	50-29-3	3.3
113. Methoxychlor	72-43-5	17.0
114. Endrin ketone	53494-70-5	3.3
115. Endrin aldehyde	7421-36-3	3.3
116. alpha-Chlordane	5103-71-9	1.7
117. gamma-Chlordane	5103-74-2	1.7
118. Toxaphene	8001-35-2	170.0
119. Aroclor-1016	12674-11-2	33.0
120. Aroclor-1221	11104-28-2	67.0
121. Aroclor-1232	11141-16-5	33.0
122. Aroclor-1242	53469-21-9	33.0
123. Aroclor-1248	12672-29-6	33.0
124. Aroclor-1254	11097-69-1	33.0
125. Aroclor-1260	11096-82-5	33.0

* Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher. There is no differentiation between the preparation of low and medium soil samples in this method for the analysis of Pesticides/Aroclors.

TABLE 3-4

INORGANIC TARGET ANALYTE LIST (TAL)

Analyte	Contract Required[1,2] Detection Limit (µg/L)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5,000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	3
Magnesium	5,000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5,000
Selenium	5
Silver	10
Sodium	5,000
Thallium	10
Vanadium	50
Zinc	20
Cyanide	10

---

1 Subject to the restrictions specified in the first page of Part G, Section IV of Exhibit D (Alternate Methods - Catastrophic Failure) any analytical method specified in SOW Exhibit D may be utilized as long as the documented instrument or method detection limits meet the Contract Required Detection Limit (CRDL) requirements. Higher detection limits may only be used in the following circumstances:

If the sample concentration exceeds five times the detection limit of the instrument or method in use, the values may be reported even though the instrument or method detection limit may not equal the Contract Required Detection Limit. This is illustrated in the example below:

For lead:	Method in use = ICP	Instrument Detection Limit (IDL) = 40
	Sample concentration = 200	Contract Required Detection Limit (CRDL) = 3

The value of 200 may be reported even though instrument detection limit is greater than CRDL. The instrument or method detection limit must be documented as described in Exhibit E.

2 The CRDL are the instrument detection limits obtained in pure water that must be met using the procedure in Exhibit E. The detection limits for samples may be considerably higher depending on the sample matrix.

shown in Attachment III, and the Level 2 data shown in Table 8-1 of the FSP and in Attachment II for 1,1,1-trichloroethane and 1,1-dichloroethane.

3.3 Completeness, Representativeness, and Comparability

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. It is expected that RMT Laboratories will provide data meeting QC acceptance criteria for 95 percent or more of all samples tested using the CLP RAS organics and inorganics analyses for Level 4 data, RMT SOP for Level 3 TOC analysis, and RMT SOPs for Level 2 quick-turn analyses of 1,1,1-trichloroethane and 1,1-dichloroethane, as well as organic analyses performed with the field gas chromatograph. Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$\% \text{ Completeness} = \frac{\text{Number of valid data}}{\text{Number of valid data expected}} \times 100$$

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter which is dependent on the proper design of the sampling program and proper laboratory protocol. The sampling network was designed to provide data representative of site conditions. During development of this network, consideration was given to past waste disposal practices, existing analytical data, physical setting and processes, planned remedial activities, and constraints inherent to the Superfund program. The rationale of the sampling network is discussed in detail in the FSP. Representativeness will be satisfied by insuring that the

methods detailed in the FSP are followed, proper sampling techniques are used, proper analytical procedures are followed, and holding times of the samples are not exceeded in the laboratory. Representativeness will be assessed by the analysis of field-duplicated samples.

Comparability expresses the confidence with which one data set can be compared to another. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data, as documented in the QAPP, are expected to provide comparable data. These new analytical data, however, may not be directly comparable to existing data because of difference in procedures and QA objectives.

Data reduction reporting procedures will be those specified in the CLP SOW/OLM01.0 and the most current revision in effect for organics and SOW/ILM01.0 and the most current revision in effect for inorganics.

RMT Laboratories will prepare and retain full analytical and QC documentation as required by the Contract Laboratory Program. Such retained documentation need not be hard (paper) copy, but may be in other storage media (e.g., magnetic tape). As needed, RMT Laboratories will supply a hard copy of the retained information.

RMT Laboratories will report the data in the same chronological order in which it is analyzed along with the QC data. RMT Laboratories will provide the following information in each analytical data package submitted:

1. Cover sheets listing the samples included in the report and narrative comments describing problems encountered in analysis.

2. Tabulated results of inorganic and organic compounds identified and quantified.

3. Analytical results for QC sample spikes, sample duplicates, initial and continuous calibration verifications of standards and blanks, standard procedural blanks, laboratory control samples, and ICP interference check samples.

4. Tabulation of instrument detection limits determined in pure water.

5. Raw data system printouts (or legible photocopies) identifying date of analyses, analyst, parameters determined, calibration curve, calibration verifications, method blanks, sample and any dilutions, sample duplicates, spikes, and control samples.

For organic analyses, the data packages must include matrix spikes, matrix spike duplicates, surrogate spike recoveries, chromatogram, GC/MS spectra, and computer printouts.

Data for samples which are not analyzed using RAS CLP protocols will be reported in a similar manner to those following RAS CLP protocols. This includes cover sheets, tabulated results of compounds identified and quantified, analytical results for QC samples, tabulation of

instrument detection limits, and raw data systems printouts. Each of these was described above for the RAS CLP data packages.

RMT assessment will be accomplished by the joint efforts of the Data Reviewer and Project Manager. The data assessment by the Project Manager will be based on the criteria that the sample was properly collected and handled according to the Field Sampling Plan and Section 5 of this QAPP.

The Data Reviewer will conduct a systematic review of the data for compliance with the established QC criteria based on the spike, duplicate, and blank results provided by the laboratory. An evaluation of data accuracy, precision, sensitivity, and completeness, based on criteria in Section 3, will be performed and presented in the RI Report.

The Data Reviewer will follow guidelines found in the following documents:

- USEPA Contract Laboratory Guidelines for Organic Data Review (12/90, revised 6/91).
- Laboratory Data Validation: Functional Guidelines for Evaluating Inorganics Data Analysis (7/88).

The Data Reviewer will identify any out-of-control data points and data omissions and interact with the laboratory to correct data deficiencies. Decisions to repeat sample collection and analyses may be made by the Project Manager based on the extent of the deficiencies and their importance in the overall context of the project.

All data generated for the NIROP Fridley RI will be computerized in a format organized to facilitate data review and evaluation. The computerized data set will include the data flags provided by RMT Laboratories (in accordance with USEPA, 1990a and USEPA, 1990b), as well as additional comments of the Data Reviewer. The laboratory-provided data flags will include items such as: 1) concentration below required detection limit; 2) estimated concentration due to poor spike recovery; and 3) concentration of chemical also found in laboratory bank. The

4. SAMPLE CONTAINERS, PREPARATION, PRESERVATION, AND MAXIMUM HOLDING TIMES

Table 4-1 summarizes container, preservation, and holding time information.

As specified in the USEPA Region V memorandum dated November 21, 1991, on the subject of Final Bottle Requirements for Superfund Projects, the contaminant-free sample containers (bottles) used for analyzing CLP TCL and TAL analytes for this sampling effort will be prepared according to the procedures specified in USEPA's "Specifications and Guidance for Obtaining Contaminant-Free Sample Containers, April 1990." It will be assured that the bottles used for the sampling activity do not contain target organic and inorganic contaminants exceeding the levels specified in the above-mentioned document. For non-CLP TCL and TAL types of analytes, bottles either should be cleaned in the same way as for the similar types of analytes or it will be negotiated with the bottle supplier(s) to clean and test the bottles for the analytes of interest to insure that the contaminant levels of those analytes do not exceed approximately 1/3 of the required quantitation limits. Specifications for the bottles will be verified by checking the supplier's certified statement and analytical results for each bottle lot, and will be documented on continuous basis. This data will be maintained in the project evidence file, and will be available, if requested, for EPA or MPCA review.

In addition, the data for field blanks, rinsate blanks, and trip blanks, etc., will be monitored for contamination, and corrective actions will be taken as soon as a problem is identified. This will be accomplished either by discontinuing the use of a

TABLE 4-1

SOIL SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

Parameter	Container	Preservative	Holding Time
Volatile Organics	Two 120-mL wide-mouth glass vials with Teflon® septa; no headspace	Cool to 4°C, and protect from light	14 days from date of sample collection
Semivolatile Organics*	One 500-mL amber glass bottle (Teflon®-lined lid)	Cool to 4°C, and protect from light	Extract within 14 days from date of sample collection, analyze within 40 days from date of extraction
Pesticides and PCBs*	One 500-mL amber glass bottle (Teflon®-lined lid)	Cool to 4°C, and protect from light	Extract within 14 days from date of sample collection, analyze within 40 days from date of extraction
Metals, Total (Except Mercury)**	One 500-mL polyethylene bottle	Cool to 4°C	6 months from date of sample collection
Mercury**	One 500-mL polyethylene bottle	Cool to 4°C	28 days from date of sample collection
Cyanide**	One 500-mL polyethylene bottle	Cool to 4°C	14 days from date of sample collection
Total Organic Carbon	Two 60-mL wide-mouth glass vials	Cool to 4°C	28 days from date of sample collection

Notes:

* Semivolatile organics and pesticides/PCBs can be taken from a single 500-mL bottle.

** Metals, mercury, and cyanide can be taken from a single 500-mL bottle.

specific bottle lot, contacting the bottle supplier(s) for retesting a representative bottle from a suspect lot, re-sampling the suspected samples, validating the data taking into account that the contaminants could be introduced by the laboratory (i.e., common laboratory solvents, sample handling artifacts, etc.), or could be a bottle QC problem, so as to make an educated determination of whether the bottles and hence the data are still usable, etc., whichever is appropriate.

NIROP FRIDLEY SOILS RI
QAPP
ATTACHMENT VI
RMT STANDARD OPERATING PROCEDURE FOR
HNU MEASUREMENT

2313.07 0000:RTE:niro0309

STANDARD OPERATING PROCEDURE

INSTRUMENT TYPE: Portable Photoionization Analyzer

MANUFACTURER: HNU Systems

MODEL: PI-101

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1.0 PURPOSE

To establish a procedure delineating minimum requirements for operation and calibration of the HNU PI-101 (HNU) portable photoionizer.

2.0 SCOPE

This procedure is applicable to HNU instruments that are used on RMT projects or by RMT staff to acquire data used for health, safety, or training purposes; or to fulfill project objectives; or that require calibration per manufacturer's specifications.

3.0 RESPONSIBILITIES

The Regional Health and Safety Coordinator and Equipment Manager shall ensure that the user has been appropriately trained and certified in the usage of the HNU instrument. He/she shall also ensure that the instrument is properly maintained and calibrated prior to its release for field service. The instrument user should be confident that he/she has been adequately trained and understands the operation and limitations of the instrument. He/she is further responsible to ensure that the appropriate probe(s) have been selected for compounds to be evaluated on-site and that the instrument has been calibrated and is being operated properly.

4.0 PROCEDURES

4.1 PRINCIPLE OF OPERATION

The HNU System portable photoionizer detects the concentrations of many organic gases as well as some inorganic gases. The basis for detection is the ionization of gaseous species. The incoming gas molecules are subjected to ultraviolet (UV) radiation, which supplies sufficient energy to ionize many gaseous compounds. The individual gas molecules are transformed into charged-ion pairs, creating a current between two electrodes. Each type of molecule has a characteristic ionization potential, which is the energy required to remove an electron from the molecule, yielding a positively charged ion and a free electron. The instrument measures this energy level.

4.2 INSTRUMENT CONFIGURATION

Three probes, each containing a different UV light source, are available for use with the HNU. Probe energies are 9.5, 10.2, and 11.7eV. All three probes detect many aromatic and large-molecule hydrocarbons. The 10.2 and 11.7eV probes also detect some smaller organic molecules and some halogenated hydrocarbons. The 10.2eV probe has proved to be the most useful for environmental response work, since it is more durable than the 11.7eV probe and detects more compounds than the 9.5eV probe.

4.3 CALIBRATION

Calibration Responsibilities - instruments requiring calibration shall be calibrated according to their respective manufacturer's specifications, shall be given an operational check, and shall be calibrated

prior to assignment to a project. Only qualified individuals, knowledgeable (or certified, if applicable) in the proper procedures, are permitted to perform instrument calibration. For those instruments which require calibration, it is unacceptable to use that instrument without following appropriate calibration procedures. It is the responsibility of the equipment operator/user to ensure that all instruments in his/her control have been properly calibrated and are given an operational check prior to field use.

Procedures and Schedules - Calibration frequencies and procedures shall follow: (1) RMT Operating Procedures; or (2) manufacturer's specifications.

Record Keeping - All calibration activities shall be documented to ensure compliance with both applicable regulatory standards and with the requirements of this program. Proper and timely documentation is the responsibility of the person(s) performing the calibration. These records shall be updated and maintained for at least the life of the instrument. All equipment calibration efforts shall be documented using calibration forms (see Addendum A). Items that must be included on these documents shall include either the manufacturer's recommendations or those items specified in the Standard Operating Procedures. Any equipment maintenance efforts also shall be documented using the Maintenance Service record (see Addendum B). It shall be the responsibility of the Equipment Manager in each office to maintain these records.

Upon use and task completion, the user/operator is required to document any problems or malfunctions noted during use. This information shall be accompanied by the user's/operator's name, identification of the instrument involved, and identification of the job/project involved. This information shall be used to inspect, repair, and/or maintain instruments. Any such activities shall be conducted in accordance with Equipment Tagging Procedures.

The primary HNU calibration gas is benzene (or isobutylene, a benzene equivalent). The span potentiometer is adjusted for benzene calibration. The instrument's response can be adjusted to give more accurate readings for specific gases and eliminate the need for calibration charts. Daily calibration is to be performed in accordance with the Daily Calibration Procedures form (see Addendum C).

4.4 SPECIALIZED USES

While the HNU is used primarily to qualify or quantify the presence of a specific compound, it can also be used to identify unknown contaminants or eliminate certain contaminants from consideration. For instance, a compound's ionizing potential may be such that the 9.5eV probe produces no response, but the 10.2 and 11.7eV probes do elicit a response, eliminating some contaminants from consideration. The HNU does not detect methane or hydrogen cyanide.

4.5 INSTRUMENT ADVANTAGES

The HNU is easy to use in comparison to many other types of field monitoring instrumentation. Its detection limit is also in the low parts per million range. Response time is rapid; for benzene, the meter needle reaches 90 percent of the indicated concentration in 3 seconds. The HNU can be zeroed in a contaminated atmosphere.

4.6 PRECAUTIONS

The instrument can monitor only certain vapors and gases in air. Nonvolatile liquids, toxic solids, particulates, and many other toxic gases and vapors cannot be detected. Because the compounds that the HNU can detect are only a fraction of the chemicals possibly present at a field site, a zero reading does not necessarily signify the absence of air contaminants.

The instrument is nonspecific, and its response to various compounds is relative to the calibration setting. Instrument readings may be higher or lower than the true concentration. These discrepancies can be especially serious when monitoring for total contaminant concentrations if several different compounds are being detected at once. In addition, the response of this instrument is not linear over the entire detection range. Care must, therefore, be taken when interpreting the data. All identifications should be reported as tentative until they can be confirmed by more precise analysis. Concentrations should be reported in terms of the calibration gas and span potentiometer of the gas-select-knob setting.

The instrument cannot be used as an indicator for combustible gases or oxygen deficiency.

5.0 REFERENCES

HNU Systems, Inc. Instruction Manual for Model PI 101 Photoionization Analyzer, 1975.

E. & E., FIT Operation and Field Manual: HNU Systems PI 101 Photoionization Detector and Century Systems (Foxboro) Model OVA-128 Organic Vapor Analyzer.

ADDENDUM A

HNU PI-101 CALIBRATION FORM

RMT HNU NO. _____			SERIAL NO. _____			
PROJECT NO.	DATE	PERSON	9.5eV SPAN	10.2eV SPAN	11.7ev SPAN	COMMENTS

ADDENDUM B

MAINTENANCE SERVICE RECORD

ITEM	MOD#	SER#	RMT ID#

DATE	MAINTENANCE SERVICE/REMARKS

ADDENDUM C

DAILY CALIBRATION PROCEDURES OF HNU PI-101

HNU PI-101 organic vapor meters are to be field calibrated at a minimum of twice a day at the beginning and end of each work day.

In order to accomplish this, HNUs assigned to jobs shall be accompanied with a calibration gas cylinder, an appropriate regulator, and a flexible connecting hose. The procedure for performing field calibration is as follows:

1. Connect the probe to the instrument, and turn it on.
2. Attach the 8-inch extension to the probe.
3. Set the Span Potentiometer to the setting specified on the calibration cylinder.
4. Connect the cylinder regulator to the cylinder.
5. Connect the cylinder and the instrument together with the flexible tubing.
6. Open the cylinder valve, and wait 15 seconds.
7. The instrument reading should coincide with the reading stated on the calibration cylinder label.
8. If item number 7 does not coincide, adjust the Span Potentiometer until the desired reading is achieved.

If the desired reading is not achieved by adjusting the Span Potentiometer, the instrument is to be returned to the RMT Health and Safety equipment manager for inspection, necessary cleaning and maintenance, and recalibration.

The manufacturer also recommends that the lamp inside of the probe be checked twice per week (16 hours of use) and cleaned at least weekly. The RMT maintenance schedule (Addendum E) recommends monthly cleaning. This involves removing any noticeable obstructions or contamination from the lamp by wiping it off with a clean, soft cloth, being careful not to scratch the circular window.

In using this instrument to protect RMT employees, it is imperative that it is accurately responding to airborne substances present at the work site. By implementing these procedures, this end will be better achieved.

Additionally, all calibration activities must be documented in field log books, instrument calibration log sheets, or equivalent. This information must include the date inspected, the person calibrating the instrument, the instrument serial or identification number, the probe lamp eV (9.5, 10.2, or 11.7), identification of the calibration gas (gas source stated on the cylinder label), the initial and final Span Potentiometer settings, and the instrument resultant reading. This information must be submitted to the RMT Site Health and Safety person at the completion of the job.

ADDENDUM D

START-UP AND SHUTDOWN PROCEDURES

Start-up

1. Attach the probe to the readout unit. Match the alignment key, and then twist the connector clockwise until a distinct locking is felt.

2. Turn the FUNCTION switch to the battery check position. Check to ensure that the indicator reads within or beyond the green battery arc on the scale plate. If the indicator is below the green arc, or if the red LED comes on, the battery must be charged prior to using.

3. To zero the instrument, turn the FUNCTION switch to the STANDBY position and rotate the ZERO POTENTIOMETER until the meter reads zero. Wait 15-20 seconds to ensure that the zero adjustment is stable. If not, then readjust.

4. Check to see that the SPAN POTENTIOMETER is set at the appropriate setting for the probe being used. Follow procedures in Addendum C in the performance of daily calibrations.

5. Set the FUNCTION switch to the desired ppm range.

6. Listen for the fan operation to verify fan function.

7. Check instrument with an organic point source (such as a felt tip marker) prior to usage to verify instrument function.

Shut Down

1. Turn FUNCTION switch to OFF.

2. Attach the instrument to the charger.

ADDENDUM E

MAINTENANCE AND CALIBRATION SCHEDULE

Function	Frequency
• Routine Calibration	Prior to each use*
• Factory Check-out and Calibration	Yearly or when malfunctioning
• Wipe Down of Read-Out Unit	After each use
• Cleaning of UV Light Source Window	Every month or as use and site conditions dictate
• Cleaning of the Ionization Chamber	Monthly
• Recharging of Battery	After each use

*In accordance with the specifications identified in Addendum C.

ADDENDUM F

CLEANING THE UV LIGHT SOURCE WINDOW

1. Turn the FUNCTION switch to the OFF position and disconnect the sensor/probe from the Read Out/Control unit.

2. Remove the exhaust screw located near the base of the probe. Grasp the end cap in one hand and the probe shell in the other. Separate the end cap and lamp housing from the shell.

3. Loosen the screws on the top of the end cap and separate the end cap and ion chamber from the lamp housing, taking care that the lamp does not fall out of this housing.

4. Tilt the lamp housing with one hand over the opening, so that the lamp slides out of the housing into your hand.

5. The lamp window may now be cleaned with any of the following compounds using lens paper:

   a) Clean 9.5 and 10.2eV lamp with methanol.

   b) Clean 11.7eV lamp with freon.

6. Following cleaning, reassemble by first sliding the lamp back into the lamp housing. Place the ion chamber on top of the housing, making sure the contacts are properly aligned.

7. Place the end cap on top of the ion chamber, and replace the two screws. Tighten the screws only enough to seal the O-ring. Do Not Overtighten.

8. Line up the pins on the base of the lamp housing with pins inside the probe shell, and slide the housing assembly into the shell. It will only fit one way. Reinsert the exhaust screw.

ADDENDUM G

CLEANING THE IONIZATION CHAMBER AND PROBE EXTENSION

1. Turn the FUNCTION switch to the OFF position, and disconnect the sensor/probe from the Read Out/Control unit.

2. Remove the exhaust screw located near the base of the probe. Grasp the end cap in one hand and the probe shell in the other. Separate the end cap and lamp housing from the shell.

3. Loosen the screws on the top of the end cap and separate the end cap and ion chamber from the lamp housing, taking care that the lamp does not fall out of this housing.

4. The ion chamber may now be cleaned according to the following sequence:

   a. Acetone rinse with agitation (10 min.), and then dry (preferably with oven at 100°C).

   b. Methanol rinse with agitation (10 min.), and then dry (preferably with oven at 100°C).

   c. Probe extension may be rinsed with acetone or methanol, and then dried.

5. Place the ion chamber on top of the housing, making sure the contacts are properly aligned.

6. Place the end cap on top of the ion chamber, and replace the two screws. Tighten the screws only enough to seal the O-ring. Do Not Overtighten.

7. Line up the pins on the base of the lamp housing with pins inside the probe shell, and slide the housing assembly into the shell. It will only fit one way. Reinsert the exhaust screw.

ADDENDUM H

TROUBLESHOOTING

To be performed by a qualified technician only.

1. No meter response in any switch position (including BATT CHK).

   A. Broken meter movement.

      (1) Tip instrument rapidly from side to side. Meter needle should move freely and return to zero.

   B. Electrical connection to meter is broken.

      (1) Check all wires leading to meter, and clean the contacts of quick-disconnects.

   C. Battery is completely dead.

      (1) Disconnect battery, and check voltage with a volt-ohm meter.

   D. If none of the above solves the problem, consult the factory.

2. Meter responds in BATT CHK position, but reads zero or near zero for all others.

   A. Power supply defective.

      (1) Check power supply voltage per Figure 11 of the HNU owner's manual. If any voltage is out of specification, consult the factory.

   B. Input transistor or amplifier has failed.

      (1) Rotate zero control. Meter should deflect up/down, as control is turned.

      (2) Open probe. Both transistors should be fully seated in sockets.

C. Input signal connection broken in probe or readout.

(1) Check input connector on printed circuit board. The input connector should be firmly pressed down.

(2) Check components on back side of printed circuit board. All connections should be solid, and no wires should touch any other object.

(3) Check all wires in readout for solid connections.

NIROP FRIDLEY SOILS RI
QAPP
ATTACHMENT III
RMT STANDARD OPERATING PROCEDURE
FOR TOTAL ORGANIC CARBON ANALYSIS

ANALYTICAL METHOD

TITLE: Total Organic Carbon Analysis

DEPARTMENT: Inorganic - Wet Chemistry

APPLICATION: Determination of organic carbon in soil, sludge and solid waste.

REFERENCE: ASTM Method D4129-82, 1982
EPA Manual SW-846, 3rd Edition, Method 9060
Dohrmann DC-80 TOC Systems Manual, 6th Edition, January 1984.

PROCEDURE SUMMARY:

Inorganic carbon from carbonates and bicarbonates is removed by acid treatment. The sample is burned in a resistance furnace under oxygen. The interfering gases are removed by a sparger/scrubber system and carbon dioxide is measured by a nondispersive infrared detector and shown on a digital display in concentration units.

DETECTION LIMITS:

100 mg/Kg

RANGE OF MEASUREMENT (working linear range):

100 - 16,000 mg/Kg

REVIEWED BY: Eric L. Thomas — 3/6/92
Eric L. Thomas
Supervisor
Inorganic Section
Date

Mark S. Wirtz — 3/6/92
Mark S. Wirtz
Quality Assurance Officer
Date

APPROVED BY: Eric L. Thomas for — 3/6/92
Karen M. MacKenzie
Laboratory Director
Date

SAMPLE HANDLING & PRESERVATION:

The sample is collected in a glass jar and refrigerated at 4°C. The holding time is 28 days from sample collection.

INTERFERENCES:

Carbonate and bicarbonate carbon represent an interference under the terms of this test and must be removed or accounted for in the final calculation.

Removal of carbonate and bicarbonate by acidification can result in the loss of volatile organic substances.

Volatile organics may be lost in the decarbonization step resulting in a low bias.

Bacterial decomposition and volatilization of the organic compounds are minimized by maintaining the sample at 4°C and analyzing within the specified holding time.

APPARATUS:

Dohrmann DC 80 Total Organic Carbon Analyzer
Syringes: 50 µL
Volumetric flasks: 100 mL, 200 mL, 1000 mL
Forceps
Watch glass
Small spatula
Platinum boat
Drying oven maintained at 103°-105°C

REAGENTS:

Deionized (D.I.) water
Potassium persulfate
Potassium hydrogen phthalate (KHP)
5% Sulfuric acid
Nitric Acid

Prepare Standard (ppm as Carbon), 2,000 ppm [instrument calibration, initial calibration verification (ICV), continuing calibration verification (CCV), and matrix spiking]

- Dissolve 425 mg KHP in 100 mL D.I. water. Add 0.1 mL concentrated HNO_3. Store in an amber bottle and refrigerate. Shelf life is one month. This standard is used for initial calibration and matrix spiking. Another 2,000 ppm standard is prepared from a second source that is used as the ICV and CCV.

Prepare 5% Sulfuric Acid Solution

- Dilute 10 mL of concentrated H_2SO_4 (sulfuric acid) to 200 mL with distilled water in a volumetric flask.

Prepare Initial Calibration Blank (ICB), Continuing Calibration Blank (CCB) and Preparation Blank (PB)

- Use the same D.I. water that was used for the preparation of the standards. Inject 40 µL onto an ottawa sand (40 mg) which has gone through the same sample preparation procedures.

Prepare Laboratory Control Sample (LCS)

- Use a commercially prepared standard with a concentration of 1,000 to 3,500 ppm. Inject between 10 and 40 µL (depending on the concentration of the LCS concentrate) into the boat through a septa in the sample port.

SAMPLE PREPARATION:

Air dry the sample overnight, then mix until homogeneous. Transfer approximately 5 g of the sample into a porcelain dish. Add 5% sulfuric acid dropwise, while mixing, until effervescence is no longer visible. Dry in an oven at 105°C until constant dry weight is obtained. Also prepare an ottawa sand in the same manner for quality control.

INSTRUMENT OPERATION:

A. Sample Analysis

1. Turn on O_2 purge gas tank and verify line pressure of 30 psi.

2. Connect lines from PRG-1 purgeables module labeled "4" and "5" to ports 4 and 5, respectively, on the right side of the DC-80 Reaction Module. Verify gas flow by observing bubbling in reaction vessel.

3. Turn on power switch labeled "Furnace" on PRG-1 module.

4. Turn "Power" switch of DC-80 reaction module on. Turn off switches labeled "Pump" and "Lamp".

5. Turn on "Power" switch of DC-80 Electronics Module.

6. Set function switch to "TOC".

7. Set injection volume control to "40 µL" setting.

8. Allow furnace to heat up (~ 30 minutes) and baseline value to stabilize to historical value, typically 0.0100-0.0200.

9. Boat preparation. The platinum boat is lined with quartz wool. The boat is introduced into the furnace and allowed to "bake-out".

10. Calibrate the instrument using an instrument blank and a 2,000 ppm KHP standard. Inject the blank and standard into the boat through a septa in the sample port. Calibration is done with 3 separate injections of the 2,000 ppm KHP standard. These three are then averaged, and the instrument is calibrated. A second source KHP is used for the initial calibration verification (ICV).

    NOTE: When calibrating, the boat is immediately introduced into the furnace.

11. Weigh a well-mixed, dry homogeneous sample into a lined platinum boat.

    NOTE: Sample size must be kept between 10 and 100 mg.

12. Place the sample in the saddle and close the injection port. Allow the sample to stand outside of the furnace for about 2 minutes to stabilize the system.

13. Push "START" and introduce the sample into the furnace. When the sample has been processed, the "READY" light will come on and the integrated concentration will be sent to the printer. This indicates that the instrument is ready for the next sample.

B. Shutdown

1. Disconnect lines to Ports 4 and 5.

2. Turn off purge gas.

3. Leave power to Horiba PIR-2000 ON at all times!

4. Turn off switches on the following:
   a. DC-80 Electronics Module
   b. DC-80 Reaction Module
   c. ASM-1 Autosampler Module
   d. PRG-1 Furnace Module

ROUTINE PREVENTATIVE MAINTENANCE

A. Septum Replacement

Replace the injection septum every 100 injections or at any time leakage is obvious.

B. Reagent Replenishment

Check daily.

C. Sparge/Carrier Gas Replenishment

Check once a week.

D. Tin Scrubber

Check daily. Color will change as it is used. Repack the tube when one-half of the tin is exhausted. Use 20-mesh granular tin.

E. Pump Tube Replacement

Replace every two weeks if instrument is operated continuously. Release pressure fingers when not in use. Plug reagent lines before releasing.

F. Printer Tape

Check every two or three days. Always check before an unattended automated run.

G. Infra-red Zero

Check once or twice a day to see that the zero reading is around 0.0100 on the digital readout when the detector/ppm switch is in the detector position. It should always be ABOVE zero. A reading of 0.0100 on the DVM is reasonable.

H. Infra-red Span

The span does not need any routine resetting.

QUALITY CONTROL:

- Initial Calibration Verification (ICV)
  The ICV must be run immediately after calibration and meet current control limits of ± 10% of true value.

- Initial Calibration Blank (ICB)
  The ICB must be analyzed after the ICV and must be less than the instrument detection limit (IDL).

- Preparation Blank (PB)
  Analyze the preparation blank before the analytical samples. The preparation blank must be less than the IDL.

- Laboratory Control Sample (LCS)
  Prepare the LCS consisting of a known concentration must be and analyze for each matrix type. The LCS recovery must meet current control limits. See addendum for limits.

- Continuing Calibration Verification (CCV)
  The CCV is analyzed after every 10 analytical samples and meet current control limits of ± 10% of true value.

- Continuing Calibration Blank (CCB)
  The CCB is analyzed after every CCV and be less than the IDL.

ACCURACY:

A spike of at least 25% above the sample concentration must be performed on each group of samples of a similar matrix type with a frequency of 10%. See addendum for limits.

If sample concentration does not allow a 25% sample concentration spike, reduce the spike concentration depending upon sample concentration.

Spike calculation:

$$\% \text{ Recovery} = \frac{SSR-SR}{SA}$$

SSR = Spiked Sample Result
SR = Sample Result
SA = Spike Added

PRECISION:

A duplicate must be analyzed on each group of samples of a similar matrix type with a frequency of 10%. See addendum for limits.

Duplicate sample sizes should be approximately the same.

Duplicate calculation:

If the sample value, the duplicate value, or both are less than 5 times the instrument detection limit (IDL), use absolute difference.

|Sample-Duplicate| = Absolute Difference

If both the sample value and the duplicate value are equal to or greater than 5 times the IDL, use relative percent difference (RPD).

$$RPD = \frac{S-D}{(S+D)/2} \times 100$$

S = Original Sample Value
D = Duplicate Sample Value

CALCULATION:

$$\frac{\text{Instrument Reading (mg/L) x 40 µL (standard)}}{\text{Weight of Sample (mg, dry weight)}} = \text{mg/Kg TOC (dry weight)}$$

DATA DELIVERABLES/DOCUMENTATION:

All reports and documentation must be legible, single-sided and clearly labelled.

Sample analysis reports will include: sample result (dry weight), project name, laboratory name, station ID, laboratory sample number, sample collector, project number, collection date, report date, work order number, comments describing in detail any problems encountered in processing the sample and signature of the section supervisor.

The following documentation will be completed but not submitted as a deliverable unless requested: summary of initial calibration and continuing calibration check results, summary of QC sample analyses, raw data (instrument printout), and instrument log books (analytical run logs and maintenance logs.

Total Organic Carbon

Quality Control Limits

LCS*

87-129% recovery

Accuracy (Matrix Spike)

74-124% recovery

Duplicate

If the sample value, duplicate value, or both are less than 5 times the IDL, use the absolute difference.

Absolute Difference = ± IDL

If both the sample value and duplicate value are equal to or greater than 5 times the IDL, use the relative percent difference.

0-26 RPD

* An aqueous LCS will be used until a commercially prepared source can be purchased or prepared in the laboratory.

APPENDIX A - ATTACHMENT I

FIELD SAMPLING PLAN

REVISION 1

JANUARY 1992

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1. SUMMARY OF SAMPLING ACTIVITY

Soils are the only environmental media to be sampled. The sampling and analysis program, including the specific parameters and the frequency of QC samples, is summarized in Table 1-1. The number of soil borings to be drilled (and, therefore, samples to be collected) is approximate, because the boring program includes a significant, but unpredictable, number of contingency borings.

TABLE 1-1

FIELD QC SAMPLING FREQUENCY FOR PHASE II SOILS RI

Matrix	Test Parameters[1]	Number of Samples to be Analyzed with the Field GC[2] Type 1	Type 2	Number of Samples to be Submitted for Laboratory Analysis Type 1	Type 2	Field Duplicates (1 per 10 samples)	Field (Equipment Rinsate) Blanks[6] (1 per day)	Trip Blanks[5] (1 per cooler)	Matrix Spikes and Matrix Spike Duplicates (1 per 20 samples)	Total Samples (does not include field GC)
Soil Samples										
Soil	TCL-VOCs	308	280	106	70	18	24	24	9	251
Soil	TCL-Semivolatiles	0	0	106	0	11	15	0	6	138
Soil	TCL-PCB/Pesticides	0	0	106	0	11	15	0	6	138
Soil	TAL	0	0	106	0	11	15	0	6	138
Soil	Total Organic Carbon	0	0	106	70	18	24	0	9	227
Soil	1,1,1-TCA, 1,1-DCA	0	0	4	0	1	0	0	0	5
Water	Completed TCL and TAL Parameters	0	0	5[4]	0	1	0	0	1	7

Notes:

[1] VOCs - Volatile Organic Compounds; TCL - Target Compound List; TAL - Target Analyte List; TCA - trichloroethane; DCA = Dichloroethane. All TCL and TAL analyses will be performed following Contract Laboratory Program routine analytical services protocols. TCA and DCA analysis will be performed following modified EPA Method 8010.

[2] Number of samples for field GC analysis is based on eight sampling intervals per boring (31 Type 1 and 35 Type 2 borings) and five sampling intervals per test pit (assumed 12 test pits). The field GC will not be used on the 10 background borings.

[3] Number of samples for laboratory analysis based on two samples per each of the Type 1 borings (41 borings), test pits (12 test pits), and Type 2 borings (35 borings).

[4] Water samples include the drilling/decontamination water source. One sample per truckload will be analyzed. Five truckloads were estimated.

[5] These are water samples that will be analyzed for the same test parameters as the soil matrix samples.

[6] The field GC will be used to analyze the following TCL-VOCs: Tetrachloroethene (PCE), trichloroethene (TCE), cis- and trans-1,2-dichloroethene (DCE), and benzene, toluene, ethylbenzene, and xylenes (BTEX).

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2. SAMPLING NETWORK DESIGN AND RATIONALE

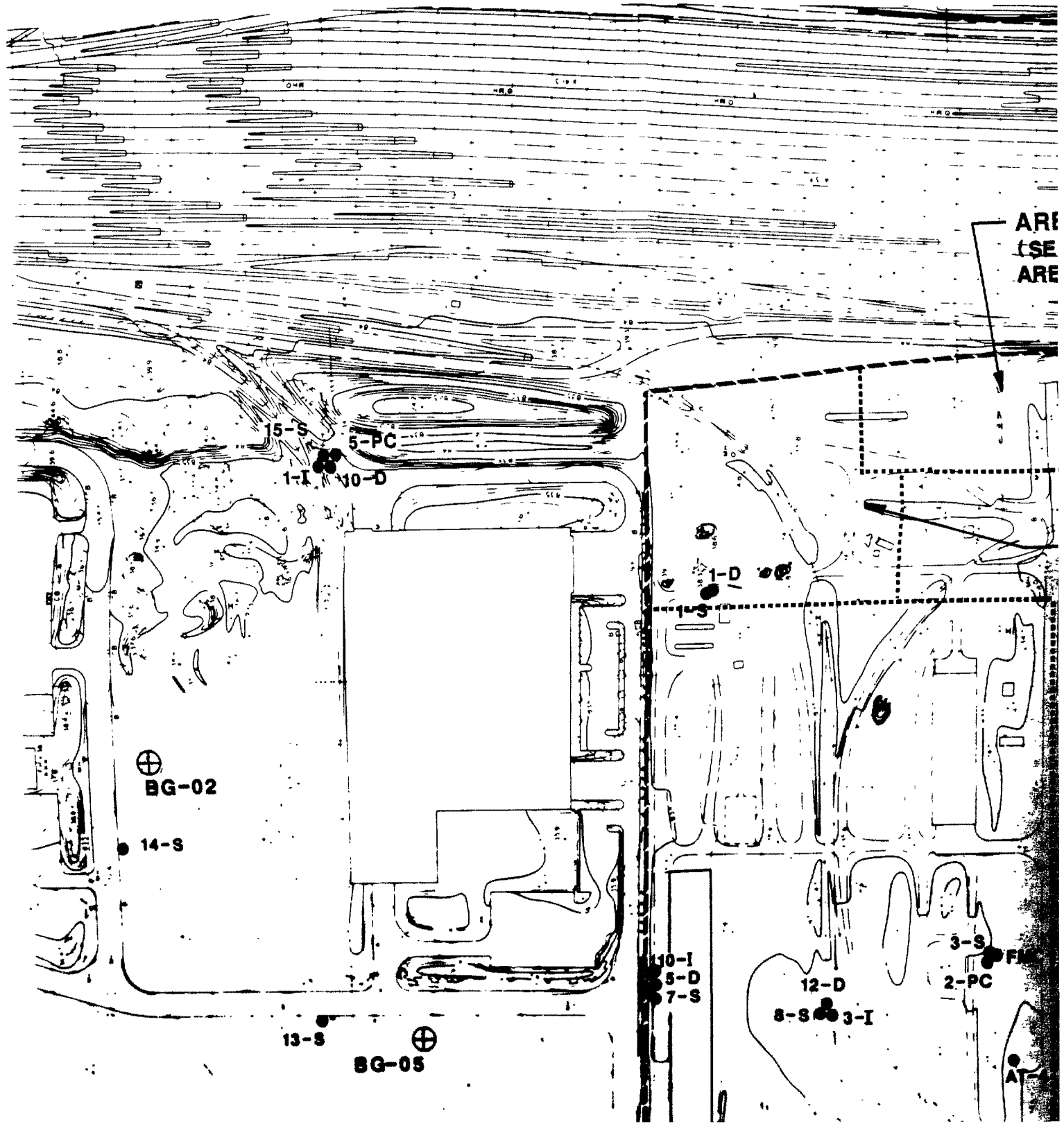
The objectives of the sampling program are described in Section 6 of the RI Workplan. This section describes the design of the sampling network and the rationale for selecting the sampling locations. The sampling locations in each of the six areas are shown on the following figures:

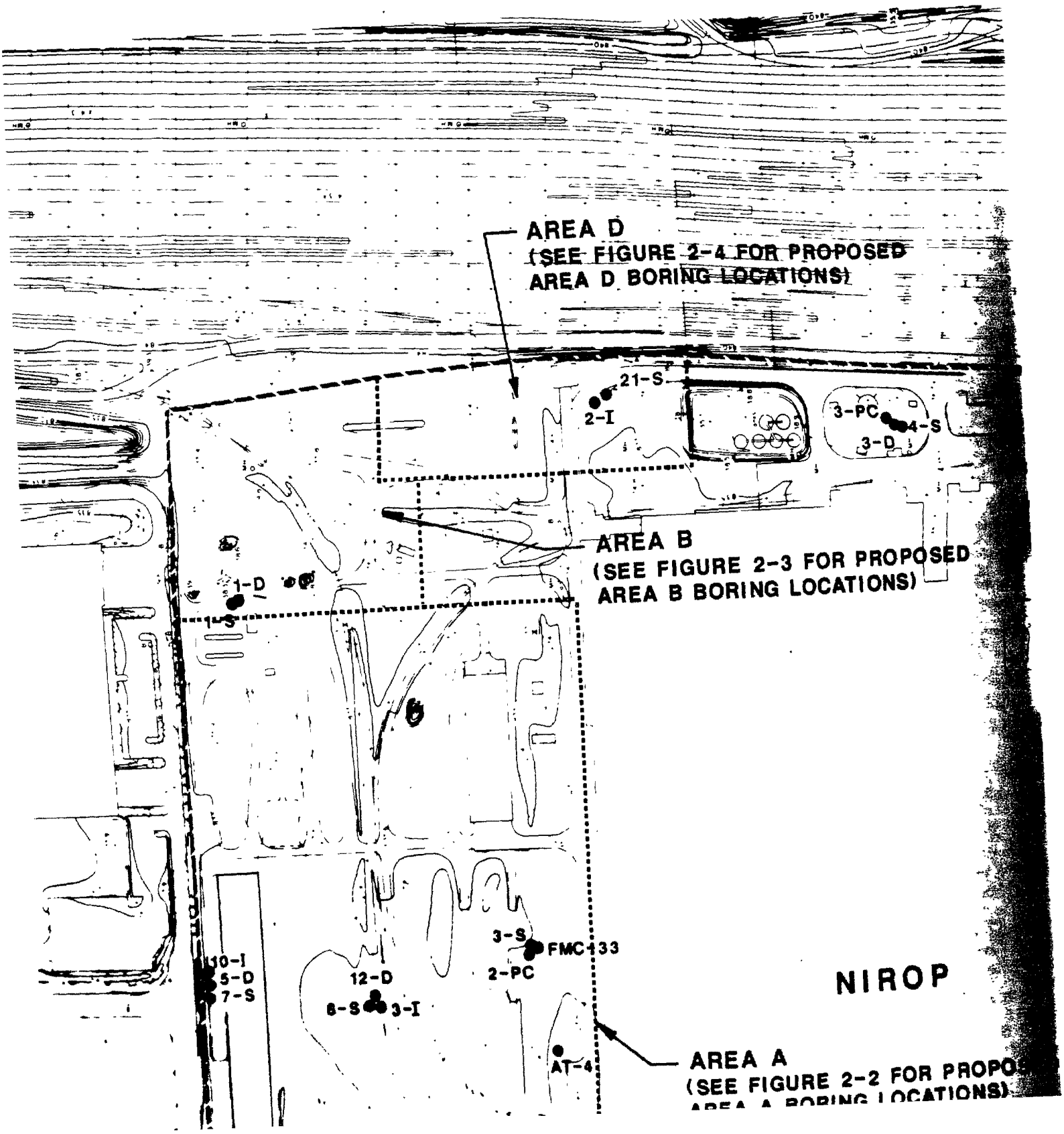
Area	Figure
Background	2-1
A	2-2
B	2-3
D	2-4
E	2-5
F	2-6

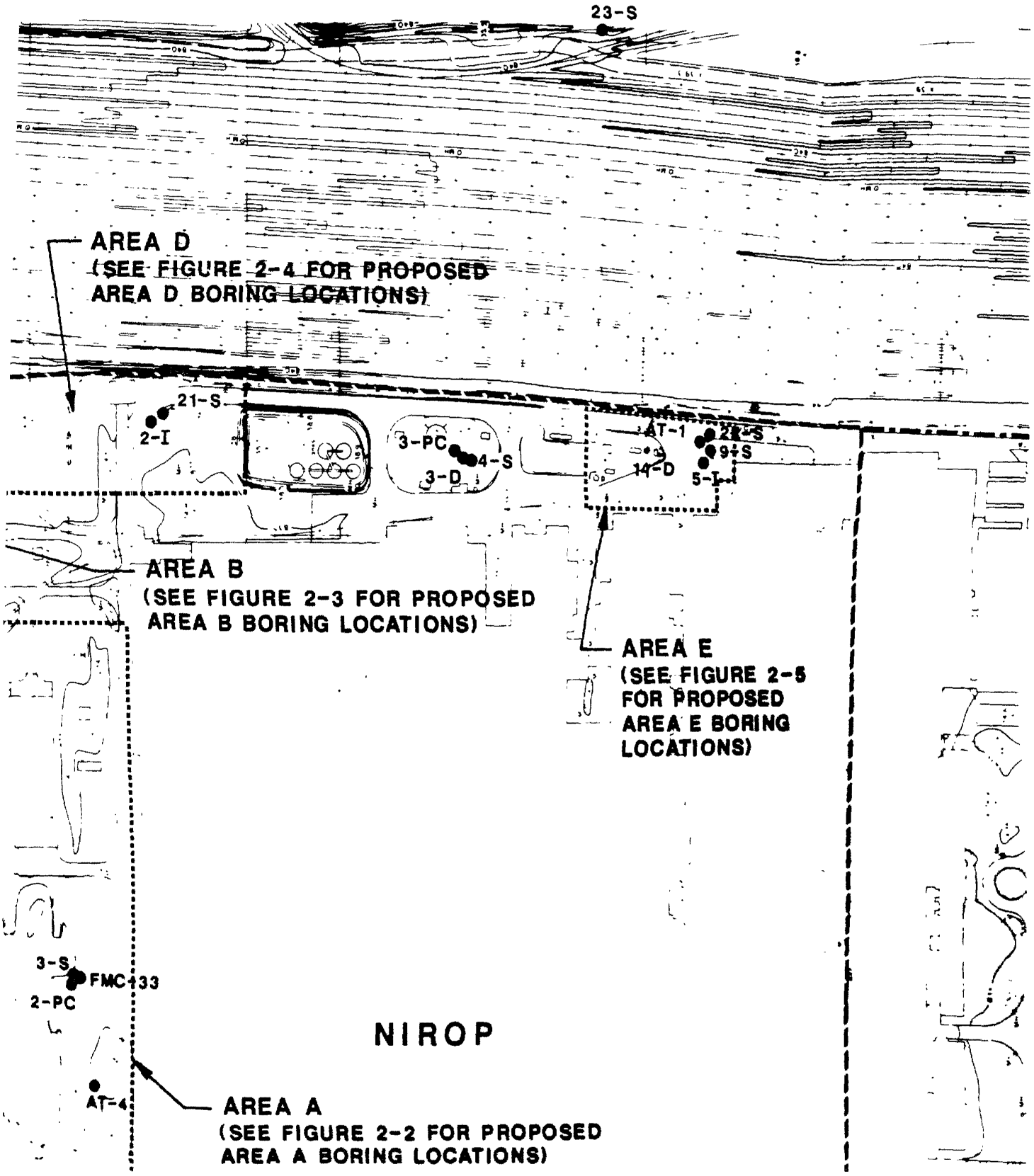
Selection of Boring Locations

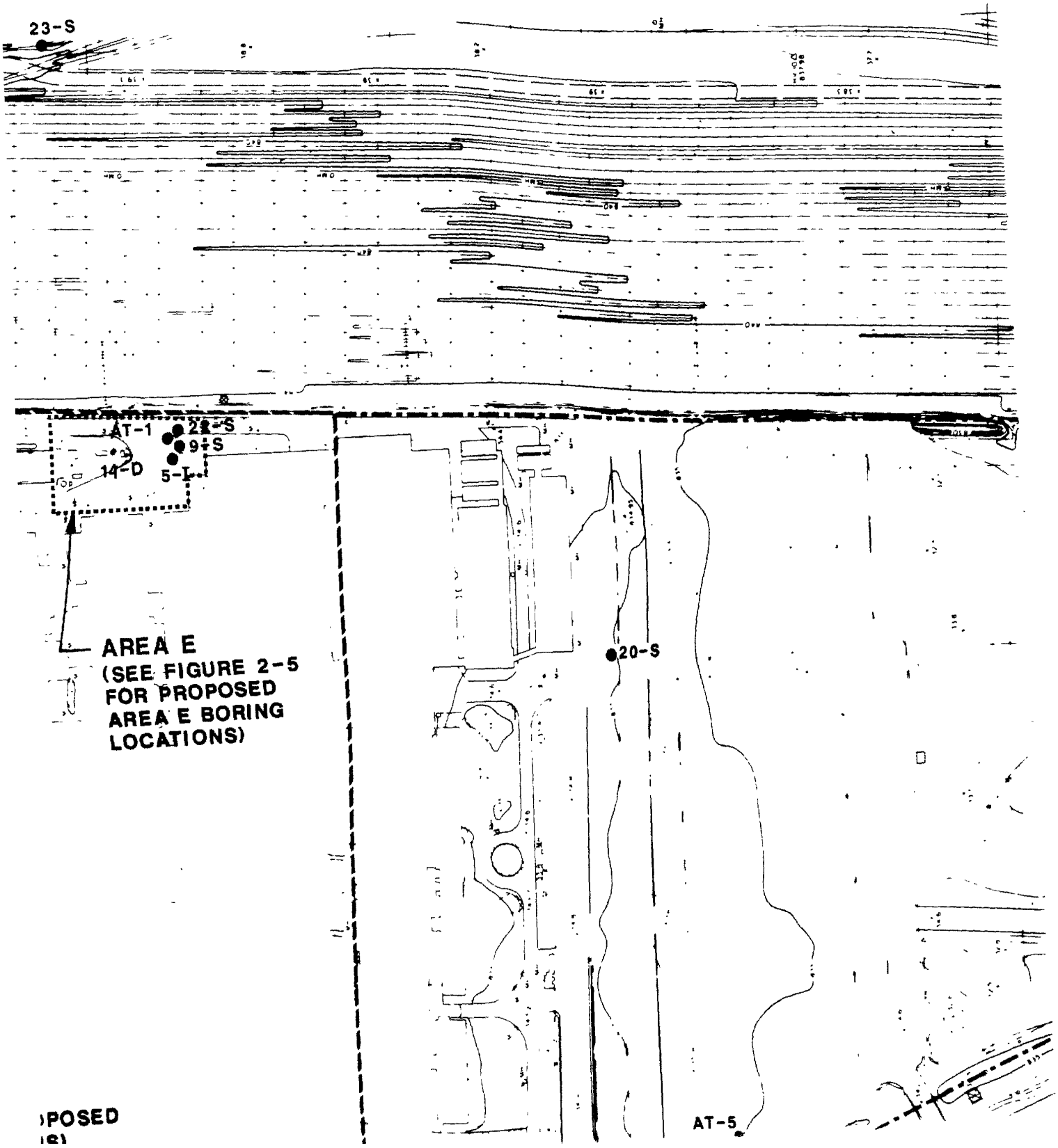
The selection of the specific soil boring locations was based on a review of the following:

- Results of the USACE Electrical Conductivity and Magnometric Surveys (USACE, 1984).
- Pit and trench excavation documentation and drawings.
- Results of the soil pore gas survey (RMT, 1988a).
- Results of the Fall 1990 Soils Investigation (RMT, 1991b).
- Ground water quality and flow data (RMT, 1987b and 1991b).
- Review of historical aerial photographs.
- Results of a preliminary investigation during construction of an addition to the Hazardous Materials Storage Areas (Wenck, 1991).
- Observations made during excavations which were part of a storm sewer improvement project.


15-S
5-PC
1-I
10-D
1-D
1-S
BG-02
14-S
10-I
5-D
7-S
13-S
BG-05
12-D
8-S
3-I
3-S
2-PC

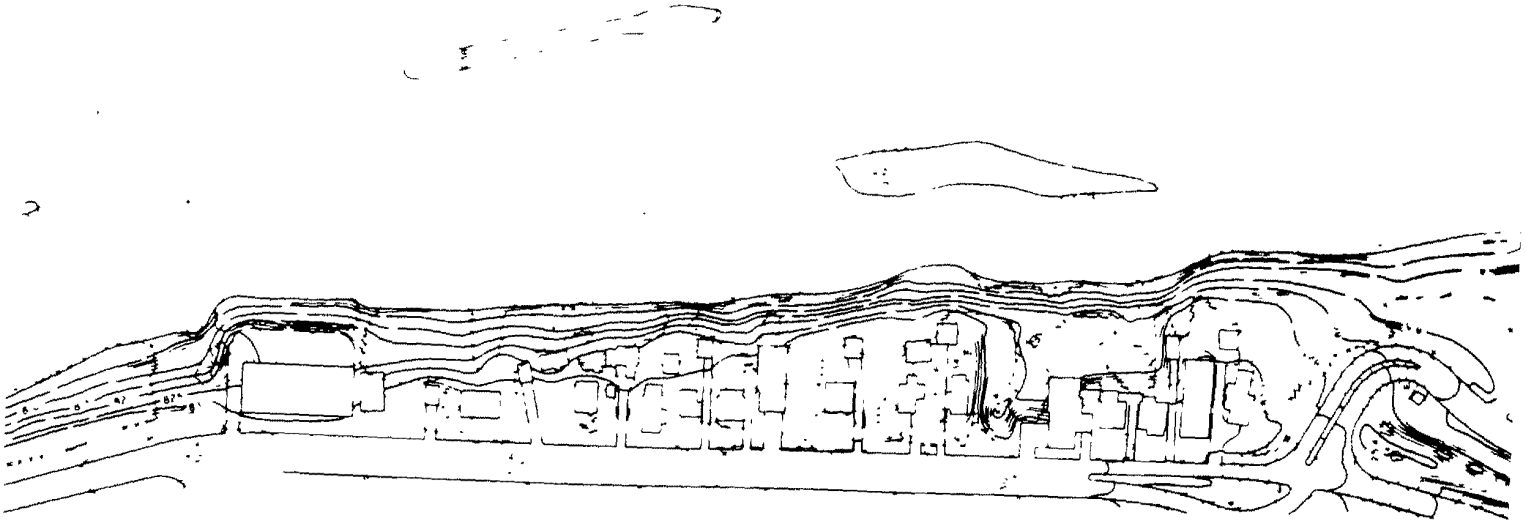

AREA D
(SEE FIGURE 2-4 FOR PROPOSED
AREA D BORING LOCATIONS)
21-S
2-I
3-PC
4-S
3-D
AREA B
(SEE FIGURE 2-3 FOR PROPOSED
AREA B BORING LOCATIONS)
1-D
1-S
3-S
FMC-33
2-PC
10-I
5-D
7-S
12-D
8-S
3-I
AT-4
NIROP
AREA A
(SEE FIGURE 2-2 FOR PROPO


23-S
AREA D
(SEE FIGURE 2-4 FOR PROPOSED
AREA D BORING LOCATIONS)
21-S
2-I
3-PC
4-S
3-D
AT-1
28-S
9-S
14-D
5-I
AREA B
(SEE FIGURE 2-3 FOR PROPOSED
AREA B BORING LOCATIONS)
AREA E
(SEE FIGURE 2-5
FOR PROPOSED
AREA E BORING
LOCATIONS)
3-S
FMC-33
2-PC
NIROP
AT-4
AREA A
(SEE FIGURE 2-2 FOR PROPOSED
AREA A BORING LOCATIONS)


23-S
AT-1
22-S
9-S
14-D
5-I
AREA E
(SEE FIGURE 2-5
FOR PROPOSED
AREA E BORING
LOCATIONS)
20-S
AT-5

)POSED
(S)

20-S



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TIALLY
S

SCALE: 1 = 200'

0 200 400 600 FEET

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2.			
1.			

PROJECT :

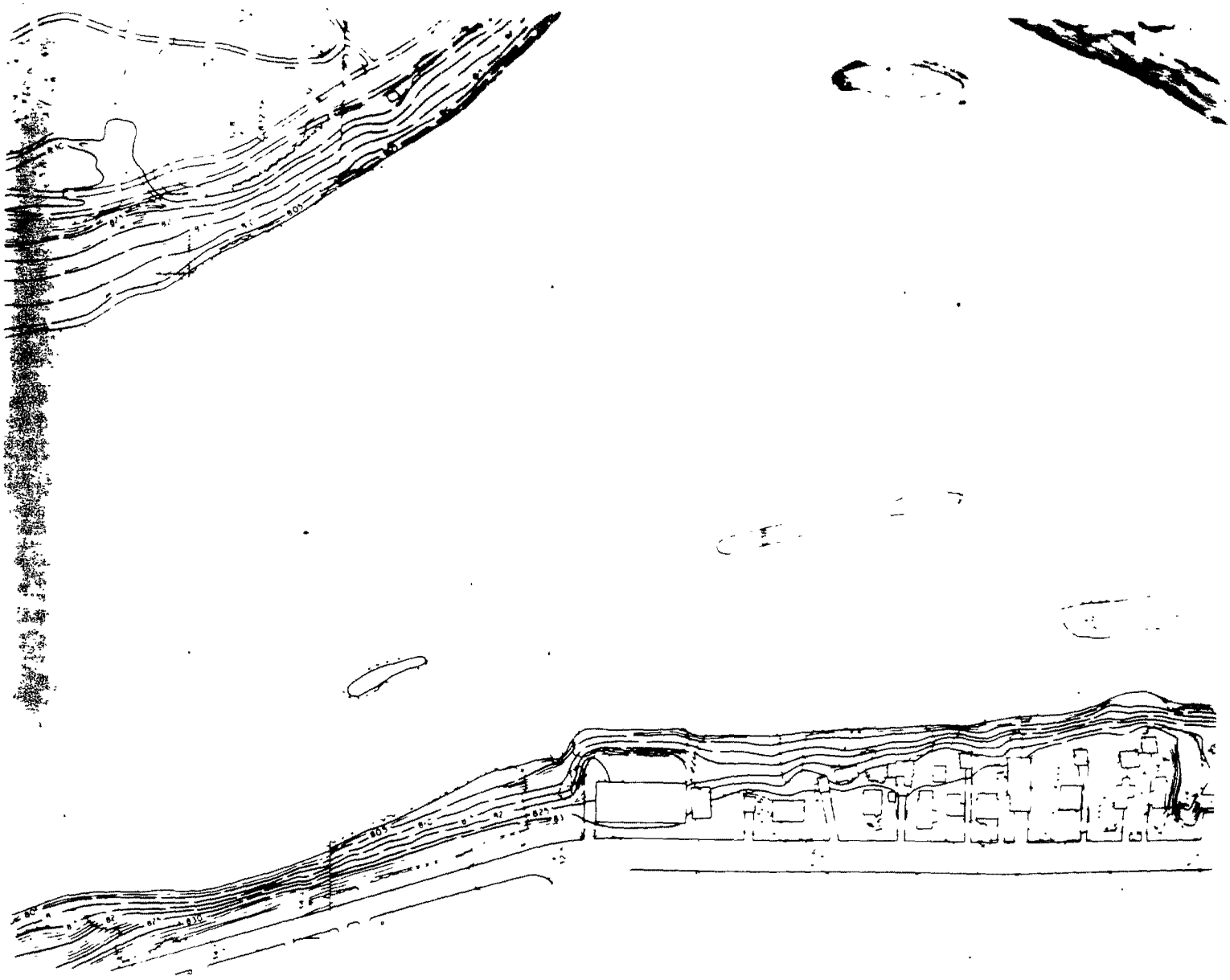
REMEDIAL INVESTIGATI(
NIROP - FRIDLEY, MINNES

SHEET TITLE :

NIROP FACILITY MAP AND PR
SOIL BORING LOCATION

DRAWN BY: DPR	SCALE : 1"=200'	PI
CHECKED BY: J. Koch		DI
APPROVED BY: G. Kenager	DATE PRINTED :	SI
DATE : JANUARY 1992		

RMT INC



APPROXIMATE NIROP PROPERTY LINE

APPROXIMATE FMC PROPERTY LINE

APPROXIMATE BNR PROPERTY LINE

APPROXIMATE BOUNDARY OF POTENTIALLY IMPACTED SOILS FOR RI, FOR AREAS A, B, D, E, AND F

SCALE: 1 = 200'

0 200 400 600 FEET

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APPROVED

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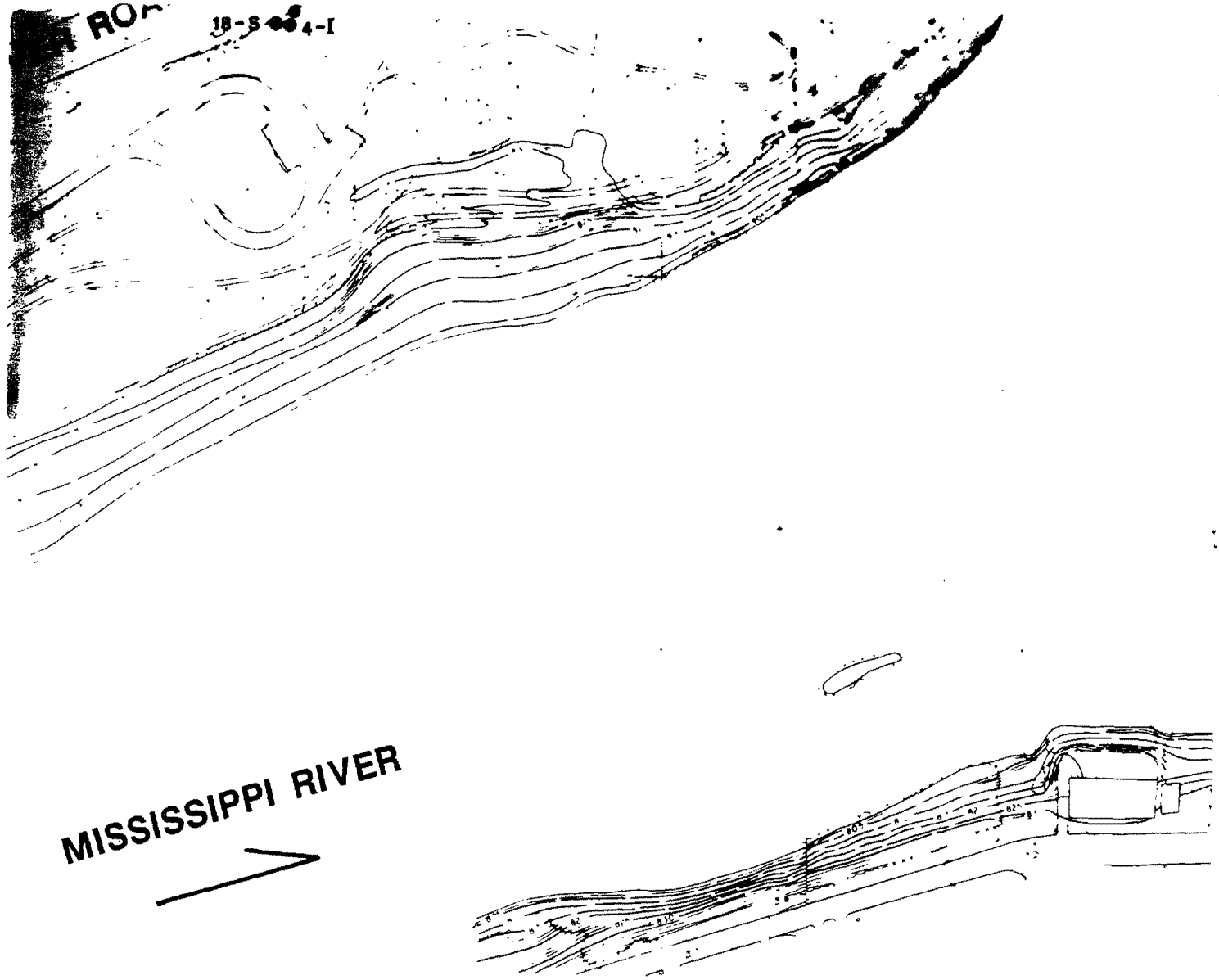

APPROXIMATE NIROP PROPERTY LINE

APPROXIMATE FMC PROPERTY LINE

APPROXIMATE BNR PROPERTY LINE

APPROXIMATE BOUNDARY OF POTENTIALLY IMPACTED SOILS FOR RI, FOR AREAS A, B, D, E, AND F

SCALE: 1

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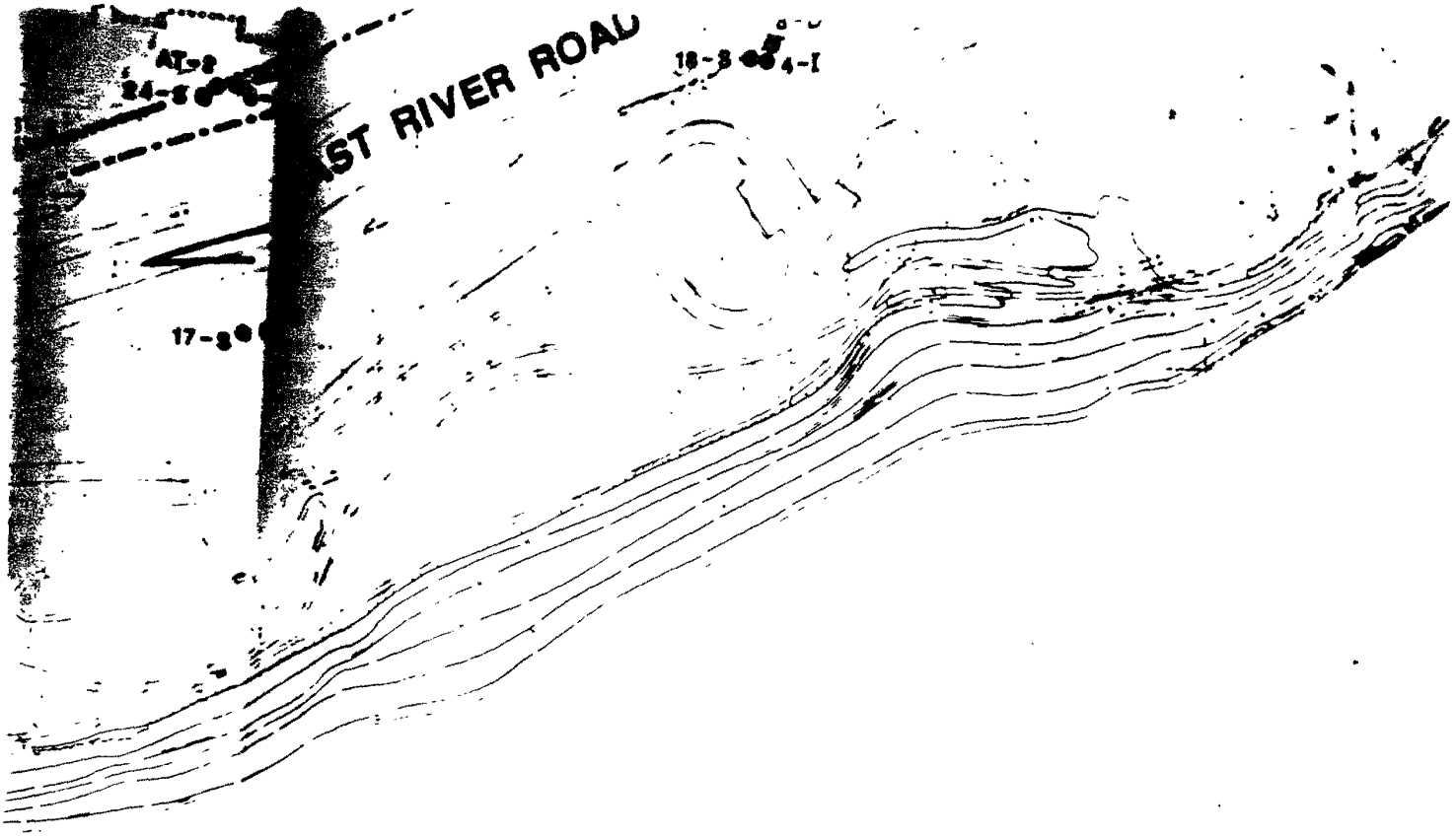
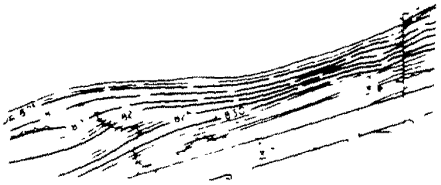




ATER TABLE OBSERVATION WELL
N UNCONSOLIDATED SEDIMENTS

ITERMEDIATE DEPTH PIEZOMETER
N UNCONSOLIDATED SEDIMENTS

EEP PIEZOMETER IN UNCONSOLIDATED
EDIMENTS

EDROCK PIEZOMETER

RODUCTION WELL

UNICIPAL WELL

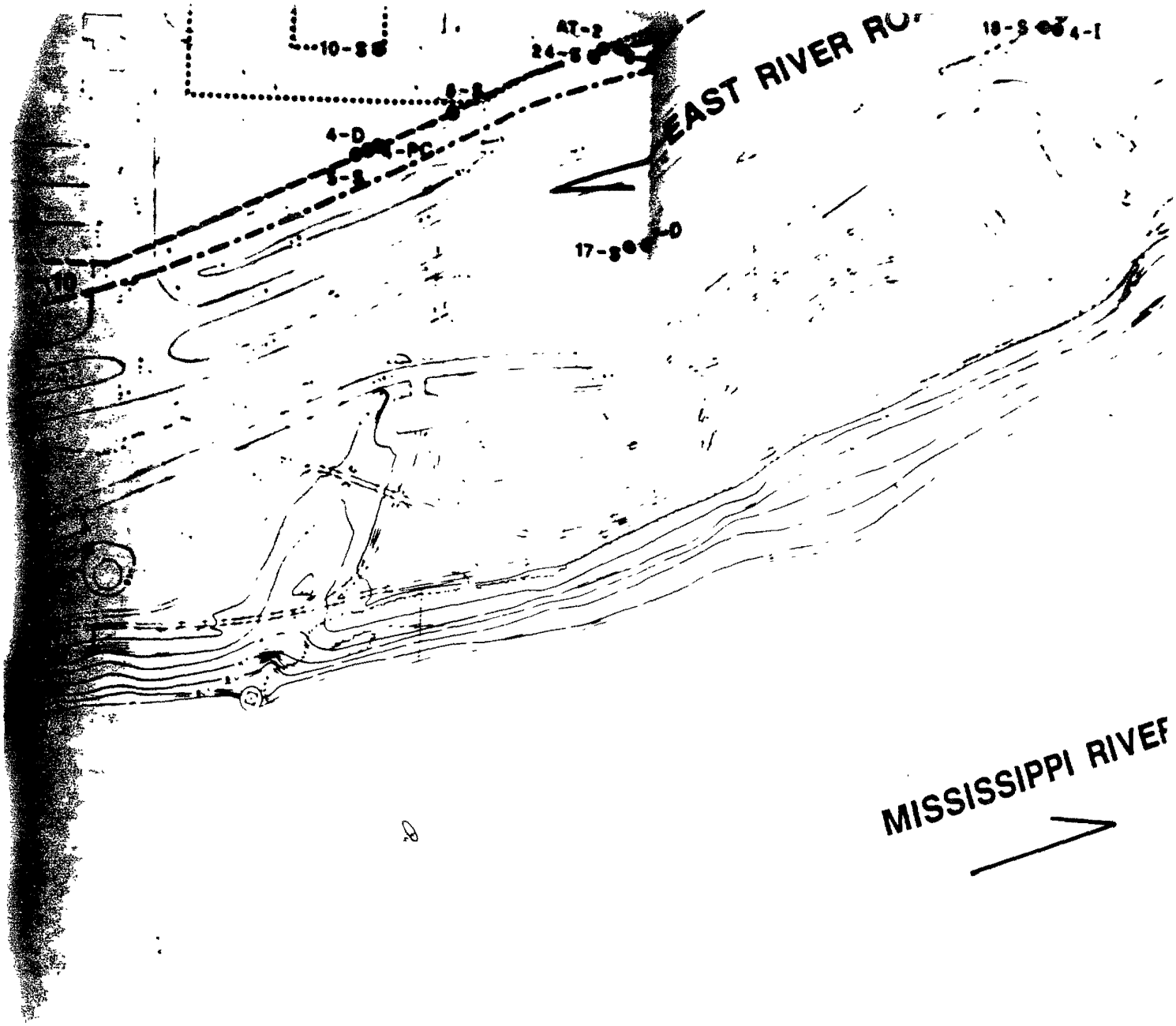
ROPOSED PHASE II BACKGROUND SOIL
ORING LOCATION

APPROXIMATE NIROP PROPERT

APPROXIMATE FMC PROPERTY

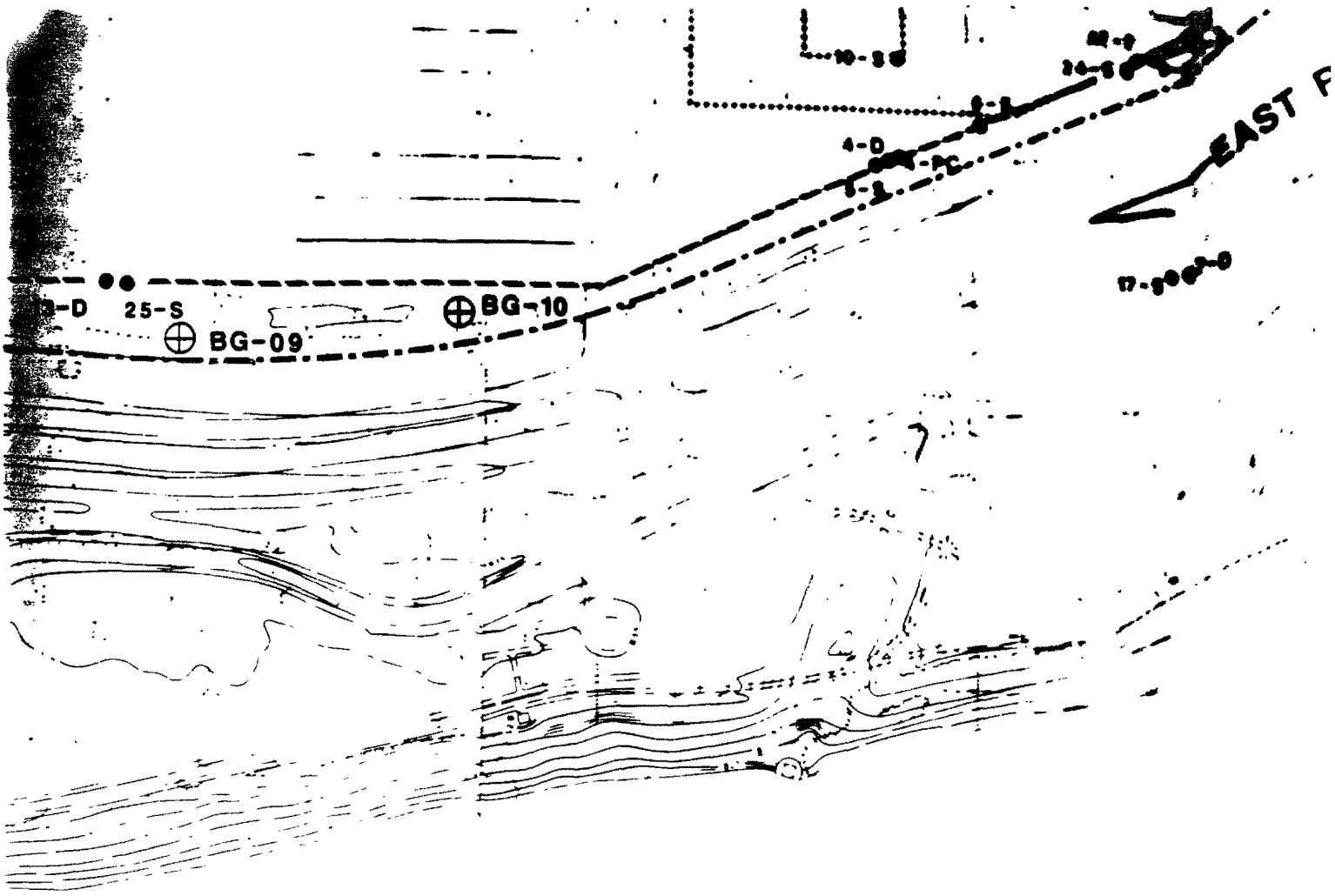
APPROXIMATE BNR PROPERTY

APPROXIMATE BOUNDARY OF P(
IMPACTED SOILS FOR RI, FOR
A, B, D, E, AND F



AVED ROAD
NPAVED ROAD
UILDING
ENCE
CONTOUR
CONTOUR
POT ELEVATION
/ OR BRUSH
ATER

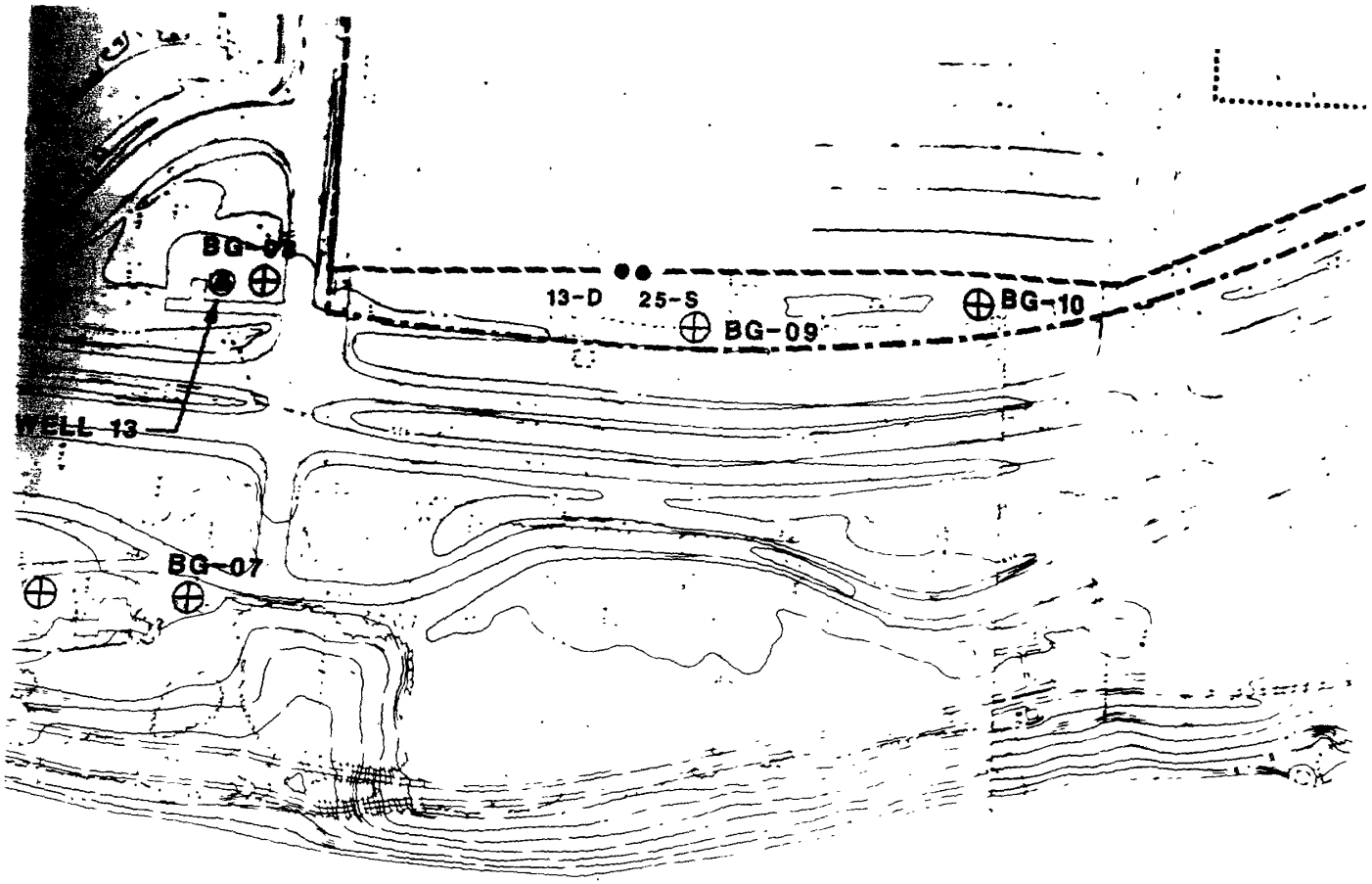
● 1-S	WATER TABLE OBSERVATION WELL IN UNCONSOLIDATED SEDIMENTS
● 1-I	INTERMEDIATE DEPTH PIEZOMETER IN UNCONSOLIDATED SEDIMENTS
● 1-D	DEEP PIEZOMETER IN UNCONSOLIDATED SEDIMENTS
● 1-PC	BEDROCK PIEZOMETER
● AT-1	PRODUCTION WELL
◆	MUNICIPAL WELL
⊕ BG-01	PROPOSED PHASE II BACKGROUND SOIL BORING LOCATION



LEGEND

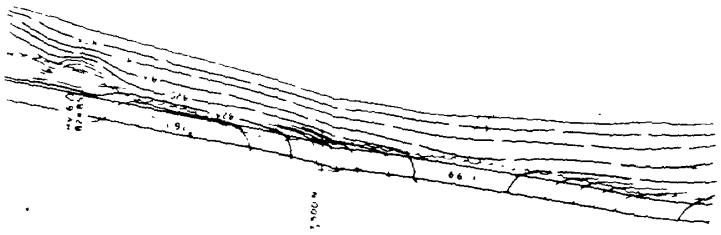
	EXISTING PAVED ROAD
	EXISTING UNPAVED ROAD
	EXISTING BUILDING
—×—×—	EXISTING FENCE
—800—	EXISTING 5' CONTOUR
	EXISTING 1' CONTOUR
x 865.1	EXISTING SPOT ELEVATION
	TREES AND / OR BRUSH
	EDGE OF WATER
	WET AREA

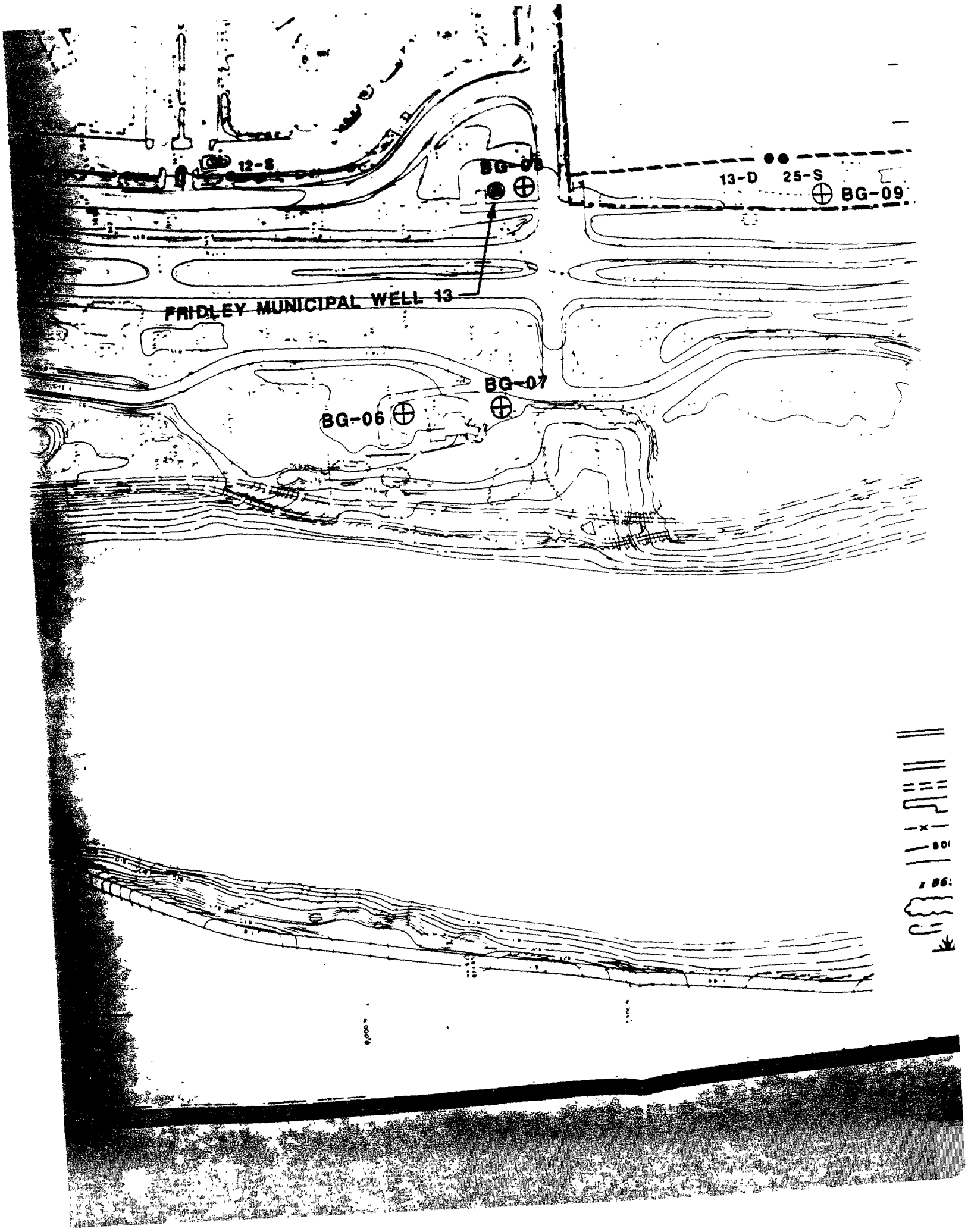
● 1-S	WATER TABLE OBSERVATIO IN UNCONSOLIDATED SEDIM
● 1-I	INTERMEDIATE DEPTH PIEZ IN UNCONSOLIDATED SEDIM
● 1-D	DEEP PIEZOMETER IN UNCO SEDIMENTS
● 1-PC	BEDROCK PIEZOMETER
● AT-1	PRODUCTION WELL
▲	MUNICIPAL WELL
⊕ BG-01	PROPOSED PHASE II BACKG BORING LOCATION



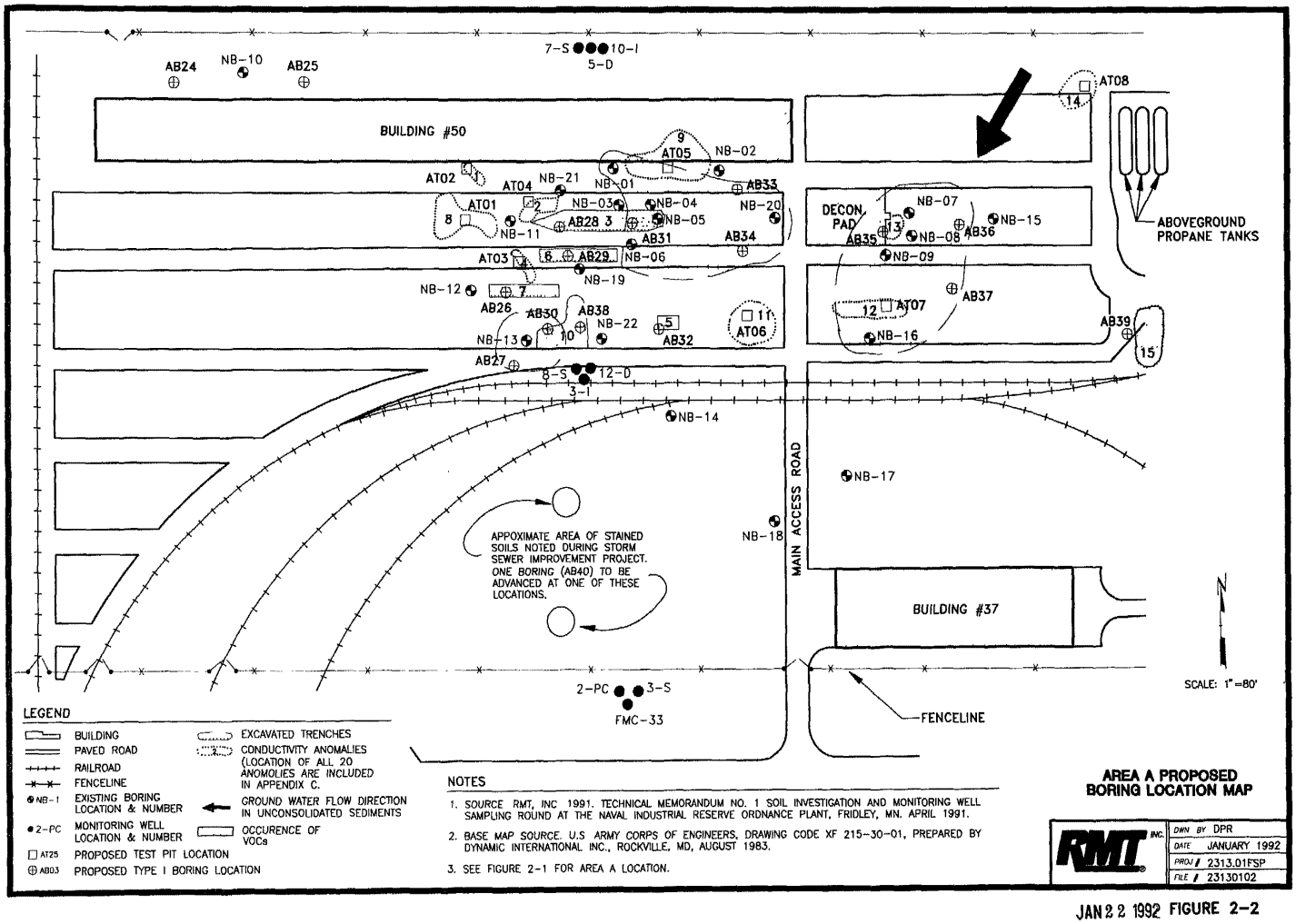
LEGEND

- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING BUILDING
- EXISTING FENCE
- 800 — EXISTING 5' CONTOUR
- EXISTING 1' CONTOUR
- x 865.1 — EXISTING SPOT ELEVATION
- TREES AND / OR BRUSH
- EDGE OF WATER
- WET AREA




12-S
BG-08
13-D
25-S
BG-09
FRIDLEY MUNICIPAL WELL 13
BG-07
BG-06

12-S
BG-0
FRIDLEY MUNICIPAL WELL 13
BG-06
BG-0
5,500 N
5,000 N
PORT
HAWAII



NOTES

1. SOURCE RMT, INC 1991. TECHNICAL MEMORANDUM NO. 1 SOIL INVESTIGATION AND MONITORING WELL SAMPLING ROUND AT THE NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT, FRIDLEY, MN. APRIL 1991.
2. BASE MAP SOURCE. U.S ARMY CORPS OF ENGINEERS, DRAWING CODE XF 215-30-01, PREPARED BY DYNAMIC INTERNATIONAL INC., ROCKVILLE, MD, AUGUST 1983.
3. SEE FIGURE 2-1 FOR AREA A LOCATION.

AREA A PROPOSED BORING LOCATION MAP

RMT INC.

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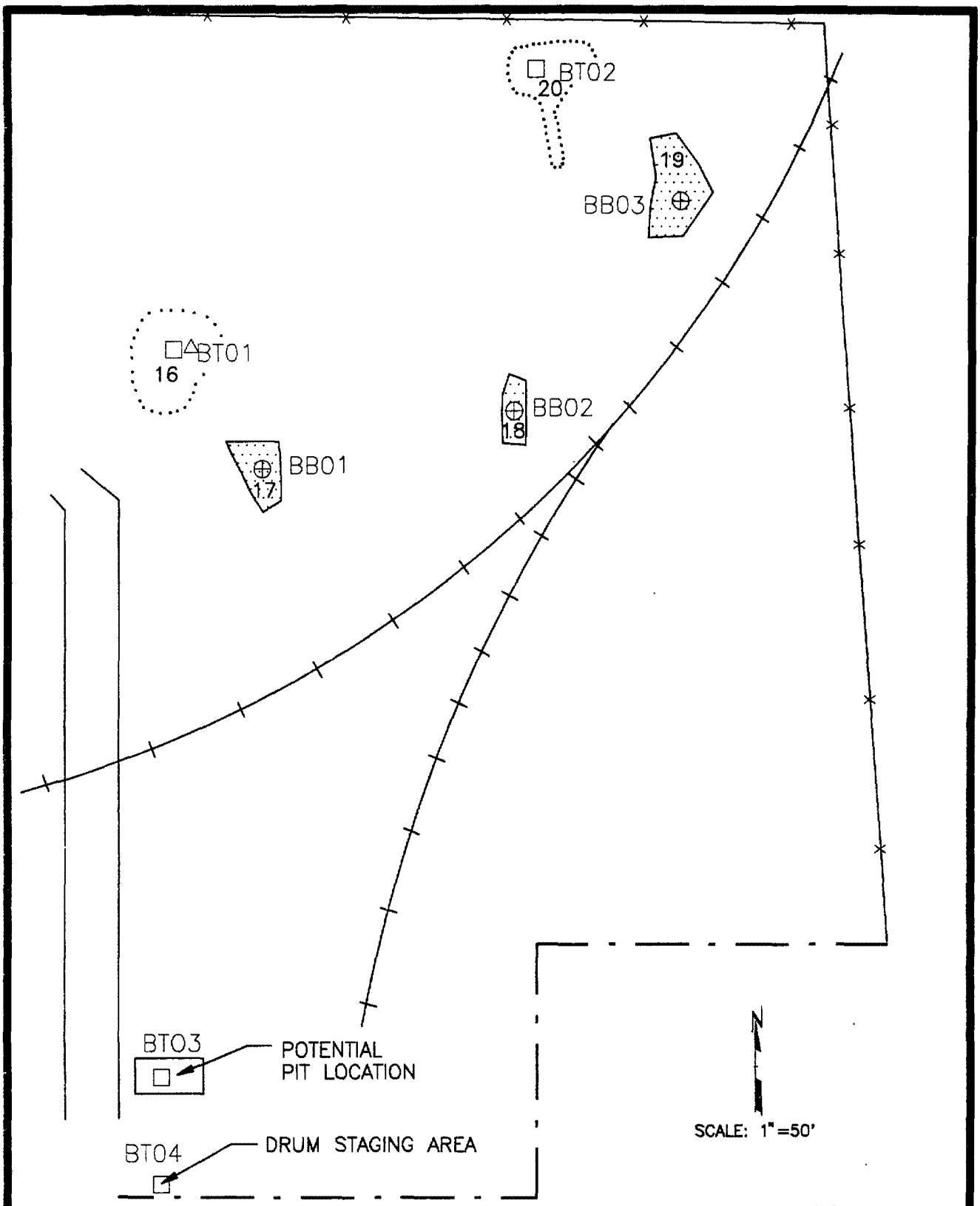
JAN 22 1992 FIGURE 2-2



AREA B PROPOSED BORING LOCATION MAP

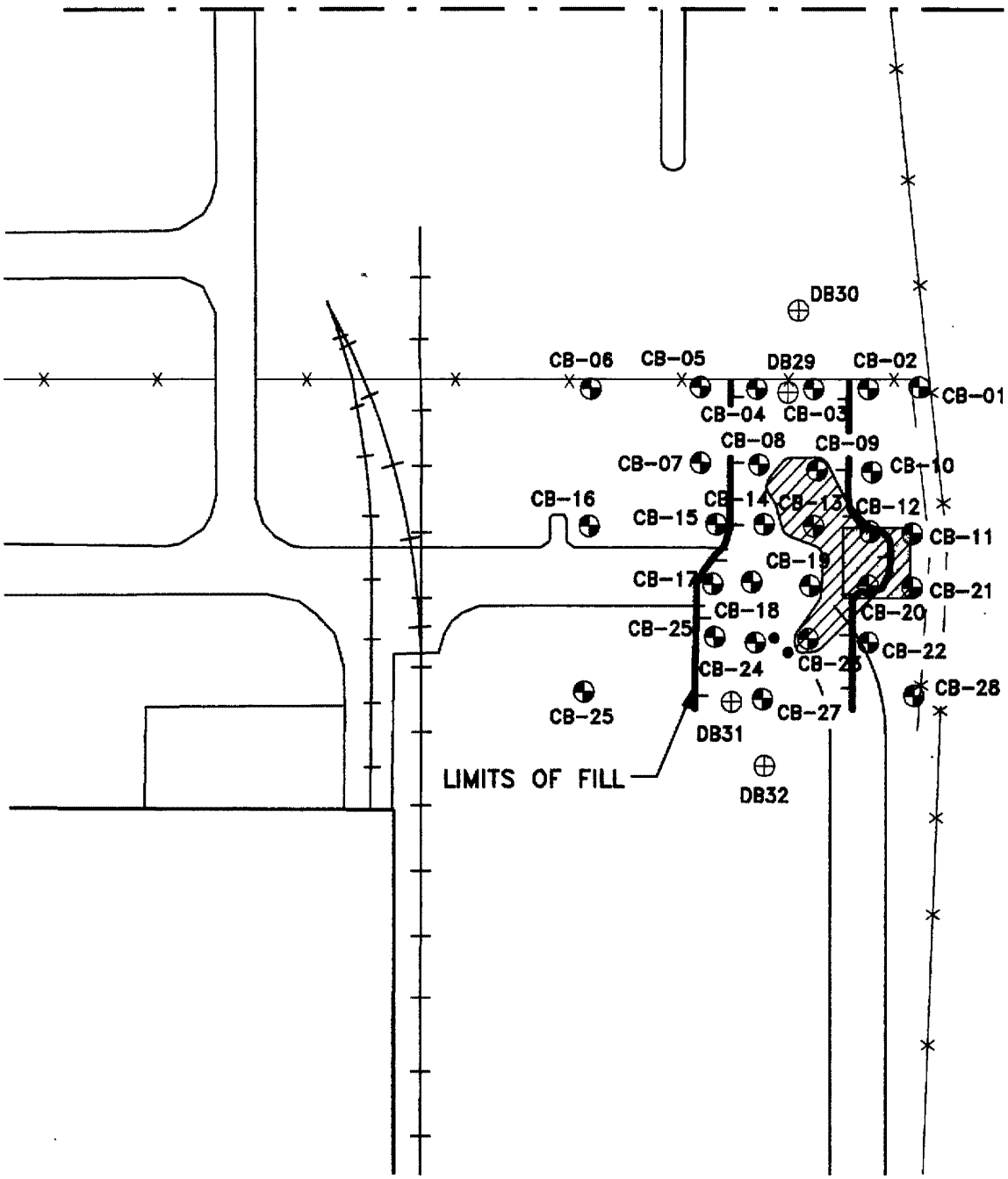
LEGEND

- RAILROAD
- FENCELINE
- BT01 PROPOSED TEST PIT LOCATION
- BB01 PROPOSED SOIL BORING LOCATION
- EXCAVATED TRENCHES
- STUDY AREA BOUNDARY
- 18 CONDUCTIVITY ANOMALIES

*SEE FIGURE 2-1 FOR AREA B LOCATION

RMT INC.

DWN. BY:	DPR
DATE:	JANUARY 1992
PROJ.#	2313.01FSP
FILE #	23130106



LEGEND

- BUILDING
- RAILROAD
- FENCELINE
- CB-01 FALL 1990 BORING
- DB01 PROPOSED BORING LOCATION
- APPROX. EXCAVATED AREA (HAZARDOUS WASTE STORAGE AREA C)
- STUDY AREA BOUNDARY
- DENOTES LIMITS OF RCRA CLOSURE BOUNDARY TO FORMER HAZARDOUS WASTE STORAGE AREA C

*SEE FIGURE 2-1 FOR AREA D LOCATION

N

1"=100'

AREA D PROPOSED BORING LOCATION MAP

RMT INC.

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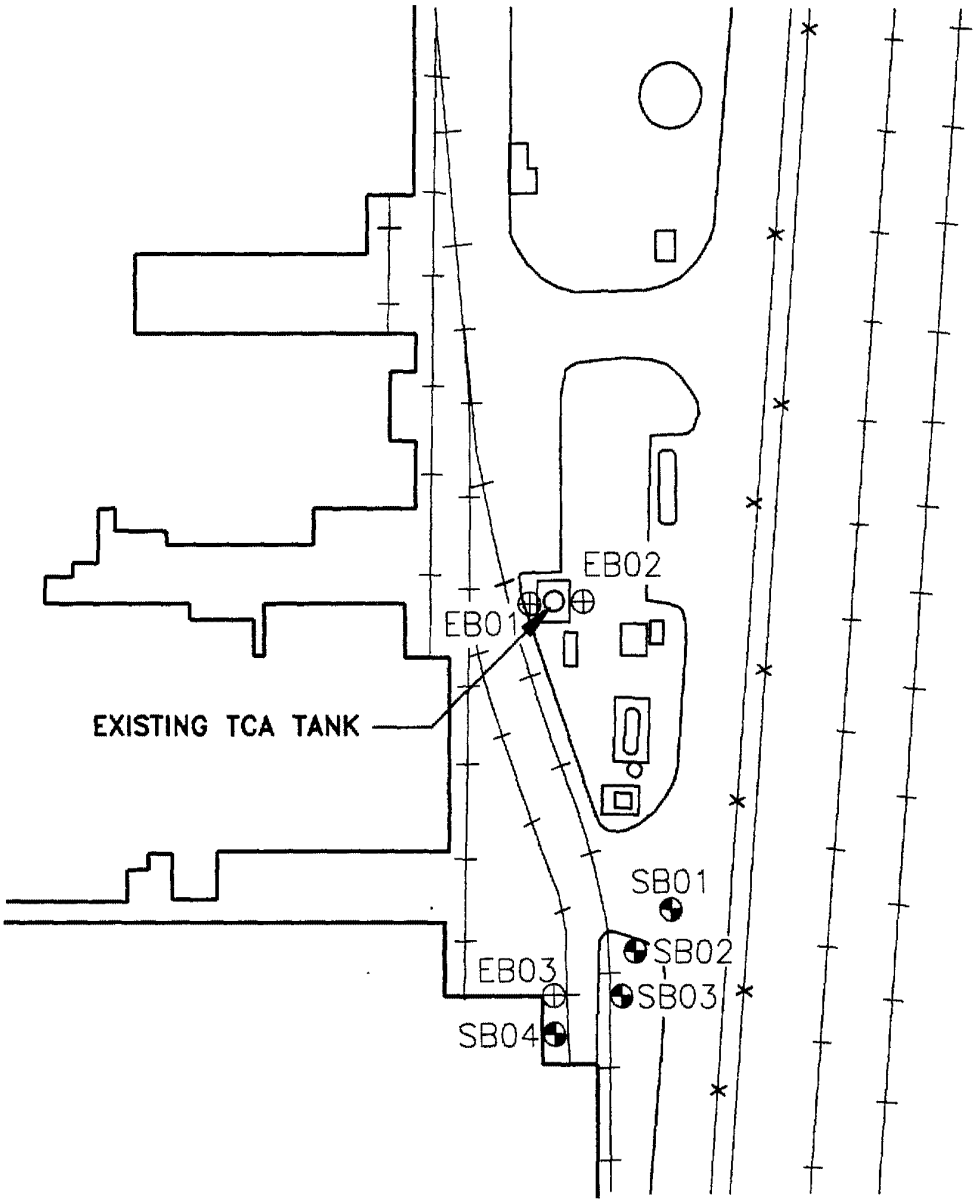
DATE:	JANUARY 1992
PROJ.#	2313.01FSP
FILE #	23130107



LEGEND

- BUILDING
- RAILROAD
- FENCELINE
- ⊕ EB01 PROPOSED BORING LOCATION
- SB01 BORING COMPLETED IN SOUTHEAST AREA DURING THE FALL 1990 SOIL INVESTIGATION

*SEE FIGURE 2-1 FOR AREA E LOCATION

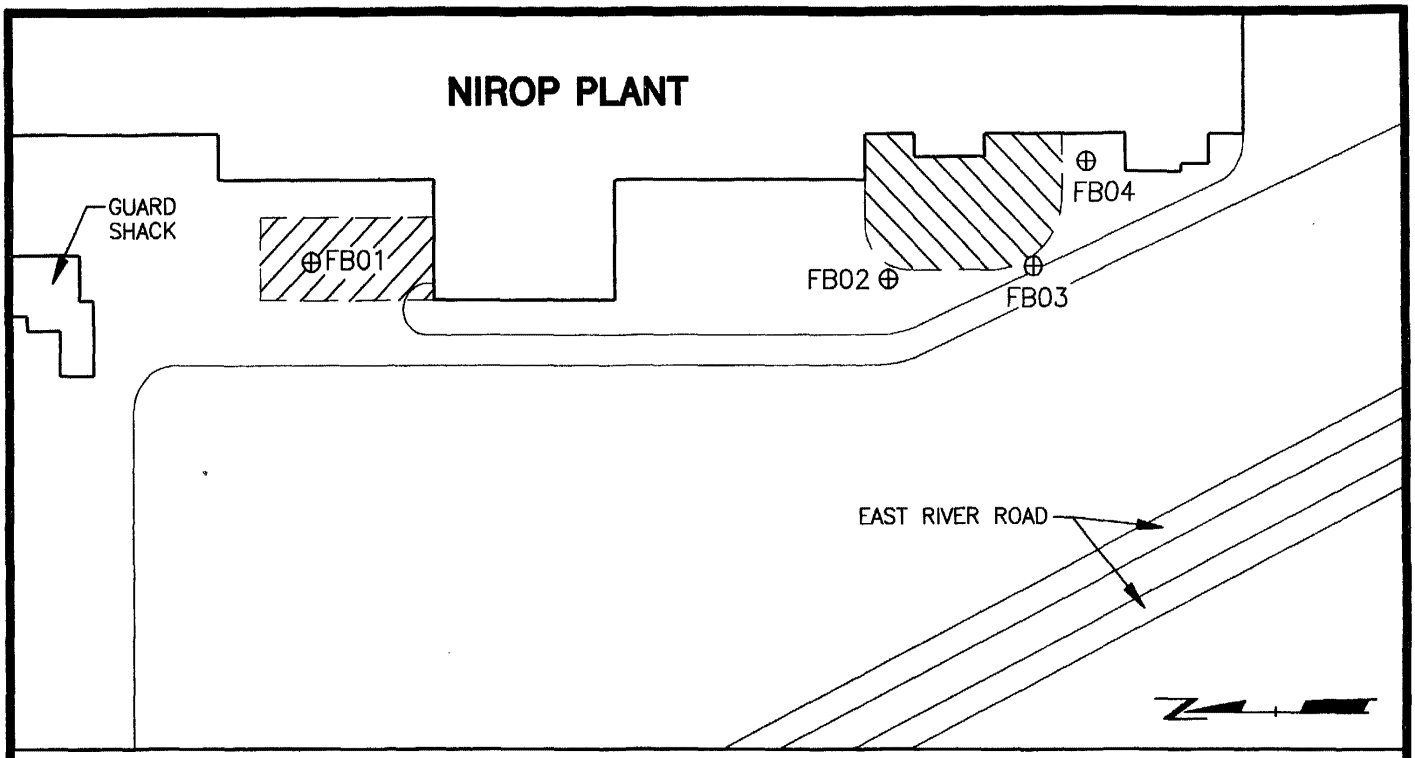
N

SCALE: 1"=100'

AREA E PROPOSED BORING LOCATION MAP

RMT INC.

DWN. BY:	DPR
DATE:	JANUARY 1992
PROJ.#	2313.01FSP
FILE #	23130108



LEGEND

- ⊕ FB01 PROPOSED TYPE 1 BORING LOCAITON
- POTENTIAL BARREL STORAGE AREA IDENTIFIED IN AREA 1 PHOTOGRAPHS
- EXAVATED AREA FOR HAZARDOUS MATERIALS BUILDING ADDITION.

SEE FIGURE 2-1 FOR AREA F LOCATION

NOTE

1. BASE MAP SOURCE: DEPARTMENT OF THE NAVY. DRAWING #2000522, PREPARED BY FMC CORPORATION, MINNEAPOLIS, MIN, SEPTEMBER 1972.
2. HAZARDOUS MATERIALS BUILDING. ADDITION EXCAVATION SOURCE: EXCAVATION DOCUMENTATION REPORT, DECEMBER 1991, BY WENCK ASSOC. INC., MAPLE PLAIN, MN.

0 100 200

SCALE: 1"=100'

AREA F PROPOSED BORING LOCATION MAP

RMT INC.

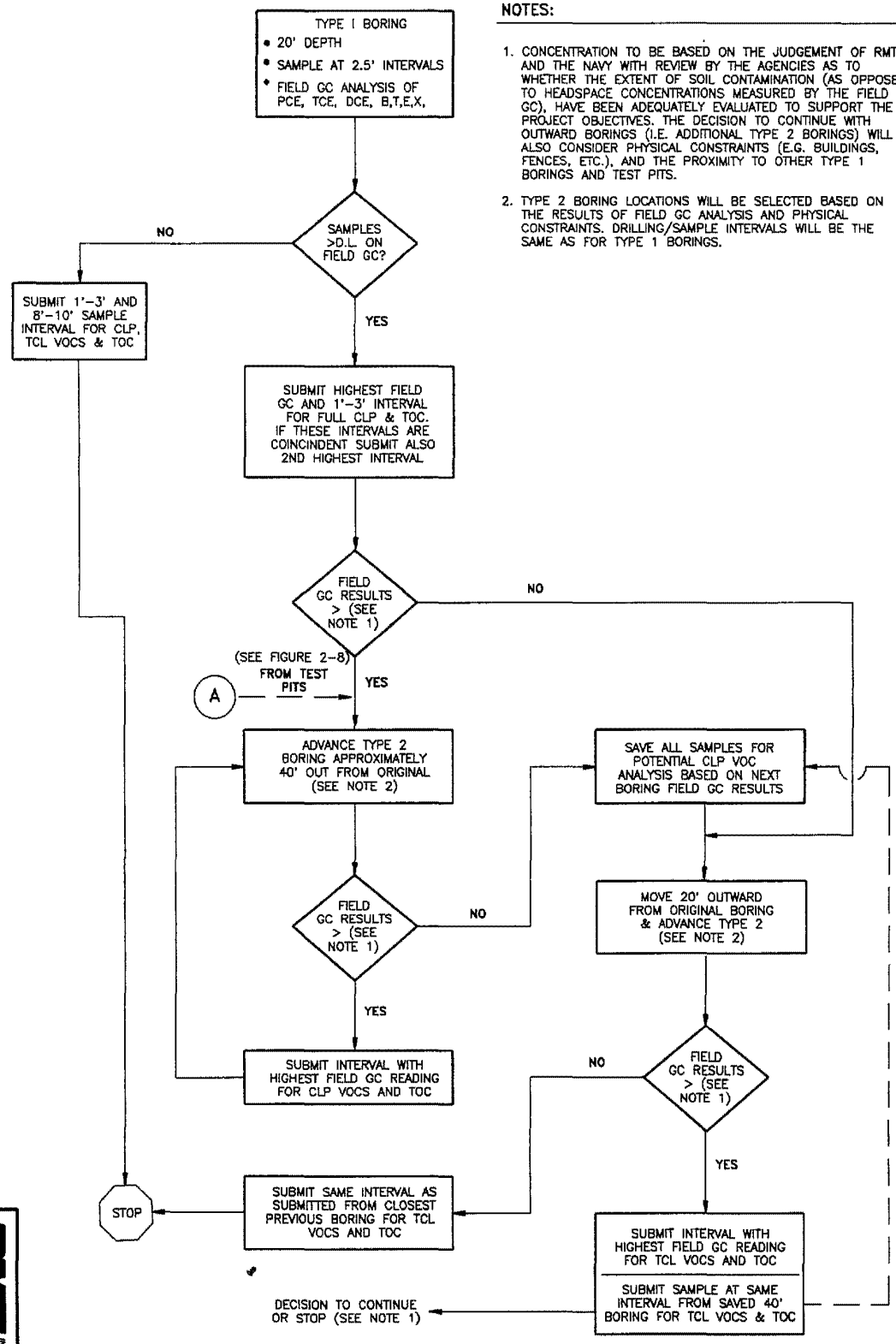
DWN. BY:	DPR
DATE:	JANUARY 1992
PROJ.#	2313.06FSP
FILE #	23130601

JAN 22 1992 **FIGURE 2-6**

Proposed soil boring and test pit locations will be staked prior to mobilization of drilling rigs to the site. Proposed locations will be staked by the RMT Project Representative and an RMT surveyor. On-site boring and test pit locations will be reviewed by an FMC representative and the RMT Project Representative for utility clearances, and adjusted as required by representatives of FMC and local utility companies, as appropriate. Adjustments will be based on accessibility to the proposed locations and the presence of underground utilities. Utility clearances for the background borings will be obtained from local utility companies by RMT, and access permission for background borings will be obtained from appropriate landowners by RMT, on behalf of the Navy.

The general RI approach is to advance soil borings and test pits at locations of known or suspected impacted soils, and to then advance additional borings outward from confirmed sources in order to determine the extent of contamination. A field gas chromatograph (GC) will be used to screen soils for specific VOCs known to be present. Sample intervals for Contract Laboratory Program (CLP) chemical analysis will be based on results of the field GC and the data needs to evaluate risks and remedial alternatives. For example, the 1- to 3-foot depth interval will be analyzed at all locations so that the risk associated with direct contact with the soils can be evaluated. The accuracy of the field GC analyses will be assessed qualitatively by comparison with laboratory CLP analyses during the preparation of the RI Report. Once the initial borings are completed within each area to be investigated (i.e., the Type 1 borings), contingency borings (Type 2 borings) will be advanced to aid in evaluating the extent of contamination. Figures 2-7 and 2-8 present decision diagrams to be used in the field to aid in focusing the soils program. Section 7 of the RI Workplan discusses the rationale for this approach.

Specific locations and the rationale for selecting these locations for the proposed Type 1 borings are presented by area, as described below.



NOTES:

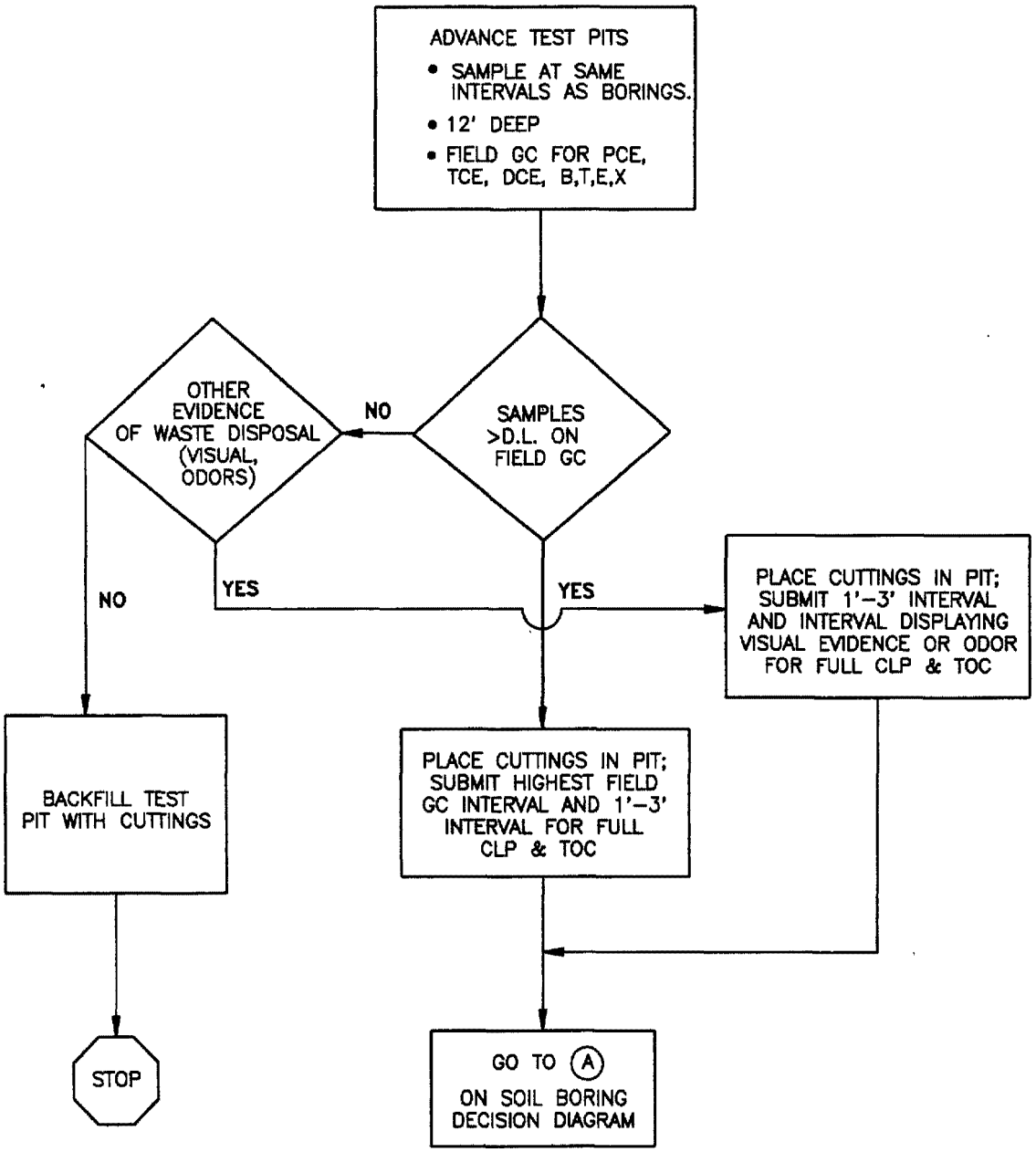
1. CONCENTRATION TO BE BASED ON THE JUDGEMENT OF RMT AND THE NAVY WITH REVIEW BY THE AGENCIES AS TO WHETHER THE EXTENT OF SOIL CONTAMINATION (AS OPPOSED TO HEADSPACE CONCENTRATIONS MEASURED BY THE FIELD GC), HAVE BEEN ADEQUATELY EVALUATED TO SUPPORT THE PROJECT OBJECTIVES. THE DECISION TO CONTINUE WITH OUTWARD BORINGS (I.E. ADDITIONAL TYPE 2 BORINGS) WILL ALSO CONSIDER PHYSICAL CONSTRAINTS (E.G. BUILDINGS, FENCES, ETC.), AND THE PROXIMITY TO OTHER TYPE 1 BORINGS AND TEST PITS.
2. TYPE 2 BORING LOCATIONS WILL BE SELECTED BASED ON THE RESULTS OF FIELD GC ANALYSIS AND PHYSICAL CONSTRAINTS. DRILLING/SAMPLE INTERVALS WILL BE THE SAME AS FOR TYPE 1 BORINGS.

DECISION DIAGRAM FOR SOIL BORING SAMPLING

RMT INC.

DWN. BY	DPR
DATE	JANUARY 1992
PROJ #	2313.01FSP
FILE #	23130110

JAN 22 1992 FIGURE 2-7



DECISION DIAGRAM FOR TEST PIT SAMPLING

RMT INC.

DWN. BY:	DPR
DATE:	JANUARY 1992
PROJ.#	2313.01FSP
FILE #	23130111

JAN 9 9 1992 FIGURE 2–8

Background

Ten background boring locations are shown on Figure 2-1. The locations selected are to the north and west of the NIROP Fridley, in upgradient or sidegradient positions hydrologically. The selected locations include sites both on and off of the NIROP Fridley property, in order to maximize the opportunity to collect soils which are of a similar nature to those found on-site. Background soil borings will be advanced to a depth of 10 feet and will not be analyzed with the field GC. The 1- to 3-foot interval and the 8- to 10-foot interval will be sampled and analyzed for the full TCL/TAL by CLP and for TOC analysis. Subsection 7.1.2 of the RI Workplan explains the rationale for background boring depths and the preselected sampling intervals.

Area A

Seventeen Type 1 soil borings and eight test pits are proposed in Area A as shown on Figure 2-2. Table 2-1 summarizes the Type 1 boring designations, the planned coordinates (based on the existing site grid), and the objective for each boring and test pit. The location of one additional Type 1 boring is not shown on Figure 2-2. Determination of the location for the additional boring (AB40) will be made in the field with the aid of the USEPA observer who was on-site during construction of the storm sewer improvement project. It was during this project that stained soils were noted at locations which cannot be exactly located at this time. RMT personnel will advance hand-auger borings or shovel holes to a depth of 2 to 3 feet to attempt to find the stained soils. Once located, one Type 1 boring will be advanced to determine the nature of the staining.

Area B

Three Type 1 soil borings and four test pits are proposed in Area B as shown on Figure 2-3 and summarized in Table 2-1. The objectives for the borings and test pits in

TABLE 2-1

TYPE 1 SOIL BORING AND TEST PIT LOCATIONS IN AREAS A, B, D, E, AND F[a]

Boring/Test Pit Designation	Coordinates[b]		Objective
	North	East	
AB24	7485	5145	Investigate the elevated soil pore gas reading along the northern property fence.
AB25	7485	5270	Confirm the elevated soil pore gas reading along the northern property fence.
AB26	7295	5460	Further characterize soils in previously excavated trench 7.
AB27	7230	5465	Further characterize soil contamination detected during the Fall 1990 Investigation at boring NB13 to the southwest of previously excavated trench 10.
AB28	7350	5510	Further characterize soil contamination at the west end of previously excavated trench 3.
AB29	7325	5520	Further characterize soil contamination at previously excavated trench 6.
AB30	7260	5495	Characterize potential soil contamination northeast of Fall 1990 boring NB13 and near previously excavated trench 10.
AB31	7350	5580	Further characterize soil contamination at the east end of previously excavated trench 3.
AB32	7260	5600	Further characterize soil contamination at previously excavated trench 5.
AB33	7380	5680	Further characterize soil contamination at Fall 1990 borings NB05 and NB20.
AB34	7325	5685	Further characterize soil contamination at Fall 1990 borings NB05 and NB20.
AB35	7340	5820	Characterize potential soil contamination beneath the southeast corner of the decontamination pad.
AB36	7345	5890	Characterize soil contamination east of the decontamination pad.
AB37	7285	5885	Characterize soil contamination southeast of the decontamination pad.
AB38	7260	5525	Additional boring to characterize excavated trench 10.
AB39	7245	6050	Further characterize soil contamination near previously excavated trench 15.
AB40	--	--	AB40 will be used to determine the character of stained soils observed in November 1991 during excavation for a storm sewer improvement project. The location of AB40 will be determined using hand augers or shovels to a depth of 3 feet.

2113.01:RTE:niro0704.t1

TABLE 2-1 (CONTINUED)

TYPE 1 SOIL BORING AND TEST PIT LOCATIONS IN AREAS A, B, D, E, AND F[a]

Boring/Test Pit Designation	Coordinates[b]		Objective
	North	East	
AT01	7360	5420	Evaluate the presence of buried waste at conductivity anomaly 8.
AT02	7405	5420	Evaluate the presence of buried waste at conductivity anomaly 1.
ATO3	7370	5480	Evaluate the presence of buried waste at conductivity anomaly 4.
AT04	7320	5470	Evaluate the presence of buried waste at conductivity anomaly 2.
AT05	7400	5615	Evaluate the presence of buried waste at conductivity anomaly 9.
AT06	7270	5685	Evaluate the presence of buried waste at conductivity anomaly 11.
AT07	7270	5820	Evaluate the presence of buried waste at conductivity anomaly 12.
AT08	7465	6015	Evaluate the presence of buried waste at conductivity anomaly 14.
BB01	7340	6205	Further characterize previously excavated trench 17.
BB02	7360	6305	Further characterize previously excavated trench 18.
BB03	7435	6375	Further characterize previously excavated trench 19.
BT01	7385	6170	Evaluate the presence of buried waste at conductivity anomaly 16.
BT02	7485	6320	Evaluate the presence of buried waste at conductivity anomaly 20.
BT03	7110	6155	Evaluate if waste was buried in a potential pit observed during aerial photograph review.
BT04	7070	6155	Evaluate area of staged drums noted during aerial photograph review.
DB29	6960	6425	Evaluate northern extent of apparent waste disposal trench identified during Phase I.
DB30	7000	6430	Evaluate northern extent of apparent waste disposal trench identified during Phase I.
DB31	6800	6400	Evaluate southern extent of apparent waste disposal trench identified during Phase I.
DB32	6765	6425	Evaluate southern extent of apparent waste disposal trench identified during Phase I.

TABLE 2-1 (CONTINUED)

TYPE 1 SOIL BORING AND TEST PIT LOCATIONS IN AREAS A, B, D, E, AND F[a]

Boring/Test Pit Designation	Coordinates[b]		Objective
	North	East	
EB01	6075	6320	Evaluate whether operations at the TCA tank have impacted area soils.
EB02	6080	6350	Evaluate whether operations at the TCA tank have impacted area soils.
EB03	5862	6412	Evaluate soils near boring SB04 where TCE was reported at a depth of 3 to 5 feet during the fall 1990 investigation.
FB01	6305	4865	Characterize soils in an area suspected of having been used for drum storage identified during the aerial photograph review.
FB02	5895	4845	Characterize stained soils in an area identified during the aerial photograph review. This area coincides with the location of an excavation made in November 1991 during construction of an addition to the Hazardous Materials Storage Area.
FB03	5810	4860	Characterize stained soils in an area identified during the aerial photograph review. This area coincides with the location of an excavation made in November 1991 during construction of an addition to the Hazardous Materials Storage Area.
FB04	5755	4933	Characterize stained soils in an area identified during the aerial photograph review. This area coincides with the location of an excavation made in November 1991 during construction of an addition to the Hazardous Materials Storage Area.

Notes:

AB24 = Proposed soil boring. The first letter specifies the area (A, B, D, E, or F)

AT01 = Proposed test pit. The first letter specifies the area (A, B, D, E, or F)

[a] Locations of Type 2 borings to be determined in the field, based on the results of the Type 1 borings.

[b] Based on existing NIROP grid system. Actual locations to be determined in the field.

2113.01:RTE:niro0704.t1

Area B, as summarized in Table 2-1, are to characterize two potential pits identified during aerial photograph review, two conductivity anomalies, and three previously excavated trenches in Area B.

Area D

Four Type 1 soil borings are proposed in Area D, as shown on Figure 2-4 and summarized in Table 2-1. Borings in Area D are intended to evaluate the extent of the apparent waste disposal trench identified during the Fall 1990 boring program.

Area E

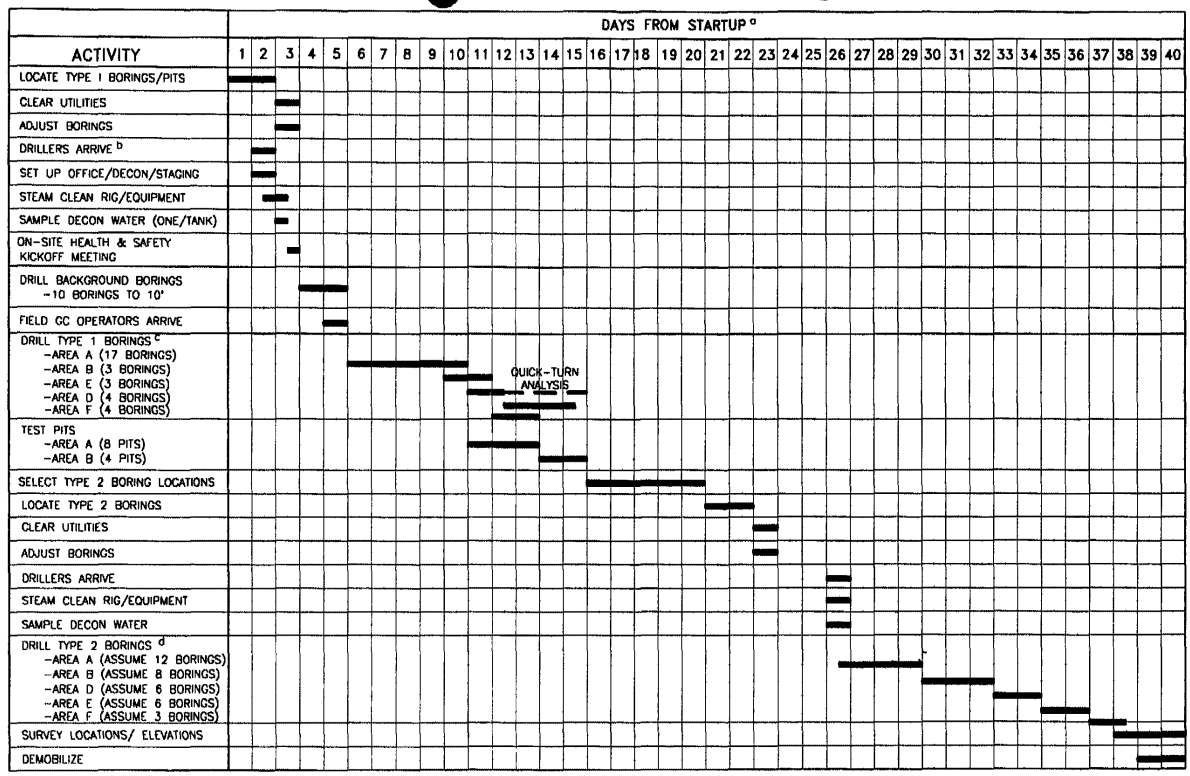
Two Type 1 soil borings are proposed near the existing TCA storage tank, as shown on Figure 2-5 and summarized in Table 2-1. These borings are intended to evaluate potential soil impacts resulting from tank operations. One additional boring is proposed near boring SB04, which was advanced during the fall 1990 investigation. TCE was reported in a sample from SB04.

Area F

Four Type 1 soil borings are proposed in Area F as shown on Figure 2-6. Three borings are intended to evaluate potential soil impacts in the vicinity of the addition to the hazardous materials storage building. This area includes the area noted during the aerial photograph review where metal shavings and milling wastes were apparent. One additional Type 1 boring is proposed in Area F to evaluate a suspected drum storage area observed during the aerial photograph review.

Field Schedule

Figure 2-9 shows the proposed schedule for completion of the field effort.



a - DAYS SHOWN ARE WORKING DAYS FROM STARTUP AND EXCLUDE WEEKENDS. ASSUMES NO DELAYS DUE TO BAD WEATHER OR FACILITY LIMITATIONS.
b - ASSUMES TWO DRILL RIGS ON SITE FROM DAY 2 THROUGH DAY 13; THEN 1 RIG ON SITE FROM DAY 14 THROUGH DAY 15.
c - ONE ADDITIONAL TYPE 1 D TOTAL OF 18 WILL BE ADVANCED IN AREA A BASED ON OBSERVATIONS OF STAINED SOILS MADE DURING COMPLETION OF A STORM SEWER IMPROVEMENT PROJECT. THE LOCATION WILL BE DETERMINED IN THE FIELD UPON COMPLETION OF HAND AUGER HOLES WHICH WILL BE ADVANCED IN AREAS SUSPECTED OF CONTAINING THE STAINED SOILS.
d - ASSUMES TWO DRILL RIGS ON SITE FROM DAY 26 THROUGH DAY 38.

FIELD SCHEDULE

RMT INC.

DWN. BY: DPR
DATE: JANUARY 1992
PROJ.# 2313.01FSP
FILE # 23130117

JAN 22 1992 FIGURE 2-9

3. SAMPLE CUSTODY PROCEDURES

3.1 Sample Identification System

Soil sample identification numbers will be unique and will correspond with individual boring identifiers shown in Table 2-1. Two-foot-long samples will be collected and labeled sequentially beginning with the letter A (AB24A, AB24B, etc.). Duplicate samples will be labeled with a "QCD" prefix (Quality Control Duplicate), and then numbered sequentially rather than labeled with a well identification number (QCD01, QCD02, etc.). Duplicate samples are "blind" samples that will be used as a quality control check on sampling procedures. Locations of duplicate samples will be kept in field notebooks.

Trip blanks will be labeled with a "QCT" prefix (Quality Control Trip blank) and then numbered sequentially in a manner similar to the duplicate samples. Source water samples will be labeled with a "SRC" prefix and then numbered sequentially.

Field sample identification numbers will be included on chain-of-custody forms. A copy of the chain-of-custody form with its assigned sample numbers will be kept in the field office files and in the laboratory to help identify lost or missing samples.

The Site Coordinator will distribute and keep track of users of bound and numbered field notebooks. Transfer of field notebooks to other individuals who have been designated to perform specific tasks on the project will be recorded. None of the documents is to be destroyed or thrown away, even if it is illegible or contains inaccuracies. Voided documents will be returned to the originator and sent to the project file.

The field notebook will also be used to document samples collected, sample date and time, sample identification, general site observations, problems encountered, and any other information that may be relevant to the completion of the investigation. Soil boring logs will be kept on standard RMT logs as shown on Figure 3-1. Sample intervals will be labeled A, B, C, etc., beginning with the 1- to 3-foot interval. If a sample is not obtained from a particular

RMT

LOG OF TEST BORING

BORING NO.:	
SHEET of	
PROJECT:	PROJECT NO.:
LOCATION:	SURFACE ELEVATION:
DRILLED BY:	DATE STARTED: / DATE COMPLETED:
CREW CHIEF:	LOGGED BY: / CHECKED BY:

SAMPLING NOTES					DEPTH (ft.)	VISUAL CLASSIFICATION AND GENERAL OBSERVATIONS	GENERAL WELL CONSTRUCTION
INTERVAL			RECOVERY				
NO.	TYPE		BLOWS	%			

NOTES	WATER LEVEL OBSERVATIONS			
DRILLING METHODS:	FIRST OCCURENCE:			
	DATE/TIME			
BOREHOLE DIAMETER:	DEPTH TO WATER			
DRILL RIG:	DEPTH TO CAVE IN			

FILE #2313.01FSP

F-204A (R 09-87)

FIGURE 3-1

interval, the corresponding letter designation will be skipped so that different borings with samples from the same depth interval will have the same letter designation. Preselected sample intervals and designations will be as follows:

Designation	Sample Interval (feet below ground surface)
A	1 - 3
B	3 - 5
C	6 - 8
D	8 - 10
E	10 - 12
F	13 - 15
G	16 - 18
H	18 - 20

Some deviation at specific locations may be necessary due to unforseeable circumstances. Documentation of each boring location will be performed as follows:

- Insert a labeled metal monument on an iron rod and place in grout at ground surface (wait until grout has partially set).
- After completion of all borings, an RMT surveyor will locate all borings on the existing NIROP Fridley coordinate system to the nearest 0.1-foot coordinate. Boring elevations will be surveyed to the nearest 0.1 foot.

Surveying Notes

Surveying notes will be kept in a separate bound notebook as detailed below. The taking of accurate, complete, and informative surveying notes is the primary objective. The quality of the final output is a reflection of the field record. The field notes are the only reliable record of measurements made and information gathered in the field.

Information gathered will be recorded in the field in bound notebooks. Notes will be legible and complete, and will be made with a hard lead pencil. Records will not be made on

scratch paper and copied later, or include other information recorded only from memory. Mistakes in field notes will be crossed out; no erasing of field notes will be allowed.

Field notes will be lettered, not written in cursive. The lettering will be of an easily readable size. The surveyor is encouraged to use notebook space liberally in recording necessary data. Explanatory remarks will be used to clarify the field procedures and provide added details. Field sketches will be included to clarify notes.

The following two important aspects of each survey will be addressed in the field notes.

1. The Starting and Ending Basis of the Survey. The surveyor will explain and document the starting and ending points of the survey. This applies to both the horizontal and vertical controls. This will require a paragraph of explanation and sketches and/or cross references to data in notes of previous surveys.

2. Clear Indication of Final Results and Checking Procedures. The final results and checks will be plainly indicated. Erasures will not be used, as they raise uncertainties about the reliability of the data. Non-pertinent or insignificant errors, such as misspelled words, wrong column headings, or a change in wording may properly be erased. Alterations, additions, revisions, reductions, or comments added to field notes will be done in ink (usually red) to indicate that such information is not part of the original field record. The person making such notations will initial and date each page so altered.

   A checklist of information to include in field notes is as follows:

   1. Date.
   2. Names of crew members.
   3. Condition of weather, observed temperatures, relative wind speed, and barometric pressure if an electronic distance measuring device is to be used.
   4. Numbers or other identification of equipment used.
   5. Location of survey by section description or other legal parcel identification.
   6. Project number.
   7. North arrow.
   8. Description of monuments found.

9. Measurements made (slope distance and vertical angles, temperature, taping, horizontal angles, etc.).
10. Corrected distances and angles.
11. Description of monuments set (stamped metal monument on an iron rod placed in concrete).
12. Outline or sketch of major traverse or property boundary.

Standard surveying signs and symbols that promote a common understanding and save space on the field notebook pages will be used.

3.2 Initiation of Field Sample Custody Procedures

- The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples.
- All bottles will be tagged with sample numbers and locations.
- Sample tags are to be completed for each sample using waterproof ink, unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample tag because the ballpoint pen would not function in freezing weather.
- The Site Coordinator will review all field activities to determine whether proper custody procedures were followed during the fieldwork and decide if additional samples are required.

3.3 Field Activity Documentation/Logbooks

The field logbook will provide the means of recording data-collection activities performed. As such, entries will be described in as much detail as possible so that persons going to the site could reconstruct a particular situation without reliance on memory.

Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in the document control center when not in use. Each logbook will be identified by the project-specific document number.

The title page of each logbook will contain the following:

- Person to whom the logbook is assigned.
- Logbook number
- Project name
- Project start date
- Project end date

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigation team personnel, and the purpose of their visit will also be recorded in the field logbook. Notebooks will also be used to document photographs taken by recording photograph number, conditions, and pertinent field observations. The location, interval, and identification of blind QC samples will also be recorded in the field notebook.

3.4 Sample Shipment and Transfer of Custody

The possession of samples must be traceable from the time of collection through the use of chain-of-custody procedures. Specific chain-of-custody forms must accompany all sample shipping containers to document the transfer of the shipping containers and samples from the field to the laboratory receiving the samples for analysis. The procedures to be implemented are as follows:

- Preparation of sample containers with pre-applied labels by the laboratory, with chain-of-custody seals on shipping containers.
- Proper identification and labeling of each sample in the field with indelible, waterproof ink.
- Completion of chain-of-custody forms in the field, indicating sample identification, containers filled, sampling date, sampling time, sample collector,

and sample preservation, if applicable. This information will also be noted in the field notebooks maintained on the site.

- Repacking of shipping containers with samples, chain-of-custody forms, and ice packs. Each set of sample containers to be shipped together in a single shipping container is assigned a chain-of-custody form, which travels with the shipping container.

- Sealing and shipping of containers to the appropriate laboratory. Common carriers or intermediate individuals shall be identified on the chain-of-custody form, and copies of all bills-of-lading will be retained.

- Receiving and checking of shipping containers in the laboratory for broken seals or damaged sample containers. If no problems are noted, samples are logged into the laboratory, and the chain-of-custody form is completed. The person relinquishing the samples to the facility or agency should request the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses, this is noted in the "Received By" space.

- Inclusion of copies of the chain-of-custody form with the analytical data.

- Unused sample containers are returned to the laboratory with the chain-of-custody forms.

An example chain-of-custody form is shown on Figure 3-2. While filling out the Chain-of-Custody Form, it is important to use only black ink and to write legibly. Errors are to be corrected by drawing a single line through the incorrect information and entering the correct information. All corrections are to be initialed and dated by the person making the correction. This procedure applies to words on figures inserted or added to a previously recorded statement.

A checklist of information that must be included on the Chain-of-Custody Form (Figure 3-2) is as follows:

1.* ***Bottles prepared by*** - The laboratory providing the bottles must sign their name here.

2. ***Date / Time*** - To be filled out by the person preparing the bottles.

3. ***Office code*** - To be filled out by the person preparing the bottles.

4. ***Project no.*** - To be completed by the laboratory.

RMT INC

Madison, WI 53717
744 Heartland Trail
Phone (608)831-4444
FAX (608)831-3334

Washington, DC | Santa Monica, CA | Grand Ledge, MI | Greenville, SC

F-268 (R2/88)
(Use Black Ink Only)

CHAIN OF CUSTODY RECORD

12 Sample Type. (GW, WW, SW, Soil, Other) № 009949

Bottles Prepared by: 1 | Date/Time 2 | Office Code: (State) 3

Project No. 4 | Client: 5

Container Inventory 13 — Filtered (Yes/No) 14 — Preserved (Code) 15 — Refrigerated (Yes/No) 16

Code. A - None
B - HNO_3
C - H_2SO_4
D - NaOH
E - _____

RMT Lab NO. 7	Yr. ___ Date 8	Time 9	Sample Station ID 10	Total Number Of Containers 11								Comments. 17

SAMPLER Relinquished by (Sig.)	Date/Time	Received by (Sig.)	Date/Time
① 6		② Shipper Name & # 18	
Relinquished by (Sig.) ③ 18	Date/Time	Received by (Sig.) ④ Shipper Name & # 18	Date/Time
Relinquished by (Sig.) ⑤ 18	Date/Time	Received by (Sig.) ⑥ Shipper Name & # 18	Date/Time

HAZARDS ASSOCIATED WITH SAMPLES 21

(For Lab Use Only)
Receipt Temp _____ Receipt pH _____
Client P.O. Number _____
Subsequent Analysis. _____ (Check)
Date Resubmitted _____

Seal # 19 at'chd by ◯ Recvd. Intact by ◯ Seal # 20 at chd by ◯ Recvd. Intact by ◯

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FIGURE 3-2

5. ***Client*** - To be completed by the laboratory.

6. ***Sampler*** - The person/persons collecting the samples must sign their name and print their name under their signature. The date and time the sampler relinquishes the samples to either the laboratory or shipper.

7. ***RMT laboratory no.*** - This number is a unique identification number assigned by the laboratory.

8. ***Year / Date*** - The year and date the samples are collected.

9. ***Time*** - The time the sample is collected. This time **MUST** also be noted on the sample bottle.

10. ***Sample station ID*** - The location the sample was collected from, e.g., Pit 1, Tank 17, etc.

11. ***Total number of containers*** - Add all of the bottles filled and write total here.

12. ***Sample type*** - Circle sample type listed on Chain-of-Custody Form.

13. ***Container Inventory*** - To be completed by laboratory providing the bottles.

14. ***Filtered*** - Place Y (yes) or N (no) to indicate whether the sample in a particular bottle is filtered or not.

15. ***Preserved*** - To be completed by laboratory.

16. ***Refrigerated*** - To be completed by laboratory.

17. ***Comments*** - Sampler may provide additional information about a sample, e.g., if an odor is present.

18. ***Relinquished by / Received by*** - This part of the form is a record of the individuals who actually had the samples in their custody. The spaces must be used in chronological order as the Chain-of-Custody Form is transferred with the samples.

    (1) Sampler signs when relinquishing custody.
    (2) Person accepting custody of samples from sampler signs.
    (3) Person in (2) must sign when relinquishing custody.
    (4)-(6) These are completed as necessary in the same manner as above.

    Note: If commercial carriers are used, the name of the carrier, any airbill number, and date and time of relinquishing is written in by sample entry or field personnel and the airbill is attached to the Chain-of-Custody Form.

    The final signature is that of the person receiving the samples at the laboratory.

19. ***Seal #*** - If applicable.

20. ***Seal #*** - If applicable.

21. ***Hazards associated with samples*** - This section is for field use. It can include any known or suspected hazard associated with the samples. Sample entry may add information to this section based on project manager or supervisor communication to the laboratory after samples are received. Laboratory group supervisors will use any hazard information to update and advise their analysts before work is started.

* The numbers of the items correspond to the numbers on the Chain-of-Custody Form (Figure 3-2).

Completed chain-of-custody forms will be placed in a plastic bag, sealed, and taped to the inside cover of the shipping container. After icing the samples, the coolers will be sealed, dated, and shipped to the laboratory using an overnight delivery service. The samples to be sent to the RMT Soils Laboratory for physical analysis will not be iced and will be shipped by regular carrier or delivered by the field crew.

A separate sample receipt is prepared whenever samples are split with a government agency. The receipt is marked to indicate with whom the samples are being split. The person relinquishing the samples to the agency should request the agency representative's signature acknowledging sample receipt. If the representative is unavailable or refuses, this is noted on the receipt and in the field notebook.

If a chain-of-custody form is damaged in shipment, a written statement will be prepared by the person who collected the samples listing the samples that were recorded on the damaged form and describing when and how the samples were collected. The statement should include information such as field logbook entries regarding the sample. This statement is submitted to the RI Task Leader and RMT Project Manager for further action, as necessary.

4. SAMPLE CONTAINERS, PREPARATION, PRESERVATION, AND MAXIMUM HOLDING TIMES

Table 4-1 summarizes container, preservation, and holding time information.

TABLE 4-1

SOIL SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

Parameter	Container	Preservative	Holding Time
Volatile Organics	Two 120-mL wide-mouth glass vials with Teflon® septa; no headspace	Cool to 4°C, and protect from light	14 days from date of sample collection
Semivolatile Organics*	One 500-mL amber glass bottle (Teflon®-lined lid)	Cool to 4°C, and protect from light	Extract within 14 days from date of sample collection, analyze within 40 days from date of extraction
Pesticides and PCBs*	One 500-mL amber glass bottle (Teflon®-lined lid)	Cool to 4°C, and protect from light	Extract within 14 days from date of sample collection, analyze within 40 days from date of extraction
Metals, Total (Except Mercury)**	One 500-mL polyethylene bottle	Cool to 4°C	6 months from date of sample collection
Mercury**	One 500-mL polyethylene bottle	Cool to 4°C	28 days from date of sample collection
Cyanide**	One 500-mL polyethylene bottle	Cool to 4°C	14 days from date of sample collection
Total Organic Carbon	Two 60-mL wide-mouth glass vials	Cool to 4°C	28 days from date of sample collection

Notes:

* Semivolatile organics and pesticides/PCBs can be taken from a single 500-mL bottle.

** Metals, mercury, and cyanide can be taken from a single 500-mL bottle.

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5. SAMPLE HANDLING, PACKAGING, AND SHIPMENT

Sample handling, packaging, and shipment procedures are described in detail in Section 3 of the FSP. Sample collection is discussed in Subsection 7.1.2 of the FSP.

6. DECONTAMINATION PROCEDURES

6.1 Personnel

Decontamination procedures will be as follows:

- Protective disposable outer garments will be removed and placed in disposable plastic bags at the perimeter of the exclusion zone before each departure from the exclusion zone.
- If disposable outer boots are worn, they will be removed first and then gloves. If reusable rubber or neoprene boots are worn, they will be washed and rinsed before leaving the contamination reduction zone.
- Field personnel will wash and dry their hands and all exposed surfaces before leaving the contamination reduction zone, and used paper towels will be placed in the disposal bag.
- The plastic bags containing waste materials will be disposed daily in a dumpster located in the central staging area.

Clean outer garments will be accessible to field personnel in an area free from potential contamination. Water, soap, and paper towels will also be kept in a clean location for both regular clean-up and emergency use.

6.2 Sample Bottles

Sample bottles will be precleaned by the manufacturer.

6.3 Drilling Equipment and Backhoe

The drill rig, augers, drill rods, backhoe, and bucket will be steam-cleaned before startup and after each boring and test pit using a high-pressure, high-temperature, hot water-cleaner. Potable water from the NIROP Fridley water supply system will not be used because of the possibility that it may contain VOCs. The steam-cleaner will be supplied with potable water from an off-site source to be identified by the drilling subcontractor. RMT will collect and analyze a water sample from each truckload of water brought to the NIROP Fridley. Work will

proceed prior to receipt of analytical results for the source water samples. The samples will be prepared, shipped, and analyzed for Target Compound List (TCL) and Target Analyte List (TAL), using Contract Laboratory Program (CLP) protocols.

During decontamination, care will be taken to clean all work surfaces and the wheels of all vehicles. Other project-related vehicles that enter the zone will be decontaminated. The drilling rig, backhoe, and equipment will be decontaminated prior to the start of work and before drilling or excavating at each borehole or test pit.

Decontamination of the drilling rig, backhoe, and equipment will take place on a temporary decontamination pad constructed in the central staging area which will be located in an area where soils are known to have been contaminated. The temporary decontamination pad will consist of a high-density plastic liner covered with gravel. The liner will be sloped to collect water in a sump. Water from decontamination activities will be spread on soils where contamination is known to have occurred.

6.4 Sampling Equipment

Three-inch-diameter stainless-steel split-spoons will used, and will be decontaminated between each sample by using the following sequential procedures: 1) a Liquinox® wash; 2) a potable water rinse; 3) a reagent-grade isopropanol rinse; and 4) a double-distilled water rinse. At the end of drilling at each borehole, the split-spoons will be steam-cleaned, and will be washed and rinsed following the above procedures. Other reusable sampling equipment—bowls, spatulas, etc.—will be decontaminated by using only the wash and rinsing procedures.

Spent decontamination liquids for sampling equipment will be handled in the same manner as the water from the drilling equipment decontamination procedures.

7. SAMPLING EQUIPMENT AND PROCEDURES

7.1 Soil Borings

7.1.1 Drilling Procedures

Purpose and Scope

The objectives of the soil boring program are to provide additional data regarding the nature and vertical and horizontal extent of soil contamination within each area, and to identify potential source areas that may contribute to the documented ground water contamination at the NIROP Fridley. This study has been designed to use primary (Type 1) and contingency (Type 2) soil borings and test pits in order to approximate the volume of contaminated soils for remedial action, as appropriate. Forty-one Type 1 soil borings and an estimated 35 Type 2 soil borings will be advanced in six areas (Areas A, B, D, E, and F and Background), as shown on Figures 2-1 through 2-6. Borings in areas of potential contamination will be advanced to a depth of 20 feet. Background borings will be advanced to a depth of 10 feet. The five on-site areas have been chosen based on historical data and past site activities. Figures 2-7 and 2-8 depict the decision diagram for determining the analytical program for selected samples.

Drilling Equipment

Proposed soil boring and test pit locations will be staked prior to mobilization of drilling rigs to the site. Proposed locations will be staked by the RMT Project Representative and an RMT surveyor. On-site boring and test pit locations will be reviewed by an FMC representative and the RMT Project Representative for utility clearances, and adjusted as required by representatives of FMC and local utility companies, as appropriate. Adjustments will be based on accessibility to the proposed locations and the presence of underground utilities. Utility clearances for the background borings will be obtained from local utility companies by RMT,

and access permission for background borings will be obtained from appropriate landowners by RMT, on behalf of the Navy.

Soil borings will be advanced by truck-mounted drill rigs using 3.25-inch or larger diameter hollow-stemmed augers. Vegetable oil or Teflon® tape may be used on the drill pipe joints at the discretion of the driller. Samples for chemical and geotechnical analysis will be collected using a 2-foot-long, 3-inch-outer-diameter, stainless-steel, split-barrel sampler (split-spoon).

Downhole Sample Retrieval

Soil samples will be collected at intervals indicated in Subsection 3.1. When the auger is advanced to the top of the desired sampling interval, the split-spoon will be lowered into the hollow-stemmed auger on the end of the drill rod. The split-spoon will be driven 24 inches or to refusal (i.e., more than 60 blow counts per 6 inches) using a 140-pound weight. Automated weights (hammer) may be used in lieu of free-falling weights. The number of blows required to drive each 6-inch increment will be noted by the driller and also recorded by the geologist. Once driven, the split-spoon will be withdrawn from the auger and removed from the rod. If a boring is to remain open overnight, the boring will be terminated at the completion of downhole sample retrieval prior to augering to the top of the next sample interval.

The split-spoon will be opened, the Hnu will be immediately held over the core, and the amount of sample recovery will be quickly measured. Appropriate samples for chemical and physical analysis will be taken from the split-spoon, and the boring log (see Figure 3-1) information will be recorded. If the sample volume is not sufficient for analytical requirements, the soil sample from the interval immediately below the selected interval will be used to provide the required volume.

The split-spoon will be decontaminated before each sample is collected. See Section 6 for decontamination procedures.

Backfilling

After sampling is completed, each boring will be backfilled from the bottom to the top with a neat cement grout using a tremie pipe. If a boring is to remain open overnight prior to backfilling, soil cuttings will be mounded around the borehole to prevent surface run-off from entering it.

7.1.2 Soil Sampling Procedures

Soil Sampling for Chemical Analysis

Soil sampling for chemical analysis will consist of collecting soil samples at 2.5-foot intervals indicated in Subsection 3.1 from boreholes drilled for site characterization. Samples will be collected using a stainless-steel, split-spoon sampler in the following manner:

1. Upon retrieval of a split-spoon sample for chemical analysis, completely fill (i.e., no headspace) two 120-mL glass vials with soils for potential CLP VOC analysis, using plastic or stainless-steel scoops or a clean gloved (PVC or latex) hand. Seal and label the sample vials and place in a cooler with ice.

2. Half-fill two clean, 40-mL vials with a portion of the remaining soil sample from the split-spoon sampler. Seal and label for field GC screening. Place vials in a shady area or in a vehicle out of direct sunlight. The field GC operator will be responsible for collecting screening samples from each boring. The sampler will notify the GC operator of results of the Hnu screen so that proper instrument and operator precautions can be followed.

3. Place remaining soil in a clean aluminum foil–lined pan, label, cover, and hold until samples are selected for chemical analysis. (See Figure 2-6 for information regarding holding soils for potential analysis at Type 2 boring locations.) If the sample interval is chosen for analysis, use the remaining soil for all remaining analyses (e.g., metals, pesticides/PCBs, grain size).

4. If the sample volume is insufficient for the required analysis, collect an additional sample immediately below the desired sample zone from the adjacent sample zone and fill the remaining bottles.

5. Refer to Figures 2-7 and 2-8 to determine the appropriate sample intervals for chemical analysis and the type of analysis to be performed.

6. Place selected samples for laboratory analysis into coolers, and pack with ice.

7. Complete documentation of the sample collection in the sample logbook and on the chain-of-custody forms.

Soil Sampling for Geotechnical Analysis

In addition to collecting soil samples for chemical analysis, soil samples for geotechnical analysis will also be collected at the interval selected for chemical analysis or from an adjacent interval consisting of the same material. One soil sample per boring will be selected for geotechnical analysis. These samples will be taken only when an adequate sample volume is available to fulfill chemical analytical requirements.

Geotechnical parameters will be tested at the RMT Soils Laboratory, where analysis of soil particle gradation (by sieve and hydrometer), Atterberg limits (if appropriate), moisture content, and laboratory classification according to the Unified Soil Classification System (USCS) will be performed.

Samples will be transported to the laboratory in 8-ounce, wide-mouthed plastic or glass jars, the lids of which will be sealed with at least three wraps of electrical tape. Labels will be attached to each jar showing the project number, boring designation, and depth interval. Soil samples for geotechnical analysis will be transported to the RMT Soils Laboratory by the Site Coordinator or geologist, or shipped via private carrier.

7.1.3 Drill Cuttings and Protective Equipment Disposal

Cuttings from background borings will be transported back to the NIROP Fridley facility where they will be thin-spread in an area to be determined. Drill cuttings from on-site borings will be stockpiled near each boring during drilling in piles representative of 10-foot

intervals. Upon completion of the boring, if the concentrations of tested VOCs from the field GC analysis are less than a total of 10 ppmv for a given 10-foot interval, soils will be evenly spread out on the ground surface around each borehole. If the field GC indicates that soil vapors exceed 10 ppmv for a 10-foot interval, those cuttings will be moved to a central staging area and stockpiled.

Personal protective equipment and similar materials will be placed into sealed plastic trash bags and put in a dumpster to be disposed by the Navy.

7.2 Test Pits

7.2.1 Digging Procedures

Purpose and Scope

The objectives of the test pit program are to characterize the vertical and horizontal nature and extent of possible soil contamination, and to identify potential source areas that may contribute to the existing ground water contamination. A total of 12 test pits are to be advanced to a depth of 12 feet below the ground surface in Areas A and B, as shown on Figures 2-2 and 2-3. The 12 test pit locations have been selected based on the unexcavated anomalies from the electrical conductivity survey performed by the USACE and results of the aerial photograph review, as discussed in Subsection 4.3.1 of the RI Workplan.

Proposed test pit locations will be staked prior to mobilization of the backhoe to the site. Proposed locations will be staked by the RMT Site Coordinator and an RMT surveyor. Test pit locations will be reviewed for utility clearances, and will be adjusted as required by representatives of FMC and local utility companies during the following week. Adjustments will be based on accessibility of the proposed locations and the presence of underground utilities. Methods and procedures used for test pits are discussed below.

Excavation Method and Equipment

Test pits will be performed by a backhoe excavator. The backhoe operator will be certified under OSHA 29 CFR 1910, and will be prepared to upgrade to Level B personal protection standards if necessary. Excavating will be performed using a large-volume bucket. Soil samples for chemical and geotechnical analysis will be collected directly from the bucket from 2-foot sample intervals using a stainless-steel scoop for placing soil samples directly into sample bottles or aluminum foil–lined stainless-steel bowls. The 2-foot intervals will coincide as near as possible to those outlined in Subsection 3.1 for the soil borings. Excavated soils will be then removed from the bucket and placed on top of sheet plastic near the test pit.

Test Pit Sample Retrieval

Soil samples will be collected at 2-foot intervals beginning at 1 foot below the ground surface. Sample intervals will be the same as those described in Subsection 3.1 for test borings. The geologist will screen the sample with an Hnu photoionization detector by passing the instrument near the bucket. The geologist will collect a soil grab sample from the bucket by scooping or using a gloved hand to place an ample amount of sample in an aluminum foil–lined pan. Plastic or stainless-steel scoops or gloved hands will then be used to fill the sample container as soon as practical after placement in the lined pan. After each interval has been sampled, the remaining soil will be placed on the stockpile of soil that has been placed on sheet plastic near the test pit.

Backfilling

Each test pit will be backfilled with cuttings from the pit. If there is evidence of leaking drums or waste materials, the Navy and the RMT Project Manager will be notified, at which time an evaluation for emergency removal action will be made. If necessary, an emergency

removal action will be conducted by the Navy in a manner consistent with the Federal Facilities Agreement for this site, CERCLA, 10 U.S.C. Section 2701(c) et.seq. (DERP), and the NCP.

In the case of such an emergency removal action, the Navy shall provide the USEPA and the MPCA with oral notice as soon as possible and written notice within 48 hours after the Navy determines that an emergency removal action is necessary. The opportunity for review and comment for proposed removal actions may not apply if the action is in the nature of an emergency removal taken because of an immediate, imminent, and substantial endangerment to human health or the environment, if the Navy determines that such review and comment is impractical. Promptly after initiating an emergency removal action, the Navy shall provide the USEPA and the MPCA with the written basis (factual, technical, and scientific) for such action and any available documents supporting such action. Upon completion of an emergency removal action, the Navy shall state whether, and to what extent, the emergency removal action varied from the description of the action in the written notice.

7.2.2 Soil Sampling Procedures

Soil sampling procedures for test pits will be the same as those outlined in Subsection 7.1.2 for soil borings.

7.2.3 Test Pit Soils and Protective Equipment Disposal

Stockpiled soils will be placed on top of a sheet of plastic sheeting near each test pit during digging. Excavated soils will be used to backfill the test pit.

Protective equipment (gloves, boots, tape, etc.) will be placed in plastic garbage bags, and the bags will be put in a dumpster at the central staging area.

7.3 Quality Control Samples

7.3.1 Trip Blanks

Trip blanks will be prepared in the laboratory and will consist of 40-mL vials filled (zero headspace) with laboratory grade deionized water. The trip blanks will be transported to the site with the sample vials to be used during the investigation. Each day after collection and packaging of soil samples, two trip blank vials will be included for shipment and analysis within each cooler containing samples for VOC analysis. The trip blanks will be entered on the chain-of-custody form.

7.3.2 Field Equipment Rinsate Blanks

One field equipment rinsate blank will be collected per day when drilling and sampling take place, as follows:

- Select decontaminated split-spoon sampler and a clean aluminum foil–lined bowl.
- Using locally available distilled water, pour water through the split-spoon and completely fill two 40-mL VOC vials.
- Next, pour additional water through the same split-spoon allowing it to be collected in the foil-lined bowl.
- Pour water from the bowl and fill the remaining sample bottles (same as those shown in Table 4-1) for analysis. Field rinsate samples collected during the drilling of Type 1 Borings and Test Pits will be analyzed for the full TCL/TAL and TOC. Field equipment rinsate blanks collected during the advancement of Type 2 borings will be submitted for analysis of TCL VOCs and TOC only. On days when both activities (Type 1 and Type 2 borings) are taking place, the field equipment rinsate blank will consist of the full TCL/TAL and TOC analysis.
- Field rinsate blanks will be entered on the chain-of-custody form.

8. FIELD MEASUREMENTS/SCREENING

8.1 Field Measurements

Specific field analytical methods and procedures are presented below. To ensure that the analytical data gathered in the field are both valid and unbiased, the following steps are taken:

- Field technicians are trained in the use of each piece of equipment.
- Operating manuals accompany each piece of equipment in the field.
- Preventive maintenance programs are carried out on a scheduled basis.
- Spare components are taken into the field in case of equipment failure or damage.
- Instruments are calibrated on a daily basis and rechecked at various times during the day.
- Readings and calibrations are documented.
- Daily QC checks of field notes are performed.

8.2 Field Gas Chromatograph Analyses of Soil Headspace

Portable gas chromatograph (GC) analysis of soil headspace using a Photovac Model 10S50 GC will be performed on each sample interval. The field GC analysis will be used to characterize the presence and relative concentrations of selected VOCs in the soil headspace on a near real-time basis. The results of the field GC analyses will be used to determine which soil samples will be submitted to the laboratory for CLP analysis, and to determine the need for, and the locations of, additional soil borings during this phase of the field investigation. Standard operating procedures for the field GC are included in Attachment II of the RI Workplan.

TABLE 8-1

ANTICIPATED LIMITS OF DETECTION FOR FIELD GC PARAMETERS

Parameter	Anticipated Detection Limit (uL/L)
Benzene	0.010
Toluene	0.010
Ethylbenzene	0.010 (coelutes with m,p-xylene)
Xylenes	0.020
1,1-Dichloroethene	0.050
cis-1,2-Dichloroethene	0.050
trans-1,2-Dichloroethene	0.050
Trichloroethene	0.010
Tetrachloroethene	0.010

9. PREVENTIVE MAINTENANCE PROCEDURES/SCHEDULE

An Hnu photoionization detector and a Photovac Model 10S50 gas chromatograph (GC) are the only instruments to be used in the field during this investigation. Field preventive maintenance will include a cursory check of instrument operation without disassembly of test equipment. If any of these preliminary checks is negative, the instrument may not be functioning properly, and the back-up meter will be used. Field-check procedures for the Hnu instruments are described below. Procedures for the GC are quite detailed and are included in Attachment III.

Hnu Calibration

The recommended and most accurate procedure for calibration of the instrument from a pressurized container is to connect one side of a "T" to the pressurized container of calibration gas, another side of the "T" to a rotameter, and the third side of the "T" directly to the 8-inch extension to the photoionization probe. The most convenient packages for calibration are the nontoxic analyzed gas mixtures available from Hnu Systems in pressurized containers.

Crack the valve of the pressurized container until a slight flow is indicated on the rotameter. The instrument draws in the volume of sample required for detection, and the flow in the rotameter indicates an excess of sample. Now adjust the span pot so that the instrument is reading the exact value of the calibration gas. (If the instrument span setting is changed, the instrument should be turned back to the standby position and the electronic zero should be readjusted, if necessary). The manufacturer's operations manual for the Hnu will be taken into the field with the field team, and is available upon request. Portions of the manual have been included as Attachment 6 of the QAPP.

10. SAMPLE DISPOSAL

Soil samples analyzed by the field GC, but not submitted to the laboratory, will be thin-spread on the ground near the borehole if the field GC indicates that total VOCs in the soil vapors exist at concentrations less than or equal to 10 ppmv. If the field GC indicates soil vapors exist at concentrations greater than 10 ppmv, the samples will be placed in a roll-off box at a central staging area and later disposed by the Navy. Extra samples from the background borings will be thin-spread on-site in an area to be designated by the Navy.

Samples analyzed by RMT Laboratories will be disposed 30 days after the results are reported by the laboratory in accordance with the laboratory's sample disposal standard operating procedure.

ATTACHMENT II

RMT STANDARD OPERATING PROCEDURE FOR FIELD GAS CHROMATOGRAPH ANALYSIS

STANDARD OPERATING PROCEDURE FOR PHOTOVAC 10S50

1. Parameters To Be Analyzed

The constituents to be analyzed by the field GC and their anticipated limits of detection are presented on Table II-1. These constituents have been selected based on the previously identified constituents of concern in ground water and soils, and on the sensitivity of the field GC to these parameters. The peak area of target contaminants will be determined for each sample. Quantitation is determined by comparing peak areas of standards to those of samples.

2 & 3. Range of Measurement and Limits of Detection

The anticipated working linear range and limits of detection are presented in Table II-1. These detection limits are based on the concentration represented by the minimum recorded peak area for the GC (0.1 v-sec) at normal operating conditions. The maximum measurable concentrations for the different parameters are around 1,000 μL/L (parts per million by volume). Equivalent parameter concentrations in μg/L are also presented in Table II-1. However, the μL/L (or ppm) units will be used to avoid confusion between concentration units in water and air.

4. Sample Matrix

As a means of screening soil samples for VOC contamination, the headspace over the soil sample is measured for the VOCs. Thus, the sample matrix is air that has been contacted with the sample. Headspace measurement evaluates soil concentrations indirectly by determining the parameter concentration in the air in contact with the soil (i.e., the headspace). Parameter distribution between the soil and headspace is affected by a number of soil and parameter properties, including the parameter Henry's Law constant, and soil organic and water content and consistency. Since some of these properties can vary

TABLE II-1 ANTICIPATED LIMITS OF DETECTION FOR FIELD GC PARAMETERS		
Parameter	**Anticipated Detection Limit (µL/L)**	
	µL/L	µg/L
1,1-Dichloroethene	0.050	0.20
cis-1,2-Dichloroethene	0.050	0.20
trans-1,2-Dichloroethene	0.050	0.20
Trichloroethene	0.010	0.55
Tetrachloroethene	0.010	0.070

NOTE: The upper range for all compounds is around 1,000 µL/L.

between samples, the parameter distribution between the soil and headspace can vary between samples. Headspace measurement thus does not give a direct measurement of parameter concentration in the soil, but rather gives a qualitative indication of the soil concentration.

5. Principle, Scope, and Application

Soil headspace analysis is a convenient means of screening soils for VOC contamination. In principle, VOCs contained in the soil will partition between the soil and any air in contact with the soil, with partitioning depend on VOC concentration in the soil as well as on several other factors (Devitt, et al., 1987). Analysis of the soil headspace can be done in the field using a portable gas chromatograph, and can provide near real-time screening analysis of VOCs in soil. Due to the variety and variability of factors that influence VOC partitioning between the soil and air, soil gas analysis is best used for screening VOC levels rather than for quantitative analysis of the VOC content in the soil. However, measurement of the VOC concentration in the gas itself is a quantitative measurement.

Soil headspace screening is useful for locating areas of soil contamination and relative levels of contamination, for selecting samples for further laboratory analysis, and for determining the areas which should be further investigated (e.g., soil borings or monitoring well installation).

6. Interferences and Corrective Action

There are no common interferences in the analysis for the parameters analyzed under standard operating conditions. Component of gasoline coelute with di and trichloroethylene and, if gasoline is present, it is difficult to quantify di and trichloroethylene. Generally, however, gasoline and the chlorinated ethylenes are not found in the same sample. Water vapor interferes with vinyl chloride analysis, when the vinyl chloride is present at low

concentrations. The detection limit of vinyl chloride in higher than if the interferences were not present. In addition, ethyl benzene and m&p-xylene peaks overlap. If both peaks are present, the peak is calculated as if it contained the constituent giving the large peak, and a note made that both compounds were present.

Dirty apparatus can cause problems with a portable GC, since many surfaces (notably teflon) can adsorb and desorb gaseous constituents. Several precautions and cleanup steps are used to avoid such cross contamination. First standards are transported separately from the syringes, septa, etc., so that no cross contamination during transport occurs. Secondly, column and syringe blanks are run whenever contamination is suspect. Third, syringes are cleaned between each run by removing the plunger and allowing the contamination to disperse, or by purging the syringe or plunger with compressed air from the air cylinder. If syringe contamination is suspect a syringe blank is run in which room air or compressed air is injected into the GC with the syringe in question. Syringes that remain contaminated after purging are baked overnight in a portable oven. Laboratory air contamination has not been found to be a problem.

7. Safety Precautions

Samples are contained in 40-mL VOA vials, and the analyst does not come into direct contact with the soil. If soil needs to transferred from one vial to another, or if a vial breaks, then the analyst will use normal precautions used when working with chemicals, e.g., washing hands after working with the material, not eating while handling the material, etc. All pure solvents used for making standards are likewise kept in 40-mL VOA vials, and the analyst does not come into contact with the solvents.

Standard laboratory practice precautions are taken when working with the gas cylinders used for gas supply to the GC. The cylinders are either secured to the wall by chains or, in places where no wall mountings are available, supported by a gas cylinder stand.

8. Sample Size, Collection, Preservation, and Handling.

Soil samples are collected in 40-mL VOA vials with a septum top. If the samples are analyzed in the field, the vials are filled approximately half full with soil when the sample is collected. If the samples are analyzed in the laboratory, the vials are filled completely in the field, then a second vial filled half-full in the laboratory. The vials are then allowed to equilibrate at room temperature for at least 30 minutes. No preservatives are used in the samples. After the equilibration time, an aliquot of the headspace is removed with a syringe through the septum, and injected into the GC for analysis. Injections are repeated until the peaks of interest are on scale. The sample is discarded by either returning the vials to RMT Laboratories or by returning the soil to the sampling area. In the RMT laboratory, the vials are opened in a hood, and the VOCs are allowed to volatilize, after which the soil is discarded. After the soil has been removed from the vials, the empty vials are discarded.

9. Apparatus

The GC used is a Photovac Model 10S50 Portable Gas Chromatograph. Other sampling equipment used for the headspace analysis is listed in Table II-2.

10. Routine Preventive Maintenance

The routine preventive maintenance procedures used in day-to-day operation of the GC are described in section 14 below. The procedures include running column and syringe blanks at the start of a day's operation, and when there is suspicion of syringe or instrument contamination. The injection port septa is changed after 50 to 75 injections. VOA vial blanks

TABLE II-2
PORTABLE GC FIELD EQUIPMENT CHECKLIST

EQUIPMENT	# NEEDED	CHECKOFF
INSTRUMENTS		
Photovac 10S50		
Battery Pack for Oven		
Electrical Cord for Using GC with 110 V		
Electrical Cord for Charging Battery Pack		
Electrical Cord for GC from Battery Pack		
Gas Flow Meter and Connecting Gas Lines		
Gas Tank Regulator and Connecting Lines or Internal Tank Refill Gas Line		
0.1-ppm Grade Air Tank		
GC SUPPLIES		
Plotter Pens		
Plotter Paper		
Extra UV Lamp		
White Teflon®-Coated Septa for GC		
PAPERWORK		
Field GC Logbook		
Field Notebook		
Photovac GC Instruction Manual		
SYRINGES		
10 µL		
25 µL		
100 µL		
250 µL		
1,000 µL		
Syringe Needles		
SAMPLE CONTAINERS		
VOA Vials		
1-L Gas Sample Bottles		
250-mL Gas Sample Bottles		
Green Septa for Sample Bottles		
Labels for Vials/Sample Bottles		
Standards (Pure Solvent/Gas STD)		

TABLE II-2 (CONTINUED)

PORTABLE GC FIELD EQUIPMENT CHECKLIST

EQUIPMENT	# NEEDED	CHECKOFF
TOOLS		
Adjustable Wrench for Gas Cylinder		
Small Wrench for Gas Line Fittings		
Slotted Screwdriver		
Phillips Head Screwdriver		
MISCELLANEOUS		
Kim Wipes®		
Paper Hand Towels		
Markers		
Pens		
Calculator		
Knife		
Rubber Bands		
Paper Clips		
Water Bottle		

are run if there is suspicion of vial contamination. Vial contamination would be suspected if similar peak patterns were found in several soil samples from different areas.

The neat solvents used for preparing standards are stored and transported separately from the other GC equipment to avoid cross contamination. Septa, syringes, and the plastic portions of the gas sample bottles are stored in organic contamination-free areas.

A common analytical problem is clogging or partial clogging of the injection syringe needles. Occurrence of partial clogging is determined by running replicate samples. If the results cannot be replicated after several runs, the syringe needle is changed. Clogged syringes are detected by injecting air into a water-filled vial. If no bubbles are observed, then the needle is changed.

11. Reagents and Calibration Standards

Pure solvents are purchased from chemical supply companies. A small portion approximately 5 mLs of the neat liquid is placed in a 40-mL VOA vial and allowed to stand. The neat liquid volatilizes to saturate the headspace in the vial. As long as sufficient liquid is present to saturate the headspace, the volume of liquid is not important. The saturated headspace from the VOA vial is used in preparing standards for instrument calibration. A new vial is prepared when the septum on the standard vial becomes too perforated, or when the solvent volatilizes through the septum.

Calibration standards are prepared by diluting the headspace from the neat solvent vials. The volumes of headspace injected into a 125-mL gas sample bottle and resultant concentration are given in Table II-3. Chromatograms of the standard are compared with previous standard chromatograms to ensure that the standard was prepared properly.

12. Calibration Procedures

A. Standards should be prepared according to the protocol given above.

TABLE II-3

GAS STANDARD PREPARATION PROCEDURE

Compound	Vapor Pressure (at 20°C) ppm (µL/L)	µL Solvent Headspace in 125-mL bottle	Gas Concentration ppm (µL/L)
1,1-Dichloroethene	789,000	3	18.9
trans-1,2-Dichloroethene	426,000	3	10.2
cis-1,2-Dichloroethene	274,000	10	21.9
Trichloroethene	76,200	25	15.2
Tetrachloroethene	17,800	125	17.8
Benzene	125,000	12.5	12.5
Toluene	37,400	188	56.2
Ethylbenzene	7,000	375	21.0
Xylenes (each)	13,200	375	39.6

B. A standard should be run after the column blank when starting the instrument. For the most accurate results, standards should be prepared daily. The standard can be used for calibrating the instrument response factor on the first run or runs, then for peak identification for the rest of the day.

C. To calibrate the GC, do the following:

i. Select the library to be used by pressing "USE" button and selecting the appropriate library.

ii. Press "LIST" and "ENTER" to get a list of the compounds stored in the library.

iii. Press "EDIT" and follow prompts to delete compounds from the library.

iv. To enter compounds in the library, press "STORE" button and follow prompts. Instrument will ask, in order, for

a. Peak number.

b. Compound ID.

c. Concentration.

d. Limit Value (enter 0.00).

v. Store all compounds that were run and are to be saved. If the compounds are already in the library, the peaks can be recalibrated using the "CAL" button.

vi. Press "LIST" and "ENTER" for a printout of the library in use. The library numbers for the compounds are important for recalibrating peaks.

D. After the instrument is calibrated, a second standard should be run to verify that the first standard is reasonable. If the results differ by more than 5 percent, rerun and recalibrate (if necessary) the instrument using a different syringe or a different needle.

E. Record on the strip chart both the V-sec and ppm readings on standards that are used for calibration, so that the calibration factor the instrument is using can be calculated.

F. If there is a question on the identity of a given peak in a sample run, run a standard to determine the retention time of the compound of interest. Peak identification by the GC can be in error if the air flow rate or column temperature drift. The analyst should be familiar with the peak patterns of the compounds of interest, check to ensure that the GC is correctly identifying peaks, and check retention times against standards if there is any question.

13. Sample Preparation

Sample preparation is discussed in Section 8 above.

14 & 15. Step-by-Step Analytical Methodology

The daily operation of the GC, including routine procedures, preventative maintenance and daily quality control procedures, is described below:

A. Connect the power supply for the GC (unless using the internal battery).

B. Connect battery for column oven to the external DC input connector. Set column to desired temperature, and allow to heat for approximately 30 minutes to reach operating temperature.

C. Connect the exhaust gas lines to the gas flow meter. The left side of the flow meter measures flow through the detector and is connected to the "Detector Out" port, while the right side is connected to the needle valve on the "Aux Out" post.

D. Connect the input gas lines, turn gas flow on, adjust flow through column, and backflush to the appropriate values. The backflush flow should be set slightly higher than the column flow. If using the internal tank, fill the tank before adjusting flow. The gas flow through both the detector and backflush lines is set by the "A + B" valve at center left of front panel. The backflush flow is also controlled by the "Aux Out" needle valve. Note that the internal gas pressure should be set at 40 psi.

E. Turn instrument on (Note: gas must be flowing past detector before the lamp is turned on). The instrument will read "LAMP NOT READY. PLEASE WAIT" for a few minutes after turning the instrument on. If the lamp does not come on after several minutes, as indicated by the instrument reading "READY," turn the instrument off ("OFF", then "ENTER"), and then back on and wait for a minute. If the lamp still does not turn on, use the special Teflon® screwdriver to adjust the lamp power supply on the lamp box inside the unit. If the lamp still does not light, change the detector bulb.

F. Set daily information, using USE button. Also enter project information, if necessary, using INFO button.

G. If you are not sure of the GC's valve timing, press "TEST" then "ENTER." The GC will print out the Event timing. Event 1 should be set for an ON time of 8 (sec) and one OFF time of 10 sec. Event 1 controls the buzzer for sample injection, and the injection port sequence. Event 3 controls the backflush start time. The ON time should be 0 (sec) and the OFF time should be one-fourth to one-fifth of the retention run time of the slowest analyte of interest. The run time is set by the CYCLE button.

H. Set gain to desired value (Note: Gain defaults to 2 when instrument is turned off).

I. Change septum on injection port, if necessary (septa are good for approximately 50 injections).

J. Prepare daily injection log. All runs should be recorded on log.

K. Run a column blank (no injection) and a syringe blank.

L. Prepare appropriate standards (if necessary). Directions for standards preparation are given in Section II.

M. Run standard. Recalibrate instrument, if necessary (see Calibrating the GC in Section II-12). If possible, obtain the peak areas in V-sec as well as ppm-V, so that the instrument calibration factor (in (μL/L)/V-sec) can be determined.

N. If time, run syringe blank (an injection of room air or 0.1 air) to ensure syringe cleanliness using the syringes that will be used in day's work.

O. Run samples. Adjust injection volume until peaks of interest are on scale and preferably more than 1/4 of maximum size for chart paper. If time permits, runs should be duplicated and average values used for quantification.

P. Record sample ID, injection volume, and gain on the injection log. Also record sample ID and injection volume on chromatogram at start of run.

Q. Record results of run on calculation sheet for project. Correct GC output for injection volume (and gain if results are in mV or V-sec) to those values used for standard. When two replicate runs are made, calculate for both separately, then average results.

R. Record corrected results on results sheet for project. One copy of results sheet should be given to PM/person-in-charge, and one copy placed in the project notebook.

S. Clean syringes by removing plunger after an injection and letting plunger air.

T. If replicate runs are not satisfactory (< 10 percent difference is a suggested guideline), reinject sample. If third run is still inconsistent, replace needle on syringe, then rerun sample. Also check for syringe contamination by running a syringe blank. Check for plugged syringes by injecting air into a vial filled with water.

U. If instrument is not recognizing obvious peaks, recalibrate the known peak. If unsure of peak ID, run standard for peak identification. (Note: once the septa is punctured in the gas sample bottle, the VOCs are slowly lost from the bottle. Therefore, the standard should be used for calibrating the <u>concentration</u> only shortly after the standard is prepared. The standard can still be used for <u>peak identification</u> until the peaks disappear.)

V. Standards should be run periodically throughout the day, for peak identification (not for recalibration of concentration) and at any time there is a question on peak identification. At least three standards should be run each day.

W. Column and syringe blanks should be run periodically throughout the day, and if there is any question of syringe contamination. Column and syringe blanks are particularly important when the sample concentration is low, or if there is a sharp drop in sample concentration (< factor of 5 change in concentration).

X. Under normal operation, the maximum gain is 20, and under all conditions, the maximum injection volume is 1,000 µL.

Y. After 50 to 60 injections, change the injection septum.

Z. The instrument should always be calibrated in µL/L (ppm-V). Even when analyzing water headspace, record the results in µL/L and convert to µg/L or mg/L by hand.

AA. After last run has been completed, disconnect oven battery from instrument, then shut the power off to the instrument. After the instrument has turned off, turn off the air flow, either by closing the tank or decreasing the regulator (if using an external tank). If using the internal tank, turn off the flow by using the instrument flow control knob.

BB. At the end of a days' run, tear off the chart paper and mark the end with the date, project name and number, and, if possible, samples run.

CC. If the instrument is using the internal power supply, then it should be recharged overnight. Fill the internal gas tank in the instrument, and bring the GC to a place where there is a 110 v power supply. Plug the instrument in, turn the air flow to a very slow rate (5 to 10 mL/min), then turn the instrument on overnight. Be sure the air tank is full or has sufficient air to keep air running through the detector throughout the night.

16. Data Treatment

The Photovac measures the area under peaks for the compounds in the injected gas sample. The area, in V-sec or MV-sec, is converted to µL/L (ppm-V) in the gas phase by calibrating the instrument using a known concentration of the compound in question (with gas standards). The instrument compares areas of standards with sample peak areas to determine the concentration of the unknown. The instrument corrects for gain, but not for injection volume. The instrument concentrations output should be corrected for injection volume as follows:

$$(\textit{Actual Conc.}, \mu L/L) = (\textit{Instrument Reading}, \mu L/L)\left(\frac{\textit{Injection volume of standard}}{\textit{Injection volume of sample}}\right)$$

If the reading is given in V-sec, a correction needs to be made for gain as well as injection volume, i.e.,

$$(\textit{Actual Conc.}, \mu L/L) = (\textit{Instrument Reading, V-Sec})\left(\textit{Response Factor}\ \frac{\mu L/L}{V\text{-sec}}\right)$$

$$\left(\frac{\textit{Injection volume of standard}}{\textit{Injection volume of sample}}\right)\left(\frac{\textit{Gain setting for standard}}{\textit{Gain setting for sample}}\right)$$

where the injection volume and gain are the values for the standard at the time the instrument was calibrated.

The response factor is the conversion factor for the V-sec given by the detector at a given standard concentration, i.e.

$$\textit{Response factor} = \left(\frac{\textit{Standard concentration}, \mu L/L}{\textit{Instrument Reading}, V\text{-sec}}\right)$$

The response factor is specific for the injection volume, gain, and detector response.

Gas measurements are commonly reported in ppm or $\mu g/m^3$. A gas phase unit of ppm is a $\mu L/L$. To avoid confusion between measurements made on different matrices (air, water, or soil) units of $\mu L/L$ are used in the calculations.

17. Data Deliverables

Portable GC Results Notebooks will be prepared. The notebook will consist of the following sections:

A. Project information.

B. Standards preparation and SOP for the sample handling and GC operation.

C. Injection logs.

D. Calculation sheets.

E. Results summary sheets.

F. Replicate comparison and standards results sheets.

G. Chromatograms.

After the field work, the chromatograms are xeroxed and placed in the appropriate section. Replicates are recorded separately, and compared in a separate section of the notebook. The calculation and results summary sheets should be checked by the QC reviewer. The notebook should be comb bound and placed in the project file. The calculation and results summary sheets can be xeroxed and stored at the GC operator's desk for later reference, if appropriate.

The notebooks contain the information required to follow the results from the original chromatogram to the final results sheet. Standards are included so retention times can be checked. However, syringe or column blanks, runs that went off-scale, and other miscellaneous runs are not included. The original chromatograms are stored in the RMT Applied Chemistry Laboratory.

18. Quality Control

The degree of QA/QC for the portable GC use is dependant on the use of the results, and should be adjusted as appropriate. It should be recognized that the GC itself is a precise analytical instrument, capable of providing as consistent and reliable results as a laboratory GC, if used under optimum conditions. However, use in the field under less controlled conditions increases the analytical variation in the results. Further, and more important, soil headspace analysis is designed to be a screening method, giving approximate indicators of soil concentrations. There is inherent variability in a soil headspace measurement due to

changes in the soil itself that cannot be eliminated by QC procedures during the analysis. The extent of QC should be appropriate to the end use of the results.

During field operation of the GC, the operator checked for syringe clogging or contamination, machine malfunction, and miscalibration as discussed in Sections 14 and 15. If replicate runs vary by more than 10 percent difference between the results, the sample is reanalyzed by repeating the injections until the results do replicate or the cause of the poor replication is identified.

The purpose of the QA/QC procedures can be divided into three areas, as follows:

A. Verification

Much of the verification of peak identification, syringe cleanliness and proper operation is done during machine operation, and is discussed in Section 12, Calibration Procedures. During the QC check of the results, the following steps are needed:

i. Sample and standard peak retention times and peak patterns are compared. GC identification of the peaks is checked. Incorrect GC peak identification is noted on the chromatogram.

ii. If there is a question of peak identification that cannot be resolved by comparing sample peak retention time with that of the standard, relative retention times for the unknown and for a known compound are calculated and compared between the sample and standard.

iii. If there is still a question of peak identification after a relative retention time check, the peak is identified as the compound of interest with a note saying "Tentative Identification."

B. Data and Calculations Checks

i. All results to be reported should be recorded on the calculation sheet.

ii. The results should be corrected for injection volume and gain. Note: the Photovac automatically corrects for gain if the reports are presented in ppm, but does not correct for gain if the results are presented as V-sec.

iii. Further calculations should be recorded on the DATA CALCULATION SHEET.

iv. The corrected results should be recorded on the sample results sheet. All results should be reported as $\mu L/L$ (ppm-V).

v. All data transcriptions and calculations should be checked by a QC person, unless otherwise instructed. The QC person should check the results for accuracy of transcription, and spot check the calculations. Furthermore, the QC person should compare the final results for reasonableness, based on previous results or anticipated results.

vi. A xerox of the chromatograms used for calculation should be made. The xerox facilitates QC checking and project file documentation. If duplicate injections were made, both chromatograms should be recorded. Further, if there is any uncertainty about peak identification, then the standards used for retention time calibration should be xeroxed also.

vii. The QA/QC person should initial and date each page of data calculation or results sheet checked and any corrections that are made. Corrections should be in a different color ink (e.g., blue or red) than the original.

C. Documentation

i. A portable GC project notebook should be used unless there are instructions not to. The project notebook should consist of the following sections:

Section Topic

a. General Project Information
   - Include the proposed Scope of Services if available.

b. Standard Operating Conditions
   - Standards preparation forms.
   - Standards chromatogram.
   - Calculation equations.
   - Sample handling instructions (if prepared).

c. Results Summary forms

d. Daily Injection Log

e. Calculation Sheets and Chromatograms

ii. While the project is active, the notebook should be kept in a 3-ring binder (unless otherwise specified).

iii. After the project is completed, the notebook should be comb bound, with a cover page, and stored in the project files. The GC operator is responsible for putting the final notebook together.

iv. The original chromatograms should be stored in the Applied Chemistry Laboratory. The chromatograms should be organized by project and date.

19. References

Devitt, D.A., R.B. Evans, W.A. Jury, T.R. Starks, B. Eklund and A. Gnolson. 1987. Soil Gas Sensing For Detection and Mapping of Volatile Organics. EPA 600/8-87-036, USEPA, Las Vegas, NV.

ATTACHMENT III

RMT STANDARD OPERATING PROCEDURE FOR TOTAL ORGANIC CARBON ANALYSIS

ANALYTICAL METHOD

TITLE: Total Organic Carbon Analysis

DEPARTMENT: Inorganic - Wet Chemistry

APPLICATION: Determination of organic carbon in soil, sludge, and solid waste.

REFERENCE: ASTM Method D4129-82, 1982
EPA Manual SW-846, 3rd Edition, Method 9060
Dohrmann DC-80 TOC Systems Manual, 6th Edition, January 1984.

PROCEDURE SUMMARY:

Inorganic carbon from carbonates and bicarbonates is removed by acid treatment. This procedure uses the persulfate ultraviolet oxidation method. The sample is burned in a resistance furnace under oxygen. The interfering gases are removed by a sparger/scrubber system, and carbon dioxide is measured by a nondispersive infrared detector and shown on a digital display in concentration units.

DETECTION LIMITS:

100 mg/Kg

RANGE OF MEASUREMENT (working linear range):

100 to 16,000 mg/Kg

REVIEWED BY: Eric L Thomas — 1/21/92
Eric L. Thomas
Supervisor
Inorganic Section
Date

Mark S. Wirtz — 1/21/92
Mark S. Wirtz
Quality Assurance Officer
Date

APPROVED BY: Karen M MacKenzie — 1.21.92
Karen M. MacKenzie
Laboratory Director
Date

SAMPLE HANDLING & PRESERVATION:

The sample is collected in a glass jar and refrigerated at 4°C. The holding time is 28 days from sample collection.

INTERFERENCES:

Carbonate and bicarbonate carbon represent an interference under the terms of this test and must be removed or accounted for in the final calculation.

Removal of carbonate and bicarbonate by acidification and purging with nitrogen, or other inert gases, can result in the loss of volatile organic substances.

Volatile organics may be lost in the decarbonization step resulting in a low bias.

Bacterial decomposition and volatilization of the organic compounds are minimized by maintaining the sample at 4°C and analyzing within the specified holding time.

APPARATUS:

Dohrmann DC 80 Total Organic Carbon Analyzer
Syringes: 50 µL, 100 to 250 µL, 1 mL
Volumetric flasks: 100 mL, 200 mL, 1,000 mL
Forceps
Watch glass
Small spatula
Platinum boat
Drying oven maintained at 103° to 105°C

REAGENTS:

Deionized (D.I.) water
Potassium persulfate
Potassium hydrogen phthalate (KHP)
5% Sulfuric acid
Nitric acid

Prepare Potassium Persulfate Solution

- Dissolve 40 g potassium persulfate in 1 L of D.I. water.

- Add 1 mL concentrated nitric acid. Mix well. Store in a cool, dark place. Shelf life is one month.

Prepare Standard (ppm as Carbon), 2,000 ppm [instrument calibration, initial calibration verification (ICV), continuing calibration verification (CCV), and matrix spiking]

- Dissolve 425 mg KHP in 100 mL D.I. water. Add 0.1 mL concentrated HNO_3. Store in an amber bottle and refrigerate. Shelf life is one month. This standard is used for initial calibration and matrix spiking. Another 2,000 ppm standard is prepared from a second source that is used as the ICV and CCV.

Prepare Standard (ppm as Carbon), 1,000 ppm (alternate matrix spiking source)

- Dilute 50.0 mL 2,000 ppm standard to 100 mL in a volumetric flask. Store in an amber bottle and refrigerate. Shelf life is one month.

Prepare Standard (ppm as Carbon), 500 ppm (alternate matrix spiking source)

- Dilute 25.0 ml 2,000 ppm standard to 100 mL in a volumetric flask. Store in amber bottle and refrigerate. Shelf life is one month.

Prepare 5% Sulfuric Acid Solution

- Dilute 10 mL of concentrated H_2SO_4 (sulfuric acid) to 200 mL with distilled water in a volumetric flask.

Prepare Initial Calibration Blank (ICB) and Continuing Calibration Blank (CCB)

- Use the same D.I. water that was used for the preparation of the standards. Inject 40 μl.

Prepare Laboratory Control Sample (LCS)

- Use a commercially prepared standard with a concentration of 2,500 to 3,500 ppm. Inject between 10 and 40 µl (depending on the concentration ranges of the samples analyzed) into the boat through a septa in the sample port.

SAMPLE PREPARATION:

Air dry the sample overnight, then mix until homogeneous. Transfer approximately 5 g of the sample into a porcelain dish. Add 5% sulfuric acid dropwise, while mixing, until effervescence is no longer visible. Dry in an oven at 105°C until constant dry weight is obtained.

INSTRUMENT OPERATION:

A. Sample Analysis

1. Turn on O_2 purge gas tank and verify line pressure of 30 psi.

2. Connect lines from PRG-1 purgeables module labeled "4" and "5" to Ports 4 and 5, respectively, on the right side of the DC-80 Reaction Module. Verify gas flow by observing bubbling in reaction vessel.

3. Turn on power switch labeled "Furnace" on PRG-1 module.

4. Turn "Power" of ASM-1 autosampler module on. Verify that "Manual" switch is lit.

5. Turn "Power" switch of DC-80 reaction module on. Turn off switches labeled "Pump" and "Lamp."

6. Turn on "Power" switch of DC-80 Electronics Module.

7. Set function switch to "TOC."

8. Set injection volume control to "40 µL" setting.

9. Allow furnace to heat up (~ 30 minutes) and baseline value to stabilize to historical value, typically 0.0100-0.0200.

10. Boat preparation. The platinum boat is lined with quartz wool. The boat is introduced into the furnace and allowed to "bake-out."

11. Calibrate the instrument using an instrument blank and a 2,000 ppm KHP standard. Inject the blank and standard into the boat through a septa in the sample port.

    NOTE: When calibrating, the boat is immediately introduced into the furnace.

12. Weigh a well-mixed, dry homogeneous sample into a lined platinum boat.

    NOTE: Sample size must be kept between 10 and 100 mg.

13. Place the sample in the saddle and close the injection port. Allow the sample to stand outside of the furnace for about 2 minutes to stabilize the system.

14. Push "START" and introduce the sample into the furnace. When the sample has been processed, the "READY" light will come on and the integrated concentration will be sent to the printer. This indicates that the instrument is ready for the next sample.

B. Shutdown

1. Disconnect lines to Ports 4 and 5.

2. Turn off purge gas.

3. <u>Leave power to Horiba PIR-2000 ON at all times!</u>

4. Turn off switches on the following:

   a. DC-80 Electronics Module
   b. DC-80 Reaction Module
   c. ASM-1 Autosampler Module
   d. PRG-1 Furnace Module

ROUTINE PREVENTATIVE MAINTENANCE

A. Septum Replacement

Replace the injection septum every 100 injections or at any time leakage is obvious.

B. Reagent Replenishment

Check daily.

C. Sparge/Carrier Gas Replenishment

Check once a week.

D. Tin Scrubber

Check daily. Color will change as it is used. Repack the tube when one-half of the tin is exhausted. Use 20-mesh granular tin.

E. Pump Tube Replacement

Replace every two weeks if instrument is operated continuously. Release pressure fingers when not in use. Plug reagent lines before releasing.

F. Printer Tape

Check every two or three days. Always check before an unattended automated run.

G. Infra-Red Zero

Check once or twice a day to see that, the zero reading is around 0.0100 on the digital readout when the detector/ppm switch is in the detector position. It should always be ABOVE zero. A reading of 0.0100 on the DVM is reasonable.

H. Infra-Red Span

The span does not need any routine resetting.

QUALITY CONTROL:

- ICV

  Run the ICV immediately after calibration and must meet current control limits of ±10% of the true value.

- ICB

  Analyze the ICB after the ICV and must be less than the instrument detection limit (IDL).

- LCS

  Prepare the LCS consisting of a known concentration and analyze for each matrix type and must meet current control limits. See addendum for limits.

- CCV

  Analyze the CCV after every 10 analytical samples and must meet current control limits of ±10% of the true value.

- CCB

  Analyze the CCB after every CCV and must be less than the IDL.

ACCURACY:

A spike of (2,000 ppm of KHP) must be performed on each group of samples of a similar matrix type with a frequency of 10%. See addendum for limits.

If sample concentration does not allow a 2,000 ppm spike, reduce the spike concentration to 500 ppm or 1,000 ppm depending upon sample concentration.

Spike calculation:

$$\% \text{ Recovery} = \frac{SSR-SR}{SA}$$

SSR Spiked Sample Result.
SR Sample Result.
SA Spike Added.

PRECISION:

A duplicate must be analyzed on each group of samples of a similar matrix type with a frequency of 10%. See addendum for limits.

Duplicate sample sizes should be approximately the same.

Duplicate calculation:

If the sample value, the duplicate value, or both are less than 5 times the IDL, use the absolute difference (AD).

$$|\text{Sample}-\text{Duplicate}| = AD$$

If both the sample value and the duplicate value are equal to or greater than 5 times the IDL, use the relative percent difference (RPD).

$$RPD = \frac{S-D}{(S+D)/2} \times 100$$

S Original sample value.
D Duplicate sample value

CALCULATION:

$$\frac{\text{Instrument Reading (mg/L)} \times 40\ \mu L\ \text{(standard)}}{\text{Weight of Sample (mg, dry weight)}} = \text{mg/Kg TOC (dry weight)}$$

DATA DELIVERABLES/DOCUMENTATION:

All reports and documentation must be legible, single-sided, and clearly labeled.

Sample analysis reports will include: sample result (dry weight), project name, laboratory name, station ID, laboratory sample number, sample collector, project number, collection date, report date, work order number, comments describing in detail any problems encountered in processing the sample, and signature of the section supervisor.

The following documentation will be completed but not submitted as a deliverable unless requested: summary of initial calibration and continuing calibration check results, summary of QC sample analyses, raw data (instrument printout), and instrument log books (analytical run logs and maintenance logs).

Total Organic Carbon

Quality Control Limits

LCS*

87-129% recovery

Accuracy (Matrix Spike)

74-124% recovery

Duplicate

If the sample value, duplicate value, or both are less than 5 times the IDL, use the absolute difference.

Absolute Difference = ± IDL

If both the sample value and duplicate value are equal to or greater than 5 times the IDL, use the relative percent difference.

0-26% RPD

* An aqueous LCS will be used until a commercially prepared source can be purchased or prepared in the laboratory.

ATTACHMENT IV

RMT STANDARD OPERATING PROCEDURE FOR SCREENING ANALYSIS OF HALOGENATED VOLATILES BY ELCD

STANDARD OPERATING PROCEDURE

TITLE: Screening Analysis of Halogenated Volatiles by ELCD

DEPARTMENT: Organics - Volatiles Area

APPLICATION: This method is analogous to USEPA Method 8010, but with reduced QC procedures and documentation.

REFERENCES: USEPA SW-846, 3rd Edition, Revision 1, November 1990

PROCEDURE SUMMARY: The method provides for the detection of halogenated volatile organic compounds using an electrolytic conductivity detector (ELCD) and capillary or packed column chromatography. Sample introduction is via purge-and-trap (Method 5030).

PURGE AND TRAP OPERATING PARAMETERS

Trap type	Tekmar #5[a]	Tekmar #8[b]
Purge gas	Helium	Helium
Purge pressure (p.s.i.)	20	20
Purge gas flow rate (mL/min)	40	40
Purge time (min)	10	10
Dry purge time (min)	0	6
Purge temperature (°C)	Ambient	Ambient
Desorb preheat temperature (°C)	175	245
Desorb temperature (°C)	180	250
Desorb time (min)	4	4
Backflush gas flow (mL/min)	20 - 60	20 - 60
Bake temperature (°C)	225	260
Bake time (min)	10	11
Concentrator line and valve temperatures (°C)	100	100

[a] OV-1 / Tenax / silica gel / charcoal

[b] Carbopack B / Carbosieve S-III

GC OPERATING PARAMETERS WITH ELCD DETECTOR[1]

GC type:	Tracor	HP5890	Capillary Column
GC column type:	60/80 Carbopak B 1% SP 1000 8 ft	60/80 Carbopak B 1% SP 1000 8 ft	DB-624 75/105 meter
GC carrier flow: (mL/min)	40	40	5-10
Makeup gas flow rate: (mL/min)	None	None	To total 30 (20-25)
Carrier/makeup gas:	Helium	Helium	Helium
GC temperature program:			
Initial temp.	45°C	45°C	35°C
Initial time	3 min	3 min	10 min
Program rate	8°C/min	8°C/min	6°C/min*
Final temp.	220°C	220°C	200°C
Run time	--------5 minutes longer than-------- retention time of latest parameter.		
ELCD parameters:			
Run temp.	850°C	850°C	850°C
Hydrogen flow (mL/min)	50	95	95
n-propanol flow (mL/min)	0.50	0.050	0.050

[1] Any one of the three columns listed above may be used as long as the laboratory is able to meet the detection limits shown on page 17 of 18.

PROCEDURE:

QA/QC for VOCs using Gas Chromatography

A. A standard curve is run as described herein.

1. The correlation of linear regression (r) should be 0.995 or greater for the entire list.

2. If one or more compounds fail this criterion, the curve need only be repeated for the failing compounds.

B. Instrument detection limits (IDLs) are determined.

1. Seven or more replicates of a standard are run at a concentration near but above the estimated detection limit. The standards are quantified against the curve as outline herein. The following calculation is used to determine the IDL:

IDL (for 1 analyte) = $t_n S$

where t_n = student t value for n number of replicates

S = sample standard deviation of the concentrations of the n replicates

C. A standard mixture is the first run of the day. It is analyzed daily to determine whether initial calibration is still valid.

1. The percent recovery of the standard must be within the limits specified in Table X1 (see Appendix 1) before further analyses may be done.

2. If standards deviate out of the specified limits, corrective action must be taken. Corrective action may consist of rerunning the standard if there is evidence that it may have not been run correctly, making new standards and then rerunning either the daily standard or the curve.

3. The manner in which the standard is run must match the matrix of the sample. The standard must be run heated if it is to be used for heated samples (soils). If ambient temperature runs are to be performed, the sample must be purged at ambient temperature. The standard is compared to the curve that was run in the same manner.

4. An instrument blank must be run each day before sample setup to assure that the reagent water is free from interferences.

   a. No analytes may be present in the blank above the detection limits, with the exception of common laboratory solvents.

   b. The blank must be run in the manner of the samples, i.e. heated for soils and not heated for waters.

   c. In addition, a methanol blank must be performed if methanol extracts are to be run that day. The same limits apply to the methanol blank that apply to the regular method blank.

Volatile Organic Compound Analysis by Gas Chromatography

A. Calibration

1. To calibrate the Purge and Trap/Gas Chromatograph for volatile organic compounds, using the external standard method, a minimum of five concentration levels for each parameter is used.

   a. One external standard should be at a concentration near, but above the detection level and the other concentrations should correspond to the working range of the detector or to the expected range of concentrations found in real samples.

2. Both analytes are calibrated at the same time from standard mixtures, as described in Section B.

3. Five concentration levels are run once per week or as needed at the following concentrations: 1, 5, 10, 20 and 40 µg/L (parts per billion).

   a. The gasses may require calibration more often than once per week.

   b. Calibration curves for additional parameters not designated in Section B are run as needed.

4. Heated and unheated calibrations are to be performed to match the matrices of the samples to be run.

B. Standard Mixtures

The following mixture* is made on a monthly basis. The two analytes of relevance to this method are boldfaced.

VOC-A

Methylene chloride

1,1-Dichloroethene

1,1-Dichloroethane

trans-1,2-Dichloroethene

Chloroform

1-2-Dichloroethane

1,1,1-Trichloroethane

Carbon tetrachloride

Bromodichloromethane

1,2-Dichloropropane

Trichloroethene

1,1,2-Trichloroethane

Bromoform

Tetrachloroethene

* Other mixtures of analytes are also made and calibrated.

C. Parameter Identification

1. Identify the parameters in the sample by comparing the retention times of the peaks in the sample chromatogram with those of the peaks in the standard chromatograms.

   a. The experience of the analyst should weigh heavily in the interpretation of chromatograms by gas chromatography. See Table X1 (Appendix 1).

D. Calculations

1. The concentration levels in the standard calibration runs and their corresponding peak areas in the standard's chromatograms are used to plot a linear regression curve for each parameter.

   a. This plot can be accomplished on a calculator with statistics functions, or by an automated data system.

   b. The concentration of an identified parameter in the sample chromatogram is quantified by putting its peak area in the linear regression plot of the corresponding standard parameter.

2. If the response for a peak exceeds the working range of the calibration curve and/or the system, prepare a dilution of the sample as described in Section GB-3 for aqueous samples and in Section GB-5 for soil or solid matrix samples.

Aqueous sample calculation:

Concentration from single pt. std. comparison x dilution factor = concentration (µg/L)

Soil sample calculation:

$$\frac{\text{Concentration from single pt. standard comparison} \times \text{dilution factor} \times \frac{\text{5 grams}}{\text{weight of soil purged}}}{\text{fraction}} = \text{concentration } (\mu g/kg \text{ dry weight})$$

E. Glassware for VOC Analysis

1. Sampler tubes and purge tubes used for VOC setup should be cleaned according to glassware SOP and oven dried at about 110° to 120°C for minimum of 2 to 4 hours in an oven exclusive for VOC glassware.

2. Before using, glassware should be cooled to room temperature.

3. Volumetric flasks should never be oven dried.

4. Flasks (100 mL) with the red stripe down the neck are to be dedicated to standards for calibration. These flasks are to be sent for cleaning after one use; before using they are to be rinsed with purified water twice in the volatile testing room.

5. Volumetric flasks (100 mL) without the red stripe on neck are to be dedicated for lab water blanks.

F. Calibration Standards Preparation

1. Fill a 100-mL volumetric flask (with a red stripe down the neck) to the mark with purified water (analyte free).

2. Rapidly inject the standard stock solution into the body of the flask using a syringe with a measured volume according to the concentrations listed on the table on the next page. (Do not inject the standard into the neck of the flask as this will cause error.)

3. Stopper and mix the solution by inverting the flask gently three times only.

4. Proceed to rinse twice a 5.0-mL gastight syringe with a luer lock valve using the prepared standard solution.

5. Fill the barrel of the syringe a third time until it overflows a little; compress the plunger to the 5.0-mL volume mark.

6. Proceed to mount this on the purge and trap sample port according to the method used.

7. The standard solution is unstable and should be discarded after 1 hour.

CALIBRATION STANDARDS TABLE										
	Standard Concentrations (µg/L)*									
	0.5	1.0	5.0	10	20	40	100	500	1,000	5,000
Standard Stock (ppm)	10	10	1,000	1,000	1,000	1,000	1,000			
Syringe Volume (µL)	5.0	10.0	0.5	1.0	2.0	4.0	10.0			
Standard Stock (ppm)	100	100	100	100	100		5,000	5,000	5,000	5,000
Syringe Volume (µL)	0.5	1.0	5.0	10	20		2.0	10.0	20.0	100.0
Standard Stock (ppm)		200	200	200	200	200				
Syringe Volume (µL)		0.5	2.5	5.0	10.0	25.0				

Note:

* To be prepared in a 100-mL volumetric flask.

G. Procedure for the ALS Auto Sampler Setup with Needle Spargers

G-A. **Sampler Tubes**

1. The glass sampler tube attaches to the sampler fitting with Teflon® ferrules.

2. Insert the tube all the way into the fitting making adjustments for the needle sparger, then tighten this fitting finger-tight only.

3. The tip of the needle sparger should be approximately 5 mm from the inside bottom of the sampler tube.

G-B. **Sample Loading on the ALS**

G-B-1. Sample Loading

a. Samples can be loaded in two ways: either by removing the glassware, inserting the sample into the sampler tube, and reinstalling it, or by using a luer lock syringe to load the sample through the sample valve above the sampler fitting.

b. Loading through the sample valve can be done only with aqueous samples. Solids are weighed directly into the sampler tube as described in part B-4 below.

c. When loading through the sample valve, turn the stem to point away from the syringe to open the valve, lock the syringe tip onto the valve and compress the plunger to load, then point the valve stem to the left to close the valve, lastly unlock the syringe tip from the valve.

G-B-2. Loading an Aqueous Sample

a. Remove the plunger from a 5-mL gastight syringe with a luer lock valve attached to the tip.

b. Before filling the syringe barrel with a sample for loading, the barrel must be rinsed at least twice with either purified water or with the sample itself.

c. Open the sample vial to be analyzed and carefully pour the sample into the syringe barrel until it overflows a little.

d. Replace the plunger and compress the sample without air bubbles to a volume of 5.0 mL for loading.

e. Load the sample through the sample valve as described in part B-1 above.

f. For aqueous sample dilution refer to the table in Section B-3 below.

G-B-3. Aqueous Sample Dilutions

a. For dilutions in the range from 1:10 to 1:1,000, fill a well-rinsed 5.0-mL gastight syringe with purified water until it overflows the barrel slightly.

b. Compressing the plunger, adjust the volume according to the table below for the desired dilution.

c. For dilutions in the range of 1:10,000 to 1:100,000, use a 100-mL volumetric flask in place of the 5.0-mL syringe and spike with the sample according to the table.

d. Refer to section on calibration standards preparation for procedure.

AQUEOUS SAMPLE DILUTIONS TABLE

	Dilutions					
Volumes	1:10	1:50	1:100	1:1,000	1:10,000	1:100,000
Water	4.5 mL	4.9 mL	4.95 mL	5.0 mL	100 mL	100 mL
Sample	500 µL	100 µL	50 µL	5 µL	10 µL	1 µL

G-B-4. Loading a Soil Sample

a. Before using the Mettler balance, check the calibration once daily and sign the calibration log book.

b. Tare out a clean, dry sampler tube on the balance to zero.

c. Open the soil sample vial or jar, remove a top layer of soil, and discard it.

d. Proceed to remove approximately 5 grams of soil and place it along the inside wall of the tube so as not to plug the needle sparger when mounting the tube on the ALS.

e. Reweigh the sampler tube with soil and record the weight on the injection log sheet.

f. Quickly mount the sampler tube as described in Section G-A above.

g. Using a 5-mL gastight syringe with a luer lock tip, add 5.0 mL of purified water to the mounted soil sample by loading it through the sample valve as described in Section G-B above.

G-B-5. Soil Sample Extractions

a. Soils that have medium to high levels of contamination are usually extracted at a 1:1 ratio (5 grams of soil per 5.0 mL extraction liquid).
b. Tare out a 14-mL clean, dry vial to zero on the Mettler balance.

c. Add 5.0 grams of the soil sample to the vial.

d. Record the weight of the soil with the RMT sample number on a small white label. Attach the label with scotch tape over it to the vial.

e. Add 5.0 mL of methanol (Purge & Trap Grade) to the vial using a 5.0-mL volumetric pipet.

f. Cap the vial with a screw cap and Teflon®-lined septum disc.

g. Shake contents of vial for 2 minutes to extract the soil.

h. Let the extract settle until the methanol becomes clear of particulates.

i. Use this methanol extract for water dilutions according to the table below. Proceed as in section G-B-3.

SOIL EXTRACT DILUTION TABLE

Volume	1:50	1:100	1:1,000	1:10,000	1:100,000
Water	4.9 mL	4.95 mL	5.0 mL	5.0 mL	100 mL
Extract	100 µL	50 µL	5 µL	0.5 µL	1.0 µL

G-C. **Needle Sparger Cleanup**

1. After each sample run the needle sparger must be rinsed through at least once and wiped off with a clean wipe.

2. Fill a clean 5.0-mL syringe to overflowing with purified water, insert the plunger 1 centimeter, lock the syringe tip onto the sampler valve, open the valve up by pointing its stem toward the back, and rinse through the needle by compressing the plunger all the way.

3. Catch the rinse water at the end of the needle with a small beaker.

4. Reinstall a clean, baked sampler tube to the fitting of the cleaned needle sparger.

H. Procedure For the 4200 Auto Sampler Setup

H-A. **Purge Tubes**

1. The purge tube slides up through the sample mount fitting from the bottom.
2. Do not insert or remove purge tubes from the top. This will contaminate the top set of Teflon® ferrules and produce carryover problems.
3. Insert the purge line septum plug into the purge tube so that the Teflon® portion is all the way inside the top of the purge tube.
4. Tighten the top fitting 1/4 turn past finger tight using the special wrench provided.

H-B. **Sampler Tubes**

1. The glass sampler tube attaches to the sampler mount with Teflon® ferrules.
2. The glassware should be inserted as far as possible using the mounting tool provided, then pulled out slightly and tightened.
3. If the glassware is not pulled out slightly, hairline cracks may develop on the upper edge of the tube as the fitting is tightened.
4. The mounting tool is used as follows: place the sampler tube inside the tool, raise the tool all the way up and around the mount nut, pull back slightly, and tighten the mount nut snugly around the tube by turning the tool to the right.
5. Note: Before loading a sample into the sampler tube, be sure the tip of the purge tube is approximately 5 mm from the bottom of the sampler tube.

H-C. **Loading a Water Sample**

1. Remove the plunger from a 5.0-mL gastight syringe with a luer lock valve attached to the tip.
2. Fill the barrel with either purified water or the aqueous sample and compress the plunger all the way.

3. The syringe must be rinsed this way at least twice through before loading the sample.
4. Fill the barrel a third time with the sample to be analyzed until it overflows the barrel a little.
5. Replace the plunger and compress the sample without air bubbles to a volume of 5.0 mL.
6. Unload the syringe with the 5 mL of sample directly into the sampler tube by allowing the water to flow into the tube alongside the inside wall of the tube thus avoiding any agitation or spraying of the aqueous sample.
7. Mount the sampler tube quickly using the mounting tube provided as described in Section H-B. above.
8. For aqueous sample dilutions refer to section G-B-3.
9. Note: The handling of water samples for VOC analysis must be done carefully and quickly since sample validity may diminish rapidly as soon as the vial is opened and the sample is exposed to the air where volatiles can escape.
10. When the last sample is mounted on the 4200, set the sample selector to the proper value.

H-D. **Loading a Soil Sample**

1. Before using the Mettler balance, check the calibration once daily and sign the calibration log book.
2. Tare out a clean, dry sampler tube on the balance to zero.
3. Open the soil sample vial or jar, remove a top layer of soil, and discard it.
4. Proceed to remove approximately 5 grams of soil and place it along the inside wall of the sampler tube so that the purge tube will reach to the bottom of the sampler tube when it is mounted.
5. Reweigh the sampler tube with soil and record the weight on the injection log sheet.
6. Quickly mount the sample using the mounting tool as described in Section H-B.
7. Using a 5 mL-gastight syringe with a luer lock tip, add 5.0 mL of purified water to the mounted soil sample by injecting it through the top of the purge tube.
8. Insert the purge line septum plug.

H-E. **Sample Heaters**

1. The sample heaters are to be used with soil samples.
2. The heating jackets slide up over the mounted sampler tubes.
3. There are two "ears" on the jacket. The "ear" with a hole in it should face the front and align with the guidepost in front of the sampler mount fitting.
4. Slide the jacket up as far as it goes.
5. Temperature sensor and heater power connections are made automatically.
6. Set the preheat switch to 4 minutes, the heater switch to auto, and the sampler selector to the proper value.

H-F. **Temperature Settings**

Sample 40°C (for soils)
Line 100°C
Valve 100°C

These temperatures are adjusted by small screws at the top right hand corner of the front panel. Once they are set, further adjustment is unnecessary.

H-G. **Soil Extractions**

Refer to Section G-B-5.

I. Maintenance

The following table lists the general maintenance schedule for the purge-and-trap GC-VOA systems. Most of the maintenance concerns the detectors.

EQUIPMENT	ACTION	FREQUENCY
ELCD detector	Keeping Propanol filled	Check Daily
	Change Resins followed by recalibration	Every 6 months
	Change Reaction Tube	Every 6 months

J. INTERFERENCES

1. High Concentrations

If a sample contains an analyte at a very high concentration, it may carry over into the next analysis, or may reproduce itself when the same autosampler port is used. Samples may be screened to help prevent this from occurring. When it does occur, the purge-and-trap system lines are flushed and blanks are run through the system to ensure the analyte has been removed.

2. Moisture

Moisture usually results in negative interference and excessive baseline noise. This is most notable on an ELCD detector. It is a result of moisture entering the detector, usually through the column.

Moisture traps are used on all carrier gasses. The purge-and-trap method, however, is quite conducive to moisture entering the column through the transfer line from the trap during the desorb stage. To minimize this, certain analyte traps have been designed that do not trap much moisture. There is usually a trade-off, however, with how well they trap water soluble compounds. The industry also has responded to this problem by including moisture control apparatus on many purge-and-trap systems. These apparatus work by attempting to condense out moisture before it is desorbed onto a column.

K. SAFETY

RMT's Laboratory Health and Safety manual is read and understood by every analyst and technician prior to working with hazardous substances. Particular stress is given to eye safety, hood usage and flammability concerns. Please refer to the manual for specific information.

LIST OF ANALYTES

The following is the list of analytes reported by this method with their normal reporting limits. There are other analytes that can be analyzed by this method. Detection limits may vary with instrument conditions.

Compound Name	Water Reporting Limit in µg/L	Soil[1] Reporting Limit in µg/kg
1,1-Dichloroethane	1.0	1.0
1,1,1-Trichloroethane	1.0	1.0

[1] Wet weight bases

APPENDIX 1

TABLE X1

PACKED COLUMN CHECK STANDARD LIMITS - WATER

Compound	Lower Limit (%)	Upper Limit (%)
1,1-Dichloroethane	72.10	131.2
1,1,1-Trichloroethane	80.89	129.6

ATTACHMENT V

RMT LABORATORIES QUALITY ASSURANCE MANUAL

QUALITY ASSURANCE MANUAL
RMT LABORATORY

Prepared by:

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Approved for Issue:

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Senior Vice President
Operations

COPY NO. _____

20.96:LAB:QAmanual

STATEMENT OF MANAGEMENT POSITION

RMT, Inc., is committed to producing analytical work of the highest quality to meet the needs of their clients and to assist in complying with all regulatory requirements.

This manual shall serve as a statement of the Company's quality assurance policies. Adherence to the procedures listed in this manual shall be the responsibility of all RMT Laboratory employees. Laboratory management shall be responsible for seeing that the principles and practices outlined in the manual are followed.

R. Alan Doughty
Laboratory Director
August 1, 1988

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1.0 INTRODUCTION

The purpose of the RMT Laboratory Quality Assurance Program is to verify that analytical data provided by the laboratory are of good quality and meet all pertinent regulatory requirements. This requires a comprehensive program which controls:

- Sample collection
- Sample receipt
- Sample handling
- Sample log-in
- Sample preservation
- Sample processing
- Sample analysis
- Equipment maintenance
- Equipment calibration
- Data calculation
- Data reporting
- Records maintenance
- Data review
- Management responsibilities

This manual is intended to be a summary of the quality assurance procedures used in this laboratory.

1.1 QUALITY ASSURANCE OBJECTIVES

The goal of any laboratory quality assurance program is the production of laboratory data of known quality. This requires a comprehensive and effective quality control program to measure and verify laboratory performance, and the use of approved or proven methods to produce data that is accurate, precise, and complete. In addition, the system must identify factors which adversely affect quality and provide for corrective action where required. The system must also provide for the maintenance of records relating to sample submittal and the production of laboratory data.

Specifically, the quality assurance program must address the following topics:

- Specifications for supplies and instrumentation
- Sample receipt, chain-of-custody forms and sample storage
- Sources of laboratory methods
- Instrument calibration and preventive maintenance
- Statistical analysis of quality control data
- Data validation and reporting
- Laboratory records
- Corrective action
- Staff training
- Laboratory audits

1.2 QUALITY ASSURANCE DOCUMENTS

There are several types of quality assurance documents.

- The Quality Assurance Manual provides the overall policy for the laboratory.
- Standard Operating Procedures (SOP's) are detailed instructions outlining a specific routine task performed in the laboratory.

- Project Specific Manuals may be prepared where a project requires unique or different quality assurance requirements or when they are required by regulatory agencies. These documents are frequently called Quality Assurance Project Plans (QAPP's).

1.3 DOCUMENT CONTROL

All of the Quality Assurance Documents listed above shall be approved and controlled documents as spelled out in this paragraph. The Quality Assurance Manual shall require the approvals of the Senior Vice President - Operations and the Laboratory Director before changes are issued. SOP's shall be approved by the Laboratory Director. QAPP's require the approval of the Project Manager. These documents shall be signed and dated by these responsible individuals before issuance.

The Quality Assurance Manual and the SOP's shall be numbered, and distribution lists shall be maintained so that all appropriate individuals receive updates. Revisions shall require the same signature levels as the originals and shall be consecutively numbered. All revisions shall be accompanied by a receipt which shall be signed and returned to signify that the revision has been received and placed in the proper location.

Unnumbered copies of quality assurance documents may be issued to parties outside of RMT, Inc. Where required, a numbered copy may be issued to parties outside of the Company. This numbered copy shall be updated the same as internal copies but must be returned to RMT, Inc. when the need for the document no longer exists.

2.0 LABORATORY ORGANIZATION

This section outlines the quality assurance responsibilities of the laboratory staff.

2.1 QUALITY ASSURANCE RESPONSIBILITIES

The quality assurance responsibilities of the RMT staff are listed below:

- The Laboratory Director:
  - Reports directly to the Senior Vice President - Operations at RMT, Inc.
  - Is responsible for the proper functioning of the Quality Assurance Program within the laboratory.
  - Issues laboratory reports.
  - Maintain's the current laboratory organization chart.
  - Is responsible for laboratory participation in interlaboratory proficiency programs.
  - Is responsible for laboratory certification
- The Operations Manager:
  - Serves as designate for Laboratory Director when he is absent.
  - Organizes work and ensures its timely completion.
  - Monitors laboratory expenses.
  - Oversees sample log-in and documentation, sample storage, and sample disposal.
- The Inorganic and Organic Supervisors:
  - Provide technical overview of the inorganic and organic groups.
  - Are responsible for training and continuing compliance of analysts with methods, standard operating procedures, and quality assurance requirements.
  - Serve as technical specialists to adapt methods in areas of new or unique technologies.

- Review the work of Group Leaders.
- Serve as technical specialists and consultant in areas of software used in the inorganic and organic groups.
- Define the preventive maintenance and calibration programs for laboratory instrumentation.
- Establish standards for laboratory supplies, chemicals, and standards.
- Review and approve RMT and subcontractor data.

. The Quality Control Coordinator:

- Performs statistical analysis on quality control data.
- Reviews statistical data from laboratory quality control samples.
- Maintains round-robin quality control programs and results.
- Reviews nonconformance reports.
- Maintains extensive records and archives of quality assurance data.
- Is responsible for assuring the documentation and resolution of nonconformances.
- Stops production of laboratory data when quality control data demonstrate significant trend problems.
- Conducts a monthly laboratory quality assurance audit.
- Establishes a laboratory quality assurance training program.
- Reports to the Laboratory Director on the status of quality control program and audit results.
- Recommends methods, standard operating procedures, and quality control procedures to the Laboratory Director, Project Managers, and Client Services.

. The Group Leaders:

- Report to the appropriate Group Supervisor.
- Serve as lead analyst within their service group.
- Review data generated by their staff.

- Are responsible for instrument performance, calibration, and preventive maintenance.

- Take an active role in cross-training.

- Report out-of-control situations to the Quality Control Coordinator by completing nonconformance reports.

- Maintain adequate and appropriate quantities of laboratory supplies.

. The Analysts/Sample Preparation Personnel:

- Perform methods, data recording and data validation using prescribed methods.

- Report out-of-control situations and nonconformances to the Group Leader or Supervisor.

. The Client Services Coordinator:

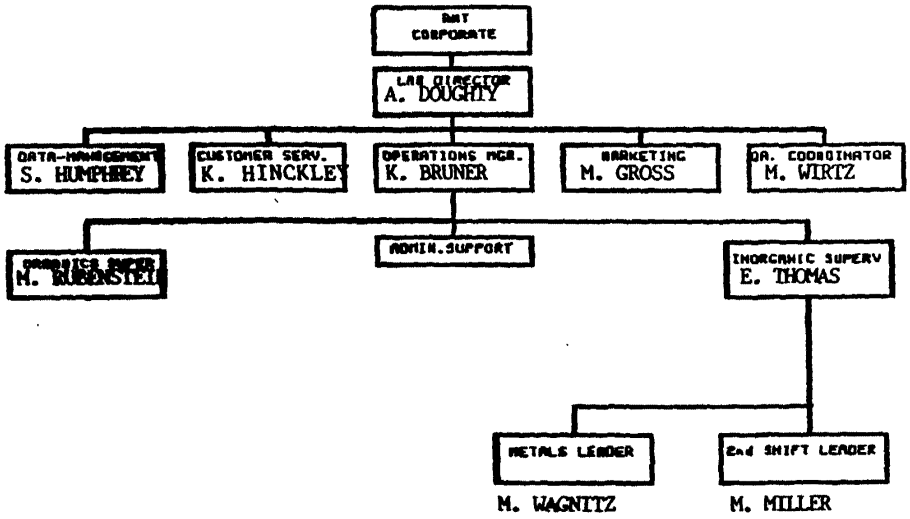
- Organizes incoming projects.

- Resolves problems with internal RMT clients.

FIGURE 2-1

12-1-1988

RMT LABORATORY



RMT

3.0 STANDARD LABORATORY PRACTICES

There are many laboratory functions that need to be controlled before and after analysis to produce good quality data. These functions, along with the actual analysis, comprise the daily Quality Assurance Program.

It must be recognized that each quality function is, to some extent, dependent on those which preceded it. This means that each quality function must be controlled or specified, and verification of the steps taken must be documented.

This section summarizes those quality functions which are discussed in more detail in Sections 4.0 trough 13.0.

3.1 MATERIAL PROCUREMENT

The grades of chemicals, solvents, gases, and water shall be specified and verified. The tolerances and types of glassware shall be specified, as well as the procedures to be used in cleaning glassware. All reagents shall be dated when received and when opened. All reference standards shall be marked with a lot number, dated and have purity specified.

3.2 SAMPLE RECEIPT

The following steps shall be taken by the Sample Coordinator when samples arrive in the laboratory:

- Case seals and sample seals shall be examined for integrity.
- Samples shall be examined for proper labels, damage, proper preservatives and temperature, and compared to the chain-of-custody.
- The chain-of-custody form shall be signed.

- Samples shall be stored under the proper environmental conditions, and their location and condition shall be noted in the appropriate log.
- Samples shall be entered into the Laboratory LIMS System.
- A Sample Acknowledgment Form shall be filled out and sent to the project manager.
- Supervisors shall be notified of the arrival of the samples.

3.3 INSTRUMENT CALIBRATION AND PREVENTIVE MAINTENANCE

Calibration may be against either national standards (for instruments which measure parameters such as mass, time, and temperature) or against chemicals of known composition and concentration. It may be daily as part of instrument usage or at specified calendar periods such as quarterly or yearly. Detailed procedures can be found in Section No. 6.0 of this manual.

Preventive maintenance involves scheduling regular service for instruments, maintaining an adequate inventory of spare parts, and keeping instrument log books so that the performance of an instrument over time can be assessed. See Section No. 7.0 for details of this program.

3.4 ANALYTICAL PROCEDURES

The analyst shall verify that sample holding times (see Section No. 5.0) and sample storage requirements have been met, and that analysis is by approved methods or by methods specified by the client. Otherwise, the data shall be qualified.

3.5 DATA QUALITY CONTROL

Verification of analytical data requires: 1) calculation of quality control data, 2) comparison with acceptance limits for accuracy and precision, and 3) independent validation of the analytical results by another person.

3.6 CORRECTIVE ACTION

If the quality control data are not within the specified limits, the cause shall be determined. It may be necessary to re-analyze all affected samples, to raise detection limits, or to qualify the data.

3.7 DATA HANDLING AND VALIDATION

The methods shall include the computational process to be used for determining analytical results. The data shall be reviewed by a second individual.

3.8 LABORATORY REPORTS

The analytical data reports shall be reviewed by the Group Supervisors for accuracy and completeness before being reviewed and signed by the Laboratory Director or his designee.

3.9 RECORDS MANAGEMENT

The document control system shall cross-reference laboratory records so that the proper functioning of the Quality Assurance Program shall be demonstrated. The list of documents to be retained and their location, is outlined in Section No. 12.