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FEED MATERIALS PRODUCTION CENTER SAMPLING AND ANALYSIS REPORT - VOL 1 OF 2, DRAFT, DOE, OAK RIDGE OPERATIONS OFFICE OAK RIDGE, TN - (USED AS A REFERENCE IN OU 2 RI REPORT)

06/00/88

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REPORT

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Feed Materials Production Center

Sampling and Analysis Data Document

This document contains uninterpreted sampling and analytical data. The data will be interpreted by the DOE Environmental Survey Team and used with the tentative Survey findings contained in the Environmental Survey Preliminary Report. Final Survey findings will be contained in the Environmental Survey Interim Report.

DRAFT PART 1

DEPARTMENT OF ENERGY

ENVIRONMENTAL SURVEY

000001

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DEPARTMENT OF ENERGY

ENVIRONMENTAL SURVEY

000002

DOE ENVIRONMENTAL SURVEY
FEED MATERIALS PRODUCTION CENTER
SAMPLING AND ANALYSIS DATA DOCUMENT

June 1988

Prepared by:

DOE Environmental Survey

and

Argonne National Laboratory

for the

U.S. Department of Energy
Office of Environmental Audit
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PREFACE

The environmental survey of the Feed Materials Production Center (FMPC) in the vicinity of Fernald, Ohio, is part of a larger DOE-wide Environmental Survey announced by Secretary of Energy John S. Herrington on September 18, 1985. The purpose of this effort is to identify existing environmental problems and areas of environmental risk at Department of Energy facilities, and prioritize them department-wide using a consistent risk-based ranking methodology.

The environmental survey, and resulting sample collection and analysis at FMPC, occurred prior to the reorganization of the DOE Environmental Survey. Although the sampling and analysis requests supplied by the Survey Team generally specified the number and type of samples to be collected and the analyses to be performed, the requests did not define environmental problems or sampling objectives. Thus, environmental problems and objectives were defined as this report was being prepared. Many of the procedures and protocols that are now required by the DOE Environmental Survey Manual did not exist at the time the site was sampled and analyses were performed. The Sampling Plan for the Feed Materials Production Center was developed largely according to the guidance supplied by the Draft Environmental Survey Manual (May 1986), in combination with many of the EPA sampling procedures. Therefore, it may be difficult to compare data from this site to others in the Environmental Survey which were subject to other methods and procedures.

Because of the unique nature of the sampling and analysis conducted for FMPC, this report presents considerable information supporting sampling, analysis, and related activities. The information provides a framework for interpreting the data presented in this report. It is recommended, therefore, that the data be used only within the context of this supporting information.

FEED MATERIALS PRODUCTION CENTER SAMPLING AND ANALYSIS DATA DOCUMENT

1 INTRODUCTION

The purpose of this document is to present the DOE Environmental Survey with field and analytical data collected by the ANL sampling and analysis team at the Feed Materials Production Center (FMPC). This document will be used by the Survey Team to prepare the Interim Report for FMPC, which will contain final findings and the interpretation of the sampling and analysis data.

Volume I of this document contains five sections. Section 1 provides background information on the DOE Environmental Survey Sampling and Analysis Program, a description of the FMPC survey and sampling team efforts, and background information on the FMPC. Section 2 is an executive summary describing the scope of the sampling and analysis (S&A) effort, an overview of results, and summary statements on each environmental problem. Section 3 provides a brief description of field and analytical procedures, while Section 4 contains important information on how to evaluate the S&A data plus the main data presentations on each environmental problem. Quality assurance (QA) data are presented and discussed in Section 5.

Volume II contains Appendices A through E. Appendix A contains analytical procedure summaries; Appendix B provides sampling and analytical requests; Appendix C lists all relevant QC data; Appendix D presents the findings of EPA audits of the ANL Analytical Chemistry Laboratory; and Appendix E presents a complete listing of the analytical results.

1.1 PURPOSE OF THE DOE ENVIRONMENTAL SURVEY

The Environmental Survey of the Feed Materials Production Center near Fernald, Ohio is part of the larger DOE-wide Environmental Survey announced by Secretary of Energy John S. Herrington on September 18, 1985. The purpose of this effort is to identify existing environmental problems and areas of environmental risk at DOE facilities, and prioritize them department-wide using a consistent risk-based ranking methodology. This ranking will enable DOE to more effectively establish priorities for addressing environmental problems and to more efficiently allocate the resources necessary to correct these problems. Because the Survey is "no fault" and is not an "audit," it is not designed to identify specific isolated incidents of noncompliance, or to analyze environmental management practices. Such incidents and/or management practices, however, will be used in the Survey as a means of identifying existing and potential environmental problems. Additionally, the Survey is not intended to be a substitute for the ongoing efforts of DOE Operations Offices or facilities to characterize and correct environmental problems, and to pursue environmental compliance; rather, it is designed to complement and coordinate those efforts.

For purposes of the Survey, environmental problems are defined as either of the following: (1) situations resulting from DOE operations where pollutants or hazardous materials exist in the air, surface water, groundwater, or soil, in concentrations that pose or may pose a hazard to human health or the environment, and (2) the existence of conditions at a DOE facility that pose or may pose a hazard to human health or the environment. The levels of such materials that constitute an environmental problem are generally those that exceed some federal, state, or local statute or regulation for release of, contamination by, or exposure to such materials. In some cases, the Survey may determine that the presence of some nonregulated material is in a concentration or situation that presents the potential for sufficient hazard to the local population or the environment to be termed an environmental problem. The presence of regulated materials at concentrations below those established by regulatory authorities might also be classified an environmental problem based on consideration of the actual or potential hazard.

A good deal of professional judgment is applied to the identification of environmental problems. Likewise, environmental risk is based on conditions judged to have a relatively high probability for the release of pollutants to the environment. Environmental risk situations are those in which pollutants are not necessarily found in the environment, but where the likelihood of the occurrence of releases is high, e.g., due to the condition or design of pollution abatement equipment or engineered barriers to pollution migration. Waste handling, storage, and disposal conditions could also constitute environmental risk where hazardous materials are not currently being released, but could be released under feasible accident scenarios (including equipment failure and human error).

The DOE Environmental Survey involves the review of approximately 40 DOE facilities over a 2.5 year period. Five Survey teams, led by DOE Headquarters personnel and supported by outside experts, review and analyze site environmental information prior to conducting extensive on-site observation of facilities, operations, and associated environmental controls and procedures. Use of existing information is made, including interviews with knowledgeable DOE and site contractor personnel. These "findings" are subject to modification based on the results of the sampling and analysis described in the Environmental Survey Sampling and Analysis Report, comments on technical accuracy from the operating contractors and knowledgeable DOE area and operations offices, and the receipt of any other new information. The modified preliminary findings are then incorporated into an Interim Report for each site, which ultimately serves as the primary source of information for the Environmental Survey Report including Department-wide prioritization.

1.2 OVERVIEW OF THE SAMPLING AND ANALYSIS PROGRAM

After the on-site portion of each environmental survey, sampling and analysis activities begin with the development of the Sampling and Analysis Plan. The plan focuses on the sampling and analysis requirements for each selected environmental problem that is in need of additional information and culminates in the actual on-site field sampling, corresponding laboratory analysis, and the eventual reporting of results.

These data are then combined with data from the Preliminary Report to produce the Survey Interim Report. The planning, preparation, and review process for each site is shown in Figure 1.1.

The goal of the S&A Program is to strengthen the environmental data base for each site by complementing the Survey's preliminary findings with additional information to further determine the existence and nature of environmental problems and risks. Selective sampling and analysis will be performed to fill data gaps by identifying the presence of contaminants and, in some cases, by defining the general nature of contamination for those environmental problems requiring further investigative information.

Sampling and analysis is not intended to characterize a site's environmental problems by determining specific contaminant boundaries, rate of contaminant movement, or contaminant concentration gradients; nor will sampling and analysis duplicate DOE Operations Offices and/or site-sponsored sampling and analysis activities. It will, however, help complete information gaps by identifying the presence and, in some limited cases, the approximate location and direction of movement of contaminants for those environmental problems chosen by the Survey Team for follow-up sampling and analysis.

Sampling and analytical support for the DOE Environmental Survey is provided by complementary sampling and analysis teams from Argonne National Laboratory (ANL), Oak Ridge National Laboratory (ORNL), Idaho National Engineering Laboratory (INEL), Battelle-Columbus Division (BCD), and the Oak Ridge Gaseous Diffusion Plant (ORGDP).

These teams operate under the general technical guidance of the Sampling and Analysis Program Manager from the DOE Office of Environmental Audit, but report directly to the various DOE Survey Team Leaders for on-site sampling and analysis coordination and other Survey activities. Each laboratory, with their respective teams, participates in the development and preparation of Sampling and Analysis Plans, conducts the specific sampling and analysis described in each site Sampling and Analysis Plan, and prepares the Sampling and Analysis Data Document for each site survey they support. For further details on the Sampling and Analysis Program, refer to Chapter 4 and Appendix K of the DOE Environmental Survey Manual.

1.3 THE FEED MATERIALS PRODUCTION CENTER ENVIRONMENTAL SURVEY

The FMPC environmental survey was the second to be performed under this program. A survey was conducted of all media by a multidisciplinary team of environmental specialists, led and managed by DOE's Environment, Safety, and Health's Office of Environmental Audit. The survey was conducted from June 16 through 27, 1986. The DOE Team Leader was Randy Scott and the Assistant Team Leader was Chris Grundler. The remainder of the Survey Team was composed of technical specialists provided by a private contractor. The team included W. Smith, the Team Coordinator; M. Malloy, QA/toxics; R. Tarbert, surface water; J. Crist and H. Firstenberg, air; D. Daugherty and C. Yates, radiation; P. Alexandro, waste management; G. Kelly, inactive waste sites; and D. Riddle, hydrogeology.

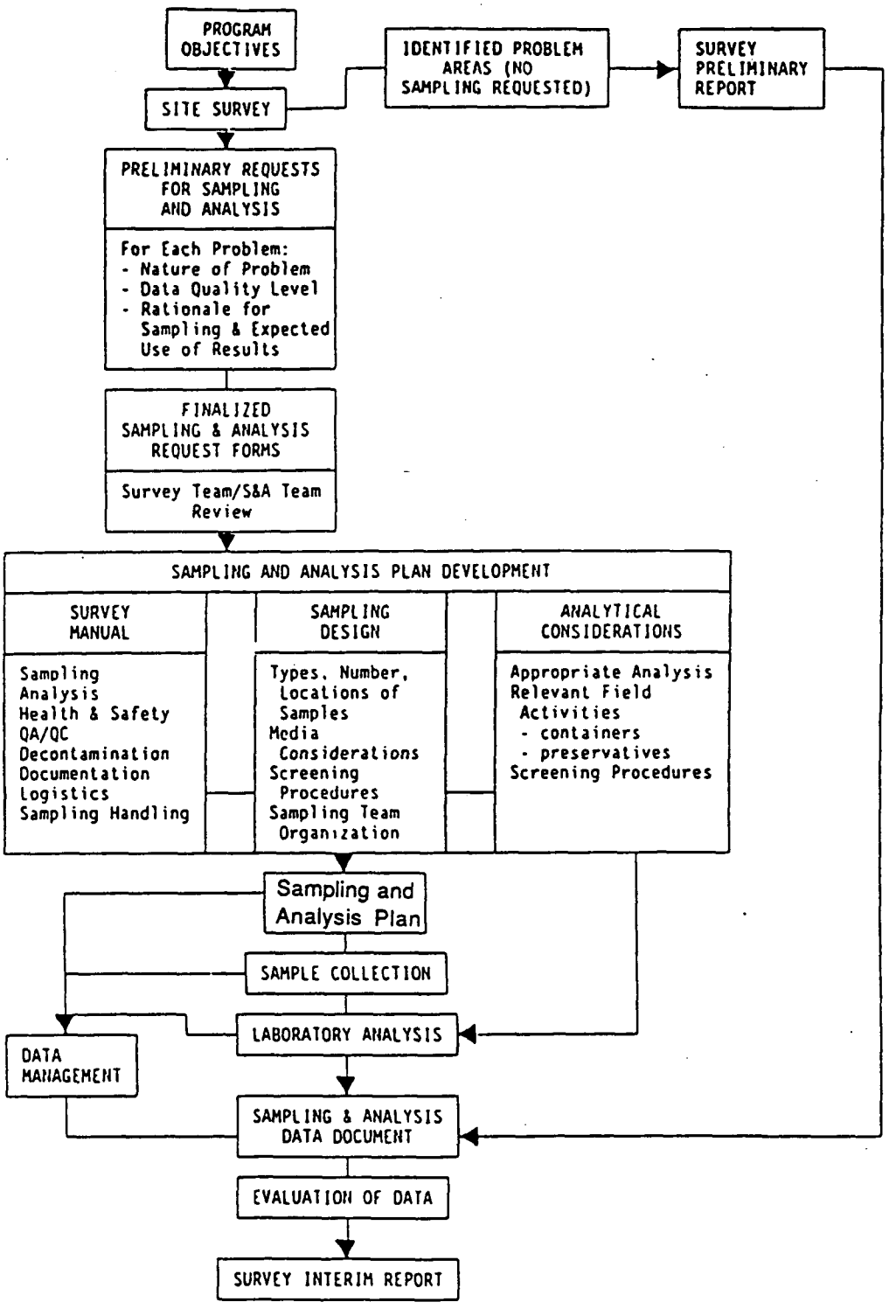


FIGURE 1.1 Activities Leading to the Survey Interim Report

The Survey Team prepared a Preliminary Report in March of 1987 that described the existing and potential environmental problems at FMPC and placed them into one or more of four categories, depending on the team's assessment of the impact and risk of the problem. Problems in Category I are those which involve immediate threat to human life. These are addressed immediately by site personnel. Category II findings included environmental problems where the risk is high but where the definition of risk is broader than in Category I. Information exists on the identity of the problem, but it may be insufficient to fully characterize it. Category III findings are those environmental problems for which the broadest definition of risk is used. These are potential problems, but insufficient information exists to fully characterize them. Category IV findings include instances of administrative noncompliance and management practices that are indirectly related to environmental risk, but are not appropriate for inclusion in other categories. Generally, the Category II and III findings are those investigated by the Sampling and Analysis Team. The data generated from the field sampling effort will provide additional information to further characterize the problems.

The overall objective of the Sampling and Analysis Program is to assist the Survey by providing data of known quality that identifies the presence of contaminants and general zone of contamination associated with environmental problems at the various sites under investigation.

1.4 FMPC SITE SAMPLING AND ANALYSIS

At the time of sampling and analysis for FMPC, the present Environmental Survey comprehensive requirements and guidelines designed to ensure the comparability and data quality of results (as discussed in the preceding paragraphs) were not in place. Instead, the sampling plan was developed and implemented under a less comprehensive set of guidelines contained in the May 1986 draft version of the DOE Environmental Survey Manual (ESM).

The purpose of this report is to present all the information from the sampling and analysis activities that is necessary for the preparation of the Interim Survey Report. Enough information on procedures employed during the FMPC sampling and analysis is provided to support an independent appraisal regarding data quality and comparability relative to data from other DOE sites in the survey.

1.5 SAMPLING AND ANALYSIS TEAM

1.5.1 Field Personnel

The Argonne National Laboratory (ANL) equipment and mobilization team arrived at FMPC on September 9, 1986. The ANL field sampling team arrived at FMPC on September 15. The first samples were collected on September 18. Sample collection was largely complete by October 10, with remaining activities being limited to well installation and air sampling. Air sampling was completed by mid-November and samples from groundwater monitoring wells were collected during June 1987.

While the Sampling Team was at FMPC, 21 people took part in some phase of the sampling effort. The per person amount of time spent on site varied -- some team members spent almost the entire period there, while most were involved for only a portion of the time. Team member's names and their duties are listed in Table 1.5.1. Team members were rotated to accommodate other commitments as well as to allow the maximum number of people to become trained in field procedures. In addition to the ANL team members, subcontractors were also involved in three areas of the sampling effort (drum sampling, well installation and backhoe trenching).

All media team leaders and most team members had received training in field sample collection procedures prior to arriving at the site. The training was based on the May 1986 draft DOE Environmental Survey Manual.

Many team leaders and members had extensive previous field experience.

1.5.2 Analytical Laboratory Personnel

The Argonne National Laboratory Analytical Chemistry Laboratory personnel who participated in the handling or analysis of FMPC samples are listed in Table 1.5.2.

1.6 SITE LOCATION AND DESCRIPTION

The site description summarized here is taken from U.S. Department of Energy, Environment, Safety, and Health Office of Environmental Audit, Environmental Survey Report: Feed Materials Production Center, Fernald, Ohio. March 1987.

The Feed Materials Production Center (FMPC) is located in a rural area of southwestern Ohio, near the community of Fernald. Less than 100 people live within 1 to 6 kilometers of the site. Approximately 11,000 people live within 8 kilometers. The site occupies a total of 425 hectares (1,050 acres), bounded on the south by Willey Road, on the west by Paddy's Run Road, on the north by farm land and State Route 126, and on the east by a dairy farm (see Figure 1.6.1). Production facilities occupy 55 hectares (136 acres) in the center of the site. All of the production and waste storage areas lie within Hamilton County, Ohio.

The FMPC was originally constructed in 1954 to produce high purity uranium-metal in various physical forms and isotopic assays. Most of the production metal is cast into ingots, for eventual fabrication into fuel cores for production reactors at the Hanford Reservation near Richland, Washington, and the Savannah River Plant near Aiken, South Carolina. A wide variety of chemical and metallurgical process steps are utilized.

A small amount of thorium processing was also performed in the past, but present thorium activities are limited to storage. Small quantities of fission products (Sr-90, Cs-137, and Tc-99) and transuranics are also possible in some plant effluents and wastes as a consequence of processing of recycled fuel.

TABLE 1.5.1 Field Sampling Team Members and Duties

Name	Duties
Program Manager	
Stephen Ballou	
Site Team Leaders	
Kevin Flynn	
Donald McCown	
Water	
Kevin Flynn	Team leader/member
Charlotte Sholeen	Team member/leader
Norbert Golchert	Team member
Norbert Kretz	Team member
Marshall Monarch	Team member
George Mosho	Team member
Howard Svoboda	Team member
Soil	
Kevin Flynn	Team leader
John Taylor	Team leader/member
Conrad Tome	Team member/leader
Kenneth Brubaker	Team member
Duane Knudson	Team member
George Mosho	Team member
David Reilly	Team member
LaVern Trevorrow	Team member
Groundwater	
Marshall Monarch	Team leader
Steve Miller	Team member
Air	
McLouis Robinet	Team leader
David Reilly	Team member
Kenneth Brubaker	Team member
Radiological	
McLouis Robinet	Team leader
George Mosho	Team member
David Reilly	Team member
Charlotte Sholeen	Team member
Kevin Flynn	Team member
Marshall Monarch	Team member
Special	
Kenneth Brubaker	Team leader
Marshall Monarch	Team leader
Charlotte Sholeen	Team leader

TABLE 1.5.1 (Cont'd)

Name	Duties
Decontamination	
Kenneth Brubaker	
Duane Knudson	
Conrad Tome	
QA/QC Coordinator	
Jacob Sedlet	
Health & Safety Coordinator	
James Woodring	
Robert Utesch	
Logistics	
Marshall Monarch	
Carl Bebrich	
Richard Bowen	
Shipping	
Richard Bowen	
Bruce Cook	

The makeup of the FMPC consists of eight separate operations plants, support buildings and facilities, and waste treatment and storage facilities. Figure 1.6.2 is a diagram of the plant layout. Waste storage facilities are located on the west side of the plant and include tanks (silos) and both active and inactive (covered) shallow pits.

The site is located on an elevated plain approximately 177 meters (580.7 feet) above sea level. Topography is generally level; the land rises to 213 meters at the northern boundary and slopes downward (168 meters) to Paddy's Run on the west. The FMPC is situated in the Great Miami River Basin. Natural surface drainage of the site is to Paddy's Run, an intermittent stream discharging to the Great Miami River. The river valley contains unconsolidated glacial drift deposits to a depth of 46 to 61 meters. Most of the glacial drift is covered by approximately 15 meters of clay-rich till, which restricts infiltration of surface water; however, there are regions where sand and gravel deposits extend to the surface. In the area of the FMPC, a thin clay layer, about 38 meters below the surface, divides the sand and gravel deposits into two layers (see Fig. 1.6.3).

The average daily temperature for the site area ranges from 0° in the winter months to the low 20°C's in summer months. Average annual precipitation is approximately 96 centimeters (37.8 inches). Prevailing winds are from the south-southwest with average monthly speeds ranging from 10.8 to 18.0 kilometers per hour (6.7 to 11.2 miles per hour).

TABLE 1.5.2 Analytical Team Members

Laboratory Manager/Administration
- Peter Lindahl

Quality Assurance Coordinator
- Fredric Martino

Sample Receiving
- Lilia Mojica

Radiological Analysis
- Lynn Gillis
- Donald Graczyk
- Robert Heinrich
- Frank Markun
- Everett Rauh
- Elane Streets

Organic Analysis
- John Schneider
- Amrit Boparai
- Mary Hansen
- Elizabeth Hwang
- Mary Picel
- Ronald Wingender

Inorganic Analysis
- Ralph Bane
- Alice Essling
- Irene Fox
- Edward Huff
- Kenneth Jensen
- Steven Newnam
- Florence Williams

Subcontractors
- Hazleton Laboratories of America, Inc. - volatile and semi-volatile organic analyses
- Teledyne Isotopes - radiological analyses
- McCrone Environmental Services, Inc. - asbestos determinations
- Gulf Coast Laboratories - total organic carbon and total organic halogen analyses

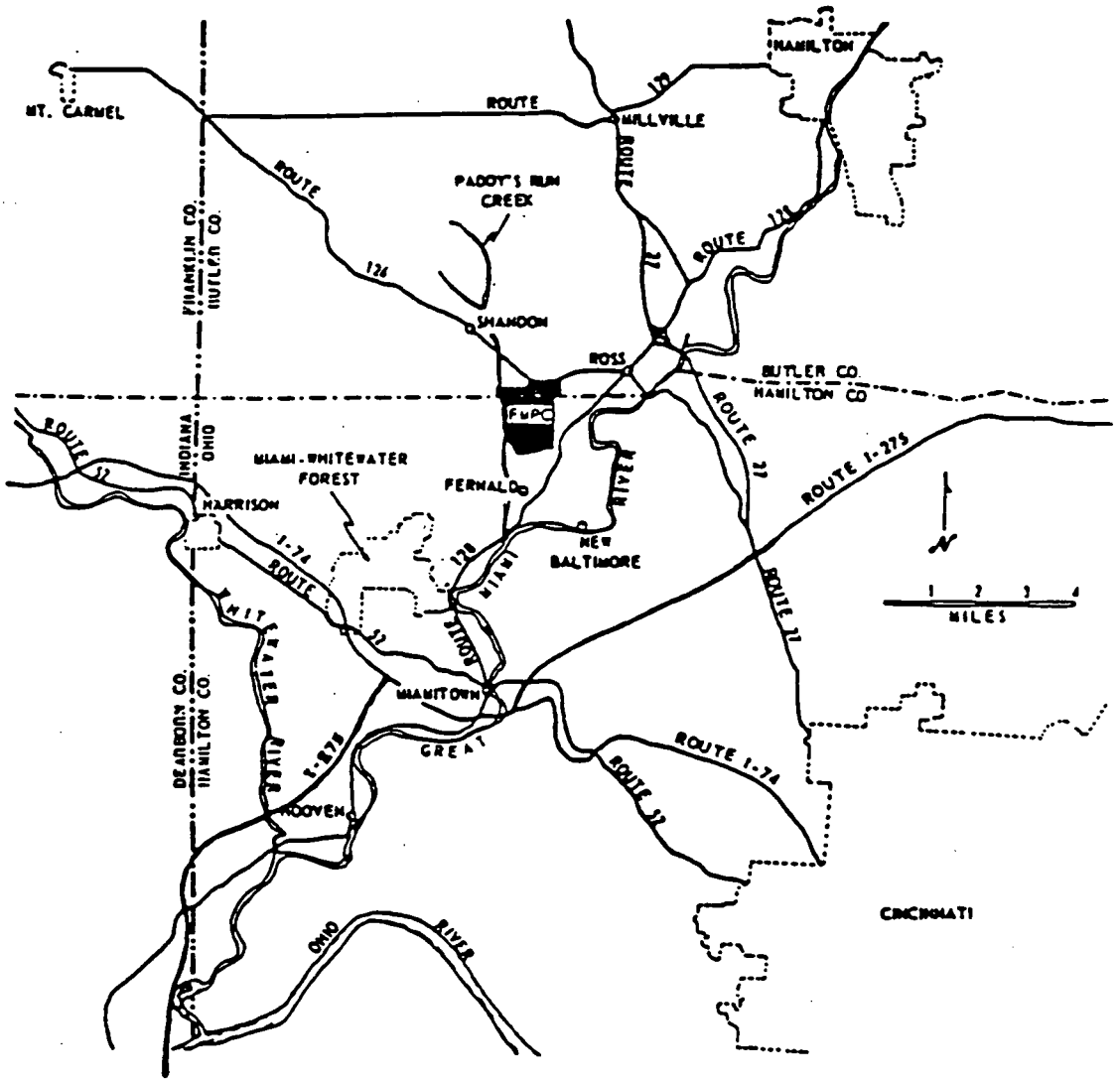
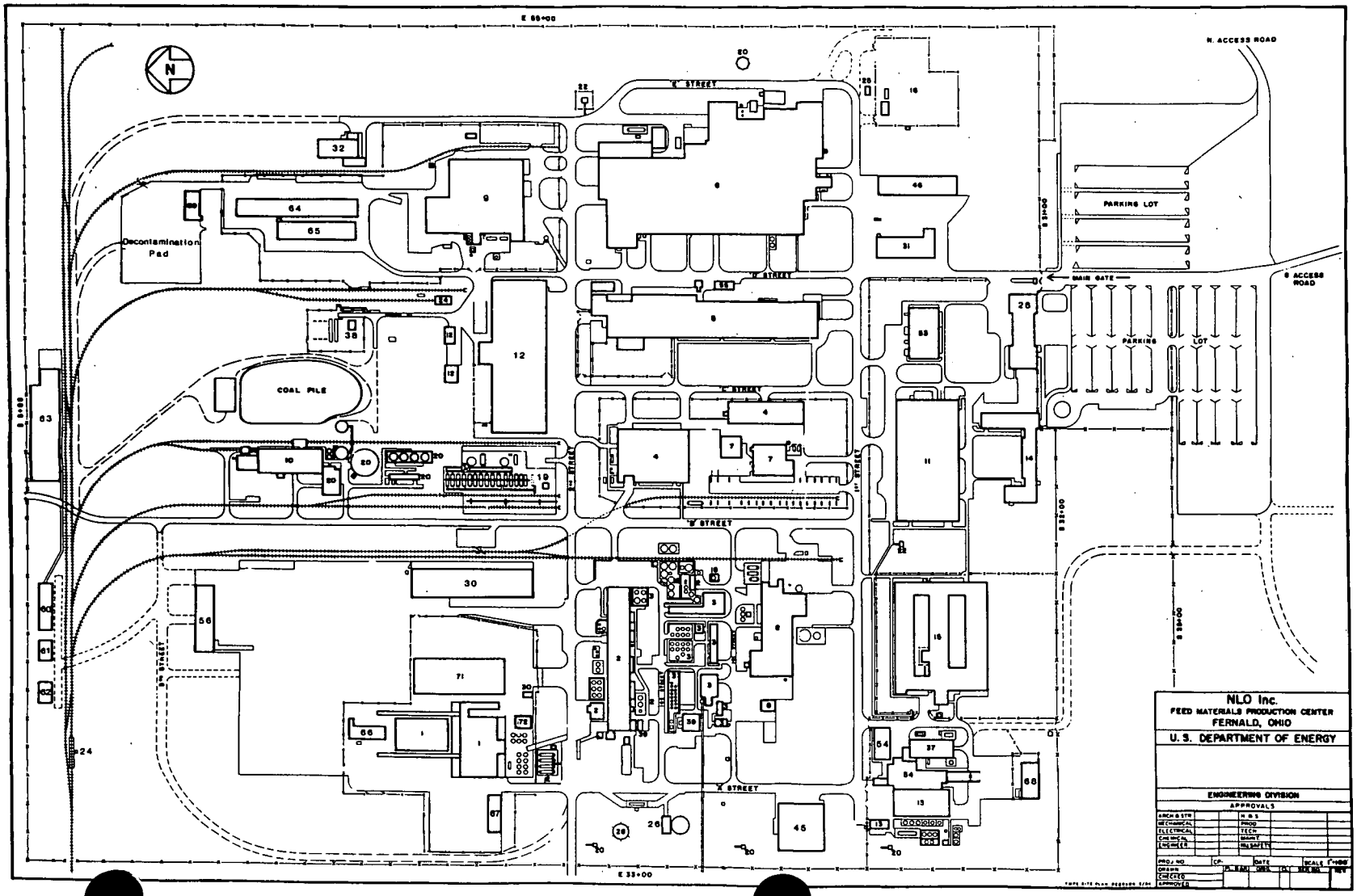
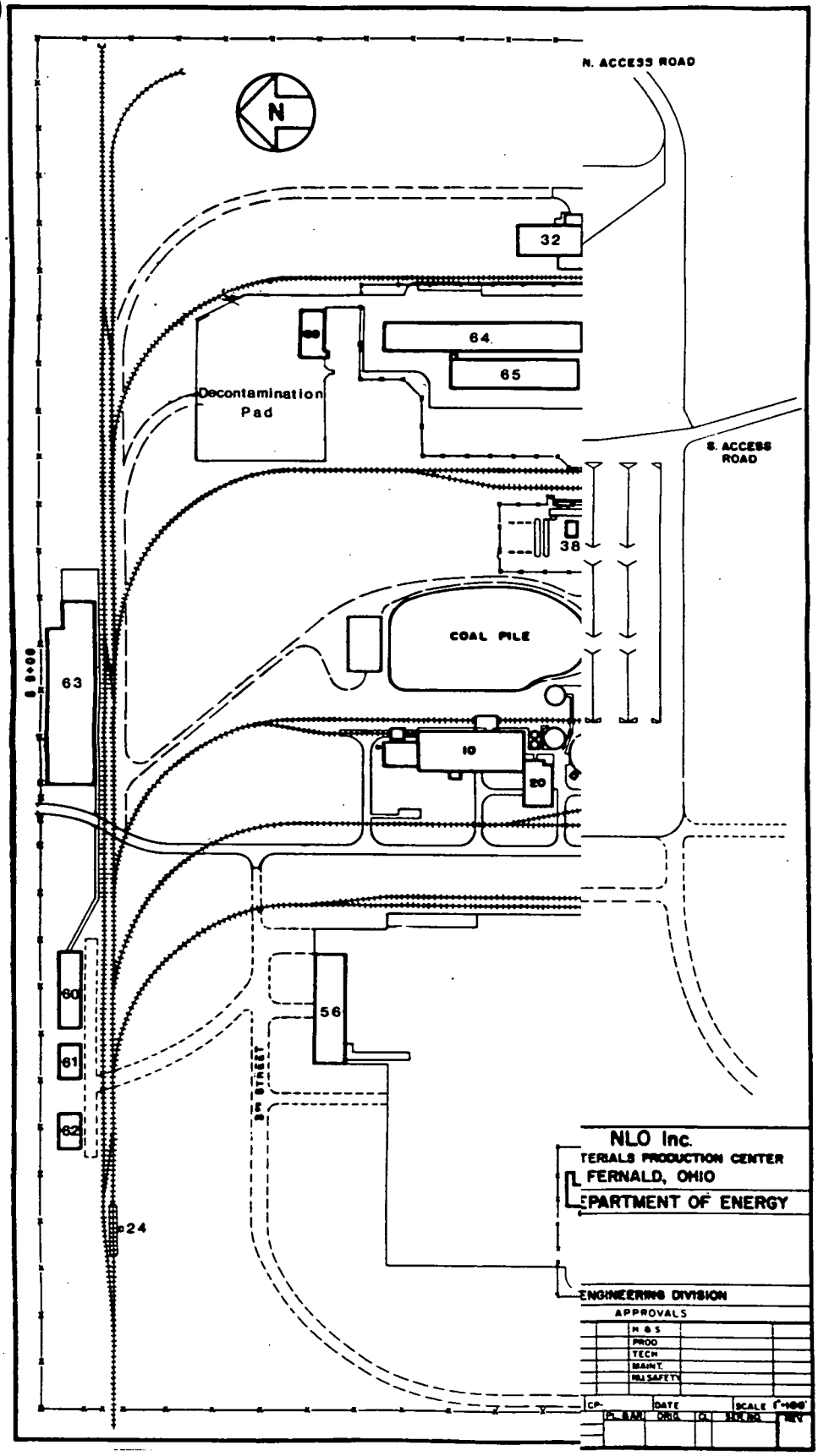


FIGURE 1.6.1 Map of Southwestern Ohio Indicating the Location of the Feed Materials Production Center



Area Code Number	Title
0	General
1	Preparation Plant
	Silo Storage (South of Sampling Plant)
2	Ore Refinery Plant
3	Nitric Acid Recovery Plant
4	Green Salt Plant
5	Metals Production Plant
6	Metals Fabricating Plant
7	Building 7
8	Recovery Plant
9	Special Products Plant
10	Boiler Plant
11	Service Building
12	Mechanical Shop & Storeroom
13	Pilot Plant (Wet End)
14	Administration Building
15	Laboratories
16	Main Electric Sub-Station
17	General Area
	Paved Areas (See 74)
18	Water Pollution Control
	Chemical Feed Building
	General Sump
	Biodenitrification Towers
	Surge Lagoon
	Storm Water Retention Basin
19	Metal Tank Farm
20	Water Supply System
	Cooling Tower
	Cooling Tower Pump House
	Elevated Storage Tank - East
	Chlorine Building (For Water Treatment Area)
	Water Wells
	Reactivator
21	Roads, Sidewalks, Fences, Pits, Etc.
22	Interplant Service & Product Lines
	Gas Meter House
	Lift Station
	Pipe Trestle
	Truck Scale
23	Communication & Alarm System
24	Railroad System
25	Sanitary Sewer System
	Sewage Disposal
	Imhoff Tanks
	Sludge Beds
26	Fire Protection System
	Elevated Water Tower - West
27	Mobile Equipment (Also See 47)
28	Security System - Guard House
30	Chemical Warehouse
31	Engine House - Garage
32	Magnesium Storage
34	K-65 Storage Area
35	Metal Oxide Storage Area
37	Pilot Plant Annex (Dry)
38	Propane Storage
39	Incinerator Plant
40	Waste Management - Solids
44	Temporary Structures (Trailers)
45	Building 45
46	Heavy Equipment Garage
47	Mobile Equipment (Also 27)
51	UF6 to UF4 Reduction Facility II
53	Health, Safety & Production Control Building
54	UF6 to UF4 Reduction Facility I
55	Slag Recycling Plant - East
58	CP Storage Warehouse
60	Quonset Number 1
61	Quonset Number 2
62	Quonset Number 3
63	KC-2 Warehouse
64	Plant 9 Warehouse
65	Plant 5 Warehouse
66	Drum Reconditioning Building
67	Plant 1 Storage Building (No. 1 & No. 2)
68	Pilot Plant Warehouse
69	Decontamination Building
71	General In-Process Storage Warehouse
73	Fire Brigade Training Center
74	Paved [illegible]torage
75	Sit[illegible], Parking Lots

FIGURE 1.6.2 Feed Materials Production Center Plant Layout



Area Code Number	Title
0	General
1	Preparation Plant
	Silo Storage (South of Sampling Plant)
2	Ore Refinery Plant
3	Nitric Acid Recovery Plant
4	Green Salt Plant
5	Metals Production Plant
6	Metals Fabricating Plant
7	Building 7
8	Recovery Plant
9	Special Products Plant
10	Boiler Plant
11	Service Building
12	Mechanical Shop & Storeroom
13	Pilot Plant (Wet End)
14	Administration Building
15	Laboratories
16	Main Electric Sub-Station
17	General Area
	Paved Areas (See 74)
18	Water Pollution Control
	Chemical Feed Building
	General Sump
	Biodentrification Towers
	Surge Lagoon
	Storm Water Retention Basin
19	Metal Tank Farm
20	Water Supply System
	Cooling Tower
	Cooling Tower Pump House
	Elevated Storage Tank - East
	Chlorine Building (For Water Treatment Area)
	Water Wells
	Reactivator
21	Roads, Sidewalks, Fences, Pits, Etc.
22	Interplant Service & Product Lines
	Gas Meter House
	Lift Station
	Pipe Trestle
	Truck Scale
23	Communication & Alarm System
24	Railroad System
25	Sanitary Sewer System
	Sewage Disposal
	Imhoff Tanks
	Sludge Beds
26	Fire Protection System
	Elevated Water Tower - West
27	Mobile Equipment (Also See 47)
28	Security System - Guard House
30	Chemical Warehouse
31	Engine House - Garage
32	Magnesium Storage
34	K-65 Storage Area
35	Metal Oxide Storage Area
37	Pilot Plant Annex (Dry)
38	Propane Storage
39	Incinerator Plant
40	Waste Management - Solids
44	Temporary Structures (Trailers)
45	Building 45
46	Heavy Equipment Garage
47	Mobile Equipment (Also 27)
51	UF6 to UF4 Reduction Facility II
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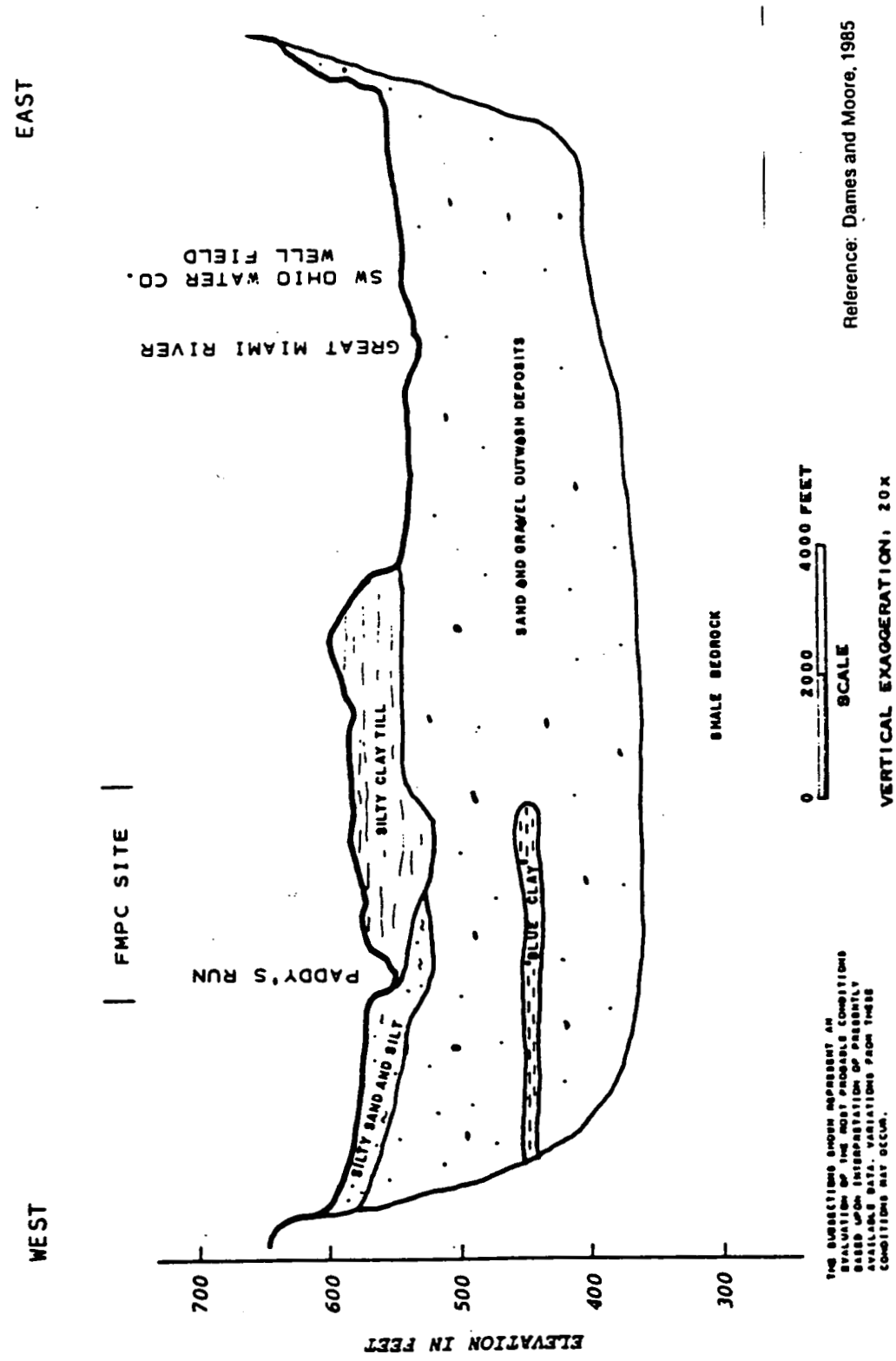
58	CP Storage Warehouse
60	Quonset Number 1
61	Quonset Number 2
62	Quonset Number 3
63	KC-2 Warehouse
64	Plant 9 Warehouse
65	Plant 5 Warehouse
66	Drum Reconditioning Building
67	Plant 1 Storage Building (No. 1 & No. 2)
68	Pilot Plant Warehouse
69	Decontamination Building
71	General In-Process Storage Warehouse
73	Fire Brigade Training Center
74	Paved Area Storage
75	Site Preparation, Parking Lots

FIGURE 1.6.2 Feed Materials P



Reference: Dames and Moore, 1985

FIGURE 1.6.3 Generalized Geologic Cross Section of New Haven Trough

1.7 POTENTIAL CONTAMINANT SOURCES AND RELATED MONITORING INFORMATION

1.7.1 Air

There are approximately 430 air-emission sources throughout the FMPC plant. Of these, the major sources originate from the uranium production operations. Sixty-eight dry dust collectors (baghouses) exhaust these operations. In addition to the dry collectors, there are approximately 10 systems equipped with wet scrubbers for control of radioactive particulates and gases (UF_6) and chemical fumes, vapors, or gases, e.g., HF and NO_x. Other sources include such operations as individual analytical laboratory hoods, roof and wall vent fans, fugitive emissions, a coal-fired steam plant, a dry cleaning facility, and solid- and liquid-waste incinerators for nonhazardous wastes. Some characterization of these sources have been accomplished by site operations personnel.

Routine sampling for particulate uranium releases is performed on the 68 baghouse stacks. Although data from this monitoring is used to develop a total source term for calculating doses to off-site personnel, the major past use of stack monitoring data was to estimate the total quantity of uranium released through exhaust discharges for purposes of materials accountability. Limited grab sampling has been performed on some wet scrubber system discharges and on the steam plant stack; there is a continuous monitor for oxides of nitrogen in the nitric acid recovery tower stack. At best, limited monitoring is conducted on the other emission sources.

Air monitoring is performed at seven locations on the plant perimeter. The sample locations were, however, selected without the full benefit of an evaluation of the local meteorology. The Oak Ridge National Laboratory (ORNL) Energy Systems Group was given the task of performing a modeling study relevant to siting of additional samplers.

Currently, there are two off-site ambient air monitoring stations; one at the Cosby Township School (generally upwind) and one at the Ross School (generally downwind). In addition, FMPC is establishing an operational site meteorological monitoring system.

The steam plant stack has been surveyed and determined to be in compliance with OEPA regulations. Concentrations of total suspended particulates, measured at the perimeter fence, are reported to be in compliance with State of Ohio guidelines. Certain permit applications for air emission sources are pending.

1.7.2 Surface Water

Routine sampling by the plant is performed at six on-site locations to assure effective control of liquid effluents. These sampling locations are at the two National Pollution Discharge Elimination System (NPDES) outfalls (Manhole 175 and the Storm Sewer overflow to Paddy's Run) and the four contributing discharge streams to Manhole 175. Water samples are also collected from three locations in the Great Miami

River and three locations in Paddy's Run. Flow metering devices (flumes and weirs) are employed at the outfalls but are not regularly inspected or calibrated.

Surface flow and stormwater runoff at the FMPC site has not been fully characterized. During field inspections related to the Phase I survey activity, a flow was observed in the overflow outfall to Paddy's Run, although weather conditions were not such that overflow would be expected. This suggests subsurface seepage into the discharge pipe or leakage around the weir system. Discussions with FMPC personnel revealed that, during the summer months, there is little or no flow in the southern portion of Paddy's Run. These individuals indicated that the stream goes underground a short distance south of the waste pit area.

Based on plant operations, the potential liquid-waste stream pollutants which are not currently monitored included heavy metals, trace metals, and a number of organic compounds.

The FMPC has several major liquid-waste control or treatment projects currently under construction. These projects include a biodentrification treatment system, a diversion system for coal-pile runoff, and a stormwater runoff retention basin. Completion of these projects is expected in 1986. A Spill Prevention Control and Countermeasure Plan has been developed.

1.7.3 Solid Waste

Previous FMPC activities have generated a large quantity of miscellaneous wastes including general noncontaminated scrap and refuse, contaminated and noncontaminated metal scrap, waste oils, low-level radioactive waste, RCRA hazardous wastes, co-contaminated and mixed wastes, sewage treatment plant sludge, and flyash from the steam plant. Most of this waste has been retained on site. There are six shallow pits (three of which are soil covered, and a fourth, which is partially covered) which have been used for disposal of wastes contaminated with uranium. Wastes previously placed in the pits and silos were characterized only in generic terms and no specific analyses are available. In addition, there are four silos (two containing K-65 radium bearing residues), two flyash piles (one partially covered), numerous piles of metal scrap, a sanitary landfill, construction rubble and debris, and hazardous RCRA wastes from the RMI facility in Ashtabula, Ohio. Also, FMPC has been designated as the DOE thorium storage center and a large quantity of thorium feed-material and products is stored on the site. Ultimate disposition of this material has not been determined.

Contaminated waste oil and noncontaminated combustibles are incinerated on site. Toxic co-contaminated wastes, such as PCB wastes, are segregated and packaged for storage.

The FMPC is engaged in programs to characterize the waste area, to determine the mechanisms of known groundwater contamination and to evaluate options for ultimate disposition of the wastes.

1.7.4 Groundwater

The groundwater monitoring program at FMPC consists of 37 on-site wells and 25 off-site wells. Most of these wells monitor the sand and gravel aquifer while only five wells monitor the perched aquifer within the glacial till.

There are three known groundwater systems beneath the FMPC. These systems are presently being characterized by Dames and Moore. Waste disposal/storage areas are situated within or on the surficial till; thus the uppermost aquifer has the greatest potential for contamination. None of the previously existing wells monitored this layer, but four of the newly installed Dames and Moore wells are in this shallow groundwater system.

Potential sources of contaminant release to groundwater at the FMPC include the six waste pits, the burn pit, the clearwell, the K-65 silos, the metal oxide tanks, the scrap metal piles, the flyash piles, the sanitary landfill, and runoff from the plant production area. The present well monitoring system is not adequate for properly monitoring the individual contribution from each of these potential sources. In addition, the continued use of the older on-site wells for these purposes is questionable due to their poor condition.

Previous sampling results have indicated elevated uranium concentrations in on-site wells near the waste pit area and in three off-site wells located south of the FMPC. Although the measured concentrations were significantly above typical background levels, they remain within DOE 5480.1A and OEPA guidelines. The radionuclide analysis has been limited to uranium. Additional analysis for radionuclides are needed to evaluate groundwater quality.

2 SUMMARY

This section contains a brief overview of the sampling and analysis efforts conducted at FMPC. A summarization of the significant sampling and analysis results for each environmental problem is also provided.

2.1 SAMPLING AND ANALYSIS EFFORTS

As discussed in Chapter 1, environmental problem definitions were derived from the Survey Team sampling requests and the Preliminary Survey Report. Complete environmental problem definitions are provided in Chapter 4. A site-wide summary of the number of samples collected by media and the number of analyte concentrations exceeding the minimum detection limits for the analysis are provided in Tables 2.1.1 through 2.1.3.

2.2 ENVIRONMENTAL PROBLEM SUMMARIES

A brief summary of sampling and analysis results is presented for each of the environmental problems.

2.2.1 K-65 Trench

Refinery residues from processing pitchblende ores were pumped to the K-65 silos via a trench connecting the production area and the silos. Samples of soil and sediment from the K-65 trench were collected and analyzed for uranium, RCRA-metals, volatile organics, and radionuclides to provide information on the residual hazard from previous use of the trench. In this case, the presence of radium was of particular concern.

Maximum gamma emitting radionuclides were found at the east end of the trench. The activities of uranium, thorium, and cesium ranged from 0.24 pCi/g to 1.8 pCi/g. Radium 226 and its decay daughter, bismuth 214 were present at activity levels of 5.7 pCi/g each. Total uranium activities were highest on the north side of the trench, ranging up to 15 pCi/g at the west end. Analyses for RCRA metals and volatile organics resulted in low values for these parameters.

2.2.2 Particulate Deposition

Surfaces at the FMPC (pavement, soil, etc.) have received substantial uranium particulate deposition from past releases associated with production operations at the site. The potentially contaminated soil is subject to resuspension and airborne transport off-site, as well as transport to surface water and percolation into the groundwater.

TABLE 2.1.1 NUMBER OF SAMPLES ANALYZED BY MEDIA WITH NUMBER EXCEEDING MINIMUM DETECTION LEVELS - ORGANICS

NUMBER OF ANALYSES / NUMBER > MDL

VOLATILES	MDL (LIQUIDS)	MDL (SOLIDS)	FLYASH	LIQUID	SEDIMENT	SLUDGE	SOIL	SOLID	WATER	TOTAL
ACETONE	10 µg/L	10 µg/kg	8/8	1/1	18/15	1/0	56/45	13/9	51/20	148/98
BENZENE	5 µg/L	5 µg/kg	8/0	1/0	18/0	1/0	56/0	13/0	51/0	148/0
BROMODICHLOROMETHANE	5 µg/L	5 µg/kg	8/0	1/0	18/0	1/0	56/0	13/0	51/0	148/0
BROMOFORM	5 µg/L	5 µg/kg	8/0	1/0	18/0	1/0	56/0	13/0	51/0	148/0
BROMOMETHANE	10 µg/L	10 µg/kg	8/0	1/0	18/0	1/0	56/0	13/0	51/0	148/0
CARBON DISULFIDE	5µg/L	5 µg/kg	8/0	1/0	18/0	1/0	56/0	13/0	51/0	148/0
CARBON TETRACHLORIDE	5 µg/L	5 µg/kg	8/0	1/0	18/0	1/0	56/1	13/0	51/0	148/1
CHLOROBENZENE	5 µg/L	5 µg/kg	8/0	1/0	18/0	1/0	56/0	13/0	51/0	148/0
CHLOROETHANE	10µg/L	10 µg/kg	8/0	1/0	18/0	1/0	56/0	13/0	51/0	148/0
CHLOROFORM	5 µg/L	5 µg/kg	8/3	1/1	18/4	1/0	56/33	13/5	51/4	148/50
CHLOROMETHANE	10µg/L	10 µg/kg	8/0	1/0	18/0	1/0	56/0	13/0	51/0	148/0
CIS-1,3-DICHLOROPROPENE	5 µg/L	5 µg/kg	8/0	1/0	18/0	1/0	56/0	13/0	51/0	148/0
DIBROMOCHLOROMETHANE	5 µg/L	5 µg/kg	8/0	1/0	18/0	1/0	56/0	13/0	51/0	148/0
ETHYLBENZENE	5 µg/L	5 µg/kg	8/0	1/0	18/1	1/1	56/1	13/1	51/0	148/4
METHYLENE CHLORIDE	5 µg/L	5 µg/kg	8/8	1/1	18/14	1/0	56/45	13/12	51/18	148/98
STYRENE	5 µg/L	5 µg/kg	8/0	1/0	18/0	1/0	56/0	13/0	51/0	148/0
TETRACHLOROETHENE	5 µg/L	5 µg/kg	8/0	1/1	18/1	1/1	56/2	13/1	51/0	148/6
TOLUENE	5 µg/L	5 µg/kg	8/3	1/1	18/1	1/1	56/9	13/4	51/0	148/19
TOTAL XYLENES	5 µg/L	5 µg/kg	8/0	1/0	18/2	1/1	56/1	13/2	51/0	148/6
TRANS-1,2-DICHLOROETHENE	5 µg/L	5 µg/kg	8/0	1/0	18/2	1/0	56/1	13/2	51/0	148/5

TABLE 2.1.1 (Cont.) ORGANICS

NUMBER OF ANALYSES / NUMBER > MDL

VOLATILES	MDL (LIQUIDS)	MDL (SOLIDS)	FLYASH	LIQUID	SEDIMENT	SLUDGE	SOIL	SOLID	WATER	TOTAL
TRANS-1,3-DICHLOROPROPENE	5 µg/L	5 µg/kg	8/0	1/0	18/0	1/0	56/0	13/0	51/0	148/0
TRICHLOROETHENE	5 µg/L	5 µg/kg	8/0	1/1	18/0	1/0	56/1	13/1	51/0	148/3
VINYL ACETATE	10µg/L	10 µg/kg	8/0	1/1	18/0	1/0	56/0	13/0	51/0	148/1
VINYL CHLORIDE	10µg/L	10 µg/kg	8/0	1/0	18/0	1/0	56/0	13/0	51/0	148/0
1,1-DICHLOROETHANE	5 µg/L	5 µg/kg	8/0	1/1	18/1	1/1	56/2	13/2	51/0	148/7
1,1-DICHLOROETHENE	5 µg/L	5 µg/kg	8/0	1/1	18/0	1/1	56/1	13/1	51/0	148/4
1,1,1-TRICHLOROETHANE	5 µg/L	5 µg/kg	8/2	1/1	18/2	1/1	56/8	13/7	51/0	148/21
1,1,2-TRICHLOROETHANE	5 µg/L	5 µg/kg	8/0	1/0	18/0	1/0	56/0	13/0	51/2	148/2
1,1,2,2-TETRACHLOROETHANE	5 µg/L	5 µg/kg	8/0	1/0	18/0	1/0	56/0	13/0	51/0	148/0
1,2-DICHLOROETHANE	5 µg/L	5 µg/kg	8/0	1/0	18/0	1/0	56/0	13/0	51/0	148/0
1,2-DICHLOROPROPANE	5 µg/L	5 µg/kg	8/0	1/0	18/0	1/0	56/0	13/0	51/0	148/0
2-BUTANONE	10µg/L	10 µg/kg	8/1	1/1	18/0	1/0	56/2	13/1	51/0	148/5
2-CHLOROETHYLVINYL ETHER	10µg/L	10 µg/kg	8/0	1/0	18/0	1/0	56/0	13/0	51/0	148/0
2-HEXANONE	10µg/L	10 µg/kg	8/0	1/1	18/0	1/0	56/0	13/0	51/0	148/1
4-METHYL-2-PENTANONE	10µg/L	10 µg/kg	8/0	1/1	18/0	1/0	56/0	13/0	51/0	148/1

SEMI-VOLATILES	MDL (LIQUIDS)		WATER
ACENAPHTHENE	10µg/L		4/0
ACENAPHTHYLENE	10µg/L		4/0
ANTHRACENE	10µg/L		4/0

TABLE 2.1.1 (Cont.) ORGANICS

NUMBER OF ANALYSES / NUMBER > MDL

SEMI-VOLATILES	MDL (LIQUIDS)		WATER
BENZIDINE	50µg/L		4 / 0
BENZO(A)ANTHRACENE	10µg/L		4 / 0
BENZO(A)PYRENE	10µg/L		4 / 0
BENZO(G,H,I)PERYLENE	10µg/L		4 / 0
BENZO(K)FLUORANTHENE	10µg/L		4 / 0
BIS(2-CHLOROETHOXY)METHANE	10µg/L		4 / 0
BIS(2-CHLOROETHYL)ETHER	10µg/L		4 / 0
BIS(2-CHLOROSOPROPYL)ETHER	10µg/L		4 / 0
BIS(2-ETHYLHEXYL)PHTHALATE	10µg/L		4 / 0
BUTYL BENZYL PHTHALATE	10µg/L		4 / 0
CHRYSENE	10µg/L		4 / 0
DI-N-BUTYL PHTHALATE	10µg/L		4 / 0
DI-N-OCTYL PHTHALATE	10µg/L		4 / 0
DIBENZO(A,H)ANTHRACENE	10µg/L		4 / 0
DIETHYL PHTHALATE	10µg/L		4 / 0
DIMETHYL PHTHALATE	10µg/L		4 / 0
FLUORANTHENE	10µg/L		4 / 0
FLUORENE	10µg/L		4 / 0
HEXACHLOROBENZENE	10µg/L		4 / 0
HEXACHLOROBUTADIENE	10µg/L		4 / 0

TABLE 2.1.1 (Cont.) ORGANICS

NUMBER OF ANALYSES / NUMBER > MDL

SEMI-VOLATILES	MDL (LIQUIDS)		WATER
HEXACHLOROCYCLOPENTADIENE	10µg/L		4 / 0
HEXACHLOROETHANE	10µg/L		4 / 0
INDENO(1,2,3-CN)PYRENE	10µg/L		4 / 0
ISOPHORONE	10µg/L		4 / 0
N-NITROSODI-N-PROPYLAMINE	10µg/L		4 / 0
N-NITROSODIMETHYLAMINE	10µg/L		4 / 0
N-NITROSODIPHENYLAMINE(2)	10µg/L		4 / 0
NAPHTHALENE	10µg/L		4 / 0
NITROBENZENE	10µg/L		4 / 0
P-CHLORO-M-CRESOL	10µg/L		4 / 0
PENTACHLOROPHENOL	10µg/L		4 / 0
PHENANTHRENE	10µg/L		4 / 0
PHENOL	10µg/L		4 / 0
PYRENE	10µg/L		4 / 0
1,2-DICHLOROBENZENE	10µg/L		4 / 0
1,2-DIPHENYLHYDRAZINE(1)	10µg/L		4 / 0
1,2,4-TRICHLOROBENZENE	10µg/L		4 / 0
1,3-DICHLOROBENZENE	10µg/L		4 / 0
1,4-DICHLOROBENZENE	10µg/L		4 / 0
2-CHLORONAPTHALENE	10µg/L		4 / 0
2-CHLOROPHENOL	10µg/L		4 / 0
2,4-DICHLOROPHENOL	10µg/L		4 / 0

TABLE 2.1.1 (Cont.) ORGANICS

NUMBER OF ANALYSES / NUMBER > MDL

SEMI-VOLATILES	MDL (LIQUIDS)		WATER
2,4-DIMETHYLPHENOL	10µg/L		4 / 0
2,4-DINITROPHENOL	10µg/L		4 / 0
2,4-DINITROTOLUENE	10µg/L		4 / 0
2,4,6-TRICHLOROPHENOL	10µg/L		4 / 0
2,6-DINITROTOLUENE	10µg/L		4 / 0
3,3-DICHLOROBENZIDINE	10µg/L		4 / 0
3,4-BENZOFLUORANTHENE	10µg/L		4 / 0
4-BROMOPHENYL PHENYL ETHER	10µg/L		4 / 0
4-CHLOROPHENYL PHENYL ETHER	10µg/L		4 / 0
4-NITROPHENOL	10µg/L		4 / 0
4,6-DINITRO-2-METHYLPHENOL	10µg/L		4 / 0

PCB'S	MDL (LIQUIDS)	MDL (SOLIDS)	OIL	SOIL	WASTE	SLUDGE	TOTAL
AROCLOR-1242	0.4 µg/L	0.3 mg/kg	4 / 0	4 / 0	6 / 0	3 / 0	17 / 0
AROCLOR-1248	0.5 µg/L	0.4 mg/kg	4 / 0	4 / 0	6 / 0	3 / 0	17 / 0
AROCLOR-1254	0.5 µg/L	0.2 mg/kg	4 / 0	4 / 0	6 / 1	3 / 1	17 / 2
AROCLOR-1260	0.4 µg/L	0.3 mg/kg	4 / 0	4 / 0	6 / 0	3 / 0	17 / 0

TABLE 2.1.2 NUMBER OF SAMPLES ANALYZED BY MEDIA WITH NUMBER EXCEEDING MINIMUM DETECTION LEVELS - INORGANICS

NUMBER OF ANALYSES / NUMBER > MDL

METALS	MDL (LIQUIDS)	MDL (SOLIDS)	FLYASH	WATER	SOIL	WASTE/RAFF	SEDIMENT	SLUGE	DUST	TOTAL
Ag	0.1 mg/L	10 mg/kg	16/0	61/3	84/0	14/0	14/0	3/0	25/0	217/3
As	0.5 mg/L	100 mg/kg	16/0	61/3	84/0	14/0	14/0	3/3	25/0	217/3
Ba	0.05 mg/L		16/15	61/58	84/84	14/13	14/14	3/0	25/25	217/212
Cd	0.02 mg/L	5 mg/kg	16/0	61/3	85/0	14/1	14/0	3/0	25/3	218/7
Cr	0.03 mg/L	10 mg/kg	16/1	61/10	84/14	14/3	14/0	3/1	25/19	217/48
Hg	0.001 mg/L	0.05 mg/kg	16/0	60/3	87/0	14/1	14/0	3/0	25/5	219/9
Pb	0.3 mg/L	20 mg/kg	16/0	61/8	84/0	14/3	14/0	3/0	33/29	225/40
Se	0.5 mg/L	20 mg/kg	16/0	61/3	84/0	14/0	14/0	3/0	25/0	217/3
Mg		100 mg/kg							58/58	

ANIONS	LIMITS (SOLIDS)		DUST
F	100 mg/kg		33/33

ASBESTOS	WATER	SOIL	FLYASH
PRESENCE OF ASBESTOS		14/0	16/0
TOTAL COUNT	4/3		
FIBERS > 10μ	4/1		

TABLE 2.1.3 NUMBER OF SAMPLES ANALYZED BY MEDIA WITH NUMBER EXCEEDING MINIMUM DETECTION LEVELS - RADIONUCLIDES

NUMBER OF ANALYSES / NUMBER WITH DETECTED COUNTS

RADIONUCLIDES	FLYASH	WATER	SOIL	WASTE	SEDIMENT	SLUDGE	MILK	DUST	TOTAL
U-235	16/0	40/4	82/62	1/1	15/4	1/1	2/0		157/72
U-238	16/0	40/0	82/34	1/1	14/5	1/1	2/0		156/41
Bi-214	16/16	42/3	82/79	1/0	15/14		2/0		158/112
Cs-137	16/0	42/0	82/22	1/0	15/3	1/0	2/0		159/25
Ra-226	16/16	43/2	82/80	1/0	16/15		2/0		160/113
Th-227		22/8			9/9	1/1			32/18
Th-228	16/16	64/10	82/78	1/0	24/22	2/2	2/0		191/128
Th-229					8/0	1/0			9/0
Th-230		22/2			9/9	1/1			32/12
Th-232	16/16	65/4	82/78	1/0	24/21	2/2	2/0		192/121
Pu-238		23/0		1/1	10/9	1/1	1/0	3/3	39/14
Pu-239+Pu-240		23/0		1/0	10/9	1/1	1/1	3/3	39/14
Pu-241+Pu-242		23/1		1/1	1/0	0/0	1/0	3/2	29/4
Np-237		23/2		1/1	10/10	1/1	1/0	3/3	39/17
TOTAL U	16/16	46/46	88/88	1/1	14/14	2/2	1/1	33/33	201/201

Sweepings from a number of locations at the plant were collected and analyzed for metals, total uranium, and radionuclides to provide an indication of general site-wide surface contamination. Samples from the production area indicate high Mg, F, and Pb levels in surface material associated with specific operations. Highest concentrations of Mg and Pb were found in the dust samples collected in the vicinity of the Drum Reconditioning Building, with values of 72,100 mg/kg and 806 mg/kg, respectively. Analysis of the samples for RCRA metals indicates elevated levels of Pb, Ba, and Cr in the collected surface material. Total uranium values exceeding 1,000 mg/kg are prevalent site-wide and the values range to a maximum of 10,450 mg/kg.

2.2.3 Process Emissions

A potentially important source of process emissions are fugitive releases associated with operation of the Rockwell furnaces in Building 5 and from stacks with particulate control systems with a history of malfunctioning. To gage the importance of these sources, particulate samples collected above the Rockwell furnaces (located in Plant 5) and from the Plant 5 stacks were analyzed for total uranium, fluoride, magnesium, and total particulates. Samples collected from either side of the dust collector for the Plant 9 stack were analyzed for total organic carbon, total organic halogens, uranium, total particulates, and volatile organics.

Sampling results indicate no significant variations in particulate concentrations within Plant 5 associated with Rockwell furnace operation. Results from the high-volume filters show particulate concentrations generally in the range of 150-200 $\mu g/m^3$. The particulate matter was analyzed for total uranium, magnesium, and fluoride. Fluoride had the highest concentration of these three elements in all the samples, with a high value of about 120 $\mu g/m^3$.

Other emission samples from the Plant 5 and 9 stacks indicate that uranium emission rates are less than about 0.3 g/hr. Tenax tube samples collected on the Plant 9 stacks show generally low organics emission rates.

2.2.4 Production Area Soil Contamination

Although emissions of uranium from point sources may have been significantly reduced in recent years, there may be substantial residual contamination in soils within the facility boundary. These contaminants are subject to resuspension and, more likely, to migration into groundwater.

Soil samples from the surface to depths of 20 feet were collected at a number of locations inside the production area and analyzed for metals, uranium, and radionuclides to provide a general indication of production area soil contamination. Based on the samples collected, soils in the production area show low levels of RCRA metals, a maximum value of 50 mg/kg of total uranium obtained from a depth of 10-15 feet west of Building 6, and U-238 activity levels of 18-20 pCi/g from surface and subsurface samples in the vicinity of Plant 6 and the Pilot Plant.

2.2.5 Nonproduction Area Soil Contamination

Various types of soil samples (e.g., surface soil, borings, and backhoe trenches) were collected from a number of on-site nonproduction area locations. The sampling and analysis was conducted to provide information on a wide variety of potential contaminants from specific past or present activities. Soil samples were collected in the vicinity of the old incinerator, cone house, lime pit, firefighter training area, sanitary landfill, Pit #4 (burn pit), and from several backhoe trenches at selected locations. Samples were analyzed for RCRA metals, total uranium, and radionuclides. Samples from the sanitary landfill and Pit #4 were also analyzed for asbestos.

Analytical results did not indicate high levels of RCRA metals or asbestos. Highest levels of total uranium and radionuclide activity were found in samples from Pit #4 and the old incinerator area. A sample from Pit #4 (burn pit) had a total uranium concentration of 13,300 mg/kg, with a U-238 activity of 9,432 pCi/g. Similarly, a sample from the old incinerator area had a total uranium concentration of 12,400 mg/kg, with a U-238 activity of 2,399 pCi/g.

2.2.6 South of Production Area Soil Contamination

Soil samples were collected from specific locations in the on-site area south of the FMPC production area to provide information on a wide variety of potential contaminants associated with past or present activities. Samples were collected from the new flyash pile, old flyash pile, and from four baseline trenches in the area commonly referred to as the south field. Primary analyses consisted of RCRA metals, total uranium, and radionuclides.

Total uranium concentrations between 55 mg/kg and 85 mg/kg were found in samples taken from the old flyash area and in three of the four trenches. Uranium-238 activities for these samples ranged from 20 pCi/g through 49 pCi/g. However, the highest activity level (53 pCi/g) was reported for a sample from the old flyash area with a total uranium concentration of only 8.8 mg/kg.

2.2.7 On-Site Surface Water Contamination

Natural surface water bodies in the area of the FMPC are Paddy's Run and the Great Miami River. The normal surface water flow from the site is directed to Paddy's Run. This runoff transports contaminants from the ground surface through uncontrolled storm-water ditches. Surface water and sediment samples were collected in and around Paddy's Run and areas where contaminants would be expected to be concentrated in the surface runoff. Samples were analyzed for RCRA metals, uranium, radionuclides, and volatile organics.

The analysis of samples for RCRA metals indicated no high concentrations. The highest concentration of total uranium found in the collected samples is 176 mg/kg in surface sediment taken from the K-65 ditch. The next highest concentrations of uranium, with values of 89 mg/kg and 67 mg/kg were obtained from the Pit 5 ditch and

storm sewer outfall ditch samples, respectively. Uranium 238 activity levels as high as 54 pCi/g in the K-65 ditch and 41 pCi/g in Paddy's Run were also found.

2.2.8 Off-Site Surface Water Contamination

Off-site surface water and sediment sampling concentrated on the Great Miami River, with a supplementary set of samples collected from the gravel pits just off of Highway 128 between the site and the Great Miami River. The samples were analyzed for radionuclides, total uranium, RCRA metals, and volatile organics.

The highest radionuclide activity in the collected samples was 1.1 pCi/g for sediment samples and 0.98 pCi/L for water samples. The maximum concentrations of total uranium were 12.0 μg/L in water and 1.30 mg/kg in sediments. The only RCRA metal present at above analytical method detection limits was barium, with a concentration of 1.17 mg/L.

Values of 39 μg/kg and 33 μg/kg were found for acetone in sediment samples from the Great Miami River.

2.2.9 On-Site Groundwater Contamination - Construction and Sampling of Six New Wells in the Production Area

A shallow (perched) groundwater table within the till beneath the production area has been identified as contaminated. However, prior to this effort, no shallow wells existed within the production area to monitor the contamination level.

Groundwater monitoring wells were installed into the shallow (perched) aquifer and into the deeper sand and gravel aquifer. Samples were collected from all six of the new wells and analyzed for volatile organics, total uranium, RCRA-metals, and radionuclides by gamma spectroscopy.

The highest total uranium concentrations found in samples from the shallow and deep wells are 442 μg/L and 2.2 μg/L, respectively. All other analyte concentrations are either near or below the minimum detection limits or instrument detection limits.

2.2.10 Off-Site Groundwater Contamination - Domestic Wells

The production area is a source of contaminants because of the use and release of chemicals and radioactive materials. Production activities have caused a build-up of pollutants in the soil and groundwater in the immediate area. This build-up acts as a source for continuing release of contaminants to the groundwater. Thirteen private and domestic wells were sampled and analyzed to determine levels of RCRA metals, radionuclides and volatile organics in the aquifer off-site.

Results indicate concentrations of volatile organics and RCRA metals either below or slightly above minimum detection limits. Radionuclide analyses indicated a maximum value for thorium 227 of 0.71 pCi/L in the sample from the Flicks Inn well. Prevalent radionuclide activity levels for samples from the other wells were much lower, ranging from 0.05 pCi/L to 0.15 pCi/L.

2.2.11 Abandoned Tanks

A large quantity of abandoned equipment and piping is found on-site, including above ground storage tanks east of Pits 2 and 3 in the waste pit area. These tanks were sampled for uranium and other radionuclides, RCRA-metals, and volatile organics.

Analyses indicate that the material in the tanks contains uranium concentrations as high as about 8800 mg/kg. Radioisotope activity was as high as 360 pCi/g for Th-230. Other radioisotope activities were much lower.

2.2.12 Wastewater Treatment and Discharge

The sludge from the water treatment plant, coal pile runoff water, boiler blowdown, and other boiler house waters are alternatively sent to Tanks 6 and 7 at the General Sump, which receives liquid wastes from the processing areas of the plant. It consists of 12 tanks of various sizes used to collect, hold, neutralize, and settle the wastewaters. After treatment, all aqueous wastes from the process areas of the plant are eventually discharged from the General Sump to Pit #5 (in the waste pit area) and thence to the Clear Well.

Liquid and sediment samples were collected from a number of locations along the wastewater treatment system. All samples were analyzed for total uranium, radionuclides, and RCRA metals. Samples from selected locations were also analyzed for volatile organics and asbestos.

The maximum total uranium concentration was found in liquid from Pit #5, with a value of 33,100 μg/L. High total uranium concentrations were also found in Pit #6, with a maximum of 25,400 μg/L. The highest radionuclide activity level was a value of 16,650 pCi/g uranium 238 for a sample taken from Pit #6. Analyses of samples for volatile organics and metals show only a few compounds or elements above detection levels. The highest asbestos concentration found in these samples is 2.73 MFL for fibers greater than 10μ.

2.2.13 Unidentified Substances

FMPC operations are suspected of generating hazardous wastes that have not been previously identified as hazardous. This may result in the improper treatment, storage, handling, and/or disposal of these wastes. Samples from a variety of tanks and drums were taken to provide information regarding the presence (or absence) of hazardous materials. Samples collected from drums or containers representing different waste streams were analyzed for PCB's, RCRA metals, and/or radionuclides.

The analytical results for these samples show AROCLORS-1254 as the only PCB detected above the minimum detection limit, with a maximum value of 1.1 mg/kg. A number of the RCRA metals were found at low concentrations. Of these, only barium was found at concentrations greater than 2 mg/L, with a peak value of 44.9 mg/kg. The maximum radionuclide value found was 161 pCi/g for U-235. However, the sample was not analyzed for U-238 so that the relative portions of U-235 and U-238 cannot be determined.

2.2.14 Contamination in Milk

Milk samples were collected from the Knollman Farm Dairy adjacent to the FMPC site and analyzed for total uranium and nonuranium radionuclides. Total uranium concentration in the milk samples was 292 μg/L.

2.2.15 Direct Radiation-Selected Locations

A radiological survey was conducted on the South Field to determine the location and exposure rates of elevated levels of radiation. Eighty (80) spots and areas of contamination were detected in the surveyed portion of the south field area. Also, there was general contamination in the vicinity of the old incinerator and manhole 175.

3 METHODS

This section provides a brief description of some of the methods used in sampling and analysis at FMPC. The site was sampled and the samples analyzed prior to finalization of ESM field sampling methods or analytical procedures. The use of Contract Laboratory (CLP) protocols was not required at the time most analyses were being performed.

3.1 FIELD SAMPLING

Field sampling protocols used at FMPC were based upon guidance provided by the May 1986 Draft Environmental Survey manual, which was largely a compilation of EPA protocols, and EPA guidance documents. The FMPC S&A plan provided an overview description of a set of sampling procedures likely to be used. Exceptions to implementation of the S&A Plan are provided in the discussion of each environmental problem.

3.1.1 Surface Soil Sampling

Composite Samples

Precleaned stainless steel scoops and stainless steel garden trowels were used to collect surface soil samples using the 1-meter square composite method, in which a 1-meter square was measured on the ground and individual aliquots were collected from the four corners and from the center. Vegetation was cleared if it was present. The scoops and trowels were cleaned according to the procedure described later in this section. Compositing was performed either by mixing the aliquots in the sampled area or in a precleaned aluminum roasting pan. Soil samples were not screened in the field to eliminate large material.

Grab Samples

Soil grab samples were collected using precleaned stainless steel scoops and/or hand trowels. Samples were transferred directly from the parent material to the sample container.

3.1.2 Subsurface Soil Sampling

Split Spoon Sampling

Subsurface soil samples were obtained through use of a split spoon sampler which had been stripped of paint and cleaned. The split spoon was cleaned according to the method described later in this section prior to collection of each set of samples.

Trenching Sampling

Soil samples collected from an open trench were obtained by removing grab samples of soil brought to the surface in a backhoe bucket from the appropriate depth.

Water samples were collected from the trench with a precleaned stainless steel dipper and transferred into sample containers.

Auger Samples

Soil samples were collected directly from the auger by transferring the soil material from the auger into individual sample containers using precleaned stainless steel scoops or trowels.

3.1.3 Surface Water Sampling

Surface water samples were obtained either by sample bottle immersion or by collection into a precleaned stainless steel dipper followed by distribution into individual sample bottles. Field measurements of pH, conductivity, and temperature were obtained with appropriate instruments.

Where sediment samples were collected at the same place, sediment samples were collected after surface water sampling was completed.

3.1.4 Groundwater Sampling

Domestic Water Supply Wells

In sampling domestic water supply wells, the location for obtaining the water sample was selected to assure that water was obtained directly from the well tank. The associated pipes were purged prior to obtaining the sample.

New Groundwater Monitoring Wells

Six new groundwater monitoring wells were installed according to standard EPA RCRA specifications, modified for this program. The shallow wells were drilled with a hollow stem auger and the deep wells were drilled with a cable tool device. Stainless steel screens and casings were installed.

Sample collection from these wells followed standard groundwater monitoring well sampling procedures. Wells were developed at least 48 hours after grouting. Wells were purged either 3 to 5 times their volume or dry prior to collecting the groundwater sample. Field measurements were taken of pH, temperature, and conductivity during purging and following sample collection.

3.1.5 Special Sampling

Samples were collected of liquid, solid, and sludge from various containers and environments. For all samples, the collection apparatus was either precleaned stainless steel or glass. Most special samples were grab samples. Several of the drum samples were composites of two drums with the same lot number.

3.1.6 Emission Sampling

Samples were obtained of stack and fugitive releases of atmospheric contaminants. Samples were collected with equipment designed not to bias or contaminate the sample. Sampling for airborne contaminants is discussed in detail in Section 4.3.

3.1.7 Equipment Cleaning and Decontamination

Sampling equipment was cleaned prior to use according to the following procedure:

(1) All excess dirt and other material was removed by scraping and/or rinsing the article

(2) The article was washed using a scrubber (plastic bristle) and/or sponge in water containing a household low-phosphate detergent

(3) The article was rinsed in distilled water

(4) The article was rinsed with ethanol

(5) The article was allowed to air dry either by hanging or resting on aluminum foil

(6) Clean and dry articles were wrapped in aluminum foil and stored

Clean wrapped articles were stored separately from noncleaned articles.

No QC rinsate samples were collected from the cleaned articles.

Some sampling equipment associated with soil coring and trenching was also steamed cleaned. Upon completion of cleaning, sampling equipment was wrapped in either aluminum foil or plastic.

All mechanical equipment associated with soil coring, trenching, and well drilling was steam cleaned prior to use and in-between sampling locations, as necessary.

3.2 ANALYTICAL METHODS

Standard operating procedures (SOPs) were developed and followed for analysis of samples from the FMPC by the Analytical Chemistry Laboratory (ACL), which is part of the Chemical Technology Division (CMT) of Argonne National Laboratory.* At the time during which the majority of samples were being analyzed, the SOPs were in draft form; the SOPs have since been finalized and have been incorporated as part of the ACL quality assurance program.

Table 3.1.1 provides a list of the applicable procedures followed for analysis of the FMPC samples. Method summaries, including the references for procedures applied by subcontractor laboratories (Hazleton Laboratories of America for volatile and semivolatile organic analyses, Teledyne Isotopes for radiological analyses, McCrone Environmental Services Inc. for asbestos determinations, and Gulf Coast Laboratories Inc. for total organic carbon and total organic halogens) are provided in Appendix A.

Table 3.1.2 provides a list of the general analytical methods used to obtain results for each analyte for samples from FMPC.

*In some instances, the SOP's were developed from methodology in Contract Laboratory Program SOW 785, as referenced.

TABLE 3.1.1 List of Procedures Followed for the Analysis of FMPC Samples

Document Title	Identification Number (Date of Issue)
Argonne National Laboratory, Analytical Chemistry Laboratory	
Sample Preparation of Sediments, Sludges, and Soils	Contract Laboratory Program SOW 785 Attachment 1
Percent Solids	Contract Laboratory Program SOW 785 Attachment 9
Mercury Analysis - Water (Manual)	Contract Laboratory Program SOW 785 Attachment 5
Mercury Analysis - Sediment	Contract Laboratory Program SOW 785 Attachment 6
ICP Methods	Contract Laboratory Program SOW 785 Attachment 3
AAS - Furnace Methods	Contract Laboratory Program SOW 785 Attachment 2
Toxicity Characteristic Leaching Procedures (TCLP) for Inorganic Contaminants (RCRA)	SOP: ACL-023 (January 30, 1987)[a]
Determination of Fluoride in Solids	SOP: ACL-025 (January 30, 1987)[a]
Procedure for Determination of Uranium in Soils	CMT-ACL Quality Assurance Document ANL C-0030-0248 (April 20, 1982)
Determination of Uranium in Waters	SOP: ACL-029 (January 30, 1987)[a]
Determining Isotopic Composition of Uranium or Plutonium by Thermal Ionization Mass Spectrometry	SOP: ACL-030 (January 30, 1987)[a]

TABLE 3.1.1 (Cont'd)

Document Title	Identification Number (Date of Issue)
Gamma Spec Analyses of ^{137}Cs-17 Standard on Detector 4 and ^{137}Cs-8 Standard on Detector 9 Using the Ortec System	SOP: ACL-062 (January 30, 1987)[a]
Calibration of Ge(Li) Detectors Used for Obtaining Gamma Spectra of Environmental Samples	SOP: ACL-070 (January 30, 1987)[a]
Preparation of Environmental Samples for Gamma Spectroscopy Analysis	SOP: ACL-072 (January 30, 1987)[a]
Gamma Spec Analysis of ^{137}Cs-17 Standard on Detectors 3 and 6 Using the ND-66 System	SOP: ACL-075 (January 30, 1987)[a]
Long Term (>1 Week) Counting Protocol for Gamma Spectra Acquisition	SOP: ACL-076 (January 30, 1987)[a]
Obtaining Gamma Spectra for Environmental Samples on Detectors 3 and 6 Using the ND-66 System	SOP: ACL-080 (January 30, 1987)[a]
Gamma Spec Analysis of ^{137}Cs-17 Standard on Detector 1 Using the Northern NS-636 System	SOP: ACL-081 (January 30, 1987)[a]
Obtaining Gamma Spectra of Environmental Samples on Detector 1 Using the Northern NS-636 System	SOP: ACL-082 (January 30, 1987)[a]
Obtaining Gamma Spectra for Environmental Samples on Detectors 4 and 9 Using the Ortec System	SOP: ACL-083 (January 30, 1987)[a]
Calculation of Environmental Samples for General Survey of Gamma Radioactivity Based on Isotope Identification by GAMANAL, with no Isotopes Specified to be Monitored	SOP: ACL-084 (January 30, 1987)[a]
Gross Alpha and Beta Radioactivity	SOP: ACL-095 (January 30, 1987)[a]
Sample Preparation and Separation of Plutonium and Thorium from Solid (soils, sediments, sweepings) and Liquid (waters, milk) Environmental Samples for Analysis by Alpha-Spectrometry	SOP: ACL-031 (January 30, 1987)[a]
Operation of Kicksort Alpha-Spectrometer, Promeda Multichannel Analyzer, and Texas Instrument Silent 700 Printer for Isotopic Analysis of Environmental Samples by Alpha Spectrometry Using Isotope Dilution	SOP: ACL-087 (August 3, 1987)[a]

TABLE 3.1.1 (Cont'd)

Document Title	Identification Number (Date of Issue)
Calculation of Plutonium, Neptunium, and Thorium Isotopic Concentrations in Environmental Samples Using Isotope Dilution after Analysis by Alpha-Spectrometry	SOP: ACL-088 (January 30, 1987)[a]
Radium-226 and Radium-228 Determination in Water and Soil samples Using NaI Detector and Least-squares Processing of Data	SOP: ACL-108 (May 18, 1987)[a]
Analysis of PCBs in Soil, Sediment, Oil, and Aqueous Media	CMT-ACL Quality Assurance Document ANL: C-0030-0265 (September 3, 1982)
Method for the Determination of Organic Compounds Collected Using Tenax-GC Traps	Draft SOP: (December 5, 1986)

Hazleton Laboratories America, Inc.

Volatile Fraction

Methods for Organic Analysis of Municipal and Industrial Wastewater, EPA Publication No. 600/4-82-057, method 624, U.S. EPA, Cincinnati, OH (revised October 1984).

U.S. EPA Method 624 (Federal Register, Vol. 49, No. 209, PG. 43373-43384, Oct. 26, 1984).

Test Methods for Evaluating Solid Waste, EPA Publication No. SW-846, 2nd Edition, Method 8240, U.S. EPA, Washington, DC (Revised April 1984).

Semi-Volatile Fraction

Methods for Organic Analysis of Municipal and Industrial Wastewater, EPA Publication No. 600/4-82-057, method 625, U.S. EPA, Cincinnati, OH (revised October 1984)

U.S. EPA Method 625 (Federal Register, Vol. 49, No. 209, pp 43385-43406, October 26, 1984).

Test Methods for Evaluating Solid Waste, EPA Publication No. SW-846, 2nd Ed, Method 8270, U.S. EPA, Washington, DC (revised April 1984).

TABLE 3.1.1 (Cont'd)

Document Title	Identification Number (Date of Issue)
Teledyne Isotopes	
Determination of Plutonium, Uranium, Americium, Curium, and Thorium by Alpha Spectroscopy	PRO-052-32 Reissue 12 11/05/84
McCrone Environmental Services Inc.	
McCrone, W.C., "Routine Detection and Identification of Asbestos," The Microscope 33, 273-284 (1985).	
U.S. EPA, "Interim Method for the Determination of Asbestos in Bulk Insulation Samples," EPA 600/M4-82-020 (1982).	
Gulf Coast Laboratories, Inc.	
Total Organic Carbon in Wastes	EPA Method 415.1 (no number or date)
Total Organic Halogen for Solids (Wastes) by Dohrman TOX Analyzer	Revision 1 02/01/88

[a]These Argonne National Laboratory Analytical Chemistry Laboratory Standard Operating Procedures were in draft form at the time Fernald samples were being analyzed. Therefore, the date of issue of the original document is after most sample analyses were completed.

TABLE 3.1.2 List of General Analytical Methods Used to Obtain Analyte-Specific Results

Radionuclides by Alpha Spectroscopy
- Plutonium-238, 239+240, 241+242
- Thorium-227, 228, 230, 232
- Neptunium-237

TCLP Metals by ICP
- Arsenic
- Barium
- Cadmium
- Chromium
- Lead
- Selenium
- Silver

TCLP Metals by CVAA
- Mercury

Radionuclides by Gamma Spectroscopy
- Bismuth-214
- Radium-226
- Thorium-232
- Thorium-228
- Cesium-137
- Uranium-238
- Uranium-235

Metals by ICP
- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Calcium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Magnesium
- Manganese
- Mercury
- Nickel
- Potassium
- Selenium
- Silver
- Sodium
- Thallium
- Vanadium
- Zinc

Miscellaneous
- Fluoride
- Radium-226, 228
- Radium-228

Radionuclides by Uranium Fluorescence
- Uranium, Total

Radionuclides by Mass Spectroscopy Isotope Dilution
- Uranium-234
- Uranium-235
- Uranium-236
- Uranium-238

Metals by FAA
- Antimony
- Arsenic
- Cadmium
- Lead
- Selenium
- Silver
- Thallium

Metals by CVAA
- Mercury

Fibers by Microscopy
- Asbestos

Compounds by X-ray Diffraction
- MgF_2
- MgO
- UO_2

PCBs by GC/ECD
- Aroclor-1242
- Aroclor-1248
- Aroclor-1254
- Aroclor-1260

Volatile Organics by GC/MS
- Chloromethane
- Bromomethane
- Vinyl Chloride
- Chloroethane
- Methylene Chloride
- Acetone
- Carbon Disulfide
- 1,1-Dichloroethene
- 1,1-Dichloroethane
- Trans-1,2-Dichloroethene
- Chloroform
- 1,2-Dichloroethane
- 2-Butanone
- 1,1,1-Trichloroethane
- Carbon Tetrachloride
- Vinyl Acetate
- Bromodichloromethane
- 1,1,2,2-Tetrachloroethane
- 1,2-Dichloropropane
- cis-1,3-Dichloropropene
- Trichloroethene
- Dibromochloromethane
- 1,1,2-Trichloroethane
- Benzene
- trans-1,3-Dichloropropene
- 2-Chloroethylvinyl Ether
- Bromoform
- 2-Hexanone
- 4-Methyl-2-pentanone
- Tetrachloroethene
- Toluene
- Chlorobenzene
- Ethylbenzene
- Styrene
- Xylenes (total)

Semivolatile Organics by GC/MS
- Phenol
- bis(2-Chloroethyl) Ether
- 2-Chlorophenol
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- 1,2-Dichlorobenzene
- bis(2-Chloroisopropyl) Ether
- N-Nitroso-di-N-Propylamine
- Hexachloroethane
- Nitrobenzene
- Isophorone
- 2-Nitrophenol
- 2,4-Dimethylphenol
- bis(2-Chloroethoxy) Methane
- 2,4-Dichlorophenol
- 1,2,4-Trichlorobenzene
- Naphthalene
- Hexachlorobutadiene
- Para-chloro-meta-cresol
- Hexachlorocyclopentadiene
- 2,4,6-Trichlorophenol
- 2-Chloronaphthalene
- Dimethyl Phthalate
- Acenaphthylene
- 2,6-Dinitrotoluene
- Acenaphthene
- 2,4-Dinitrophenol
- 4-Nitrophenol
- 2,4-Dinitrotoluene
- 4-Chlorophenyl Phenyl Ether
- Fluorene
- N-nitrosodiphenylamine
- 4-Bromophenyl Phenyl Ether
- Hexachlorobenzene
- Pentachlorophenol

Semivolatile organics (Cont'd)
- Phenanthrene
- Anthracene
- Di-n-butylphthalate
- Fluoranthene
- Pyrene
- Butyl Benzyl Phthalate
- 3,3-Dichlorobenzidine
- Benzo(a)anthracene
- Chrysene
- bis(2-ethylhexyl)phthalate
- Di-n-octyl Phthalate
- Benzo(k)fluoranthene
- Benzo(a)pyrene
- Indeno(1,2,3-cd)pyrene
- Dibenzo(an)anthracene
- Benzo(g,h,i)perylene
- 4,6-Dinitro-o-cresol
- Benzidine
- 3,4-Benzofluoranthene
- Benzo(k)fluoranthene
- Diethyl phthalate
- 1,2-Diphenylhydrazine
- N-Nitrosodimethylamine

Acronyms:
- TCLP = Toxicity Characteristic Leaching Procedure
- PCBs = Polychlorinated biphenyls
- CVAA = Cold Vapor Atomic Absorption Spectrophotometry
- FAA = Furnace Atomic Absorption Spectrophotometry
- ICP = Inductively Coupled Plasma-Atomic Emission Spectrometry
- GC/ECD = Gas Chromatography/Electron Capture Detector
- GC/MS = Gas Chromatography/Mass Spectroscopy

4 DATA

This chapter contains a description of each environmental problem, giving some background information defining the problem, providing the sampling and analysis objectives, defining the sampling design and implementation, presenting the analytical data, and providing a brief statement of the data quality level. Only the analytical data for each problem above a specified criteria (usually the minimum detection limit for an analyte in a media) are presented in this chapter. A complete listing for all sample analyses is provided in Appendix E.

When the sampling plan was drafted, the concept of environmental problems was not yet developed. Therefore, the concept of an environmental problem has been imposed on the collected samples in the development of this report. The samples have been assigned to a problem for ease of presentation and clarity. The sample requests as given to ANL, are presented in Appendix B.

The sample numbers assigned to each problem, the location where each sample was collected, the reference(s) and page number(s) of the request(s), the requester(s), the number(s) of samples requested (if discernible) and the number of samples actually collected are presented for each problem. There are four groups of requests referenced as follows:

(1) *Fernald Feed Material Production Center: Preliminary Sampling Analysis Requirements*, dated June 26, 1986. This contains 49 pages and the requester's name is on each page.

(2) A U.S. Dept. of Energy Telecommunication Message consisting of three pages from Chris Grundler, U.S. Dept. of Energy to Steve Ballou, Argonne National Laboratory dated Aug. 7, 1986.

(3) A U.S. Dept. of Energy Telecommunication Message consisting of 20 pages from Chris Grundler, U.S. Dept. of Energy to Steve Ballou, Argonne National Laboratory dated Aug. 7, 1986.

(4) A Facsimile Transmission consisting of 10 pages from Mike Malloy, NUS Corp. to Dr. Ballou dated Aug. 18, 1986.

The presentation of each environmental problem in this report begins with a *Finding and Basis*. The text for this discussion is taken from *Environmental Survey Report: Feed Materials Production Center, Fernald, Ohio*, U.S. Dept. of Energy, Environment, Safety and Health Office of Environmental Audit, March 1987. That report is designated as Reference 5. The section and finding number of the Survey report where the information was obtained for the development of finding and basis is also given.

The sampling design and implementation are given in a detailed description for each problem. The sampling locations are also presented.

Complete presentation of the analytical data are provided in Appendix E. The data discussed for each problem in this section represent a summarization of those data, presenting only the results where contaminants were found at levels above the minimum detection level for the analyte and media.

The evaluation of data quality for each environmental problem is based on guidance from the DOE Environmental Survey Manual, Appendix A, Criteria for Data Evaluation. Chapter 5 of this report provides a complete discussion of application of the methodology to the FMPC data.

4.1 ENVIRONMENTAL PROBLEM 1: K-65 TRENCH

Requesters: Kelly and Riddle

Details are provided in Table 4.1.1.

Finding and Basis

The K-65 silos (1 and 2) contain refinery residues that were generated by the acid digestion of pitchblende ores from South Africa. The K-65 material is a radioactive solid residue. It is insoluble in nitric acid and consists mostly of siliceous matter. The radioactivity of the material is caused by the presence of radium. The K-65 silos also contain other insoluble metallic compounds. Waste material was pumped to these silos from the production area via an open cement block trench. The soil and sediment in this trench could be contaminated by residual hazardous materials from this activity (Ref. 5, Sec. 4.3.2.3). It should be noted that Pit 1 and Pit 2 in the Waste Pit area received decant water from the K-65 silos while Pit 3 received storm water pumped from the sump draining the area around the K-65 silos (Ref. 5, Sec. 4.5.1).

4.1.1 Sampling and Analysis Objective

Samples of soil and sediment taken from the K-65 trench should provide information regarding residual hazardous materials left in the soil from that time when material was pumped through the trench.

4.1.2 Sampling and Analytical Design and Implementation

Sampling Design

Samples were taken at five locations (see Fig. 4.1.1) along the length of the trench on alternative sides: (1) 63 ft east of the western end of the trench; (2) 96 ft east of #1; (3) 153 ft east of #2; (4) 189 ft east of #3; and (5) 180 ft east of #4. At each location stainless steel augers and trowels were used to get surface soil from a depth of 0-12 inches.

TABLE 4.1.1 Environmental Problem 1: Sample Request Table

Sample Number	Location	Reference/Page Number	Requester	Samples Proposed	Samples Collected
FE0128IS	63 ft east of west end	1/37, 1/48	Kelly, Riddle	6, 5	5
FE0129IS	159 ft east of west end				
FE0130IS	312 ft east of west end				
FE0131IS	501 east of west end				
FE0132IS	681 ft east of west end				

FMPC S&A Data Doc. 6540
Issue Date: 06/17/88
Revision: 00

000053

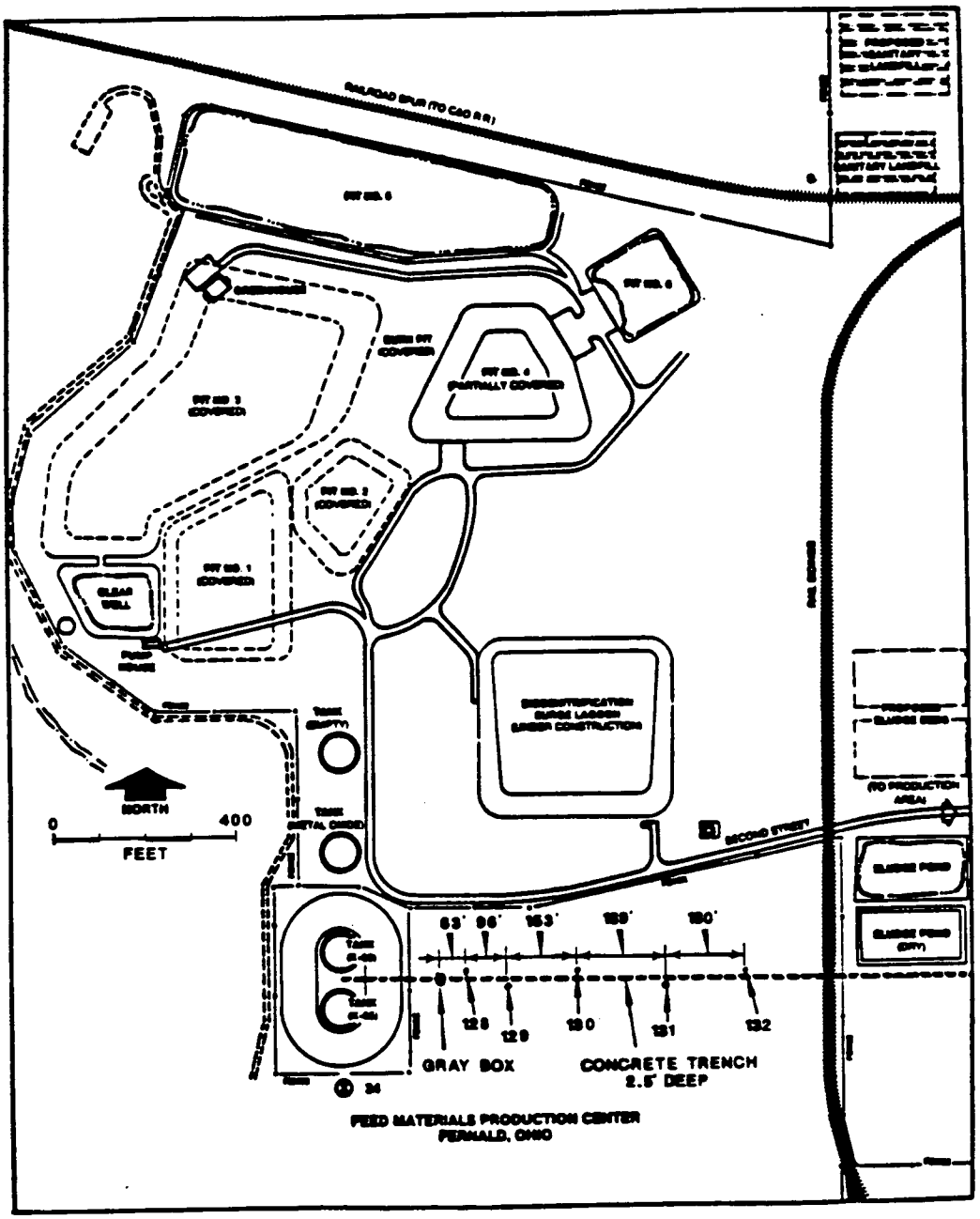


FIGURE 4.1.1 Sampling Locations Along the K-65 Trench

Analytical Design

The soil and sediment samples from the K-65 trenches were analyzed to determine the concentration of uranium, RCRA metals, volatile organics, and radionuclides present at or above analytical method detection limits. Of particular importance is the determination of residual radium which is the primary suspect contaminant. For more information on analytical methods, see Appendix A.

4.1.3 Field and Analytical Data

Field Data

Field measurements for radioactivity were taken along the length of the trench. The measurements decreased noticeably while proceeding east in the trench. The following readings were recorded at each sampling location: (1) 1000 μR/hr; (2) 650 μR/hr; (3) 350 μR/hr; (4) 170 μR/hr; and (5) 105 μR/hr.

Analytical Data

Concentrations of analytes in samples from the K-65 trench which exceed MDLs are presented in Table 4.1.2. The maximum gamma emitting radionuclides were found in the sample from the east end of the trench. The activities of uranium, thorium and cesium ranged from 0.24 pCi/g to 1.8 pCi/g. Ra-226 and its decay daughter Bi-214 had higher activities, 5.7 pCi/g each. The total uranium concentrations on the north side of the trench ranged from 12 pCi/g to 15 pCi/g from the east end to the west end. Barium is the only RCRA metal found in the samples at higher than the analytical method detection limit, with a peak value of 0.63 mg/L.

For a complete presentation of analytical data, see Appendix E.

4.1.4 Data Quality Evaluation

Sampling Design - The number, location, and type of sampling points were adequate to provide representative information. Data utility level 2.

Sample Collection - EPA-approved sample containers and sample collection methods were used. Appropriate field measurements were taken. Field logbooks contain all necessary supporting information and are signed and dated. Data utility level 2.

Sample Analysis - Sample handling was appropriate for the media and analysis performed. Instruments and procedures used meet established standards. Laboratory notebooks contain sufficient information and are signed and dated. Data utility level 2.

TABLE 4.1.2 Environmental Problem 1: Analyte Concentrations Which Exceed Minimum Detection Levels for Samples Collected in the K-65 Trench

Sample Number	Media	Location	RCRA Metals: Ba mg/L	Radionuclides: U-235 pCi/g	Bi-214 pCi/g	Cs-137 pCi/g	Ra-226 pCi/g	Th-228 pCi/g	Th-232 pCi/g	Total U mg/kg
FE0128IS2B	Soil	K-65 Trench	0.53	0.11	0.9		0.88	1.1	1.4	15
FE0129IS2B	Soil	K-65 Trench	0.63	0.19	1.2		1.30	1.4	1.1	9.4
FE0130IS2B	Soil	K-65 Trench	0.54	0.23	1.2	0.13	1.30	1.4	1.6	12
FE0131IS2B	Soil	K-65 Trench	0.50	0.15	2.0		2.10	1.5	1.5	1.8
FE0132IS2B	Soil	K-65 Trench	0.55	0.42	5.7	0.24	5.70	1.8	1.7	12

Sample Number	Media	Location	Organics: Acet µg/kg	ChlF µg/kg	M Chl µg/kg
FE0128IS3B	Soil	K-65 Trench	18 B	8	11 B
FE0129IS3B	Soil	K-65 Trench	18 B	9	18 B
FE0130IS3B	Soil	K-65 Trench	24 B	10	30 B
FE0131IS3B	Soil	K-65 Trench	24 B	11	12 B
FE0132IS3B	Soil	K-65 Trench	28 B	10	16 B

Footnotes & Flags
B = analyte was found in the blank as well as the sample.
Blank spaces indicate concentration below MDL.

Key to Organics Abbreviations
Acet --Acetone; ChlF -- Chloroform;
M Chl -- Methylene Chloride

QA/QC and Documentation - The S&A Plan contained a QA plan covering all aspects of the sampling and analysis program. No field QC samples were collected for this Problem. Adequate laboratory QC analyses were performed. Records were maintained regarding laboratory instrument calibration and maintenance. Data are reported in appropriate units accompanied by estimates of uncertainty. Supporting information is available. Data utility level 2.

4.2 ENVIRONMENTAL PROBLEM 2: PARTICULATE DEPOSITION

Requester: Crist

Details are provided in Table 4.2.1.

Finding and Basis

There are numerous sources of fugitive airborne emissions of uranium-containing particulates at FMPC. Fugitive uranium emissions can be categorized as one of two types at the FMPC site: current emissions or resuspension of past emissions. Current fugitive emissions are those that escape from the process buildings through doors, windows, and exhaust fans that are not considered point sources/stacks. These emissions are primarily particulates and fumes from leaks in piping and tanks as a result of the handling of the production feed materials, the conversion process to metal, and the grinding/milling of metal into various product forms. Additionally, fugitive emissions result from the flyash piles, landfill, waste pits, tank farms, and waste drums on the site. Uranium has been historically deposited on roadways, fields, and storage areas of the plant from spills, accidents, and air emissions.

Particulate emissions are of special concern because of their uranium and other radionuclide constituents. These emissions could cause adverse environmental impact to off-site receptors. Standard operating procedures have been developed at FMPC to limit discharge of uranium-containing particulates. Nevertheless, fifteen sources (of the approximately 530 process and point emission sources) are categorized as "major" by FMPC since they account for over 90 percent of these uranium-containing particulate emissions in most years. Table 4.2.2 shows a breakdown of these major sources in 1984 (Ref. 5, Sec. 3.1.2).

Contaminated soils can become airborne from road traffic and/or wind erosion. Fugitive emissions from the flyash piles, especially the inactive flyash pile, which had been treated with contaminated oils as a dust suppressant, are of major concern (Ref. 5, Sec. 3.1.4.2.2).

Soil on the FMPC facility has been contaminated with uranium by past releases from the production operations on the site. The contaminated soil may potentially be resuspended in the air to be transported off the site as a fugitive emission, and contribute to groundwater and surface-water contamination. Uptake of this contamination by vegetation is also a concern.

Although emissions of uranium from point sources may have been significantly reduced in recent years, a large quantity of uranium exists in soils within the facility boundary from past deposition.

The FMPC soil sampling program concentrates on off-site locations (Ref. 5, Sec. 3.2.4.3.1).

TABLE 4.2.1 Samples Collected for Environmental Problem 2: Sample Request Table

Sample Number	Location	Ref./ Page No.	Requester	Samples Proposed	Samples Collected
FE0229OT	North side Bldg. 66	1/9	Crist	4	4
FE0230OT	East side Bldg. 66				
FE0231OT	West side Bldg. 66				
FE0232OT	South side Bldg. 66				
FE0500FD	Road next to K-65 drums	1/13	Crist	10	10
FE0501FD	Road next to bio surge lagoon				
FE0502FD	Intersection between pit 4 and pit 6				
FE0503FD	Road adjacent to wet chemical pit 5				
FE0504FD	End of road near scrap pit 3				
FE0505FD	Road near scrap pit 2				
FE0506FD	End of road near Clearwell				
FE0507FD	Concrete slab near pit 4				
FE0509FD	Pump platform on berm from bio surge lagoon				
FE0510FD	Road from bio surge lagoon to production area				
FE0513FD	Storage area near Bldg. 64	1/12	Crist	?	16
FE0514FD	Docks of Bldg. 12				
FE0515FD	2nd street south side of Bldg. 12				
FE0516FD	Between Bldg. 71 and Bldg. 1				
FE0517FD	Between drums near Bldg. 1				
FE0518FD	Around west water tower				
FE0519FD	South side Bldg. 18				
FE0520FD	Driveway into metal tank farm				
FE0521FD	D street in front of Bldg. 55				
FE0522FD	Intersection 2nd St and E St				
FE0523FD	Road E Bldg. 9 near stack				
FE0524FD	Directly behind Bldg. 11				
FE0525FD	East end Bldg. 37 (loading dock)				
FE0526FD	SW corner Bldg. 13				
FE0528FD	Storage tank area near Bldg. 2/3				

TABLE 4.2.2 Major Uranium Air Emission Sources FMPC-Fernald, Ohio

Discharge Number	Plant Number	Emission Source	Control System	1984 Emissions (Pounds Uranium)	Cumulative % of Total Emission
G9N1	9	Remelt Furnace	Fabric Filter	374.1	47.3
G4-2	4	Packaging	Fabric Filter	66.8	55.7
G5-261	5	Crucible Burnout	Fabric Filter	65.0	64.0
8-RKS	8	Rotary Kiln	Scrubber	63.7	72.0
G5-55	5	Storage	Fabric Filter	34.2	76.3
G5-259	5	Crucible Burnout	Fabric Filter	33.1	80.5
1-SLY	1	Cutting/ Milling	HEPA Filter	19.4	83.0
G5-260	5	Casting	Fabric Filter	18.5	85.3
8-OFS-1	8	Oxidation Furnace	Scrubber	11.5	86.8
G5-251	5	Blending	Fabric Filter	11.0	88.2
G4-5	4	Packaging	Fabric Filter	9.3	89.3
G4-14	4	Packaging	Fabric Filter	7.9	90.3
8-035	8	Oxidation Furnace	Fabric Filter	7.9	91.3
G5-254	5	Breakout	Fabric Filter	6.6	92.2
8-024	8	Muffle Furnace	Fabric Filter	6.0	92.9
All Others	-	-	-	56.0	100
Total	-	-	-	791[a]	100

[a]Not including unmonitored sources.

Lead Contamination

The contamination of soils (that subsequently become a fugitive air emissions source) by past operational practices at FMPC is not confined to radioactive materials. Lead shot has been used in the Plant 1 drum shot blaster, and the historical emissions from this facility are considered not only a potential source of lead soil contamination, but also a fugitive air source (Ref. 5, Sec. 3.1.2).

4.2.1 Sampling and Analysis Objectives

Samples were collected and analyzed to determine the concentration of uranium, RCRA metals, and fluorine present in road sweepings taken from representative locations site-wide.

4.2.2 Sampling and Analytic Design and Implementation

Sampling Design

Road sweepings consisting of the dust or soil from unpaved or gravel roads were collected at several locations within three main areas of the site: the pit area, the production area; and the drum reconditioning building.

A clean brush was used at each location to collect a sample ranging from 20 to 50 grams into a ziploc bag.

All samples were surveyed for radiation prior to transfer to the shipping container.

Pit Area

Road sweepings were collected from 10 locations throughout the pit area as shown in Fig. 4.2.1. The samples were taken from least 6 to 12 inch sections of the road. These locations are as follows:

1. freshly paved road (asphalt) next to the K-65 drums (FE0500FD)

2. gravel road next to the Bio. Surge Lagoon(FE0501FD)

3. at the intersection of the paved road between the Dry Chemical Pit #4 and Dry Residue Pit #6 (FE0502FD)

4. gravel road adjacent to Wet Chemical Pit #5 (FE0503FD)

5. gravel road adjacent to Scrap Pit #3 (FE0504FD)

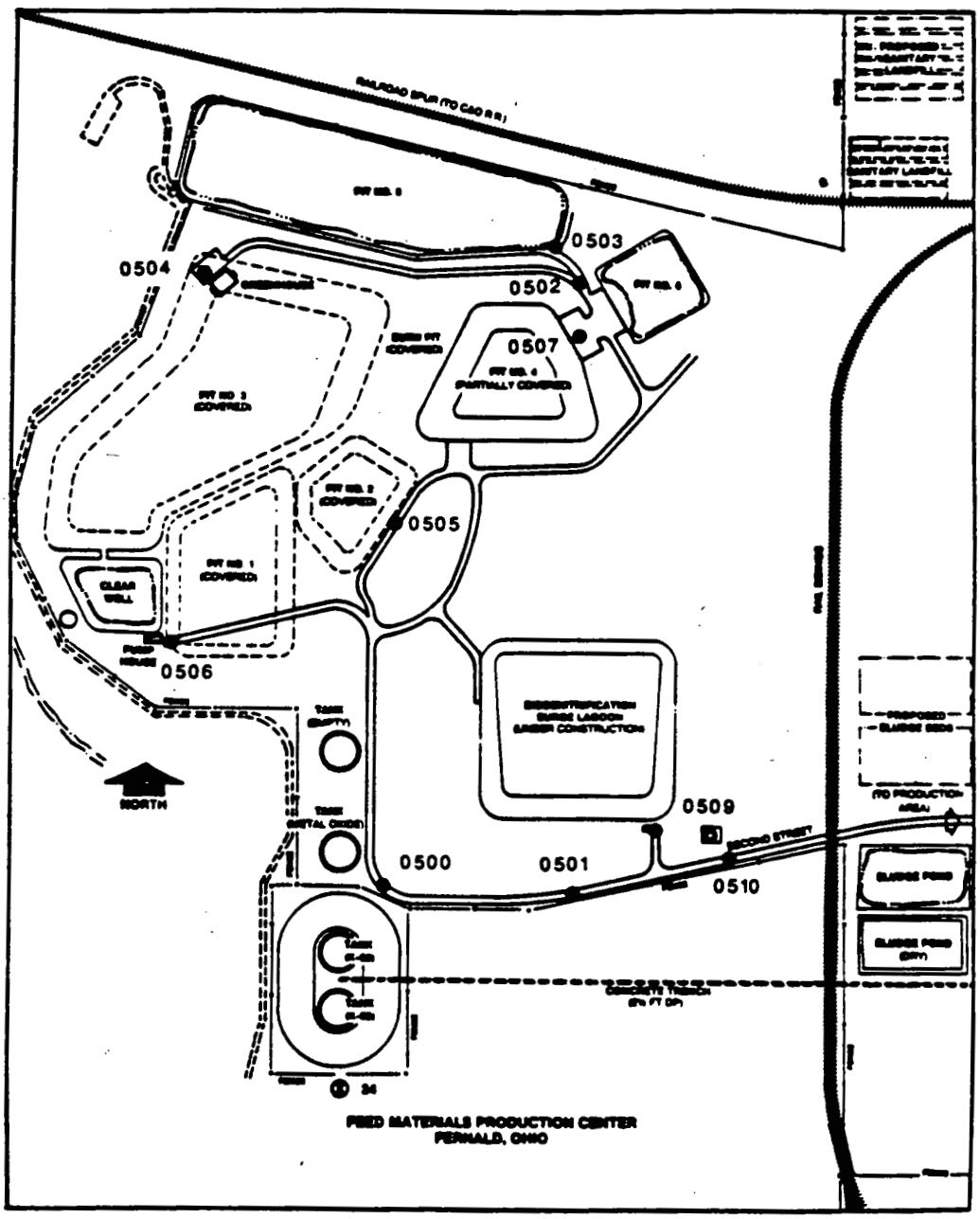


FIGURE 4.2.1 Sweepings from the Pit Area

6. paved road near Scrap Pit #2 (FE0505FD)

7. paved road adjacent to Clear Well (FE0506FD)

8. concrete slab adjacent to Dry Chemical Pit #4 (FE0507FD)

9. pump platform on berm from the Bio. Surge Lagoon (FE0509FD)

10. paved road leading from Bio. Surge Lagoon back into the Production Area (FE0510FD)

Production Area

Road sweepings were also collected from 15 locations throughout the production area as shown in Figs. 4.2.2 through 4.2.5. These locations and sample numbers are as follows:

1. paved storage area inside the fenced area of Bldg. 64 (FE0513FD)

2. paved road across from the loading docks of Bldg. 12 (FE0514FD)

3. paved road (2nd St.) on the south side of Bldg. 12 (FE0515FD)

4. paved road near drums stored between Bldg. 71 and Bldg. 1 (FE0516FD)

5. paved area between drums stored adjacent to Bldg. 1 (FE0517FD)

6. paved road west of Water Tower (FE0518FD)

7. road adjacent to the south side of Bldg. 18 (FE0519FD)

8. paved driveway leading into Metal Tank Farm (FE0520FD)

9. paved road (D St.) directly in front of Bldg. 55 across from Bldg. 6 (FE0521FD)

10. paved road at intersection of 2nd St. and E St. (FE0522FD)

11. paved road (E St.) at Bldg. 9 near the stack (FE0523FD)

12. paved road directly behind Bldg. 11, the laundry and shower facilities. (FE0524FD)

13. paved loading dock area at the east end of Bldg. 37 (FE0525FD)

14. paved area at the southwest corner of Bldg. 13 (FE0526FD)

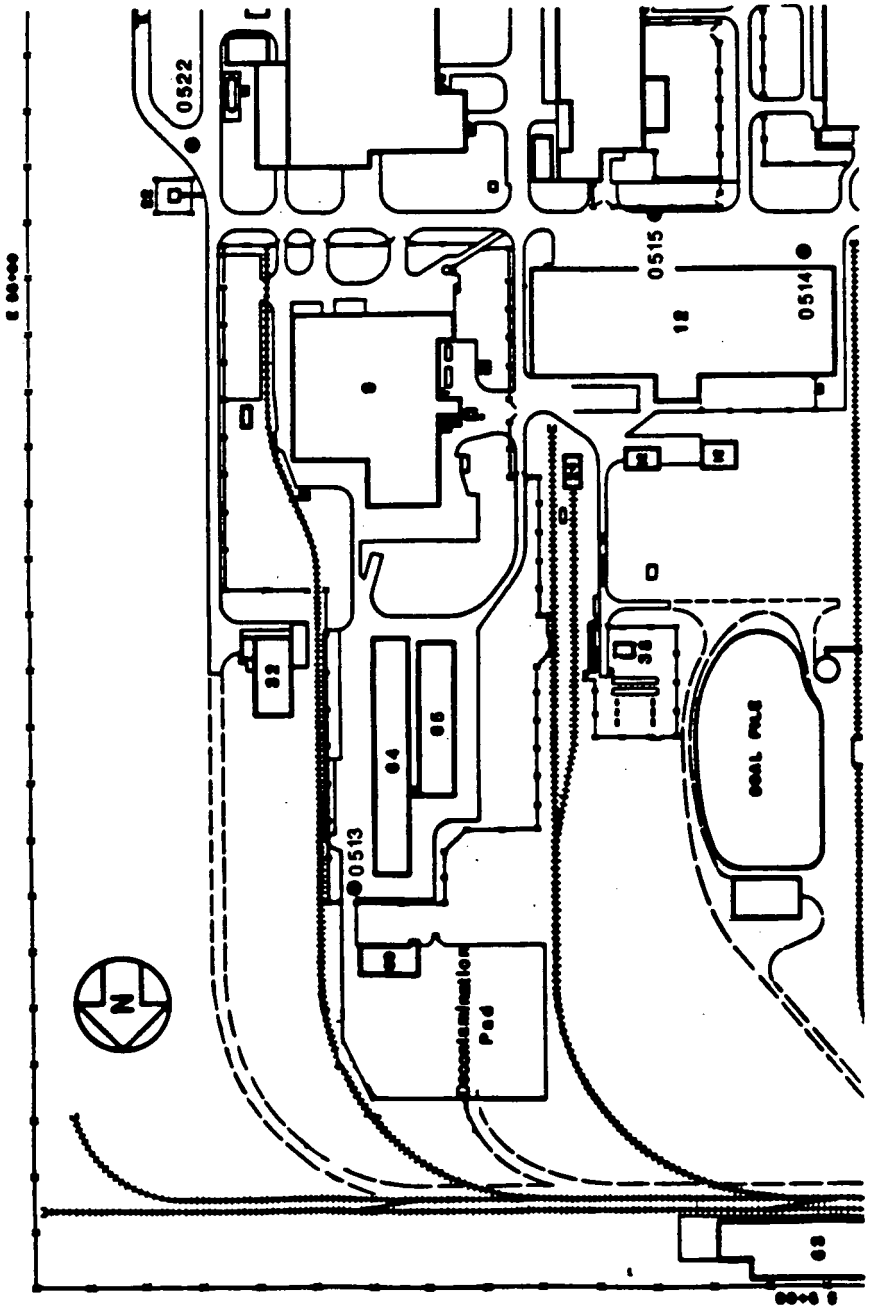


FIGURE 4.2.2 Sweepings from the Production Area - Northeast Quadrant

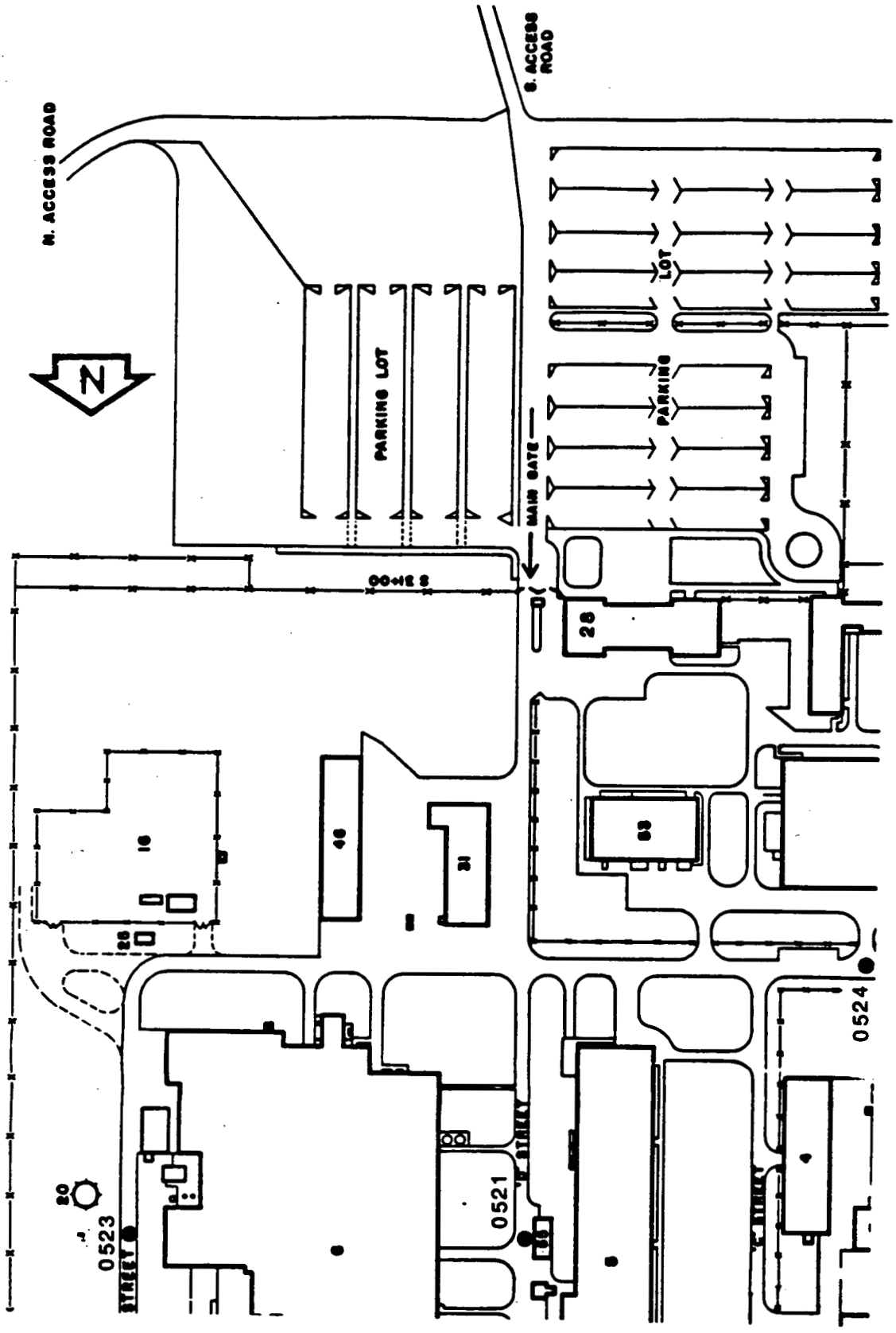


FIGURE 4.2.3 Sweepings from the Production Area - Southeast Quadrant

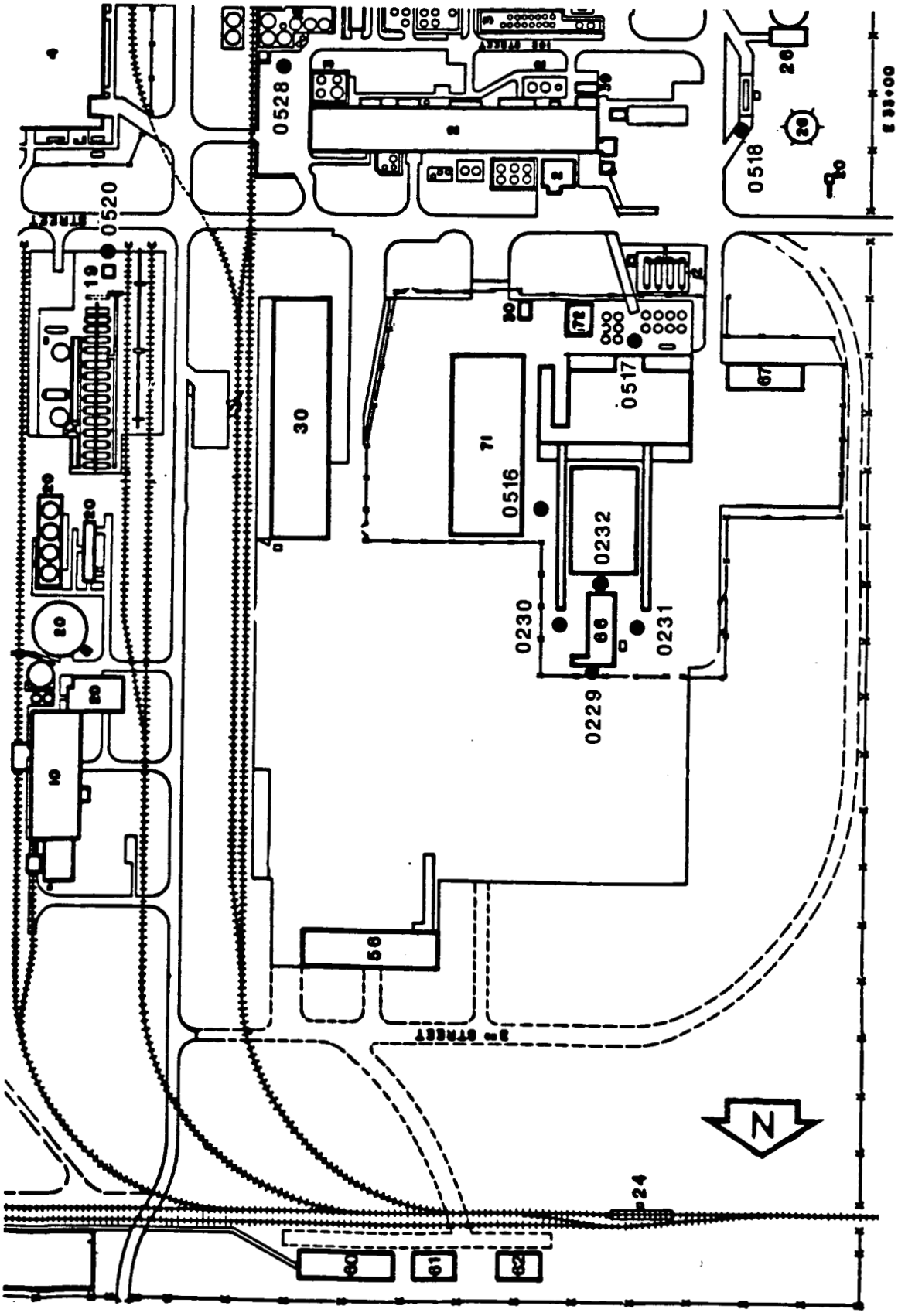


FIGURE 4.2.4 Sweepings from the Production Area - Northwest Quadrant

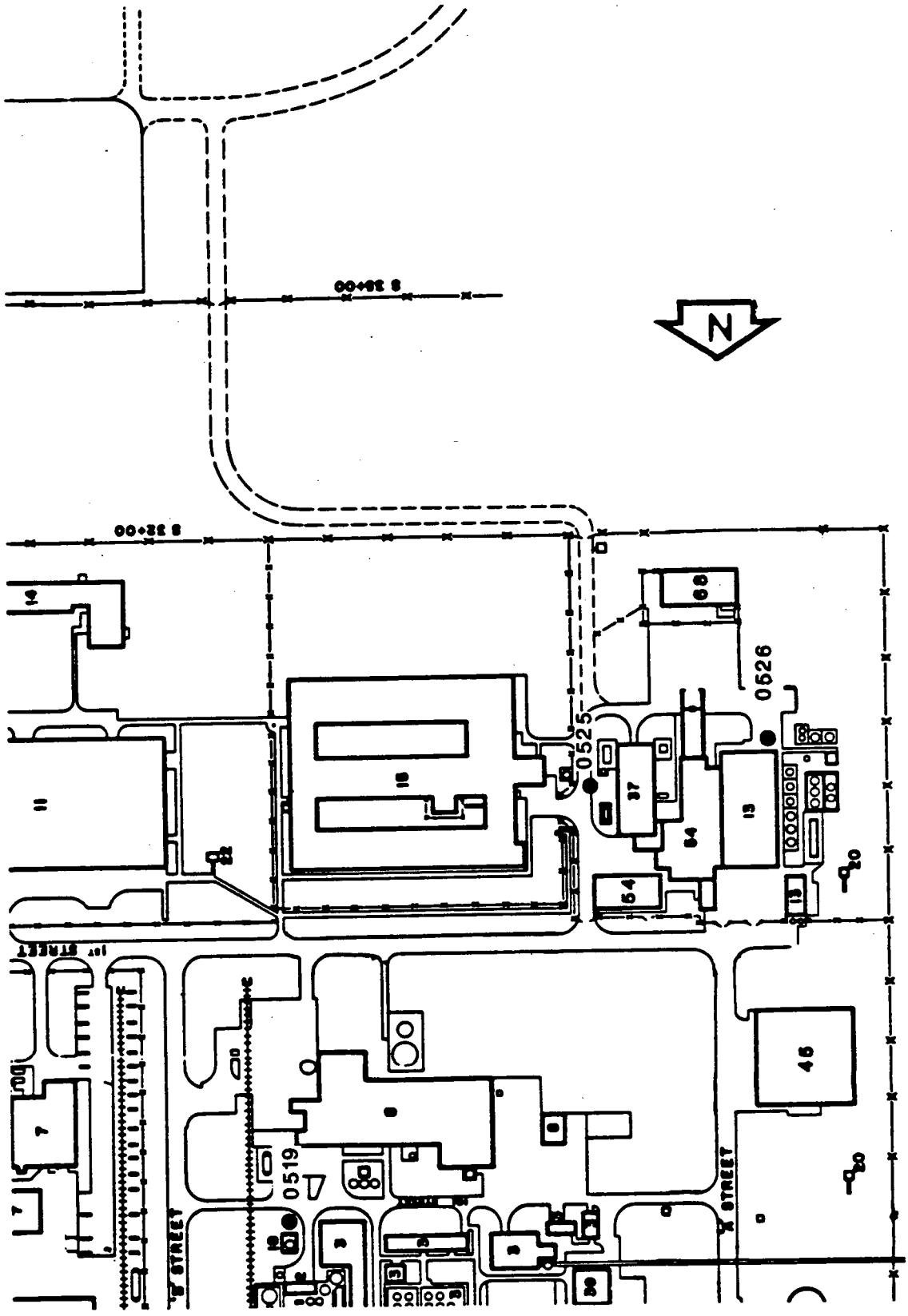


FIGURE 4.2.5 Sweepings from the Production Area - Southwest Quadrant

15. paved storage tank area adjacent to Bldg. 2/3 Refinery on the south side. (FE0528FD)

Drum Reconditioning Building

Road sweepings were composited from five to six locations on each side of Building 66 (the drum conditioning building) yielding four composite samples as shown in Fig. 4.2.6. The location for each aliquot was an area ~2 ft^2 in the center of the roadway. The center of the north road was 15 feet from Building 66; the east road was ~46 feet from the building; the west road was 50 feet from the building; and the south road was 50 feet from the building. Approximately 40 feet of this roadway was under roof and it was wet from water used in cleaning operations. Each sample consisted of a 1000 ml mixture of dust, stone and dirt. The samples were loaded into 2-500 ml amber glass bottles.

Analytical Design

Road sweepings from representative areas throughout FMPC were analyzed to determine the concentration of uranium, magnesium, fluorine and RCRA metals present at or above analytical detection limits. For more information on analytical methods, see Appendix A.

4.2.3 Field and Analytical Data

Analytical Data

Table 4.2.3 presents the analytical data which exceed analytical method detection limits for analyses performed on samples collected in the pit area, production area, and in the vicinity of Building 66.

Apparent from Table 4.2.3, Mg concentrations in the range of 15,000 to about 48,000 mg/kg are prevalent in both the pit and production areas. Concentrations of total U and F are more variable and range from less than 1,000 through 45,000 mg/kg for F and 15 through 10,450 mg/kg for total U. Samples collected in the vicinity of Building 66 (Drum Reconditioning Building) show high concentrations of F, Mg, Pb, and total U. These samples exhibit the highest concentrations of Mg and Pb in the sweepings samples collected for this problem, with values of 72,100 mg/kg and 806 mg/kg, respectively.

Analyses of the samples for RCRA metals indicates elevated levels of Pb, Ba, and Cr were present in production area samples. Concentrations of Pb ranged from 46 mg/kg to 412 mg/kg; concentrations of Ba ranged from 29 mg/kg to 1550 mg/kg; and concentrations of Cr ranged from 12 mg/kg to 55 mg/kg.

Only three samples were analyzed for neptunium and plutonium with a maximum concentration of 2.51 pCi/g found for Np-237.

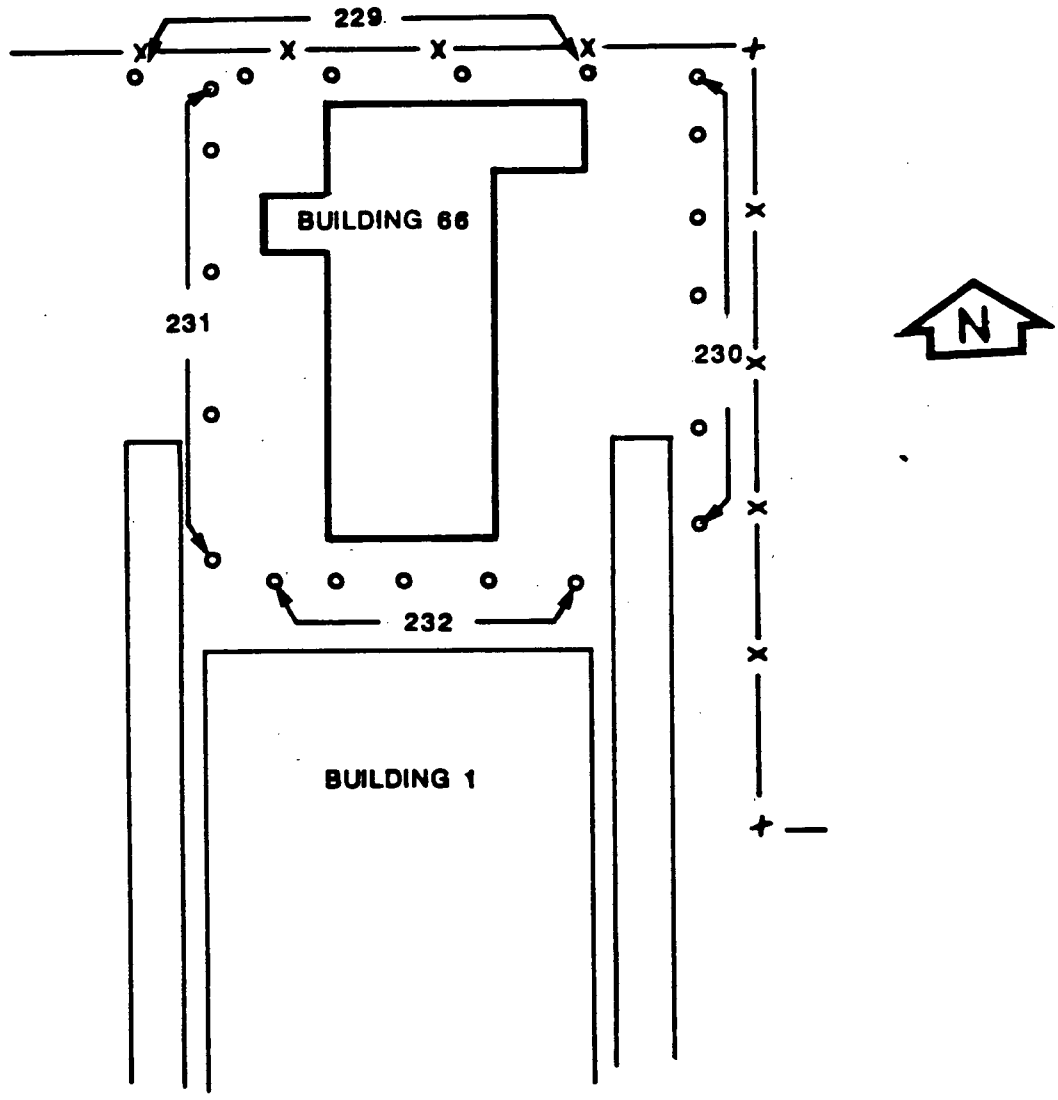


FIGURE 4.2.6 Sweepings in the Vicinity of the Drum Reconditioning Building

TABLE 4.2.3 Environmental Problem 2: Analyte Concentrations above Minimum detection Limits for Dust and Sweepings Samples

Sample Number	Media	Location	RCRA Metals: Ba mg/kg	Cd mg/kg	Cr mg/kg	Hg µg/g	Pb mg/kg	Radionuclides Total U mg/kg	Miscellaneous F mg/kg	Mg(ICP) mg/kg	Mg(TCLP) mg/kg
		Pit Area									
FE0500FD1B	Dust	Road @ K65 Silos	46		12		26	100	1800	34700	22800
FE0501FD2B	Dust	Rd@Bio.Surge Lagoon	34		10			172	1600	26100	20100
FE0502FD3B	Dust	Road@ Chem Pit 4	27				22	4900	10200	36600	23100
FE0503FD3B	Dust	Rd@WetChem Pit 5	21					2540	4100	26000	28800
FE0504FD5B	Dust	Rd @ Scrap Pit 3	15					160	2300	28600	24200
FE0505FD6B	Dust	Rd @ Scrap Pit 2	32				24	6050	8100	31100	26600
FE0506FD7	Dust	Road @Clear Well	58		16		35	1930	4700	26400	26300
FE0507FD8B	Dust	Conc.Slab Ch Pit 4	72		18		37	4370	45000	37900	18200
FE0509FD9B	Dust	Pump.Plat Surg Lag	67		20		38	15	700	23100	17100
FE0510FD10B	Dust	Rd @Bio Surg Lag	24		10			76	1300	35900	31300
		Production Area									
FE0513FD12B	Dust	Stor Area @ Bd 64	46		21		66	170	700	28000	23900
FE0514FD13B	Dust	Rd @ Bd 12 Docks	29		23		86	1420	2600	27600	24600
FE0515FD14B	Dust	Road @ Build 12	163	7	33	0.94	187	1720	3300	28500	23400
FE0516FD15B	Dust	Road @ Bd 1 & 71	125	14	55		217	737	4900	24500	17500
FE0517FD16B	Dust	Paved Area @ Bd 1	127	7	25		92	1070	2400	30000	24300
FE0518FD17B	Dust	Rd @ Water Tower	54		20		135	545	9400	36700	28200
FE0519FD18B	Dust	Road @ Build 18	110		39		46	1060	3100 D	36000	24800
FE0520FD19B	Dust	Rd@ Metal Tank Farm	63		30	0.17	158	435	4500	30400	23900
FE0521FD20B	Dust	Road @ Build 55	80		49		154	10450	6700	47600	31300
FE0522FD21B	Dust	Rd @ Inter 2 & E	53		14	0.56	48	797	1400	28200	22500
FE0523FD22B	Dust	Road @ Build 9	55		20		64	7820	3200	30900	22800
FE0524FD23B	Dust	Road @ Build 11	45		17	0.06	85	1630	3400	30100	22300
FE0525FD24B	Dust	Road @ Build 37	45		12		63	369	990	32300	32200
FE0526FD25B	Dust	Road @ Build 13	1150		44		283	336	1600	30800	15000
FE0528FD27B	Dust	Storage Tank Area	1550		50	0.25	412 D	1230	3300	27800	21800

Footnotes & Flags
Blanks indicate sample concentration below MDL
D = Duplicate results greater than 20% different

TABLE 4.2.3 (Cont.) Environmental Problem 2: Analyte Concentrations above Minimum detection Limits for Dust and Sweepings Samples

Sample Number	Media	Location	Radionuclides: Np-237 pCi/g	Pu-238 pCi/g	Pu-239+240 pCi/g	Pu-241+242 pCi/g	Ra-226 pCi/g	Ra-228 pCi/g
FE0507FD8	Dust	Conc.Slab Ch Pit 4	2.06	0.09	0.48	0.03	3.10 ± 0.48 K	3.65 ± 0.48 K
FE0520FD19	Dust	Rd@ Metal Tank Farm	0.27	0.11	0.18	0.27	1.80 ± 0.06 K	0.70 ± 0.04 K
FE0521FD20	Dust	Road @ Build 55	2.51	0.22	1.5	0.01	2.15 ± 0.70 K	5.85 ± 0.66 K

			RCRA Metals: Pb mg/kg	Radionuclides: Total U mg/kg	Miscellaneous: F mg/kg	Mg mg/kg
FE0229OT1A	Sweepings	Building 66	322	6040	3000	39200
FE0229OT2A	Sweepings	Building 66	243	4700	540	40800
FE0230OT1A	Sweepings	Building 66	215	3080	2300	43000
FE0230OT2A	Sweepings	Building 66	166	1730	1400	46100
FE0231OT1A	Sweepings	Building 66	93	1180	700	70100
FE0231OT2A	Sweepings	Building 66	70	850	970	72100
FE0232OT1A	Sweepings	Building 66	455	6530	1300	29200
FE0232OT2A	Sweepings	Building 66	806	4610	3300	25800

Footnotes & Flags

K= Samples canned for gamma-counting; data processed by least squares analysis program.

A complete list of the analytical data for these samples is provided in Table 4.2.3. For a complete presentation of analytical data, see Appendix E.

4.2.4 Data Quality Evaluation

Sampling Design - The number, location, and type of sampling points were adequate to provide representative information. Data utility level 2.

Sample Collection - EPA-approved sample containers and sample collection methods were used. Appropriate field measurements were taken. Field logbooks contain all necessary supporting information and are signed and dated. Data utility level 2.

Sample Analysis - Sample handling was appropriate for the media and analysis performed. Instruments and procedures used meet established standards. Laboratory notebooks contain sufficient information and are signed and dated. Data utility level 2.

QA/QC and Documentation - The S&A Plan contained a QA plan covering all aspects of the sampling and analysis program. No field QC samples were collected for this Problem. Adequate laboratory QC analyses were performed. Records were maintained regarding laboratory instrument calibration and maintenance. Data are reported in appropriate units accompanied by estimates of uncertainty. Supporting information is available. Data utility level 2.

4.3 ENVIRONMENTAL PROBLEM 3: PROCESS EMISSIONS

Requesters: Crist and Firstenberg

Details are provided in Table 4.3.1.

Finding and Basis

There are approximately 430 process-emission sources at FMPC and 109 emission point sources (stacks and vents). Control equipment has been installed at most point sources. These controls consist primarily of fabric filters, with a small number of electrostatic precipitators, venturi scrubbers, and high efficiency particulate (HEPA) filters.

FMPC developed practices to limit particulate uranium discharges, including administrative controls instituted in all process baghouse filters directed at the timely detection of failures, to avoid a repetition of the 1984 accidental release from the G9N1-1039 (Plant 9) baghouse. Those practices include a daily visual inspection of the baghouse for signs of failure and hourly checks and recording of the differential pressure across the baghouse. In some facilities, such as G9N1-1039, a high-efficiency particulate (HEPA) filter has been installed downstream of the baghouse. Based on the 1985 and 1986 emissions data, these measures have been effective in reducing the airborne releases of uranium-bearing particulates (Ref. 5, Sec. 3.1.2).

Plant 5 Fugitive Emissions

Uncontrolled emissions from Plant 5 are a source of fugitive uranium-containing emissions at FMPC. A total of 207 magnesium flashes and 23 blowouts occurred in the area of the Plant 5 Rockwell furnaces during the first 3-1/2 months of 1986. These events released uranium-bearing particulates into the building area, which were then released to the outside environment through the building ventilation system. These events are considered to be a potentially important source of unmonitored and uncontrolled emissions at FMPC (Ref. 5, Sec. 3.1.4.2.4).

Plants 6 and 9 Emissions

Uncontrolled emissions of uranium-containing particles occur from Plants 6 and 9 because the electrostatic precipitator (ESP) units are not functional. These units, the principal control for particulate emissions from various operations, have not, according to site personnel, operated for many years. The Plant 9 unit had a coarse fiberglass curtain that could remove the larger particulates. The Plant 6 units (not inspected) presumably have similar screens that appear to originally have served to keep the larger particles from the ESPs. These screens would not be expected to be very efficient for the removal of smaller particles.

TABLE 4.3.1 Environmental Problem 3: Sample Request Table

Sample Number	Location	Ref./ Page No.	Requester	Samples Proposed	Samples Collected
FE0200OT FE0201OT	North Rockwell furnaces				
FE0202OT FE0203OT	South Rockwell furnaces				
FE0204OT FE0205OT	North Rockwell furnaces				
FE0206OT FE0207OT	South Rockwell furnaces				
FE0208OT FE0209OT	North Rockwell furnaces				
FE0210OT FE0211OT	South Rockwell furnaces	1/7	Crist	10	32
FE0212OT FE0213OT	North Rockwell furnaces				
FE0214OT FE0215OT	South Rockwell furnaces				
FE0216OT FE0217OT	North Rockwell furnaces				
FE0218OT FE0219OT	South Rockwell furnaces				
FE0220OT FE0221OT	North Rockwell furnaces				
FE0222OT FE0223OT	South Rockwell furnaces				
FE0224OT FE0225OT	North Rockwell furnaces				
FE0226OT FE0227OT	South Rockwell furnaces				
FE0228OT FE0233OT	North Rockwell furnaces				

TABLE 4.3.1 (Cont'd)

Sample Number	Location	Ref./ Page No.	Requester	Samples Proposed	Samples Collected
FE0234OT FE0235OT	South Rockwell furnaces	1/7	Crist		
FE0236OT FE0244OT FE0245OT FE0246OT FE0247OT	Plant 9 organics Plant 9 upstream Plant 9 downstream Plant 9 organics Plant 9 organics	1/8	Crist	1	2
FE0242OT	Plant 5 stack #G5-216	1/6	Firstenberg	1	1

The stacks at Plants 6 and 9 are sampled continuously. However, only one Minor Events Report (required when a sampler detects more than 0.1 kg of uranium in one month) has ever been filed for these sources (Ref. 5, Sec. 3.1.4.2.6).

4.3.1 Sampling and Analysis Objectives

Collection of particulate samples from above the Rockwell furnaces was conducted to provide an estimate of airborne contaminant concentrations in Plant 5. Stack sampling from Plants 5 and 9 was conducted to provide an estimate of specific airborne contaminants released to the environment from those sources.

4.3.2 Sampling and Analytical Design and Implementation

Sampling Design

Sampling above Rockwell Furnaces

Samples in Plant 5 above the Rockwell furnaces were taken at two locations. The north location was near a heating vent unit (#G5-388) platform over the east row of Rockwell furnaces numbers 2 through 13. The south location was near a heating vent unit (#G5-389) platform over the east row of Rockwell furnaces numbers 2 through 13. Two simultaneous samples were taken from each location. One was a high volume sample on a 10.5 cm diameter (8.8 cm diameter entrance) Whatman 0.8 μm glass

microfiber filter #934-AH with a flow rate that was typically 400 L/min at the start of sampling and dropped to 380 L/min by the end of sampling. The second was a low volume sample on a 4.7 cm diameter (3.5 cm diameter entrance) Gelman 0.8 μm glass fiber filter type A-E with a flow rate that was typically 15 L/min (see Fig. 4.3.1). The filters were conditioned according to EPA Method 5 procedures. The sample heads (see Fig. 4.3.2) were suspended approximately 15 feet above the furnaces and 23.5 feet above the floor (see Fig. 4.3.3). Half of the samples were submitted for analysis in the event that further analyses were required.

Plant 5 Stack Sampling

One stack sample was collected from stack No. G5-216 with equipment hoisted up to the sampling platform shown in Fig. 4.3.4. The sampling ports were 22 feet downstream of a transition damper and approximately 16 feet downstream of the plant's sampling probe. A single isokinetic sample was collected for two days using the EPA Method 5 sampling train (40 CFR 60 Appendix A) seen in Fig. 4.3.5. The 125 mm glass fiber filter and the nozzle wash were submitted as sample FE0242OT-02 for analysis. The nozzle and probe wash was evaporated, weighed, and submitted for analysis in a 250 ml beaker as sample FE0242OT-01. This was the same beaker which was originally used for the wash. A blank 125 mm glass fiber filter, identical to the type used for the sample, was submitted for analysis as sample FE0243OT.

The air velocity traverse data are presented in Fig. 4.3.6 for the Plant 5 stack. Stack parameters are given in Table 4.3.2.

Plant 9 Stack Sampling

Isokinetic samples of particulate material were collected from two places in the Plant 9 stack assembly, one before the dust collector G9E2-400 and one after it, as seen in Fig. 4.3.7. The isokinetic samples were collected for two days using the EPA Method 5 with modifications as shown in Fig. 4.3.8. Details of the stack sampler probe assembly are given in Fig. 4.3.9. The 45 mm glass fiber filters from the filter holders were submitted as one part of the sample. The nozzle wash and scraping from the filter gasket were submitted as the second part of the sample in a 250 ml beaker. This beaker was covered with parafin. A blank 45 mm glass fiber filter, identical to the type used for the Plant 9 stack was submitted for analysis.

The air velocity traverse data for the Plant 9 stack downstream location are presented in Fig. 4.3.10. The stack parameters are given in Table 4.3.3 for the upstream sampling and Table 4.3.4 for the downstream sampling.

In addition to the particulate samples, two sets of organic gas samples were collected using Tenax tubes. The tubes were volatile purge traps for U.S. EPA Method 601 (Supelco Cat. No. 2-0294). At the inlet there was 1 cm 3% SP-2100 on 60/80 chromasorbe WAW; followed by 7.7 cm 60/80 Tenax TA; followed by 7.7 cm 35/60 silica gel Gd-15, with 7.7 cm 20/50 charcoal at the outlet. The tubes were conditioned in an oven for 24 hours at 180°C with a helium purge at 1 L/min before being taken to the site

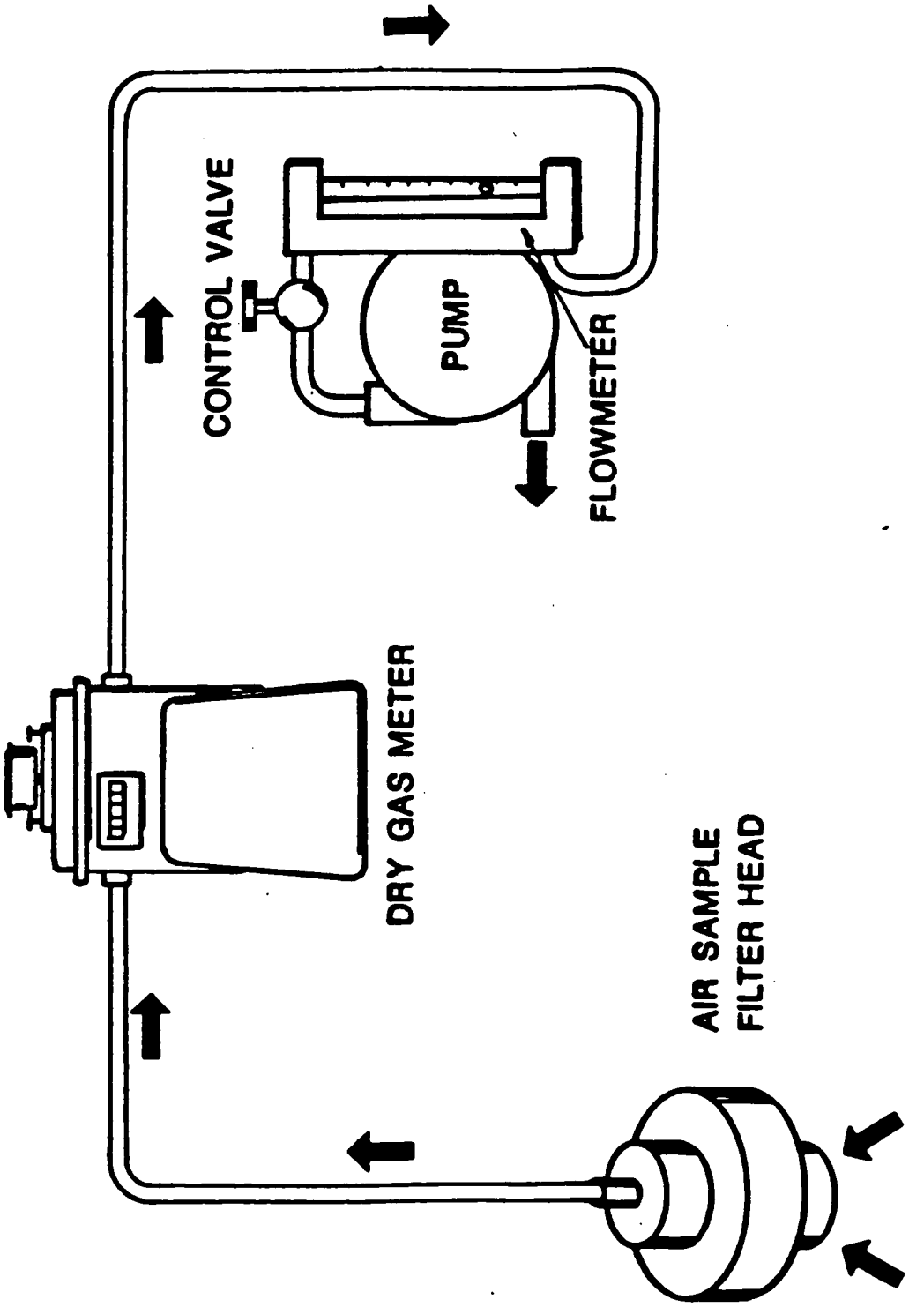
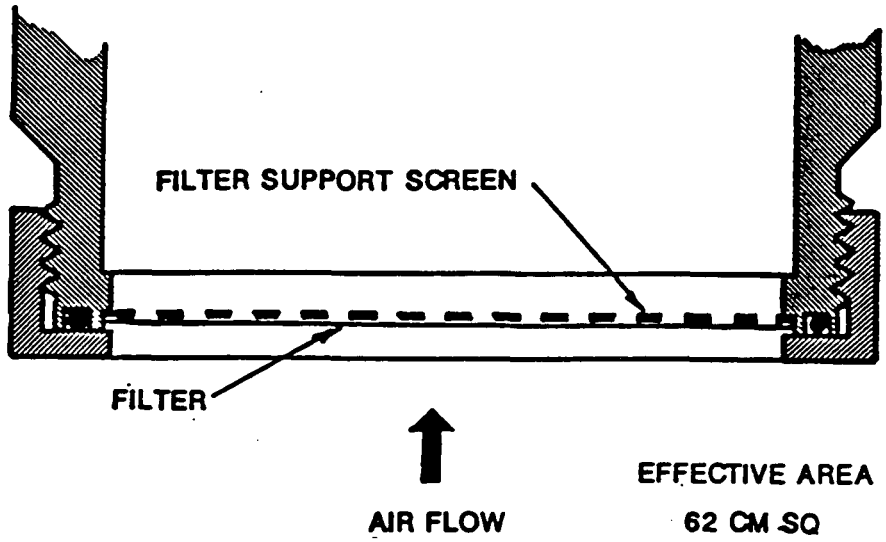


FIGURE 4.3.1 Schematic of Air Sampler Inside Plant 5



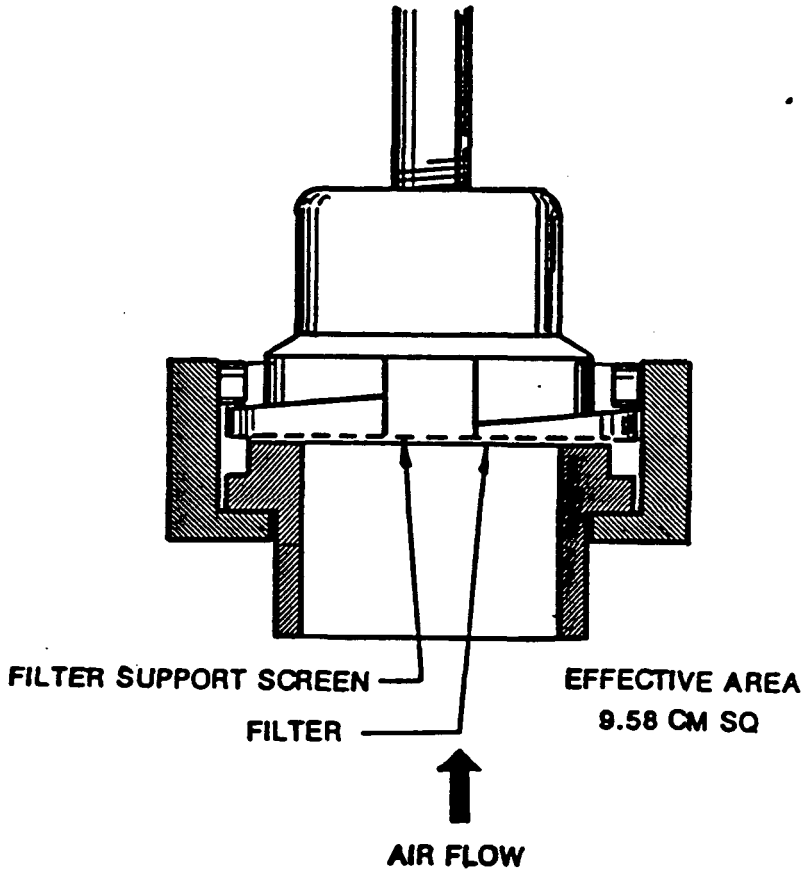


FIGURE 4.3.2 Filter Holders Used for Air Sampling above Rockwell Furnace Inside Plant 5

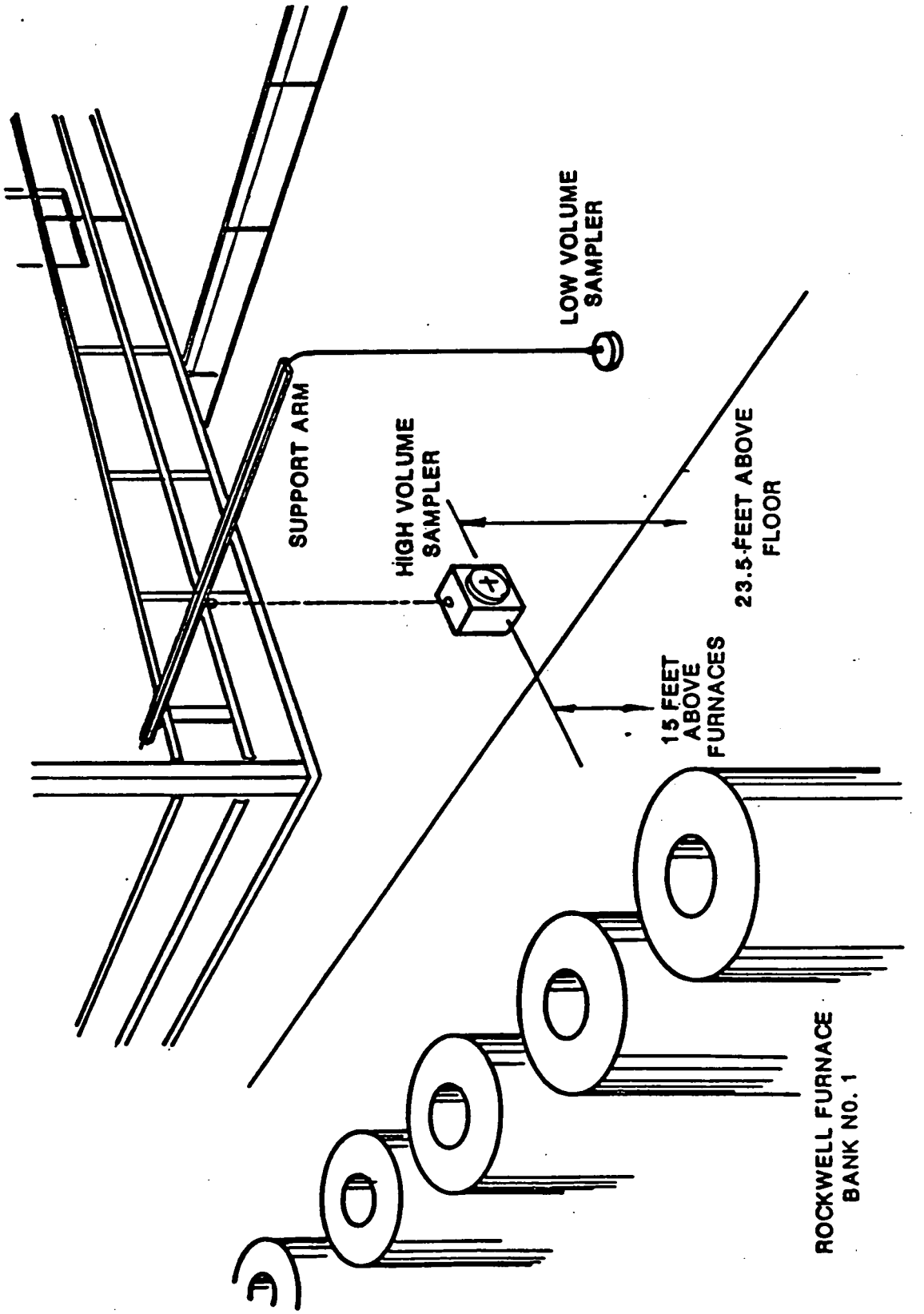


FIGURE 4.3.3 Air Sampling Above Rockwell Furnaces Inside Plant 5

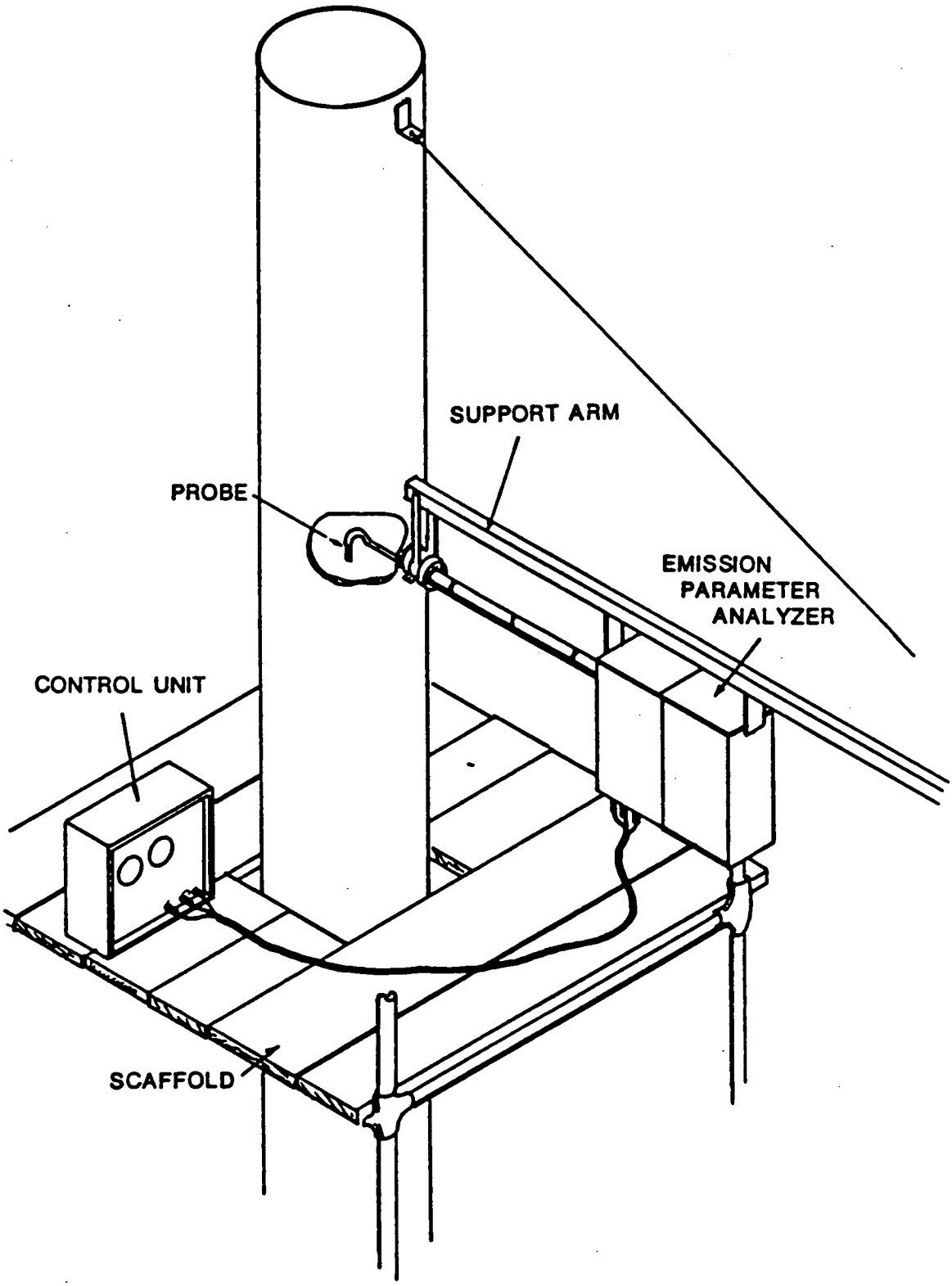


FIGURE 4.3.4 Stack Sampling - Plant 5

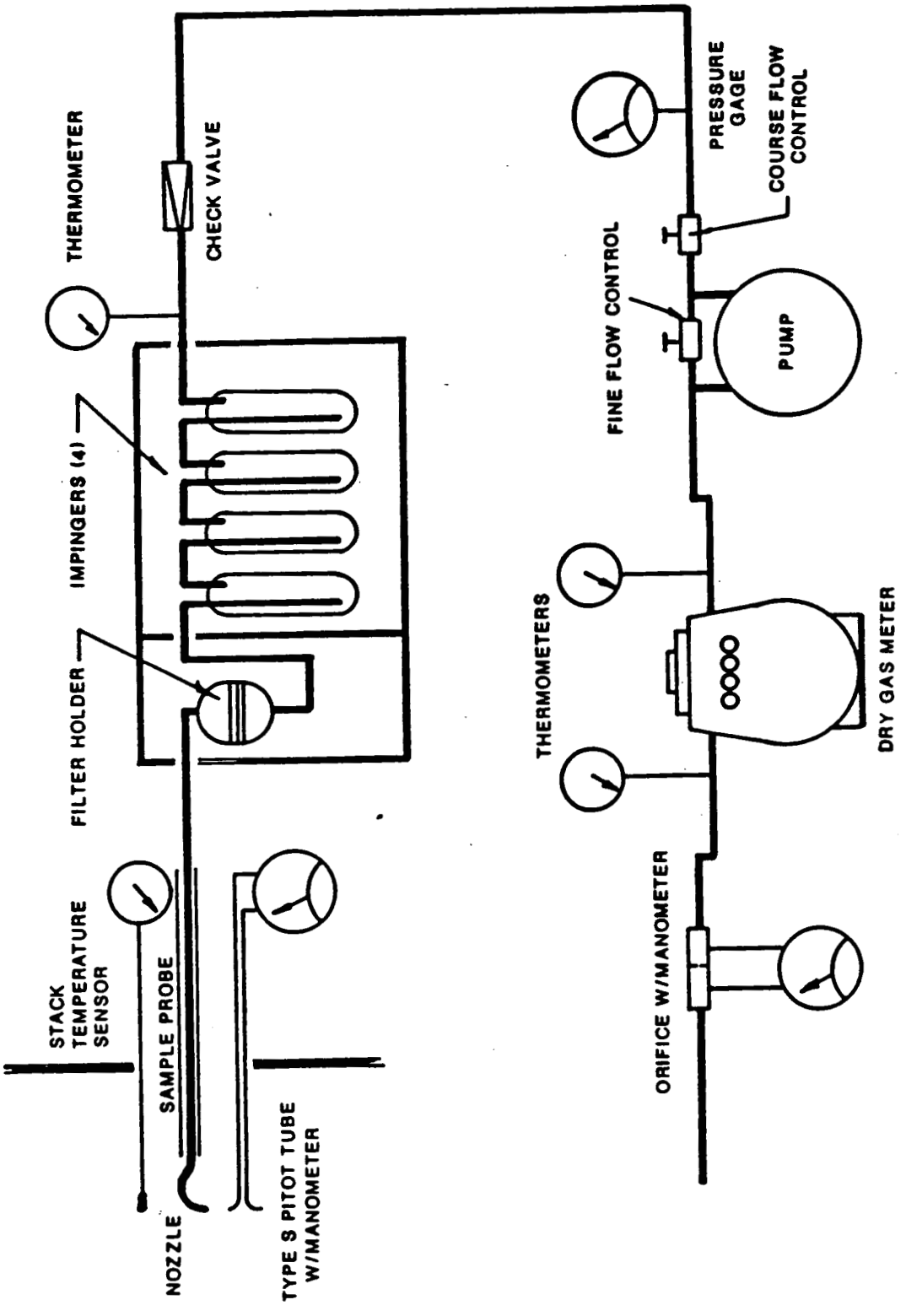


FIGURE 4.3.5 Schematic of Stack Sampler - Plant 5

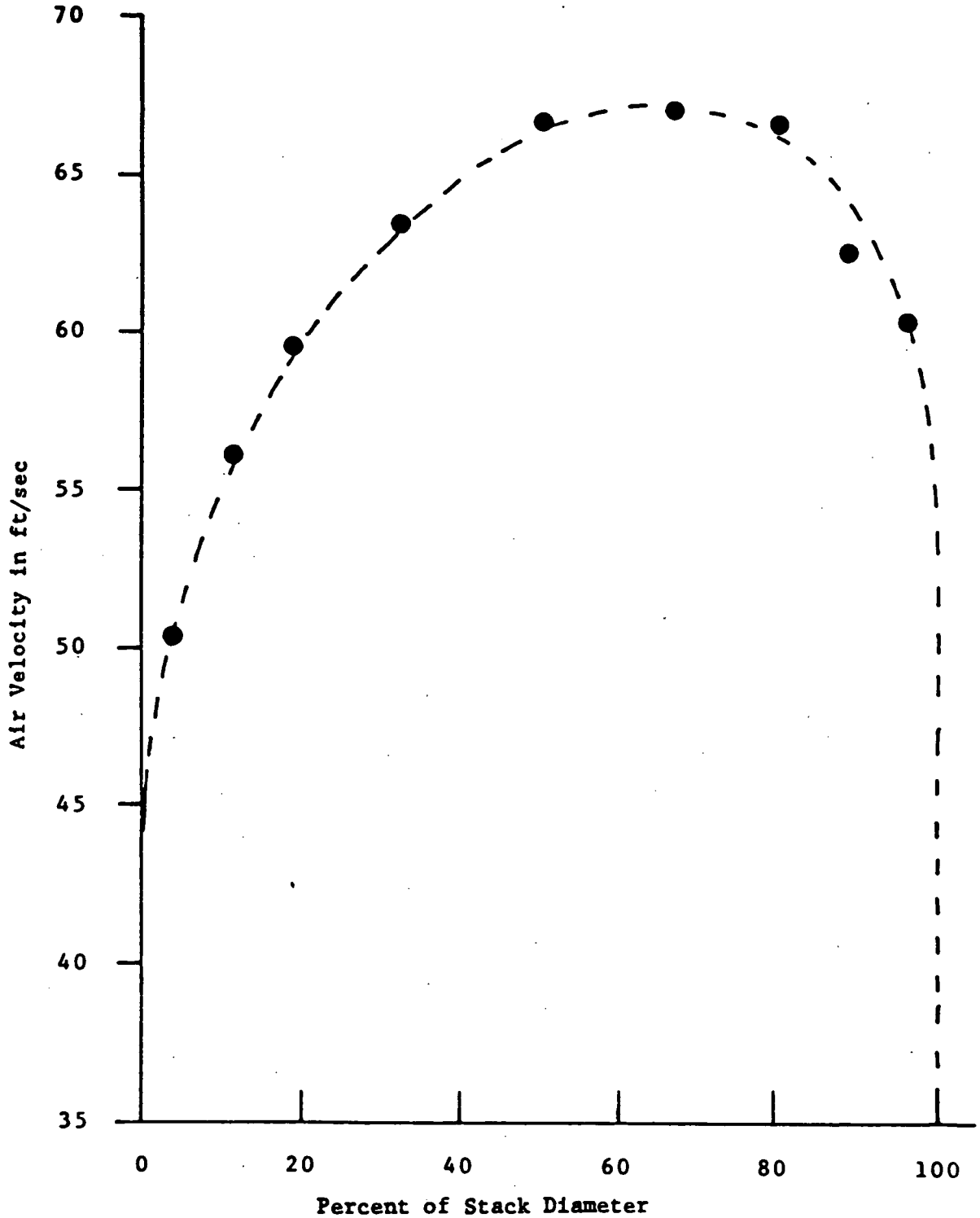


FIGURE 4.3.6 Emission Velocity as a Function of Distance from the Wall Opposite the Sampling Port - Plant 5 Stack No. G5-216

TABLE 4.3.2 Stack Sample Fernald Plant 5 Stack No. G5-216 November 19, 1986 through November 21, 1986

Sample No.:	FEO 242 OT (FP5)
Time On:	11/19/86 (1118), Time off: 11/21/86 (0855)
Total sampling time:	2737 minutes
Total volume sampled:	2146 ± 80 ft^3 (60.7 ± 2.3 m^3)
Average stack velocity:	64 ± 5 ft/sec (3840 ± 300 ft/min)
Cross sectional area of stack:	4.91 ft^2 (2.5 ft diameter)
Flow rate through stack:	$18.85 \times 10^3 \pm 1.47 \times 10^3$ ft^3/min ($32.0 \times 10^3 \pm 2.5 \times 10^3$ m^3/h)
% Isokinetic variation:	113 (ratio of velocity through nozzle to stack velocity)
Collection media:	4 in. diameter Reeve Angel Glass Fiber Filter (Andersen)
Stack Release Rates:	
TSP:	14600 ± 1100 mg/hr
F^-:	262 ± 21 mg/hr
Total U:	214 ± 17 mg/hr
Mg:	529 ± 41 mg/hr

Samples taken by plant during same time period:
(Plant took samples about 30 ft upstream of our sampling point)

Stack Filter No.[a]	Time on	Time off
777	11/19/86 (0954)	11/20/86 (0630)
779	11/20/86 (0630)	11/21/86 (0832)

[a]Information on stack filter numbers obtained from Dan Barber, Fernald.

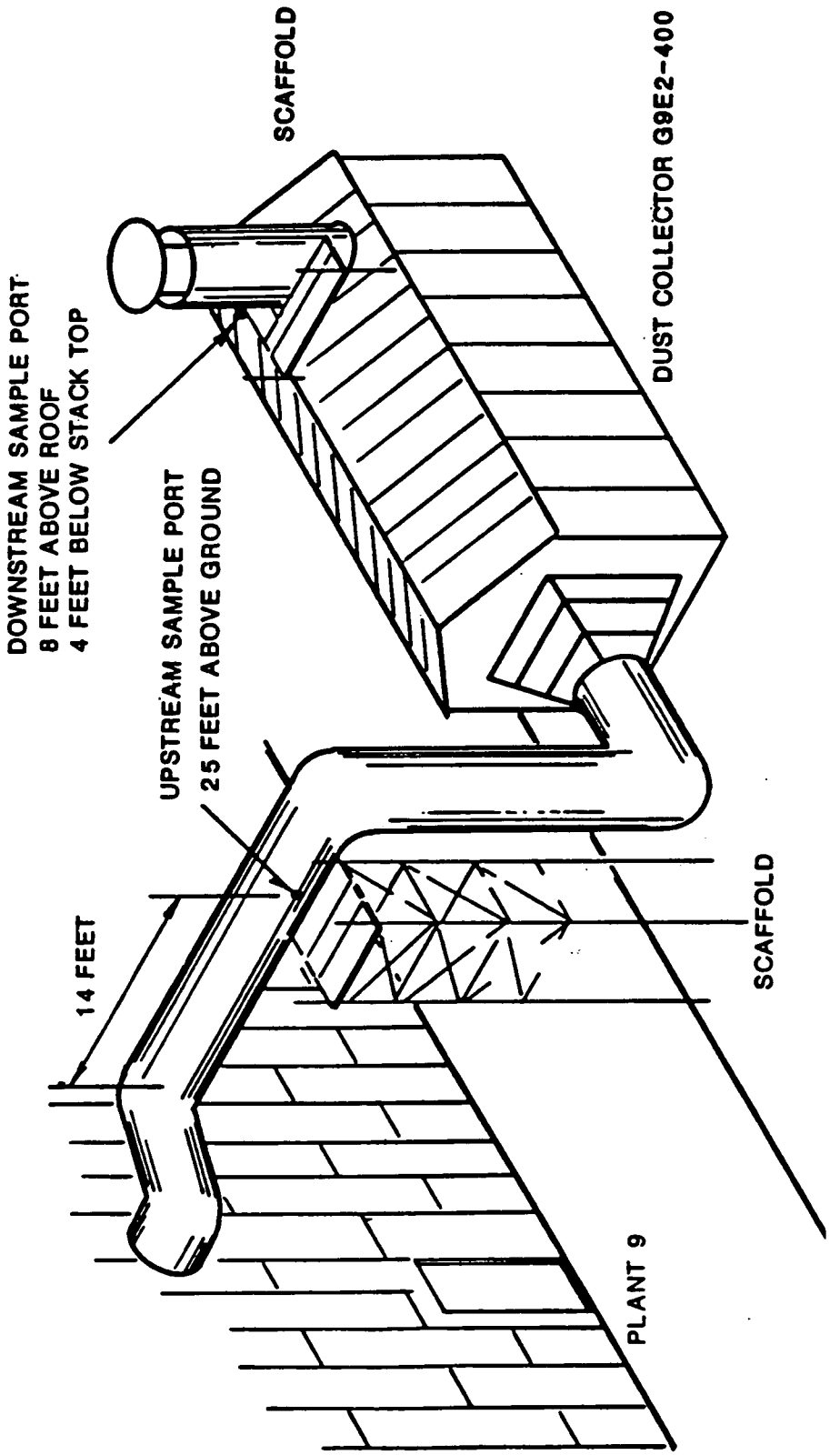


FIGURE 4.3.8 Stack Sampling - Plant 9

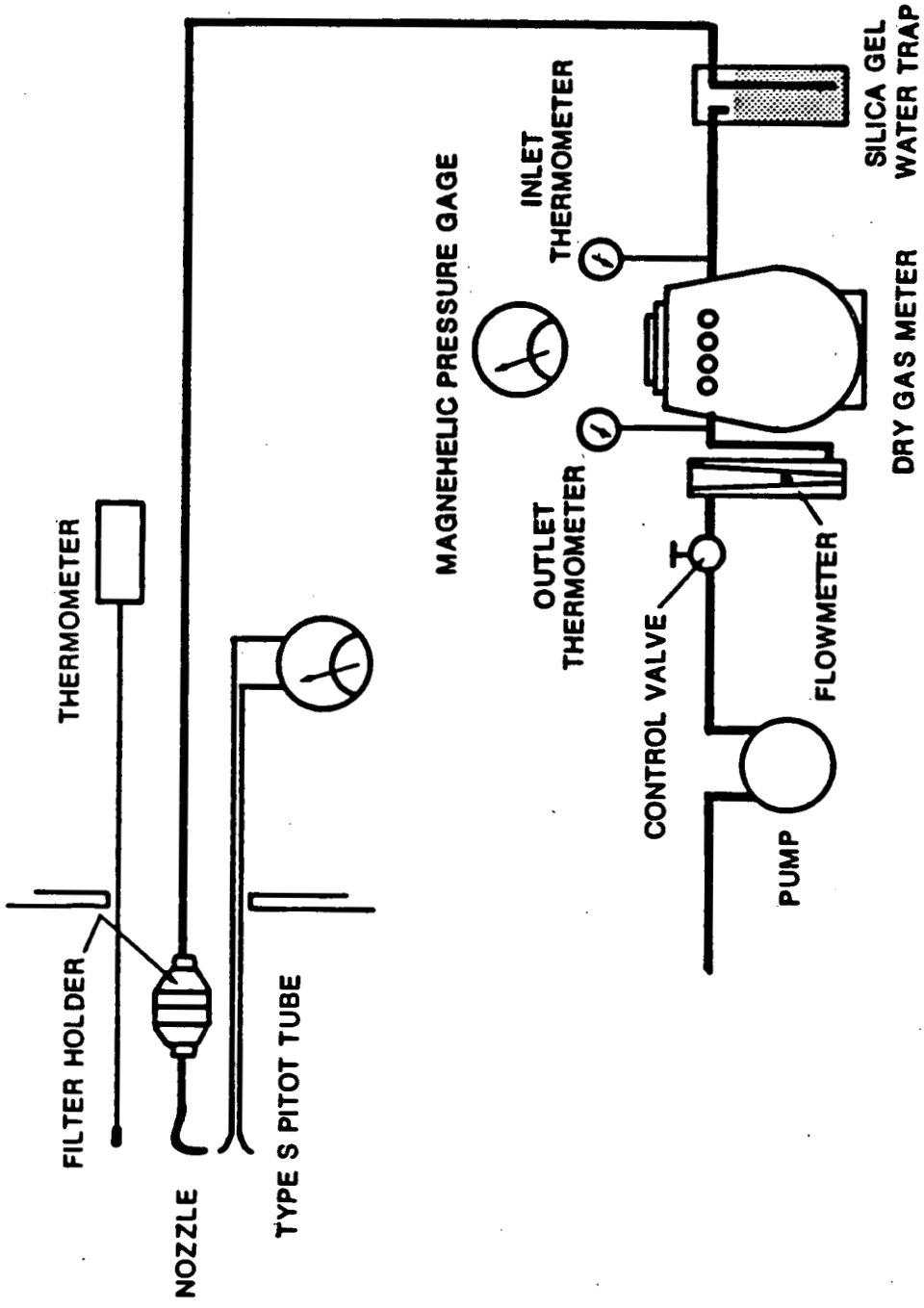


FIGURE 4.3.8 Schematic of Stack Sampler for Organic Volatiles

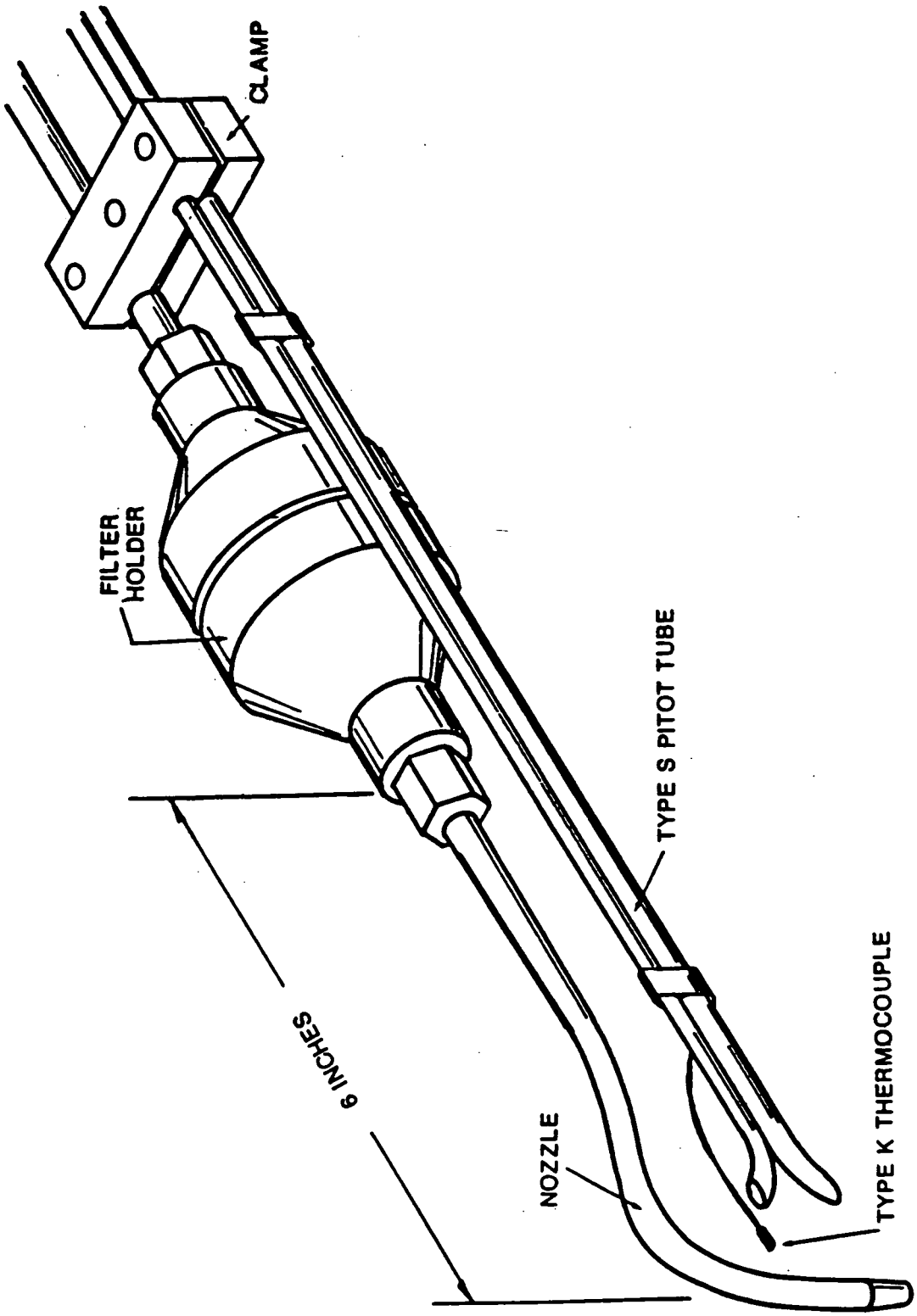


FIGURE 4.3.9 Stack Sampler Probe Assembly

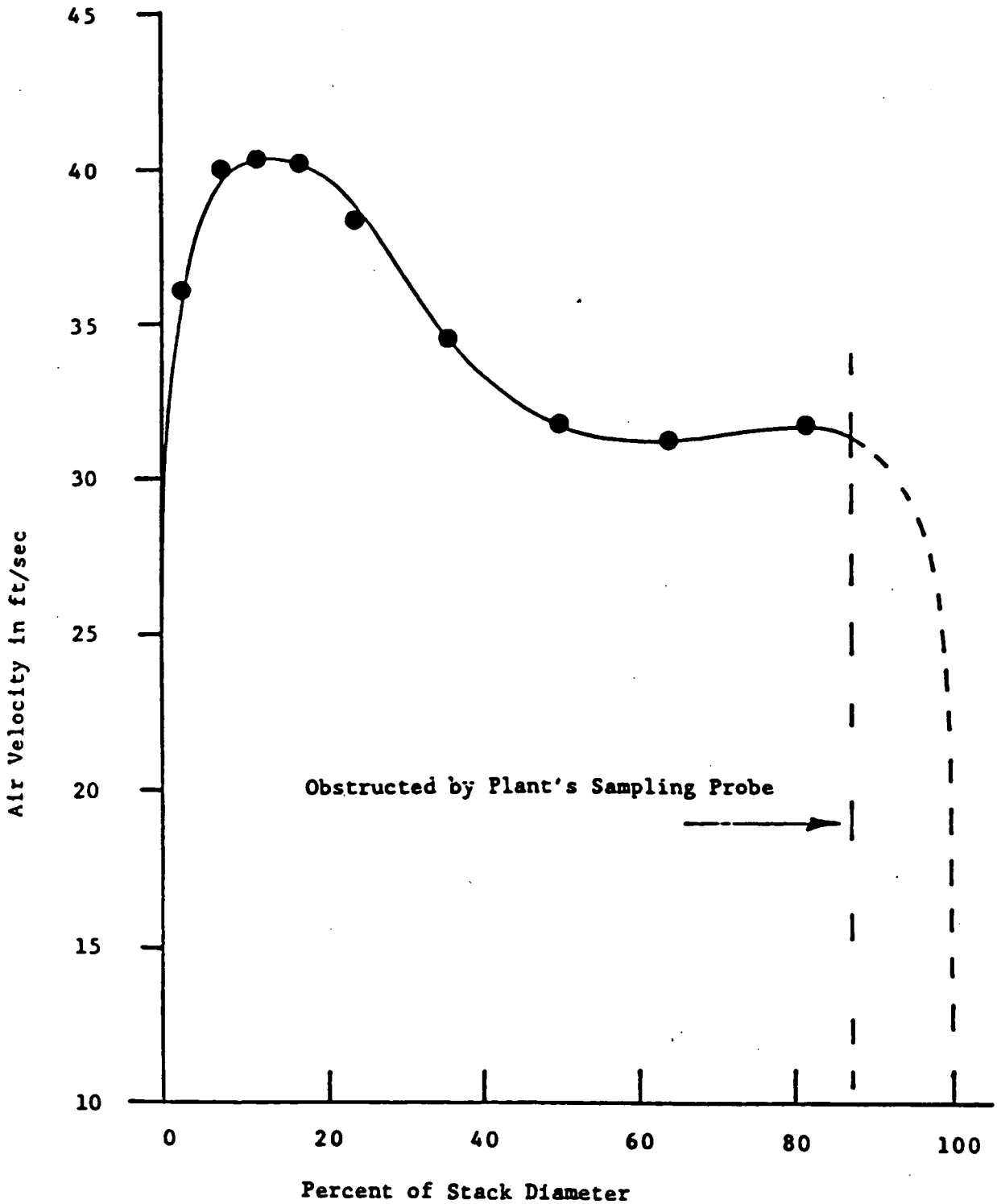


FIGURE 4.3.10 Emission Velocity As a Function of Distance from the Wall Opposite the Sampling Port - Plant 9, Stack No. EP-9-1D

TABLE 4.3.3 Stack Sample, Fernald Plant 9 Stack No. EP-9-IU, Horizontal Section of Stack Upstream of Filter House (November 19, 1986 through November 21, 1986)

Sample No.:	FEO 244 OT (FP9-14)
Time on:	11/19/86 (1846), Time off: 11/21/86 (0750)
Total sampling time:	2224 minutes
Total volume sampled:	682 ± 60 ft^3 (19.3 ± 1.7 m^3)
Average stack velocity:	36 ± 3 ft/sec (2160 ± 180 ft/min)
Cross sectional area of stack:	8.3 ft^2 (3.25 ft diameter)
Flow rate through stack:	$17.8 \times 10^3 \pm 1.1 \times 10^3$ ft^3/min ($30.2 \times 10^3 \pm 1.9 \times 10^3$ m^3/h)
% Isokinetic variation:	73 (ratio of velocity through nozzle to velocity in stack)
Collection media:	2 in diameter Gelman Type A/E Glass Fiber Filter
Stack release rates:	
TSP:	9600 ± 800 mg/hr
Total U:	311 ± 26 mg/hr

Note that these "release rates" are not the emission rates to the atmosphere but are the rates at which material enter the filter house.

for use. The tubes were mounted on the stack downstream from the dust collector G9E-400 (see Fig. 4.3.7).

Preliminary organic gas samples were collected from the Plant 9 stack using a simple sampling apparatus. One set of samples consisted of two tubes connected in series and one blank tube for quality control (sample numbers FE0236ST and FE0237ST). The sample was drawn from the stack through a small port about 4 feet from the top of the stack (see Fig. 4.3.7). Flow through the sampling apparatus was controlled to about 165 ml/min. The sampling period was 110 min.

Another set of organic gas samples was collected using the sampling train shown in Fig. 4.3.11, and consisted of two tubes connected in series and one quality control sample (sample numbers FE0246OT, FE0247OT, and FE0248OT). The sample was drawn from the stack through a small port about 4 feet from the top of the stack (see Fig. 4.3.7). Flow through the sampling apparatus was controlled to about 1 L/min. The sampling period was 69 hr and 16 min.

TABLE 4.3.4 Stack Sample, Fernald Plant 9 Stack No. EP-9-1D, Vertical Section of Stack Downstream of Filter House (November 19, 1986 through November 20, 1986)

Sample no.:	FEO 245 OT (FP9-15)
Time On:	11/19/86 (1830), Time off: 11/21/86 (0734)
Total sampling time:	2224 minutes
Total volume sampled:	662 ± 58 ft^3 (18.8 ± 1.6 m^3)
Average stack velocity:	32.2 ± 2.7 ft/sec (1932 ± 162 ft/min)
Cross sectional area of stack:	11.42 ft^2 (3.81 ft diameter)
Flow rate through stack:	$22.0 \times 10^3 \pm 1.4 \times 10^3$ ft^3/min ($37.4 \times 10^3 \pm 2.4 \times 10^3$ m^3/h)
% Isokinetic variation:	67 (ratio of velocity through nozzle to stack velocity)
Collection media:	2 in diameter Gelman Type A/E Glass Fiber Filter.
Stack Release Rates:	
TSP:	20500 ± 1700 mg/hr
Total U:	141 ± 12 mg/hr

Samples taken by plant during same time period:

Stack Filter No.[a]	Time on	Time off
778	11/19/86 (0951)	11/20/86 (0832)

[a]Information on stack filter numbers obtained from Dan Barber, Fernald.

Analytical Design

Particulate samples from above the Rockwell furnaces and from the Plant 5 stack were analyzed to determine the concentration of uranium, fluoride, and magnesium present at or above analytical method detection limits, and total suspended particulates (TSP). The filter samples upstream and downstream of the dust collector on the Plant 9 stack were analyzed for total organic carbon, total organic halogens and total uranium. The samples collected in Tenax tubes were analyzed for organic compounds. For more information on analytical design, see Appendix A.

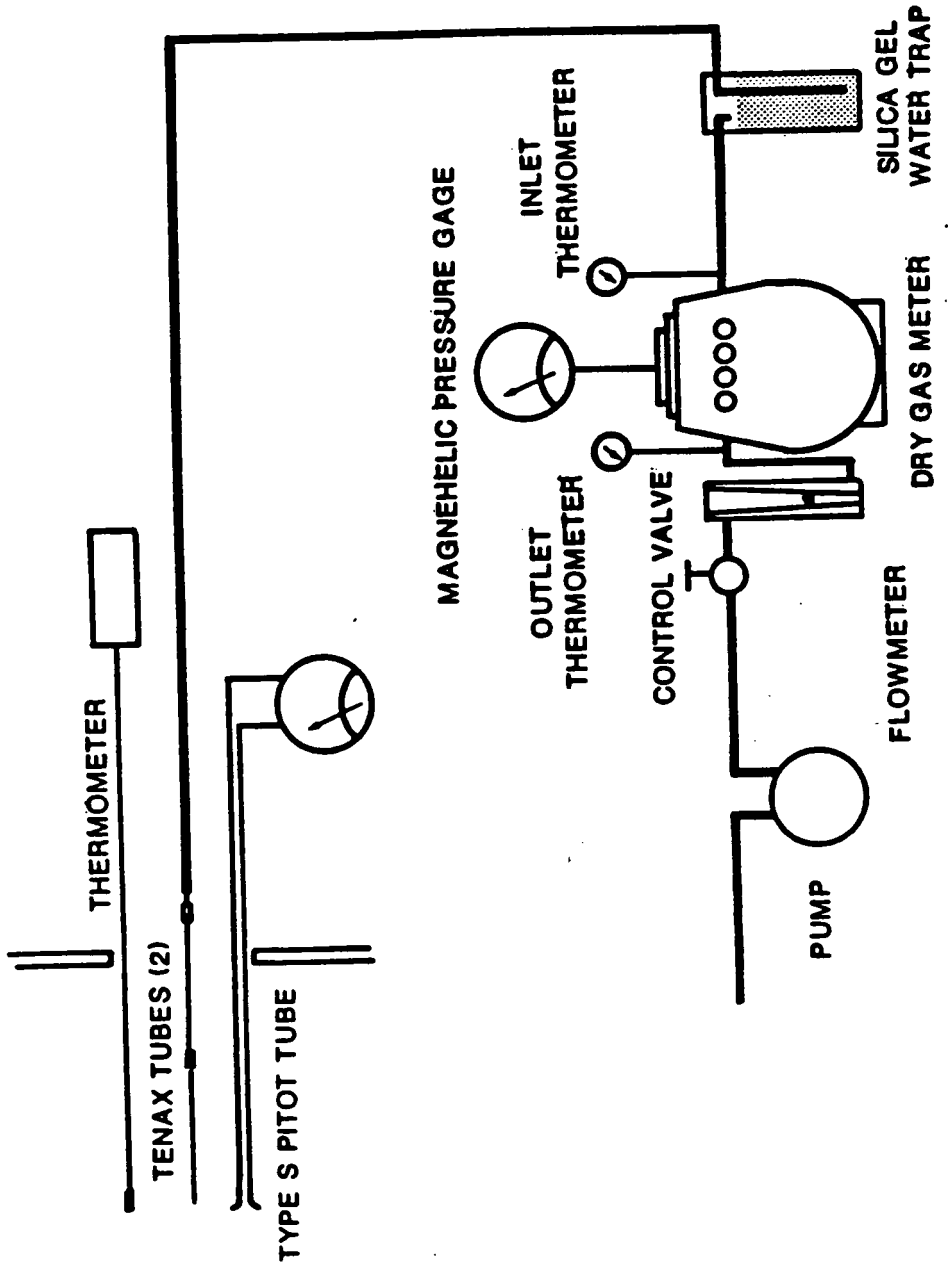


FIGURE 4.3.11 Schematic of Stack Samples - Plant 9

4.3.3 Field and Analytical Data

Analytical Data

The analytical data for the samples collected from above the Rockwell furnaces are presented in Table 4.3.5. Primarily because of internal inconsistencies, the data associated with the low volume samplers above the Rockwell furnaces have been labeled as questionable. Use of the absolute values of these data is not recommended. Review of the computational procedures for these data has indicated that the TSP value for the small filter samples (RWS) has a relatively higher error since the weighing error associated with the small sample weights is relatively large.

Data from the high volume samplers indicate particulate concentrations in the general range of 150-200 $\mu g/m^3$ for an approximate 24-hour averaging period. Analyses for total uranium, magnesium, and fluoride concentrations in the collected particulate matter show fluoride having the highest values, from less than 50 to about 140 $\mu g/m^3$. Total uranium and magnesium air concentrations computed from material collected on the high volume filters are generally comparable, and do not exceed about 20 $\mu g/m^3$.

The analytical data associated with the single sample collected from the Plant 5 stack are summarized in Table 4.3.2, along with pertinent stack parameter data. The emission rates presented in the table (14,600 mg/hr for TSP, 262 mg/hr for F, 214 mg/hr for total U, and 529 mg/hr for Mg) are the result of a one-time application of a modified standard sampling method for the collection of a single 46-hour sample. The release rates presented in Table 4.3.2 are the results of one sample, and thus may not be representative of long-term conditions.

The results from sampling the Plant 9 stack are summarized in Tables 4.3.3 and 4.3.4 along with the stack parameter data. The results from the analyses are converted to release rates in mg/h for the available analytical data. Based on the sampling results, the TSP value is greater after the filter curtain (20.5 g/hr versus 9.6 g/hr); but the total uranium release rate is lower (0.1 g/hr versus 0.3 g/hr). In using these data it should be kept in mind that the stated uncertainty in the computed release rates are such that the upstream and downstream emission estimates overlap. Therefore, the prefilter and postfilter values may not be statistically different.

Two plausible explanations of these data are the characteristics of the operating system and the sampling apparatus. The exhaust system was turned off at about midnight and restarted in the morning. Accompanying the restart process there was substantial vibration in the system. Thus, particulates which accumulated in the filter curtain during the off-period could have been resuspended when the system was restarted and biased the downstream sample. An objective of the sampling system was to operate isokinetically, so that the particulates collected were representative of the sampled stack gases. However, the sampler downstream of the filter curtain was more under-isokinetic than the sampler upstream of the filter curtain (see Tables 4.3.3 and 4.3.4), thus causing a preferential collection of larger particles downstream of the filter curtain.

TABLE 4.3.5 Fernald Workplace Air Samples Taken Inside Plant 5 above Rockwell Furnaces (September 29, 1986 through October 2, 1986)[a]

Sample No.[b]		Date and Time On	Date and Time Off	Average Concentration ($\mu g/m^3$) Total U	F^{-}[c]	Mg	TSP[d]	Plant Operating Conditions[e]
RWL-1 FEO	200 OT-1A	9-23 (1553)	9-24 (1105)	5.0	113.7	4.6	163.4	MAC flash from furnace
RWS-5	201	9-23 (1543)	9-24 (1110)	5.3	209.0	8.5	348.2	No. 41 9-23 (2110)
RWL-3	204	9-24 (1202)	9-25 (1137)	6.0	140.7	16.7	204.2	MAC flash from furnace
RWS-8	207	9-24 (1200)	9-25 (1147)	4.9	200.0	28.4	172.1	No. 12 9-25 (0648)
RWL-9	208	9-25 (1227)	9-26 (1010)	14.0	49.3	4.5	155.4	Smoke from furnace
RWS-13	209	9-25 (1229)	9-26 (1009)	10.2	120.4	65.9	83.7	No. 46 9-26 (0730)
RWL-12	212	9-26 (1048)	9-29 (1611)	19.7	89.4	20.2	239.9	All furnaces off for
RWS-15	213	9-26 (1112)	9-29 (1610)	8.8	89.5	20.2	179.0	repairs during day shift on 9-28
RWL-17	216	9-29 (1658)	9-30 (1058)	3.9	12.1	3.3	71.6	All furnaces off
RWS-27	217	9-29 (1703)	9-30 (1051)	3.3	18.0	41.3	< 25	during entire period
RWL-19	220	9-30 (1123)	10-1 (0848)	11.8	25.3	9.7	115.5	All furnaces off
RWS-29	221	9-30 (1124)	10-1 (0848)	11.8	25.1	14.0	25.1	during entire period
RWL-21	224	10-1 (0926)	10-2 (0823)	5.7	93.6	4.5	163.7	Furnaces turned on
RWS-31	225	10-1 (0927)	10-2 (0824)	5.2	136.1	7.2	140.7	10-1 (1100) MAC flash from furnace No. 24, 10-1 (2224)
RWL-23	228	10-2 (0902)	10-3 (1012)	4.9	119.7	3.2	171.7	Furnaces on
RWS-33	233	10-2 (0902)	10-3 (1010)	3.3	891.6	6.4	208.8	No incidents

[a]Use concentration data only for comparisons within the context of this table. See text for explanation.
[b]The prefix RWL indicates that the sample was above the Rockwell (RW) furnaces and that the sample was taken using a "large" (L) sampler. The 0.8 μm glass fiber collection filter used on the large sampler was 10.5 cm diameter (8.8 cm diameter entrance), and the flowrate was typically 400 liters/min. The prefix RWS indicates that the sample was taken using a "small" (S) sampler. The 0.8 μm glass fiber collection filter used on the small sampler was 4.7 cm diameter (3.5 cm diameter entrance), and the flowrate was typically 15 liters/min. A sketch of the small and large filter holders is shown in Fig. 4.4.1. The effective entrance velocity at the filter face was 216 ft/min with the large sampler and 5 ft/min with the small sampler.
[c]Total fluoride.
[d]Total suspended particulates.
[e]Information about plant operating conditions were obtained from the shift supervisors.

However, the present information does not support a complete resolution of this apparent discrepancy.

Sampling for organics in the Plant 9 stack was attempted in two ways: (1) Tenax tubes and (2) analysis of filter material for total organic carbons (TOC) and total organic halogens (TOX). Of the Tenax tube samples collected, only two (FE0236ST) provided useable data. Those samples indicated generally low organics emission rates. Analysis of air filters for TOC and TOX showed compounds present at essentially the same concentrations as in the blank filter, thus further supporting the low organic emission rate estimate.

4.3.4 Data Quality Evaluation

Rockwell Furnaces

Sampling Design - Monitoring points were carefully selected to provide representative data. The duration of sampling was adequate to provide data representative of a wide range of operating conditions. Use of low volume samplers may not have been appropriate for this application. Data utility level, high volume samplers, 2. Data utility level, low volume samplers, 3.

Sample Collection - The sample collection technique for the Rockwell furnaces was adequate for the high volume samplers. Use of low volume samplers may have been inappropriate. Field logbooks contain all necessary information and are signed and dated. Data utility level, high volume samplers, 2. Data utility level, low volume samplers, 3.

Sample Analysis - The analytical methods for specific components in the particulate matter collected above the Rockwell furnaces were modifications of methods existing at the time, which have since been incorporated into ACL Standard Operating Procedures (SOP's). Instruments used meet established standards. Laboratory notebooks contain sufficient information and are signed and dated. Data utility level 2.

QA/QC and Documentation - The S&A Plan contained a QA plan covering all aspects of the sampling and analysis program. Field QC samples were collected for this Problem (in the form of filter blanks). Laboratory documentation and QC are sufficient to support an assessment of reliability of the analytical results. Data utility level 2.

Emission Sampling - Plant 9 Stack

Sampling Design - Monitoring points were carefully selected to provide representative data. The duration and frequency of sampling was not adequate to provide data representative of a wide range of operating conditions. Use of filter media to collect a sample for TOC and TOX analysis may not have been appropriate. Data utility level 3.

Sample Collection - The sample collection technique for particulate matter from the Plant 9 stack was adequate and the second set (FE0246OT and FE0247OT) Tenax tube samples (for organics) may not have been properly handled. Data utility level 3.

Sample Analysis - The analytical methods for specific components in the particulate matter collected from the Plant 9 stack were modifications of methods existing at the time, which have since been incorporated into ACL SOP's. Instruments used meet established standards. Analysis of filter samples for TOC and TOX was by a subcontractor. Documentation of methods is available. Data utility level 2.

QA/QC and Documentation - The S&A Plan contained a QA plan covering all aspects of the sampling and analysis program. Field QC samples were collected for this Problem (in the form of filter and Tenax tube blanks). Laboratory documentation and QC are sufficient to support an assessment of reliability of the analytical results. Data utility level 2.

Emission Sampling - Plant 5 Stack

Sampling Design - Monitoring points were carefully selected to provide representative data. The duration and frequency of sampling was not adequate to provide data representative of a wide range of operating conditions. Data utility level 3.

Sample Collection - Application of the sample collection technique for particulate matter from the Plant 5 was consistent with EPA guidelines. Field logbooks contain all necessary information and are signed and dated. Data utility level 2.

Sample Analysis - The analytical methods for specific components in the particulate matter collected from the Plant 5 stack were modifications of methods existing at the time, which have since been incorporated into ACL SOP's. Instruments used meet established standards. Data utility level 2.

QA/QC and Documentation - The S&A Plan contained a QA plan covering all aspects of the sampling and analysis program. Field QC samples were collected for this Problem (in the form of a filter blank). Laboratory documentation and QC are sufficient to support an assessment of reliability of the analytical results. Data utility level 2.

4.4 ENVIRONMENTAL PROBLEM 4: PRODUCTION AREA SOIL CONTAMINATION

Requester: Riddle and Grundler

Details are provided in Table 4.4.1.

Finding and Basis

The production area is a source of contaminants because of the use and reuse of chemicals and radioactive materials in the production operations. Storage of contaminated production materials on porous soils; spills/accidents; and process releases of surface water and airborne contaminants have caused a build-up of pollutants in the soil and groundwater in the production area. This build-up acts as a source for continuing release of pollutants to the environment. Several locations within the production area were sampled to determine the presence of specific contaminants (Ref. 5, Sec. 3.4.2).

Soil on the FMPC facility has been contaminated with uranium by past releases from the production operations on the site. There are several pathways of contamination; particulates can be resuspended into the air and transported off-site, deposited onto the soil, leached into the groundwater, or transported by run-off into surface water, or taken up by vegetation.

Although emissions of uranium from point sources may have been significantly reduced in recent years, a large quantity of uranium exists on soils within the facility boundary from past deposition.

Potential problems may exist if nonuranium radionuclides are present in the soils or vegetation. The presence of nonuranium radionuclide contaminants is not known because soil samples are currently only analyzed for total uranium. The dose to the maximally exposed individual from ingestion of vegetation containing uranium could increase as a result of these nonuranium isotopes; U-235, Ra-226, Ra-228, Th-232, Pu-238, Pu-239, Np-237, Tc-99, and Cs-137 (Ref. 5, Sec. 3.2.4.2.1).

Plant 1 - Preparation Plant

Plant 1 has a large drum storage pad that is suspected of being used to store hazardous and radioactive mixed wastes. The Plant 1 storage pad contains a large inventory (1,350 tons) of contaminated steel, scrap copper, motor windings stored in a pile, and runoff from this pile flows to the stormwater system. Almost 22,000 drums containing recoverable quantities of uranium are located on the Plant 1 storage pad awaiting processing (Ref. 5, Sec. 4.1.1.2).

TABLE 4.4.1 Environmental Problem 4: Sample Request Table

Sample Number	Location	Reference/ Page Number	Requester	Samples Proposed	Samples Collected
FE0116SS	Pilot Plant Tile Field	1/48 and 3/15	Riddle & Grundler	5 or 4 borings for production area	6 borings
FE0117SS	Pilot Plant Tile Field				
FE0118SS	Pilot Plant Tile Field				
FE0624DS	S. of Pilot Plant				
FE0625DS	S. of Pilot Plant				
FE0626DS	S. of Pilot Plant				
FE0627DS	Building 69				
FE0628DS	Building 69				
FE0629DS	Building 69				
FE0630DS	Building 69				
FE0631DS	Plant 1				
FE0632DS	Plant 1				
FE0633DS	Plant 1				
FE0634DS	Plant 1				
FE0635DS	Plant 6				
FE0636DS	Plant 6				
FE0637DS	Plant 6				
FE0638DS	Plant 6				
FE0639DS	Plant 6				
FE0640DS	Plant 4				

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Building 69 - Decontamination Building

Any large pieces of contaminated scrap metal are sent to the scrap metal storage pile behind Building 69. The material on the pile has extended beyond the asphalt pad, which serves as its base. The pile contains approximately 8,000 tons of contaminated steel. Runoff from the pad goes to the stormwater system and onto the ground beyond the pad (Ref. 5, Sec. 4.1.1.2).

Pilot Plant

The pilot plant warehouse contains storage space for drums of hazardous waste and thorium (Ref. 5, Sec. 4.1.1.2).

Miscellaneous Locations

Soil samples were collected in the vicinities of Plant 4 (Green Salt Plant), Plant 6 (Metals Fabricating Plant), and South of the Pilot Plant (UF_6 to UF_4 Reduction Facility). There is no information in Reference 5 regarding these facilities.

4.4.1 Sampling and Analysis Objectives

The various processes that occur within the production area associated with the storage and handling of materials and waste products may be a source of soil contamination. To provide a general indication of potential soil contamination, soil samples were collected at specific locations inside the production area and analyzed for volatile organics, RCRA metals, uranium, and radionuclides by gamma spectrometry.

4.4.2 Sampling and Analytical Design and Implementation

Sampling Design

Soil samples were collected from the area around Plant 1, Plant 4, Plant 6, South of the Pilot Plant, Building 69 and the Pilot Plant Tile Field. Table 4.4.2 presents the sample number, location of sampling, type of soil sample and method of collection. Sample collection locations are shown in Figs. 4.4.1-4.4.3.

The area called the Pilot Plant Tile Field contained an underground tile drain leading to a manhole. The soils in the immediate area of the tile drain were sampled.

The sampling location near Plant 1 was outside the fence in an area by a scrap pile and drums. The area sampled near Plant 4 was a gravel area with nearby tanks.

Samples collected from the auger were obtained by removing soil from the auger flights and placing it directly into the sample container.

TABLE 4.4.2 Production Area Soil Sampling Locations and References

Sample No.	Location of Sampling	Soil Sample Type	Figure Reference	Method of Collection
FE0631DS	NW of Plant 1	Boring 0-5'	4.4.1	Grab from auger
FE0632DS	NW of Plant 1	Boring 5-10'	4.4.1	Grab from auger
FE0633DS	NW of Plant 1	Boring 10-15'	4.4.1	Grab from auger
FE0634DS	NW of Plant 1	Boring 15-20'	4.4.1	Grab from auger
FE0640DS	N of Plant 4	Boring 8"-2'	4.4.1	Grab from auger
FE0635DS	Hole 1, W of Plant 6	Boring 0-5'	4.4.2	Grab from auger
FE0636DS	Hole 1, W of Plant 6	Boring 5-10'	4.4.2	Grab from auger
FE0637DS	Hole 1, W of Plant 6	Boring 10-15'	4.4.2	Grab from auger
FE0638DS	Hole 2, W of Plant 6	Boring 0-5'	4.4.2	Grab from auger
FE0639DS	Hole 2, W of Plant 6	Boring 10-15'	4.4.2	Grab from auger
FE0624DS	S of Pilot Plant	Boring 0-5'	4.4.3	Grab from auger
FE0625DS	S of Pilot Plant	Boring 5-10'	4.4.3	Grab from auger
FE0626DS	S of Pilot Plant	Boring 10-15'	4.4.3	Grab from auger
FE0627DS	NE of Building 69	Boring 0-5'	4.4.2	Grab from auger
FE0628DS	NE of Building 69	Boring 5-10'	4.4.2	Grab from auger
FE0629DS	NE of Building 69	Boring 10-15'	4.4.2	Grab from auger
FE0630DS	NE of Building 69	Boring 15-18'	4.4.2	Grab from auger
FE0116SS	Pilot Plant Tile	Surface Field	4.4.3	Spatial composite
FE0117SS	Pilot Plant Tile	Surface Field	4.4.3	Spatial composite
FE0118SS	Pilot Plant Tile	Surface Field	4.4.3	Spatial composite

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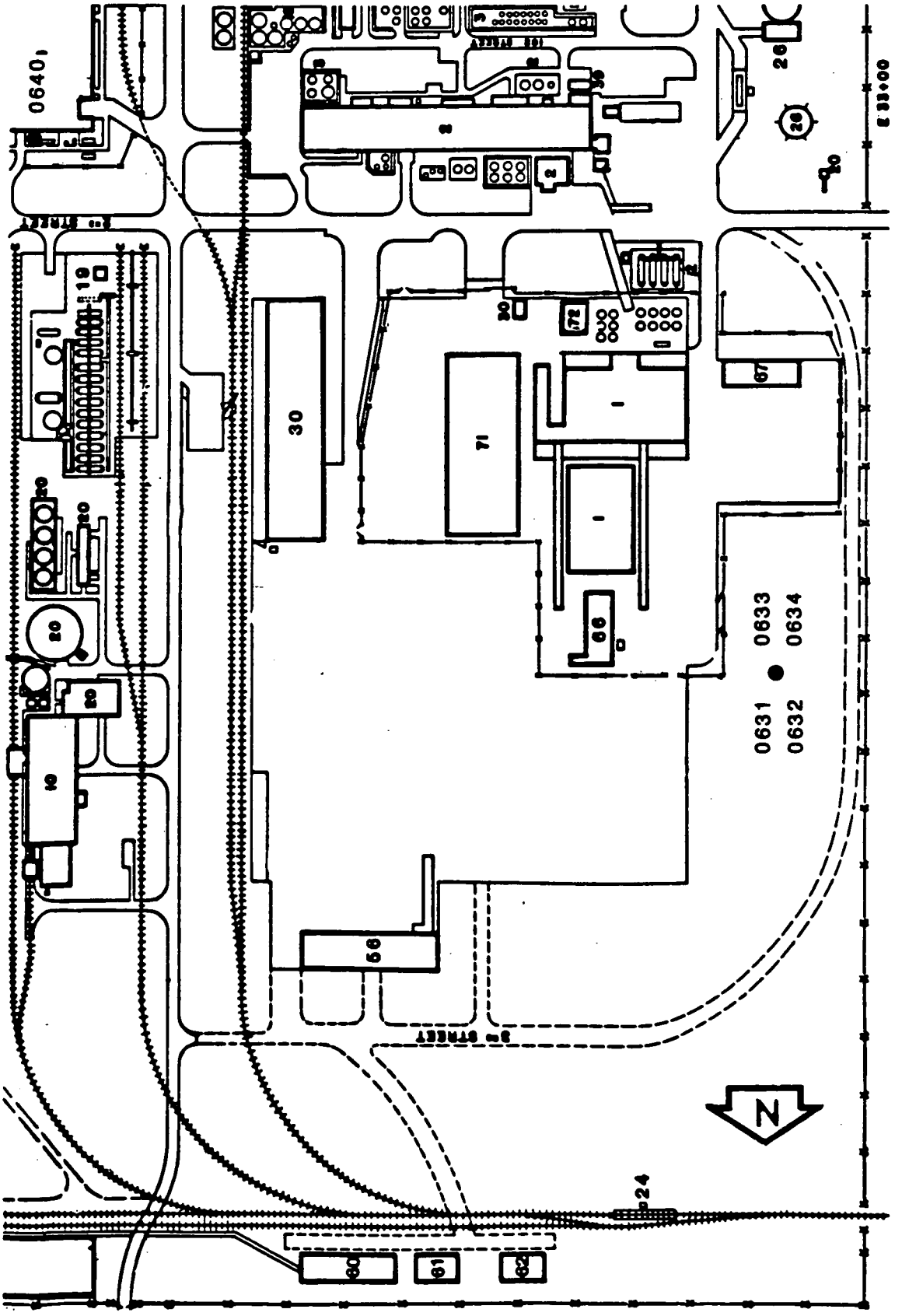

FIGURE 4.4.1 Soil Sampling Locations in the Plant Production Area - Northwest Quadrant

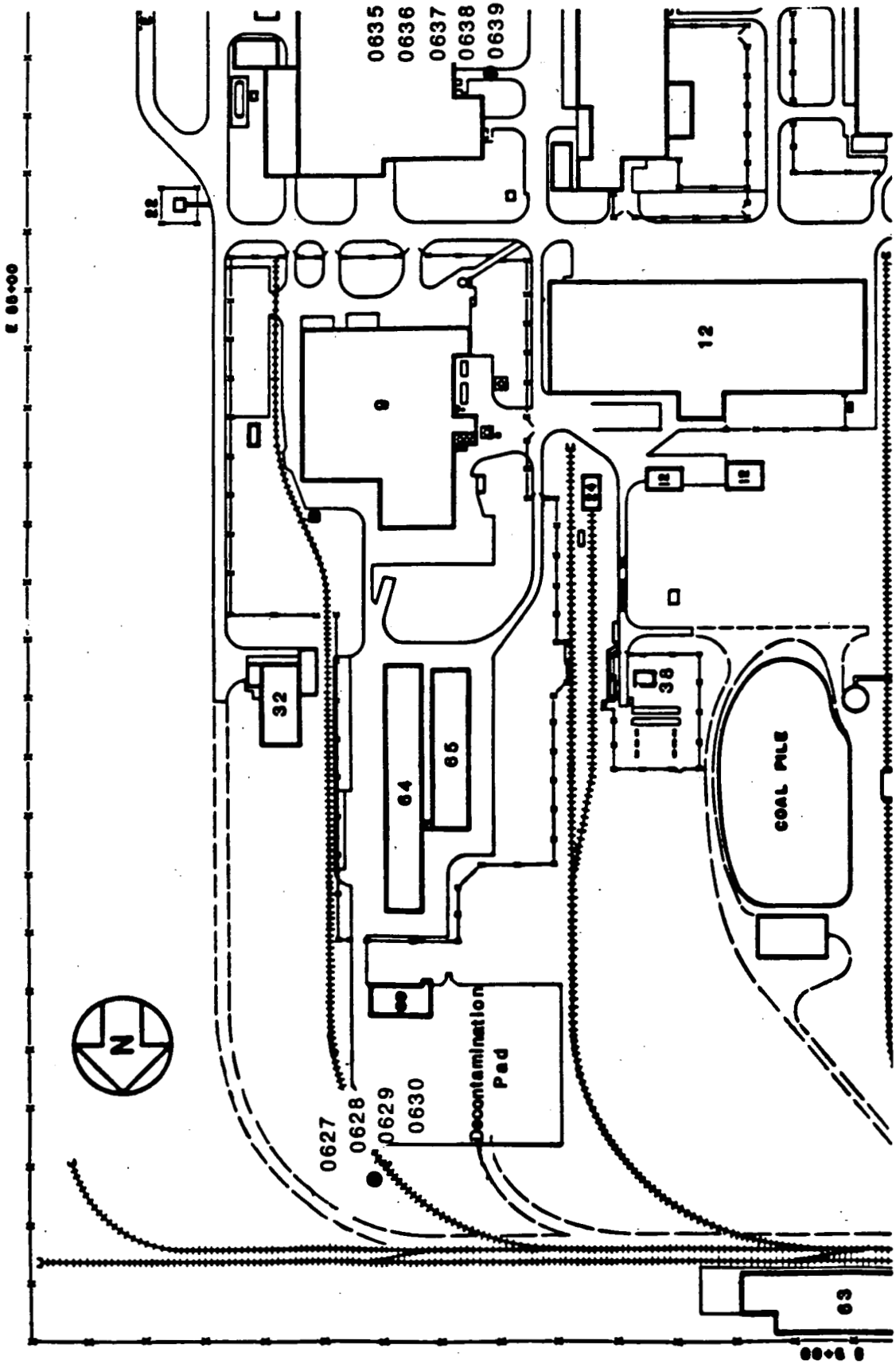

FIGURE 4.4.2 Soil Sampling Locations in the Plant Production Area - Northeast Quadrant

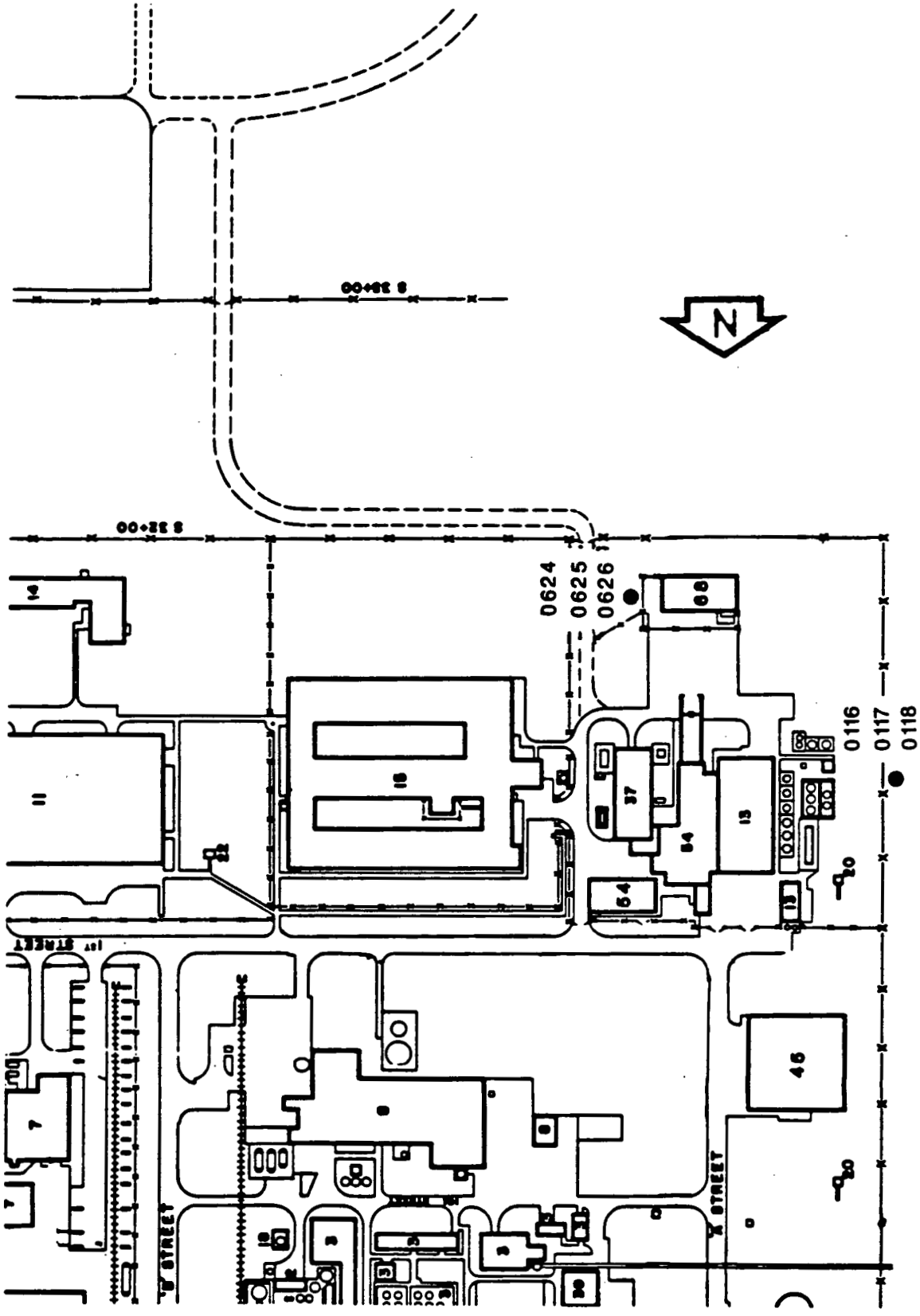

FIGURE 4.4.3 Soil Sampling Locations in the Plant Production Area - Southwest Quadrant

Analytical Design

The soil samples from all of the areas were analyzed to determine the concentration of total uranium, RCRA metals, volatile organics, and radionuclides by gamma spectrometry present at or above analytical method detection limits. For more information on analytical methods, see Appendix A.

4.4.3 Field and Analytical Data

Analytical Data

The analytical data which exceed the analytical method detection limits is presented in Table 4.4.3.

The sites sampled within the production area exhibited elevated levels of total uranium and certain radionuclides in the soils. Total uranium values ranged from 1.9 mg/kg to 50.0 mg/kg, with the highest value being found in the soil around Building 6. The highest activity from the radionuclides was present in the soil in the area northeast of Building 69, with a value of 20.0 pCi/g for U-238.

Values for volatile organics in soil samples were low.

For a complete presentation of the analytical data, see Appendix E.

4.4.4 Data Quality Evaluation

Sampling Design - The number and location of sampling points were selected according to the Plan, but do not provide fully representative information for this Problem. Data utility level 3.

Sample Collection - EPA-approved sample containers were used. Appropriate field measurements were taken. Field logbooks do not contain necessary supporting information to judge whether there were deviations from standard sampling protocols. Logbooks are signed and dated. Data utility level 3.

Sample Analysis - Sample handling was appropriate for the media and analysis performed. Instruments and procedures used meet established standards. Laboratory notebooks contain sufficient information and are signed and dated. Data utility level 2.

QA/QC and Documentation - The S&A Plan contained a QA plan covering all aspects of the sampling and analysis program. No field QC samples were collected for this Problem. Adequate laboratory QC analyses were performed. Records were maintained regarding laboratory instrument calibration and maintenance. Data are reported in appropriate units accompanied by estimates of uncertainty. Supporting information is available. Data utility level 2.

TABLE 4.4.3 Environmental Problem 4: Analyte Concentrations Above Minimum Detection Limits for Soil Samples Collected from Within the Production Area

			Radionuclides:								RCRA Metals:	
Sample Number	Media	Location	U-235 pCi/g	U-238 pCi/g	Bi-214 pCi/g	Cs-137 pCi/g	Ra-226 pCi/g	Th-228 pCi/g	Th-232 pCi/g	Total U mg/kg	Ba mg/L	Cr mg/L
FE0116SS2B	Soil	Pi.Pl. Tile Field	0.27	7.60	2.50	0.09	2.20	0.91	0.98	7.30	0.58	0.03
FE0117SS2B	Soil	Pi.Pl. Tile Field			0.92		0.89	0.81	0.68	9.10	0.58	0.03
FE0118SS2B	Soil	Pi.Pl. Tile Field		18.00	1.40	0.24	1.30	2.10	1.40	25.00	0.61	
FE0624DS2B	Soil	S. of Pilot Plant	0.16	8.10	1.10		1.10	0.96	0.98	6.50	0.69	0.05
FE0625DS2B	Soil	Building 69	0.14	20.00	0.99		1.10	1.10	1.30	4.70	0.63	
FE0626DS2B	Soil	Building 69	0.14		1.30		1.50	1.20	1.10	3.70	0.41	0.05
FE0627DS2B	Soil	Building 69	0.16		1.30		1.40	1.30	1.40	5.40	0.55	
FE0628DS2B	Soil	Building 69	0.12	12.00	0.79		0.86	1.10	0.93	8.80	0.52	
FE0629DS2B	Soil	Building 69	0.09		0.62		0.76	1.20	1.00	3.40	1.05	
FE0630DS2B	Soil	Building 69	0.05		0.89		0.94	0.72	0.74	2.70	1.22	
FE0631DS2B	Soil	Plant 1	0.12		0.96		1.00	1.10	0.96	8.70	0.73	
FE0632DS2B	Soil	Plant 1	0.12		0.75		0.84	1.10	0.95	2.20	0.75	
FE0633DS2B	Soil	Plant 1	0.07		1.10		1.30	0.93	0.49	1.90	0.50	0.04
FE0634DS2B	Soil	Plant 1			1.20		1.20	0.88	0.77	2.00	0.59	0.04
FE0636DS2B	Soil	Plant 6	0.13		0.68		0.85	0.56	0.78	16.00	0.64	
FE0638DS2B	Soil	Plant 6	0.21	18.00	0.76		0.81	0.64	0.83	32.00	0.45	
FE0639DS2B	Soil	Plant 6	0.15		0.88		0.79	0.68	0.77	50.00	0.61	
FE0640DS2B	Soil	Plant 4	0.14	7.80	1.20		1.10	0.75	0.61	24.00	0.85	

Footnotes
Blank space indicates concentration below MDL.

TABLE 4.4.3 (Cont.) Environmental Problem 4: Analyte Concentrations Above Minimum Detection Limits for Soil Samples Collected from Within the Production Area

Sample Number	Media	Location	Organics: Acet µg/kg	ChlF µg/kg	M Chl µg/kg	T-1,2-DCl µg/kg
FE0116SS3B	Soil	Pi.Pl. Tile Field	49		26 B	
FE0117SS3B	Soil	Pi.Pl. Tile Field	90	8	22 B	
FE0118SS3B	Soil	Pi.Pl. Tile Field			43	
FE0624DS3B	Soil	S. of Pilot Plant	14 B	6	7 B	
FE0625DS3B	Soil	Building 69	24 B	10	13 B	
FE0626DS3B	Soil	Building 69	24 B	9 B		
FE0627DS3B	Soil	Building 69	31 B	14	17 B	
FE0628DS3B	Soil	Building 69	22 B	15		
FE0629DS3B	Soil	Building 69	20 B	12	12 B	
FE0630DS3B	Soil	Building 69	28 B	13	15 B	
FE0632DS3B	Soil	Plant 1		7		
FE0633DS3B	Soil	Plant 1	14 B	8		12
FE0634DS3B	Soil	Plant 1		7		15
FE0636DS1B	Soil	Plant 6	15 B	9		
FE0637DS1B	Soil	W of Bldg 6	13 B	11		
FE0640BS3B	Soil	Plant 4	10 B		11 B	

Footnotes & Flags
Blank spaces indicate concentration below MDL.
B = analyte was found in the blank as well as the sample.

Key to Organics Abbreviations
Acet --Acetone; ChlF -- Chloroform; M Chl -- Methylene Chloride;
T-1,2-DCl -- Trans-1-,2-Dichloroethene

4.5 ENVIRONMENTAL PROBLEM 5: NONPRODUCTION AREA SOIL CONTAMINATION

Requesters: Malloy, Kelly, Riddle, and Alexandro

Details are provided in Table 4.5.1.

Finding and Basis

Several specific locations that are not located within the main production facilities area were designated for soil sampling. These areas include the old incinerator area, the cone house, the fire training area, the sanitary landfill, the lime pit and pit #4. In addition, test pits were trenched with a backhoe for sampling.

Fire-Fighting Training Area

The fire-fighting training area may be contaminated with oil, including the soil around the tank. Used oils from the FMPC operation were stored at the location and used for practice fires for the site fire-protection personnel. These oils may have leaked, spilled, or been applied to soils at the site (Ref. 5, Sec. 4.5.2.2.3).

Sanitary Landfill

The sanitary landfill may be a possible source of groundwater and surface water contamination on- and off-site. Disposal of nonradioactively contaminated asbestos was documented to have occurred in the sanitary landfill. Both double-bagged and bulk quantities of asbestos were placed in the landfill. In addition, the landfill may contain radionuclide-contaminated materials, including construction rubble and soil used to cover exposed wastes.

The sanitary landfill was used for the disposal of cafeteria wastes, rubbish, and other wastes from nonprocess areas. The existing cells are filled to capacity, and FMPC stopped using the landfill in early 1986. The final cover has not been placed on this landfill. Limited data on wastes disposed at the landfill and the hydrogeology of the site do not permit a detailed assessment of the landfill's potential environmental impacts and public health risks (Ref. 5, Sec. 4.2.1.6 and Sec. 4.5.2.3.3).

Pit #4

The Burn Pit was originally excavated to provide clay to line Pits 1 and 2. The Burn Pit was subsequently used to dispose of laboratory chemicals and to burn combustible materials, including pyrophoric and reactive chemicals, oils, and other low-level contaminated combustible materials. The actual inventory of materials or chemicals disposed in the Burn Pit is unknown. Although reported as having been backfilled, the boundaries of the Burn Pit are no longer discernible from uncovered Pit 4.

TABLE 4.5.1 Environmental Problem 5: Samples Request Table

Sample Number	Location	Reference/ Page Number	Requester	Samples Proposed	Samples Collected
FE0123SS	Pit #4	1/2, 32, 33	Malloy, Kelly	N/A	3
FE0124SS	Pit #4				
FE0125SS	Pit #4				
FE0126SS	Cone House	1/48	Riddle	1	2 total
FE0127SS	Cone House				
FE0133IS	Old Incinerator Area	1/39	Kelly	N/D	4 total
FE0134IS	Old Incinerator Area				
FE0135IS	Old Incinerator Area				
FE0136IS	Old Incinerator Area				
FE0610DS	Fire Training Area	1/40, 1/47	Kelly, Riddle	1 boring	1 boring
FE0611DS	Fire Training Area				
FE0612DS	Fire Training Area				
FE0613OT	Fire Training Area				
FE0614SE	Fire Training Area				
FE0615SS	Fire Training Area				
FE0616SS	Lime Pit	1/42	Kelly	N/D	4 total
FE0617SS	Lime Pit				
FE0618SS	Lime Pit				
FE0619SS	Lime Pit				
FE0620SS	Sanitary Landfill	1/20 & 1/38	Alexandro, Kelly	2	5 (including test pit)
FE0621SS	Sanitary Landfill				
FE0622SS	Sanitary Landfill				
FE0623SS	Sanitary Landfill				

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TABLE 4.5.1 (Cont'd)

Sample Number	Location	Reference/ Page Number	Requester	Samples Proposed	Samples Collected
FE1001IS	Test Pit #1	1/45, 47, 48	Riddle	12 (total)	15 (total)
FE1002IS	Test Pit #2				
FE1003IS	Test Pit #4				
FE1004IS	Test Pit #3	1/48	Riddle	1	1
FE1005IS	Test Pit #6				
FE1006IS	Test Pit #7				
FE1007IS	Test Pit #9				
FE1008IS	Test Pit #10				
FE1009IS	Test Pit #11				
FE1010IS	Test Pit #12				
FE1015IS	Test Pit #8				

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Pit 4 was constructed in 1960 with a one foot clay process liner. The pit was in continuous operation until it ceased to accept process waste in early 1985; it continued to receive contaminated construction debris, asbestos, and garbage until May 1986. Pit 4 has received a variety of process and construction wastes, including hazardous and mixed wastes. Wastes include uranium, thorium, barium, solvents (e.g., 1,1,1-trichloroethane, perchloroethylene, and xylene), lead-based or chromium-containing paints, oils with a variety of additives, graphite, asbestos, process trash, and construction rubble and debris. In addition, exposed wastes in Pit 4 have been covered with contaminated soil from the old fire pond. It is estimated that Pit 4 contains 3,000,000 kilograms of uranium and 61,700 kilograms of thorium. (Ref. 5, Sec. 4.5.1)

Pit 4 is a source of contamination of the shallow water regime in the waste pit area. Sampling of shallow wells around Pit 4 has revealed 32 parameters at concentrations above background in the perched groundwater region. No other wells monitor the shallow-water aquifer in the waste pit area. The flow regime within the shallow water aquifer has not been adequately characterized, but the presence of contamination around Pit 4 is a potential source of on-site and off-site groundwater contamination.

4.5.1 Sampling and Analysis Objectives

Potential soil contamination in the designated areas can be linked to specific present or past practices. To determine the existence of contaminants in these areas, various types of soil samples, i.e., surface, borings, and backhoe trenches were collected. The samples were analyzed for RCRA metals, total uranium, volatile organics, and radionuclides by gamma spectrometry.

4.5.2 Sampling and Analytical Design and Implementation

Sampling Design

Soil samples were collected from specific locations outside the production area. Table 4.5.2 presents the sample number, location of sampling, type of soil sample and method of collection. Sample collection locations are provided in Figs. 4.5.1-4.5.7.

Due to the inability to discern any delineation between the burn pit and pit #4, the samples were taken from the general area.

Grab samples obtained from either the auger or backhoe bucket were obtained by removing material directly from the auger flights or backhoe bucket and placing it directly into sample containers.

The backhoe trenching was supervised by a geologist with the responsibility of recording the trenching procedures and specific information in the logbook. Test pits designated #5 and #13 were not excavated because they were located off-site on private property. The TW-9 area was determined by the geologist to be a natural topographic feature, thus not requiring sampling.

TABLE 4.5.2 Soil Sampling Locations - Nonproduction Area

Sample Number	Sample Location	Soil Sample Type	Method of Collection
FE0133IS	Old incinerator area 30 ft SW of incinerator	Surface 0-12"	Grabs from augers
FE0134IS	Old incinerator area 20 ft S & 65 ft E of NW corner of fence	Surface 4-14"	Grabs from augers
FE0135IS	Old incinerator area	Surface 4-14"	Grabs from augers
FE0136IS	Old incinerator area 10 ft E of fence and SW of incinerator	Surface 3-15"	Grabs from augers
FE0126SS	Cone house	Surface 0-6"	Spatial composite
FE0127SS	Cone house	Surface 0-6"	Grab
FE0616SS	Lime pit	Surface 0-6"	Spatial composite
FE0617SS	Lime pit	Surface 0-6"	Spatial composite
FE0618SS	Lime pit	Surface 0-6"	Spatial composite
FE0619SS	Lime pit	Surface 0-6"	Spatial composite
FE0610DS	Fire training area	Boring 0-5'	Composite from auger
FE0611DS	Fire training area	Boring 5-10'	Composite from auger
FE0612DS	Fire training area	Boring 10-13'	Composite from auger
FE0613OT	Fire training area	Oily sludge	Composite
FE0614SE	Fire training area	Oily sediment	Composite from auger
FE0615SS	Fire training area	Surface	Composite from auger
FE0620SS	Sanitary landfill	Surface 0-6"	Spatial composite
FE0621SS	Sanitary landfill	Surface 0-6"	Spatial composite
FE0622SS	Sanitary landfill	Surface 0-6"	Spatial composite
FE0623SS	Sanitary landfill	Surface 0-6"	Spatial composite
FE0123SS	Pit #4	Surface 0-6"	Spatial composite
FE0124SS	Pit #4	Surface 0-6"	Spatial composite
FE0125SS	Pit #4	Surface 0-6"	Spatial composite
FE1001IS	S of Sewage Treatment Plant, Test Pit 1	Backhoe trench (0.9' and 3.9')	Grab from backhoe bucket
FE1002IS	SW of Sewage Treatment Plant, Test Pit 2	Backhoe trench (1.0' and 3.0')	Grab from backhoe bucket
FE1003IS	N of Sewage Treatment Plant, Test Pit 4	Backhoe trench (1.0' and 3.0')	Grab from backhoe bucket
FE1004IS	W of Sewage Treatment Plant, Test Pit 3	Backhoe trench (1.0' and 3.0')	Grab from backhoe bucket

TABLE 4.5.2 (Cont'd)

Sample Number	Sample Location	Soil Sample Type	Method of Collection
FE1005IS	E of Bldg. 16 Test Pit 6	Backhoe trench (0.5' and 3.0')	Grab from backhoe bucket
FE1006IS	E of Bldg. 22 Test Pit 7	Backhoe trench (0.8' and 3.0')	Grab from backhoe bucket
FE1007IS	S of Bldg. 68 Test Pit 9	Backhoe trench (1.0', 4.0' and 9.5')	Grab from backhoe bucket
FE1008IS	SW of Bldg. 68 Test Pit 10	Backhoe trench (0.5' and 3.0')	Grab from backhoe bucket
FE1009IS	W of K-65 silos Test Pit 11	Backhoe trench (1.0', 4.1' and 8.8')	Grab from backhoe bucket
FE1010IS	NW of K-65 silos Test Pit 12	Backhoe trench (2.0', 4.0' and 7.8')	Grab from backhoe bucket
FE1015IS	Sanitary Landfill Test Pit 8	Backhoe trench (2.0', 3.5' and 6.5')	Grab from backhoe bucket

Analytical Design

Soil samples were analyzed to determine the concentration of RCRA metals, total uranium, volatile organics, and radionuclides by gamma spectrometry present at or above analytical method detection limits. Samples from the sanitary landfill and Pit #4 were also analyzed for asbestos. For more information on analytical methods, see Appendix A.

4.5.3 Field and Analytical Data

Field Data

Field radiological measurements are presented in Table 4.5.3. Samples are from the old incinerator area and the cone house area.

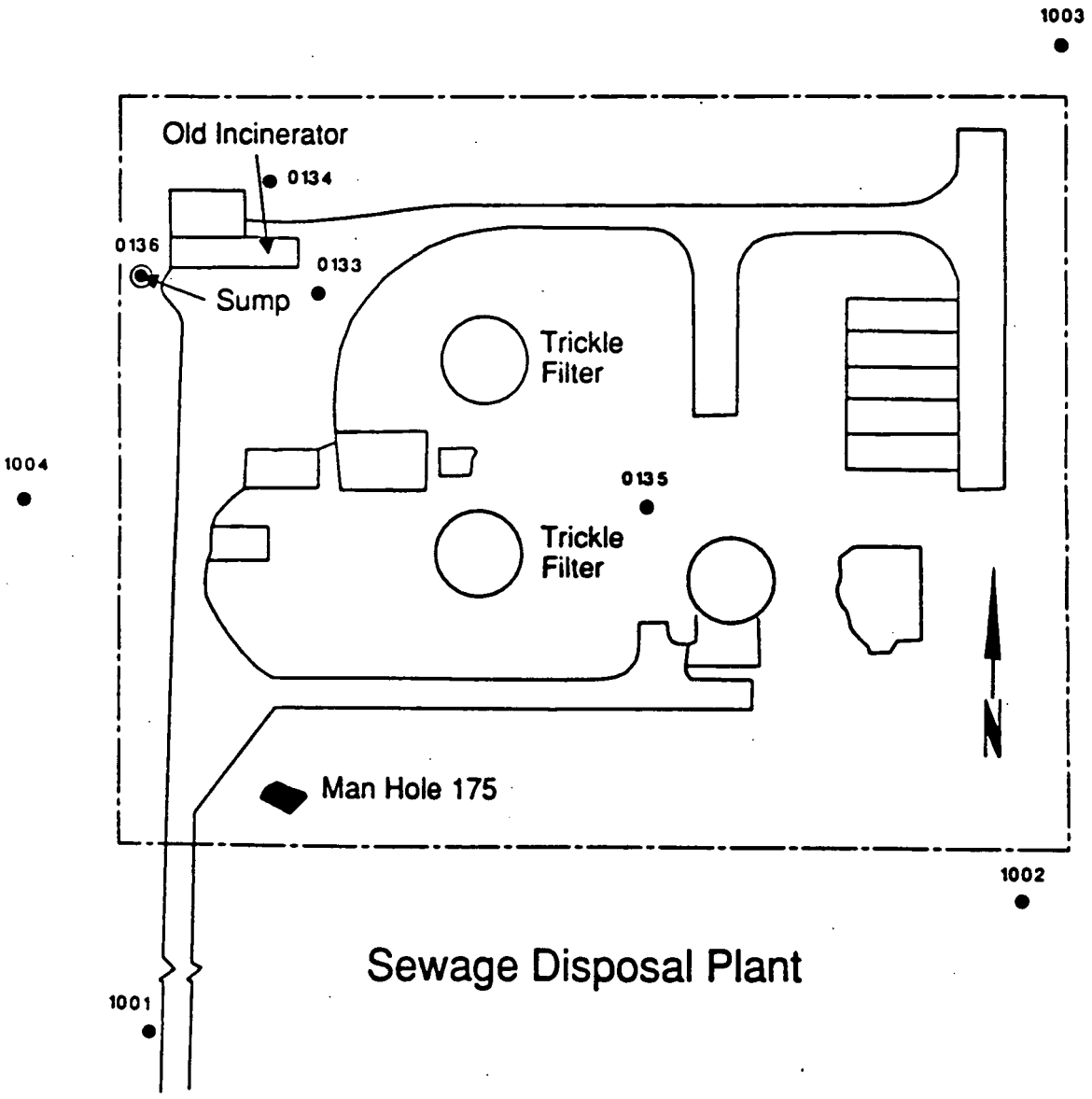

FIGURE 4.5.1 Nonproduction Area Soil Sample Locations - Sewage Disposal Plant Vicinity

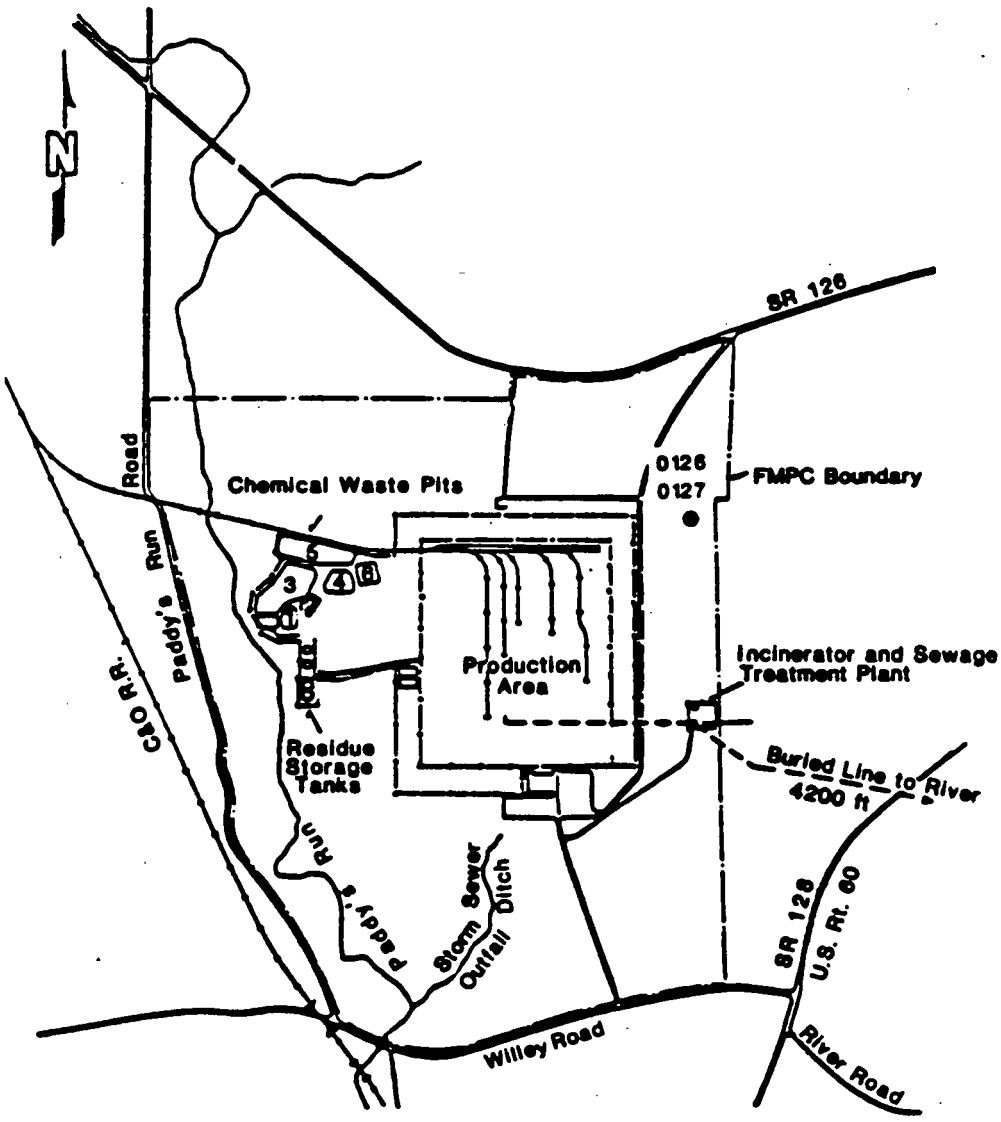

FIGURE 4.5.2 Nonproduction Area Soil Sample Locations - Cone House

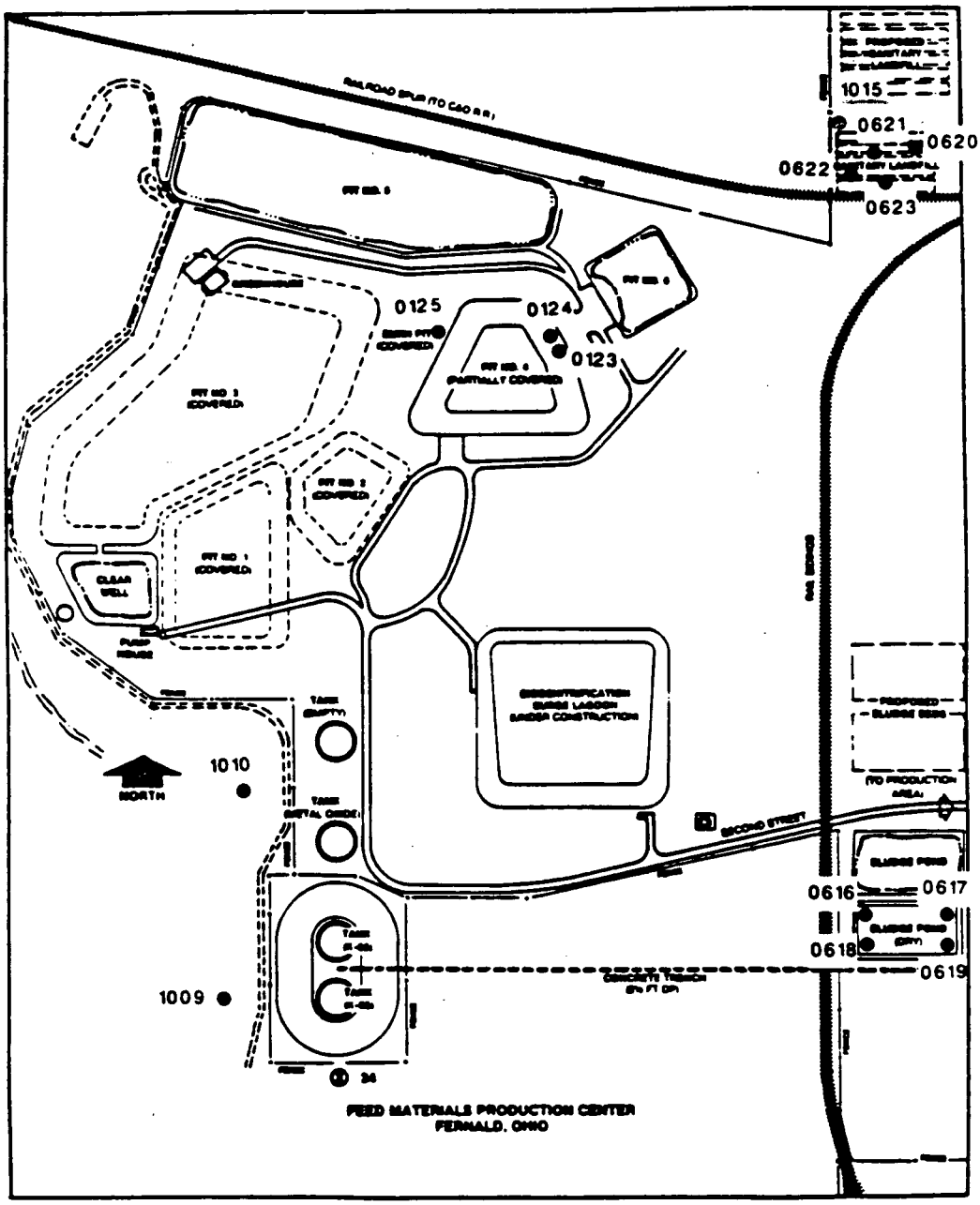

FIGURE 4.5.3 Nonproduction Area Soil Sample Locations - Pit Area

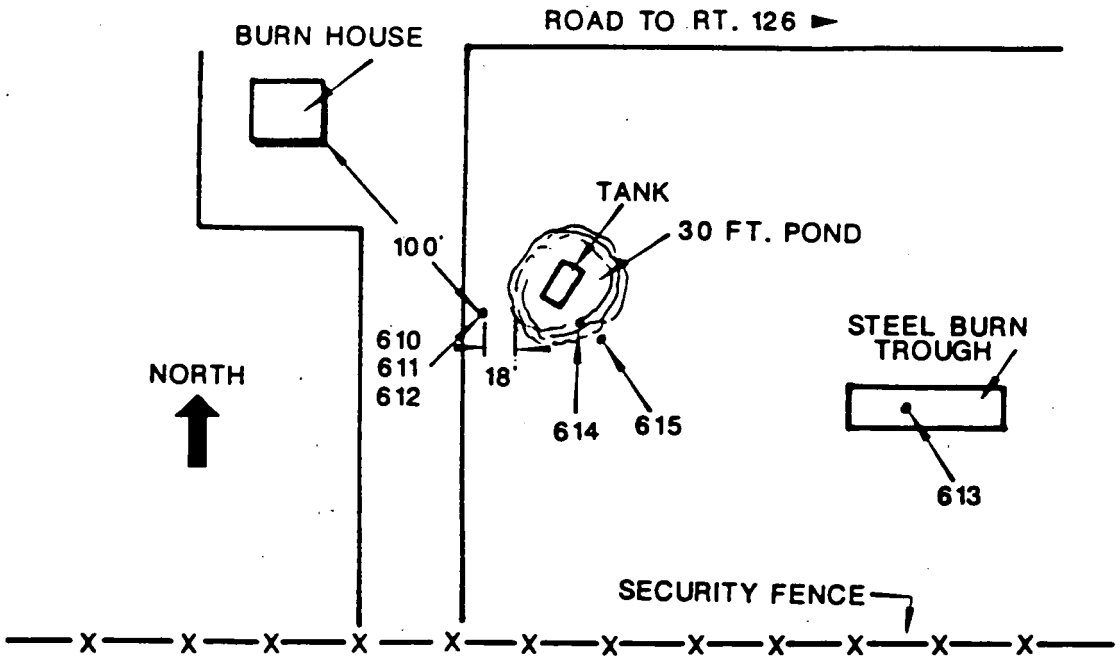

FIGURE 4.5.4 Nonproduction Area Soil Sample Locations - Fire Training Area

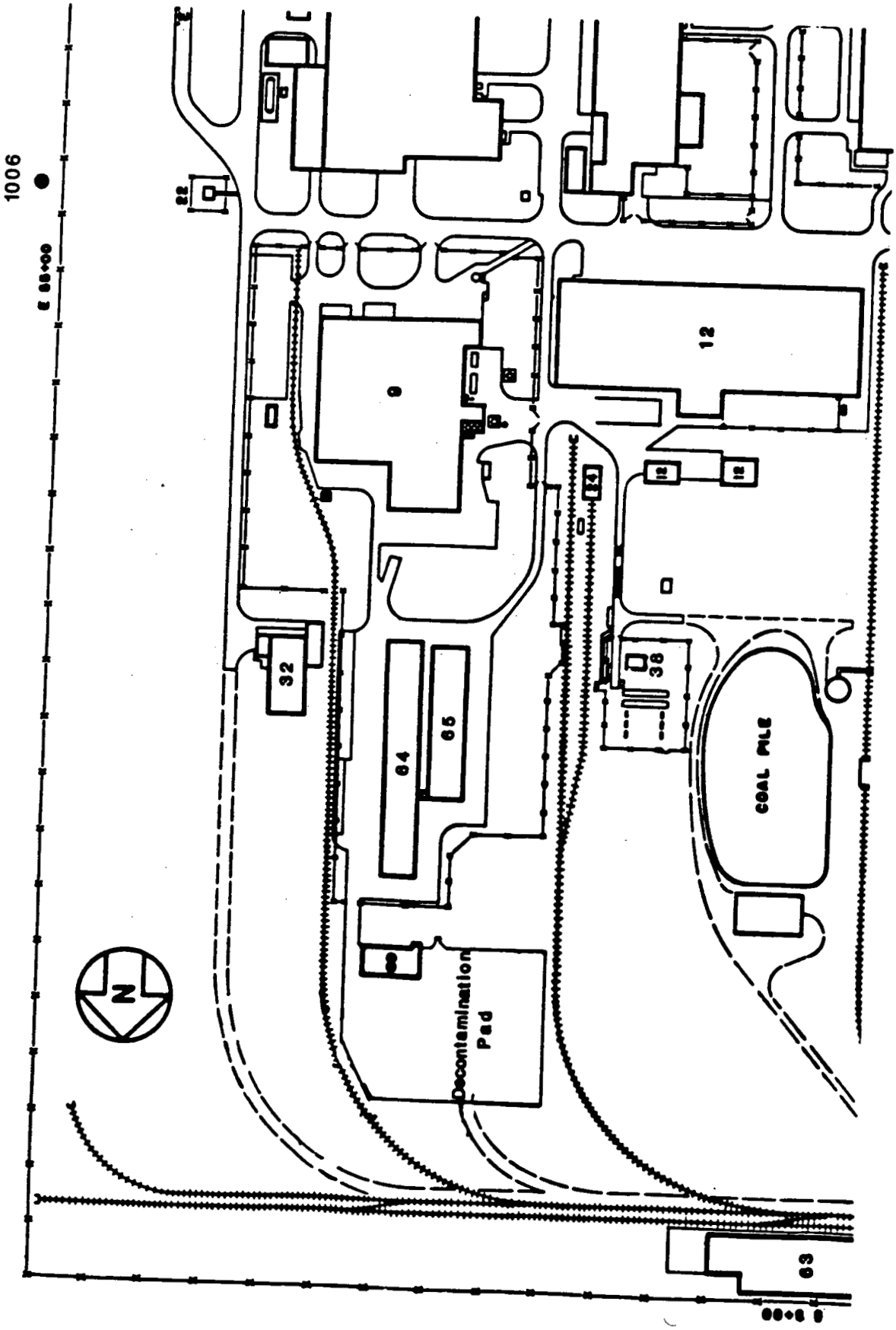

FIGURE 4.5.5 Nonproduction Area Soil Sample Locations - Test Pit Number 7

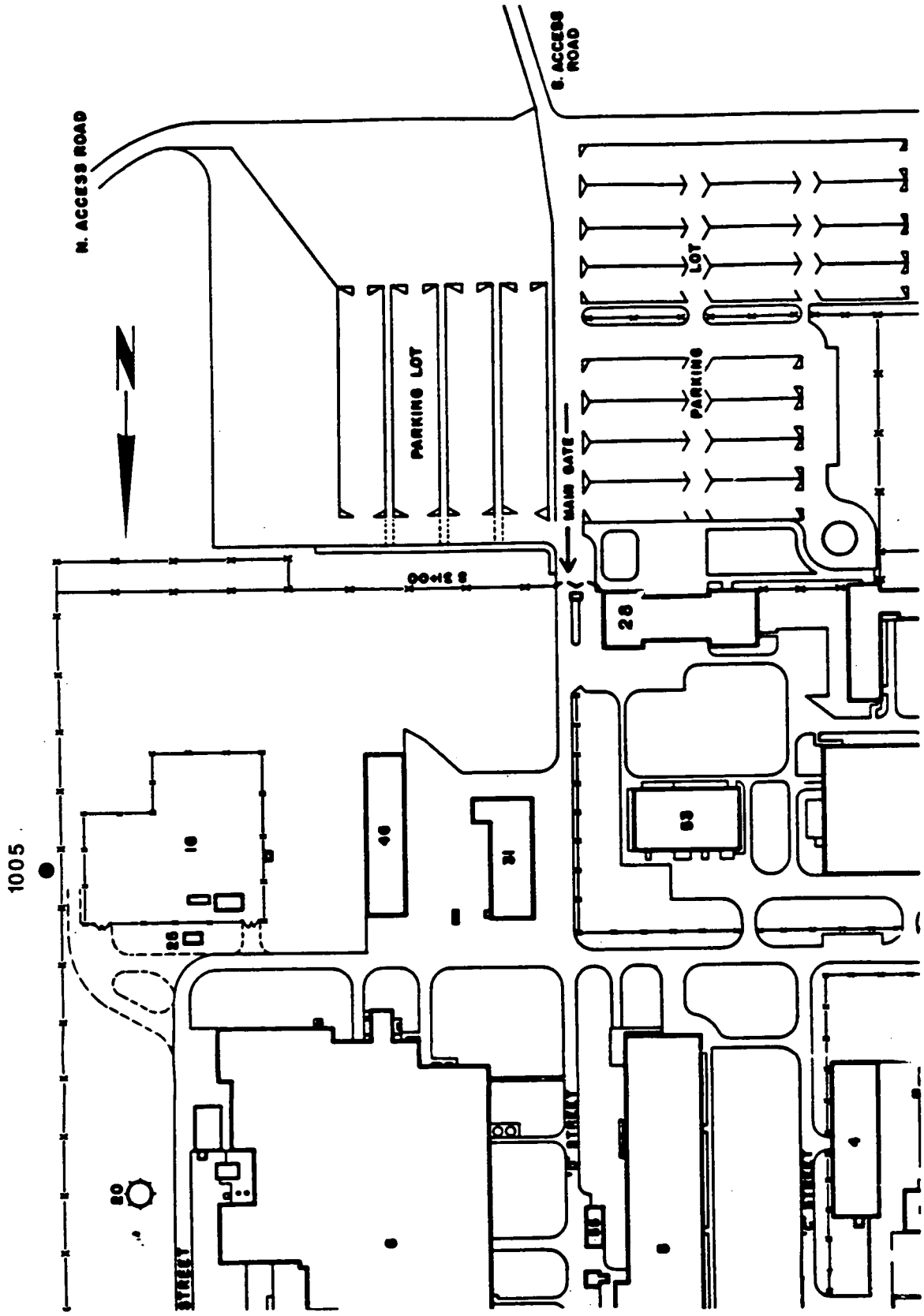

FIGURE 4.5.6 Nonproduction Area Soil Sample Locations - Test Pit Number 6

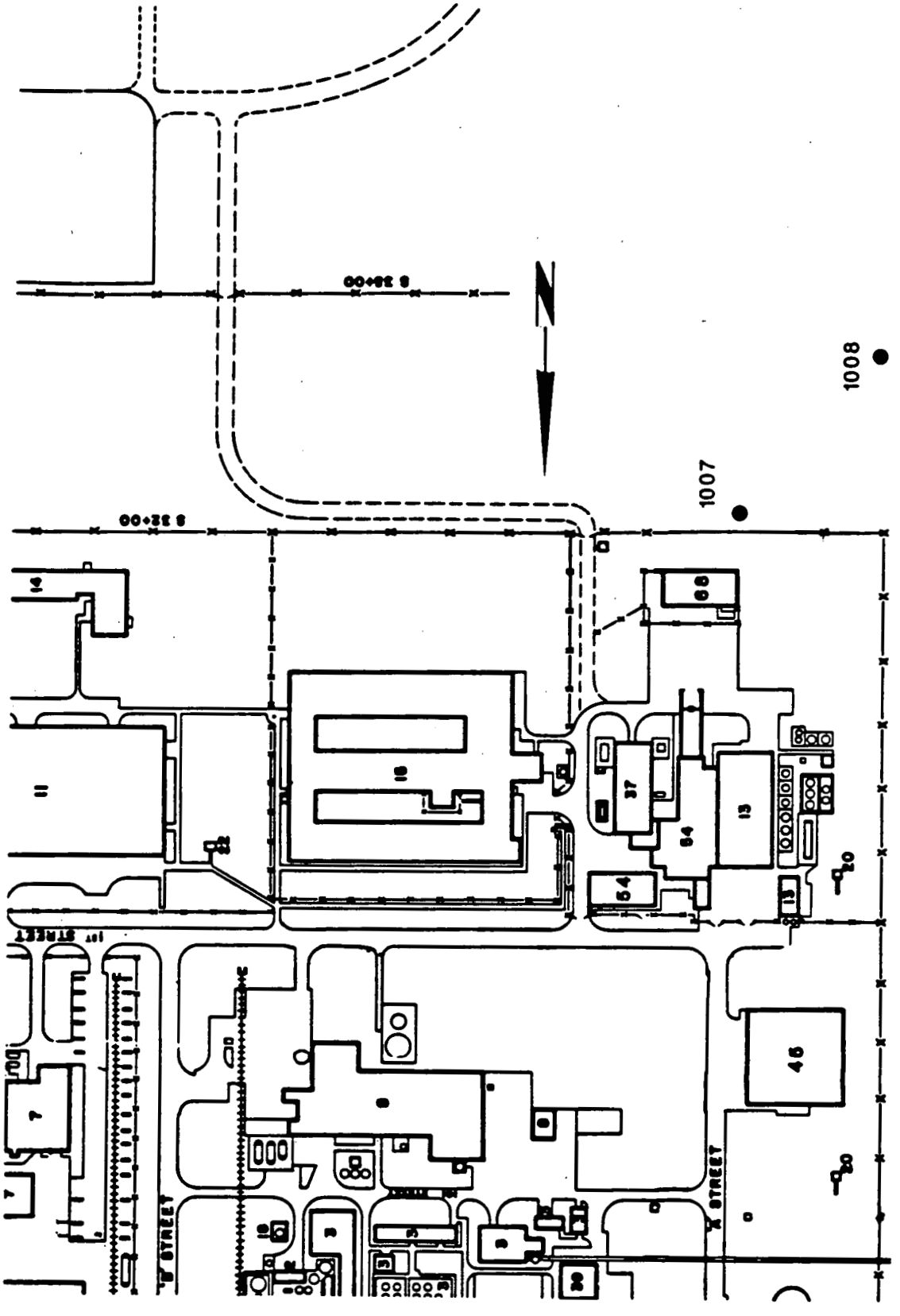

FIGURE 4.5.7 Nonproduction Area Soil Sampling Locations - Test Pits Numbers 9 and 10

TABLE 4.5.3 Field Measurements Associated with Nonproduction Area Soil Sampling

Sample Number	Rad	Background	Figure Reference
FE0133IS	110 mR/hr	10 mR/hr	Fig. 4.5.1
FE0134IS	110 mR/hr	10 mR/hr	Fig. 4.5.1
FE0135IS	110 mR/hr	10 mR/hr	Fig. 4.5.1
FE0136IS	110 mR/hr	10 mR/hr	Fig. 4.5.1
FE0126SS	110 mR/hr	10 mR/hr	Fig. 4.5.2
FE0127SS	110 mR/hr	10 mR/hr	Fig. 4.5.2
FE0616SS	N.D.[a]	10^4 counts/min at surface	Fig. 4.5.3
FE0617SS	N.D.	10^4 counts/min at surface	Fig. 4.5.3
FE0618SS	N.D.	10^4 counts/min at surface	Fig. 4.5.3
FE0619SS	N.D.	10^4 counts/min at surface	Fig. 4.5.3
FE0610DS	N.D.	200 counts/min	Fig. 4.5.4
FE0611DS	N.D.	250 counts/min/100 cm^2	Fig. 4.5.4
FE0612DS	N.D.	250 counts/min/100 cm^2	Fig. 4.5.4
FE0613OT	N.D.	200 counts/min/100 cm^2	Fig. 4.5.4
FE0614SE	N.D.	200 counts/min/100 cm^2	Fig. 4.5.4
FE0615SS	N.D.	200 counts/min/100 cm^2	Fig. 4.5.4
FE0620SS	N.D.	5,000 counts/min at surface	Fig. 4.5.3
FE0621SS	N.D.	5,000 counts/min at surface	Fig. 4.5.3
FE0622SS	N.D.	5,000 counts/min at surface	Fig. 4.5.3
FE0623SS	N.D.	5,000 counts/min at surface	Fig. 4.5.3
FE0123SS	5 mR/hr	700 mR/hr on contact	Fig. 4.5.3
FE0124SS	25 mR/hr	600 mR/hr on contact	Fig. 4.5.3
FE0125SS	5 mR/hr	40 mR/hr on contact	Fig. 4.5.3
FE1001IS	N.D.		Fig. 4.5.1
FE1002IS	N.D.		Fig. 4.5.1
FE1003IS	N.D.		Fig. 4.5.1
FE1004IS	N.D.		Fig. 4.5.1
FE1005IS	N.D.		Fig. 4.5.6
FE1006IS	N.D.	5,000-10,000 counts/min	Fig. 4.5.5
FE1007IS	N.D.	15,000-20,000 counts/min	Fig. 4.5.7
FE1008IS	N.D.	5,000-10,000 counts/min	Fig. 4.5.7
FE1009IS	N.D.	300,000 counts/min	Fig. 4.5.3
FE1010IS	N.D.	300,000 counts/min	Fig. 4.5.3
FE1015IS	20 mR/hr	2500 counts/min	Fig. 4.5.3

[a]N.D. denotes no detection over background.

Analytical Data

The data which exceed the analytical method detection limits are presented in Table 4.5.4.

The sites selected for sampling outside the main production area exhibited elevated levels of total uranium and certain radionuclides in the soils. U-238 was the most commonly encountered radionuclide with activity above MDL. The samples collected from Pit #4 (Burn Pit Area) contained notable concentrations of total uranium, with the maximum value being 13,300 mg/kg. A sample from the old incinerator area contained 12,400 mg/kg total U. Elevated activity from U-238 were encountered in the old incinerator area and Pit #4. A sample from Pit #4 contained 9,432 pCi/g U-238. The soil samples were collected by various methods (See Table 4.5.2).

The samples collected from the sanitary landfill that were analyzed for asbestos showed values below the detection limit.

Water was encountered during trenching in both Test Pits 8 and 9. The water samples were analyzed and also exhibited elevated levels of total uranium.

The analyses for volatile organic compounds revealed elevated levels of several analytes. Significant data for soil samples collected from the Fire Training Area include: 1200 µg/kg 1,1,1-trichloroethane; 4800 µg/kg tetrachloroethene; 1700 µg/kg toluene; and 2500 µg/kg total xylenes.

Data for sludge collected from the Fire Training Area include: 14,000 µg/kg, 1,1-dichloroethene; 75,000 µg/kg 1,1,1-trichloroethane; 800,000 µg/kg toluene; 300,000 µg/kg tetrachloroethene; and 500,000 µg/kg ethylbenzene.

Table 4.5.5 presents information recorded by the geologist during the trenching with the backhoe for excavation of the test pits. Field measurements for volatile organics with an HNu meter, sample collection depths and soil descriptions are included.

For a complete presentation of the analytical data see Appendix E.

4.5.4 Data Quality Evaluation

Sampling Design - The number and location of sampling points were selected according to the Plan, but do not provide fully representative information for this Problem. Data utility level 3.

Sample Collection - EPA-approved sample containers were used. Appropriate field measurements were taken. Field logbooks do not contain all necessary supporting information to judge whether there were deviations from standard sampling protocols. Logbooks are signed and dated. Data utility level 3.

Sample Analysis - Sample handling was appropriate for the media and analysis performed. Instruments and procedures used meet established standards. Laboratory notebooks contain sufficient information and are signed and dated. Data utility level 2.

TABLE 4.5.4 Environmental Problem 5: Analyte Concentrations which Exceed Minimum Detection Limits: Soil Samples

Sample Number	Media	Location	Radionuclides: U-235 pCi/g	U-238 pCi/g	Bi-214 pCi/g	Cs-137 pCi/g	Ra-226 pCi/g	Th-228 pCi/g	Th-232 pCi/g	Total U pCi/g	RCRA Metals: Ba mg/L	Cr mg/L
FE0123SS2B	Soil	Burn Pit Area	15.00	1873.0	1.90	1.50	2.00	2.80	2.10	3080.0	1.47	
FE0124SS2B	Soil	Burn Pit Area	61.00	9432.0	2.90		2.30	5.50	4.30	13300.0	0.64	
FE0125SS2B	Soil	Burn Pit Area	1.60	100.0	0.81		0.88	2.00	1.80	234.0	0.71	
FE0126SS2B	Soil	Cone House	0.14		0.94		0.80	1.10	1.30	4.3	0.43	
FE0127SS2B	Soil	Cone House			0.22		0.83	1.10	0.79	19.0	0.60	
FE0133IS2B	Soil	Old Inciner. Area	12.00	773.0	1.20	0.30	1.30	2.60	2.20	1790.0	0.47	
FE0134IS1B	Soil	Old Inciner. Area	NS	NS	NS	NS	NS	NS	NS	196.0	0.27	
FE0135IS2B	Soil	Old Inciner. Area	1.50	96.0	2.80	0.14	3.00	1.50	1.40	355.0	0.53	
FE0136IS2B	Soil	Old Inciner. Area	34.00	2399.0	1.20		1.40	2.60	2.40	12400.0	0.63	0.03
FE0610DS2B	Soil	Fire Train. Area			0.36		0.38	0.52	0.61	26.0	0.60	
FE0611DS2B	Soil	Fire Train. Area			0.88		0.82	0.91	0.86	3.0	0.55	
FE0612DS2B	Soil	Fire Train. Area			0.32		0.41	0.54	0.51	5.8	0.66	
FE0615SS2B	Soil	Fire Train. Area			0.32		0.31	0.37	0.38	27.0	0.58	0.05
FE0616SS2B	Soil	Lime Pit								14.0	0.36	0.05
FE0617SS2B	Soil	Lime Pit	0.18	1.6	0.40	0.27	0.38			19.0	0.28	0.04
FE0618SS2B	Soil	Lime Pit		41.0						36.0	0.29	0.04
FE0619SS2B	Soil	Lime Pit	0.44	22.0	0.27	0.21	0.27			28.0	0.29	0.03
FE0620SS2B	Soil	Sanitary Landfill	0.89	64.0	0.88		0.87	1.00	1.10	149.0	0.63	
FE0621SS2B	Soil	Sanitary Landfill			2.20		2.10	1.60	1.20	66.0	0.91	
FE0622SS2B	Soil	Sanitary Landfill	1.20	48.0	0.83		0.83	1.30	1.10	112.0	0.54	
FE0623SS2B	Soil	Sanitary Landfill	0.69		0.69		0.60	0.71	0.80	11.0	0.58	
FE1001IS2B	Soil	Test Pit 1 @ 0.9 ft			0.86		0.73	1.20	1.30	3.8	0.33	
FE1001IS3B	Soil	Test Pit 1 @ 3.9 ft	0.07		0.99		0.98	1.10	1.10	1.9	0.23	
FE1002IS1B	Soil	Test Pit 2 @ 1 ft	0.07		0.78		0.82	0.65	0.68	2.0	0.47	
FE1002IS2B	Soil	Test Pit 2 @ 3 ft	0.10		0.93		1.10	1.50	1.30	1.8	0.47	
FE1003IS1B	Soil	Test Pit 4 @ 1 ft	0.07		1.10		1.00	1.10	1.10	4.3	0.41	

Footnotes
Blank space indicates concentration below MDL
NS = sample not analyzed for indicated analyte

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TABLE 4.5.4 (Cont.) Environmental Problem 5: Analyte Concentrations which Exceed Minimum Detection Limits - Soil Samples

Sample Number	Media	Location	Radionuclides: U-235 pCi/g	U-238 pCi/g	Bi-214 pCi/g	Cs-137 pCi/g	Ra-226 pCi/g	Th-228 pCi/g	Th-232 pCi/g	Total U pCi/g	RCRA Metals: Ba mg/L	Cr mg/L
FE1003IS2B	Soil	Test Pit 4 @ 3 ft	0.06		0.99		1.00	1.10	1.10	1.8	0.66	
FE1004IS1B	Soil	Test Pit 3 @ 1 ft	0.12		1.00		1.20	1.20	1.10	10.0	0.37	
FE1004IS2B	Soil	Test Pit 3 @ 3 ft	0.09		1.00		1.00	1.10	1.10	1.8	0.64	0.04
FE1005IS1B	Soil	Test Pit 6 @ 0.5 ft	0.18		0.79		0.91	0.77	0.91	21.0	0.56	0.04
FE1005IS2B	Soil	Test Pit 6 @ 3 ft	0.07		1.20		1.10	1.00	1.10	1.8	0.28	
FE1006IS1B	Soil	Test Pit 7 @ 0.8 ft	0.12		0.93		0.96	0.98	0.87	12.0	0.70	
FE1006IS2B	Soil	Test Pit 7 @ 3 ft			0.77		0.89	0.72	0.67	2.0	0.66	0.03
FE1015IS1B	Soil	Test Pit 8 @ 2 ft	0.72	99.0	0.78	0.14	0.79	0.97	0.72	228*	0.54	
FE1015IS2B	Soil	Test Pit 8 @ 6.5 ft	0.41	64.0	0.93		0.90	0.97	0.94	250*	0.86	
FE1007IS2B	Soil	Test Pit 9 @ 1 ft									0.06	
FE1007IS3B	Soil	Test Pit 9	0.09		1.1		1.1	1.4	1.4	1.6*	0.40	
FE1007IS4B	Soil	Test Pit 9	0.11		1.1		1.2	1.1	0.9	14.0*	0.51	0.05
FE1008IS1B	Soil	Test Pit 10 @ 0.5 ft	0.43	24.0	1.30		1.10	13.00	11.00	35.0	0.95	0.04
FE1009IS2B	Soil	Test Pit 11 @ 1 ft	0.07		1.20		1.20	1.20	1.10	2.4	0.40	
FE1009IS1B	Soil	Test Pit 11 @ 4.1 ft								1.7	0.18	
FE1010IS1B	Soil	Test Pit 12 @ 2 ft	0.09		1.10		1.00	0.63	0.86	9.1	0.91	0.04
FE1010IS2B	Soil	Test Pit 12 @ 4 ft								2.9	0.34	

Footnotes

Blank space indicates concentration below MDL

* *Total U units are mg/kg.*

TABLE 4.5.4 (Cont.) Environmental Problem 5: Analyte Concentrations which Exceed Minimum Detection Limits - Soil Samples

Sample Number	Media	Location	Organics: Acet µg/kg	ChlF µg/kg	M Chl µg/kg	T-1,2-DCl µg/kg	1,1,1-Tri µg/kg	1,1-DiCl µg/kg	Tol µg/kg
FE0123SS3B	Soil	Burn Pit Area	64 B	15	20 B		111	11	
FE0124SS3B	Soil	Burn Pit Area	22 B	6	18 B		9	5	4 B
FE0125SS3B	Soil	Burn Pit Area	15 B	5	12 B				2 B
FE0126SS3B	Soil	Cone House	29 B	7	6				
FE0127SS3B	Soil	Cone House	16 B		4 B				
FE0133IS3B	Soil	Old Inciner. Area	16 B	9	12 B				
FE0134IS3B	Soil	Old Inciner. Area	12 B	6	10 B				
FE0135IS3B	Soil	Old Inciner. Area	11 B	6					
FE0136IS3B	Soil	Old Inciner. Area	14 B		6 B				
FE0610DS3B	Soil	Fire Train. Area	24 B	7	80	8	52	55	8
FE0611DS3B	Soil	Fire Train. Area	55 B	5	31 B		2700	160	1700
FE0612DS3B	Soil	Fire Train. Area			40 B	180	7200	1600	990
FE0615SS3B	Soil	Fire Train. Area	11 B	7	12 B		11		
FE0616SS3B	Soil	Lime Pit	18 B	7	8 B				
FE0617SS3B	Soil	Lime Pit	19 B	11	12 B		14		
FE0618SS3B	Soil	Lime Pit	21 B	7	14 B		9		
FE0619SS3B	Soil	Lime Pit	25 B	8	22 B		9		
FE0620SS3B	Soil	Sanitary Landfill	21 B	9	16 B		6		
FE0621SS3B	Soil	Sanitary Landfill	12 B	13	10 B		5		
FE0622SS3B	Soil	Sanitary Landfill	27 B	12	8 B				
FE1008IS2B	Soil	Test Pit, 10			7 B				
FE1009IS5B	Soil	Test Pit, 11	26 B	6	16 B				
FE1010IS2B	Soil	Test Pit, 12	18 B	5 B	10 B				
FE1010IS5B	Soil	Test Pit, 12	30 B	8 B	19 B				

Footnotes & Flags
Blank spaces indicate concentration below MDL.
B = analyte was found in the blank as well as the sample.

Key to Organics Abbreviations
Acet --Acetone; ChlF -- Chloroform; M Chl -- Methylene Chloride; 1,1-Tri--Trichloroethane; Tol -- Toluene;T-1,2-DCl -- Trans-1-,2-Dichloroethene; 1,1-DiCl-- 1,1-Dichloroethane.

TABLE 4.5.4 Environmental Problem 5 (Cont.): Analyte Concentrations which Exceed Minimum Detection Limits-Soil Samples

Sample Number	Media	Location	Organics (Cont.): TetCl µg/kg	1,1-DiCe µg/kg	EthB µg/kg	Xylenes µg/kg	TCE µg/kg
FE0610DS3B	Soil	Fire Train. Area	17				
FE0611DS3B	Soil	Fire Train. Area	4800	310	590	2500	11
FE0612DS3B	Soil	Fire Train. Area	1300	1200	400	1800	43

Footnotes & Flags
Blank spaces indicate concentration below MDL.
B = Analyte was found in the blank as well as the sample.
Z8 = This soil sample was analyzed as a medium level sample,methanol extraction performed, and an aliquot of the extract analyzed.

Key to Organics Abbreviations
Xyenes -- Total Xyenes;TetCl--Tetrachloroethene; TCE -- Trichloroethene;
1,1-DiCe-- 1,1-Dichloroethene; EthB -- Ethylbenzene

TABLE 4.5.4 Environmental Problem 5 (Cont.): Analyte Concentrations which Exceed Minimum Detection Limits-Sediment and Sludge Samples

Sample Number	Media	Location	Organics: TetCl µg/kg	1,1-DiCe µg/kg	EthB µg/kg	Xylenes µg/kg	TCE µg/kg
FE06130T3B	Sludge	Fire Train. Area	290000 Z8	14000 Z8	500000 Z8	1700000 Z8	
FE0614SE3B	Sediment	Fire Train. Area	110		71	870	

Sample Number	Media	Location	Organics (Cont.): Acet µg/kg	ChlF µg/kg	M Chl µg/kg	T-1,2-DCl µg/kg	1,1,1-Tri µg/kg	1,1-DiCl µg/kg	Tol µg/kg
FE06130T3B	Sludge	Fire Train. Area				200000 Z8	75000 Z8		800000 Z8
FE0614SE3B	Sediment	Fire Train. Area	24 B		16	32	100		210

Sample Number	Media	Location	Radionuclides: U-235 pCi/g	U-238 pCi/g	Bi-214 pCi/g	Cs-137 pCi/g	Ra-226 pCi/g	Th-228 pCi/g	Th-232 pCi/g	Total U µg/L	RCRA Metals: Ba mg/L	Cr mg/L
FE0613OT	Sludge	Fire Training Area	52	1752				1.4	0.94	4130*	0.63	
FE0614SE	Sediment	Fire Training Area	2.8	79	0.32		0.4	1.2	1.1	208*	0.71	

Footnotes & Flags
Blank spaces indicate concentration below MDL.
B = analyte was found int he blank as well as the sample.
Z8 = This soil sample was analyzed as a medium level sample,methanol extraction performed, and an aliquot of the extract analyzed.
*mg/kg

Key to Organics Abbreviations
Xyenes -- Total Xyenes;TetCl--Tetrachloroethene; TCE -- Trichloroethene; 1,1-DiCe-- 1,1-Dichloroethene; EthB -- Ethylbenzene; Acet -- Acetone; ChlF -- Chloroform; M Chl -- Methylene Chloride; 1,1,1-Tri--Trichloroethane; Tol -- Toluene;T-1,2-DCl -- Trans-1-,2-Dichloroethene; 1,1-DiCl-- 1,1-Dichloroethane.

TABLE 4.5.4 (Cont.) Environmental Problem 5: Analyte Concentrations which Exceed Minimum Detection Limits - Water Samples

Sample Number	Media	Location	Radionuclides: Total U µg/L	RCRA Metals: Ba mg/L	Cr mg/L
FE1007IS1B	Water	Test Pit 9	13.0		
FE1015IS3B	Water	Test Pit 8	2230.0	0.18 B	0.04
FE1015IS4B	Water	Test Pit 8	3270.0	0.19 B	0.05

Footnotes & Flags
Blank space indicates concentration below MDL
B = analyte found in blank as well as sample.

TABLE 4.5.5 Observational Data Associated with Backhoe Trenches (test pits)

Depth (feet)	Test Pit #1	Test Pit #2	Test Pit #3	Test Pit #4	Test Pit #6	Test Pit #7
1.0	silty, clay topsoil	silty, clay topsoil	silty, clay topsoil	silty, pebbly clay topsoil	silty clay topsoil clay, silty with pebbles	clay topsoil to 0.3 silty hard clay with limestone floaters
	Sample 1 @ 0.9 HNu = 2.1 ppm	Sample 1 @ 1.0 HNu = N.D.	Sample 1 @ 1.0 HNu = N.D.	Sample 1 @ 1.0 HNu = N.D.	Sample 1 @ 0.5 HNu = N.D.	Sample 1 @ 0.8' HNu = N.D.
2.0	silty clay HNu = 2.5 ppm	clay HNu = N.D.	silty, pebbly clay HNu = N.D.	silty clay HNu = N.D.	HNu = N.D.	HNu = N.D.
3.0	HNu = 1.7 ppm	Sample 2 @ 3.0 HNu = N.D.	chunk of asphalt Sample 2 @ 3.0 Hnu = N.D.	Sample 2 @ 3.0 HNu = N.D.	Sample 2 @ 3.0' HNu = N.D.	Sample 2 @ 3.0 HNu = N.D.
4.0	Sample 2 @ 3.9 HNu = 1.9 ppm	HNu = N.D.	HNu = N.D.	HNu = N.D.	HNu = N.D.	HNu = N.D.
5.0	red clay field tile fragments HNu = 3.1 ppm	HNu = N.D.	HNu = N.D.	HNu = N.D.		HNu = N.D.
6.0	Total depth = 5.0	Total depth = 5.2 Dry	Total depth = 5.1 Wet	Total depth = 5.2 Dry	Total depth = 4.5 Dry	Total depth = 5.5 Dry
	Background HNu = 1.9 ppm	Background HNu = 2.9 ppm	Background HNu = 0.5 ppm	Background HNu = 0.5 ppm	Background HNu = 0.2 ppm	Background HNu = 0.2 ppm

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Revision: 00

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TABLE 4.5.5 (Cont'd)

Depth (feet)	Test Pit #8	Test Pit #9	Test Pit #10	Test Pit #11	Test Pit #12
1.0	fill, sandy clay with wood and roofing debris	clay fill with cobbles and brick fragments Sample 1 @ 1.0 HNu = 6.2 ppm	silty clay topsoil oil thick Sample 1 @ 0.5 HNu = 3.1 ppm	clay topsoil Sample 1 @ 1.0 HNu = N.D.	clay fill, abundant cobbles and asphalt pieces HNu = 7.8
2.0	Sample 1 @ 2.0 HNu = N.D.	HNu = 0.8 ppm	HNu = 2.7 ppm	HNu = N.D.	Sample 1 @ 2.0 HNu = 7.0
3.0	fill, roofing	HNu = 0.4 ppm	Sample 2 @ 3.0 HNu = 6.4 ppm	HNu = N.D.	HNu = 2.8
4.0	water streaming in @ 3.5; collected H_2O Sample	dark clay HNu = 0.3 ppm	HNu = 4.6 ppm	HNu = 2.1 ppm	clay - large pebbles Sample 2 @ 4.0 HNn = N.D.
5.0		HNu = 3.6 ppm	HNu = 4.8 ppm	medium to coarse grained sand Sample 2 @ 4.1 HNu = 0.8 ppm	HNu = 5.6 ppm
6.0	dark clay		slight H_2O seepage		
7.0	Sample 2 @ 6.5		total depth = 5.5 wet		silty, pebbly clay
8.0		HNu = 3.9 ppm (9.5)	Background HNu = 0.2 ppm		Slight H_2O seepage VOA Sample @ 7.8 HNu = 5.6 ppm
9.0	Total depth = 9.0 Background HNu = 0.5 ppm	collected H_2O sample @ 9.5 Total depth = 9.5 Background HNu = 0.2 ppm	VOA collected @ 8.8	Total depth = 8.9 dry Background HNu = 0.2 ppm	Total depth = 7.8 Background HNu = 0.2 ppm

N.D. - Not detected.

000327

QA/QC and Documentation - The S&A Plan contained a QA plan covering all aspects of the sampling and analysis program. No field QC samples were collected for this Problem. Adequate laboratory QC analyses were performed. Records were maintained regarding laboratory instrument calibration and maintenance. Data are reported in appropriate units accompanied by estimates of uncertainty. Supporting information is available. Data utility level 2.

4.6 ENVIRONMENTAL PROBLEM 6: SOUTH OF PRODUCTION AREA SOIL CONTAMINATION

Requesters: Malloy, Daugherty, Kelley, and Riddle

Details are provided in Table 4.6.1.

Finding and Basis

Several locations in the area south of the production area have the potential for soil contamination. These locations are the new flyash pile, the old flyash pile and the south field.

New Flyash Pile

Waste oil was applied to the new flyash pile as a dust suppressant. This, as well as the normal constituents of flyash could be transported off-site via storm water run-off.

Old Flyash Pile

The inactive flyash pile could be a source of off-site chemical and radioactive contamination. The pile was contaminated in the past as a result of spreading PCB-contaminated waste oil to control dust. The pile also contains approximately 1,000 kilograms of uranium. Uranium and PCBs may be carried via storm water to Paddy's Run. In addition, airborne dust from the pile may have a radioactive component (Ref. 5, Sec. 4.5.2.2.2).

South Field

There are areas that may have been burial sites for radioactive, hazardous, and mixed wastes. One suspected area is known as the South Field, which is located directly north of the inactive flyash and disposal area. Radiological surveys indicate that the soil in this area contains elevated levels of radionuclides (Ref. 5, Sec. 4.5.2.3.4). The areas in the south field designated for sampling were chosen through utilization of the radiological survey results. The south field radiological survey is discussed in detail in Environmental Problem 15 (Sec. 4.15).

4.6.1 Sampling and Analysis Objectives

The flyash piles and south field area could contain contaminants that pose a present or potential environmental problem. To provide an indication of contaminant levels in these areas, soil and flyash samples were collected and analyzed for RCRA

TABLE 4.6.1 Environmental Problem 6: Sample Request Table

Sample Number	Location	Reference/ Page Number	Requester	Samples Proposed	Samples Collected
FE0100WP	New Flyash Pile	1/4, 11	Malloy, Daugherty	8	8
FE0101WP	New Flyash Pile				
FE0102WP	New Flyash Pile				
FE0103WP	New Flyash Pile				
FE0104WP	New Flyash Pile				
FE0105WP	New Flyash Pile				
FE0106WP	New Flyash Pile				
FE0107WP	New Flyash Pile				
FE0108SS	Old Flyash Pile	1/2, 11	Malloy, Daugherty	8	8
FE0109SS	Old Flyash Pile				
FE0110SS	Old Flyash Pile				
FE0111SS	Old Flyash Pile				
FE0112SS	Old Flyash Pile				
FE0113SS	Old Flyash Pile				
FE0114SS	Old Flyash Pile				
FE0115SS	Old Flyash Pile				
FE0601WP	New Flyash Pile	1/27, 47	Kelly, Riddle	1 boring	1 boring
FE0602WP	New Flyash Pile				
FE0603WP	New Flyash Pile				
FE0604WP	Old Flyash Pile	1/27, 47	Kelly, Riddle	2 borings	2 borings
FE0605WP	Old Flyash Pile				
FE0607WP	Old Flyash Pile				
FE0608WP	Old Flyash Pile				
FE0609WP	Old Flyash Pile				
FE1011IS	Test Pit #14	1/25	Kelly	12 (total)	15 (total)
FE1012IS	Test Pit #15				
FE1013IS	Test Pit #16				
FE1014IS	Test Pit #17				

000130
6540

metals, total uranium, volatile organics, and radionuclides. The samples from the flyash piles were also analyzed for asbestos and RCRA metals.

4.6.2 Sampling and Analytical Design and Implementation

Sampling Design

Samples of soil and flyash were collected from the new and old flyash piles and four areas in the south field. Table 4.6.2 presents the sample number, sampling location, type of soil sample and method of collection. Figures 4.6.1-4.6.3 show the sampling locations.

Analytical Design

All samples were analyzed to determine the concentration of RCRA metals, total uranium, volatile organics, and radionuclides by gamma spectroscopy present at or above analytical method detection limits. In addition, the boring samples from the flyash piles were analyzed for asbestos. The grab samples from the flyash piles were also analyzed for volatiles. For more information on analytical methods, see Appendix A.

Table 4.6.3 presents information recorded by the geologist during the trenching with the backhoe for excavation of the test pits. Field measurements for volatile organics with the HNu meter, sample collection depths, and soil descriptions are included.

For more information on analytical methods, see Appendix A.

4.6.3 Field and Analytical Data

Field Data

Field measurements for volatile organic compounds were taken with an HNu meter, and are presented in Table 4.6.3.

Analytical Data

The sites selected for sampling in the south field area exhibited elevated levels of total uranium and certain radionuclides in the soils. Data which exceed analytical method detection limits for total uranium, certain radionuclides, RCRA metals and some volatile organics are presented in Table 4.6.4.

TABLE 4.6.2 Environmental Problem 6: Soil Sampling Locations South of Production Area

Sample Number	Sample Location	Soil Sample Type	Method of Collection
FE0100WP	New flyash pile	Surface	Grab
FE0101WP	New flyash pile	Surface	Grab
FE0102WP	New flyash pile	Surface	Grab
FE0103WP	New flyash pile	Surface	Grab
FE0104WP	New flyash pile	Surface	Grab
FE0105WP	New flyash pile	Surface	Grab
FE0106WP	New flyash pile	Surface	Grab
FE0107WP	New flyash pile	Surface	Grab
FE0601WP	New flyash pile	Boring 0-5'	Composite from auger
FE0602WP	New flyash pile	Boring 5-11'	Composite from auger
FE0603WP	New flyash pile	Boring 11-13.5'	Composite from auger
FE0108SS	Old flyash pile	Surface	Grab
FE0109SS	Old flyash pile	Surface	Grab
FE0110SS	Old flyash pile	Surface	Grab
FE0111SS	Old flyash pile	Surface	Grab
FE0112SS	Old flyash pile	Surface	Grab
FE0113SS	Old flyash pile	Surface	Grab
FE0114SS	Old flyash pile	Surface	Grab
FE0115SS	Old flyash pile	Surface	Grab
FE0604WP	Old flyash pile	Boring 0-26"	Grab
FE0605WP	Old flyash pile	Boring 0-5'	Composite from auger
FE0607WP	Old flyash pile	Boring 5-10'	Composite from auger
FE0608WP	Old flyash pile	Boring 10-15'	Composite from auger
FE0609WP	Old flyash pile	Boring 15-20'	Composite from auger
FE1011IS	E2680/S4710 Test Pit 14	Backhoe trench (2.0' and 5.0')	Grab from backhoe bucket
FE1012IS	E2880/S4890 Test Pit 15	Backhoe trench (1.0, 4.0' and 10.0')	Grab from backhoe bucket
FE1013IS	E3300/S4800 Test Pit 16	Backhoe trench (1.0' and 3.0')	Grab from backhoe bucket
FE1014IS	E3240/S5510 Test Pit 17	Backhoe trench (2.0' and 4.0')	Grab from backhoe bucket

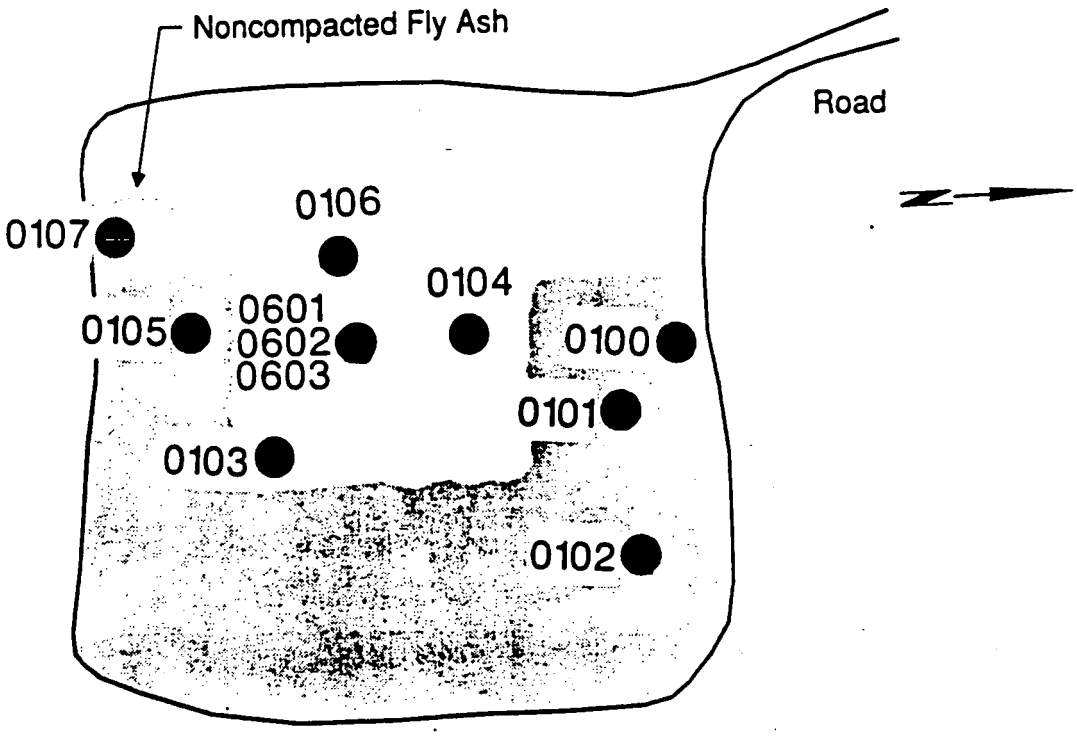

FIGURE 4.6.1 Sampling Locations - New Flyash Area

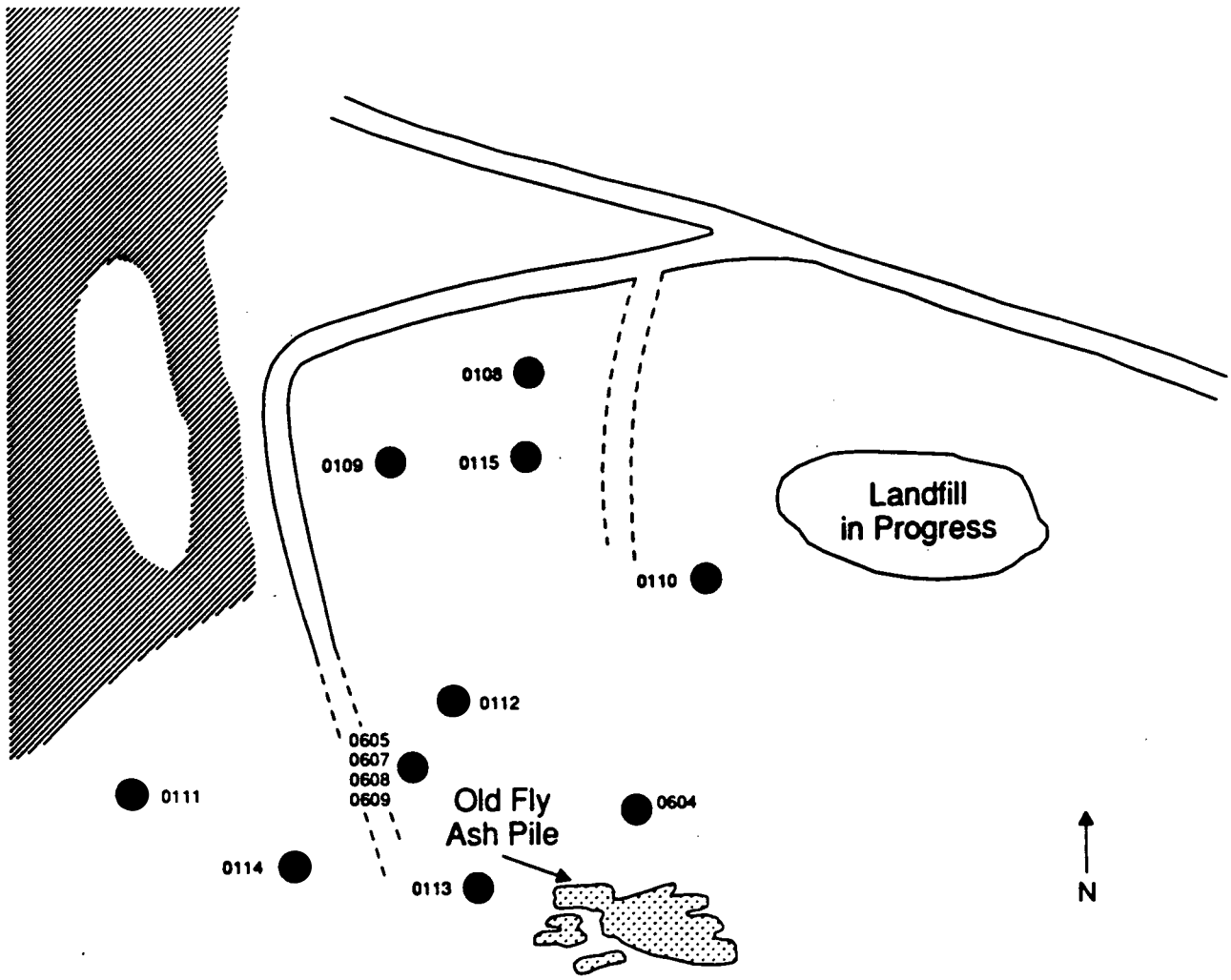

FIGURE 4.6.2 Soil Sampling Locations in the South Field Area

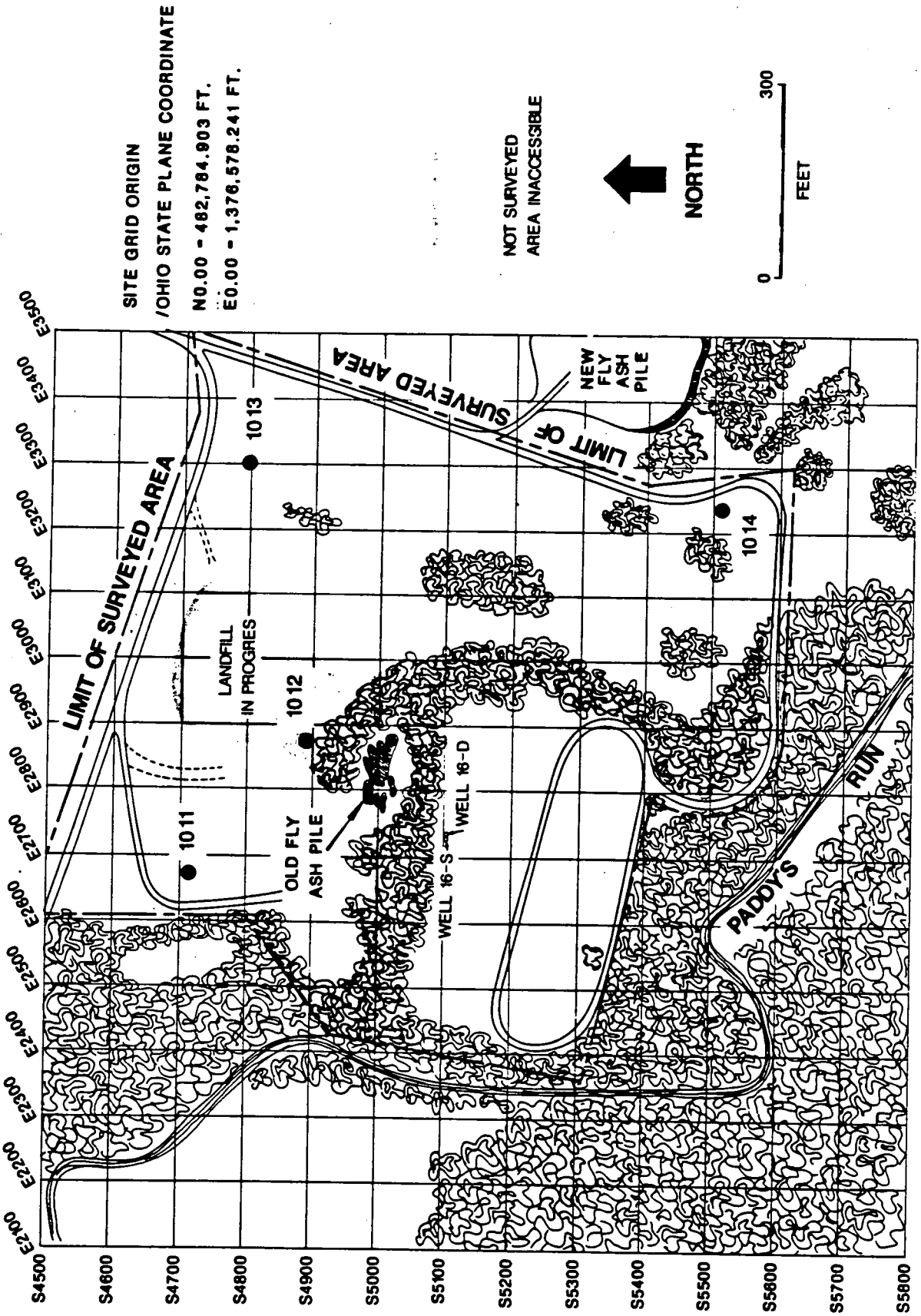

FIGURE 4.6.3 Locations of Test Pit (Backhoe Trench) Samples South of the Production Area

TABLE 4.6.3 Observational Data from the Backhoe Trenches in the Area South of the Production Area

Depth (feet)	Test Pit #14	Test Pit #15	Test Pit #16	Test Pit #17
0.0	fill, clay with misc. debris	fill, clay with construction debris	fill, clay with rubble	fill, clay with concrete and brick
1.0	HNu = 1.2 ppm	Sample 1 @ 1.0' HNu = N.D.	Sample 1 @ 1.0' HNu = N.D.	HNu = N.D.
2.0	Sample 1 @ 2.0' HNu = 1.0 ppm		HNu = N.D.	Sample 1 @ 2.0' HNu = N.D.
3.0	HNu = N.D.	HNu = N.D.	Sample 2 @ 3.0' HNu = N.D. clay	HNu = N.D.
4.0	HNu = 0.8 ppm	HNu = N.D.	Silty to sand clay HNu = N.D.	Sample 2 @ 4.5' HNu = N.D.
5.0	Sample 2 @ 5.0' HNu = N.D. clay, scattered black discolorations	Sample 2 @ 5.0' HNu = N.D.		
			Total depth = 5.2' Dry Background HNu = N.D.	Total depth - 5.2' Dry Background HNu = 0.2 ppm
6.0				
7.0				
8.0				
9.0	HNu = N.D. Total depth = 8.8'			
10.0	Dry Background HNu = 0.2 ppm	Sample 3 @ 10.0' Total depth = 10.5' Dry Background HNu = 0.4 ppm		

ND - Not detected.

TABLE 4.6.4 Environmental Problem 6: Analyte Concentrations which Exceed Minimum Detection Limits - Fly Ash Samples

			RCRA Metals:		Organics:					
Sample Number	Media	Location	Ba mg/L	Cr mg/L	1,1,1-Tri µg/kg	2-But µg/kg	Acet µg/kg	ChlF µg/kg	M Chl µg/kg	Tol µg/kg
FE0100WP2B	Fly Ash	New Fly Ash Pile	0.53 B		73		940 X		1100 X	34
FE0101WP2B	Fly Ash	New Fly Ash Pile	0.50 B				770 X		660 X	19
FE0102WP2B	Fly Ash	New Fly Ash Pile	0.55 B				580 X		480 X	
FE0103WP2B	Fly Ash	New Fly Ash Pile	0.78 B				280 X		350 X	
FE0104WP2B	Fly Ash	New Fly Ash Pile	0.25 B		190		170 X	7 B	260 X	89
FE0105WP2B	Fly Ash	New Fly Ash Pile	0.41 B				420 X	7 B	710 X	
FE0106WP2B	Fly Ash	New Fly Ash Pile	0.32 B				110 X		250 X	
FE0107WP2B	Fly Ash	New Fly Ash Pile	0.32 B			29	200 X	6 B	240 X	
FE0601WP1B	Fly Ash	New Fly Ash Pile	0.50		NS	NS	NS	NS	NS	NS
FE0602WP1B	Fly Ash	New Fly Ash Pile	0.34		NS	NS	NS	NS	NS	NS
FE0603WP1B	Fly Ash	New Fly Ash Pile	0.78	0.06	NS	NS	NS	NS	NS	NS
FE0604WP1B	Fly Ash	New Fly Ash Pile	0.61		NS	NS	NS	NS	NS	NS
FE0605WP1B	Fly Ash	New Fly Ash Pile	0.73		NS	NS	NS	NS	NS	NS
FE0607WP1B	Fly Ash	New Fly Ash Pile	0.37		NS	NS	NS	NS	NS	NS
FE0608WP1B	Fly Ash	New Fly Ash Pile	1.22		NS	NS	NS	NS	NS	NS
FE0609WP1B	Fly Ash	New Fly Ash Pile	1.15		NS	NS	NS	NS	NS	NS

Footnotes & Flags
Blank spaces indicate concentration below MDL.
B = analyte was found in the blank as well as the sample.
X = Flyash samples exhibited low internal standard recovery due to retention properties of matrix. Reported detection limits are for soil samples.
NS = sample not analyzed for indicated analyte

Key to Organics Abbreviations
1,1,1-Tri--1,1,1-Trichloroethane; 2-BUT--2-Butanone; Acet--Acetone; ChlF--Chloroform; M Chl--Methylene Chloride; Tol--Toluene

TABLE 4.6.4 (Cont.) Environmental Problem 6: Analyte Concentrations which Exceed Minimum Detection Limits - Fly Ash Samples

Sample Numbers	Media	Location	Radionuclides: Bi-214 pCi/g	Ra-226 pCi/g	Th-228 pCi/g	Th-232 pCi/g	Total U pCi/g
FE0100WP2B	Fly Ash	New Fly Ash Pile	3.9	3.8	2.7	2.7	9.1
FE0101WP2B	Fly Ash	New Fly Ash Pile	2.5	3.2	2.5	2.1	9.6
FE0102WP2B	Fly Ash	New Fly Ash Pile	4.0	2.9	2.5	1.0	10.0
FE0103WP2B	Fly Ash	New Fly Ash Pile	3.3	3.0	2.2	2.0	9.2
FE0104WP2B	Fly Ash	New Fly Ash Pile	2.7	3.1	2.9	2.2	9.7
FE0105WP2B	Fly Ash	New Fly Ash Pile	3.0	2.8	2.9	2.2	8.8
FE0106WP2B	Fly Ash	New Fly Ash Pile	3.1	2.7	2.7	2.9	13.0
FE0107WP2B	Fly Ash	New Fly Ash Pile	3.3	3.2	2.9	2.7	8.9
FE0601WP1B	Fly Ash	New Fly Ash Pile	3.1	2.5	2.9	2.8	17.0
FE0602WP1B	Fly Ash	New Fly Ash Pile	3.5	3.3	2.8	2.7	15.0
FE0603WP1B	Fly Ash	New Fly Ash Pile	2.4	2.3	1.1	1.4	5.5
FE0604WP1B	Fly Ash	New Fly Ash Pile	1.4	1.2	1.2	0.9	17.0
FE0605WP1B	Fly Ash	New Fly Ash Pile	1.9	1.7	2.2	2.2	12.0
FE0607WP1B	Fly Ash	New Fly Ash Pile	2.4	2.4	2.4	2.4	9.4
FE0608WP1B	Fly Ash	New Fly Ash Pile	2.1	1.8	2.2	2.1	8.4
FE0609WP1B	Fly Ash	New Fly Ash Pile	1.6	1.5	2.2	2.2	10.0

TABLE 4.6.4 (Cont.) Environmental Problem 6: Analyte Concentrations which Exceed Minimum Detection Limits - Soil Samples

Sample Number	Media	Location	RCRA Metals: Ba mg/L	Cr mg/L	Organics: 2-But mg/kg	Acet mg/kg	ChlF mg/kg	M Chl mg/kg	Tol mg/kg	1,1,1-Tri µg/kg	1,1-DiCl µg/kg
FE0108SS3B	Fly Ash	Old Fly Ash Area	0.58 B			7 B		32	7 B		
FE0109SS3B	Fly Ash	Old Fly Ash Area	0.42 B					18 B			
FE0110SS3B	Fly Ash	Old Fly Ash Area	0.49 B		35	180 Q	10	280 Q	26		
FE0111SS3B	Fly Ash	Old Fly Ash Area	0.46 B		11 B	100 Q		100 Q	20		
FE0112SS3B	Fly Ash	Old Fly Ash Area	0.45 B		10 B	120 Q		84 Q	13 B		
FE0113SS3B	Fly Ash	Old Fly Ash Area	0.55 B			24 B		42	10 B		
FE0114SS3B	Fly Ash	Old Fly Ash Area	0.47 B		10 B	21 B		30 B	6 B		
FE0115SS3B	Fly Ash	Old Fly Ash Area	0.55 B			16 B		51			
FE0601WP3B	Fly Ash	New Fly Ash Area				63		160		140	
FE0602WP3B	Fly Ash	New Fly Ash Area				140		200		420	
FE0603WP3B	Fly Ash	New Fly Ash Area			67	37 B	11				
FE0604WP3B	Fly Ash	Old Fly Ash Area				24 B		110			
FE0605WP3B	Fly Ash	Old Fly Ash Area						52	50		
FE0607WP3B	Fly Ash	Old Fly Ash Area				50 B		21 B			
FE0608WP3B	Fly Ash	Old Fly Ash Area						28 B		100	
FE0609WP3B	Fly Ash	Old Fly Ash Area						27	34	84	
FE1011IS1B	Soil	Test Pit 14 @ 2 ft	0.53 B		NS	NS	NS	NS	NS		
FE1011IS2B	Soil	Test Pit 14 @ 5 ft	0.60 B		NS	NS	NS	NS	NS		
FE1012IS1B	Soil	Test Pit 15 @ 1 ft	0.25 B		NS	NS	NS	NS	NS		
FE1012IS2B	Soil	Test Pit 15 @ 5 ft	0.65 B		NS	NS	NS	NS	NS		
FE1012IS3B	Soil	Test Pit 15 @ 10 ft				22 B	6 B	12			
FE1013IS1B	Soil	Test Pit 16 @ 1 ft	0.70 B	0.05	NS	NS	NS	NS	NS		
FE1013IS2B	Soil	Test Pit 16 @ 3 ft	0.43 B		22	NS	NS	NS	NS		
FE1014IS1B	Soil	Test Pit 17 @ 2 ft	0.54 B		NS	NS	NS	NS	NS		
FE1014IS2B	Soil	Test Pit 17 @ 4.5 ft	0.49 B		NS	NS	NS	NS	NS		

Footnotes & Flags
B = analyte was found in the blank as well as the sample.
Q = data of questionable value. Possible laboratory contamination.
NS = sample not analyzed for indicated analyte.
Blank spaces indicate concentration below MDL.

Key to Organics Abbreviations
2-BUT--2-Butanone; Acet--Acetone; ChlF--Chloroform;
M Chl--Methylene Chloride; Tol--Toluene;
1,1,1-Tri--Trichloroethane; 1,1-DiCl-- 1,1-Dichloroethane;

TABLE 4.6.4 (Cont.) Environmental Problem 6: Analyte Concentrations which Exceed Minimum Detection Limits - Soil Samples

Sample Number	Media	Location	Radionuclides: U-235 pCi/g	U-238 pCi/g	Bi-214 pCi/g	Cs-137 pCi/g	Ra-226 pCi/g	Th-228 pCi/g	Th-232 pCi/g	Total U mg/kg
FE0108SS3B	Soil	Old Fly Ash Area		53.0	1.20	0.74	1.20	1.5	1.3	8.8
FE0109SS3B	Soil	Old Fly Ash Area		37.0	1.20	0.74	1.20	1.5	1.3	57.0
FE0110SS3B	Soil	Old Fly Ash Area			3.00		3.00	2.6	2.7	7.4
FE0111SS3B	Soil	Old Fly Ash Area	0.16		1.20	0.07	1.20	1.0	1.1	4.8
FE0112SS3B	Soil	Old Fly Ash Area	0.30	7.9	0.87	0.08	0.87	0.9	0.8	16.0
FE0113SS3B	Soil	Old Fly Ash Area			1.00	0.44	0.89	1.2	1.0	9.7
FE0114SS3B	Soil	Old Fly Ash Area			1.00		1.00	1.0	1.0	4.5
FE0115SS3B	Soil	Old Fly Ash Area	0.79	29.0	0.92	0.24	0.85	1.1	1.1	58.0
FE1011IS1B	Soil	Test Pit 14 @ 2 ft	0.83	46.0	3.20		3.60	1.1	1.2	71.0
FE1011IS2B	Soil	Test Pit 14 @ 5 ft	0.14		1.00		0.94	1.0	1.4	2.1
FE1012IS1B	Soil	Test Pit 15 @ 1 ft	0.16		1.10		1.10	1.6	1.5	15.0
FE1012IS2B	Soil	Test Pit 15 @ 5 ft	0.30	20.0	1.20		1.30	2.4	2.5	56.0
FE1013IS1B	Soil	Test Pit 16 @ 1 ft	0.63	49.0	1.10		1.10	1.2	0.8	85.0
FE1013IS2B	Soil	Test Pit 16 @ 3 ft	0.07		1.40		1.40	1.4	1.3	2.9
FE1014IS1B	Soil	Test Pit 17 @ 2 ft	0.19	12.0	1.70		1.70	1.1	1.3	14.0
FE1014IS2B	Soil	Test Pit 17 @ 4.5 ft	0.15	9.0	1.50		1.40	0.9	0.9	12.0

Footnotes
Blank spaces indicate concentration below MDL.

Elevated concentrations of total uranium were encountered in both flyash piles and the South field area; with the highest value being 85 mg/kg collected from a backhoe trench in the South Field. The radionuclide with the most notable activity was U-238. Samples from all designated sampling locations exhibited activity, with a sample from the old flyash pile exhibiting the highest value of 53 pCi/g.

Significant data for volatile organic compounds were obtained for flyash samples from the old and new flyash pile. These data include: 280 μg/kg methylene chloride; 420 μg/kg 1,1,1-trichloroethane; and 180 μg/kg acetone.

The samples collected from the old and new flyash piles that were analyzed for asbestos, showed no detectable levels of the material.

For a complete presentation of the analytical data see Appendix E.

4.6.4 Data Quality Evaluation

Sampling Design - The number and location of sampling points were selected according to the Plan, but do not provide fully representative information for this Problem. Data utility level 3.

Sample Collection - EPA-approved sample containers were used. Appropriate field measurements were taken. Field logbooks do not contain necessary supporting information to judge whether there were deviations from standard sampling protocols. Logbooks are signed and dated. Data utility level 3.

Sample Analysis - Sample handling was appropriate for the media and analysis performed. Instruments and procedures used meet established standards. Laboratory notebooks contain sufficient information and are signed and dated. Data utility level 2.

QA/QC and Documentation - The S&A Plan contained a QA plan covering all aspects of the sampling and analysis program. No field QC samples were collected for this Problem. Adequate laboratory QC analyses were performed. Records were maintained regarding laboratory instrument calibration and maintenance. Data are reported in appropriate units accompanied by estimates of uncertainty. Supporting information is available. Data utility level 2.

4.7 ENVIRONMENTAL PROBLEM 7: ON-SITE SURFACE WATER CONTAMINATION

Requesters: Kelly, Riddle

Details are provided in Table 4.7.1.

Finding and Basis

Paddy's Run

The airborne uranium released from FMPC has been deposited to both on-site and off-site soils. These soils can serve as a source of stream sediment contamination as a result of overland wash, stream convection, settling and resuspension mechanisms (Ref. 5, Sec. 3.2.2).

Natural surface-water bodies in the area of the FMPC are Paddy's Run and the Great Miami River. As shown in Fig. 4.7.1, Paddy's Run flows in a southerly direction just inside the western boundary of the FMPC. The intermittent nature of Paddy's Run restricts its use for many purposes (Ref. 5, Sec. 3.3.1).

Average surface-water radionuclide activities and inorganic ion concentrations for Paddy's Run upstream of FMPC, are as follows:

Analyte	
Gross Alpha	2.77 pCi/l
Gross Beta	5.85 pCi/l
Total Uranium	1.60 pCi/l
Fluoride	0.25 mg/l
Nitrate (as N)	1.68 mg/l
Chloride	34.2 mg/l

The normal surface-water flow from the site is directed to Paddy's Run. The storm sewer outfall ditch originates in the northeast corner of the site and flows south to Paddy's Run. This ditch picks up stormwater flow from the east side of the site, outside the fence, as well as excess storm water from the fenced portion of the plant that is released through Outfall 002. (Ref. 5, Sec. 3.3.2.4)

Uranium is entering Paddy's Run through uncontrolled stormwater ditches originating on the plant site. The fact that contaminated storm water in these ditches is not controlled or treated may contribute to off-site release of uranium.

TABLE 4.7.1 Environmental Problem 7: Sample Request Table

Sample Number	Location	Ref./ Page No.	Requester	Samples Proposed	Samples Collected
FE0119SS	Pit 5 ditch upstream landfill	1/30	Kelly	3	3
FE0120SS	Pit 5 ditch upstream Pit 5				
FE0121SS	Pit 5 ditch upstream discharge to PR[a]				
FE0402SE	PR Spring/Seeps	1/45	Riddle	3	1
FE0404SE	SSOD[b] downstream flyash	1/28	Kelly	4	4
FE0405SE	SSOD upstream flyash				
FE0406SW	SSOD below dam				
FE0407SW	SSOD above dam				
FE0401SE	PR downstream Clear-well	1/29	Kelly	6	6
FE0408SE	PR upstream SSOD				
FE0409SE	PR downstream SSOD				
FE0410SE	PR with site boundary				
FE0411SE	PR downstream Pit 5 ditch				
FE0413SE	PR downstream recharge area				
FE0412SE	Seep/spring K-65 ditch	1/45	Riddle	2	1
FE0722OT	PR north site boundary	1/29	Kelly	3	3
FE0723OT	PR upstream SSOD				
FE072407	PR downstream recharge area				

[a]PR = Paddy's Run.

[b]SSOD = Storm Sewer Outfall Ditch.

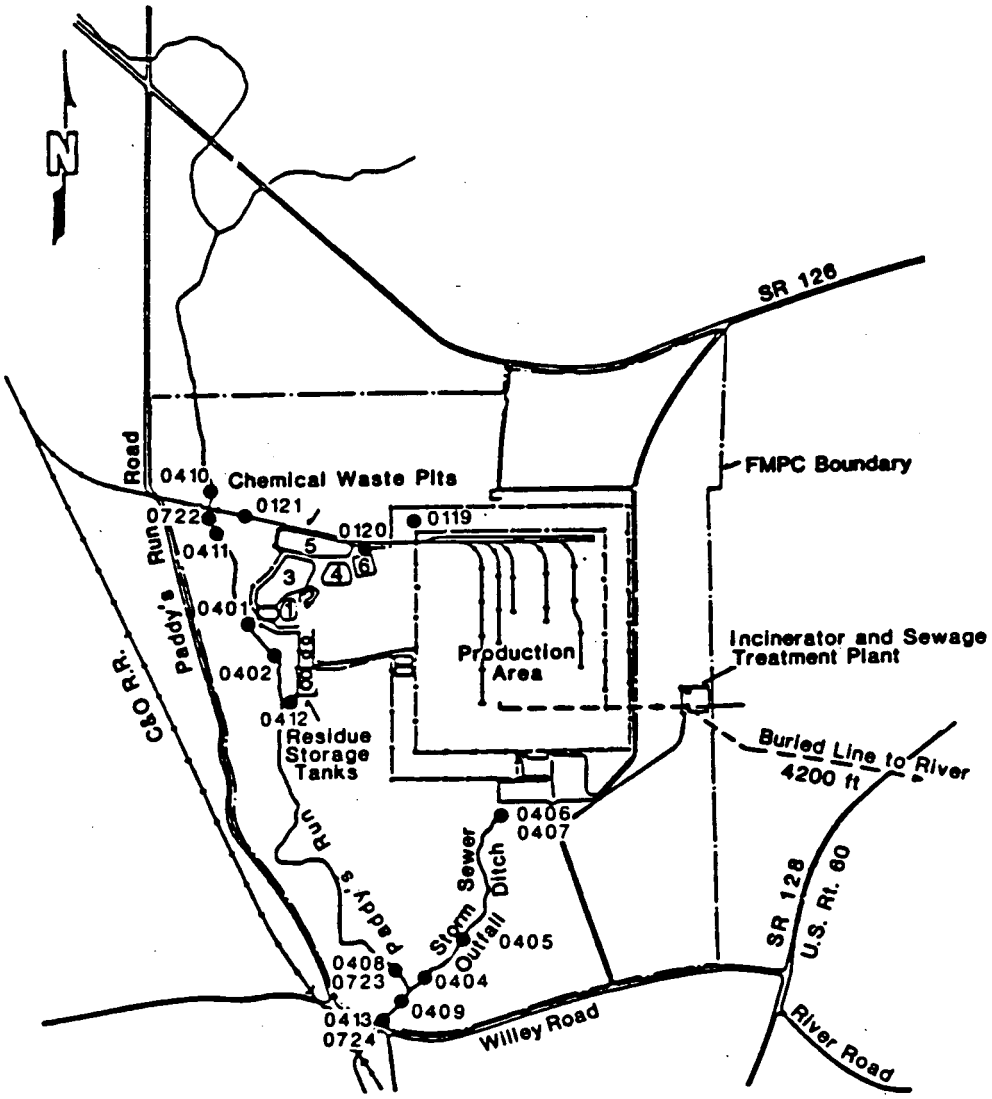

FIGURE 4.7.1 Locations for Collection of On-Site Surface Water Samples

Sampling along Paddy's Run, instituted in late 1985, indicates that several ditches on the west side of FMPC are sources of uranium entering this stream. The average total uranium concentration in the surface water samples taken during 1985 ranged from 9.8 to 661 pCi/L on site and 1.6 to 7.2 pCi/L off-site. The ditches from the plant site that discharge into Paddy's Run are described in the following paragraphs.

Storm Sewer Outfall Ditch (SSOD)

Stormwater runoff and spills outside the buildings within the fenced area are collected by the storm sewer system. Normal flow in the storm sewer is collected at a lift station and pumped to Manhole 175 for discharge into the Great Miami River. The lift station discharge is monitored as Outfall 001D. During storm events when the flow exceeds the capacity of the lift station, the excess storm water overflows through Outfall 002 to the stormwater ditch that flows into Paddy's Run south of the plant (Ref. 5, Sec. 3.3.2.4).

4.7.1 Sampling and Analysis Objectives

Surface water and sediment samples were collected from Paddy's Run and the storm sewer outfall ditch and analyzed for RCRA metals, volatile organics, uranium, and radionuclides.

4.7.2 Sampling and Analytical Design and Implementation

Sampling Design

Soil and Sediment

Composite soil samples were taken at three locations in the Pit 5 ditch adjacent to Waste Pit #5. The sampling locations are shown in Fig. 4.7.1. At each location a 1 square meter composite of the surface soil was collected. A stainless steel scoop was used to fill the designated sample containers.

Samples collected from Paddy's Run and the storm sewer outfall ditch used a stainless steel scoop. The top sediment fines were collected as the sample. The coarse lower sand was assumed to be part of the stream bed and was not used. Several locations were chosen that appeared to be likely locations for the maximum settling of sediments such as behind rocks or logs.

There were shallow streams of running water at the north site boundary and occasional standing water elsewhere in Paddy's Run when the sediment samples were collected on Sept. 18, 22, and 23, 1986. During the sediment sampling it was noted that an extended section had been backfilled and the stream bed was bulldozed. Therefore, no samples were taken in this section.

The sample to check seeps/springs near the K-65 tank was taken from a gully up hill from Paddy's Run to prevent erroneous results from the backfill.

Water

Some water samples from the storm sewer outfall ditch (SSOD) were collected by either dipping the sample bottle into the water or allowing the water from the SSOD dam to run into the bottle.

Other water samples were collected with a precleaned stainless steel beaker. The water was poured from the beaker to the appropriate bottles.

Analytical Design

All samples were analyzed for total uranium by uranium fluorometry and other radionuclides were determined by gamma ray spectrometry. Samples were also analyzed for RCRA metals and volatile organics. The samples from Paddy's Run and the K-65 ditch were analyzed for plutonium isotopes and thorium isotopes by chemical separation followed by alpha spectrometry. The water from Paddy's Run was analyzed for semi-volatile organic compounds. Three sediment samples, one from the storm sewer outfall ditch, one from Paddy's Run and the other from the K-65 ditch were analyzed for uranium isotopes by mass spectrometry.

For more information on analytical methods, see Appendix A.

4.7.3 Field and Analytical Data

Field Data

Field measurements were taken for pH, temperature and radioactivity. The data are presented in Table 4.7.2. Radiological measurements for Paddy's Run include two readings above background: 200 μR/hour and 450 μR/hour.

Analytical Data

Analytical data which exceed analytical method detection limits are presented in Table 4.7.3. Data for uranium weight and atom percent are presented in Table 4.7.4.

The sediment sample from the ditch south of the K-65 tanks that empties into Paddy's Run had a concentration of total uranium of 176 mg/kg, as well as the highest activities of Bi-214, Ra-226, Th-228, Th-232, U-235, which were all less than or equal to 2 pCi/g. This sample also had a value of 54 pCi/g for U-238 and 2.8 pCi/g for Np-237.

TABLE 4.7.2 Environmental Problem 7: Field Measurements of Sediment and Surface Water Samples

Sample Number	Radioactivity µR/h	pH	Temperature
FE0119SS	-	-	75°F
FE0120SS	-	-	75°F
FE0401SE	200	-	-
FE0402SE	450	-	-
FE0410SE	Bkgd[a]	-	-
FE0411SE	Bkgd	-	-
FE0412SE	Bkgd	-	-
FE0413SE	Bkgd	-	-
FE0722OT	-	6.0	21.5°C
FE0723OT	-	5.0	21.8°C
FE0724OT	-	5.5	23.0°C

[a]Background levels.

The sediment sample from Paddy's Run downstream from the Pit 5 ditch had a concentration of 14 pCi/g for Th-230.

For a complete presentation of the analytical data, see Appendix E.

The weight and atom percent values for uranium given in Table 4.7.4 indicate depleted uranium.

4.7.4 Data Quality Evaluation

Sampling Design - The number and location of sampling points were selected according to the Plan and provide representative information for this Problem. Data utility level 2.

Sample Collection - EPA-approved sample containers were used. Appropriate field measurements were not always taken. Field logbooks indicate that deviations from standard sampling protocols were minor. Logbooks are signed and dated. Data utility level 2.

Sample Analysis - Sample handling was appropriate for the media and analysis performed. Instruments and procedures used meet established standards. Laboratory notebooks contain sufficient information and are signed and dated. Data utility level 2.

TABLE 4.7.3 Environmental Problem 7: Analyte Concentration Exceeding Minimum Detection Limits - Sediment Samples

			Organics:			Radionuclides:						
Sample Number	Media	Location	Acet mg/kg	2-But µg/kg	Met Ch µg/kg	Bi-214 pCi/g	Cs-137 pCi/g	U-235 pCi/g	U-238 pCi/g	Np-237 pCi/g	Pu-238 pCi/g	Pu-239+240 pCi/g
FE0401SE2B	Sediment	Paddy's Run	120 Q		52	0.58				2.30	1.3	0.3
FE0402SE2B	Sediment	Paddy's Run	27 B		9 B	1.10				0.90	0.8	0.1
FE0404SE2B	Sediment	S.S. Runoff Ditch	55 B		32 B	0.41		0.26	12.0	0.14		
FE0405SE2B	Sediment	S.S. Runoff Ditch	230 Q		55	0.59				NS	NS	NS
FE0408SE2B	Sediment	Paddy's Run	14 B	10 B	30 B	0.48				0.90	1.6	0.3
FE0409SE2B	Sediment	Paddy's Run	12		21 B	0.47			18.0	0.70	1.5	0.3
FE0410SE2B	Sediment	Paddy's Run	27		10 B	0.71				0.30	1.9	0.3
FE0411SE2B	Sediment	Paddy's Run			13 B	0.81	0.04			2.40	1.5	0.3
FE0412SE2B	Sediment	K-65 Ditch	52		12 B	1.60	0.14	1.30	54.0	2.80	1.1	0.2
FE0413SE1B	Sediment	Paddy's Run	36		14 B	0.51			41.0	2.20	1.4	0.4

Footnotes & Flags
Blank space indicates sample concentration below MDL.
B = analyte was found in blank as well as sample.
NS = sample not analyzed for indicated analyte.atory contamination.
Q = Data of questionable value. Possible laboratory contamination.
Acet--Acetone: M Chl--Methylene Chloride; 2-But-- 2-Butanone

TABLE 4.7.3 (Cont.) Environmental Problem 7: Analyte Concentration Exceeding Minimum Detection Limits - Sediment Samples

			Radionuclides (Cont.):									RCRA Metals:
			Ra-226 pCi/g	Ra-228 pCi/g	Th-227 pCi/g	Th-228 pCi/g (G)	Th-228 Ci/g (A)	Th-230 pCi/g	Th-232 pCi/g (G)	Th-232 pCi/g (A)	Total U mg/kg	Ba mg/L
FE0401SE2B	Sediment	Paddy's Run	0.68		0.20	0.73	0.30	0.20	0.55	0.20	10.0	0.37 B
FE0401SE4B	Sediment	Paddy's Run	0.82 ± 0.03 K	0.51 ± 0.03 K								
FE0402SE2B	Sediment	Paddy's Run	1.30		0.20	1.20	0.40	1.40	1.10	0.20	12.0	0.77
FE0402SE4B	Sediment	Paddy's Run	1.27 ± 0.05 K	0.95 ± 0.05 K								
FE0404SE2B	Sediment	S.S. Runoff Ditch	0.49		NS 0.51		NS	0.45		24.0	0.28	
FE0404SE3B	Sediment	S.S. Runoff Ditch	0.75 ± 0.04 K	0.57 ±0.04 K								
FE0405SE2B	Sediment	S.S. Runoff Ditch	0.43		NS 0.49		NS	0.57		22.0	0.43	
FE0408SE2B	Sediment	Paddy's Run	0.58		0.20	0.61	0.10	0.40		0.10	6.3	0.31
FE0408SE4B	Sediment	Paddy's Run	0.61 ±0.03 K	0.35 ±0.03 K								
FE0409SE2B	Sediment	Paddy's Run	0.59		2.70	0.32	0.40	0.50	0.20	10.0	0.23	
FE0409SE4B	Sediment	Paddy's Run	0.59 ± 0.03 K	0.43 ± 0.03 K								
FE0410SE2B	Sediment	Paddy's Run	0.58		0.20	0.73	0.30	1.20	0.64	0.30	1.4	1.68
FE0410SE3B	Sediment	Paddy's Run	0.82 ± 0.04 K	0.73 ± 0.04 K								
FE0411SE2B	Sediment	Paddy's Run	0.53		0.60	0.57	0.80	14.00	0.80	0.49	2.0	1.62
FE0411SE4B	Sediment	Paddy's Run	0.66 ± 0.04 K	0.46 ± 0.04 K								
FE0412SE2B	Sediment	K-65 Ditch	1.30		0.50	2.00	1.10	6.20	1.90	1.00	176.0	1.02
FE0412SE4B	Sediment	K-65 Ditch	0.69 ± 0.05 K	0.36 ± 0.17 K								
FE0413SE1B	Sediment	Paddy's Run	0.64		1.30	0.60	0.60	8.30	0.54	0.50	38.0	0.39

Footnotes & Flags

Blank space indicates sample concentration below MDL.
B = analyte was found in blank as well as sample.
K= Samples canned for gamma-counting; data processed by least squares analysis program.
NS = sample not analyzed for indicated analyte.atory contamination.
Q = Data of questionable value. Possible laboratory contamination.
(A) = Alpha spectroscopy
(G) = Gamma spctroscopy

TABLE 4.7.3 (Cont.) Environmental Problem 7: Analyte Concentrations Exceeding Minimum Detection Limits - Soil and Water Samples

Sample Number	Media	Location	RCRA Metals: Ba mg/L	Organics: Acet mg/kg	Organics: Met Ch µg/kg	Organics: Tol µg/kg	Radionuclides: Bi-214 pCi/g	Radionuclides: Cs-137 pCi/g	Radionuclides: Ra-226 pCi/g	Radionuclides: Th-228 pCi/g	Radionuclides: Th-232 pCi/g
FE0119SS1B	Soil	Pit 5 Ditch	0.51		120	5 B	0.77	0.20	0.63	1.00	0.89
FE0120SS1B	Soil	Pit 5 Ditch	0.29	20	20 B	2 B	0.70	0.57	0.68	0.60	0.72
FE0121SS1B	Soil	Pit 5 Ditch	0.45		130	6 B	1.30	0.13	1.10	0.64	0.82

			Radionuclides (Cont.): Total U pCi/g	U-235 pCi/g	U-238 pCi/g
FE0119SS1B	Soil	Pit 5 Ditch	16.0		
FE0120SS1B	Soil	Pit 5 Ditch	89.0	0.36	25
FE0121SS1B	Soil	Pit 5 Ditch	4.1		

			RCRA Metals: Ba mg/L	Organics: Acet µg/L	Organics: Met Ch µg/L	Radionuclides: Np-237 pCi/L	Radionuclides: Th-227 pCi/L	Radionuclides: Total U µg/L
FE0406SW1C	Water	SS Outfall	0.08	14 B		NS	NS	67.0
FE0407SW1C	Water	SS Outfall	0.18	13 B		NS	NS	12.0
FE0722OT8C	Water	Paddy's Run	0.08		9 B			6.9
FE0723OT8C	Water	Paddy's Run	0.07		7 B		0.44	25.0
FE0724OT8C	Water	Paddy's Run	0.06			0.04		27.0

Footnotes & flags
B = analyte was found in blank as well as sample.
NS = sample not analyzed for indicated analyte.
Blank space indicates sample concentration below MDL.

Key to Organics Abbreviations
Acet--Acetone; M Chl--Methylene Chloride; Tol--Toluene

TABLE 4.7.4 Environmental Problem 7: Uranium Atom and Weight Percentages

Sample Number	Media	Location	Radionuclides: U-234 Atom %	U-234 Weight %	U-235 Atom %	U-235 Weight %
FE0404SE2B	Sediment	S.S. Runoff Ditch	0.006 ± 0.003	0.006 ± 0.003	0.599 ± 0.001	0.591 ± 0.001
FE0412SE2B	Sediment	K-65 Ditch	0.005 ± 0.003	0.005 ± 0.003	0.753 ± 0.001	0.744 ± 0.001
FE0413SE2B	Sediment	Paddy's Run	< 0.005	< 0.005	0.496 ± 0.005	0.490 ± 0.003

			Radionuclides (Cont.): U-236 Atom %	U-236 Weight %	U-238 Atom %	U-238 Weight %
FE0404SE2B	Sediment	S.S. Runoff Ditch	0.012 ± 0.003	0.012 ± 0.003	99.383 ± 0.008	99.391 ± 0.008
FE0412SE2B	Sediment	K-65 Ditch	< 0.004	< 0.004	99.241 ± 0.008	99.251 ± 0.008
FE0413SE2B	Sediment	Paddy's Run	0.013 ± 0.006	0.013 ± 0.006	99.49 ± 0.002	99.497 ± 0.002

QA/QC and Documentation - The S&A Plan contained a QA plan covering all aspects of the sampling and analysis program. No field QC samples were collected for this Problem. Adequate laboratory QC analyses were performed. Records were maintained regarding laboratory instrument calibration and maintenance. Data are reported in appropriate units accompanied by estimates of uncertainty. Supporting information is available. Data utility level 2.

4.8 ENVIRONMENTAL PROBLEM 8: OFF-SITE SURFACE WATER CONTAMINATION

Requester: Riddle and Grundler

Details are provided in Table 4.8.1.

Finding and Basis

Natural surface-water bodies in the area of the FMPC are Paddy's Run and the Great Miami River. The Great Miami River flows in a southerly direction east of FMPC and intersects with Paddy's Run approximately 3 kilometers south of the site. The Great Miami River joins the Ohio River farther downstream. The Great Miami River is not extensively used for recreational purposes, because of industrial and municipal wastes introduced from upstream communities such as Dayton, Middletown, and Hamilton. There are no known potable water users of the river downstream from FMPC.

The U.S. Geological Survey (USGS) has operated a sampling station on the Great Miami River at New Baltimore, Ohio, since 1966. Data obtained from USGS (1980) for the Water Year 1979 (October 1978 through September 1979) are presented in Table 4.8.2.

In addition to the total organic carbon data, the USGS analyzed for pesticides in both the water and bottom material at the New Baltimore location. One sample of the bottom material contained 0.6 mg/L of dieldrin. No other pesticides were detected in these samples. Background analytical data on other organic compounds were not obtained.

Average surface-water radionuclide activities and inorganic ion concentrations for the Great Miami River upstream of FMPC, provided in Reference 5, are as follows:

Analyte	
Gross Alpha	2.24 pCi/L
Gross Beta	4.91 pCi/L
Technetium-99	1.08 pCi/L
Uranium-234	3.72 pCi/L[a]
Uranium-235	0.16 pCi/L[a]
Uranium-238	3.72 pCi/L[a]
Total Uranium	1.57 pCi/L[a]
Fluoride	0.49 mg/L
Nitrate (as N)	3.57 mg/L
Chloride	60.1 mg/L

[a]Isotope concentration is the average of 2 samples, while total uranium is the average of 52 samples.

TABLE 4.8.1 Environmental Problem 8: Sample Request Table

Sample Number	Location	Media	Reference/Page Number	Requester	Samples[a] Proposed	Samples[a] Collected
FE0415SW	GMR[b] at Rt. 26[c]	Water				
FE0416SW	GMR New Baltimore	Water				
FE0417SE	GMR New Baltimore	Sediment	3/18	Grundler	10	8
FE0418SE	GMR upstream PR[d]	Sediment				
FE0419SW	GMR upstream PR	Water				
FE0420SW	GMR downstream PR	Water				
FE0421SE	GMR downstream PR	Sediment				
FE0728SE	GMR North of pumping station	Sediment				
FE0422OT	Gravel pits	Water	1/4	Riddle	3	1

[a]The requests specified number of discrete sampling locations, not samples.

[b]Great Miami River.

[c]No suitable sediment was available in the area where the water sample was collected.

[d]Paddy's Run.

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TABLE 4.8.2 USGS Data for Water Year 1979, Great Miami River at New Baltimore, Ohio

	Maximum	Minimum
Flow, CFS	37,000	575
Conductivity, µmhos	1,030	261
pH, SU	9.1	7.3
Temp, °C	30.0	0.0
D.O., mg/L	18.9	3.6
Turbidity, NTU	85	3
Fecal Coliform, cols/100 ml	22,000	480
Calcium, mg/L	110	53
Magnesium, mg/L	38	19
Sodium, mg/L	56	10
Alkalinity, mg/L as $CaCo_3$	240	140
Total organic carbon, mg/L	17	3
Sulfate, mg/L	120	36
Chloride, mg/L	90	22
Fluoride, mg/L	0.8	0.2
Solids, dissolved mg/L	599	297
Sediments, suspended mg/L	808	8
Barium, (total) µg/L	100	100
Chromium (total) µg/L	30	10
Copper (total) µg/L	29	8
Iron, (total) µg/L	9,000	1,000
Lead, (total) µg/L	66	41
Manganese, µg/L	160	60
Mercury, (total) µg/L	<0.5	<0.5
Zinc (total), µg/L	80	60

Source: USGS, 1980.

Upstream sediment samples from the Great Miami River have an average total uranium activity of 1.1 pCi/g (dry weight), and the total uranium activity of fish samples collected upstream of FMPC on the Great Miami River averaged 0.086 pCi/g (ash weight) in 1985 (Ref. 5, Sec. 3.3.1). The FMPC site is at a sufficiently high elevation that flooding of neither Paddy's Run nor the Great Miami River would have an impact.

4.8.1 Sampling and Analysis Objectives

Surface water and sediment samples were collected and analyzed to provide information on contaminants not presently being evaluated. These analyses included radionuclides, RCRA-metals, volatile organics, total uranium and uranium isotopes.

4.8.2 Sampling and Analytical Design and Implementation

Sampling Design

Sediment

The sampling locations are shown in Fig. 4.8.1. Sediment samples were collected using a stainless steel scoop. The top sediment fines were collected as the sample. The coarse lower sand was assumed to be part of the stream bed and was not used. Several locations were chosen that appeared to be likely for maximum settling of sediments, such as behind rocks or logs.

Water

The water samples from the Great Miami River were collected by immersing the sample bottle into the water. When sediment samples were collected from the same location, the water sample was collected first. On the south and east side of the Great Miami River, an area upstream of New Baltimore was undergoing what appeared to be back filling and leveling. During the sampling on September 24, 1986, there were periods of drizzle between heavy rainfall. The water had a heavy load of suspended sediment.

Analytical Design

Water and sediment samples from the Great Miami River were analyzed to determine the concentration of total uranium, RCRA metals, volatile organics, radionuclides by gamma spectroscopy, and plutonium and thorium by alpha spectroscopy present at or above analytical method detection limits. For more information on analytical methods, see Appendix A.

4.8.3 Field and Analytical Data

Field Data

Field measurements for radioactivity, pH, temperature, and specific conductivity were taken. The data is presented in Table 4.8.3.

Analytical Data

Analytical data which exceed analytical method detection limits for the surface water and sediments collected from the Great Miami River and the gravel pits adjacent to the site are presented in Table 4.8.4.

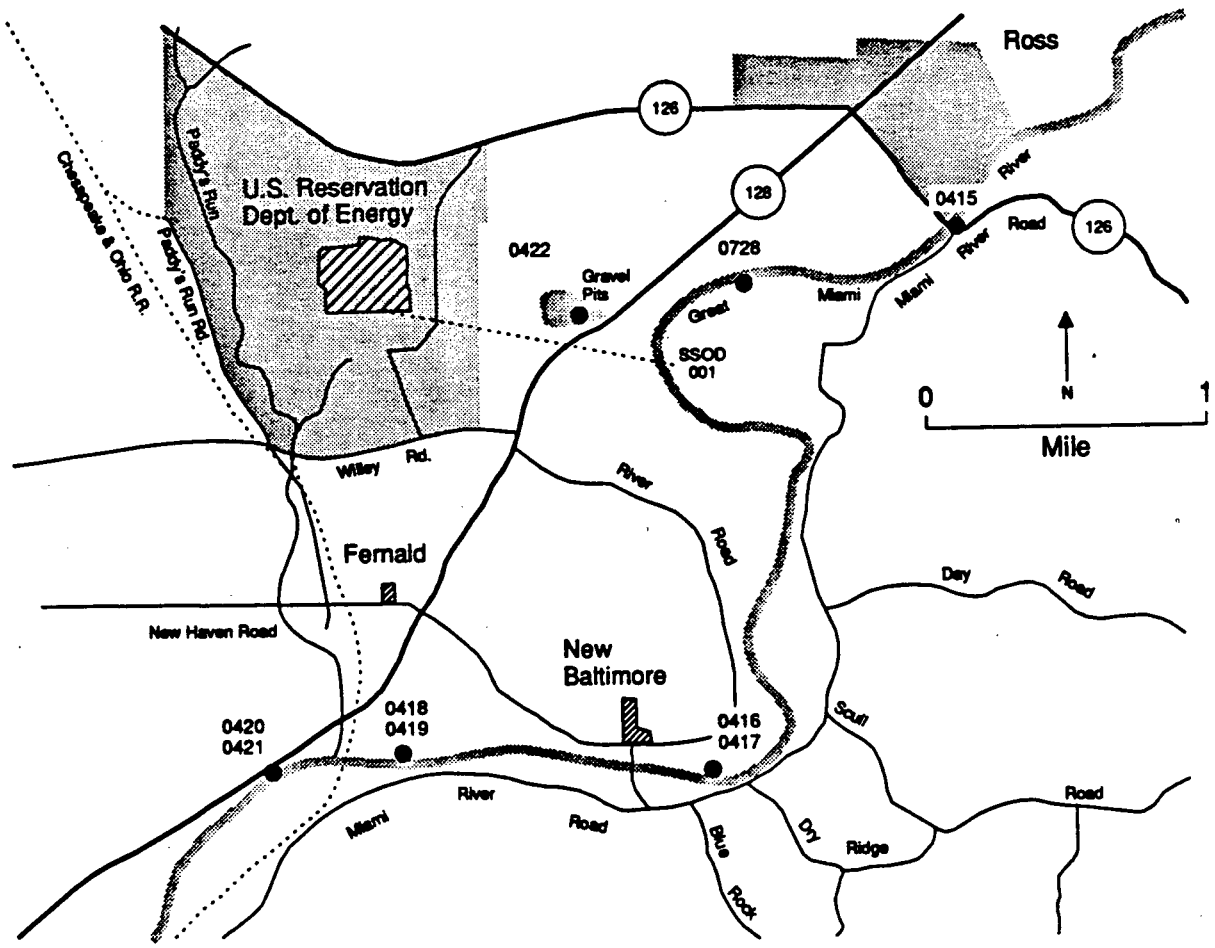

FIGURE 4.8.1 Sampling Locations for Off-site Surface Water and Sediment Samples

TABLE 4.8.3 Environmental Problem 8: Off-Site Surface Water and Sediment Samples - Field Measurements

Sample Number	Radioactivity µR/hr	pH	Temperature °C	Conductance mS
FE0415SW	Background	8.6	23.9	0.74
FE0416SW	Background	8.4	24.3	0.69
FE0417SE	Background	-[a]	-[a]	-[a]
FE0418SE	Background	-[a]	-[a]	-[a]
FE0419SW	Background	8.5	24.2	0.68
FE0420SW	Background	8.3	24.2	0.65
FE0421SE	Background	-[a]	-[a]	-[a]
FE0422SW	Background	8.2	25.2	0.50

[a]Sediment sample.

The highest radionuclide activity was 1.1 pCi/g for sediment samples and 0.98 pCi/L for water samples. The maximum concentrations of total uranium were 12.0 µg/L in water and 1.30 mg/kg in sediments. The only RCRA metals present at above analytical method detection limits was barium, with a maximum concentration of 1.17 mg/L.

For a complete presentation of the analytical data, see Appendix E.

4.8.4 Data Quality Evaluation

Sampling Design - The number and location of sampling points were selected according to the Plan and provide representative information for this Problem. Data utility level 2.

Sample Collection - EPA-approved sample containers were used. Appropriate field measurements were taken. Field logbooks contain necessary supporting information to judge whether there were deviations from standard sampling protocols. Logbooks are signed and dated. Data utility level 2.

TABLE 4.8.4 Environmental Problem 8: Analyte Concentrations Above Minimum Detection Levels - Sediment Samples

Sample Number	Media	Location	RCRA Metals: Ba mg/L	Organics: Acet µg/kg	M Chl µg/kg	ChlF µg/kg	Radionuclides: U-235 pCi/g	Bi-214 pCi/g	Cs-137 pCi/g	Np-237 pCi/g
FE0417SE2B	Sediment	G. Miami River	1.17	39	6 B					NS
FE0418SE3B	Sediment	G. Miami River	0.91	33	6 B			0.38		NS
FE0421SE2B	Sediment	G. Miami River	0.99		6 B			0.65		NS
FE0728SE2B	Sediment	G. Miami River	NS	NS	NS		0.09	0.84	0.15	1.8
FE0728SE3B	Sediment	Great Miami River		23 B	15 B	6 B				

			Radionuclides (Cont.): Pu-238 pCi/g	Pu-239+240 pCi/g	Ra-226 pCi/g	Ra-228 pCi/g	Th-227 pCi/g	Th-228 pCi/g	Th-230 pCi/g	Th-232 pCi/g	Total U mg/kg
FE0417SE2B	Sediment	G. Miami River	NS	NS			NS	0.27	NS	0.28	0.96
FE0418SE3B	Sediment	G. Miami River	NS	NS	0.28		NS		NS		0.83
FE0421SE2B	Sediment	G. Miami River	NS	NS	0.6		NS		NS	0.24	1.30
FE0728SE2B	Sediment	G. Miami River	2.4	0.4	1.1		0.70	0.57 (G)	0.5	0.59 (G)	NS
FE0728SE2B	Sediment	G. Miami River			0.72 ±0.04 K	0.05 ± 0.04 K		0.40 (A)		0.30 (A)	

Footnotes & flags
(A) = Alpha spectroscopy.
(G) = Gamma spectroscopy.
B = analyte was found in the blank as well as the sample.
K= Samples canned for gamma-counting; data processed by least squares analysis program.
NS = sample not analyzed for indicated analyte.
Blank indicates sample concentration below MDL.

Key to Abbreviations
Acet--Acetone; M Chl--Methylene Chloride; ChlF -- Chloroform.

TABLE 4.8.4 (Cont.) Environmental Problem 8: Analyte Concentrations Above Minimum Detection Levels - Surface Water Samples

			RCRA Metals:	Organics:				Radionuclides:	
Sample Number	Media	Location	Ba mg/L	1,1,1-Tri µg/L	Acet µg/L	Met Ch µg/L	Tol µg/L	Total U µg/L	Th-227 pCi/L
FE0415SW4B	Water	G. Miami River	0.53 M		17 BM	8 BM		2.10 M	0.08
FE0416SW4B	Water	G. Miami River	0.40 M	7.0 M	12 BM	9 BM	5 BM	2.40 M	0.98
FE0419SW4B	Water	G. Miami River	0.16 M					2.40 M	
FE0420SW4B	Water	G. Miami River	0.16 M		11 BM			12.00 M	
FE0422SW4B	Water	Welch Sand & Gr. Pit	0.24 DM		12 BM			1.70 M	0.39

Footnotes & Flags
D = duplicate results greater than 20% different.
B = analyte was found in the blank as well as the sample.
M = greatest value from multiple analyses of sample.
Blank indicates sample concentration below MDL.

Key to Organics Abbreviations
1,1,1-Tri--1,1,1-Trichloroethane; Acet--Acetone;
M Chl--Methylene Chloride; Tol--Toluene

Sample Analysis - Sample handling was appropriate for the media and analysis performed. Instruments and procedures used meet established standards. Laboratory notebooks contain sufficient information and are signed and dated. Data utility level 2.

QA/QC and Documentation - The S&A Plan contained a QA plan covering all aspects of the sampling and analysis program. No field QC samples were collected for this Problem. Adequate laboratory QC analyses were performed. Records were maintained regarding laboratory instrument calibration and maintenance. Data are reported in appropriate units accompanied by estimates of uncertainty. Supporting information is available. Data utility level 2.

4.9 ENVIRONMENTAL PROBLEM 9: ON SITE GROUNDWATER CONTAMINATION - CONSTRUCTION AND SAMPLING OF SIX NEW WELLS IN THE PRODUCTION AREA

Requester: Riddle

Details are provided in Table 4.9.1.

Finding and Basis

Sources of groundwater pollution at FMPC consist of various known and unknown releases of contaminants over time to other media. These releases subsequently affect groundwater. In general, the major sources of groundwater contamination at the FMPC Site can be identified as follows:

- The production area.
- The waste pits.
- Surface water discharges from the production area through the storm sewer outfall ditch to Paddy's Run.

The production area is a source of contaminants because of the use and release of chemicals and radioactive materials in the production operations. Storage of contaminated production materials on porous soils, spills/accidents, and process releases of surface water and airborne contaminants have caused a build-up of pollutants in the soil and groundwater in the production area. This build-up acts as a source for continuing release of pollutants to the groundwater.

The waste pits are a known burial ground for various hazardous and radioactive wastes since the early 1950s. The inventory of wastes mixed in these pits has not been carefully tracked and has not been easy to accurately re-create. Engineering designs used for the construction of these pits, trenches, and landfills do not meet the current criteria for containment of pollutants. Thus, releases from this waste management area probably represent the single most concentrated impact to groundwater quality.

Surface water discharges from the stormwater system in the production area are primarily a concern because of the uranium and other related radioactive particles washed from the site during storm events.

Other sources of groundwater pollution are less important individually but contribute significantly as a group (e.g., flyash piles, rubble piles, etc.) (Ref. 5, Sec. 3.4.3).

TABLE 4.9.1 Environmental Problem 9: Sample Request Table

Sample Number	Well Number and Location	Reference/ Page Number	Requester	Samples[a] Proposed	Samples[a] Collected
FE0804MW	Well 1-shallow South of Bldg 6				
FE0805MW	Well 2-shallow West of boiler plant and B street and East of railroad tracks				
FE0803MW	Well 3-shallow Grassy area north of Analytical Lab Building and south of fence for production area	1/45 3/15	Riddle Grundler	6	6
FE404015 FE404026 FE404037	Well 1-deep South of Building 6				
FE406017 FE406028 FE406039	Well 2-deep West of boiler plant and B Street and east of railroad tracks				
FE402013 FE402024 FE402035	Well 3-deep Grassy area north of Analytical Lab. Building and south of fence for production area				

[a]Number of wells.

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Shallow (perched) groundwater (see Fig. 4.9.1) within the till underlying the site has been contaminated in the following areas:

- The waste pit area.
- The production area.
- The area west and slightly south of the production area.

Prior to ANL's sampling and analysis of FMPC no shallow wells existed within the production area. A 1986 study by Dames and Moore indicated that the groundwater is contaminated by uranium at levels 200 and 4,000 times background concentrations. Samples were taken in the production area storm sewers that intercept the shallow groundwater. A flow balance performed during this study estimated that 109.4 million gallons per year of groundwater infiltrates the storm sewers at reported uranium concentrations of between 0.14 and 4.06 mg/L.

The 1986 Dames and Moore study identified a large area of uranium contamination in the sand and gravel aquifer. The area included the entire western site boundary parallel to Paddy's Run and areas south of the site. Uranium concentrations are shown at levels above 0.001 mg/L. Background uranium concentration was considered to be 0.0008 mg/L.

Potential uranium contamination east and southeast of the site has been preliminarily identified by a 1986 study by IT Corporation. The basis for these preliminary findings is uranium levels in groundwater samples above background concentrations (Ref. 5, Sec. 3.4.4.2).

4.9.1 Sampling and Analysis Objectives

Six new groundwater monitoring wells were installed in the production area at FMPC to provide information on contaminant levels in the perched (shallow) and deep aquifers beneath the production area. Groundwater samples were collected from all six of the new wells and analyzed for volatile organics, total uranium, RCRA metals, and radionuclides.

4.9.2 Sampling and Analytical Design and Implementation

Sampling Design

The locations of the new groundwater monitoring wells are shown in Figs. 4.9.2, 4.9.3, and 4.9.4. These six wells consist of three pairs of two wells (one shallow well at about 19 ft and one deep well at about 120 ft). The shallow wells were screened in the fine grained silty clay till which overlies the sand and gravel outwash deposits. The deep wells were screened in the sand and gravel outwash deposit above the blue clay lense (see Fig. 4.9.1) to provide an indication of potential groundwater contamination in these aquifers.

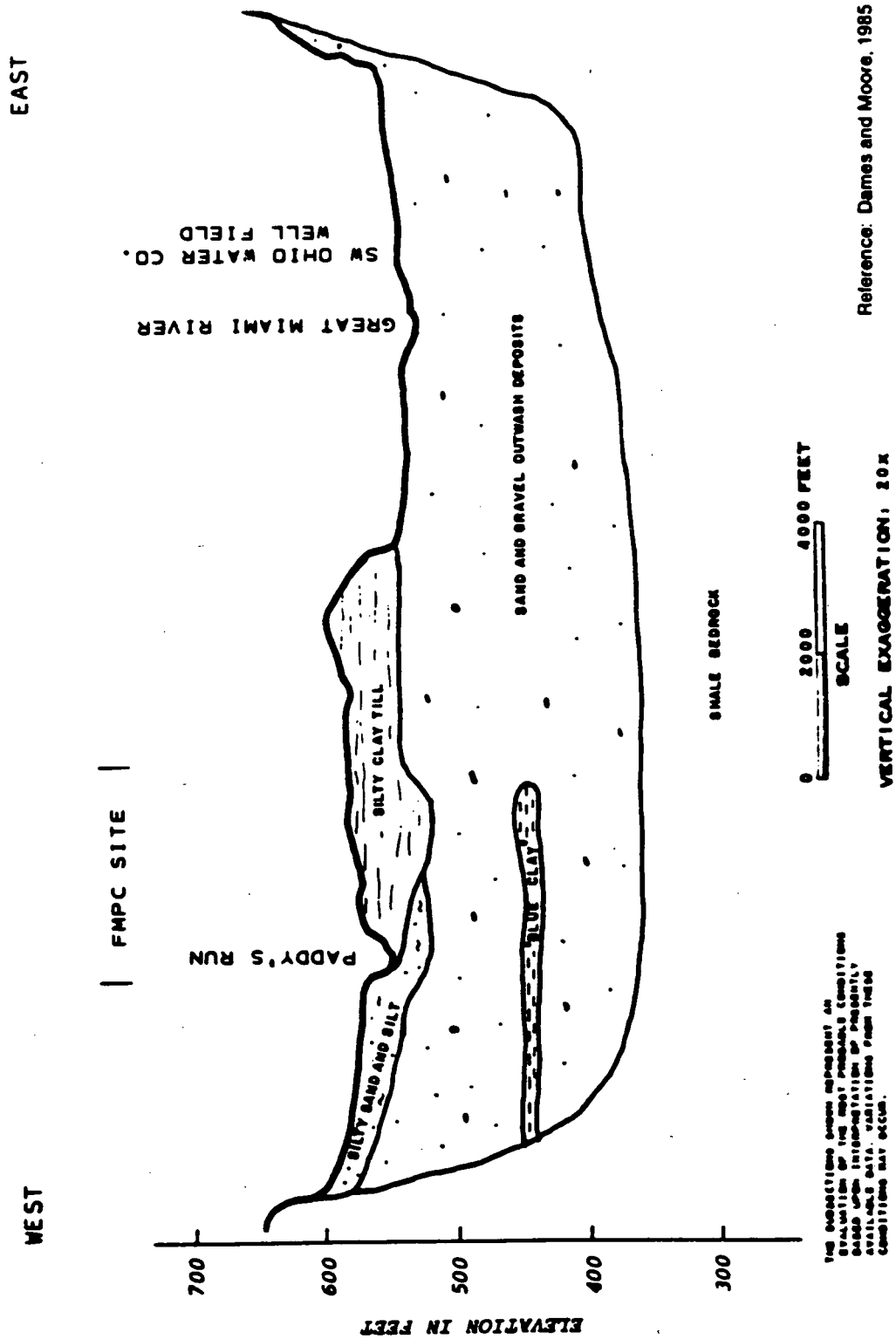

FIGURE 4.9.1 Generalized Geologic Cross Section of New Haven Trough

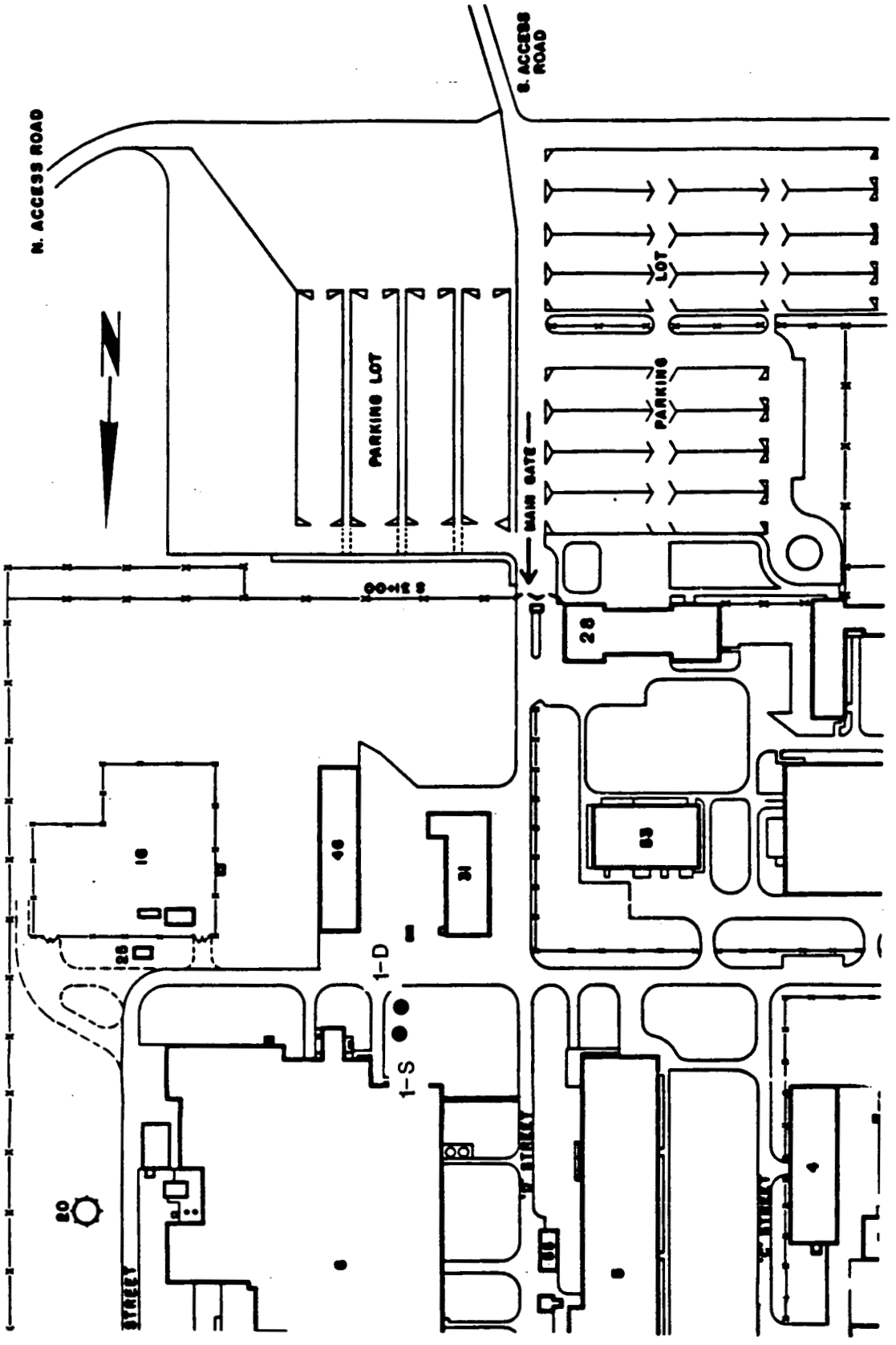

FIGURE 4.9.2 Location of New Wells 1S and 1D

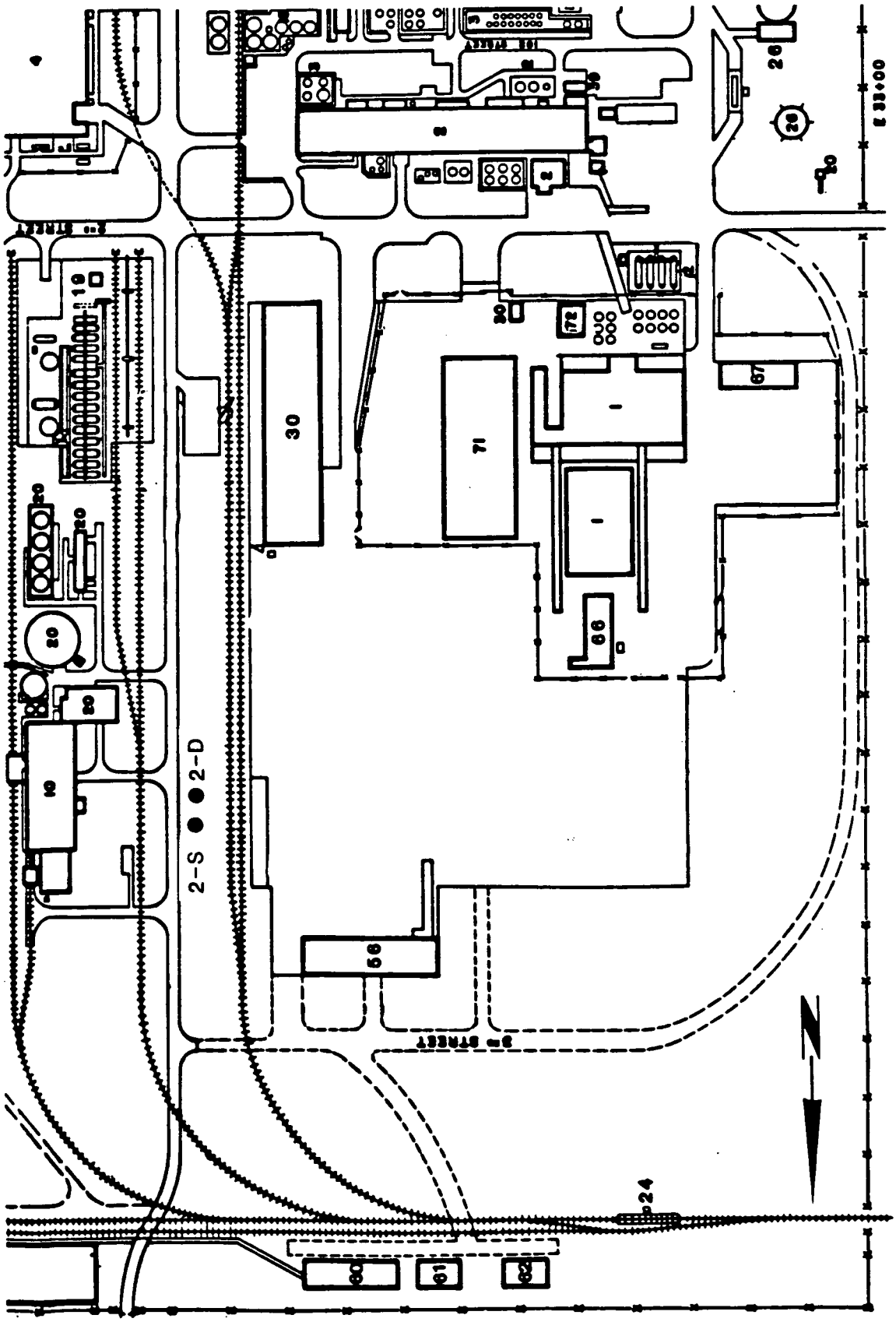

FIGURE 4.9.3 Location of New Wells 2S and 2D

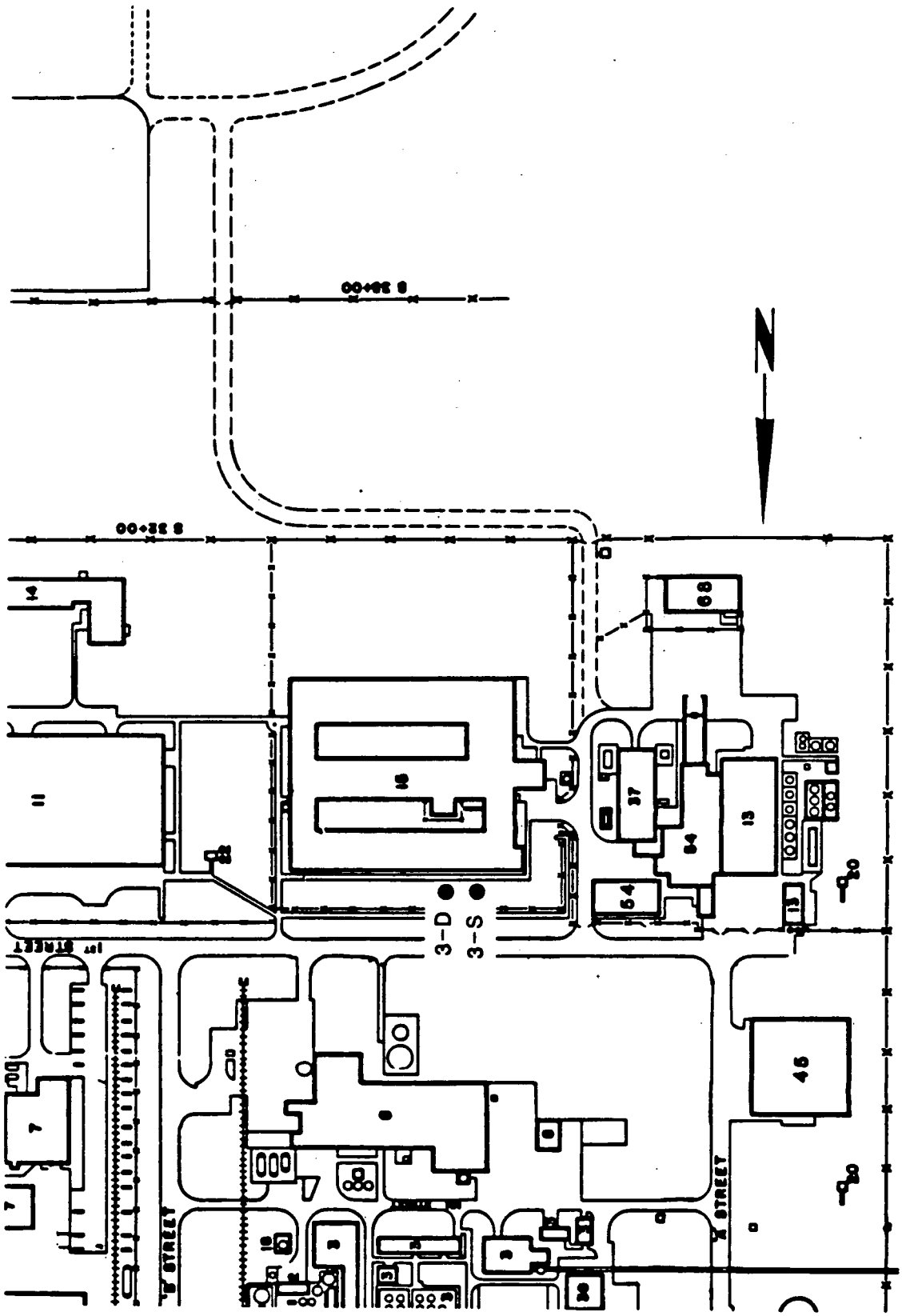

FIGURE 4.9.4 Location of New Wells 3S and 3D

Shallow Well Construction

Each well was drilled with a truck-mounted auger drill rig. A six-inch hollow-stem auger was used to drill all the wells to a depth of approximately 19 ft. Five split spoon soil samples were collected in separate bottles. The soil was checked with a radiation meter (beta pack) prior to being put into the bottle. The headspace in the bottle was then checked with an hNu meter for any organic vapors in the soil. No readings above background levels were detected with either the hNu or radiation meters, therefore, these soil samples were not analyzed. The shallow wells were constructed of 2-inch stainless steel casing and screen (0.10 slot size). The eleven foot screen was placed at the bottom of the well with sand placed around the screen and 1.5 ft above the top of the screen. A two foot thick bentonite seal was then set above the sand pack and the remaining upper portion of the well was then sealed with grout.

Each well was developed using a bailer. Caps and locks were installed on all the wells.

Shallow Well Sampling

The shallow wells were sampled with a bailer following adequate purging. Samples were preserved as necessary after sampling. The shallow wells were developed at least 48 hours after the wells were completed, with the exception of number 3, which was developed at about 24 hours of completion. A duplicate sample was collected from well 3-shallow.

Field measurements of pH, temperature and conductivity were also taken at each well following sampling.

Deep Well Construction

Each deep well was drilled with a truck mounted cable tool drill rig. An 8-in. hole was drilled to approximately 120 feet. Split spoon soil samples were collected during the drilling, but no laboratory analyses were performed on the collected soil. However, hNu and radiation measurements of the soil were taken; no levels above background were detected. The deep wells were constructed of 4-in. stainless steel casing and screen (0.010 slot size). The ten foot screened section was placed at the bottom of the well and #4 quartz sand was placed around it. A three foot thick bentonite seal was set on top of the sand pack and a portland cement/bentonite filler was placed above the bentonite seal to the surface. Each of the three deep wells was developed at least 48 hours after the well was completed. The development included: surging, overpumping, and bailing with a hand pump (bailer). All the wells were secured with a cap and lock.

Deep Well Sampling

Each well was purged with a stainless steel submersible pump. Three to five well volumes were pumped from each well prior to sampling in order to ensure a

representative sample of the groundwater. The samples were collected using a bailer. Triplicate samples were taken from each deep well. Field measurements of pH, temperature, and conductivity were taken following sample collection. All the samples were preserved as necessary upon collection.

Analytical Design

All the groundwater samples from the six new wells were analyzed to determine the concentration of volatiles, RCRA metals, total U, and radionuclides present at or above analytical method detection limits. For more information on the analytical methods used, see Appendix A.

4.9.3 Field and Analytical Data

Field Data

Field measurements for pH, temperature, and specific conductivity were taken on the water samples. Those data are presented in Table 4.9.2.

TABLE 4.9.2 Environmental Problem 9: Field Measurements

Sample Number	Well Number	pH	Temperature (°C)	Conductivity µs
FE0804MW	1-S	5.8	21.6	548
FE404015 FE404026 FE404037	1-D	[a]	14.0	320
FE0805MW	2-S	7.3	19.3	630
FE406017 FE406028 FE406039	2-D	[a]	15.0	900
FE0803MW	3-S	5.2	18.2	388
FE402013 FE402024 FE402035	3-D	5.4	15.0	360

[a]Unable to calibrate pH meter.

Analytical Data

Shallow Wells

Analytical data which exceed analytical method detection limits are presented in Table 4.9.3.

The highest total uranium concentration obtained from the three wells is 442 µg/L. Concentrations of Bi-214, Cs-137, Ra-226, Th-228, and Th-232 in the samples are below reporting levels. The only RCRA metals found in concentrations exceeding analytical method detection limits are barium, mercury, and chromium. Of these, the highest concentration found is 0.27 mg/L for barium. The analysis for volatile organics indicates low levels of acetone and methylene chloride in one sample.

Deep Wells

The concentration of total uranium found in deep well samples ranged from 1.8 to 2.2 µg/L. The only radionuclide that exceeded analytical method detection limits was Bi-214 with a value of 13 pCi/L for Well C.

The concentration of barium for two of the samples was 52 µg/L and 85 µg/L. Well C also had a concentration of 8.5 µg/L for chromium.

For a complete presentation of analytical results, see Appendix E.

4.9.4 Data Quality Evaluation

Sampling Design - The number and location of sampling points were selected according to the Plan and provide representative information for this Problem. Data utility level 2.

Sample Collection - EPA-approved sample containers were used. Appropriate field measurements were taken. Field logbooks contain necessary supporting information to judge whether there were deviations from standard sampling protocols. Logbooks are signed and dated. Data utility level 2.

Sample Analysis - Sample handling was appropriate for the media and analysis performed. Instruments and procedures used meet established standards. Laboratory notebooks contain sufficient information and are signed and dated. Data utility level 2.

QA/QC and Documentation - The S&A Plan contained a QA plan covering all aspects of the sampling and analysis program. No field QC samples were collected for this Problem. Adequate laboratory QC analyses were performed. Records were maintained regarding laboratory instrument calibration and maintenance. Data are reported in appropriate units accompanied by estimates of uncertainty. Supporting information is available. Data utility level 2.

TABLE 4.9.3 Environmental Problem 9: Analyte Concentrations Above Minimum Detection Limits for Samples from New Shallow Wells

			RCRA Metals:			Organics:			Radionuclides:	
Sample Number	Media	Location	Ba mg/L	Cr mg/L	Hg mg/L	Acet µg/L	M Chl µg/L	ChlF µg/L	Total U µg/L	Bi-214 pCi/L
FE402013	Water	Well A			0.2 CV				2.2	
FE404015	Water	Well B							2.1	
FE406017	Water	Well C							1.8	13 ± 4
FE803MW	Water	Prod. Well 3	0.27 M	0.05 M		16	10		72 MV	
FE804MW	Water	Prod. Well 1	0.18 M				5		114 M	
FE805MW	Water	Prod. Well 2	0.19 M	0.03 M	0.001 M				442 M	

Footnotes
B = Analyte was found in the blank as well as the sample.
CV = Manual Cold Vapor Atomic Absorption.
M = Greatest value from multiple analyses of sample.
Blank spaces indicate sample concentration below MDL.

Key to Organics Abbreviations
Acet--Acetone; M Chl--Methylene Chloride; ChlF – Chloroform

4.10 ENVIRONMENTAL PROBLEM 10: OFF SITE GROUNDWATER CONTAMINATION, DOMESTIC WELLS

Requester: Riddle

Details are provided in Table 4.10.1.

Finding and Basis

The production area is a source of contaminants because of the use and release of chemicals and radioactive materials in the production operations. Storage of contaminated production materials on porous soils, spills/accidents, and process releases of surface water and airborne contaminants have caused a build-up of pollutants in the soil and groundwater to the production area. This build-up acts as a source for continuing release of pollutants to the groundwater.

The waste pits are a known burial ground for various hazardous and radioactive wastes since the early 1950s. The inventory of wastes mixed in these pits has not been carefully tracked and has not been easy to accurately re-create. Engineering designs used for the construction of these pits, trenches, and landfills do not meet the current criteria for containment of pollutants. Thus, releases from this waste management area probably represent the single most concentrated impact to groundwater quality.

Surface-water discharges from the stormwater system in the production area are primarily a concern because of the uranium and other related radioactive particles washed from the site during storm events.

Other sources of groundwater pollution are less important individually but contribute significantly as a group (e.g., flyash piles, etc.) (Ref. 5, Sec. 3.4.2).

4.10.1 Sampling and Analysis Objectives

Samples were collected from selected local domestic wells to determine the concentration of RCRA metals, volatiles, and radionuclides present at or above analytical method detection limits in the groundwater.

4.10.2 Sampling and Analytical Design and Implementation

Sampling Design

Groundwater from 12 domestic wells was collected from the locations shown in Fig. 4.10.1 and described in Table 4.10.1. Water was allowed to run long enough to purge the pipes of stagnant water in order to help obtain a more representative sample of the tapped aquifer. The groundwater was collected from taps as close to the wells as

TABLE 4.10.1 Environmental Problem 10: Sample Request Table

Sample Number	Well Location[a]	Survey Team[a] Designated Well No.	U.S.G.S. Well No.	Requester	Ref./ Page No.	Samples Proposed	Samples Collected
FE0700DW	Rumpke, Inc. Well south of FMPC	4	H-124				
FE0701DW	J.W. Rolfes Well south of FMPC	5	H-128				
FE0702DW	R.C. Jackson Well south of site	10	N/A				
FE0703DW	Burwinkle Farm Well east of FMPC	3	H-114				
FE0704DW	B. Gieringer Well east of FMPC	2	H-120				
FE0705DW	Strickers Grove Well east of FMPC	1	N/A				
FE0706DW	Flicks Inn Well south of FMPC	11	16-2	Riddle	1/44	1	1
FE0707DW	Mike Lienesch Well southwest of FMPC	6	H-104				
FE0708DW	Jacob Fuchs well southwest of FMPC	13	H-123				
FE0709DW	George Frankenstein Well West of FMPC	9	H-113				
FE0710DW	George Frankenstein Well West of FMPC[b]	9	H-113				
FE0711DW	Eugene Holt Well West of FMPC	8	H-112				
FE0712DW	Delta Steel Well southwest of FMPC	7	N/A				
	West of Site (name unknown)[c]	12	N/A				

[a]See Fig. 4.10.1 for map location.
[b]Duplicate.
[c]Property inaccessible.

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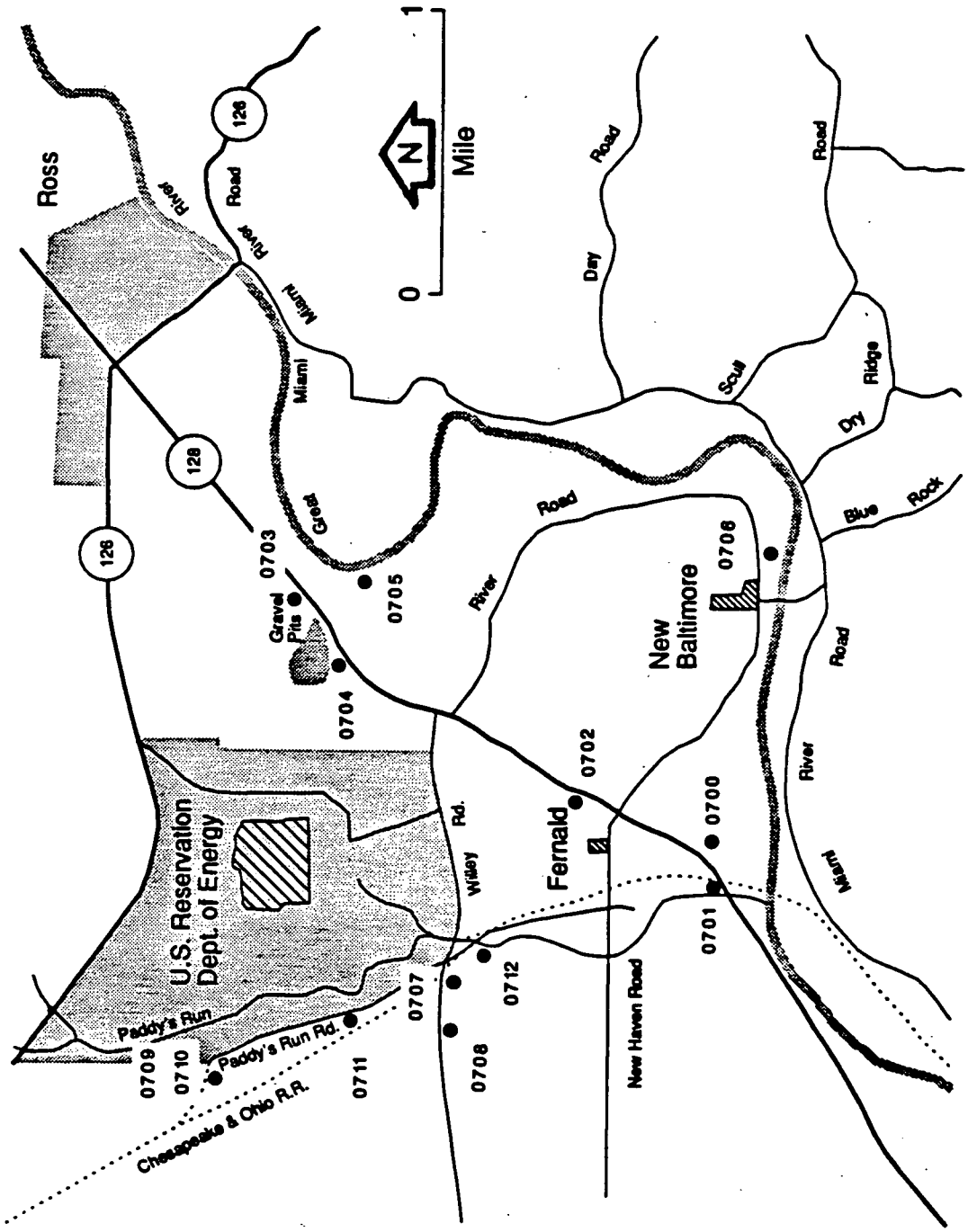

FIGURE 4.10.1 Sampling Location Map for Environmental Problem 10 - Domestic Wells

possible. The samples for RCRA metals and radionuclides were preserved as appropriate. The collection and preservation of all the samples was performed as quickly and efficiently as possible while still maintaining the integrity of the samples. Following sample collection, field measurements of pH and temperature were taken.

Duplicate samples were taken from the George Frankenstein well (U.S.G.S. well H-113) and well number 12 was not sampled because the house adjacent to it was abandoned and inaccessible.

Analytical Design

Groundwater samples from domestic wells were analyzed to determine the concentration of RCRA metals, radionuclides and volatile organics present at or above analytical method detection limits. For more information on the analytical methods used, see Appendix A.

4.10.3 Field and Analytical Data

Field Data

Field measurements for pH and temperature are presented in Table 4.10.2.

Analytical Data

Analytical data which exceeded analytical method detection limits for all the domestic wells sampled are listed in Table 4.10.3. The highest radionuclide concentration found in the samples is 0.71 pCi/L collected from the Flicks Inn well. Other reported radionuclide concentrations are generally much lower, in the 0.05 to 0.10 pCi/L range. Barium is reported at above analytical method detection limits in samples from all wells, with the highest value being 0.59 mg/L. The results of the volatile organics analyses indicate the general absence of volatile organic compounds (those subject to analysis) in the wells sampled.

For a complete presentation of analytical data, see Appendix E.

TABLE 4.10.2 Environmental Problem 10: Field Measurements

Sample Number	pH	Temp. (°C)
FE0700DW	7.0	19
FE0701DW	6.0	21
FE0702DW	5.5	22
FE0703DW	6.0	19
FE0704DW	5.0	15
FE0705DW	5.0	17
FE0706DW	5.5	25
FE0707DW	5.0	18
FE0708DW	5.5	23
FE0709DW	5.5	20
FE0710DW	5.5	20
FE0711DW	5.0	16
FE0712DW	5.5	20

TABLE 4.10.3 Environmental Problem 10: Analyte Concentrations Above Minimum Detection Levels - Domestic Well Samples

			RCRA Metals:	Organics:		Radionuclides:					
Sample Numbers	Media	Location	Ba mg/L	1,1,1-Tri µg/L	Acet µg/L	Np-237 pCi/L	Pu-239+240 pCi/L	Pu-241+242 pCi/L	Th-227 pCi/L	Th-228 pCi/L	Th-230 pCi/L
FE0700DW3B	Water	D. Well, Rumpke	0.26				0.04			0.16	
FE0701DW3B	Water	D. Well, Rolfe	0.18			0.06		0.03			
FE0702DW3B	Water	D. Well, Jackson	0.07	6							
FE0703DW3B	Water	D. Well, Burwinkle	0.08								
FE0704DW3B	Water	D. Well, Gieringer	0.07							0.12	
FE0705DW3B	Water	D. Well, Strickers	0.19						0.24	0.04	
FE0706DW3B	Water	D. Well, Flicks Inn	0.07		13				0.71		
FE0707DW3B	Water	D. Well, Liemesch	0.11								
FE0709DW3B	Water	D. Well, Shaeffer Pal	0.58							0.05	
FE0710DW3B	Water	D. Well, Shaeffer Pal	0.59							0.09	
FE0711DW3B	Water	D. Well, Shaeffer Pal	0.09						0.30		
FE0712DW3B	Water	D. Well, Delta Steel	0.08			0.58			0.17	0.04	0.02

Footnotes
NS = sample not analyzed for indicated analyte.
Blank spaces indicate sample concentration below MDL.

Key to Organics Abbreviations
1,1,1-Tri--1,1,1-Trichloroethane; Acet--Acetone

4.10.4 Data Quality Evaluation

Sampling Design - The number and location of sampling points were selected according to the Plan and provide representative information for this Problem. Data utility level 2.

Sample Collection - EPA-approved sample containers were used. Appropriate field measurements were taken. Field logbooks contain necessary supporting information to judge whether there were deviations from standard sampling protocols. Logbooks are signed and dated. Data utility level 2.

Sample Analysis - Sample handling was appropriate for the media and analysis performed. Instruments and procedures used meet established standards. Laboratory notebooks contain sufficient information and are signed and dated. Data utility level 2.

QA/QC and Documentation - The S&A Plan contained a QA plan covering all aspects of the sampling and analysis program. No field QC samples were collected for this Problem. Adequate laboratory QC analyses were performed. Records were maintained regarding laboratory instrument calibration and maintenance. Data are reported in appropriate units accompanied by estimates of uncertainty. Supporting information is available. Data utility level 2.

4.11 ENVIRONMENTAL PROBLEM 11: ABANDONED TANKS

Requester: Kelly

Details are provided in Table 4.11.1.

Finding and Basis

Scrap piles and abandoned equipment at FMPC are potential sources of radioactive contamination via groundwater and surface water pathways from these sources.

A large quantity of abandoned equipment and piping is found on site, including above ground storage tanks east of pits 2 and 3. This equipment has the potential to become a future environmental problem because it contains radioactive (uranium) and organic contaminants (waste oils) and has not yet been properly decontaminated or decommissioned (Ref. 5, Sec. 4.5.2.3.5).

4.11.1 Sampling and Analysis Objectives

Samples of the residues from selected drums were collected and analyzed to determine the concentration of uranium and other radionuclides, RCRA metals and volatile organics present at or above analytical method detection limits.

4.11.2 Sampling and Analytical Design and Implementation

Sampling Design

There was a group of three abandoned tanks east of pit 2 (see Fig. 4.11.1) from which samples were collected. One tank was standing upright, surrounded by a wooden platform. The other two tanks were lying with the axis of the cylinder parallel to the surface of the ground. The sample from the upright tank (FE0301TK) was taken with a stainless steel trowel. The sand, mud, gravel, paint chip mixture was transferred directly to a 500 ml amber glass bottle. A composite sample (FE0308TK) from the other two drums was taken with 3/4 inch outside diameter galvanized conduit tube, 5 ft long. The tube was inserted through the 1 inch diameter hole on the top of each of the tanks on the ground. Mud and sand, including some yellowish material was accumulated in the tube. A second piece of galvanized conduit with a closed end was used to push the collected material into the sample bottle.

TABLE 4.11.1 Environmental Problem 11: Sample Request Table

Sample Number	Location	Reference/Page Number	Requester	Samples Proposed	Samples Collected
FE0301TK	Tank #1 near pit #4	1/34,35	Kelly	1	2
FE0308TK	Tanks #2 and 3 near pit #4				

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FMPC S&A Data Doc.
Issue Date: 06/17/88
Revision: 00

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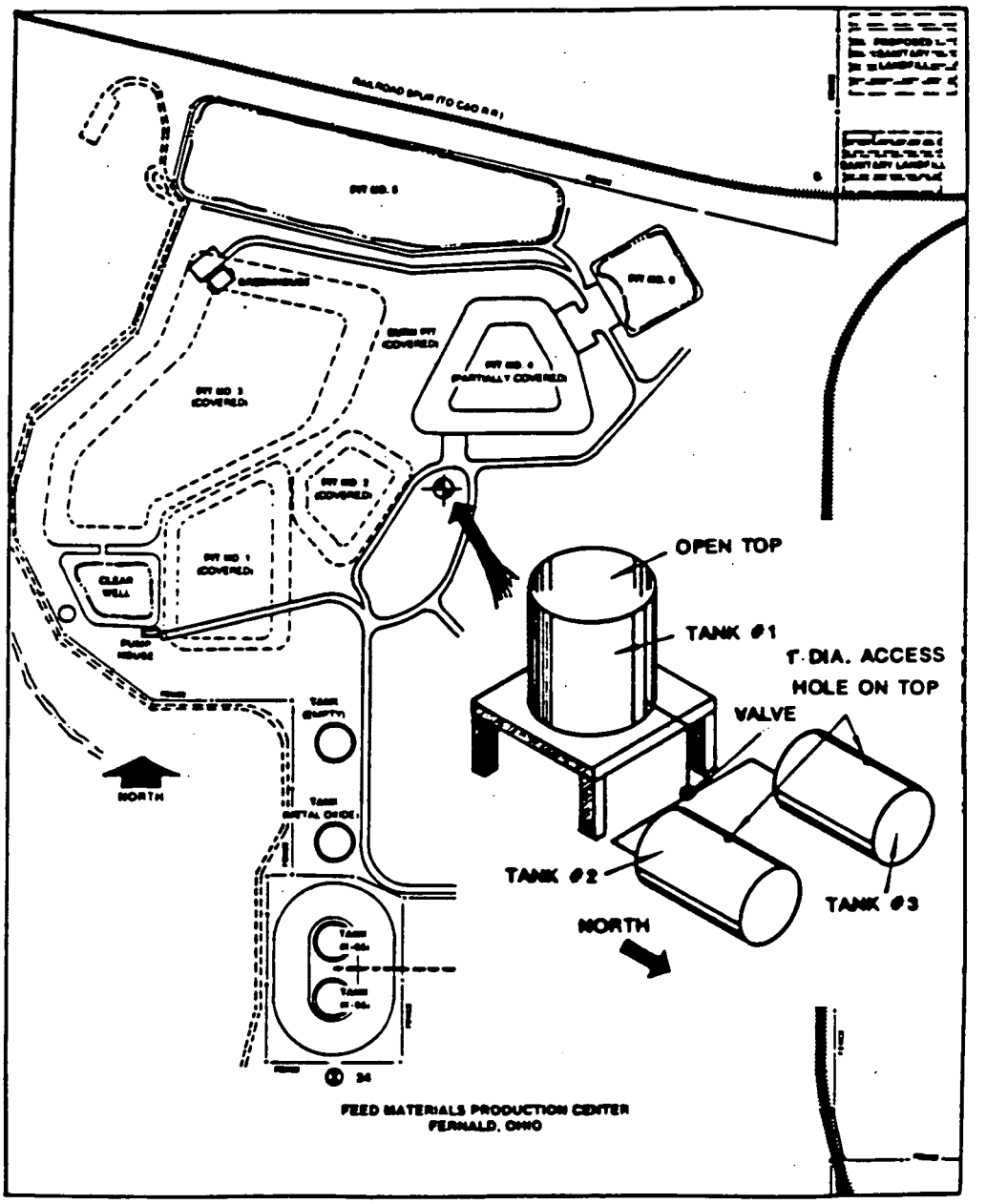

FIGURE 4.11.1 Location of Abandoned Tanks in Pit Area

Analytical Design

Samples from the tanks and drums were analyzed to determine the concentration of total uranium and uranium isotopes, RCRA metals, and radionuclides by chemical separation followed by alpha spectrometry present at or above analytical method detection limits. For more information on analytical methods, see Appendix A.

4.11.3 Field and Analytical Data

Field Data

Field measurements for radiological activity taken on the sample from the upright drum showed no detectable radiation. The radiological reading from the sample taken from the prone drums was 38 μR/hr in a 8 μR/hr background.

Analytical Data

Analytical data for samples from the two abandoned tanks which exceed analytical method detection limits are summarized in Table 4.11.2.

Barium, cadmium and chromium concentrations above the analytical method detection limits were detected in one or both samples. The upright tank had 0.4 mg/kg of barium and 0.08 mg/kg of cadmium. The composite sample contained 0.22 mg/kg of chromium and a detectable concentration of barium. The concentration of total uranium from the composite of the two tanks lying on the ground was 8570 mg/kg. This sample also contained 19 pCi/g of Np-237, 1.7 pCi/g of Pu-238, and 0.3 pCi/g of both Pu-239 plus Pu-240. Thorium was also detected for the isotopes 227 at 11 pCi/g; 228 at 19 pCi/g; 230 at 360 pCi/g; and 232 at 19 pCi/g.

For a complete presentation of the analytical data, see Appendix E.

4.11.4 Data Quality Evaluation

Sampling Design - The number and location of sampling points were selected according to the Plan and provide representative information for this Problem. Data utility level 2.

Sample Collection - EPA-approved sample containers were used. Appropriate field measurements were taken. Field logbooks contain necessary supporting information to judge whether there were deviations from standard sampling protocols. Logbooks are signed and dated. Data utility level 2.

Sample Analysis - Sample handling was appropriate for the media and analysis performed. Instruments and procedures used meet established standards. Laboratory notebooks contain sufficient information and are signed and dated. Data utility level 2.

TABLE 4.11.2 Environmental Problem 11: Concentrations of Analytes Exceeding Minimum Detection Levels for Samples from Abandoned Tanks in the Waste Pit Area

			RCRA Metals:		Radionuclides:						Organics:	
Sample Number	Media	Location	Ba mg/L	Cd mg/L	Np-237 pCi/g	Pu-238 pCi/g	Pu-241+242 pCi/g	Total U mg/kg	Ra-226 pCi/g	Ra-228 pCi/g	Acet µg/kg	1,1,1-Tri µg/kg
FE0301TK	Solid	Pit 2	0.4	0.08	0.24	0.06	0.12	635	1.93 ± 0.13 K	2.31 ± 0.48 K	20 B	7

			RCRA Metals:		Radionuclides:					
			Ba mg/L	Cr mg/L	Np-237 pCi/g	Pu-238 pCi/g	Pu-239+240 pCi/g	Th-227 pCi/g	Th-229 pCi/g	Th-232 pCi/g
FE0308TK	Sludge	Pit 2 Tank 2&3	0.08 B	0.22	19	1.7	0.3	11	19	360

			Radionuclides (Cont.):			
			Th-232 pCi/g	Total U mg/kg	Ra-226 pCi/g	Ra-228 pCi/g
FE0308TK	Sludge	Pit 2 Tank 2&3	17	8570	65.21 ± 2.91 K	47.88 ± 10.12 K

Footnotes & Flags
B = analyte found in blank as well as sample.
K= Samples canned for gamma-counting; data processed by least squares analysis program.

Key to Organics Abbreviations
Acet --Acetone; ChlF -- Chloroform; M Chl -- Methylene Chloride;

QA/QC and Documentation - The S&A Plan contained a QA plan covering all aspects of the sampling and analysis program. No field QC samples were collected for this Problem. Adequate laboratory QC analyses were performed. Records were maintained regarding laboratory instrument calibration and maintenance. Data are reported in appropriate units accompanied by estimates of uncertainty. Supporting information is available. Data utility level 2.

4.12 ENVIRONMENTAL PROBLEM 12: WASTEWATER TREATMENT AND DISCHARGE

Requesters: Riddle, Alexandro, Kelly, Malloy and Tarbert

Details are provided in Table 4.12.1.

Findings and Basis

All aqueous wastes from the process areas of the plant are eventually discharged from the General Sump to Pit 5 and then to the Clear Well. The waste treatment cycle and the NPDES sampling points are shown in Fig. 4.12.1.

The waste disposal pits consist of Waste Pits 1 through 6, the burn pit, and the Clear Well. The pits are numbered chronologically according to their order of construction. Only Pit 5 and the Clear Well are still in use. Characteristics of the pits, including their waste contents, are summarized in Table 4.12.2. Refer to Fig. 4.12.2 for a layout of the waste disposal pits.

Pit 5 was built to replace Pit 3 and was constructed by cut and fill, using the excavated material to build a dike, extending the pit approximately 10 ft above grade. The pit received liquid waste slurries until mid-1983, and now receives filtered waste streams. Process effluent containing suspended solids flows across the pit and is discharged to the Clear Well. The discharge was tested and found to be nonhazardous, based on the EP toxicity test (Ref. 5, Sec. 4.5.1).

Pit 5 may have received barium-containing materials from Pit 4 through the practice of pumping accumulated rainwater on top of the uncovered Pit 4 to Pit 5 via a portable pump. The presence of hazardous waste could signify that the pit is a hazardous waste surface impoundment requiring compliance with RCRA requirements (Ref. 5, Sec. 4.5.2.3.1).

Pit 6 was constructed in the same fashion as Pit 5. The pit received both solid and liquid wastes until early 1985. Collected rainfall is pumped to Pit 5 for discharge via the Clear Well (Ref. 5, Sec. 4.5.1).

Pit 6 may have received hazardous wastes as a result of the FMPC practice of pumping accumulated rainwater from Pit 4 (known to contain hazardous waste) to Pits 5 and 6. Pit 6 has not been observed to have torn lining joints as has Pit 5 (Ref. 5, Sec. 4.5.2.3.1).

Waste pits 1, 2, 3, 4, and 6 are primary candidates for containing radioactively-contaminated asbestos. Asbestos disposal in Pits 4 and 6 has been confirmed through survey team interviews with the FMPC staff. For the most part, this disposal (Pits 4 and 6) was accomplished in accordance with EPA NESHAPs regulations for double bagging of asbestos. Disposal in the other pits has not been verified but is suspected. Asbestos materials in these pits are probably not double bagged (Ref. 5, Sec. 4.2.1.6).

TABLE 4.12.1 Environmental Problem 12: Sample Request Table

Sample Number	Location	Reference/Page Number	Requester	Samples Proposed	Samples Collected
FE0403OT	NPDES outfall, Manhole 175	1/46	Riddle	1	1
FE0713OT	NW corner Clearwell	1/20	Alexandro	2	2
FE0714OT	Clearwell effluent	1/31	Kelly		
FE0715OT	Pit #5 outlet end	1/2	Malloy	2	2
FE0716OT	Pit #5 near influent	1/19	Alexandro		
		1/31	Kelly		
FE0717OT	Pit #6 north side	1/2	Malloy	2	2
FE0718OT	Pit #6 south side	1/21	Alexandro		
		1/31	Kelly		
FE0719SE	Pit #5 sediment	1/19	Alexandro	2	1
		1/31	Kelly		
FE0720SE	Pit #6 sediment	1/21	Alexandro	2	1
		1/31	Kelly		
FE0721SE	Clearwell sediment	1/20	Alexandro	1	1
		1/31	Kelly		
FE0727OT	Main lab sump sludge	1/17	Tarbert	1	1
		1/24	Alexandro		
		3/8	Grundler		

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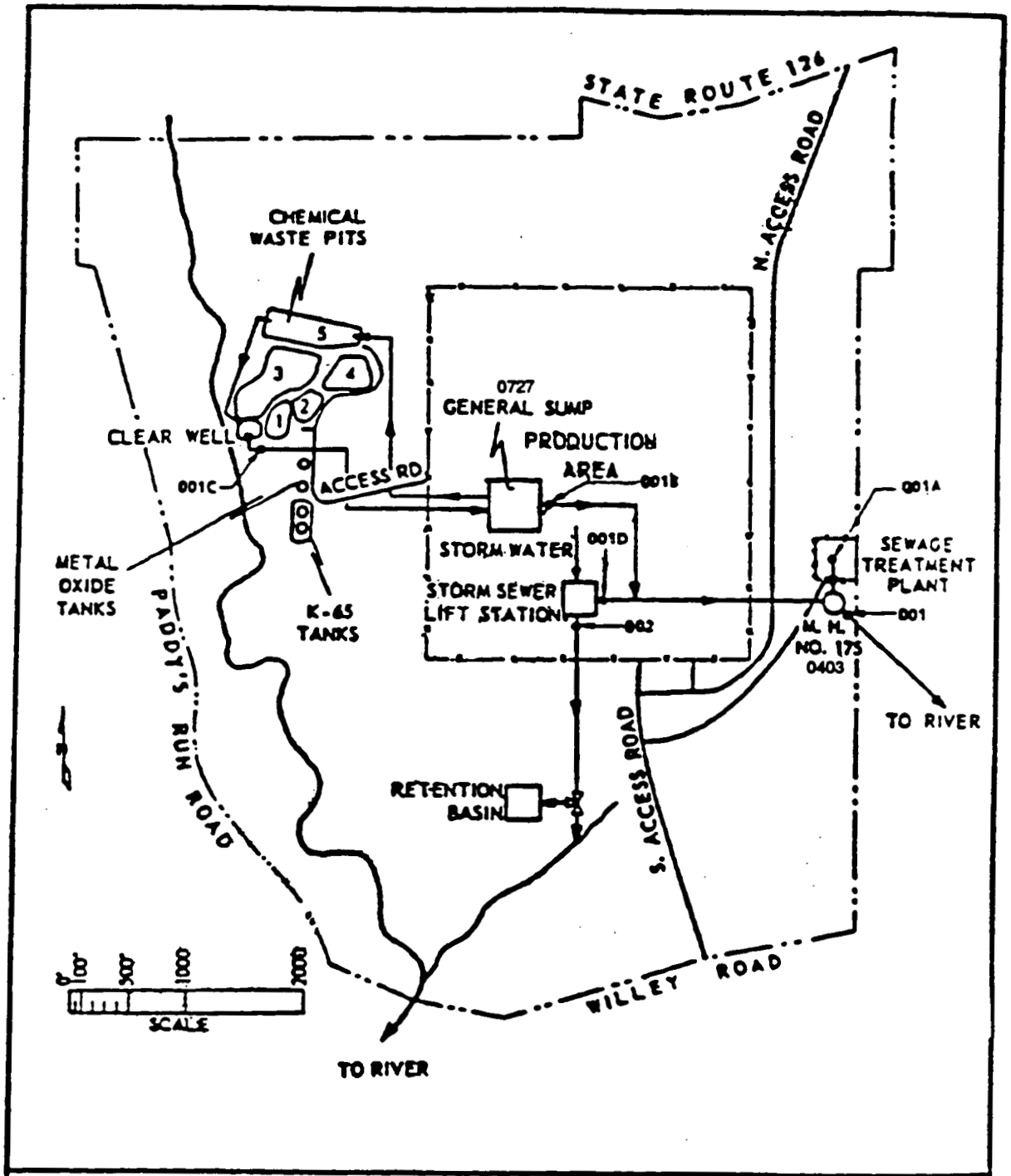

FROM ENVIRONMENTAL IMPACT ASSESSMENT, 1977, DOE

FIGURE 4.12.1 Waste Treatment Cycle and NPDES Sampling Points

TABLE 4.12.2 Characteristics of Waste Disposal Pits[a] FMPC - Fernald, Ohio

Pit	Lining	Volume (Cubic Yards)	Contents	Period of Use	Status
1	Clay	40,000	Neutralized waste filter cakes graphite, brick scrap, sump liquor and cakes, depleted slag	1952-1959	Retired, covered
2	Compacted Clay	13,000	Neutralized waste filter cakes, graphite, brick, scrap, sump liquor, and cakes depleted slag	1957-1964	Retired, covered
3	Compacted Clay	227,000	Lime neutralized raffinate concentrate, slag leach residues, filter cakes, fly ash, lime sludge	1959-1958 1975-1977	Retired, covered
4	Compacted Clay	50,000	Process residues, trailer cakes, slurries, raffinates, depleted graphite, non-burnable trash, asbestos, barium chloride salt	1960-1986	Inactive partially, covered
5	1/6 in rubberized elastomeric membrane	102,500	Depleted slag, scrap green salt, process residues, filter cakes	1968-present	Active, near capacity
6	Elastomeric membrane	9,000	Solids from neutralized raffinate, slag leach slurry, sump slurry, lime sludge	1979-1985	Inactive 70% full
Burn Pit	Natural Clay	Unknown	Pyrophoric and reactive chemicals, oils, combustible wastes	1957-1986	Retired, covered
Clear Well, Wet	Clay	Unknown	Clear process effluents, surface runoff	1959-present	Active

[a]Weston, 1986.

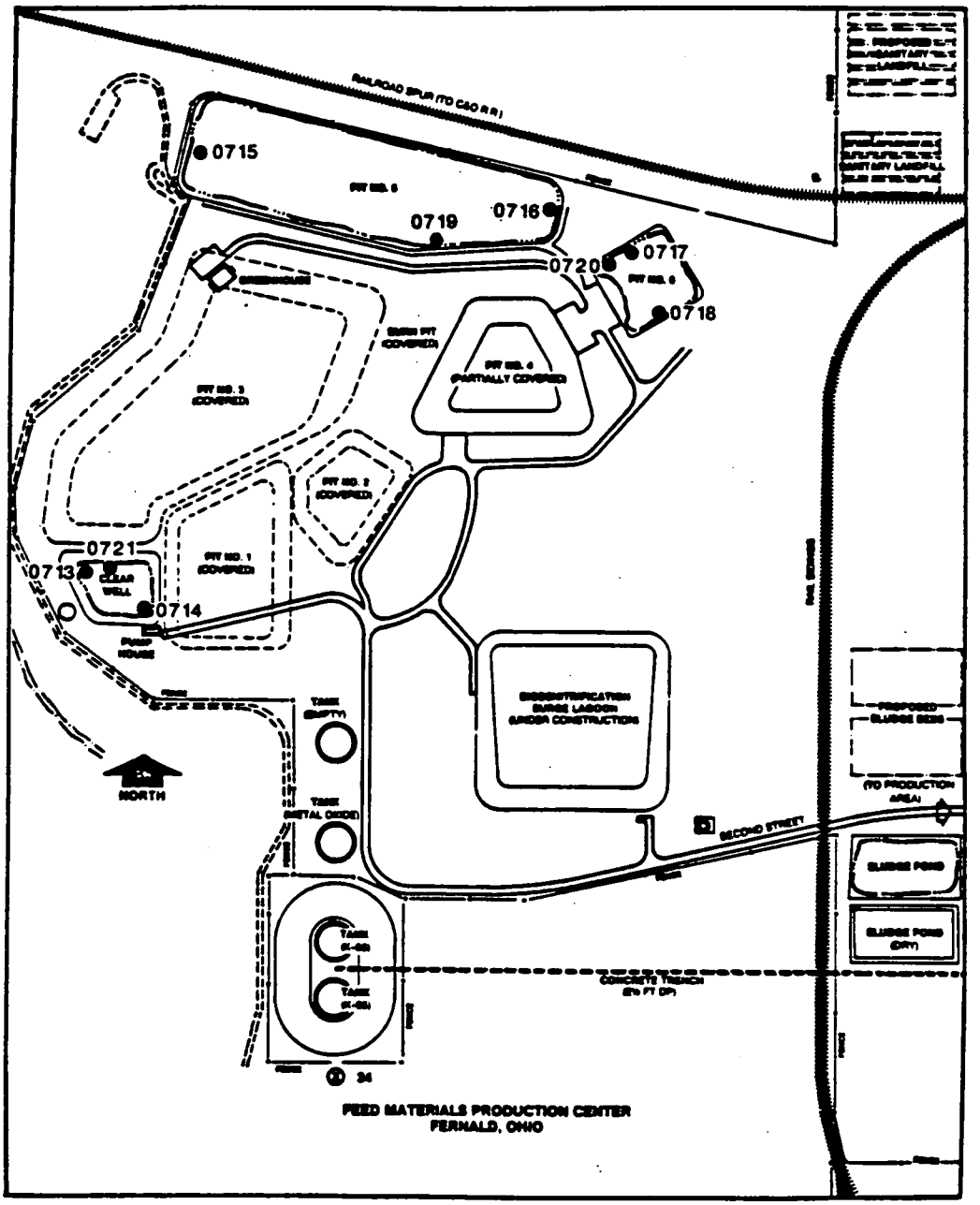

FIGURE 4.12.2 Environmental Problem 12 Sampling Locations - Waste Pit Area

The Clear Well has likely received uranium-bearing solids from process effluent flow from Pit 5 and potentially can be releasing uranium to the groundwater by migration through cracks and fissures in the clay liner. No estimates of volume or mass of solids in the Clear Well are available. The Clear Well has also received runoff from the waste pit since its construction in 1959. Uranium and other runoff-derived contaminants could seep through discontinuities in the clay lining of the Clear Well. This loss of uranium and other constituents may add to contaminants in the surrounding soil and groundwater (Ref. 5, Sec. 4.5.2.3.3).

4.12.1 Sampling and Analysis Objectives

Samples were collected and analyzed to determine whether solvents, metals, and asbestos disposed in the pits may present an environmental problem. Therefore, in addition to radionuclides and uranium, most of the samples were also analyzed for RCRA metals and volatile organics. In addition, a portion of the samples were analyzed for asbestos.

4.12.2 Sampling and Analytical Design and Implementation

Sampling Design

Water

The sampling locations for water samples from the production and the waste pit areas are shown in Fig. 4.12.2. The sample from Manhole 175 was collected with a stainless steel beaker. The water was poured from the beaker to the appropriate sample containers. All samples were preserved as necessary. The sample from Bldg. 22 west of the service building and east of the analytical laboratory, south of First Avenue and the fence was collected by connecting PVC tubing at the sump station to a continuously running spout and filling the sample bottles.

As shown in Fig. 4.12.2, grab water samples were taken from the northwest corner (inlet area) and southeast corner (outlet area) of the Clear Well; the east and west (inlet and outlet) ends of Waste Pit #5; and the north and south ends of Waste Pit #6. At each site the designated sample containers were immersed into the standing water and the samples collected directly.

Sediment

Grab samples of sediment were taken at three locations within the Waste Pit Area, as shown in Fig. 4.12.2, where areas of standing water were present. One sample was taken from each of the following locations: Pit #5, Pit #6, and the Clear Well.

Analytical Design

Water and sediment samples from the waste pit area and production area were analyzed to determine the concentration of RCRA metals, total uranium, and radionuclides present at or above analytical method detection limits. The water samples were analyzed for volatile organics, and the water sample from Manhole 175 was also analyzed for semi-volatile organics.

All samples from Pits #5 and #6 were analyzed for asbestos.

The liquid samples from the clearwell were analyzed for thorium and plutonium isotopes by alpha spectroscopy and for uranium isotopic composition by mass spectrometry.

For more information on analytical methods, see Appendix A.

4.12.3 Field and Analytical Data

Field Data

Field measurements for radioactivity, pH, temperature, and specific conductivity are presented in Table 4.12.3.

TABLE 4.12.3 Environmental Problem 12: Field Measurements

Sample Number	Radioactivity µR/hr	pH	Temperature	Conductance mS
FE0403OT	10	7.4	23.5°C	1.15
FE0715OT	100-300	8.5	24.0°C	b
FE0716OT	Bkgd[a]	11.0	38.5°C	b
FE0717OT	100-300	6.5	26.0°C	b
FE0718OT	100-300	6.0	25.5°C	b
FE0727OT	-[b]	7.95	22.9°C	0.258

[a]Bkgd - Background Levels.

[b]Not measured.

Analytical Data

Analytical data which exceed analytical method detection limits are presented in Table 4.12.4. Total uranium levels in Pits 5 and 6 are in the general range of 20,000 to 30,000 µg/L with a peak value of 33,100 µg/L. Accompanying radionuclide concentrations reach 16,650 pCi/g U-238 and 71 pCi/g U-235 for a single solid sample from Pit 6. Other radionuclide concentrations range from essentially zero for plutonium isotopes through 58 pCi/g for Cs-137.

A water sample from Pit 5 had a value of 1100 µg/L for acetone. A sediment sample from Pit 5 had a value of 440 µg/kg for acetone and 140 µg/kg for chloroform.

The results of analyses of samples for uranium atom and weight percent are presented in Table 4.12.5. The values indicate depleted uranium.

For a complete presentation of the analytical data, see Appendix E.

4.12.4 Data Quality Evaluation

Sampling Design - The number and location of sampling points were selected according to the Plan and provide representative information for this Problem. Data utility level 2.

Sample Collection - EPA-approved sample containers were used. Appropriate field measurements were taken. Field logbooks contain necessary supporting information to judge whether there were deviations from standard sampling protocols. Logbooks are signed and dated. Data utility level 2.

Sample Analysis - Sample handling was appropriate for the media and analysis performed. Instruments and procedures used meet established standards. Laboratory notebooks contain sufficient information and are signed and dated. Data utility level 2.

QA/QC and Documentation - The S&A Plan contained a QA plan covering all aspects of the sampling and analysis program. No field QC samples were collected for this Problem. Adequate laboratory QC analyses were performed. Records were maintained regarding laboratory instrument calibration and maintenance. Data are reported in appropriate units accompanied by estimates of uncertainty. Supporting information is available. Data utility level 2.

TABLE 4.12.4 Environmental Problem 12: Concentrations of Analytes Exceeding Minimum Detection Levels for Samples Collected in the Waste Pit Area - Soil Samples

Sample Number	Media	Location	Radionuclides: U-235 pCi/g	U-238 pCi/g	Bi-214 pCi/g	Cs-137 pCi/g	Ra-226 pCi/g	Th-228 pCi/g	Th-232 pCi/g	Total U mg/kg
FE0719SE2B	Soil	Pit 5	33	2046	24	1.6	25	36	24	306
FE0720SE2B	Soil	Pit 6	71	16650		26	1.6	5.6	1.7	4270
FE0721SE2B	Soil	Clear Well	1.7	176	7.9	58	8	8.3	8.1	32100

Footnotes
Blank spaces indicate sample concentration below MDL.

TABLE 4.12.4 (Cont.) Environmental Problem 12 Concentrations of Analytes Exceeding Minimum Detection Levels for Samples Collected in the Waste Pit Area - Surface Water Samples

Sample Number	Media	Location	RCRA Metals: Ba mg/L	Cr mg/L	Hg mg/L	Pb mg/L	Organics: Acet µg/L	ChlF µg/L	M Chl µg/L
FE0403OT1C	Water	Manhol 175 Outfall	0.16		NS		NS	NS	NS
FE0713OT2C	Water	Clear Well	0.22 M		0.001 M				5300 MV
FE0714OT2C	Water	Clear Well	0.14 M						11 M
FE0715OT2C	Water	Pit 5	0.07 M					25 M	
FE0716OT3C	Water	Pit 5	2.99 M	0.07 M		0.57 M	830	6	9 B
FE0716OT10B	Water	Pit 5					1100	8	7
FE0717OT2C	Water	Pit 6	0.15 M			0.37 M	34		
FE0717OT10B	Water	Pit 6					16		22
FE0718OT3C	Water	Pit 6	0.06 M						9 B

			Radionuclides: Np-237 pCi/L	Th-228 pCi/L	Th-230 pCi/L	Th-232 pCi/L	U-235 pCi/L	Total U µg/L	Asbestos: Asbestos MFL
FE0403OT1C	Water	Manhol 175 Outfall	NS		NS			NS	NS
FE0713OT2C	Water	Clear Well	0.03	0.58	3.34	0.23		3000 M	NS
FE0714OT2C	Water	Clear Well		0.43	3.49	0.2		2600 M	NS
FE0715OT2C	Water	Pit 5	NS		NS			832 M	
FE0716OT3C	Water	Pit 5	NS		NS		558	33100 M	1.37
FE0717OT2C	Water	Pit 6	NS		NS		112	25400 M	8.19 MV
FE0717OT5B	Water	Pit 5							2.73 V
FE0718OT3C	Water	Pit 6	NS		NS			27200 M	5.46

Footnotes & Flags

Blank spaces indicate sample concentration below MDL.
B = Analyte found in blank as well as sample.
D = Duplicate results greater than 20% different.
M = Greatest value from multiple analyses of sample.
NS = Sample not analyzed for indicated analyte.
V = Value from multiple analyses with high variability.

Key to Organics Abbreviations

Acet--Acetone; ChlF--Chloroform
M Chl--Methylene Chloride

TABLE 4.12.4 (Cont.) Environmental Problem 12: Concentrations of Analytes Exceeding Minimum Detection Limits for Samples Collected in the Waste Pit Area - Sediment Samples

Sample Number	Media	Location	Organics (Cont.): Acet µg/kg	ChlF µg/kg	Xylenes µg/kg	1,1,1-Tri µg/kg	Tol µg/kg
FE0719SE3B	Sediment	Pit 5	440	140	24	29	
FE0720SE3B	Sediment	Pit 6		7			5 B
FE0721SE3B	Sediment	Clear Well	19 B	8			

Footnotes & Flags
Blank spaces indicate concentration below MDL.
B = analyte was found in the blank as well as the sample.

Key to Organics Abbreviations
Acet --Acetone; ChlF -- Chloroform; Xyenes -- Total Xyenes;
1,1,1-Tri--Trichloroethane; Tol -- Toluene;

TABLE 4.12.5 Environmental Problem 12: Uranium Atom and Weight Percentages

Sample Number	Media	Location	Radionuclides: U-234 Atom %	U-234 Weight %	U-235 Atom %	U-235 Weight %
FE0713OT1C	Water	Clear Well	0.0026 ± 0.0005	0.0026 ± 0.0005	0.3519 ± 0.0005	0.3475 ± 0.0005
FE0714OT2C	Water	Clear Well	0.0019 ± 0.0005	0.0019 ± 0.0005	0.3573 ± 0.0005	0.3493 ± 0.0005

			Radionuclides (Cont.): U-236 Atom %	U-236 Weight %	U-238 Atom %	U-238 Weight %
FE0713OT1C	Water	Clear Well	0.0064 ± 0.0005	0.0063 ± 0.0002	99.639 ± 0.002	99.644 ± 0.002
FE0714OT2C	Water	Clear Well	0.0064 ± 0.0005	0.0064 ± 0.0005	99.635 ± 0.002	99.643 ± 0.002

4.13 ENVIRONMENTAL PROBLEM 13: UNIDENTIFIED SUBSTANCES

Requesters: Malloy, Alexandro, Grundler, and Firstenberg

Details are provided in Table 4.13.1.

Finding and Basis

FMPC operations are suspected of generating wastes that have not been identified as hazardous or nonhazardous, potentially resulting in improper treatment, storage, handling, or disposal. The result is that some process, treatment, or storage facilities may not be permitted under RCRA and are possibly being operated without the control, monitoring, and operating practices normally associated with such facilities. These wastes are eventually stored on the Plant 1 pad or are treated in Plant 8.

The FMPC RCRA Part B permit application for the management of hazardous and mixed waste, prepared by FMPC in 1986, identifies three on-site sources of such waste -- the maintenance shop, Plant 6, and the main laboratory. The survey found 32 additional waste streams and activities not identified in the Part B permit application that may be generating or managing hazardous/mixed waste. The 32 suspected waste streams or activities are summarized in Table 4.13.2.

It is suspected that FMPC may have three additional storage facilities (Plant 1 pad, Plant 2/3 waste oil pad, and the Plant 8 pad); seven additional treatment/incinerator facilities; and three facilities in the waste pit area (Pit 5, Pit 6, and the Clear Well) that may have received hazardous waste either directly or through the general Sump wastewater flow system (Ref. 5, Sec. 4.1.2.2.1).

The Pilot Plant stores liquid hazardous wastes in two 10,000 gal tanks (Tanks T5 and T6). The records of tank inventory maintained at the Pilot Plant identify these wastes as either contaminated solvents or contaminated oil. These tanks are sampled after each loading for percent carbon, hydrogen, chloride, fluoride, sulfur, phosphate, 1,1,1-trichloroethane, iron, sodium, and pH. The FMPC Part B RCRA permit application identifies this liquid waste as 1,1,1-trichloroethane. The FMPC hazardous waste management plan states that this material is also contaminated with PCBs. The Part B permit application indicates that the maintenance shop, garage, and paint shops are the sources of these materials.

The Pilot Plant tank T3 is marked as a hazardous waste tank. Records show that it contains unspecified waste liquid (Ref. 5, Sec. 4.1.1.2).

Waste Oil

Release of PCBs to the soil, surface water, and/or groundwater may have already occurred or could occur in the future if the waste oils in storage at the liquid incinerator are found to contain PCBs.

TABLE 4.13.1 Environmental Problem 13: Sample Request Table

Sample Number	Location	Reference/Page Number	Requester	Samples Proposed	Samples Collected
FE0302TK	T6 west of pilot plant	1/1	Malloy	4	3
FE0304TK	T5 sludge	1/24	Alexandro		
FE0305TK	T5 west of pilot plant				
FE0306TK	Plant 8 Tank 203/Plant 2/3 raffinate				
FE0307TK	Plant 8 Tank 203A/Plant 2/3 raffinate	3/7	Grundler	3	4
FE0309TK	Plant 2/3 Tank 5 bottom				
FE0310TK	Plant 2/3 Tank 5 top				
FE0311DR	Plant 8/Oxy 2 feed (solid)	1/22	Alexandro	1	2
FE0320DR	Plant 8/Oxy 2 feed (liquid)				
FE0312DR	Plant 8/Oliver filter to Calciner	1/22	Alexandro	1	1
		3/7	Grundler		
FE0313DR	Plant 8/rotary kiln feed	1/22	Alexandro	1	1
FE0314DR	Plant 8/Box furnace ash	3/7	Grundler	2	2
FE0315DR	Plant 8/Oxy 1 furnace ash				
FE0316DR	Plant 8/drum washer sludge	1/22	Alexandro	1	1
		3/7	Grundler		
FE0317DR	Plant 8/Box furnace feed				
FE0319DR	Plant 8/Box furnace feed	1/22	Alexandro	1	4
FE0318DR	Plant 8/used oil and solvent	1/3	Malloy	5	4
FE0321DR	for Box furnace feed	1/5	Firstenberg	5	4

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TABLE 4.13.1 (Cont'd)

Sample Number	Location	Reference/Page Number	Requester	Samples Proposed	Samples Collected
FE0322DR FE0323DR FE0324DR	Oil behind old incinerator	1/3	Malloy	20	3
FE0325DR	Plant 1/waste xylene	1/23	Alexandro	4	3
FE0326DR	Plant 6/Sump cake	3/7	Grundler	7	3
FE0327DR	Plant 6/Waste stream				
FE0328DR	Plant 9/Filter Press solids	3/7	Grundler	1	1

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TABLE 4.13.2 Suspected Hazardous/Mixed Waste Stream or Activity FMPC

Waste Stream/Activity	Suspected Problem	Sampling and Analysis Needed
Plant 1 storage pad waste drums	Storage of mixed or hazardous waste	Identify process area hazardous/mixed waste and determine if stored on pad
Plant 1 spray booth wastewater	May be a hazardous waste	Analyze for EP toxicity and volatiles
Plant 1 waste xylene	Definitely a hazardous waste	Test for xylene
Plant 1 peelable paint waste	May be a hazardous waste	Analyze for EP toxicity and ignitability
Plant 1 drum reconditioner, air emissions	Shot used in barrel blaster may have contained lead	Sample soil around exhaust for lead contamination
Plant 1 drum compactor, sump waste and sludge	May be a hazardous/ mixed waste and contain PCB	Sample sludge and test for PCB and EP toxicity
Plant 2/3 centrifuge solids	May be a hazardous/ mixed waste	Test for EP toxicity and volatiles
Plant 2/3 hot raffinate building, filter press solids	May be a hazardous/ mixed waste	Test for EP toxicity and volatiles
Plant 2/3 tank bottoms	May be a hazardous/ mixed waste	Test for EP toxicity and volatiles
Plant 2/3 neutralized raffinate	This material has been tested by EP toxic test and is not hazardous, but should be tested with proposed new EPA TCLP procedures	TCLP
Plant 2/3 waste oil storage pad	Older drums may contain hazardous waste, visible leakers on pad, oil draining to sump around pad and to Plant 2/3 sump	Test for EP toxicity and volatiles

TABLE 4.13.2 (Cont'd)

Waste Stream/Activity	Suspected Problem	Sampling and Analysis Needed
Plant 5 MgF_2	This material has been tested by EP toxic test and is not hazardous, but should be tested with proposed new EPA TCLP procedures	TCLP
Plant 6 filter solids from wastewater treatment system	May be a hazardous/ mixed waste	EP toxicity and volatiles
Plant 6 oil decant from oil/water separator	May be a hazardous/ mixed waste	EP toxicity and volatiles
Plant 8 wastewater treatment solids from: filters, Oxidation 1 furnace, Oxidation 2 furnace, Rotary kiln, Calciner, Box furnace, Drum washer	It is suspected that any of these facilities could be treating hazardous/ mixed waste	Feed materials and ash will be EP toxicity and volatile scan tested
Oil burner	May have burned hazardous waste	--
Plant 9 filter solids	May be a hazardous/mixed waste	EP toxicity and volatiles
Pilot Plant barium chloride treatment facility area sump	Barium chloride may be released to sump upon screening of drum content to remove foreign matter	EP toxicity
Pilot Plant, hazardous waste tank (#T3)	Contains hazardous waste	EP toxicity and volatiles
Laundry perchloro-ethylene regeneration system, waste filter material	Definitely a hazardous/ mixed waste	Perchloroethylene
Main laboratory sump	Sump sludge is period-ically removed and packaged in drums	EP toxic, volatile scan

TABLE 4.13.2 (Cont'd)

Waste Stream/Activity	Suspected Problem	Sampling and Analysis Needed
Main laboratory waste solvent storage area	Drums stored outdoors on grassy area (unlabeled)	EP toxicity and volatiles
Pit 4	Known hazardous waste in pit, barium detected in groundwater at levels above background	Corings and sampling of impounded water on surface for EP toxicity volatiles
Pit 5	Contamination by hazardous/mixed waste from process or other management activities	Representative sampling of sediment and liquid
Pit 6	Contamination by hazardous/mixed waste from process or other management activities	Representative sampling of sediment and liquid
Clear Well	Contamination by hazardous/mixed waste from process or other management activities	Representative sampling of sediment and liquid
Abandoned waste oil tank	Any remaining liquid or sludge may be hazardous	EP toxicity

An extensive waste-oil inventory is stored on a pad behind the recently closed liquid incinerator. These drums, approximately 1,000 in number, have not been tested for PCBs. They are stored on an open pad with several observed and potential leaking drums. The surrounding runoff control trough contains oils and oily sludges, which are evidence of past releases. Should any of these drums contain PCBs there is a potential that they would be released from leaking drums to the soil, surface water, and/or groundwater (Ref. 5, Sec. 4.2.2.3.1).

4.13.1 Sampling and Analysis Objectives

Samples from a variety of tanks and drums were taken to provide information regarding the presence (or absence) of hazardous materials. Most of the samples are from material that was or would become part of the process stream.

4.13.2 Sampling and Analytical Design and Implementation

Sampling Design

Tank Sampling

A stainless steel sampler was used to collect the three samples from the tanks west of pilot plant as shown in Fig. 4.13.1 (FE0302TK - FE0305TK). The actual tank and drum sampling was subcontracted to Phoenix, Inc. with ANL personnel logging the data, choosing the sampling locations and taking custody of the samples after they were collected. The sampling device was the property of the subcontractor. The samples represented a depth composite from the top, middle, and bottom of Tanks T5 and T6. A sludge sample was also taken from the bottom of T5. Tank T6 had no sludge. Tank T3 was examined and found to be empty.

The sampling device was washed with a soap solution and rinsed with distilled water before reuse.

Four samples from tanks 203 and 203A in Plant 8 and tank 5 in Plant 2/3 were collected from locations shown in Figs. 4.13.1 and 4.13.2 (FE0306TK - FE0310TK). Tanks 203 and 203A in plant 8 were agitated for 5 minutes before the samples were withdrawn. The pH of tanks 203 and 203A in Plant 8 was 10-11. Tank 5 was agitated for production purposes so the samples were withdrawn without further processing. Three of these samples were withdrawn from a faucet at the bottom of the tank. The first liquid to come from the faucet was collected in the sample collection bottles. One sample was collected by lowering the sampling bottle on a rope into the liquid from the top of Tank 5. There was froth on the top of this tank. No froth was collected.

Drum Sampling

Five of the drum samples were collected with stainless steel trowels and transferred directly into the bottles. If more than one drum was sampled, the material was composited in the bottle. The other four solid samples were collected with stainless steel trowels and transferred to a stainless steel bucket. The material was broken up and composited prior to placement in sample containers. The bucket was cleaned with a soap solution and rinsed with distilled water before reuse. All wash and rinse water was collected in 5 gallon bottles.

Two samples were collected by dipping the sample bottle into the liquid layer above the solid layer. The first sample consisted of compositing liquid from two drums. The second sample was from one drum.

The drum codes and sample numbers are given in Table 4.13.3 for all the drums sampled for this problem. The sampling locations are three areas around Plant 8 in Fig. 4.13.1. The drums for the oxy 1 feed contained air reactive materials. They consisted of uranium turnings, fines and chips under water. The top of the 55 gal drums

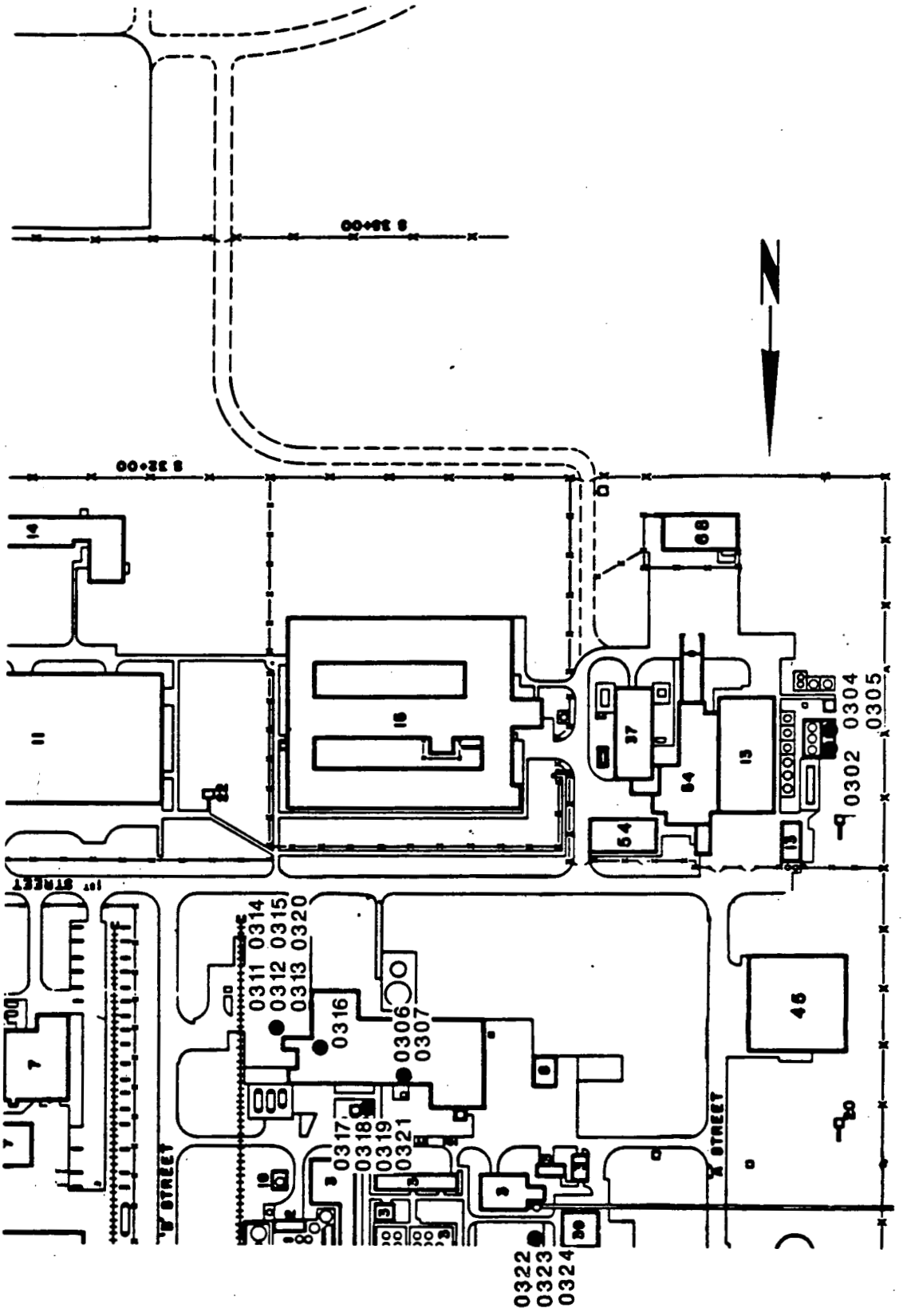

FIGURE 4.14.1 Tank and Drum Sampling in the Southwest Quadrant of the Production Area

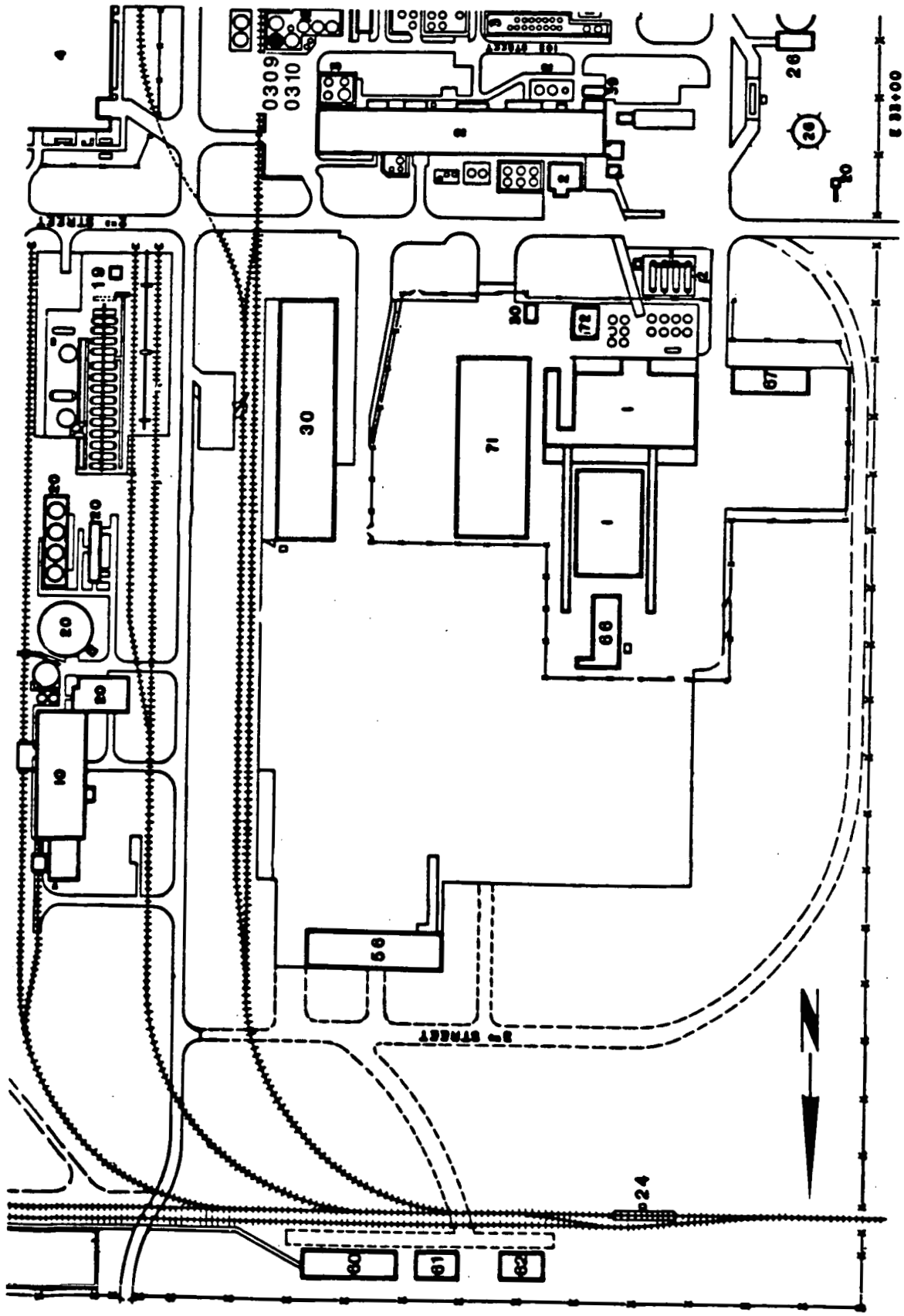

FIGURE 4.14.2 Tank and Drum Sampling in the Northwest Quadrant of the Production Area

TABLE 4.13.3 Drum Sampling Identification for Environmental Problem 13

Sample Number	Drum Code
FE0311DR (solid phase) FE0320DR (liquid phase)	S125-245-0042-0294 #49 + #50 Nonoily cleanout sludges, for roasting containing enriched uranium, up to 1.25% U-235 from the Plant 2 refinery sump system. Drummed during 6/86.
FE0312DR	S095-817-0069-7188 #18 + #19 Nonoily, nonhalide wet sump or filter cake containing enriched uranium up to 0.95% U-235 from filtration of the Plant 8 wet chemical system.
FE0313DR	S095-817-0069-7137 #21 + #22 Nonoily, nonhalide wet sump or filter cake containing enriched uranium, up to 0.95% U-235 from the filtration of the Plant 8 wet chemical system.
FE0314DR	S095-824-0154-4125 #51 U_3O_8 rotexed Plant 8 box furnace product containing enriched uranium up to 0.95% U-235
FE0315DR	S095-825-0154-5149 #60 U_3O_8 rotexed Plant 8 oxidation furnace (Number 1) product containing enriched uranium up to 0.95% U-235
FE0316DR	S095-805-0042-0297 #1 Nonoily cleanout sludges for roasting containing enriched uranium up to 0.95% U-235 from the Plant 8 drum washer. Drummed during 9/86.
FE0317DR	S095-200-0042-0297 #4 + #5 Nonoily cleanout sludges for roasting containing enriched uranium up to 0.95% U-235 from Plant 2/3. Drummed during 9/86.
FE0318DR	2 unnumbered drums marked "oily sludge"
FE0319DR	H082-800-D015-0279 Insoluble contaminated oil for the burner containing depleted uranium from Plant 8. Drummed during 9/86.
FE0321DR	2 unnumbered drums marked "oily sludge"

TABLE 4.13.3 (Cont'd)

Sample Number	Drum Code
FE0322DR	H093-655-D039-0295 #41 Oil sludges from decant separation containing depleted uranium from the Plant 6 waste treatment area. Drummed during 7/86.
FE0323DR	X095-853-0015-0009 #52 Insoluble contaminated oil containing enriched uranium from the Plant 8 Hydraulic Separator.
FE0324DR	H093-530-D015-0294 #3 Insoluble contaminated oil containing depleted uranium from the Plant 5 casting area. Drummed during 6/86.
FE0325DR	Waste Thinner Waste thinner from the drum reconditioning building, Bldg. 66
FE0326DR	H093-658-D069-0297 #69 Nonoily, nonhalide wet sump or filter cake containing depleted uranium from the Plant 6 water treatment filters. Drummed during 9/86.
FE0327DR	H-93-655-D039-0297 #46 Oily sludge from decant separation containing depleted uranium from the Plant 6 water treatment area. Drummed during 9/86.
FE0328DR	X 500-965-0069-0225 #2 and #3 Nonoily, nonhalide wet sump or filter cake containing enriched 0.867 to 0.940% uranium-235 from the Plant 9 sump liquor processing stream.

were open with a continuous stream of bubbles effusing from the water. It was decided not to take a sample of either the uranium or the water.

Three drums east of the oil incinerator (Bldg. 39) were selected. J.J. Fitzgerald (FMPC) made the drums accessible for sampling. Pertinent information concerning the selected drums is presented in Table 4.13.3 with their corresponding sample number. The sample was collected by immersing the container in the drum of oil and holding it submerged until the sample container was full. Prior to collecting the sample a 10 mm diameter glass tube was used to probe the bottom of the drum for sediments. Also the drum was stirred to produce a homogenous medium.

The drum of waste thinner on the north side of Building 66, as shown in Fig. 4.13.3, was sampled using a 10 mm diameter glass tube to withdraw successive aliquots of liquid until the sample container was full.

At Plants 6 and 9 the solid filter cake was transferred from the drum to a bucket for mixing and breaking it into pieces prior to transfer to the sample containers. The filter cake from Plant 6 was yellow whereas that from Plant 9 was green. The liquid oil from Plant 6 was collected in successive aliquots with a glass tube similar to the sampling procedure used at Building 66. Sampling locations are shown in Fig. 4.13.4.

Analytical Design

The samples from the tanks west of the pilot plant and those from the drums behind the oil incinerator were analyzed for PCBs. The tanks associated with the plant 2/3 operations were analyzed for RCRA metals. The drums of material to be used in the Plant 8 furnaces were analyzed for both PCBs and RCRA metals. The drums of waste from Plants 1, 6 and 9 were analyzed for RCRA metals or radionuclides by gamma spectroscopy.

For more information on analytical methods, see Appendix A.

4.13.3 Field and Analytical Data

Field Data

Field radiological measurements were taken. Tank T2 had a reading at the surface of > 5 mR/hour and approximately 5 mR/hour at one meter above the top of the tank. Measured radiation levels at T5, T6, and T3 were 1.2 mR/hour, 0.6 mR/hour, and 1.0 mR/hour, respectively. The general radiological background east of Plant 8 was high, up to 2.2 mR/hour, due to thorium tanks on the roof of Plant 8. The radiation levels of the samples from this area ranged from 18 μR/hour to 903 μR/hour.

Analytical Data

Analytical data which exceed analytical method detection limits are presented in Table 4.13.4. Sample showing reportable concentrations of radionuclides were collected from drums containing depleted uranium from the Plant 6 water treatment process. A sample of the filter cake contained 161 pCi/g of U-235 and 43,000 pCi/g of U-238. A sample of the sludge from the decant separation contained 1.2×10^6 pCi/L of U-238 and 3210 pCi/L of U-235. The only RCRA metals present in concentrations substantially above analytical method detection limits are barium and lead, with maximum values of 44.9 mg/L and 1.97 mg/L, respectively.

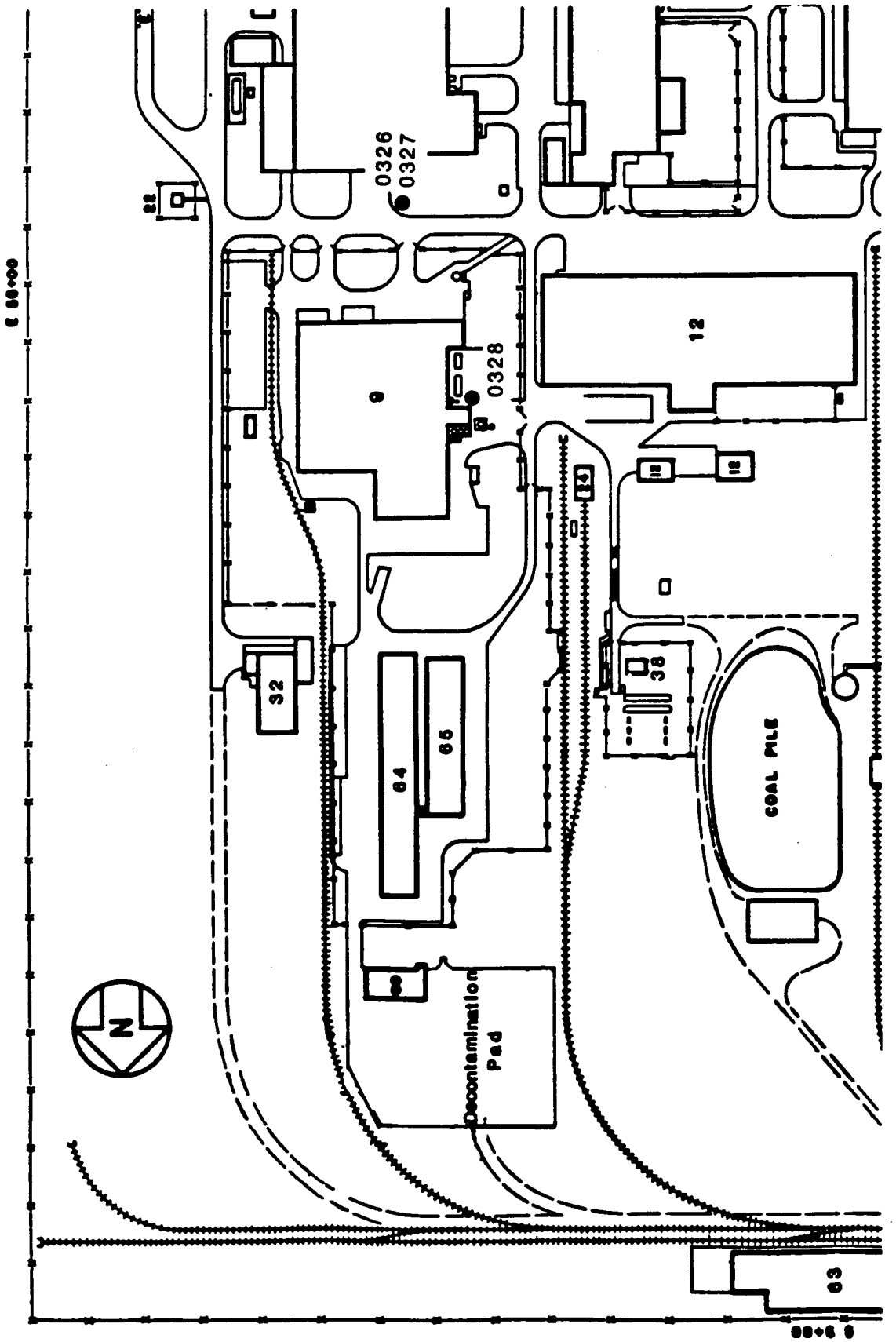

FIGURE 4.14.3 Drum Sampling Locations at Plant 1

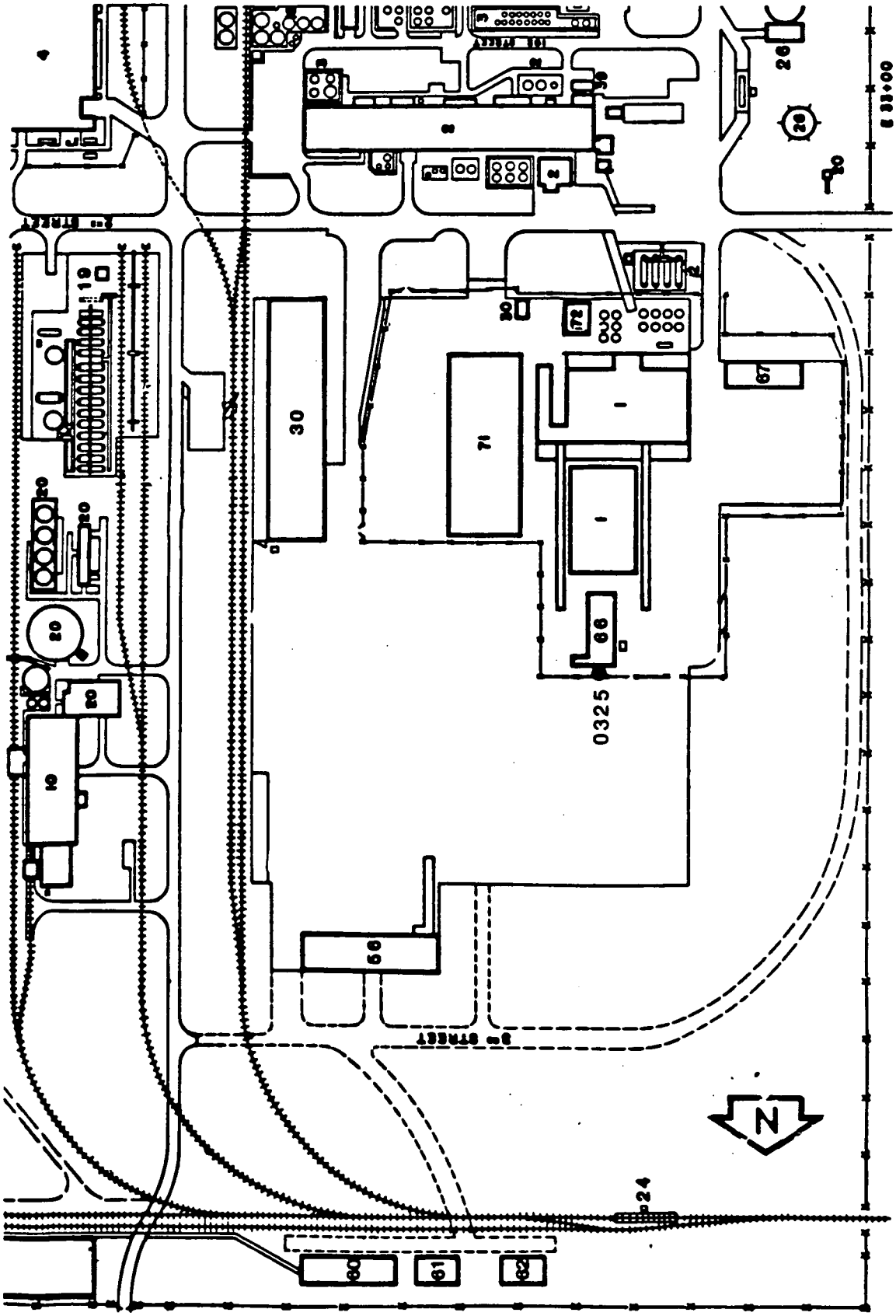

FIGURE 4.14.4 Drum Sampling Locations at Plant 1

The drum sample from the north pad of Plant 6 contained volatile organics in the following concentrations.

Analyte	Concentration (µg/kg)
Methylene chloride	150
Acetone	2100
1,1-dichloroethene	300
2-butanone	1800
1,1,1-trichloroethane	7400
4-methyl-2-pentanone	770
2-hexanone	2300
Tetrachloroethene	500
Toluene	160

For a complete presentation of analytical data, see Appendix E.

4.13.4 Data Quality Evaluation

Sampling Design - The number and location of sampling points were selected according to the Plan and provide representative information for this Problem. Data utility level 2.

Sample Collection - EPA-approved sample containers were used. Appropriate field measurements were taken. Field logbooks contain necessary supporting information to judge whether there were deviations from standard sampling protocols. Logbooks are signed and dated. Data utility level 2.

Sample Analysis - Sample handling was appropriate for the media and analysis performed. Instruments and procedures used meet established standards. Laboratory notebooks contain sufficient information and are signed and dated. Data utility level 2.

QA/QC and Documentation - The S&A Plan contained a QA plan covering all aspects of the sampling and analysis program. No field QC samples were collected for this Problem. Adequate laboratory QC analyses were performed. Records were maintained regarding laboratory instrument calibration and maintenance. Data are reported in appropriate units accompanied by estimates of uncertainty. Supporting information is available. Data utility level 2.

TABLE 4.13.4 Environmental Problem 13: Analyte Concentrations Exceeding Minimum Detection Levels - Liquid Wastes, Raffinate, and Sludge Samples

Sample Number	Media	Location	RCRA Metals: Ba mg/l	Cr mg/l	Pb mg/l	PCBs AROCLOR-1254 mg/kg
FE0309TK1B	L. Waste	Plant 2/3 Tank 5	11.5 B		0.43	
FE0310TK1B	L. Waste	Plant 2/3 Tank 5	7.28 B			
FE0320DR2B	L. Waste	Pl 8 Drums 49,50	0.11 B	0.13		
FE0325DR1B	L. Waste	Plant 1 Drum	2.29 B	0.03	1.97	
FE0306TK1B	Raffinate	Plant 8 Tank 203	20.7 B	0.03	0.71	
FE0307TK1B	Raffinate	Plant 8 Tank 203A	6.61 B	0.06	0.3	
FE0311DR2B	Sludge	Plant 8 Drums	2.09 B			1.1

			Organics: 2-But µg/L	2-Hex µg/L	4-M-2-Pen µg/L	TetCl µg/L	Tol µg/L	TCE µg/L	Vn Act µg/L
FE0327DR1B	L. Waste	Plant 6 N pad	1800	2300	770	550	160	49	100

			Organics(Cont.): Acet µg/L	ChlF µg/L	M Chl µg/L
FE0327DR1B	L. Waste	Plant 6 N pad	2100	64	150

Footnotes & Flags
B = analyte found in blank as well as sample.
Blanks indicate sample concentration below MDL.

Key to Organics Abbreviations
Acet --Acetone; ChlF -- Chloroform; M Chl -- Methylene Chloride;
Xyenes -- Total Xyenes; Tol -- Toluene;Vn Act-- Vinyl Acetate;
2-But -- 2-Butanone;2-Hex -- 2-Hexanone;4-M-2-Pen--4-Methyl-2-Pentanone;
TetCl--Tetrachloroethene; TCE -- Trichloroethene;

TABLE 4.13.4 (Cont.) Environmental Problem 13: Analyte Concentrations Exceeding Minimum Detection Levels - Waste Samples

Sample Number	Media	Location	RCRA Metals: Ba mg/L	Cr mg/L	Hg mg/L	Radionuclides: U-235 pCi/g	U-238 pCi/g
FE0312DR2B	S. Waste	Pl 8 Drums 18,19	0.67 B				
FE0313DR2B	S. Waste	Pl 8 Drums 21,22	0.65 B		0.0258		
FE0314DR1B	S. Waste	Plant 8 Drum 51	4.98 B	0.16			
FE0315DR1B	S. Waste	Plant 8 Drum 60	44.9 B				
FE0316DR1B	S. Waste	Plant 8 Drum 1	0.21 B				
FE0319DR2B	S. Waste	Plant 8 Drum	0.3 B	0.03			
FE0328DR1B	S. Waste	Plant 9 Drums 2,3		0.03			
FE0326DR1B	S. Waste	Plant 6 Drum 9				161	43000

			Organics: Acet µg/kg	ChlF µg/kg	M Chl µg/kg	Xylenes µg/kg	1,1,1-Tri µg/kg	1,1-DiCl µg/kg	1,1-DiCe µg/kg
FE0326DR1B	S.Waste	Plant 6 Drum 9	45 B	20	24 B	8	7400	120	300

			Radionuclides: U-235 pCi/L	U-238 pCi/L
FE0327DR1B	L. Waste	Plant 9	3200	1200000

Footnotes & flags
B = analyte found in blank as well as sample.
Blanks indicate sample concentration below MDL.

Key to Organics Abbreviations
Acet --Acetone; ChlF -- Chloroform; M Chl -- Methylene Chloride;
Xyenes -- Total Xyenes; 1,1,1-Tri--Trichloroethane;
1,1-DiCl-- 1,1-Dichloroethane; 1,1-DiCe-- 1,1-Dichloroethene;

4.14 ENVIRONMENTAL PROBLEM 14: CONTAMINATION IN MILK

Requester: Yates

The sampling and analytical request is found in Reference 1, page 14.

Finding and Basis

The airborne uranium released from FMPC has deposited on the soil both on the site and off the site. Surface-deposited uranium poses a potential off-site hazard because it can become resuspended in the air or bioaccumulated by vegetation. The uranium can then be directly inhaled or ingested by humans or ingested indirectly by consuming milk produced by cows that have been feeding on contaminated vegetation.

Uranium found in the soils is primarily the result of past emissions from the FMPC metal production operations. Quantities of uranium released during normal operations were historically much greater than current releases, because of better controls and operational procedures.

Nevertheless, because this is a potential dose pathway to the surrounding population, environmental monitoring of soil, vegetation and milk samples is an ongoing program in support of the DOE philosophy of keeping levels of radiation and doses to the public as low as reasonably achievable (ALARA).

Milk produced by cows grazing on FMPC and adjacent pasture land was monitored three times in 1985. The FMPC 1985 Environmental Monitoring Report indicates that the concentration of total uranium in milk is less than 0.68 pCi/L. This result was obtained at both the indicator and the control station. The survey team estimated this concentration of uranium in milk would yield an insignificant does (bone surface) of 2.49×10^{-2} millirem/year to the maximally-exposed individual.

4.14.1 Sampling and Analysis Objective

Milk samples were collected and analyzed to provide information on possible low levels of contamination being transported via the food chain into the milk.

4.14.2 Sampling and Analytical Design and Implementation

Sampling Design

Milk samples were collected from the Knollman Dairy Farm adjacent to the site at 7281 Willey Road, Hamilton Ohio 45013. The sample was taken from the dairy holding tank containing two days of collected milk. The sampling location is shown in Fig. 4.14.1.

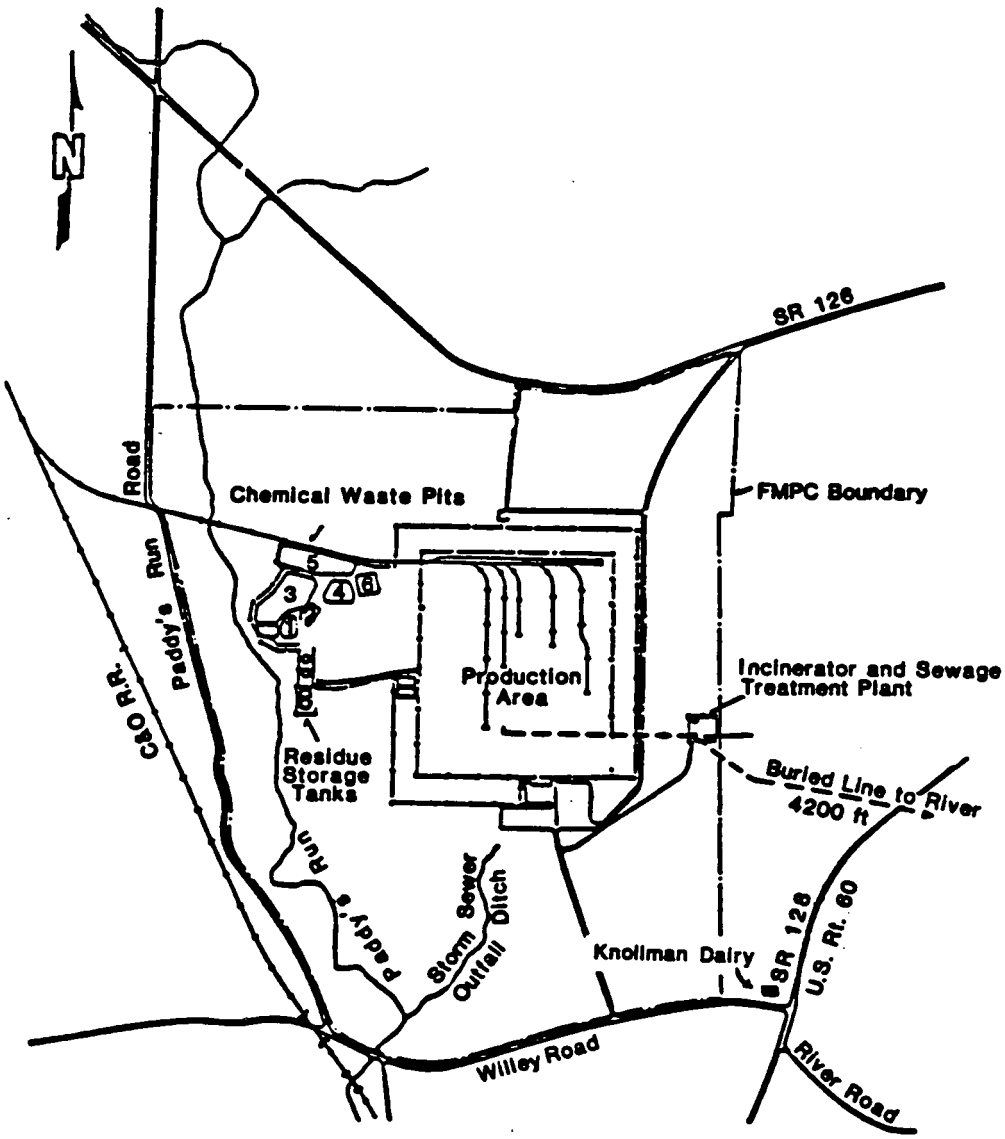

FIGURE 4.14.1 Location of the Knollman Dairy Farm

Analytical Design

Milk samples from the Knollman Dairy Farm were analyzed to determine the concentration of total uranium and radionuclides present at or above analytical method detection limits.

For more information on analytical methods, see Appendix A.

4.14.3 Field and Analytical Data

Analytical Data

Analytical data which exceed analytical method detection limits are presented in Table 4.14.1. The milk sample had a concentration for total uranium of 292 μg/L.

For a complete presentation of analytical data, see Appendix E.

4.14.4 Data Quality Evaluation

Sampling Design - The number and location of sampling points were selected according to the Plan and provide representative information for this Problem. Data utility level 2.

Sample Collection - EPA-approved sample containers were used. Appropriate field measurements were taken. Field logbooks contain necessary supporting information to judge whether there were deviations from standard sampling protocols. Logbooks are signed and dated. Data utility level 2.

Sample Analysis - Sample handling was appropriate for the media and analysis performed. Instruments and procedures used meet established standards. Laboratory notebooks contain sufficient information and are signed and dated. Data utility level 2.

QA/QC and Documentation - The S&A Plan contained a QA plan covering all aspects of the sampling and analysis program. No field QC samples were collected for this Problem. Adequate laboratory QC analyses were performed. Records were maintained regarding laboratory instrument calibration and maintenance. Data are reported in appropriate units accompanied by estimates of uncertainty. Supporting information is available. Data utility level 2.

TABLE 4.14.2 Environmental Problem 14: Analyte Concentrations Exceeding Minimum Detection Levels - Milk Samples

Sample Number	Media	Location	Radionuclides: Pu-239+240 pCi/L	Total U µg/L
FE0726OT1B	Milk	Knollman Farm	0.05	292

4.15 ENVIRONMENTAL PROBLEM 15: DIRECT RADIATION - SELECTED LOCATIONS

Requester: Riddle

The sampling and analytical request is found in Reference 1, page 46 and Reference 3, page 19.

Finding and Basis

Direct external radiation is defined as exposure to gamma photons, x-rays, beta particles coming from radioactive material outside the body. This does not include radiation from ingested or inhaled radioactivity (Ref. 5, Sec. 4.3). The total external dose rate to an individual in the Cincinnati area is estimated to be 66.5 millirem/year. This includes 36.3 millirem/year from cosmic rays (excluding the neutron component) and 30.2 millirem/year from terrestrial sources. The total compares relatively well with the FMPC estimates of background external exposure. The background external dose rate in 1985 was estimated to be 78 millirem/year. The aerial radiological survey for FMPC, conducted in April 1985, measured typical background external exposures of 9 microR/hour, or 78.8 mR/year. One roentgen (R) is equivalent to one rem, if a quality factor of one is assumed (Ref. 5, Sec. 4.3.1).

The South Field area, located directly north of the inactive flyash disposal area, is suspected of serving as a burial site for radioactive, hazardous, and mixed wastes. Former radiological surveys have indicated that the soil in this area contains elevated levels of radionuclides. In addition, contaminated soils may have been removed from this contaminated area and disposed of elsewhere (Ref. 5, Sec. 4.5.2.3.4).

4.15.1 Sampling and Analysis Objectives

A radiological survey was conducted on the South Field to determine the location and exposure rates of elevated levels of radiation.

4.15.2 Sampling and Analytical Design and Implementation

Sampling Design

South Field

The Fernald maintenance personnel cleared the area of weeds, grasses, brush and small trees prior to the survey effort. A survey of the 64,500 m^2 South Field area was performed by five ANL health physics specialists. The South Field area is shown in Fig. 4.15.1. Since the interest was in buried material, a 2 mm thick by 50 mm diameter

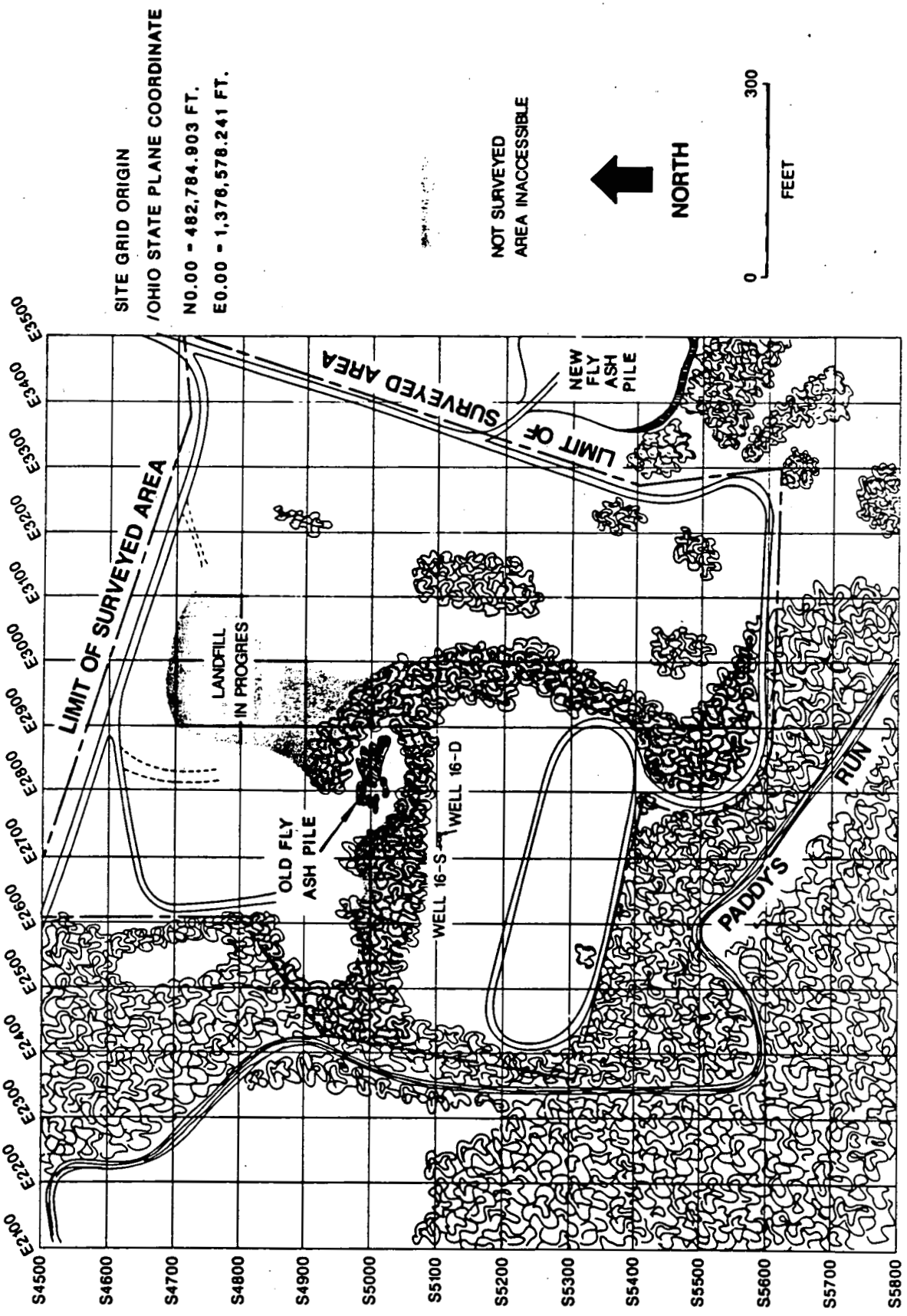

FIGURE 4.16.1 South Field - Area Surveyed

sodium iodide crystal connected to a single channel analyzer-rate meter (Eberline PG-2 detector and PRM-5-3 analyzer-rate meter) was the instrument of choice. This instrument is sometimes referred to as a min FIDLER (Field Instrument for Detection of Low Energy Radiation). The detector was held within 5 cm of the surface of the ground. Through the use of earphones, detection of areas (hot spots) above background could be discerned by walking slowly over the site. All of these spots were numbered and marked with a flag for later radiation measurement and mapping. At the same time the approximate size of this contaminated area was determined.

During this radiological assessment, the area marked on Fig. 4.15.2 was being filled with truck loads of dirt and debris from construction projects on site. Periodically a bulldozer would level the piles and push some of the dumped material down the ravine. Since the present fill would make detection of any buried material more difficult and in the interest of safety, a 12,900 m^2 area of the South field was not surveyed. Part of the unsurveyed area consisted of steep terrain and heavy brush.

After the area was surveyed, measuring equipment was used to obtain exposure rates. Exposure rates were measured with an Eberline PRM-7 μR meter, sensitive to high energy gammas. Count rates mainly from low energy gamma rays were measured with the mini FIDLER. This count rate should be considered primarily qualitative because the true detection efficiency for this kind of contamination is essentially unknown. The data from the mini FIDLER is included to give an idea of the relative depths of the contamination. For example, at location 9 the exposure rate is 34 μR/h and the count rate is 100,000 CPM, but at location 11 the exposure rate is higher (65-100 μR/h) while the current rate is lower (10,000-30,000 CPM). This suggests that the contamination at location 9 may be closer to the surface that at location 11, or the radioisotopes involved have gamma rays of vastly different energies.

Three large cloth air panels were laid out to assist in determining the orientation and size of the south field area. Each panel T pointed north. An aerial photo was taken by an outside contractor.

A plane-table alidade was set up in several convenient locations in order to locate the flagged points with respect to the air panels. The maps were drawn in the field. The direction was determined with the alidade and the distance with an electronic distance measurer. The distance is measured with a laser beam. Therefore the final measurements were accurately determined.

While the ANL team was mapping the area and the hot spots, another contractor was gridding various locations at FMPC. They located a couple of flags in the area shown in Fig. 4.15.3 which the ANL team located along with the hot spots. The flags were marked with the east and south coordinates and were used to tie the coordinates in Figs. 4.15.1 through 4.15.5 to the site grid.

Conehouse

An area in the northeast section of the site outside of the production area was surveyed with the mini FIDLER. This was referred to as Area 1 in the requests.

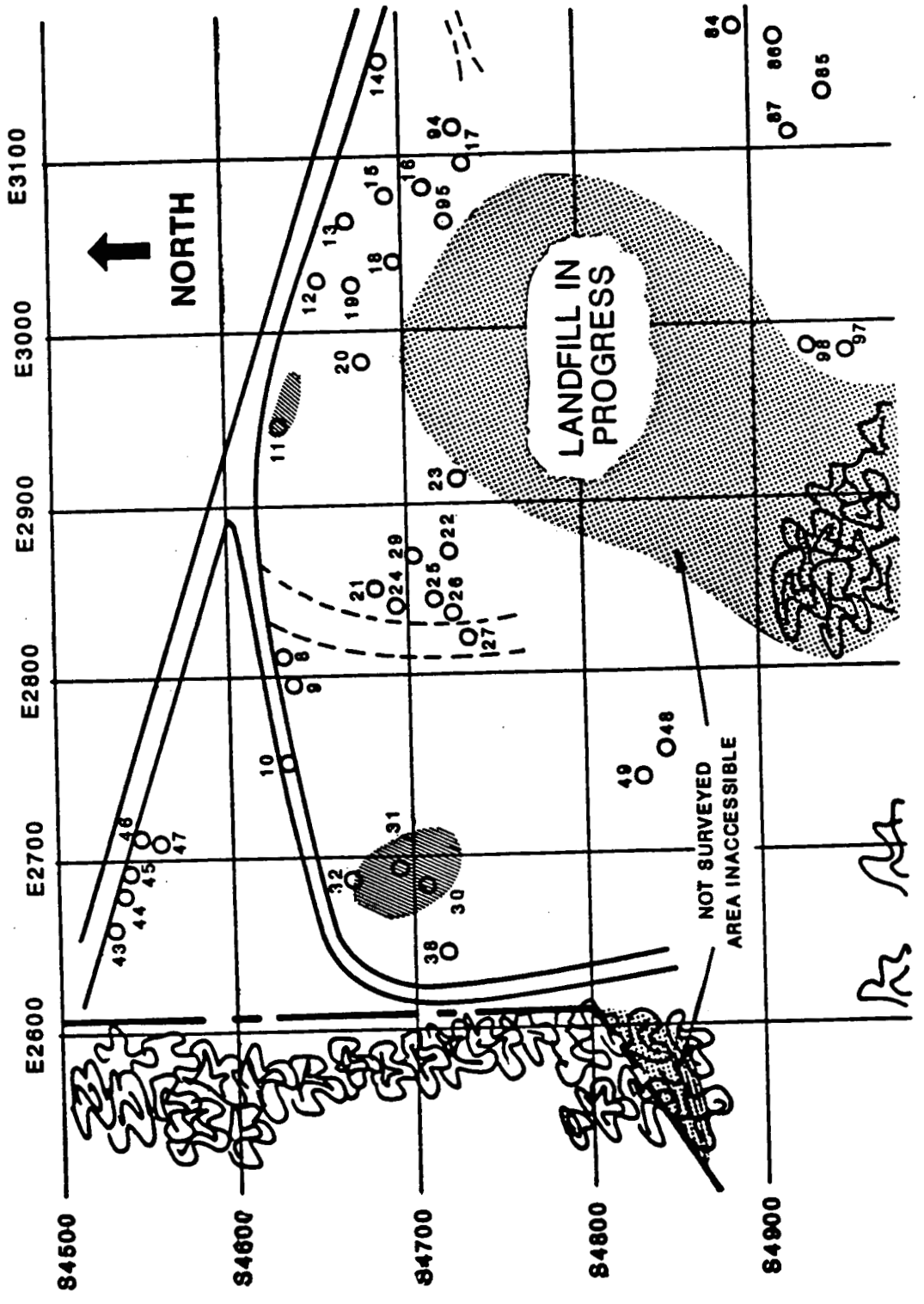

FIGURE 4.15.2 South Field - Contamination Locations in Northwest Section

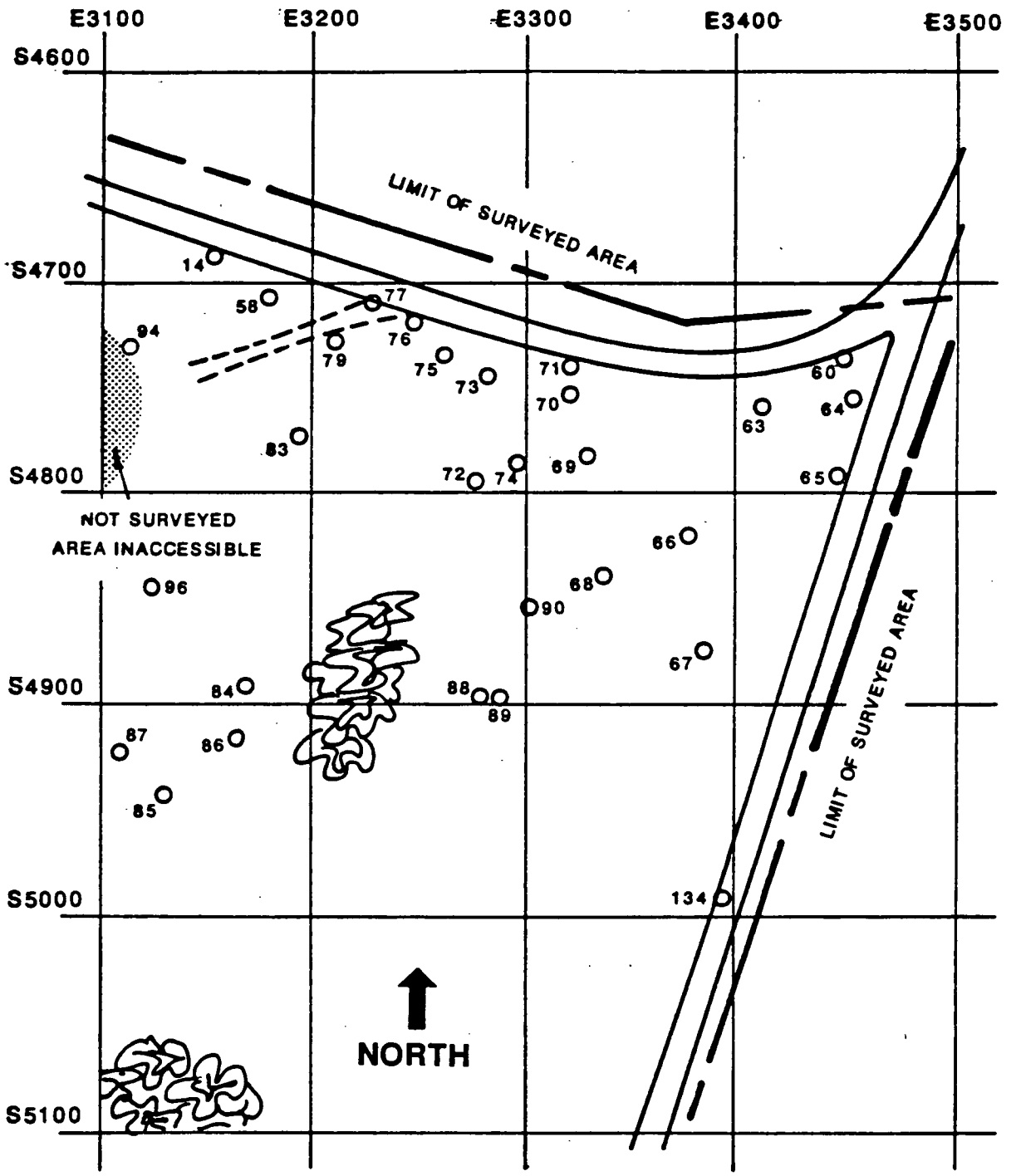

FIGURE 4.15.3 South Field - Contamination Locations in the Northeast Section

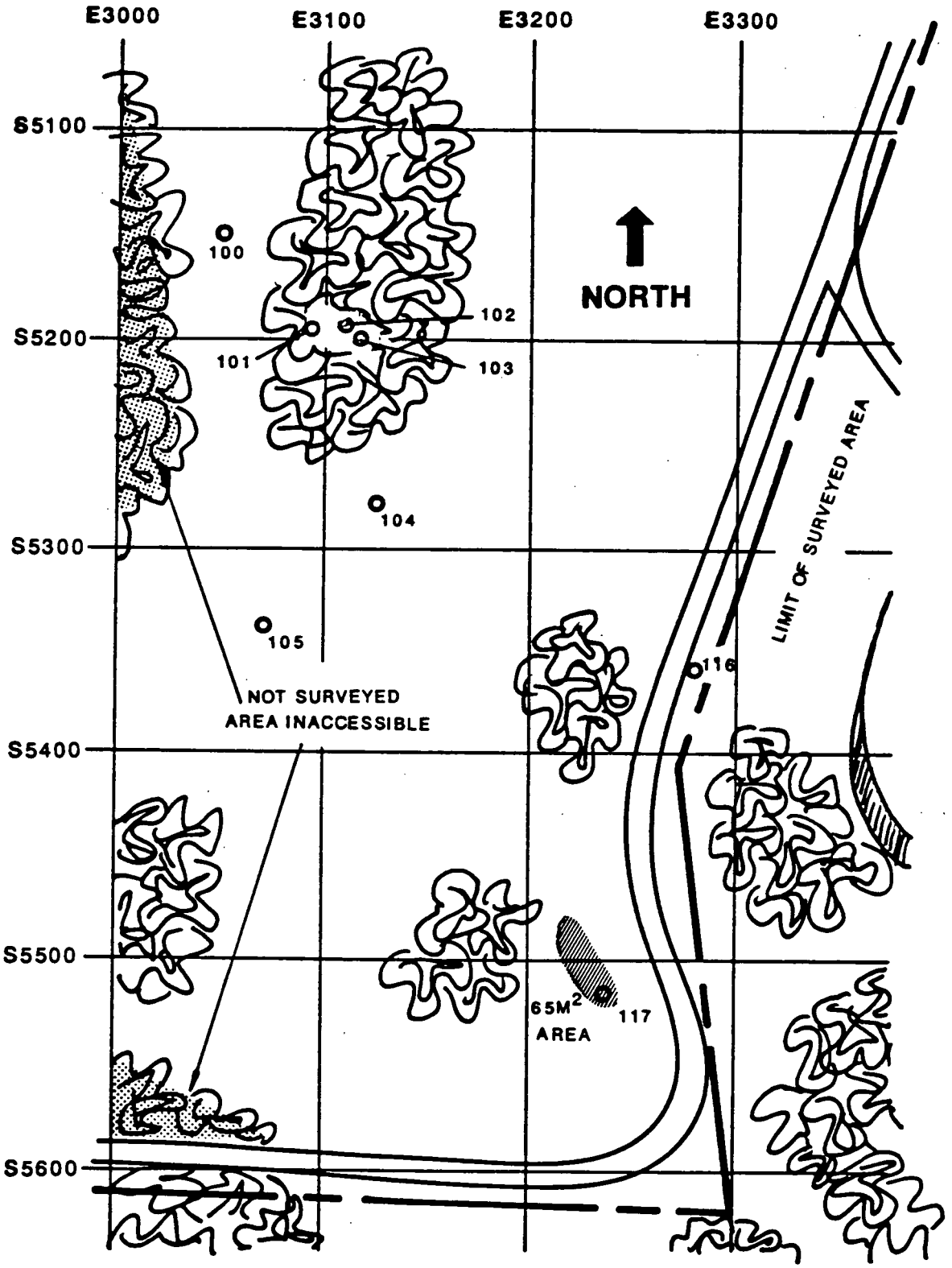

FIGURE 4.15.4 South Field - Contamination Locations in the Southeast Section

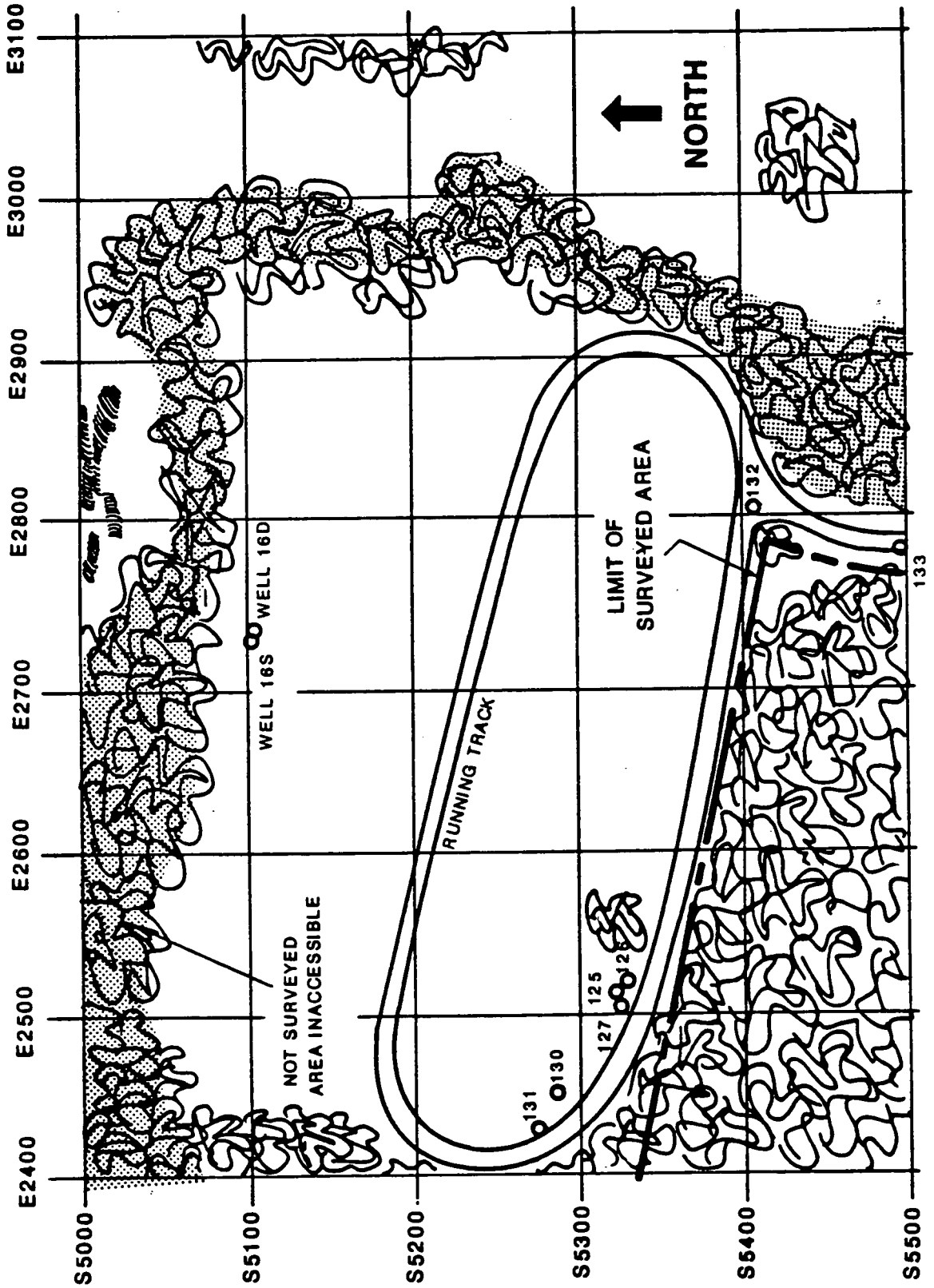

FIGURE 4.15.5 South Field - Contamination Locations in the Southwest Section

Incinerator

The waste treatment areas which contain the old incinerator was also surveyed with the mini FIDLER. This was referred to as Area 2 in the requests.

Analytical Design

No field samples were taken, therefore, no laboratory analyses were conducted.

4.15.3 Field and Analytical Data

Field Data

Eighty (80) spots and areas of contamination were detected in the surveyed portion of the south field area and are summarized in Table 4.15.1. Complete information is presented in Table 4.15.2. There were three large areas at points 11 and 30-32 in Fig. 4.15.2 and 117 in Fig. 4.15.4. Two areas were chosen for backhoe sampling based on the results of this assessment. The sampling results are presented in Environmental Problem 6. Figure 4.15.2 shows the largest area of contamination, which also had the highest readings on both of the portable radiation assessment instruments; 700 μR/h exposure rate and 150,000 counts per minute (CPM). The exposure rate ranged from 12 to 700 μR/h at the soil surface. The 12 μR/h is just slightly above the typical background 9 μR/h. The surface low-energy gamma measurement ranged from 2,000 to 150,000 CPM. Typically the background measurement for this instrument was 1500 CPM.

TABLE 4.15.1 Environmental Problem 15: Direct Radiation at Selected Locations of High Exposure - South Field

Location Number	Exposure Rate (μR/hr)		Surface beta-gamma (CPM/100 cm^2)		Area m^2
	Min	Max	Min	Max	
11	65	100	10,000	30,000	15
30-32	36	700	5,000	150,000	230
117	--	110	--	30,000	65
All 80	12	700	2,000	150,000	

TABLE 4.15.2 South Field Radiation Survey Data[a]

Location Number[b]	Site Grid Coordinates		Radiation Measurements[c] Exposure Rate at Ground Surface[d] (microR/hr)	mini FIDLER Surface[e] (CPM)	Approximate Size of Contamination (sq ft)
8	S-4627	E-2810	30	3,500	
9	S-4629	E-2797	34	100,000	
10	S-4631	E-2754	200	100,000	
11	S-4628	E-2946	65-100	10,000-30,000	160 (4 ft x 40 ft)
12	S-4655	E-3027	42	10,000	
13	S-4672	E-3063	28	10,000	10
14	S-4688	E-3156	50	10,000	
15	S-4694	E-3076	50	10,000	
16	S-4714	E-3081	80	12,000	10
17	S-4734	E-3099	28	5,000	20
18	S-4697	E-3038	55	10,000	
19	S-4673	E-3023	60	10,000	4
20	S-4679	E-2981	50	10,000	12
21	S-4685	E-2853	50	12,000	6
22	S-4725	E-2874	32	5,000	
23	S-4729	E-2917	55	10,000	3
24	S-4696	E-2842	65	12,000	2
25	S-4715	E-2845	55	12,000	2
26	S-4725	E-2838	75	12,000	2
27	S-4736	E-2825	46	8,000	
29	S-4704	E-2872	150	25,000	2
30	S-4707	E-2883	700	150,000	
31	S-4696	E-2694	160	20,000	2,500
32	S-4667	E-2687	36	5,000	(Edge of area)
38	S-4720	E-2648	60	12,000	
43	S-4530	E-2661	42	50,000	(Strip along road)
44	S-4534	E-2680	12	2,000	(Strip along road)
45	S-4541	E-2693	100	40,000	
46	S-4549	E-2712	15	2,000	
47	S-4557	E-2710	20	3,000	
48	S-4846	E-2759	35-100	5,000-30,000	
49	S-4831	E-2744	35-100	5,000-30,000	

TABLE 4.15.2 (Cont'd)

Location Number[b]	Site Grid Coordinates		Radiation Measurements[c]: Exposure Rate at Ground Surface[d] (microR/hr)	mini FIDLER Surface[e] (CPM)	Approximate Size of Contamination (sq ft)
58	S-4710	E-3181	32	8,000	
60	S-4732	E-3449	40	10,000	
63	S-4763	E-3411	40	8,000	2
64	S-4756	E-3436	30	10,000	20
65	S-4793	E-3352	85	12,000	
66	S-4821	E-3379	26	3,000	2
67	S-4876	E-3384	28	4,000	2
68	S-4840	E-3337	27	5,000	
69	S-4783	E-3329	180	40,000	8
70	S-4754	E-3322	30	5,000	20
71	S-4739	E-3322	40	50,000	
72	S-4797	E-3278	36	10,000	2
73	S-4745	E-3283	30	10,000	4
74	S-4790	E-3297	90	15,000	
75	S-4736	E-3263	70	15,000	20
76	S-4721	E-3250	60	15,000	10
77	S-4707	E-3230	--	10,000	
79	S-4730	E-3209	36	10,000	20
83	S-4776	E-3195	60	12,000	2
84	S-4892	E-3170	25	5,000-10,000	60
85	S-4944	E-3131	40	8,000	
86	S-4916	E-3163	60	15,000	
87	S-4923	E-3108	30	12,000	
88	S-4897	E-3279	120	25,000	
89	S-4898	E-3286	20	3,000	
90	S-4856	E-3302	100	35,000	
94	S-4732	E-3116	240	30,000	10
95	S-4725	E-3061	140	25,000	10
96	S-4646	E-3123	60	20,000	3
97	S-4953	E-2984	29	5,000-7,000	4
98	S-4934	E-2987	28	7,000	2

TABLE 4.15.2 (Cont'd)

Location Number[b]	Site Grid Coordinates		Radiation Measurements[c]: Exposure Rate at Ground Surface[d] (microR/hr)	Radiation Measurements[c]: mini FIDLER Surface[e] (CPM)	Approximate Size of Contamination (sq ft)
100	S-5150	E-3052	60	20,000	
101	S-5194	E-3094	160	45,000	(Concrete blocks)
102	S-5191	E-3109	32	10,000	(Fiber board)
103	S-5199	E-3120	100	35,000	
104	S-5281	E-3024	44	8,000	2
105	S-5337	E-3071	20	4,000	
116	S-5357	E-3282	110	30,000	
117	S-5515	E-3236	110	30,000	700
122	S-5105	E-2737	--	--	(Well 16D)
123	S-5103	E-2732	--	--	(Well 16S)
125	S-5320	E-2511	32	3,000	
126	S-5327	E-2518	60	25,000	
127	S-5327	E-2505	--	3,000-4,000	(General area)
130	S-5287	E-2453	45	30,000	
131	S-5277	E-2427	30	3,000-4,000	30
133	S-5499	E-2788	20	5,000	
134	S-4991	E-3394	35	15,000	1

[a]The portion of the south field designated for the survey was approximately 77,400 sq m. However, due to the terrain and heavy brush, about 12,900 sq m of the field was inaccessible. The actual area surveyed was about 64,500 sq m.

[b]Location numbers are shown in Fig. 4.15.2 through 4.15.5.

[c]The entire field was scanned with a radiation survey instrument, sometimes referred to as a mini FIDLER (Field Instrument for Detection of Low Energy Radiation). Survey details are given in Sec. 4.15.2.

[d]Using an Eberline PRM-7 micro R meter, exposure rate measurements were taken at the ground surface rather than the usual 1-meter height to reduce the interference from adjacent areas of contamination.

[e]These readings were taken at identified locations of contamination using a mini FIDLER.

In area #1, the conehouse and rubble, northeast of the site, no contamination could be found. In Area #2, around the old incinerator and manhole 175, there was general contamination throughout. High background levels, 100 μR/hr eminated from the incinerator. The exposure rate at the incinerator was 300 μR/hr. Near the sump was an area with 150 μR/hr exposure rate. Another area with an elevated exposure rate was observed near one of the trickle filters. The contamination spread beyond the fence line but decreased rapidly in the area beyond the fence, as shown in Fig. 4.15.6.

4.15.4 Data Quality Evaluation

Sampling Design - The number and location of sampling points provide representative information for this Problem. Data utility level 2.

Sample Collection - Appropriate field measurements was used. Field logbooks contain necessary supporting information to judge whether there were deviations from standard sampling protocols. Logbooks are signed and dated. Data utility level 2.

Sample Analysis - Not applicable to this problem.

QA/QC and Documentation - The S&A Plan contained a QA plan covering all aspects of the sampling and analysis program. Field QC for this Problem consists of using instrumentation with written documentation of calibration and maintenance. Data are reported in appropriate units accompanied by estimates of uncertainty. Supporting information is available. Data utility level 2.

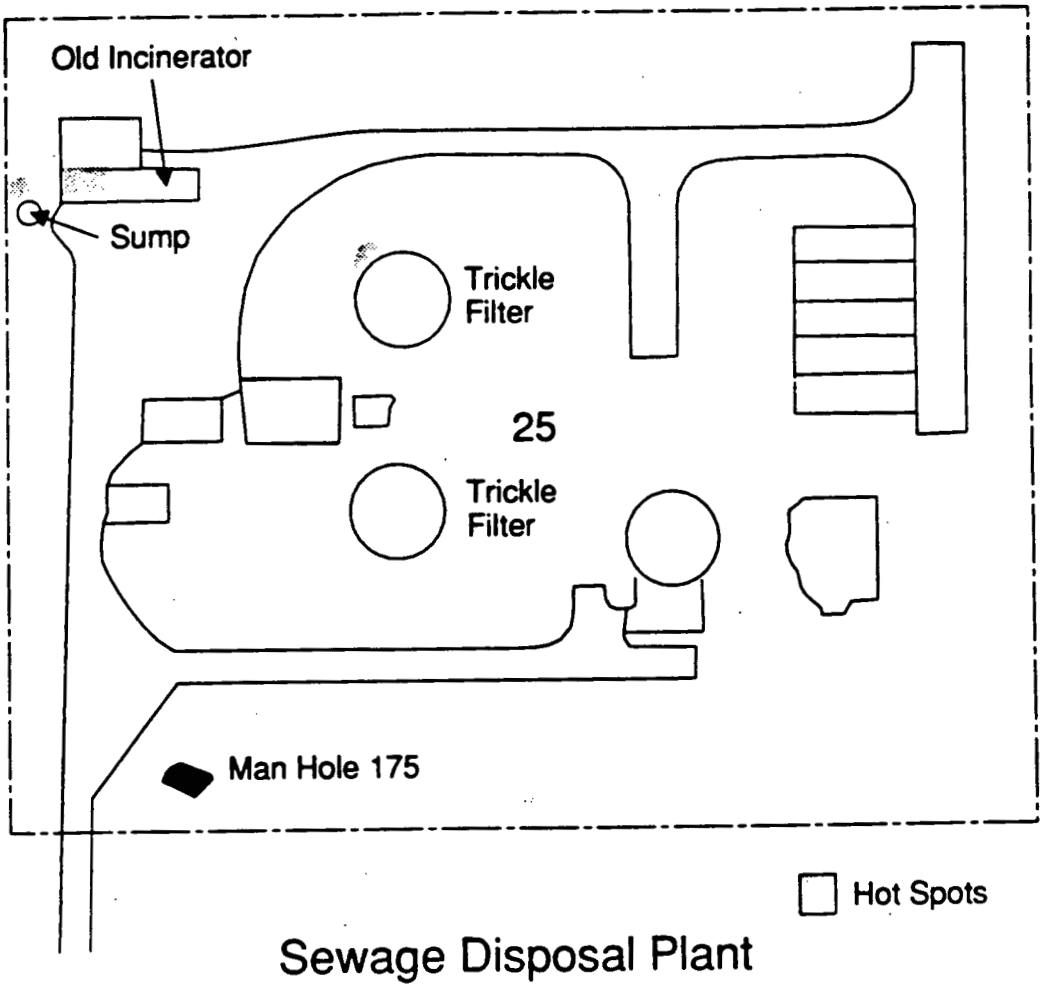

FIGURE 4.15.6 Sewage Disposal Area Contamination Locations

5 QUALITY ASSURANCE AND QUALITY CONTROL

This chapter presents information supporting assessment of the quality of the FMPC sampling and analysis data. Section 5.1 presents an overview of field quality control and field QC sample results. Section 5.2 provides information regarding analytical quality control, including QC results, accuracy and precision estimates for the data, and audit findings for ANL ACL. Section 5.3 presents an evaluation of data quality levels using guidance from the ESM.

5.1 FIELD QUALITY CONTROL

The QA Plan contained in the FMPC S&A Plan provided general requirements on the conduct of field sampling. Among the requirements contained in the QA Plan were collection of field QC samples. However, field QC activities were not well focused, resulting in minimal collection of field QC samples. Table 5.1.1 presents a summarization of field QC data.

Source Water Blank

The value of 635 µg/L of total uranium in the source water blank (FE0414OT) probably reflects contamination during preparation of the blank and does not reflect the actual concentration of uranium in the distilled water supply.

Groundwater Monitoring Well Samples - Bailer Rinsate

Two field QC samples were collected for the well sampling; a source water blank and a bailer rinsate. Comparison of the source water blank data to the bailer rinsate indicates that the cleaning method used for the bailer was adequate and the source water was without contamination, with regard to metals. These data support the integrity of the groundwater sampling data.

Emission Sampling Blanks

The filter blank data associated with the high and low volume samplers used for collecting air samples above the Rockwell furnaces (samples FE0200OT1A - FE0233OT1A) were subtracted from the filter sample data as part of the computation of emission rates.

The amount of analyte contained in the single filter blank relative to the amount of material contained in the sample provides a general indication of the relative accuracy of the high and low volume sampler data. The small filter blank, used for the low volume samplers, showed weights of 0.3, 420, and 800 µg for total U, Mg, and F, respectively. In comparison, the sample data for the low volume samples were generally in the range of 100-200, 1000-1500, and 5000 µg for total U, Mg, and F, respectively.

TABLE 5.1.1 Field Quality Control Sample Data

Sample Number	Type	Location	RCRA Metals: Al µg/L	Sb µg/L	As µg/L	Ba µg/L	Be µg/L	Cd µg/L	Ca µg/L	Cr µg/L
FE705019E	Sourcewater	Wells	[17]	3.7u	2.3u	2.5u	0.14u	2.3u	[98]	3.4u
FE705020E	Bailer Rinsate	Wells	[24]	3.7	2.3u	2.5u	0.14u	2.3u	[16]	3.4u
FE0116SS & 117SS	Duplicate	Pi.Pl. Tile Fld			App.E	App.E		App.E		App.E

Sample Number	Type	Location	RCRA Metals (Cont.) Co µg/L	Cu µg/L	Fe µg/L	Pb µg/L	Mg µg/L	Mn µg/L	Hg µg/L	Ni µg/L
FE705019E	Sourcewater	Wells	21u	44	[69]	0.53u	[23]	[2.1]	0.2u	49
FE705020E	Bailer Rinsate	Wells	21u	45	[6.9]	[1.9]	[5.9]	0.8u	0.2u	15u
FE0116SS & 117SS	Duplicate	Pi.Pl. Tile Fld				App.E			App.E	

Sample Number	Type	Location	RCRA Metals (Cont.) K µg/L	Se µg/L	Ag µg/L	Na µg/L	Tl µg/L	V µg/L	Zn µg/L
FE705019E	Sourcewater	Wells	92u	13u	[0.48]	162u	[1.7]	3.6u	3.0u
FE705020E	Bailer Rinsate	Wells	92u	1.3u	[0.52]	162u	1.7u	3.6u	3.0u
FE0116SS & FE0117SS	Duplicate	Pi.Pl. Tile Fld		App.E	App.E				

TABLE 5.1.1 (Cont.) Field Quality Control Sample Data

Sample Number	Type	Location	Radionuclides: U-235 µg/L	U-238 µg/L	Bi-214 µg/L	Cs-137 µg/L	Ra-226 µg/L	Th-228 µg/L	Th-232 µg/L	Total U µg/L	VOA's µg/L
FE0116SS & FE0117SS	Duplicate	Pi.Pl. Tile Fld	App.E	App.E	App.E	App.E	App.E	App.E	App.E	App.E	App.E
FE0414OT	Source Water									635 Fl1	

Sample Number	Type	Location	Radionuclides: (Cont.) U µg
FE0240OT	Filter Blank Low-Vol	Rockwell Frnce	0.3 Fl2
FE0243OT	Filter Blank	Plant 5 Stack	2.7
FE0249OT	Filter Blank	Plant 9 Stack	0.2
FE0250OT	Filter Blank High-Vol	Rockwell Frnce	3.4 Fl2

Sample Number	Type	Location	Miscellaneous: F µg	Mg µg	TOC µg	TOX µg
FE0240OT	Filter Blank Low-Vol	Rockwell Frnce	800 Fl2	420 Fl2		
FE0243OT	Filter Blank	Plant 5 Stack	1900	2810		
FE0249OT	Filter Blank	Plant 9 Stack			270	11
FE0250OT	Filter Blank High-Vol	Rockwell Frnce	1305 Fl2	1800 Fl2		

Sample Number	Type	Location	Organics:
FE0237ST	Blank Tenax Tube	Plant 9 Stack	None Observed
FE02480T	Blank Tenax Tube	Plant 9	Fl3

Fl1 = Labortory duplicate gave results of 633 µg/L
Fl2 = See explanation in text.
Fl3 = Blank contaminated with target compound from VOA analysis conducted by manufacturer to test trap.
U = Minimum detection limits.
[ ] = Values between the instrument and contract required detection limits.

Similarly, the analyte weights for the single high volume blank were 3.4, 1800, and 1305 μg. The sample data for the high volume samples was in the general range of 2,500, 5,000, and 50,000 μg for total U, Mg, and F, respectively.

The blank filter associated with the Plant 9 stack sampling (FE0249OT) was analyzed for total uranium, total organic carbon and total organic halogens (TOC and TOX). The TOC and TOX results from the filter blank are at virtually the same concentration as found in samples FE0244OT and FE0245OT. For this reason, TOC and TOX emission rates are not computed from the amount of this material reported for presentation in the data set. The discussion in Chapter 4 presents more detail on the stack sampling results.

The Tenax tube blank (FE0237ST) associated with organics sampling in the Plant 9 stack contained no organic compounds.

5.2 ANALYTICAL LABORATORY QUALITY CONTROL

The analysis of samples collected at FMPC was performed and/or coordinated by the ANL Analytical Chemistry Laboratory. Analyses performed by subcontractor laboratories are volatile organics by Hazleton Laboratories of America Inc., radioisotopes by Teledyne Isotopes-Midwest Laboratory, total organic carbon and total organic halogens by Gulf Coast Laboratories, and asbestos by McCrone Laboratories.

General laboratory quality control information is provided for each of these subcontractor laboratories in this section. Based on the subcontractor-supplied QC data, conditions which indicated that the integrity of the analytical results may be compromised are identified in the sample data set (Appendix E). Detailed QC data for analyses performed by ACL are provided in Appendix C.

5.2.1 ANL Analytical Chemistry Laboratory

At the time most analyses of FMPC samples were being conducted, analytical quality control requirements for the DOE Environmental Survey were being developed. The quality control applied to the FMPC samples represents reasonable laboratory practice, but may not reflect the current quality control requirements of the Survey. Quality control (QC) data applicable to FMPC sample analyses are provided in Appendix C. EPA audits of ANL ACL were conducted during the period when the majority of FMPC samples were being analyzed. The results of those audits are presented in Appendix D.

5.2.2 Hazleton Laboratories of America - Volatile Organics Analyses

All of the analyses for volatile organic compounds were conducted by Hazleton Laboratories, Madison, Wisconsin, which is a part of the U.S. EPA Contract Laboratory Program. The following summary comments outline the overall quality control.

- **GC-MS Tuning.** All samples were analyzed after a BFB tune which met CLP criteria.

- **Instrumental Calibration.** All initial and continuing calibrations met CLP criteria.

- **Method Blanks.** All method blanks were found to be within CLP criteria.

- **Surrogate Recoveries.** All surrogate recoveries for soils and waters were within CLP recovery limits except for 11 soil samples and 8 water samples.

- **Matrix Spikes.** All spiking compound recoveries and RPD's were within the CLP quality control limits.

The flyash samples produced lower internal standard and surrogate recoveries due to the retentive properties of the matrix. For these samples, the CLP soil recovery limits were used as a guideline. The detection limits listed in the data are for "normal" soil samples and should not be used as the minimum attainable limits for these samples.

5.2.3 Teledyne Isotopes - Radionuclides

Analysis of samples for plutonium and thorium isotopes and neptunium-237 was performed by Teledyne Isotopes. Detection capability for the procedure used depends upon the sample aliquot used in the analysis, the background efficiency of the counting instrument, and upon the counting interval. The minimum detectable level (MDL) for alpha-emitting nuclides in soil, sediment, or solid samples is nominally 1.7×10^{-2} pCi/g at the 4.66 sigma level. The MDL for environmental water samples is nominally 1.3×10^{-1} pci/L at the 4.66 sigma level.

Teledyne Isotopes Midwest Laboratory (formerly Hazleton Environmental Sciences) has participated in interlaboratory comparison (crosscheck) programs since the formulation of its quality control program in December 1971. The results of participation in the environmental sample crosscheck program for milk, water, air filters, and food samples during the period May 1984 through June 1987 are available. This program has been conducted by the U.S. Environmental Protection Agency Intecomparison and Calibration Section, Quality Assurance Branch, Environmental Monitoring and Support Laboratory, Las Vegas, Nevada.

5.2.4 Gulf Coast Laboratories

The analyses of air filters for TOC and TOX were performed by Gulf Coast Laboratories.

The instrument used for TOC analysis is a Xerex-Dohrman Automated Laboratory Total Organic Carbon Analyzer -- DC-80. The analyzer combusts the sample

at 800°C in an oxygen atmosphere. The CO_2 is then carried through the reactor to an infrared analyzer. The instrument's microprocessor calculates the area of the peaks produced by the analyzer, compares them to the peak area of the calibration standards stored in memory, and prints out a calibrated organic carbon value.

The instrument is on a regular maintenance schedule. After each set of 10 samples, a QC set of standards must be analyzed. These QC activities include quality control stock solution, daily quality control, spike blanks, and duplicates.

The detection limit for this analysis is 100 ppm TOC for liquid wastes. The TOC detection limit for solid waste varies with sample size.

The instrument for obtaining TOX data is a Xerex-Dohrman TOX analyzer and absorption module. The procedure uses a furnace to pyrolyze the bound halogens to hydrogen halide. The hydrogen halides are transported to a microcoulometric titration cell where the amount of halide is determined by measuring the current produced by silver ion precipitation of the halides.

Quality control is maintained by several methods which include use of duplicates, standards, spike blanks, and spikes.

The minimum detectable concentrations can be influenced by such factors as the equipment used, carbon quality, and the operator. A typical minimum detection limit for organic Cl-/L is 5 μg, and is used by Gulf Coast Labs for this procedure.

5.2.5 McCrone Environmental Services

Asbestos samples were analyzed by McCrone Environmental Services. The samples were analyzed on a detect/nondetect basis using stereomicroscopy and polarized light microscopy with dispersion staining.

The laboratory possesses such reference materials as UICC standards of amosite, anthophyllite, Canadian and Rhodesian chrysotile and crocidolite.

The laboratory's performance on round-robin samples is available upon request.

5.3 DATA QUALITY EVALUATION

This section presents an overview and summary of FMPC data quality. The data quality assessment provides a basis for comparison of the FMPC data to data associated with other sites in the Environmental Survey. Appendix A "Criteria for Data Evaluation" from the Environmental Survey Manual (ESM) in combination with information describing sampling and analysis at FMPC provides the criteria and information for this assessment.

The ESM Appendix A provides general criteria for categorizing a wide range of environmental monitoring data as to their general use. The application of the data utility criteria are dependent upon the intended use or objectives of the data. The objectives of the Survey are to identify and then prioritize, DOE-wide, areas of existing

environmental problems and risk. In that regard, sampling and analysis activities are not meant to characterize identified potential environmental problems, but rather to fill gaps in environmental monitoring data.

In this context, sampling design, sample collection, sample analysis, and QA/QC and documentation (Tables A-1 through A-4 in the DOE ESM Appendix A) associated with each environmental problem will be rated at a data utility level. Data utility levels are defined below as:

Level 1: Documentation of the highest standards for sampling, analysis, and quality control.

Level 2: Permits a wide range of data quality and allows for follow-up sampling to provide for confirmation.

Level 3: May be useful only for indicating areas on which to focus future sampling.

Chapter 4 presents the results of application of the criteria on an environmental problem-specific basis. General areas of importance are discussed in the following paragraphs.

FMPC S&A Quality Assurance Plan

The QA Plan addresses such areas as project organization, sampling and laboratory QC, sample custody, documentation, corrective actions, data validation and reporting, sampling handling and shipping, and other topics of importance. While the QA plan did lay out some reasonable structures for conducting the program, the procedures for implementing the Plan were largely not in place.

Some of the differences in field sampling relative to the current protocols under which the DOE Environmental Survey operates are outlined below:

Independent technical review - The FMPC S&A Plan did not receive independent technical review.

Written procedures - Adequate written procedures were not always available for activities having a potential impact on the quality and/or integrity of the data.

Sample collection - The May 1986 ESM served as the basis for sampling protocols. That early document is not markedly different from the final ESM in terms of routine sampling methods.

Equipment calibration and maintenance - Records providing information on calibration and maintenance performed on equipment used in the field are largely not available. The major exception to this

is the radiation survey equipment used in the South Field and at other smaller locations.

Documentation - The level of documentation is highly variable. Sampling for some problems is well documented, while for others documentation is minimal. Document maintenance and control procedures were not in place during the field sampling process.

Shipping - Shipping of samples from the field to the lab was handled in much the same manner as with the later sites. The only major difference is with the forms used in the chain-of-custody documentation.

Sample handling and control - The sample handling requirements (i.e., containers, preservatives, holding times) given in the FMPC S&A Plan were taken directly from U.S. EPA guidelines. Although sample control was implemented, the procedures used were not as rigorous as those for later sites. Although sample integrity cannot be strictly defended, it will be assumed that no samples were compromised unless the records indicate otherwise.

Collection of field QC samples - The FMPC QA Plan generally specified field QC samples to be collected. However, collection of such samples was inadequate during the main field sample collection period for most environmental problems. The only reliable QC samples collected were in support of the emission sampling and the monitoring well sampling (the monitoring well samples were collected almost a year later).

ACL Quality Assurance Plan

ACL did have an approved QA plan in place. However, at the time most of the analytical work for FMPC was being performed, the written procedures (SOP's), including those based on CLP SOW 785 requirements, were in draft form. Therefore, some of the procedures may have been different from what is currently in use by the ACL, although analytical results are credible. No attempt is made at an in-depth comparison of analytical procedures. The available QC data from the lab is adequate for judging analytical data quality (accuracy and precision).

Data Quality Assessment

Despite the lack of procedures which parallel those defining the current activities in the Survey, there is enough information to generally support reasonable judgments regarding the integrity of the field sample collection activities on a problem-by-problem basis. That information is provided in Chapter 4 with the discussion of each Environmental Problem. Table 5.3.1 provides a summarization of the data utility level categorizations given in Chapter 4.

TABLE 5.3.1 Environmental Problem Data Quality Utility Levels

Environmental Problem Number	Title	Sampling Design	Sample Collection	Sample Analysis	QA/QC and Documentation
1	K-65 Trench	2	2	2	2
2	Particulate Deposition	2	2	2	2
3	Process Emissions-Rockwell Furnaces			2	2
3	High-Volume Samplers	2	2		
3	Low -Volume Samplers	3	3		
3	Process Emissions-Plant 9	3	3	2	2
3	Process Emissions-Plant 5	3	2	2	2
4	Production Area Soil Contamination	3	3	2	2
5	NonProduction Area Soil Contamination	3	3	2	2
6	So. of Production Area Soil Contamination	3	3	2	2
7	Onsite Surface Water Contamination	2	2	2	2
8	Offsite Surface Water Contamination	2	2	2	2
9	Onsite Groundwater Contamination	2	2	2	2
10	Offsite Groundwater Contamination	2	2	2	2
11	Abandoned Tanks	2	2	2	2
12	Wastewater Treatment and Discharge	2	2	2	2
13	Unidentified Substances	2	2	2	2
14	Contamination in Milk	2	2	2	2
15	Direct Radiation-Selected Locations	2	2		2

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