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RCRA GROUNDWATER MONITORING PLAN
VOLUME 1 OF 2
DECEMBER 1992

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PLAN

RCRA GROUNDWATER MONITORING PLAN

4034

REVISION 1
DECEMBER 1992
Volume 1 of 2

Fernald Environmental Management Project
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Prepared for the
U.S Department of Energy
Fernald Office

Enclosure 2

RCRA Groundwater Monitoring Plan

EXECUTIVE SUMMARY

The Fernald Environmental Management Project (FEMP) is a Department of Energy (DOE) owned, contractor-operated facility located on 1,050 acres in a rural area approximately 18 miles northwest of downtown Cincinnati, Ohio (Figure I.A). In 1952, the facility commenced manufacturing uranium metal products for the United States defense programs. These activities occurred over approximately 136-acres called the production area. During this time, the Fernald facility was named the Feed Materials Production Center (FMPC). On July 10, 1989, production operations ceased. In August 1991, the name of the facility was formally changed to the Fernald Environmental Management Project (FEMP) to emphasize the new focus of the facility. The current mission of the FEMP is to maintain environmental compliance, perform waste management and environmental restoration activities, and to continually improve projects and services to meet the needs of the DOE, state and federal regulators, and the general public.

When President Reagan signed Executive Order 12088, all DOE facilities were mandated to comply with existing environmental statutes and regulations including the Clean Air Act, the Resource Conservation and Recovery Act (RCRA), and the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). Consequently, on July 18, 1986, a Federal Facilities Compliance Agreement (FFCA) was jointly signed by DOE and the USEPA pertaining to environmental impacts associated with the FEMP. In particular, the FFCA was intended to ensure that environmental impacts associated with past and present activities at the FEMP are thoroughly and adequately investigated so that appropriate remedial response actions can be formulated, assessed, and implemented.

In response to the FFCA, a Remedial Investigation and Feasibility Study (RI/FS) was initiated pursuant to CERCLA as implemented by the National Contingency Plan (NCP). In 1986, the FFCA was amended by a Consent Agreement under Sections 120 and 106(a) of CERCLA in order to achieve consistency with changing regulations and guidance. The Consent Agreement was signed on April 9, 1990, and became effective on June 29, 1990. The FFCA also requires compliance with RCRA. Pursuant to this, the FEMP is required to adhere to RCRA groundwater monitoring requirements.

This RCRA Groundwater Monitoring Plan (GMP) has been prepared to address RCRA monitoring requirements and is consistent with the mission of the FEMP. The program integrates the requirement to provide groundwater monitoring for RCRA regulated units with current CERCLA remedial activities at the FEMP. A regulated unit is defined as a landfill, surface impoundment, waste pile, or land treatment unit that received hazardous waste after July 26, 1982. There are nine regulated units at the FEMP: Waste Pit 4, Waste Pit 5, the Clearwell, the Biodenitrification Lagoon, the Lime Sludge Pond, the Sludge Drying Beds, the Tank Farm Sump, the Coal Pile Runoff Basin, and the Fire Training Area. These regulated units were identified in the Part A Permit Application submitted to the Ohio Environmental Protection Agency (OEPA) in June of 1991 (Figure I.B).

Meetings were held at the OEPA Southwest District Office on August 6, 1991, and September 5, 1991, to discuss the groundwater monitoring requirements for the regulated units. Present at the meetings were representatives from USEPA, OEPA, DOE, and Westinghouse Environmental Management Company of Ohio (WEMCO). During the August meeting, the possible integration of the RCRA groundwater

monitoring requirements with CERCLA remedial activities was discussed. It was agreed that the FEMP would develop a monitoring plan that utilized, to the extent possible, existing well locations. To achieve this goal, WEMCO suggested the identification of Waste Management Areas (WMAs) to most efficiently utilize existing wells and to provide monitoring for the most highly contaminated areas of the facility. A WMA is defined in OAC 3745-54-95(b)(2)/40 CFR 265.91(b)(2) as an imaginary boundary which circumscribes several waste management components (Figure I.B).

An outline of the proposed monitoring program was presented to the USEPA and OEPA on September 5, 1991. The outline designated the Waste Pit Area and the Production Area as WMAs. The outline proposed monitoring along the downgradient boundaries of the WMAs and along the downgradient facility property boundary. Regulations pertaining to a Detection Monitoring Program are inappropriate for the FEMP since the Remedial Investigation (RI) had identified releases from the Production Area, and previous RCRA monitoring had identified releases from the Waste Pit Area. The outline therefore incorporated, to the extent possible, the requirements of an Assessment Monitoring Program.

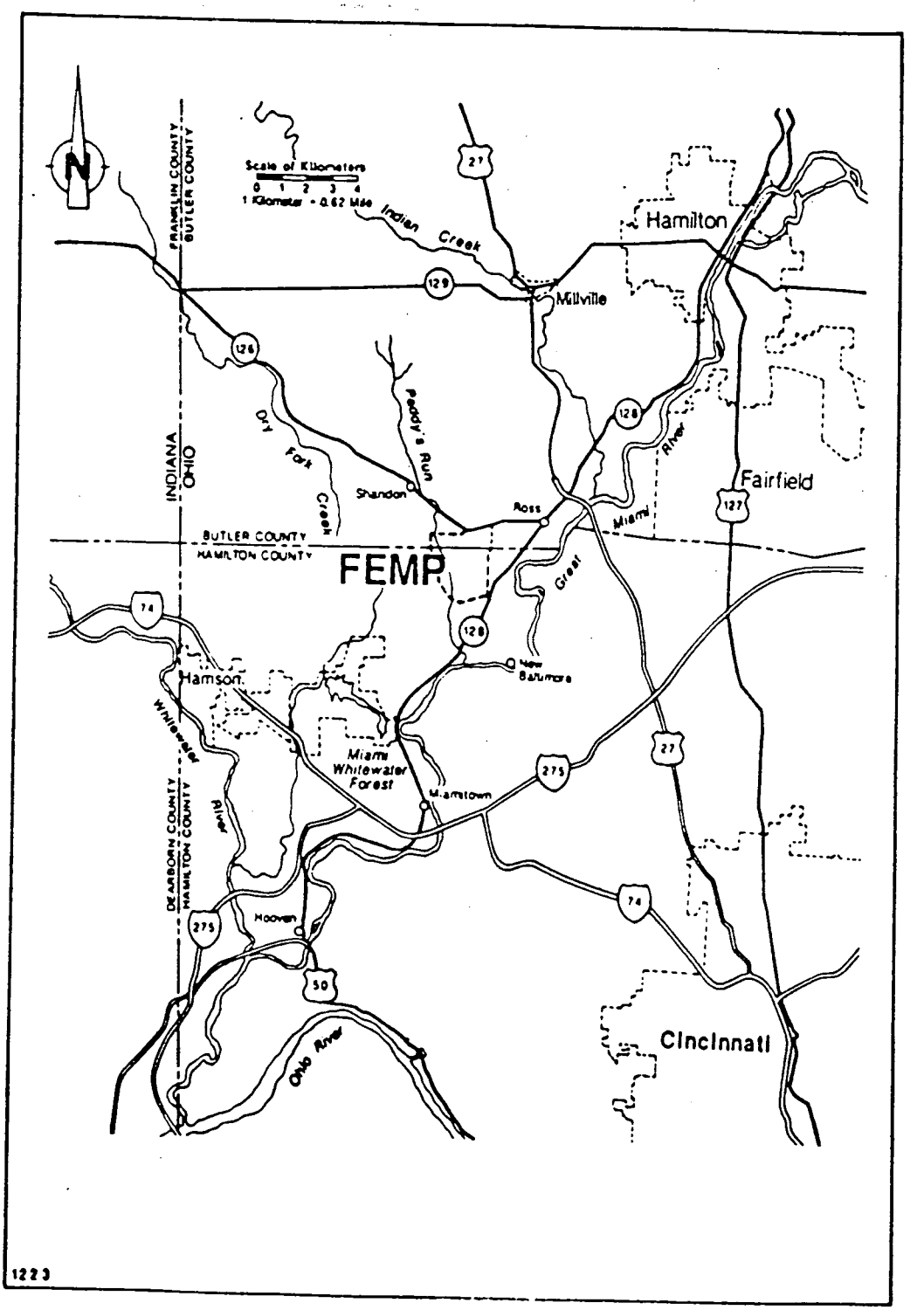
This RCRA GMP is intended to replace the existing Groundwater Quality Assessment Program Plan for Waste Pit 4 (GQAPP). The scope of the RCRA GMP is larger than that of the GQAPP due to the requirement to provide coverage for all regulated units identified in the July 1991 Part A Permit Application submittal. The GQAPP provided coverage only for Waste Pit 4, which prior to July 1991, was the only identified regulated unit at the FEMP.

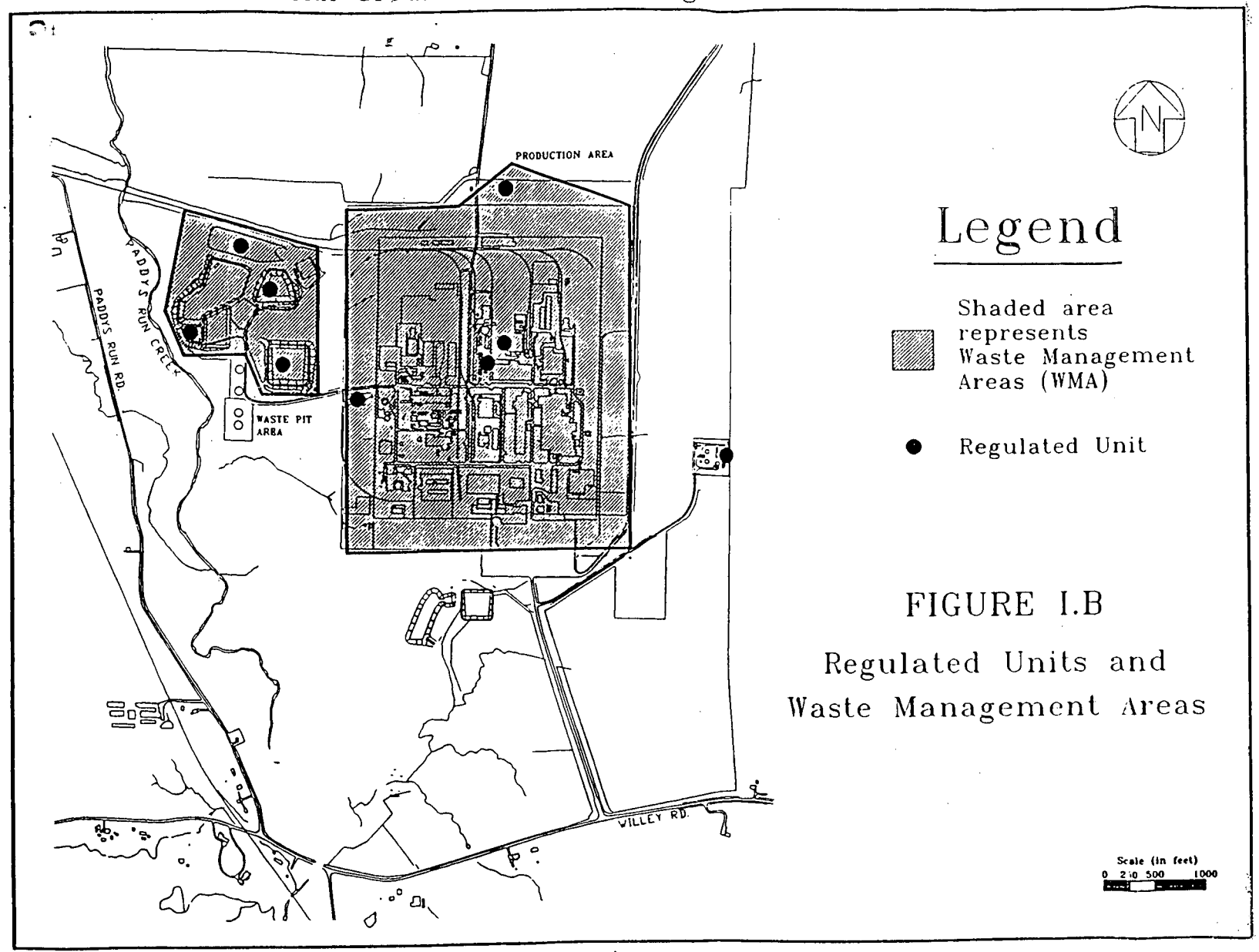
The objectives of an Assessment Monitoring Program (OAC 3745-65-93(D)(7)(a)/40 CFR 265.93(d)(7)(i)) will be addressed through implementation of this RCRA GMP. The RCRA GMP will provide: 1) monitoring on a quarterly basis for a list of site specific constituents; 2) data evaluation, including trend analysis to evaluate changes in water quality over time; 3) comparison of data to CERCLA Preliminary Remediation Goals (PRGs) or Maximum Contaminant Levels (MCL) (OAC 3745-81-11(B)/40 CFR141.11(b); and 4) the determination as to rate and extent of contaminant migration from the facility for contaminants that pose a health risk, consistent with OAC 3745-65-93(A) and 40 CFR 265.93(a). Upgradient to downgradient water quality comparisons for the purpose of release detection (OAC 3745-65-93(B) through 3745-65-93(D)(2) and 40CFR 265.93(b) through 265.93(d(2)) will not be performed, since releases had been previously identified through the RI and RCRA monitoring.

RCRA Groundwater Monitoring Plan

FIGURE I.A

Location of the FEMP Facility





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Regulated Units and Waste Management Areas

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LIST OF ACRONYMS

AEC	Atomic Energy Commission
AMSL	Above Mean Sea Level
ASL	Analytical Support Level
BFB	Bromofluorobenzene
BGS	Below Ground Surface
CERCLA	Comprehensive Environmental Response Compensation And Liability Act
CLP	Contract Lab Program
CWA	Clean Water Act
DFTPP	Decafluorotriphenylphosphine
DOE	U. S. Government Department of Energy
DQO	Data Quality Objective
EPA	Environmental Protection Agency
FEMP	Fernald Environmental Management Project
FFCA	Federal Facilities Compliance Agreement
FMPC	Feed Materials Production Center
GMP	Groundwater Monitoring Plan
GQAPP	Groundwater Quality Assessment Program Plan
GWR	Groundwater Report
HSL	Hazardous Substance List
HWMU	Hazardous Waste Management Unit
MCL	Maximum Contaminant Levels
NLO	National Lead Company of Ohio
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Unit
O&M	Operation and Maintenance
OEPA	Ohio Environmental Protection Agency
ORO	DOE Oak Ridge Operations
OU1	Operable Unit 1
OU3	Operable Unit 3
PCB	Polychlorinated Biphenyl
QA/QC	Quality Assurance/Quality Control
SCQ	Sitewide CERCLA Quality Assurance Project Plan
QAPP	RI/FS Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RF	Response Factors
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RSD	Relative Standard Deviation
RSE	Removal Site Evaluations
SOWC	Southwestern Ohio Water Company
SWL	Static Water Level

LIST OF ACRONYMS (Cont.)

SWMU	Solid Waste Management Unit
TD	Total Depth
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TOX	Total Organic Halogen
USEPA	U. S. Environmental Protection Agency
USGS	U. S. Geological Survey
VOC	Volatile Organic Compound
WEMCO	Westinghouse Environmental Management Company of Ohio
WMA	Waste Management Area
WMCO	Westinghouse Materials Company of Ohio

RCRA Groundwater Monitoring Plan

1.0 THE FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

The Fernald Environmental Management Project (FEMP) is a Department of Energy (DOE) owned, contractor-operated facility located on 1,050 acres in a rural area approximately 18 miles northwest of downtown Cincinnati, Ohio. In 1952, the facility commenced manufacturing uranium metal products for the United States defense programs. These activities occurred over approximately 136-acres called the production area. During this time, the Fernald facility was named the Feed Materials Production Center (FMPC). On July 10, 1989, production operations ceased. In August 1991, the name of the facility was formally changed to the Fernald Environmental Management Project (FEMP) to emphasize the new focus of the facility. The current mission of the FEMP is to maintain environmental compliance, perform waste management and environmental restoration activities, and to continually improve processes and services to meet the needs of the DOE, state and federal regulators, and the general public.

The DOE Oak Ridge Operations (ORO) entered a Federal Facilities Compliance Agreement (FFCA) with the U.S. Environmental Protection Agency (USEPA) on July 18, 1986 pursuant to Executive Order 12088 (43 Federal Register 47707) that sets forth compliance with existing environmental statutes and regulations. Key elements of the FFCA include compliance with the Resource Conservation and Recovery Act (RCRA), the Clean Water Act (CWA), and initiating a site-wide Remedial Investigation/Feasibility Study (RI/FS). The FEMP was added to the National Priorities List in 1989. A consent agreement was negotiated between the DOE and USEPA in April 1990. The agreement included assured compliance with changing regulations and guidance. The consent agreement was revised in September, 1991. The DOE entered a consent decree with the State of Ohio on December 2, 1988. The consent decree outlined specific actions necessary to attain compliance with RCRA and CWA including the characterization and proper management of hazardous waste, groundwater monitoring of RCRA regulated units, and the control of wastewater and surface water runoff.

2.0 RCRA COMPLIANCE AT THE FEMP

The FEMP submitted a revised Part A Permit Application to the Ohio Environmental Protection Agency (OEPA) in June 1991, which identified 51 Hazardous Waste Management Units (HWMUs) including nine regulated units and 242 Solid Waste Management Units (SWMUs). A regulated unit is defined as a landfill, surface impoundment, waste pile or land treatment unit that received hazardous waste after July 26, 1982. Figure 2.1 identifies the 51 HWMUs and Figure 2.2 identifies the 242 SWMUs.

The regulated units identified in the June 1991, Part A Permit Application include Waste Pit 4, Waste Pit 5, the Clearwell, the Biodenitrification Surge Lagoon, the Lime Sludge Pond, the Tank Farm Sump, the Coal Pile Runoff Basin, the Fire Training Area and the Sludge Drying Beds. The nine regulated units are subject to the RCRA groundwater monitoring requirements. Before June 1991, Waste Pit 4 was the only identified regulated unit at the FEMP subject to the RCRA Groundwater Monitoring requirements. On November 25, 1987, a RCRA Groundwater Quality Assessment Program Plan (GQAPP) for Waste Pit 4 (DOE, Nov. 1987) was submitted to the OEPA and the USEPA to satisfy OAC 3745-65-93 (D)(2)/40 CFR 265.93 (d)(2). In March of 1989, Revision One of the plan was submitted to update the RCRA Program. Revision Two of the GQAPP was submitted in April of 1991.

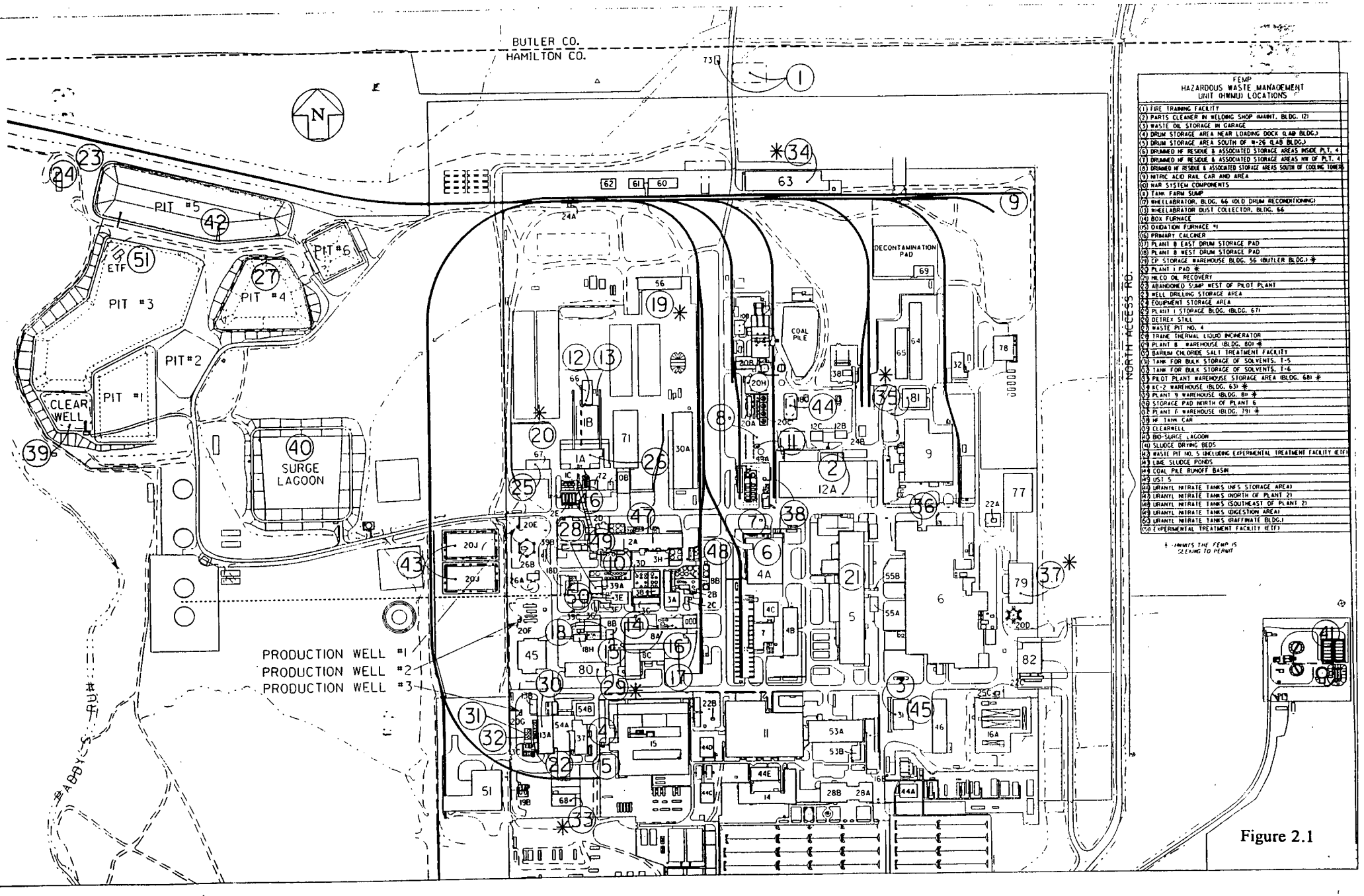

BUTLER CO.
HAMILTON CO.
N
PIT #5
PIT #6
PIT #4
PIT #3
PIT #2
PIT #1
ETF
CLEAR WELL
SURGE LAGOON
PRODUCTION WELL #1
PRODUCTION WELL #2
PRODUCTION WELL #3
DECONTAMINATION PAD
COAL PILE
NORTH ACCESS RD.
FEMP
HAZARDOUS WASTE MANAGEMENT UNIT (HWMU) LOCATIONS
(1) FIRE TRAINING FACILITY
(2) PARTS CLEANER IN WELDING SHOP (MAINT. BLDG. 12)
(3) WASTE OIL STORAGE IN GARAGE
(4) DRUM STORAGE AREA NEAR LOADING DOCK (LAB BLDG.)
(5) DRUM STORAGE AREA SOUTH OF N-26 (LAB BLDG.)
(6) DRUMMED HF RESIDUE & ASSOCIATED STORAGE AREAS INSIDE PLT. 4
(7) DRUMMED HF RESIDUE & ASSOCIATED STORAGE AREAS NW OF PLT. 4
(8) DRUMMED HF RESIDUE & ASSOCIATED STORAGE AREAS SOUTH OF COOLING TOWERS
(9) NITRIC ACID RAIL CAR AND AREA
(10) NAR SYSTEM COMPONENTS
(11) TANK FARM SUMP
(12) WHEELABRATOR, BLDG. 66 (OLD DRUM RECONDITIONING)
(13) WHEELABRATOR DUST COLLECTOR, BLDG. 66
(14) BOX FURNACE
(15) OXIDATION FURNACE #1
(16) PRIMARY CALCINER
(17) PLANT 8 EAST DRUM STORAGE PAD
(18) PLANT 8 WEST DRUM STORAGE PAD
(19) CP STORAGE WAREHOUSE BLDG. 56 (BUTLER BLDG.) *
(20) PLANT 1 PAD *
(21) MILCO OIL RECOVERY
(22) ABANDONED SUMP WEST OF PILOT PLANT
(23) WELL DRILLING STORAGE AREA
(24) EQUIPMENT STORAGE AREA
(25) PLANT 1 STORAGE BLDG. (BLDG. 67)
(26) DETREX STILL
(27) WASTE PIT NO. 4
(28) TRANE THERMAL LIQUID INCINERATOR
(29) PLANT 8 WAREHOUSE (BLDG. 80) *
(30) BARIUM CHLORIDE SALT TREATMENT FACILITY
(31) TANK FOR BULK STORAGE OF SOLVENTS, T-5
(32) TANK FOR BULK STORAGE OF SOLVENTS, T-6
(33) PILOT PLANT WAREHOUSE STORAGE AREA (BLDG. 68) *
(34) RC-27 WAREHOUSE (BLDG. 63) *
(35) PLANT 9 WAREHOUSE (BLDG. 81) *
(36) STORAGE PAD NORTH OF PLANT 6
(37) PLANT 6 WAREHOUSE (BLDG. 79) *
(38) HF TANK CAR
(39) CLEARWELL
(40) BIO-SURGE LAGOON
(41) SLUDGE DRYING BEDS
(42) WASTE PIT NO. 5 (INCLUDING EXPERIMENTAL TREATMENT FACILITY (ETF))
(43) LIME SLUDGE PONDS
(44) COAL PILE RUNOFF BASIN
(45) UST 5
(46) URANYL NITRATE TANKS (NFS STORAGE AREA)
(47) URANYL NITRATE TANKS (NORTH OF PLANT 2)
(48) URANYL NITRATE TANKS (SOUTHEAST OF PLANT 2)
(49) URANYL NITRATE TANKS (DIGESTION AREA)
(50) URANYL NITRATE TANKS (RAFFINATE BLDG.)
(51) EXPERIMENTAL TREATMENT FACILITY (ETF)
* - AREAS THE FEMP IS SEEKING TO PERMIT

Figure 2.1

RCRA Groundwater Monitoring Plan

FIGURE 2.2

Solid Waste Management Units

To be found in envelope at end of report

RCRA Groundwater Monitoring Plan

This document, entitled the RCRA GMP covers monitoring for all the RCRA regulated HWMUs, and will replace the RCRA GQAPP for Waste Pit 4 as the controlling document for RCRA groundwater monitoring. The objectives of this plan and its scope are identified in the sections to follow.

2.1 Objectives of the RCRA Groundwater Monitoring Plan

This RCRA GMP has been prepared to address RCRA groundwater monitoring requirements and to be consistent with the mission of the FEMP. The program integrates the requirement to provided groundwater monitoring for RCRA regulated units with current CERCLA remedial activities at the FEMP. To achieve an integrated monitoring program, the WMAs have been designated to most efficiently utilize existing wells, and to provide monitoring for the most highly contaminated areas of the facility. A WMA is defined in OAC-3745-65-91(B)(2)/40 CFR 265.91(b)(2) as an imaginary boundary which circumscribes several waste management components.

The Waste Pit Area and the Production Area have been designated as WMAs. Monitoring is proposed along the downgradient boundaries of the WMAs and along the downgradient facility property boundary. Regulations pertaining to a Detection Monitoring program are inappropriate for the FEMP since the Remedial Investigation (RI) has identified releases from the Production Area, and previous RCRA monitoring has identified releases from the Waste Pit Area. The program therefore incorporates, to the extent possible, the requirements of an Assessment Monitoring Program.

2.2 Program Implementation

The RCRA GMP will monitor for site specific parameters at the boundary of the WMAs and at the facility boundary. Sampling will occur quarterly for site specific parameters starting January, April, July, and October of each year and will be completed by the end of the second month (February, May, August, and November) of each quarterly sampling round.

The objectives of an Assessment Monitoring Program (OAC 3745-65-93(D)(7)(a)/40 CFR 265.93(d)(7)(i)) will be addressed through implementation of this RCRA GMP. The RCRA GMP will provide: 1) monitoring on a quarterly basis for a list of site specific constituents; 2) data evaluation, including trend analysis to evaluate changes in water quality over time; 3) comprison of data to CERCLA Preliminary Remediation Goals (PRGs) or Maximum Contaminant Levels (MCL) (OAC 3745-81-11(B)/40 CFR141.11(b); and 4) the determination as to rate and extent of contaminant migration from the facility for contaminants that pose a health risk, consistent with OAC 3745-65-93(A) and 40 CFR 265.93(a). Upgradient to downgradient water quality comparisons for the purpose of release detection (OAC 3745-65-93(B) through 3745-65-93(D)(2) and 40CFR 265.93(b) through 265.93(d(2)) will not be performed, since releases had been previously identified through the RI and RCRA monitoring.

The following sections provide a technical discussion of the site, the RCRA Monitoring Program, and methodology for implementation and operation of the RCRA Monitoring Program.

3.0 SITE SETTING

The U. S. Atomic Energy Commission (AEC), predecessor to the DOE, established the Feed Materials Production Center (FMPC) for processing uranium and its compounds from natural uranium ore concentrates and recycled, recoverable residues for government needs. This integrated production complex began operations in conformance with AEC Orders in the early 1950s. In 1951, National Lead Company of Ohio (now NLO, Inc.) entered into contract with the AEC as Operations and Maintenance Contractor (O&M). This contractual relationship lasted with AEC, and eventually DOE, until January 1, 1986. Westinghouse Materials Company of Ohio (WMCO), a wholly-owned subsidiary of Westinghouse Electric Corporation, then assumed management responsibilities of the site operations and facilities for a minimum of five years.

Production peaked in 1960 at approximately 10,000 metric tons of uranium (mtu) per year. A product decline began in 1964, to a low in 1975 of about 1230 mtu. During the 1970s, consideration was given to closing the FMPC; therefore, capital improvements and staffing were minimized. The staffing level, which peaked at 2891 in 1956, slowly declined to 538 in 1979. In 1981, the FMPC began planning to accommodate increased production requirements. Production levels significantly increased and there was a rapid staff buildup in many areas for several years. Implementation of a major facilities restoration program followed. Production ceased in the summer of 1989 to focus plant resources on the restoration program. The FMPC changed its direction in July 1991 and became the Fernald Environmental Management Project (FEMP), focusing upon environmental restoration.

A variety of chemical and metallurgical processes were utilized at the FMPC for the manufacture of uranium products. Impure starting materials were dissolved in nitric acid and the uranium was purified through solvent extraction to yield a solution of uranyl nitrate. Evaporation and heating converted the nitrate solution to uranium trioxide (UO_3) powder. This compound was reduced with hydrogen to uranium dioxide (UO_2) and then converted to uranium tetrafluoride (UF_4) by reaction with anhydrous hydrogen fluoride. Uranium metal was produced by reacting UF_4 and magnesium metal in a refractory-lined vessel. This primary uranium metal was then remelted with scrap uranium metal to yield a purified uranium ingot. Various uranium metal working processes were also housed on the FMPC.

From 1953 through 1955, the FMPC refinery processed pitchblende ore from the Belgian Congo. Pitchblende ore contains all daughter products of the uranium decay chains and is particularly high in radium content. No chemical separation or purification was performed on the ore prior to arrival at the FMPC. Beginning in 1956, the refinery feedstock consisted of uranium concentrates (yellowcake) from Canada and the United States. Canadian concentrates were not processed after 1960. In the production of these concentrates, most of the uranium daughters had been removed. However, Radium-226 (Ra-226) remained in the yellowcake in amounts that varied with the process.

Small amounts of thorium were produced at the FMPC on several occasions from 1954 through 1976. Thorium operations were performed in the metals fabrication plant, the recovery plant, the special projects plant, and the pilot plant. The FEMP currently serves as the thorium repository for DOE and maintains long-term storage facilities for a variety of thorium materials.

Large quantities of liquid and solid wastes were generated by the various operations at the FMPC. Before 1984, solid and slurried wastes from FMPC processes were disposed of in the on-property Waste Storage Area. This area, which is located west of the production facilities (Figure 3.1), includes six low-level radioactive waste storage pits; two earthen-bermed concrete silos containing K-65 residues that are high-specific activity and low-level radium-bearing residues resulting from the pitchblende refining process; one concrete silo containing metal oxides; one unused concrete silo; two Lime Sludge ponds; and a sanitary landfill.

Solid waste materials associated with uranium metals production are presently stored at the FEMP in steel drums awaiting either further processing or off-site disposal at approved facilities. These wastes include oils, sludge, contaminated combustibles, filter cake, off-spec UF_4 or thorium tetrafluoride (ThF_4), and reject UO_3. The drums sit either on various pads or in warehouses and are inspected weekly. Contents of deteriorated drums are repackaged. Other wastes, stored in drums on contained surfaces, include spent degreasing solvents and material contaminated with polychlorinated biphenyls (PCBs).

An Inactive Fly Ash disposal area and an Active Fly Ash pile are located approximately 3000 feet south-southeast of the waste storage area. One pile remains active for the disposal of fly ash from the FEMP coal-fired boiler plant. An area between and adjacent to the fly ash areas, known as the Southfield, is believed to be the disposal site for construction debris and possibly other types of solid wastes from past operations.

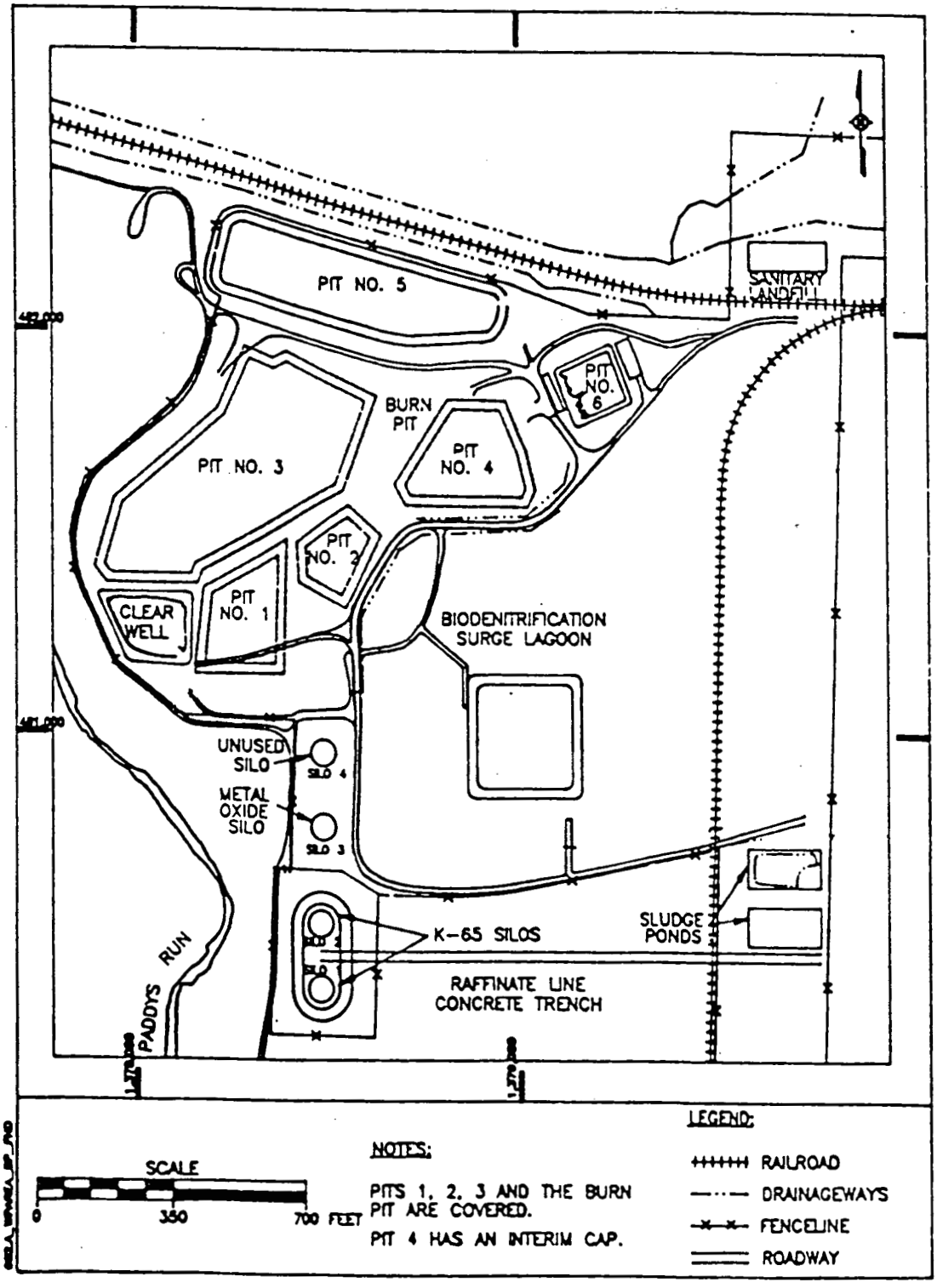
Some surface water runoff from the Waste Storage Area, fly ash piles, and other affected areas within the western portion of the FEMP enters Paddy's Run, a tributary of the Great Miami River. Paddy's Run originates just north of the FEMP and flows south-southeast along the western edge of the site. For most of the year, it is a dry stream bed with occasional rainfall-induced flows. Leachate from these same areas can potentially migrate vertically through a till layer of varying thickness to the regionally important Great Miami Aquifer that underlies the site. This aquifer serves as a principal source of domestic, municipal, and industrial water throughout the region. A portion of the flow in Paddy's Run is also known to enter this aquifer as a result of leakage through the stream bottom. Leakage occurs over the length of Paddy's Run, beginning at a point west of the Waste Storage Area and extending to the Great Miami River.

Liquid waste effluent generated from the FEMP process operations was sent to a general plant sump for treatment and analysis prior to release to the Great Miami River through the main effluent line. The main effluent line to the Great Miami River is the permitted discharge point for wastewater from the FEMP. The discharge is regulated by a National Pollutant Discharge Elimination System (NPDES) permit and DOE Orders, with compliance monitoring performed at Manhole 175 before the effluent leaves the FEMP boundary. Stormwater runoff from the production area is collected in a stormwater retention basin located on the south side of the Production Area. The basin allows for the removal of solids prior to the runoff being analyzed and released to the Great Miami River through the main effluent line. if the stormwater retention basin overflows, stormwater is discharged through the Storm Sewer Outfall Ditch to Paddy's Run.

RCRA Groundwater Monitoring Plan

FIGURE 3.1

Waste Storage Area



3.1 Surface Features

The FEMP lies on the boundary between the southern extent of Pleistocene Glaciation and the ancient unglaciated upland. The advance and retreat of continental glaciers not only shaped the topography but determined the hydrogeologic setting for the site.

3.1.1 Physiographic Province

The FEMP lies in the Till Plains section of the Central Lowland physiographic province, characterized by structural and sedimentary basins and domes. The underlying bedrock in this region is shale and fossiliferous limestone from the Middle and Late Ordovician age (Fenneman, 1916). In some areas, it is overlain by glacial deposits that range in thickness to as much as 400 feet. The main physiographic features in the area are gently rolling uplands, steep hillsides along the major streams, and the Great Miami River Valley, which is a somewhat broad, flat-bottomed valley flanked on either side by bluffs that rise to a maximum of 300 feet above the general level of the valley floor.

3.1.2 Topography

Maximum elevation along the northern boundary of the FEMP property is slightly more than 700 feet above mean sea level. The Production Area and Waste Storage Area rest on a predominately level plain at an approximate elevation of 580 feet. The plain slopes from 600 feet along the eastern boundary of the FEMP to 570 feet at the K-65 silos, and then drops off toward Paddy's Run at an elevation of 550 feet. All drainage on the FEMP is from east to west into Paddy's Run, with the exception of the extreme northeast corner that drains east toward the Great Miami River.

3.2 Surface Water Hydrology

The FEMP is located within the Great Miami River Basin drainage, but above the river's present day flood plain. The Great Miami River is the receiving stream for the FEMP effluent discharge and represents the main surface water feature near the FEMP (Figure 3.2). The river flows generally to the southwest and has a drainage area of approximately 3360 square miles at the Hamilton gauge, which is located about 10 miles upstream from the FEMP discharge outfall.

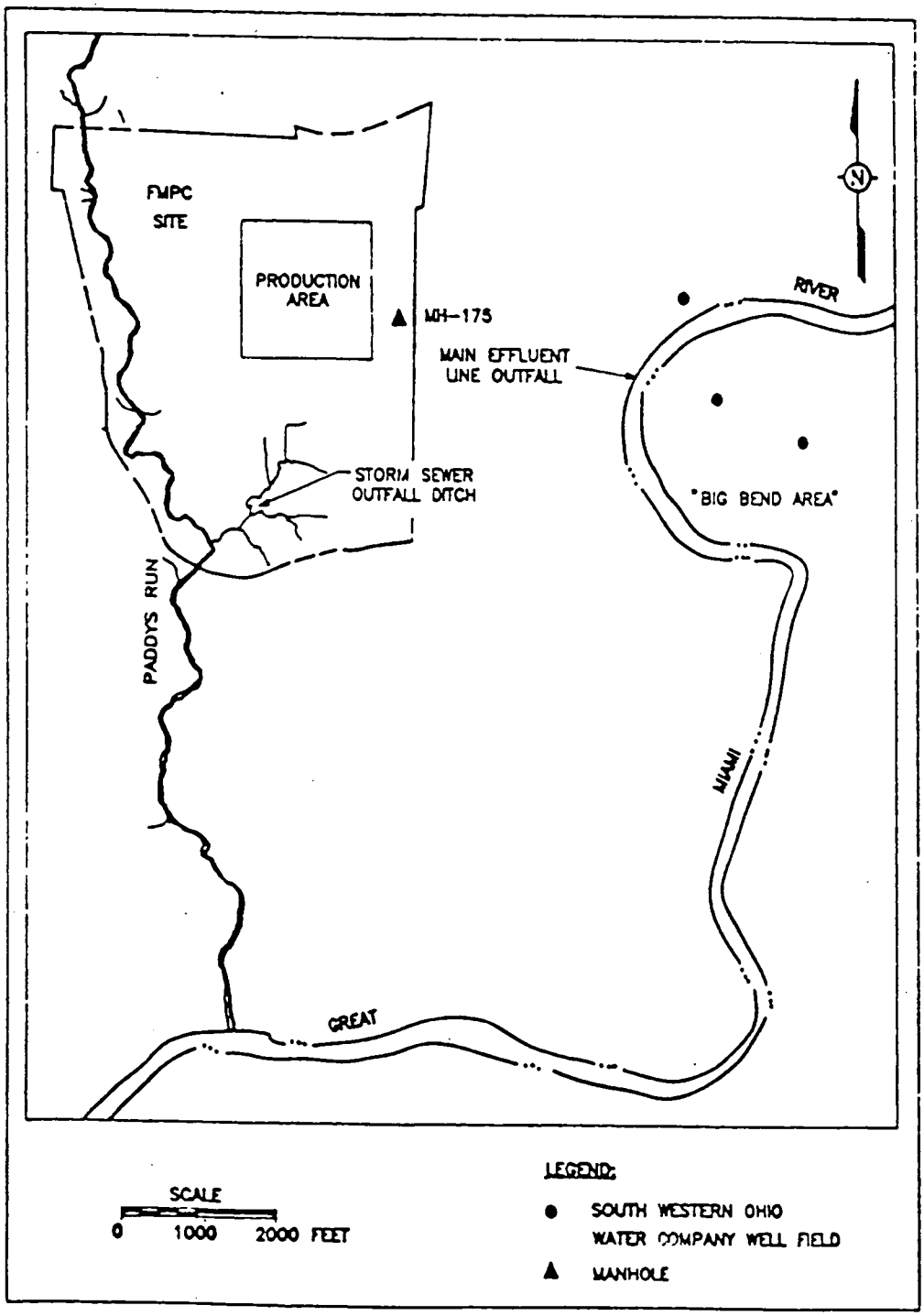
The river exhibits meandering patterns that result in sharp directional changes over distances of less than 3000 feet. Directly east of the FEMP and within the RI/FS study area, the river passes through one 180-degree curve known as the "Big Bend" (Figure 3.2). A 90-degree bend in the river also occurs near New Baltimore, approximately two miles downstream from the FEMP discharge point.

The average discharge of the Great Miami River at Hamilton, based on 55 years of records, is 3305 cubic feet/second (ft^3/s). Using drainage area scaling, the corresponding average flow at the FEMP point of discharge has been estimated to be 3460 ft^3/s.

RCRA Groundwater Monitoring Plan

FIGURE 3.2

Surface Water Hydrology



The maximum discharge ever recorded for the Great Miami River at Hamilton occurred on March 26, 1913, and was estimated to be 352,000 ft^3/s. The maximum discharge since the construction in 1922 of five retarding basins, located approximately seven miles upstream of Ross, was 108,000 ft^3/s and occurred on January 21, 1959. The ten-year-flood discharge has been calculated to be 81,455 ft^3/s for the site reach. The minimum daily discharge of 155 ft^3/s was recorded on September 27, 1941. This value is approximately half of the seven-day, ten-year low flow value ($Q_{7\text{-}10}$) of 267 ft^3/s, as computed by the U. S. Geological Survey (USGS) for the Hamilton gauge. This translates to 280 ft^3/s, at the site reach. Natural surface drainage from the FEMP is primarily to Paddy's Run.

Paddy's Run originates north of the site, drains southward along the west side of the FEMP, and eventually enters the Great Miami River approximately 1.5 miles south of the FEMP (Figure 3.2). This stream loses flow to the underlying aquifer along much of its course due to its highly permeable channel bottom that is carved into the Great Miami Aquifer. Paddy's Run is an ungauged, intermittent stream that flows primarily between January and May, with an estimated discharge for this period ranging between 0.2 and 4.0 ft^3/s. Peak flows have not been measured.

A principal drainage feature of the FEMP is a tributary to Paddy's Run known as the Storm Sewer Outfall Ditch. This drainage course originates east of the Production Area and flows to the southwest corner of the property (Figure 3.2). Much of the stream bottom of this drainage course, which also collects runoff from an area east of the Production Area, is composed of sand and gravel. Vertical seepage rates through the stream's bottom are similar to those of Paddy's Run. This drainage course is generally dry throughout most of the year, with flows occurring during and immediately after precipitation.

The Storm Sewer Outfall Ditch historically conveyed surface water runoff from the Production Area directly to Paddy's Run when the capacity of the storm sewer lift station, which diverts low flow stormwater to Manhole 175, was exceeded. The stormwater retention basin was constructed in October 1986 and December 1989 at the head of the Storm Sewer Outfall Ditch. Stormwater runoff from the production area is now conveyed to the retention basin. After at least a 24-hour retention period to allow for settling of suspended solids, the water is pumped out of the basin to the Great Miami River via the FEMP's main effluent line. The basin is designed to retain the runoff from a 10-year, 24-hour rainfall event. Only in the event of an overflow would stormwater from the Production Area enter the outfall ditch.

3.3 Geology

The following provides a summary of the geologic history and hydrogeologic setting of the area surrounding the FEMP.

The FEMP is located within a two to three mile wide subterranean valley known as the New Haven Trough. This valley formed as a result of Pleistocene Glaciation and subsequently filled with glacial outwash materials and till. The geological history of the FEMP area, as presented by Fenneman (1916), is summarized in the following paragraphs.

In Late Ordovician time, approximately 450 million years ago, sediments that would become a predominantly flat-lying shale with thin interbedded limestone were deposited in a shallow sea. This shale is primarily impermeable bedrock which now underlies the FEMP area and forms the adjacent highlands.

Prior to Pleistocene Glaciation, the area was primarily flat and sloped in a northward direction. This level plain contained a northward flowing drainage system. This system was referred to as the Teays River System and consisted of two major streams with many tributaries. At some time during the early Pleistocene period, this north-flowing river system was disrupted by the advance of Nebraskan and Kansan Glaciation to the north of the Cincinnati area. The drainage system that developed south of the advancing ice sheets is known as the Deep Stage Drainage System (Figure 3.3). The Deep Stage Drainage System was composed of three major rivers: the Miami River, the East Fork of the Little Miami River, and the Licking River. The Miami River followed much of the same channel as the present-day Great Miami River from Middletown to Ross. The East Fork of the Little Miami River entered the area from the northeast. The Licking River came in from the south in essentially its present-day channel, but continued to the north of the present-day Ohio River.

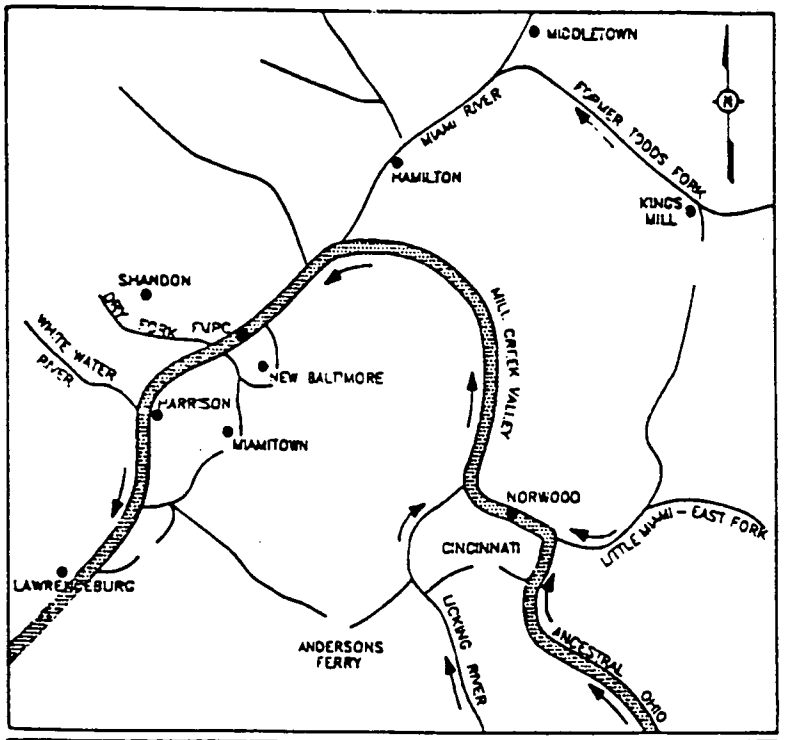
These three rivers combined to form what is known as the ancestral Ohio River, which entered the area from the east along the present-day channel of the Ohio River, then turned northeast through the valley now occupied by the Little Miami River. There it was joined by the East Fork and flowed west through the Norwood Trough to the Mill Creek Valley where it joined the Licking River. The stream then flowed north through the Mill Creek Valley and turned west to join the Miami River south of Hamilton. It continued to the southwest through the New Haven Trough to near Harrison, where it turned and flowed south through what is now the Whitewater River Valley (Figure 3.3).

Several tributary streams of later importance entered the main stream in the vicinity of the FEMP. Two streams originated near Miamitown: one flowed north to join the main stream between Shandon and Fernald and the other flowed south following the course of the present-day Great Miami River. Two other small streams originated near New Baltimore and flowed north to the main stream. The Dry Fork of the Whitewater River, which now lies to the west of the area, formerly turned east to Shandon and then flowed through what is now the Paddy's Run Valley (Figure 3.3).

During the time of Deep Stage Drainage and the early stages of Illinoisan Glaciation (300,000 to 400,000 years ago), the river valleys cut deeply into the shale bedrock to depths up to 200 feet below current land elevations. As the Illinoisan ice sheet advanced into the area, ice began to block the Miami River and its confluence with the ancestral Ohio River, causing water to pond in the Mill Creek Valley. For a time, water still flowed to the west along the front of the advancing ice sheet and carved the present-day Great Miami River Valley along the tributary system near Miamitown (Figure 3.3).

FIGURE 3.3

Schematics of Deep Stage and Present Drainage System



LEGEND:

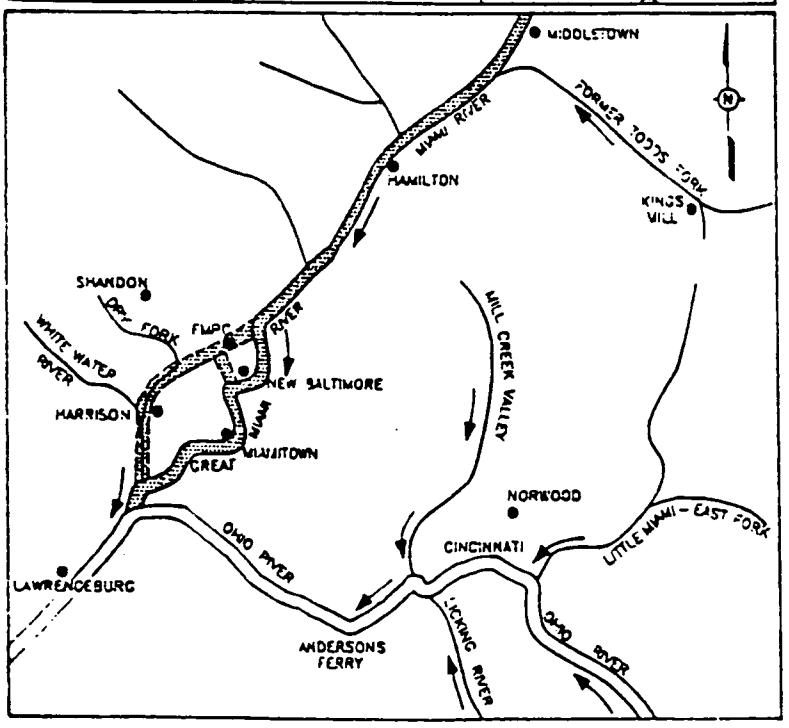
→ DIRECTION OF FLOW

▒ ANCESTRAL OHIO

SOURCE:

FENNEMAN, N.M., 1916 "THE GEOLOGY OF CINCINNATI AND VICINITY", GEOLOGICAL SURVEY OF OHIO, BULLETIN 19.

NOT TO SCALE



LEGEND:

→ DIRECTION OF FLOW

▒ GREAT MIAMI AQUIFER

═ PRESENT OHIO RIVER

- - - NEW HAVEN TROUGH

When the confluence of the Miami River and the ancestral Ohio River was completely blocked, the ponded water in the Mill Creek Valley rose until it overflowed low divides and carved outlets at Anderson's Ferry and at what is now downtown Cincinnati. This created the present-day channel of the Ohio River. As the ice retreated, the valleys of the Deep Stage Drainage were filled with well-sorted sand and gravel outwash deposits, and the Great Miami River and the Ohio River were established in their present-day channels (Figure 3.3).

The last stage of glaciation, the Wisconsin, was much less disruptive to the drainage in the area. The ice sheet advanced only as far as the south side of the FEMP. The main effect of this glacial advance in the area was the displacement of the Dry Fork of the Whitewater River from its historic channel into its present day channel. As it retreated, the ice deposited a moraine in the historic channel that formed a dam. The dam was breached two times, with the final breach draining the lake permanently. The lake basin is now occupied by Paddy's Run.

Since the last retreat of continental glaciers, the stream in the area removed much of the glacial overburden and lacustrine mantle left by the ice sheets. The Great Miami River has eroded through the glacial overburden and is now in direct contact with the glaciofluvial outwash deposits that comprise the buried valley aquifer. Paddy's Run is also in contact with these deposits in its lower reaches. The FEMP itself is located on a dissected till plain and lacustrine deposits left by Wisconsin Glaciation.

3.4 Hydrogeology

The bedrock in the vicinity of the FEMP consists of predominantly flat-lying, olive-gray Ordovician shales with thin, interbedded layers of limestone. This shale forms the floor and valley walls of the New Haven Trough. The buried valley is generally carved into this shale between 60 and more than 200 feet below the pre-erosional land surface in the vicinity of the FEMP.

Approximately 150 feet of regionally extensive Pleistocene glacial valley fill deposits are overlying the shales in the bedrock channel. Figure 3.4 is a generalized stratigraphic column of the valley fill deposits. As indicated by the generalized hydrogeologic cross-sections, (Figure 3.5), the buried valley is about one-half to over two miles wide and is U-shaped, having a broad, primarily flat bottom and step valley walls.

Interbedded glacial overburden deposits occur within the outwash deposits, but in most cases are of limited lateral extent. The glacial overburden deposits are composed primarily of poorly sorted pebbles, cobbles, and boulders in a predominantly clay matrix.

Within some areas, glacial deposits overlie the bedrock uplands and portions of the outwash materials where they form the thick unconsolidated sediment layers beneath the soil zone. This glacial overburden is composed of dense, silty clay that varies in composition vertically and laterally. The glacial overburden contains lenses of poorly sorted fine- to medium-grained sand and gravel, silty sand, and silt with layers of silty clay.

FIGURE 3.4

Generalized Stratigraphic Column of the FEMP Region

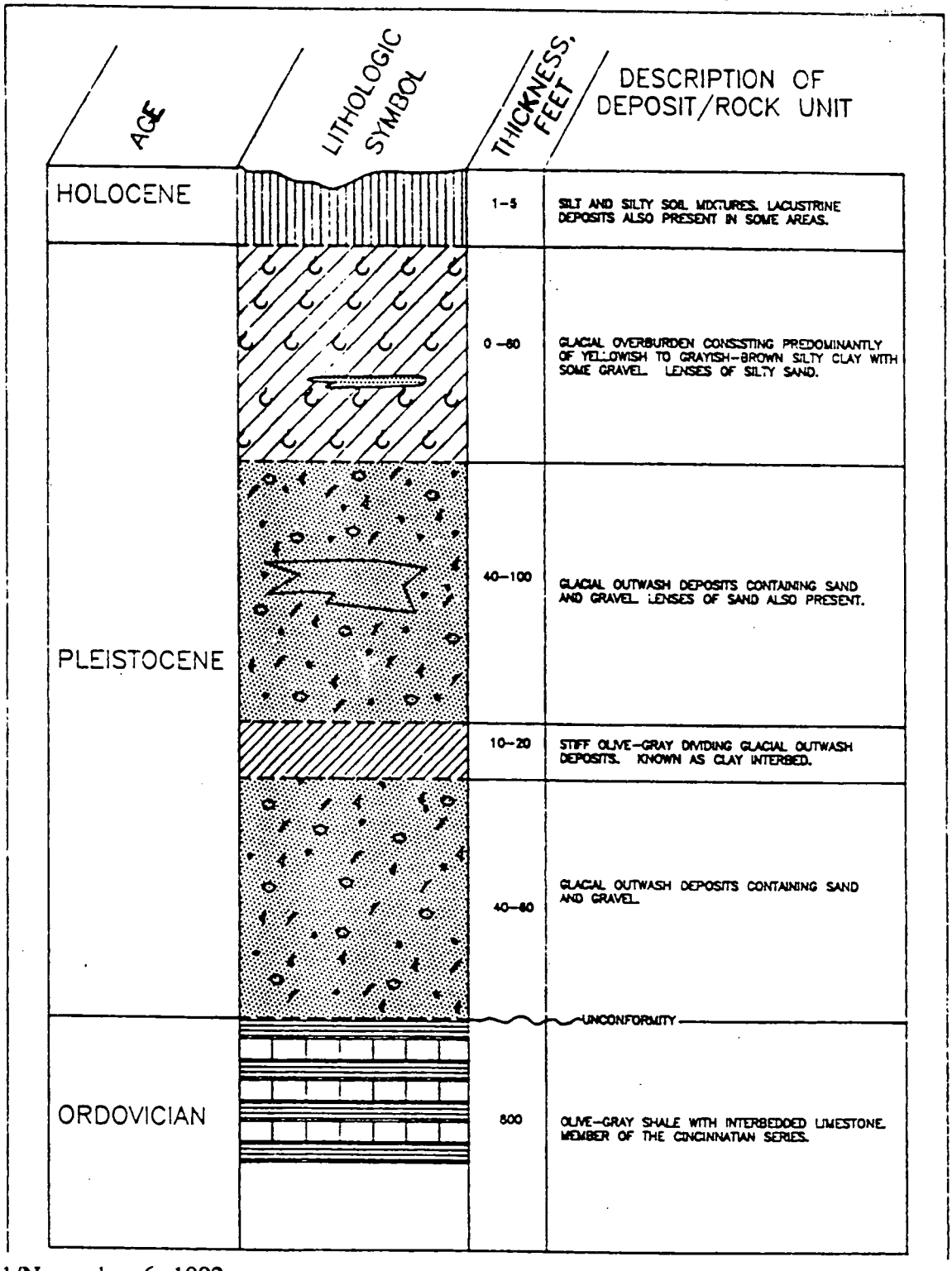


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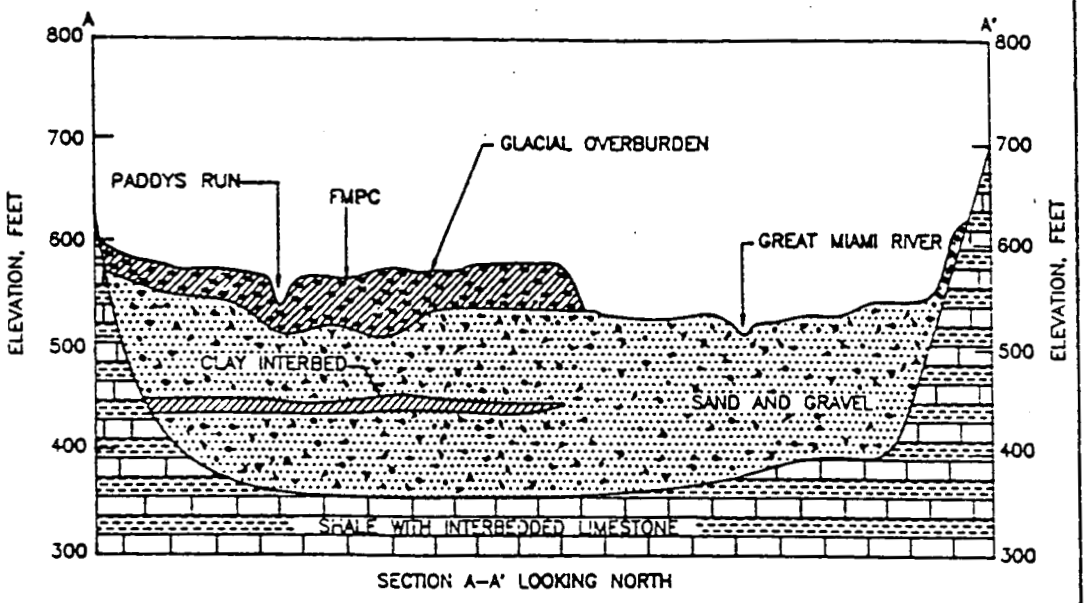
FIGURE 3.5

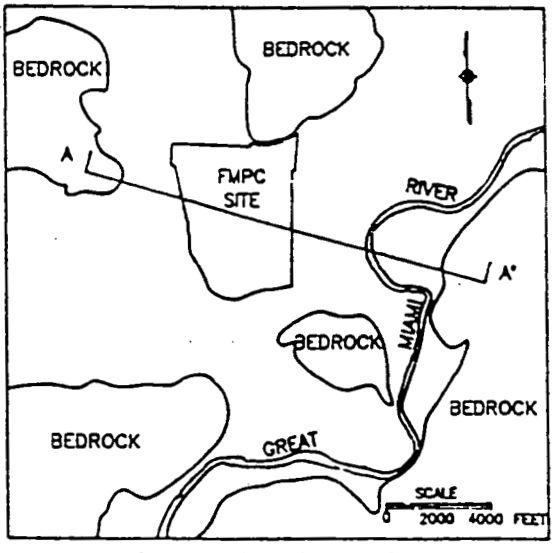
Schematic Cross Section of Buried Channel



SECTION A–A' LOOKING NORTH

NOTE:

INFORMATION CONCERNING THE DEPTH AND ATTITUDE OF THE BEDROCK SHALE WAS OBTAINED FROM IT CORPORATION DRAWING 303317-8208.



LOCATION OF CROSS SECTION

Regional hydrogeologic environments of the buried channel aquifer have been investigated and reported by the USGS. A hydrogeologic environment describes a portion of an aquifer possessing hydrologic and geologic properties that differ from the properties of the aquifer in adjacent areas. Five major hydrogeologic environments have been identified and mapped in the Great Miami River Valley (Figure 3.6). Type I, III, and V environments generally describe the hydrogeologic conditions in the vicinity of the FEMP and are summarized in the following paragraphs.

The Type I hydrogeological environment is found along the flood plain of the Great Miami River to the south and east of the FEMP facility. The lithology of the aquifer consists principally of sand and gravel. Scattered lenses of clay and other fine-grained material may exist anywhere in the environment. However, these lenses are not of sufficient thickness or lateral extent to act as semiconfining layers or to otherwise affect the groundwater movement. The potential for induced stream infiltration exists in these areas. Transmissivity values generally range from 40,000 to 67,000 square feet per day (ft^2/day). The Type I aquifer may be classified with a storage coefficient of about 0.2. Individual wells can yield as much as 3000 gallons per minute (gpm).

The Type III hydrogeologic environment is characterized by 50 or more feet of clay glacial overburden overlying the main buried channel aquifer. In the region of the FEMP, the buried channel aquifer is further divided into an upper and lower part by a semipervious clay layer approximately 10 to 20 feet thick, occurring approximately 120 feet below land surface. Hence, the lower aquifer is classed as a semiconfined or leaky confined aquifer. A coefficient of storage of 0.001 was estimated for the lower sand and gravel aquifer. Estimated transmissivities range from 4700 to 40,000 ft^2/day.

The Type V hydrogeologic environment included all of the area outside of the buried channel. These areas are uplands and consist of shale with interbedded limestone overlain by fewer than 50 feet of clay-rich glacial overburden. Large quantities of groundwater are not generally transported through this material. Well yields vary widely, typically ranging from near 0 to 10 gpm. However, because sand and gravel lenses are erratically distributed throughout the overlying glacial overburden, wells completed in these units may yield up to 50 gpm.

Large groundwater supplies occur in the outwash deposits of the buried channel aquifer and are recharged by three principal sources; recharge from bedrock, precipitation recharge, and recharge by stream infiltration. Although the shales and limestones have a low permeability, small amounts of water occur in erratically distributed joints and cracks and produce seepage into the glacial deposits. The average hydraulic conductivity of the bedrock has been estimated to be very low and on the order of 10-7 ft/day (10^{-10} cm/s) of contact with the glacial deposits. Recharge by precipitation amounts to approximately 570,000 gallons per day (gpd) per square mile of catchment area (12 in/yr) and represents the dominant source of recharge on a regional basis. Under natural conditions, the gradient of groundwater flow is from the aquifer to the Great Miami River, except during dry periods when the gradient is reversed. Intermittent recharge to the aquifer also occurs along Paddy's Run.

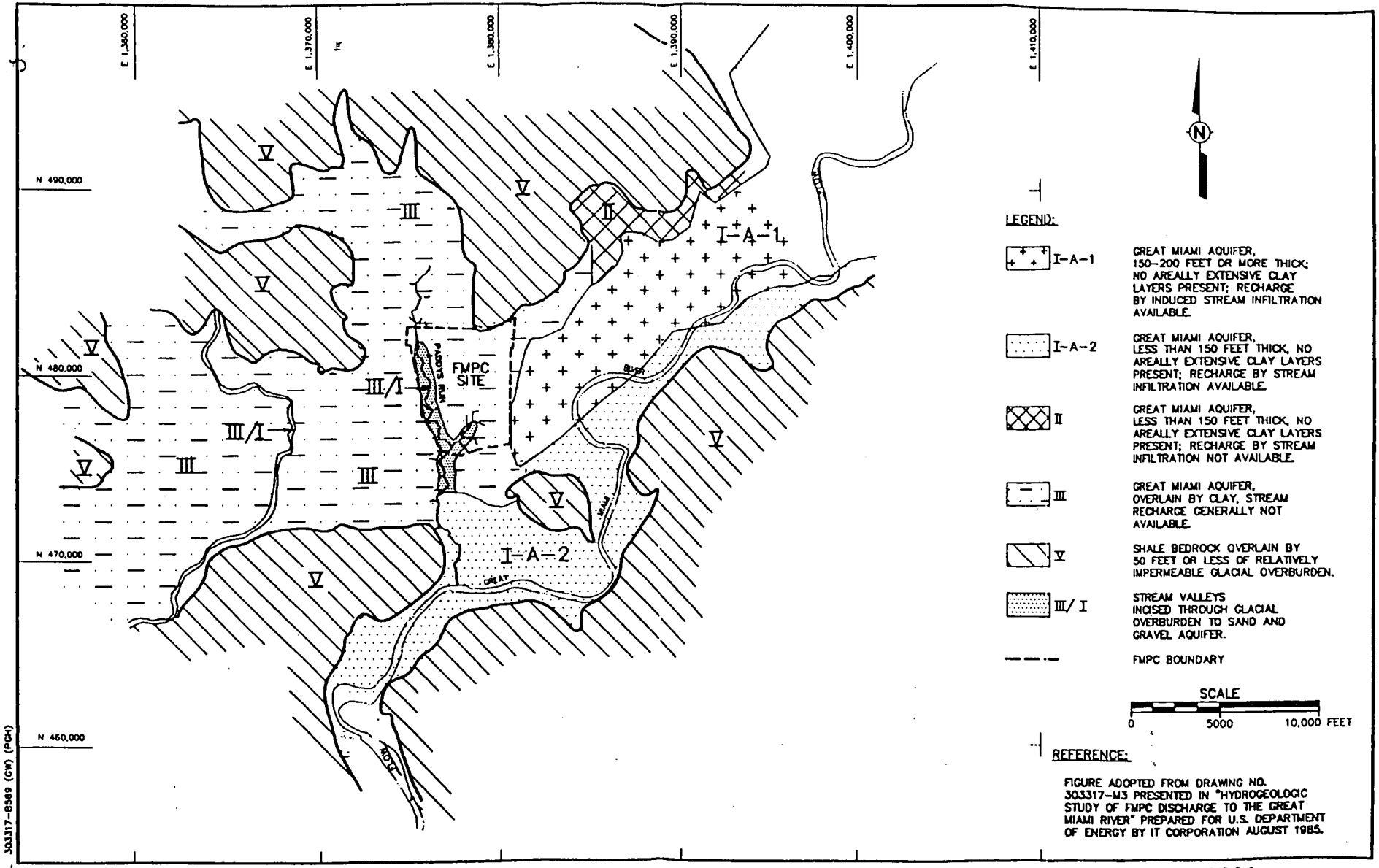


FIGURE 3.6
Hydrogeologic Environments

The groundwater in the regional aquifer enters the FEMP study area from the buried valleys on the west, north, and east. Natural gradients cause the groundwater to exit the FEMP study area by either flowing to the east to the Great Miami River upstream from New Baltimore, or by flowing south through the branch of the bedrock channel west of New Baltimore.

In either case, the Great Miami River is the ultimate receptor of all groundwater in the study area (Figure 3.7). The large pumping wells of the Southwestern Ohio Water Company (SOWC) in the "Big Bend" meander of the Great Miami River east of the FEMP produces a pronounced and persistent cone of depression in the potentiometric surface centered on the pumping wells. Groundwater elevation maps indicate that the resultant cone of depression from the collector wells influences groundwater flow patterns beneath the FEMP. In particular, a groundwater flow divide is created such that groundwater underlying the northern portion of the FEMP, including those areas underlying the waste storage area and the production area, flows to the east toward the collector wells and the Great Miami River. Groundwater from the southern and southwestern portion of the FEMP continues to flow along the natural gradient to the south-southwest through the buried valley. Near the southwest corner of the FEMP, a groundwater component from the west is also present due to the western leg of the buried channel (Figure 3.7). This causes recharge from certain reaches of Paddy's Run to flow east-southeast until the regional southern component of flow is encountered.

3.5 Climate

Data from the Greater Cincinnati International Airport has been shown to characterize satisfactorily the climate regime of the FEMP area. The regional climate is defined as continental, with temperatures ranging from a monthly average of 29.0 degrees Fahrenheit in January to 75.5 degrees Fahrenheit in July. The highest temperature recorded from 1950 through 1984 was 102 degrees Fahrenheit in August 1962, and minus 25 degrees Fahrenheit was the lowest in January 1977. The average number of days per year with a minimum temperature of 32 degrees Fahrenheit or less is 110 days, and the average number of days with a maximum temperature of 90 degrees Fahrenheit or above is 20 days per year. The frost depth ranges from 30 to 36 inches.

The average annual precipitation for the period of record is 40.14 inches (National Oceanic and Atmospheric Administration, 1989). The highest precipitation occurs during the spring and early summer; precipitation is lowest in late summer and fall. The average annual snowfall is 24.0 inches, with heaviest snowfall in January. The period from late 1987 through October of 1988 was characterized by average monthly precipitation significantly below normal, as shown in Figure 3.8. The 1989 precipitation data indicated above-normal precipitation.

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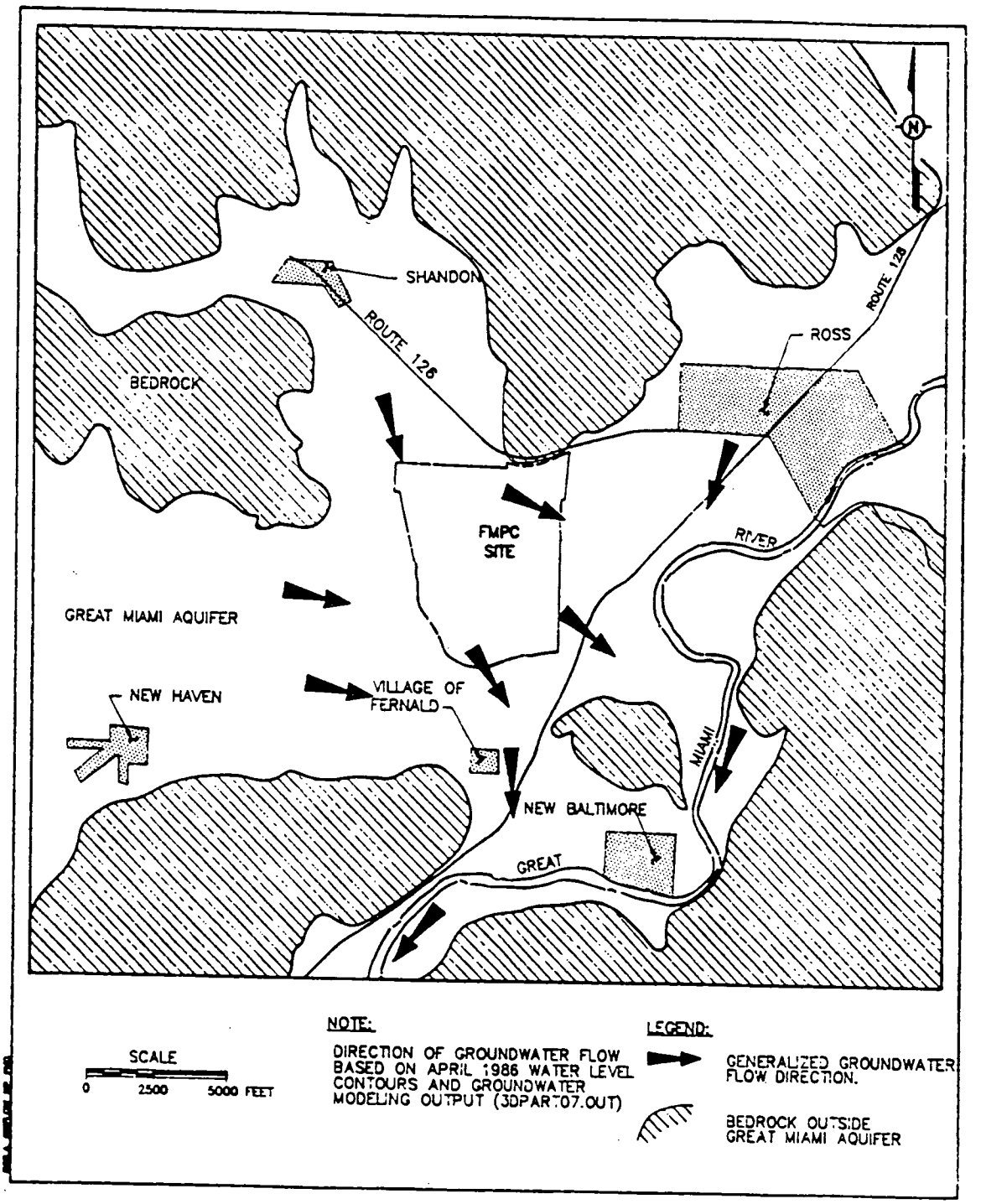
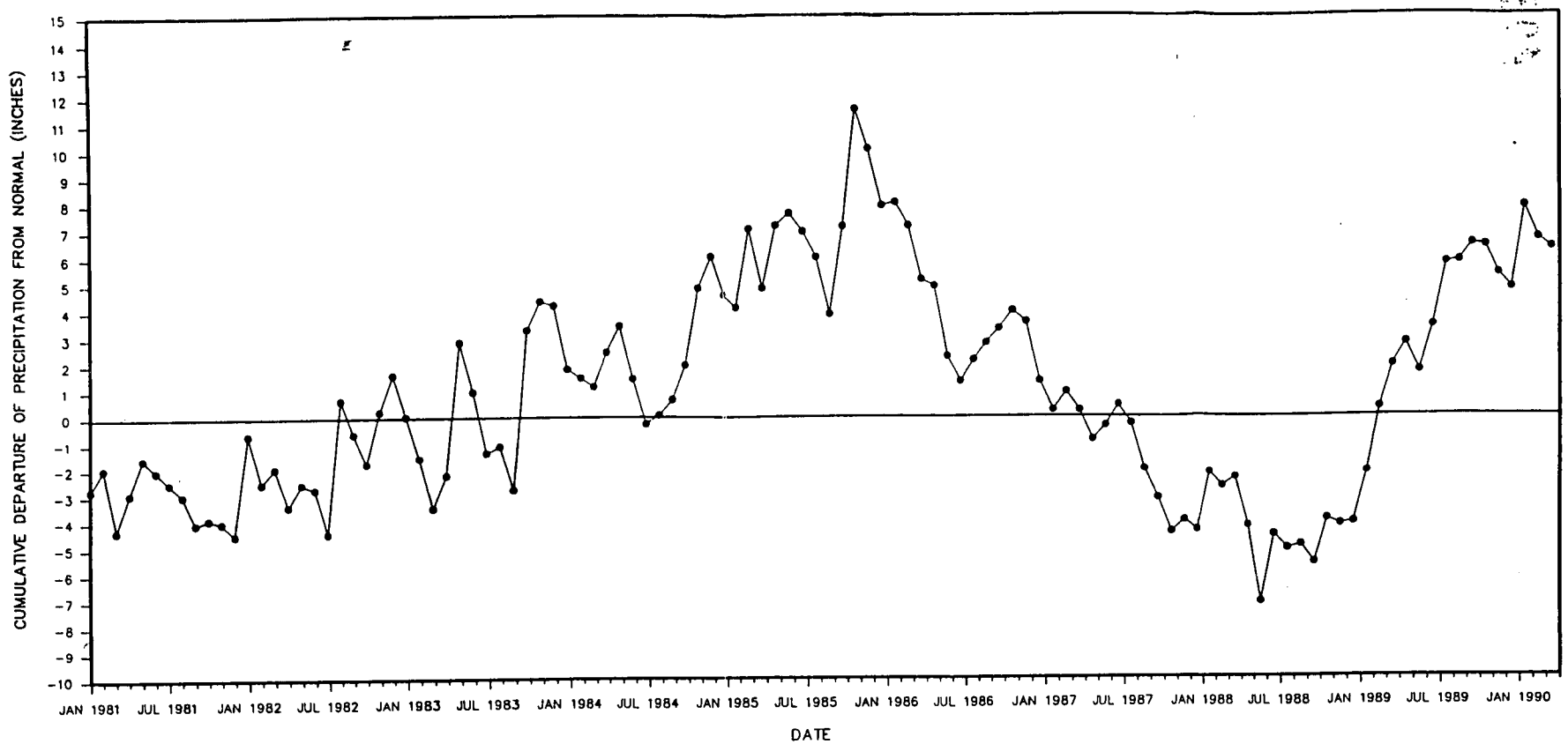
FIGURE 3.7

Generalized Groundwater Flow in Buried Channel Aquifer





LEGEND:

• CUMULATIVE DEPARTURE OF PRECIPITATION RECORDED FROM NORMAL

NOTES:

1. DATA USED ARE FOR THE GREATER CINCINNATI AIRPORT, BOONE COUNTY, KY STATION.

REFERENCE:

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICE
NATIONAL CLIMATIC DATA CENTER
ASHEVILLE, NORTH CAROLINA

FIGURE 3.8

Cumulative Departure from Normal Precipitation

303317-8573 (GW) (PGH)

32

3.6 Groundwater Use

Large groundwater supplies occur in the deposits that fill the buried valley. The aquifers that occur in these deposits are together known as the Buried Valley Aquifer System of the Great Miami River Basin (Great Miami Aquifer) and have been designated a Sole-Source Aquifer by the Environmental Protection Agency (EPA) under Section 1424 (a) of the Safe Drinking Water Act (Federal Register Vol. 53 No. 131, July 8, 1988). Under this designation, the Region V Administrator of the EPA has determined that this aquifer is the sole or principal source of drinking water for this area and that contamination would create a significant hazard to the public health.

Groundwater is the source of water for industrial and domestic use in the area. Groundwater users have been identified in this chapter. Pumping centers downgradient of the FEMP are shown in Figure 3.9. The estimated pumping from the major well fields averages about 18 million gallons per day (Mgd). Additionally, there are many smaller industrial, commercial, agricultural, and private groundwater users in the area.

3.6.1 Industrial Water Use

In 1952, the SOWC installed a large-diameter radial collector well in the sand and gravel glacial outwash deposits east of the Great Miami River near Ross, Ohio. The collector well was pumped for industrial water supply purposes at an average rate of 10 Mgd from 1952 to 1955. Its effective radius is approximately 200 feet. In 1955, a second collector well was installed with an effective radius of 212 feet to establish an adequate water supply for 13 industries in the Mill Creek Valley area. Historical data from the 1950s indicated that the average pumping rate from the collector wells was about 14 to 15 Mgd after completion of the second well. From 1980 through 1986, this pumping rate increased to about 18.4 Mgd (Miami Conservancy District, 1987). Spieker (1986b) and Dove (1961) concluded that from 60 to 76 percent of the total flow from the collector wells comes from induced recharge from the Great Miami River.

Water which is pumped from collector wells 1 and 2 (Figure 3.9) is piped about 14 miles through a 36-inch-diameter main to a reservoir in the Mill Creek Valley. The water flows by gravity from the reservoir to the industries served by the collector well system. In 1986, a third collector well was installed for emergency use only. Due to the standby status of collector well 3, the total flow from the three wells is not expected to exceed the current 18.4 Mgd level. This level is expected to be maintained in the near future. The only significant pumping centers within the study area are the water supply well 4103 at the FEMP and the two water supply wells used by the Albright & Wilson Company. The FEMP pumps groundwater from any of three wells located along the southwestern edge of the Production Area. Well 4103 is the most commonly used of the three wells. Each is screened over a ten-foot interval approximately ten feet above the bottom of the aquifer and well below the clay interbed. These wells are sampled routinely; however, there is no evidence of any contamination reaching these wells.

The average daily flow from well 4103 is 290 gpm, although this well is in operation for only part of the day. The Albright & Wilson Company uses water from two wells located approximately 2000 feet south

of the FEMP. The combined flow from these two wells is approximately 225 gpm. Uranium contamination in the southern Albright & Wilson Company well has been documented since 1981.

3.6.2 Potable Water Use

The residences in the area use either domestic wells or cisterns for water supplies. Generally, cisterns are used in areas underlain by bedrock. Many residents use bottled water for drinking because of the bad taste and smell of the water from some parts of the aquifer. Figure 3.9 shows the location of domestic and commercial wells that are downgradient from the FEMP to the south and east. With the exception of the large volume wells discussed in Section 3.6.1, the downgradient wells are generally constructed in the upper part of the aquifer and pump only when there is a demand for water for domestic washing and sanitation. The presence of these wells, therefore, is insignificant in terms of their impact on groundwater flow.

3.6.3 Agricultural Use

There are several large farms in the vicinity of the FEMP. Two known irrigation wells on farms east of the site and northwest of Route 128 are currently being used for field irrigation. One farm on New Haven Road south of the site, between Route 128 and the village of New Baltimore, also is known to irrigate from a well on the property. Those farmers east and south of the FEMP, who are near the Great Miami River, irrigate their fields with water from the river (Plummer, 1990).

3.7 Groundwater Monitoring at The FEMP

Groundwater monitoring has been conducted at the FEMP since the early 1960s. Detailed groundwater quality investigations began in 1984. Monitoring wells were installed under tasks with specific objectives since 1959. A comprehensive program for characterizing site groundwater was not initiated until 1986 when the FEMP began a CERCLA RI/FS. Over 400 monitoring wells and piezometers have been installed on- and off-property for the RI/FS and RCRA monitoring programs. Groundwater monitoring is being conducted in the Great Miami Aquifer and in perched water zones above the aquifer.

3.7.1 Well Numbering System and Logic

Wells were installed to four different depths. Figure 3.10 is a diagram depicting the well installation depth and series numbers. Wells that are screened in the glacial overburden are numbered in the 1000-series. Wells that are screened at the water table in the Great Miami Aquifer are in the 2000-series. Wells screened ten feet above the clay interbed layer sometimes present near the middle of the Great Miami Aquifer, or at the equivalent elevation if the clay was not encountered, are in the 3000-series; and wells that are screened ten feet above bedrock at the bottom of the aquifer are in the 4000-series.

The glacial overburden material, which underlies most of the Production and Waste Storage areas, is most likely to be contaminated by direct contact with wastes and by surface water infiltrating through waste areas.

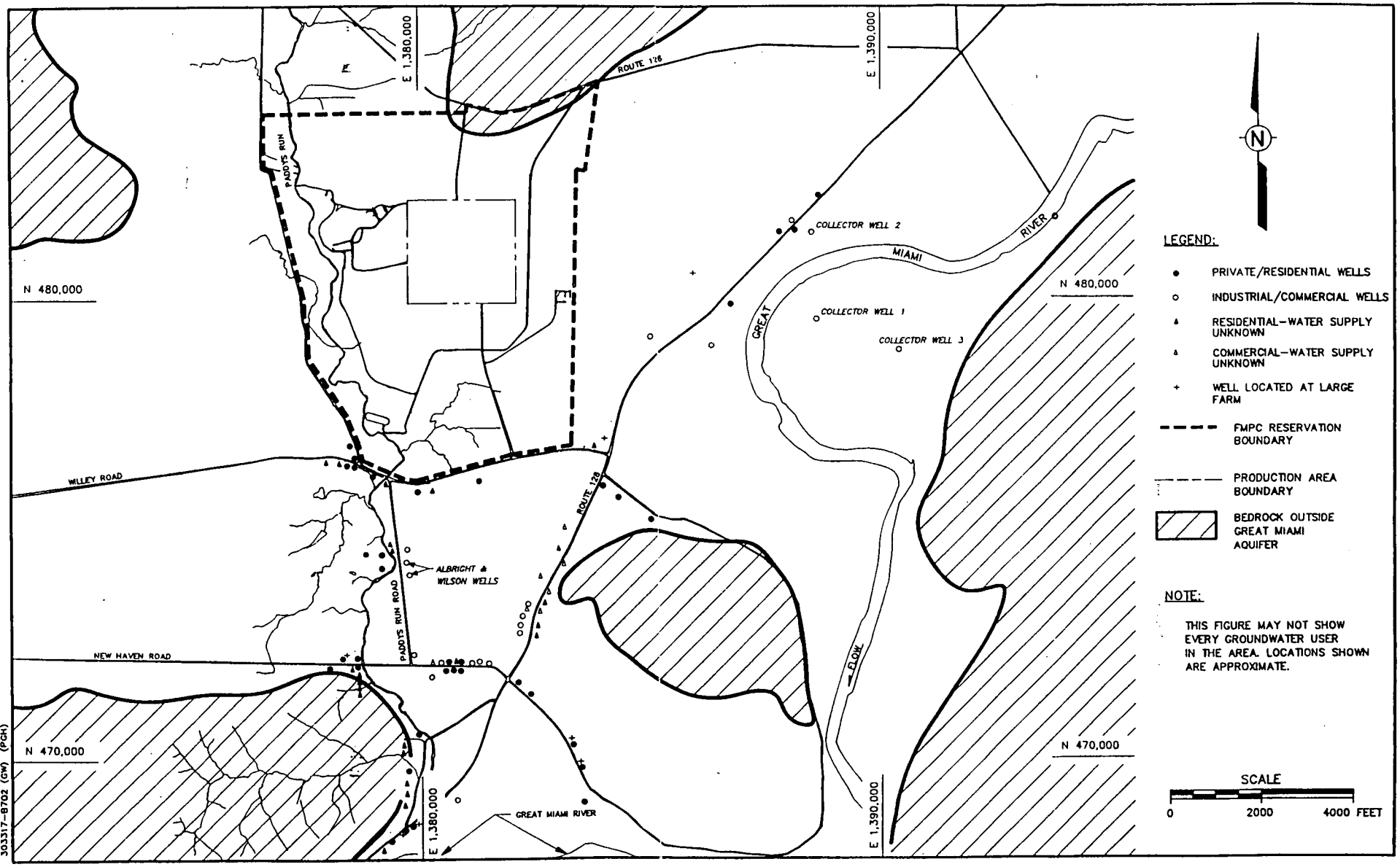
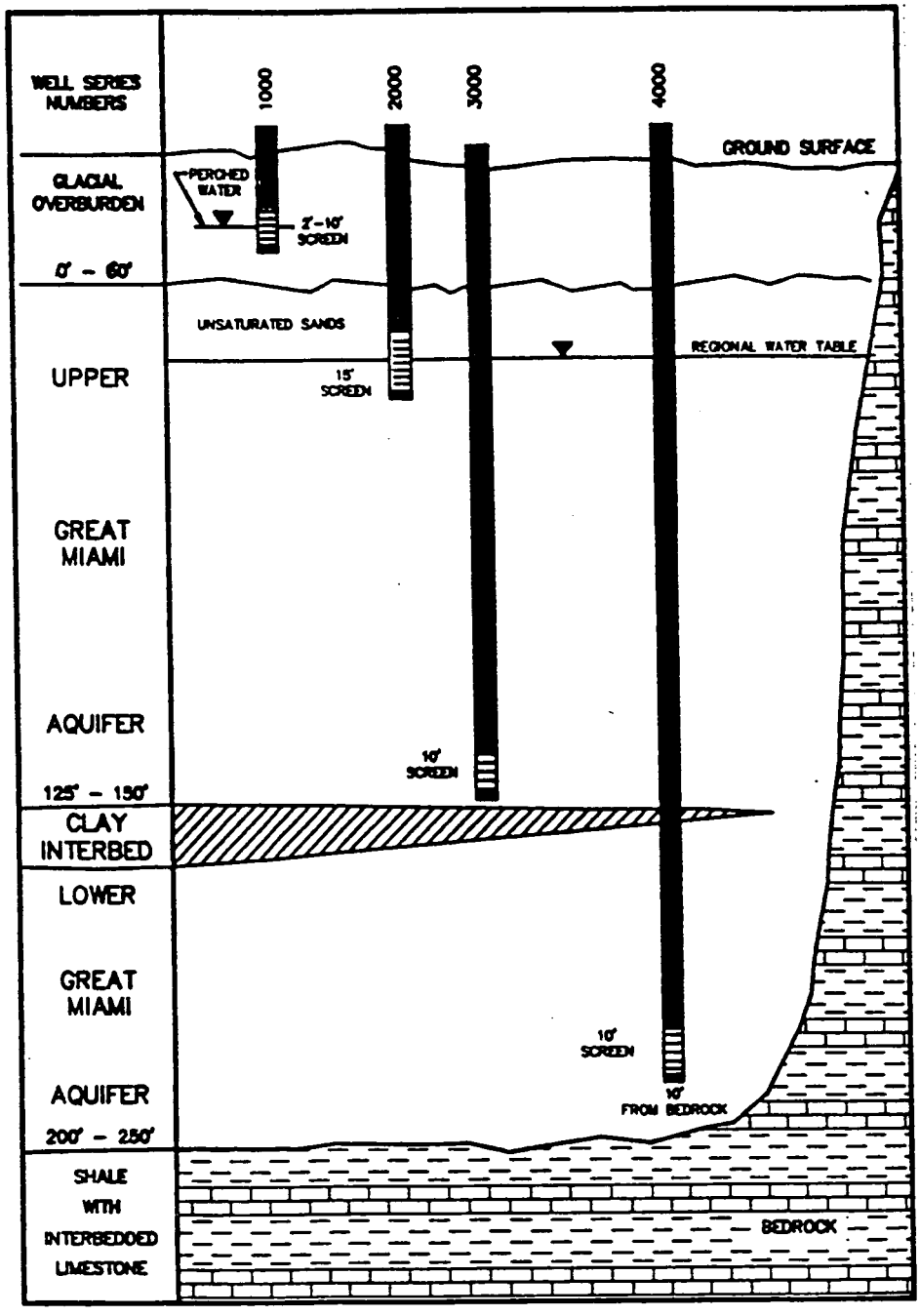


FIGURE 3.9

Potential and Known Groundwater Users Downgradient of the FEMP

FIGURE 3.10

Groundwater Monitoring Well Completion Depths



The 1000-series wells are screened in the glacial overburden either in the first water-bearing zone encountered or, if water was not encountered, the most permeable zone based on field observations. The groundwater encountered in the glacial overburden is perched water. The well screen length varies from two to ten feet in these wells, based on the thickness of the water-bearing zone or the most permeable zone. If water was not encountered during boring advancement, ten feet of well screen was installed.

The sand and gravel outwash deposits, known as the Great Miami Aquifer, underlie the glacial overburden and are hydrogeologically less complex than the overburden. These deposits are also more extensive and constitute a regional-scale buried channel aquifer. There are unsaturated outwash sand and gravel between the glacial overburden and the saturated outwash sand and gravel of the Great Miami Aquifer. The 2000-series wells are installed to a depth of approximately 70 feet and screened at the water table. Fifteen feet of well screen was installed in all the 2000-series wells so that approximately ten feet of screen was below the water table and five feet of screen was above the water table to determine if nonaqueous phase contaminants were present on the water table surface. Groundwater samples collected from the 2000-series wells were designed to sample for general groundwater quality at the top of the aquifer, which would be the first zone affected by vertically infiltrating contaminants.

The 3000-series wells are installed to investigate the potential downward transport of contaminants from the upper portion of the Great Miami Aquifer. Knowing the vertical component of groundwater movement is important to assess the current and future effect upon contaminant transport pathways. Previous investigations had indicated the presence of a significant clay unit in the Great Miami Aquifer beneath the FEMP (Dames and Moore, 1985). This unit was labeled the "clay interbed" and was thought to be a barrier to vertical groundwater flow. Reasons for installing the 3000-series wells were to better define the extent of this clay unit, to determine if the clay layer influenced the migration of contaminants of groundwater flow, and to provide water samples and hydrologic data at a consistent hydrogeologic elevation within the Great Miami Aquifer.

The anticipated average depth of these 3000-series wells was 120 feet. If the clay layer was encountered, the well was constructed so that the bottom of the well screen was at the top of the clay unit. Every effort was made during boring advancement to prevent penetration of the clay unit, thereby avoiding the development of a new contaminant pathway through the clay layer. If the clay was not encountered at the target elevation, the borehole was advanced a minimum ten feet beyond the anticipated depth of the clay to ensure that the clay unit was not present. If the clay unit was still not detected, the well was constructed so that the bottom of the well screen was at the target elevation of the clay unit.

The 4000-series wells were installed just above bedrock in the lower part of the Great Miami Aquifer underlaying the "clay interbed" where encountered, or at a similar elevation where not encountered. All 4000-series wells were advanced until bedrock was encountered. Each boring was advanced several feet into bedrock to determine that it was bedrock and not a large boulder in the outwash sands and gravel. The wells are constructed with the bottom screen set ten feet above the bedrock surface.

4.0 REVIEW OF FEMP RCRA MONITORING ACTIVITIES

RCRA groundwater monitoring activities were initiated in 1985 for one regulated unit. Detection monitoring occurred until 1987 when the FEMP notified the EPA that Waste Pit 4 was effecting groundwater quality. An assessment program has been conducted since 1988 to determine the concentrations, rate and extent of contaminants emanating from the Waste Pit Area. The assessment monitoring program focused on the Waste Pit Area because it was infeasible to separate Waste Pit 4 from neighboring waste pits.

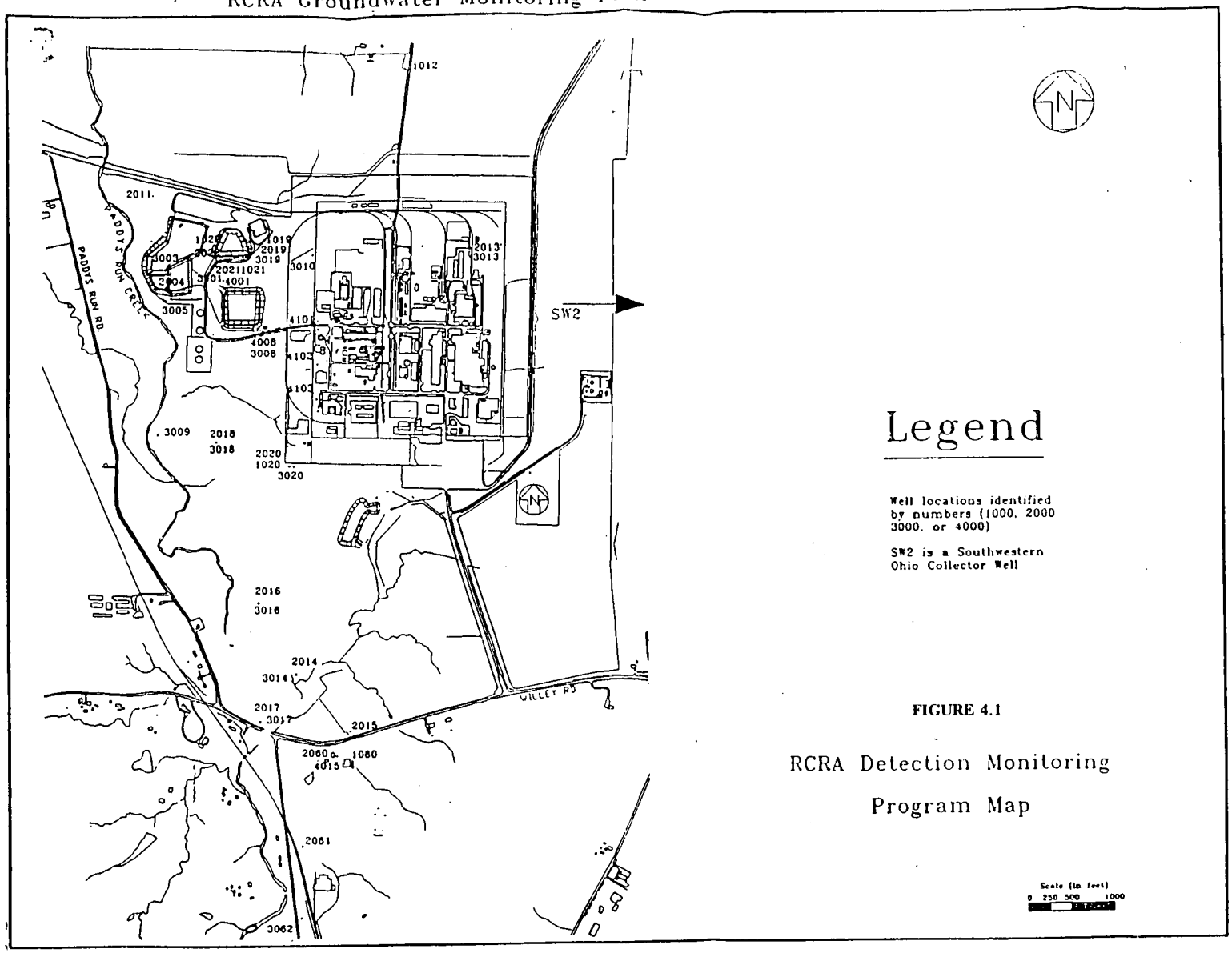
A Part A Permit was submitted to the OEPA in June, 1991. The Part A Permit identified 8 additional regulated units that require groundwater monitoring, 42 hazardous waste management units other then the regulated units, and 242 solid waste management units. The solid or hazardous waste management units may require groundwater monitoring if a release is documented. The RCRA GQAPP that guided the RCRA groundwater assessment for Waste Pit 4 needed be revised to include the 8 additional regulated units. The RCRA GMP has been written to replace the RCRA GQAPP.

4.1 Summary of the RCRA Groundwater Detection Monitoring Program

In accordance with the requirements of OAC 3745-65-90 through 3745-65-93 (D)(2)/ 40 CFR 265.90 through 93 (d)(2), a Detection Monitoring Program was initiated at Waste Pit 4 in August 1985. The Detection Monitoring Program included quarterly monitoring for one year of wells upgradient and downgradient of the regulated unit for general water quality, drinking water suitability, and indicator parameters as specifically defined in OAC 3745-65-92/40 CFR 265.92.

Representative water quality samples were withdrawn from the 41 detection monitoring wells during six rounds of sampling and analyzed. Figure 4.1 represents the detection monitoring program. A statistical analysis that compared upgradient and downgradient monitoring well parameters at Waste Pit 4 was completed following Round 5 on the groundwater indicator parameters. A more detailed discussion of the RCRA Detection Monitoring Program may be found in the RCRA Groundwater Monitoring Report Volume 6 - Round 6 Sampling (March, 1988). In general, the water quality data collected under this program indicated the following:

* Water quality parameters in the sand and gravel aquifer beneath the FEMP Waste Pit area appears to indicate degradation of water quality with respect to sulfate and nitrates.
* No pesticides/herbicides were detected in any of the wells sampled.
* Volatile organic compounds were detected consistently in only two monitoring wells (MW-15s and MW-19tp). Volatile organics detected in Monitoring Well MW-15s are; 1,1,1-Trichloroethane, and 1,1-Dichloroethane. Volatile organics detected in Monitoring Well MW-19tp were; 1,1-Dichloroethane, Methylene Chloride, 1,1,1-Trichloroethane, cis-1,2-Dichloroethene, Bromoform, and Cloroethene. Concentrations of organic compounds identified in these monitoring wells ranged from less than one part per billion (ppb) to less than 30 ppb.



Legend

Well locations identified by numbers (1000, 2000 3000, or 4000)

SW2 is a Southwestern Ohio Collector Well

FIGURE 4.1

RCRA Detection Monitoring Program Map

Scale (in feet)
0 250 500 1000

4.2 Summary of the RCRA Groundwater Assessment Program

In accordance with OAC 3745-65-93(D)(1)/40 CFR 265.93(d)(1), the USEPA and the OEPA were notified on November 13, 1987, that Waste Pit 4 may be affecting groundwater quality in the Waste Pit area. This notification was based upon the statistical comparisons completed as part of the Interim Status Detection Monitoring Program implemented in the vicinity of Waste Pit 4. On November 25, 1987, a FEMP RCRA GQAPP for Waste Pit 4 was submitted to the USEPA and OEPA. This plan stated that the Assessment Program could be most efficiently accomplished as part of the on-going site-wide RI/FS at the FEMP.

Assessment sampling was initiated in May, 1988. Each well was sampled quarterly for one year. The fourth round of sampling was completed in March of 1989. All groundwater samples collected during the first four rounds of the Assessment Monitoring Program were analyzed for a full suite of general water quality parameters. Over 200 parameters were analyzed, including radionuclides, volatiles, semi-volatiles, metals, water quality parameters, Pesticides/PCBs, Organophosphorus Pesticides, Dioxins, and Furans.

In response to comments from USEPA and to keep pace with progressive activities and findings made under the Assessment Program, a revised GQAPP was submitted to the USEPA and OEPA on March 23, 1989. On the basis of a detailed evaluation of the available water quality and flow information, the revised GQAPP identified 43 specific wells (Table 4.1) for continuation of the RCRA Groundwater Quality Assessment Program, following the fourth round of sampling. Each well was sampled for the parameters listed in Table 4.2.

During 1990, the RCRA Groundwater Quality Assessment Program determined that 33 monitoring wells from a 43 well program contained constituents statistically significant when compared to background values. The 33 monitoring wells contained some or all of 18 site-specific constituents determined to be statistically significant, six of which are listed in 40 CFR 264 Appendix IX. Data analysis was performed to determine the highest concentrations, the rates, and the extent of occurrence of these constituents in the groundwater.

A listing of the monitoring wells and constituents found to be statistically significant are provided in Tables 4.3 and 4.4. A more detailed discussion of the RCRA Assessment Program results can be found in the 1990 RCRA Annual Report. The GQAPP was revised a second time in April, 1991, to include findings from previous RCRA sampling and regulatory comments. The total number of wells sampled was increased to 54.

RCRA Groundwater Monitoring Plan

TABLE 4.1

RCRA Assessment Monitoring Wells
Identified in the GQAPP Rev. 1, (March-89)

1000 series	2000 series	3000 series	4000 series
1004	2010	3001	4001
1024[1]	2013	3008	4008
1025	2019	3010	4010
1027	2021	3013	4013
1028	2027	3019	
1030	2037	3024	
1031	2043[2]	3037	
1038	2051	3043[2]	
1052[1]	2055	3051	
1072	2066[2]	3055	
1074	2084	3066[2]	
1079		3084	
1080			
1081			
1082			
1083			

[1] Background Well

[2] Upgradient Well

TABLE 4.2

Parameters Tested for in the GQAPP, Rev. 1., 3-89

Cobalt
Beryllium
Zinc
Vanadium
Nickel
Copper
Magnesium
Calcium
Aluminum
Barium
Chromium
Lead
Silver
Iron
Fluoride
Nitrate
Chloride
Sulfate
pH
Conductivity
TOC
TOX
Tetrachloroethene
Methylene chloride
Dichloroethane
Acetone
Trichloroethane
Toluene
Total Uranium
Uranium-234
Uranium-235
Uranium-238
Thorium-228
Thorium-230
Technetium-99

42

RCRA Groundwater Monitoring Plan

TABLE 4.3

Wells and Site Specific Constituents Found to Have Statistically Significant Concentrations in 1990 In the Glacial Overburden

Well Number	Constituent
1025	Calcium, Chloride, Magnesium, Manganese, Nickel, Nitrate, Sodium, Sulfate, Conductivity, pH
1027	Sulfate
1028	Nickel, Conductivity, pH
1031	Calcium, Chloride, Fluoride, Nickel, Nitrate, Sodium, Sulfate, Total Organic Halides, Total Organic Carbon, 1,1-Dichloroethane, Copper, Sulfate, Tetrachloroethane, Trichloroethene, Conductivity, pH
1038	Calcium, Chloride, Magnesium, Sulfate, pH
1074	Calcium, Chloride, Fluoride, Magnesium, Nickel, Conductivity
1079	Calcium, Magnesium, Sulfate
1080	Calcium, Magnesium, Sulfate
1081	Calcium, Chloride, Magnesium, Nitrate, Sulfate, Conductivity
1082	Calcium, Chloride, Magnesium, Sulfate, Conductivity
1083	Calcium, Chloride, Magnesium, Nitrate

Listing of Constituents

1,1-Dichloroethane	Sodium	Calcium
Sulfate	Chloride	Tetrachloroethane
Copper	Total Organic Halides	Fluoride
Total Organic Carbon	Magnesium	Trichloroethene
Manganese	Conductivity	Nickel
pH	Nitrate	

TABLE 4.4

Wells and Site Specific Constituents Found to Have Statistically Significant Concentrations in 1990 In the Sand and Gravel Aquifer

Well Number	Constituent
2010	Calcium, Manganese, Sulfate, Conductivity
2013	Sulfate
2019	Nitrate, Calcium, Conductivity
2021	Calcium, Nitrate, Sulfate, Conductivity
2027	Calcium, Chloride, Iron, Magnesium, Manganese, Sulfate, Conductivity
2037	Calcium, Manganese, Sulfate
2051	Calcium, Manganese, Sulfate
2055	Sulfate
2084	Calcium, Chloride, Magnesium, Manganese, Nitrate, Sodium, Sulfate, Conductivity
3001	Manganese
3008	Manganese, Conductivity
3010	Calcium, Manganese, Sulfate
3013	Sulfate, Manganese
3019	Calcium, Manganese, Nitrate, Sulfate, pH
3024	Sulfate
3037	Calcium, Magnesium, Manganese, Sulfate, pH
3051	Sulfate
3055	Sulfate, pH

RCRA Groundwater Monitoring Plan

TABLE 4.4 (Cont.)

Wells and Site Specific Constituents Found to Have Statistically Significant Concentrations in 1990 In the Sand and Gravel Aquifer

Well Number	Constituent
3084	Calcium, Magnesium, Manganese, Nitrates, Sulfate, pH
4001	Manganese
4008	Manganese
4013	Calcium, Magnesium, Sulfate

Listing of Constituents

Calcium	Sulfate
Chloride	Sodium
Iron	Conductivity
Manganese	pH
Magnesium	Nitrates

5.0 THE RCRA GMP MONITORING WELL NETWORK

The monitoring well network has been established around Waste Management Areas because of the large number of units in close proximity to each other. There are two Waste Management Areas and a site boundary network. The monitoring well network along the site boundary has been established to determine if off-property contamination is present and to provide monitoring for the sewage treatment area sludge drying beds. The networks are separated into 3 vertical monitoring zones that represent different hydrogeologic units. The purpose of the monitoring well networks is to determine the presence of contaminants leaving the Waste Management Area boundary.

5.1 RCRA Monitoring Network in the Sand and Gravel Aquifer

This RCRA plan will provide Groundwater Monitoring at the downgradient boundaries of each WMA and will monitor the facility boundary. The monitoring will be responsible for determining constituent releases from the WMAs to the groundwater. See Figure 5.3. The sand and gravel monitoring networks include monitoring wells at three separate depths (2000-, 3000-, and 4000-series) to monitor vertical migration. The 2000-series wells monitor at the top of the saturated aquifer to determine the existence of floating contamination. The 3000-series wells monitor the middle aquifer at the blue clay layer or equivalent elevation. The 4000-series wells monitor the lower portion of the aquifer to identify sinking contamination. The background monitoring wells from the RCRA GQAPP for Waste Pit 4 (monitoring wells 2043, 2066, 3043, 3066 and 4011) will be monitored under this RCRA plan to maintain background groundwater information.

The first and second monitoring well networks at WMA boundaries are capable of determining water quality as physically close as possible to the contaminant sources in order to document constituent releases to the groundwater.

For the Waste Pit Area, appropriate monitoring wells from the RCRA GQAPP for Waste Pit 4 have been incorporated into the Waste Pit Area monitoring network identified in this RCRA Plan. Previous results from these existing wells will help the transition between RCRA sampling programs. The Waste Pit Area monitoring well network extends to provide monitoring of the Biodenitrification Surge Lagoon. Monitoring wells in the 3000-series will not be installed around the Biodenitrification Surge Lagoon because releases have not been documented from this unit which utilizes two leak detection systems. The 2000-series wells located at the boundary of the Biodenitrification Surge Lagoon will provide a first line of detection in case of a release. The Production Area monitoring well network includes the entire Production Area, the Lime Sludge Ponds, and the Fire Training Area.

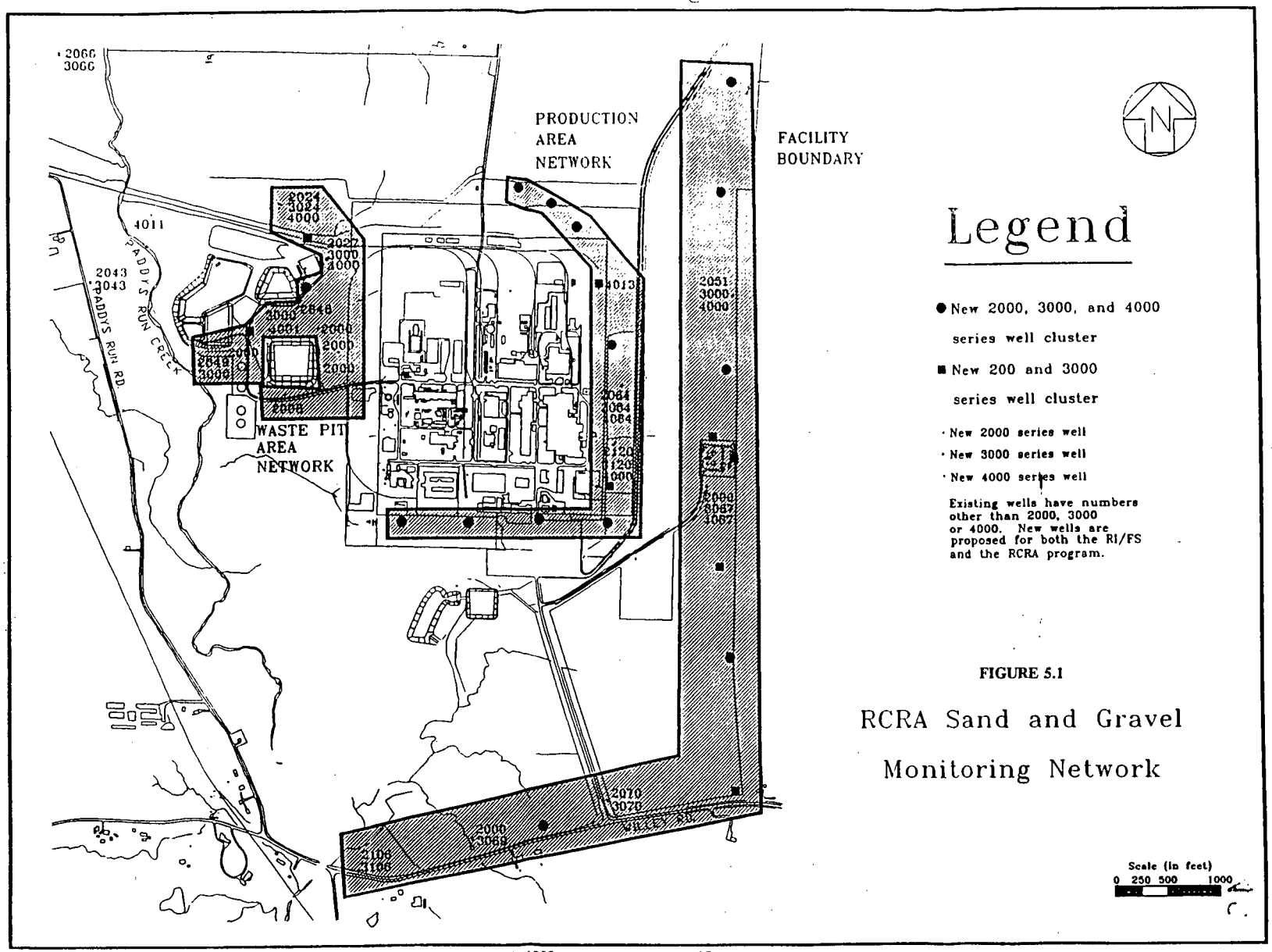


FIGURE 5.1

RCRA Sand and Gravel Monitoring Network

The third monitoring well network along the downgradient boundary of the facility will provide monitoring for potential waste sources not located within the boundaries of the Waste Pit and Production Areas. The sewage treatment sludge drying beds are one waste source that will be monitored by the facility boundary network. Also, the facility boundary network will document contaminant levels existing at the facility boundary and provide an additional safeguard to assure that contaminant plumes do not leave the site boundary undetected.

The RI/FS currently being conducted at the FEMP is required to determine the existence of contamination in the groundwater and its extent and rate of migration. Monitoring locations used to determine rate and extent of migration will be installed as part of the CERCLA process.

6.0 GMP MONITORING WELL INSTALLATION

To complete the monitoring well networks new monitoring wells or points will have to be installed. The location of these new monitoring wells or points can be seen from Figures 5.2 and 5.3. All monitoring wells drilled at the FEMP are drilled to conform to EPA requirements. Well drilling and development procedures are outlined in sections 5.3 and 5.4 of the RI/FS Quality Assurance Project Plan (QAPP), and are also identified in the Sitewide CERCLA Quality Assurance Project Plan (SCQ). The following is an outline of the procedures that will be used for the RCRA plan. These procedures are consistent with the QAPP and the SCQ, but may be more specific due to RCRA requirements.

6.1 Methods and Materials

All field measurements and comments related to well construction are recorded on well construction forms. An example of the type of form used and the information recorded is provided in Appendices A through D. All monitoring wells will use the following design and materials:

* Well casing for groundwater monitoring wells will be four-inch inside diameter, 316 stainless steel with flush-thread joints.

* Five, ten, and fifteen foot sections of stainless steel screens will be used (minimum of 3 square inch open area per foot of screen). Commercial 0.01-inch-slot screen will be used unless the sieve analysis, performed on the lithologic material in which the screen resides, identifies a more appropriate screen size.

* Screen sand pack material will be a well-sorted, medium or coarse quartz sand. The grain size of the sand pack will be determined by the sieve analysis completed on the lithologic materials in which the well is screened. The sand pack will not exceed two feet above the top of the screen. A representative sample from each supplier will be retained for documentation.

* Sodium bentonite pellets and Volclay grout will be used to seal the annular space for 1000- and 2000-series wells. Only Volclay grout will be used in 3000- and 4000-series wells. Samples of all grouts will be retained for documentation. A sample of the grout material will be collected from one of every 20 well locations or fraction thereof for analysis to identify the presence of metals, sulfate, nitrate, and chloride.

* The annular space in the 1000- and 2000-series wells will be filled from bottom to top with a sand pack to a height of two feet above the screened section, then a five foot bentonite pellet plug will be placed on top of the sand pack and, finally, the annular space will be grouted to the surface.

* Annular space grout seals will be composed of Volclay grout mixed with the plant's potable water as per manufacturer's instructions.

* All grout material will be placed from the bottom to the top using pumps and tremie line methods.

* A five foot length (minimum thickness of 1/4 inch) of ten-inch inside diameter black iron pipe will be used as a protective casing. Each protective casing will be fitted with a hinged cap, hasp, and lock. A drain hole will be drilled in the oversleeve one foot above the ground surface.

* A mixture of cement, sand, and potable water in a ratio of approximately 1:4:0.5 (by weight) will be placed between the well riser and the outer protective casing to a height just below the drain hole mentioned above. The water used in this mixture is obtained from the plant supply. This design will allow water that enters the annulus to drain.

* The top of the inside casing will be finished with a vented stainless steel cap or an airtight cap and a vent hole not more than six inches from the top of the casing.

* All wells will be identified with a number welded into the lid of the protective casing. All protective casings are painted to provide visibility.

* A measuring point notch approximately 1/2 inch deep will be filed on the inner casing of each well and will be identified on the notes and well sketches.

* All disturbed drilling areas will be regraded and restored to near original conditions upon completion.

A one-quart or one-liter representative sample of each type of proposed sandpack shall be submitted by the contractor for approval prior to use. Each sample shall be described in terms of lithology, grain size distribution, and source (both company from whom purchased and pit or quarry of origin). This material shall be clean, inert, and siliceous. Typically, graded sand meeting the requirements of ASTM C-33 for fine aggregate (concrete sand) is sufficient.

A diagram of the well installation shall be recorded and shall show at least the bottom of the boring (by depth from the surface grade), screen location, granular backfill, seals, grout, cave-in, centralizers (if used), and height of riser above the ground surface. Also, the actual composition of the grout, seals, and granular backfill shall be recorded. Also indicated shall be the screen height, slot size (in inches), and slot configuration. Any use of polyvinylchloride (PVC) solvents, glues, or cleaners is prohibited. Also, well construction diagrams shall include details of the protective casing. Appendices A through D have examples of these construction diagrams.

Protective casing will be installed around all monitoring wells. Minimum elements in the protection design include:

* A five-foot length of black iron pipe a minimum of four inches greater in diameter than the well casting as a protection casting and set in Volclay grout and concrete apron.

* A locking cover and lock shall be provided and secured to the top of each protective casing.

* The location identification shall be labeled on the well protector in two places using two methods: (1) painted on the inside of the cover with enamel type paint; and (2) welded into the top of the locking cover. Location identification shall conform with the format designated by the site manager.

* The cover must keep precipitation out of the protective casing and shall be secured to that casing with a padlock.

* All padlocks at a given site shall be keyed alike.

* Protective casings are to be painted high-visibility orange.

* Guardposts may be necessary in high traffic areas or in areas where vegetation or debris obscures the protective casing. Guardposts are required only on the high-traffic side of wells.

* Three-inch diameter steel posts, each radially located four feet around each well, placed two feet below the ground surface and extending a minimum of six inches above the protective well casing will be concreted in place to provide traffic protection.

Once the boring has been advanced to the desired depth, the well will be constructed by the following procedure:

* Place the desired length of screen and casing inside the temporary casing.

* Place the sand pack in the annular space between the screen/casing and temporary casing.

* Withdraw the temporary casing slowly while placing sand pack material.

* After placing the sand pack to a level of at least two feet above the screen, a five-foot-thick bentonite pellet layer (on 1000- and 2000-series wells only) is placed on top of the sand pack as the temporary casing continues to be slowly withdrawn. Periodic measurements will be made to check the uniform placement of the sand pack and bentonite pellets.

* The remaining annular space will be filled to the surface using Volclay grout.

* The temporary casing will be removed gradually as the backfill materials are placed in such a manner that the bottom of the temporary casing is kept below the top of the backfill material.

* The protective casing will be installed and concreted in place.

* A three-foot by three-foot by four-inch concrete apron will be installed around the protective casing.

* The ground elevation, top of well casing, and top of protective casing will be surveyed to determine their elevation above mean sea level (amsl). Also, the well will be surveyed to determine its location according to state planer coordinates.

6.2 Monitoring Well Development

All field measurements and comments will be recorded on the well development forms. A well development form will contain at least the information that is identified in the example form provided as Figure 6.1. Monitoring well development will be performed as soon as possible after well installation, but no sooner than 48 hours after grouting is completed. Well development equipment may include, but is not limited to, bailers, surge blocks, pumps, and hoses.

Equipment and materials used for well development will be properly decontaminated, the same way as drilling equipment, before and between each use. Decontamination of equipment used to develop the well will normally be conducted using high-pressure hot-water washing (steam cleaning).

The internal mechanisms of the pumps will be flushed using either dilute solutions of methanol and deionized water or dilute hydrochloric acid and deionized water when contaminants are visible. Development shall be continued with a sump and/or bottom discharge bailer, possibly supplemented with a surge block, until the well water is clear and sediment within the well is removed to the fullest extent practical.

Wells are developed until the natural hydraulic conductivity of the formation has been restored and foreign sediment removed to provide turbid-free groundwater samples. Turbidity is used and tracked as an acceptance/rejection indicator. As a minimum:

* Those wells where the boring was made without the use of drilling fluid water; five times the standing water volume in the well will be removed (well screen and casing plus saturated annulus). The turbidity in the well will be measured and development will continue past five times the standing water volume until turbidity levels are below the five Nephelometric Turbidity Units (NTU) standard or similar to other FEMP groundwater turbidities (a portion of the monitoring wells at the FEMP indicates groundwater contains a higher turbidity than five NTUs, therefore it may be impossible to develop a well to below the five NTU standard).

* For those wells where the boring was made or enlarged with the use of drilling fluid (water), five times the measured amount of total fluids lost while drilling plus five times the standing water volume as above will be removed. Any water added to the boring for the purpose of drilling should be sampled for all constituents of concern. Water samples should be obtained from the effluent end of the hose for each day of drilling in order to detect any contamination associated with the water source, tank, or hose.

* No water will be added to the well to assist development without prior approval. No dispersing agents, acids, or disinfectants are to be used.

* During development, an effort is made to remove the standing water from points near the bottom of the well screen as well as from the top of the water column.

FIGURE 6.1

FERNALD RI/FS
PROJECT NO. 602
TASK 3.2

MONITORING WELL DEVELOPMENT

PAGE ___ OF ___

WELL NUMBER _____

DATE(S) OF WELL INSTALLATION _____

WELL DEVELOPMENT START DATE/TIME _____ COMPLETION DATE/TIME _____

		BEFORE DEVELOPMENT	AFTER DEVELOPMENT
STATIC WATER LEVEL			
DEPTH OF OPEN HOLE			
CHANGES IN PHYSICAL CHARACTER OF WATER REMOVED	TURBIDITY		
	COLOR		
	PARTICULATES		
	ODOR		

TOTAL CALCULATED VOLUME OF WATER TO BE REMOVED (IN GALLONS) _____

TOTAL VOLUME OF WATER ACTUALLY REMOVED DURING DEVELOPMENT (GALLONS) _____

TYPE AND SIZE OF PUMP _____ TYPE AND SIZE OF BAILER _____

PHYSICAL CHARACTER OF REMOVED SEDIMENTS (LITHOLOGY AND GRAIN SIZE)

DESCRIPTION OF SURGE TECHNIQUES (IF USED)

METER CALIBRATION

pH TEMP	pH STD.	pH STD.	SPECIFIC CONDUCT.	uMHOS/CM	uMHOS/CM	TURBIDITY NTU	TURBIDITY NTU

METER MODEL/ SERIAL NO.	pH METER	SPECIFIC CONDUCTANCE METER	TURBIDITY METER	DISSOLVED OXYGEN METER

FIELD ENGINEER/GEOLOGIST _____ DATE _____

DRILLER/HELPER _____

CHECKED/VERIFIED BY _____ DATE _____

7.0 GROUNDWATER SAMPLING STRATEGY AND PROTOCOLS

All sampling conducted for the RCRA monitoring program will be performed in accordance with OAC 3745-65-93(C)(2)/40 CFR 265.93(c)(2). Under the RCRA Groundwater Monitoring Program, each well will be monitored quarterly for the parameters listed in Table 7.1. These parameters were selected after reviewing the results of the Characterization Investigation Study (Weston, 1986), and previous RCRA and RI/FS groundwater monitoring data.

For the newly constructed monitoring wells proposed under this Workplan, the FEMP will sample for 40 CFR 264 Appendix IX constituents during the first round of sampling. If parameters are confirmed in the 40 CFR 264 Appendix IX sample results from the newly constructed wells that are not listed in Table 7.1, those parameters will be added to the quarterly analytical schedule.

Quarterly sampling will occur on a three month time scale, starting in January, April, July, and October. Sampling for the Waste Pit Area network will be completed at the beginning of each sampling quarter, followed by the Production Area and the facility boundary networks.

The sampling as a part of this plan will be implemented as a component of the CERCLA response action process at the FEMP. Sampling protocols for the CERCLA RI/FS will be observed. Sampling protocols are identified in the FEMP SCQ (DOE, 1991), and the previous RI/FS QAPP, Rev. 3, (DOE, 1988). The sample collection and analysis sections to follow, as well as the well construction and development section 6.0 is consistent with the SCQ and the QAPP, but may be more specific due to RCRA requirements.

The Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of the data required to support decision making. Because they are based on the end uses of the data to be collected, different uses may require different levels of data quality. There are five analytical levels that define the various data uses and the Quality Assurance/Quality Control (QA/QC) methods required to achieve the desired level of quality.

The DQOs to be used for the RCRA plan are Analytical Support Level (ASL) A, field results; and ASL B, analytical results. ASL D, Contract Lab Program (CLP) analytical results, may be required for CERCLA use. ASL A data provides the most rapid results and is collected through the use of photoionization detectors, pH, conductivity, dissolved oxygen probes, and electronic water elevation probes. ASL B data is analyzed and verified in accordance with procedures from SW-846 or other standard analytical laboratory methods. ASL D CLP analysis requires full analytical and data validation procedures in accordance with EPA-recognized protocol.

The primary consideration in sample collection, after safety, is to obtain a representative sample of the groundwater. The sample collection process consists of the following six steps; (1) detection of immiscible layers, (2) measurement of the static water level (SWL), (3) well evacuation, (4) field analyses, (5) sample withdrawal, and (6) equipment and site cleanup. Procedures used to control each step of the sampling collection process are adapted from the RCRA Ground Water Monitoring Technical Enforcement Guidance Document, EPA, 1986.

RCRA Groundwater Monitoring Plan

TABLE 7.1

Parameters To Be Tested Under the Plan

A. Groundwater Quality Parameters
(OAC 3745-65-92(B)(2)/40 CFR 265.92(b)(2))

Manganese	Chloride
Iron	Phenols
Sodium	Sulfate

B. Groundwater Contamination Parameters
(OAC 3745-65-92(B)(3)/40 CFR 265.92(b)(3))

pH	Temperature
Specific Conductance	

C. Parameters Characterizing the Suitability of Groundwater as a Drinking Water Supply
(OAC 3745-81-11(B)/40 CFR 141.11(b))

Arsenic	Barium
Cadmium	Chromium
Gross Alpha	Gross Beta
Lead	Mercury
Nitrate	Radium 226-228
Selenium	Silver
Fluoride	

D. Site Specific Parameters

Aluminum	Beryllium
Calcium	Cobalt
Copper	Magnesium
Nickel	Vanadium
Zinc	Uranium
Acetone	Benzene
Carbon disulfide	Chloroform
1,1-Dichloroethane	1,2-Dichloroethane
1,1-Dichloroethene	trans-1,2-Dichloroethene
1,2-Dichloroethene (Total)	Methylene chloride
Tetrachloroethene	Toluene
1,1,1-Trichloroethane	Trichloroethene
Vinyl chloride	

7.1 Detection of Immiscible Layers

An initial determination of immiscible layers will be performed for all the monitoring locations in the RCRA plan. If a monitoring location does not initially indicate an immiscible layer, it will be retested once a year. If the initial test determines an immiscible layer at a monitoring location, the monitoring location will be retested before each quarterly RCRA sampling. A photoionization detector and an interface probe or translucent bailer will be used to detect organic phases before the well is evacuated for sampling.

* The air in the wellhead will be sampled for organic vapors using a photoionization detector.

* An interface probe will be lowered into the well to determine the existence of any immiscible layer(s), light and/or dense. If a translucent bailer is used, it will be lowered to the water surface and a sample will be drawn for observation. The translucent bailer will be lowered to the bottom of the well and a sample of that groundwater will be drawn for observation.

* If an immiscible phase is present, a sample will be collected prior to any purging activities.

* The SWL will be determined and the total well depth will be recorded.

7.2 Measurement of Static Water Level (SWL)

SWL elevation and total depth (TD) of the monitoring well will be determined prior to each sampling event. A conductance probe (or equivalent) will be used to take the depth measurements, and depths will be reported to the nearest 0.01 foot. The volume of stagnant water in the well casing will be calculated from these measurements. Three well volumes will then be evacuated from the well-bore.

Because sampling events occur over a long period of time (months), water elevations will be measured separately for all of the RCRA monitoring locations at the FEMP. The separate water elevation measurements will be taken on a monthly basis and completed within seven days. These water elevation readings are more representative of real time conditions and are used in the determination of flow directions and seasonal effects on groundwater.

7.3 Well Evacuation

All monitoring wells will be pumped or bailed prior to collecting a sample. The rate of purge, in any case, will not exceed 20 gallons per minute (gpm). Evacuation of at least three well volumes of water is recommended for a representative sample. However, the hydraulic yield characteristics of a well may limit the ability to extract three well volumes. Wells that are capable of yielding three well volumes of water will be purged of three well volumes prior to the collection of samples. Wells that are not capable of yielding three well volumes will be pumped to dryness and allowed to recover prior to the collection of samples.

Temperature, pH, dissolved oxygen, and specific conductance measurements are made in the field. Measurements will be taken and recorded prior to purging and after the first, second, and third purge volumes from the monitoring well. Three consecutive readings will be used to verify the stability of the water being sampled over time. A copy of the Water Quality Field Collection Record is provided in Figure 7.1.

A stainless steel submersible pump, a stainless steel and/or teflon positive displacement bladder pump, or a teflon bailer with stainless steel cable or disposable nylon cord will be used to purge the well. If the draw-down is significant, the submersible pump will be lowered during purging to keep the pump five to ten feet below the water level in the casing and the pumping rate will be reduced. Dedicated monitoring equipment is being used at the FEMP in some of the RCRA plan wells. New wells constructed for this plan will have dedicated equipment installed where appropriate. The use of dedicated equipment will change the well evacuation procedure described above.

7.4 Purge Water Disposal

Prior to sampling, purge water is withdrawn from the monitoring well and transferred directly to a purge water storage tank which is located on the sampling vehicle. Purge water that is determined to be non-hazardous through comparison to regulatory guidance, and is also determined not to exceed the NPDES permit "notification levels" (40 CFR 122), is then transferred to the FEMP General Sump for discharge. Purge water collected from any well that is contaminated with RCRA defined hazardous wastes or hazardous waste constituents will be properly managed as a hazardous waste under federal, state, or local regulations.

7.5 Field Analyses

During the purging operation, the temperature, pH, and specific conductance of the purged water is measured and recorded. The pH, temperature, specific conductivity, and dissolved oxygen content of the groundwater (after the well has been purged) is also measured and recorded on Water Quality Field Collection Records (Figure 7.1). All measurements are performed on unpreserved samples. The following is an overview of the procedures.

7.5.1 Temperature

The temperature of groundwater is important for numerous applications. It is required to normalize data from other analytical determinations such as pH, specific conductance, alkalinity, and dissolved oxygen. Temperature readings will be obtained by partially immersing the thermometer in a sample and allowing it to equilibrate for about two minutes. The procedure is as follows.

* A temperature reading will be taken on an unpreserved sample at the start of sampling.
* A post-sampling temperature reading will be taken of the sample to record any temperature change during the sampling process.
* All readings will be recorded on the appropriate field collection reports.

FIGURE 7.1

WATER QUALITY FIELD COLLECTION RECORD

PREPARED BY / DATE	
REVIEWED BY / DATE	

WELL NO.	DATE SAMPLED	SAMPLE TYPE ☐ REG ☐ DUP ☐ SPT
NON RAD C/C NO.	NON RAD RFA NO.	SAMPLE PROGRAM
RAD C/C NO.	RAD RFA NO.	RELEASE NO.
WEMCO C/C NO.	WEMCO RFA NO.	TEAM

WATER ELEVATION AND PURGE DATA

TOTAL DEPTH - WATER LEVEL = WATER COLUMN x GAL/FT = 1 PURGE VOL x 3 = TOTAL PURGE VOLUME
(ft) (ft) (ft) (gal) (gal)

_____ - _____ = _____ x _____ = _____ x3 = _____

*IF PACKER INSTALLED: (SCREEN LENGTH + 3 FT) x GAL/FT = 1 PURGE VOL x 3 = TOTAL PURGE VOLUME
(ft) (gal) (gal)

_____ + _____ = _____ x _____ = _____ x3 = _____

2" = 0.16 (gal/ft) 4" = 0.65 (gal/ft) 6" = 1.47 (gal/ft) 8" = 2.61 (gal/ft)

REFERENCE POINT/Material	MAX Pumping Rate (gpm)	PURGE TYPE	STATIC WATER PROBE NO.
☐ TPC ☐ TOW ☐ NOTCH ☐ QED M.P. ☐ SS ☐ PVC ☐ STEEL	_____	☐ PUMPED ☐ BAILED ☐ QED ☐ DEDICATED	

WATER QUALITY FIELD MEASUREMENTS

	TIME	pH	TEMP	SPEC COND	D.O.	TURBIDITY
PRE-PURGE						
PRE-SAMPLING						
POST SAMPLING						

TOTAL GALLONS PURGED	HNU METER #	HNU READINGS Meter Units
	_____	_____ ACCESS AREA _____ WELL BORE

NOTES: _____

7.5.2 pH

pH is defined as the negative logarithm of hydrogen-ion activity in a sample and is a measure of effective hydrogen-ion concentration. The pH values are very useful for assessing the acidic or basic nature of a body of water and also for elucidating complex chemical reactions occurring in water. The pH of groundwater is normally determined by immersing a combination electrode (glass and reference electrode) in the solution and measuring the potential difference with a pH meter. The pH is measured to the nearest 0.01 unit. The procedure is as follows:

Apparatus used to perform the measurement includes: (1) a standard pH meter (battery operated) with an expanded scale capable of measuring pH to the nearest 0.01 unit; (2) a combination pH electrode; (3) three standard buffer solutions of pH 4.0, pH 7.0, and pH 10.0, and (4) a metal-cased direct-reading thermocouple with a normal range of zero to 50 degrees Celsius measured in two degree intervals.

Calibration Criteria:

* The pH meter will be calibrated on each day before sampling. Results of the calibration are documented on a Water Quality Meter Calibration Form (example form shown as Figure 7.2).

* The electrode will be rinsed with distilled water.

* The pH meter will be set to the proper ambient water temperature. The temperature correction of readings is automatic.

* The pH meter will be calibrated with at least two appropriate buffers before starting pH measurement. Manufacturer's instructions for calibration will be followed.

Measurement Criteria:

* The water temperature will be measured and used to set the pH meter to the correct temperature setting.

* Electrodes will be rinsed with distilled water between each measurement.

* Personnel will verify that the line cord is properly attached to the instrument.

* The electrode tip will be immersed sufficiently to obtain accurate readings.

* The connecting cables will not be touched during a pH measurement.

* All readings will be recorded on the Water Quality Field Collection Record (see Figure 7.1 for example form).

FIGURE 7.2

GROUNDWATER QUALITY METER CALIBRATION RECORD

PREPARED BY:	DATE:
REVIEWED BY:	DATE:

EQUIPMENT VERIFICATION	METER ID: YSI Model 3500 Water Quality Meter	METER SERIAL NO.:	DATE OF LAST CALIBRATION
	pH PROBE ID: YSI Model 3530 pH Electrode	PROBE SERIAL NO.:	DATE PROBE REPLACED:
	TEMPERATURE PROBE ID: YSI Model 3510 Temperature Probe	PROBE SERIAL NO.:	DATE PROBE REPLACED:
	CONDUCTIVITY CELL ID: YSI Model 3520 Conductivity Cell	CELL SERIAL NO.:	DATE CELL REPLACED:

CALIBRATION STANDARDS VERIFICATION	pH BUFFER SOLUTIONS ID	MANUFACTURER:		LOT NUMBER:
	pH BUFFER SOLUTIONS EXPIRATION DATE(S)	pH 4.0:	pH 7.0:	pH 10.0:
	CONDUCTIVITY STANDARD ID	MANUFACTURER/LOT NUMBER:		EXPIRATION DATE:

CONDUCTIVITY STANDARD ASSAYED VALUE: mmho/cm	CELL/METER % ACCURACY: ± 3% of Full Scale = ±0.06 mmho/cm		
	CONDUCTIVITY STANDARD % ACCURACY:	SYSTEM % ACCURACY:	ACCEPTABLE RANGE:

WATER QUALITY METER CALIBRATION	pH CALIBRATION		BUFFER	TIME	TEMP (C)	METER VALUE
		pH				
		pH				

CONDUCTIVITY CALIBRATION	STANDARD mmho/cm	TIME	TEMP (C)	ACCEPTABLE RANGE	METER VALUE

CALIBRATION CHECK SHEET	pH CALIBRATION CHECK						
	WELL NO.	BUFFER VALUE	TIME	TEMP (C)	INITIAL VALUE	POST SAMP. VALUE	INITIALS

CONDUCTIVITY CHECK					
STANDARD mmho/cm	TIME	TEMP (C)	ACCEPTABLE RANGE	METER VALUE	INITIALS

7.5.3 Specific Conductance

The ability of a solution to carry an electric current under specific conditions is measured by specific conductance values. These values will generally have a direct relationship to the concentration of dissolved solids in the water. A conductivity cell will be immersed in a sample of water and the conductance in millimhos per centimeter will be measured directly from the meter. The readings will be corrected for temperature to 25 degrees Celsius.

The following apparatus is needed to take the measurement: (1) a conductivity cell or probe; (2) a conductivity meter; and (3) a thermometer.

Calibration Criteria:

* The conductivity meter will be calibrated before each day's sampling. The results of the calibration will be recorded on a Water Quality Meter Calibration Form (example form shown as Figure 7.2)

* The instrument will be allowed to warm up for a few minutes before use.

* The equipment will be calibrated according to the manufacturer's instructions before use.

Measurement Criteria:

* The probe will be inserted into the sample.

* The meter will be set to the appropriate scale and readings will be recorded in millimhos per centimeter.

* The temperature of the sample will be measured.

* All readings will be recorded on the Water Quality Field Collection Record (see Figure 7.1 for example form).

* The specific conductance reading will be corrected for temperature to 25 degrees Celsius.

* The probe will be rinsed with distilled water between each measurement.

7.5.4 Dissolved Oxygen

Adequate dissolved oxygen is necessary to maintain the life of aquatic organisms. The dissolved oxygen concentration may have an effect on the redox potential of groundwater and the chemical behavior of aqueous constituents. Physical, chemical, and biochemical activities in water may affect the dissolved oxygen levels.

Apparatus needed to measure the dissolved oxygen content includes: (1) an oxygen-sensitive membrane electrode (polarographic or galvanic), which includes two solid metal electrodes separated from the test solution by a selective membrane (commonly polyethylene or fluorocarbon); (2) samples with known dissolved oxygen concentration for calibration or reading against water-saturated air; (3) distilled water for calibration and instrument cleaning; and (4) a metal-cased, direct-reading thermocouple with a normal range of zero to 50 degrees Celsius measured in two-degree intervals.

Sampling personnel are to follow manufacturer's calibration instructions. Generally calibration is performed against water-saturated air or water with a known dissolved oxygen concentration before measuring any fresh water containing possible interfering substances. Calibration is performed before each sample location and results of the calibration are recorded in the Daily Field Activity Log.

Measurement Criteria:

* Temperature measurements will be taken at the time of the dissolved oxygen reading.

* The probe will be inserted into the sample.

* Sufficient time will be taken for the sample to flow across the membrane surface to overcome any erratic responses of the instrument.

* The correct reading from the meter will be recorded on the Water Quality Field Collection Record (example form shown as Figure 7.2) and corrected for temperature if the meter is so equipped.

7.6 Sampling Procedures

Sampling procedures are followed to ensure that representative samples are being collected from the monitoring wells. The following sampling procedures define the activities required to collect representative samples for the RCRA GMP.

7.6.1 Sample Identification and Labeling

Sampling personnel will assure that each sample collected in the field is properly labeled. The labels, at a minimum, will contain the following information:

* Sample identification number
* Initials of collector(s)
* Date and time of collection
* Place of collection
* Type of sample
* Parameters requested
* Filtered or non-filtered
* Preserved or non-preserved

All sample bottles will be immediately sealed with a laboratory sample seal to verify that the sample has reached the analysis point without tampering.

7.6.2 Chain-of-Custody Record

A Chain-of-Custody Record (Figure 7.3) will be completed for each sample collected and will accompany every sample that is sent to a contract lab for analysis. The purpose of the Chain-of-Custody Record is to provide written documentation of the handling of the sample.

7.6.3 Request for Analysis Form

A Request for Analysis Form (Figure 7.4) will be completed for each sample submitted to a lab for analysis and will accompany every sample that is sent to a lab for analysis. The Request for Analysis Record is used to communicate analytical needs to the laboratory and to provide the lab with needed information concerning the samples that are being sent to them (i.e., turn around time, hazard identification, disposal requirements).

7.6.4 Quality Assurance and Quality Control

Quality control blanks (trip, field, and rinsate) will be routinely collected as part of the sampling program. Sample events are considered the purging and sampling of one monitoring location.

* Trip blanks will be prepared for each day of sampling. A trip blank is prepared for each bottle type in use by filling identical bottles with deionized water. The blanks will be transported to the collection site and returned unopened as a sample. The blanks will be subjected to the same analytical program as the sample. Analysis of trip blanks determines if the integrity of the corresponding samples was affected during transport and handling.

* Field blanks will be prepared routinely (one out of every set of ten sampling events or fraction thereof) at a selected sampling location. A field blank will be prepared for each bottle type in use by filling identical bottles with deionized water in the field. The field transferred water will be subjected to the same analytical tests as the sample. Analysis of field blanks will help determine if parameters of interest are being introduced into the samples through field activities.

* Rinsate or cleaning blanks will be prepared routinely (one out of every set of ten sampling events or fraction thereof) to verify that non-dedicated sampling devices are clean. They will be prepared by pouring deionized water over just cleaned sampling equipment and then into sample bottles. The rinsate blank will be subjected to the same analytical program as the sample.

* A Water Quality Field Collection Record, a chain-of-custody record, a laboratory request for analysis form, and a sample log will be completed. These forms, except for the field collection record and log, will accompany the samples to the laboratory.

FIGURE 7.3

CHAIN-OF-CUSTODY RECORD

Project Name/Number: _____ R/A Control No.: _____

Sample Team Members: _____ C/C Control No.: _____

Lab Destination: _____

Carrier/Waybill No: _____

SAMPLE NUMBER	SAMPLE LOCATION AND DESCRIPTION	DATE AND TIME COLLECTED	SAMPLE TYPE	CONTAINER TYPE	CONDITION ON RECEIPT (NAME AND DATE)	DISPOSAL RECORD NO.

Special Instructions: _____

Possible Sample Hazards: _____

SIGNATURES:

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
NAME/COMPANY:	NAME/COMPANY:	NAME/COMPANY:	NAME/COMPANY:
DATE:	DATE:	DATE:	DATE:
TIME:	TIME:	TIME:	TIME:

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
NAME/COMPANY:	NAME/COMPANY:	NAME/COMPANY:	NAME/COMPANY:
DATE:	DATE:	DATE:	DATE:
TIME:	TIME:	TIME:	TIME:

DISTRIBUTION OF COPIES	
White	Original, to Accompany Samples
Yellow	Field Copy

FIGURE 7.4

R/A Control No.:

C/C Control No.: _____

REQUEST FOR ANALYSIS

Project Name: _____

Project Number: _____

Project Manager: _____

Bill To: _____

Purchase Order No.: _____

Date Samples Shipped: _____

Lab Destination: _____

Laboratory Contact: _____

Send Lab Report To: _____

Date Report Required: _____

Project Contact: _____

Project Contact Phone No.: _____

SAMPLE NO.	SAMPLE TYPE	SAMPLE VOLUME	PRESERVATIVE	REQUESTED TESTING PROGRAM	SPECIAL INSTRUCTIONS

TURNAROUND TIME REQUIRED: *(Rush must be approved by the Project Manager.)*

☑ Normal - 4 Weeks ☐ Rush - (Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION: *(Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances.)*

☐ Nonhazard ☐ Flammable ☐ Skin Irritant ☐ Highly Toxic ☑ Low-Level Radionuclides ☐ Other: _____

SAMPLE DISPOSAL: *(Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, and disposal.)*

☐ Return to Client ☑ Disposal by Lab

DISTRIBUTION OF COPIES	
White	Original, to Accompany Samples
Yellow	Field Copy

FOR LAB USE ONLY

Received By: _____ Date/Time: _____

7.6.5 Sampling Order

Samples will be collected in accordance with the stability and solubility of the parameters to be tested. For example, samples to be tested for parameters that are sensitive to pH, specific conductance, and temperature will be collected first. Parameters which are not sensitive to pH or volatilization will be drawn last. Care will be taken to avoid excessive pumping of a monitoring well as this can lead to an increase or decrease in the concentrations of a contaminant at the sampling point of interest.

Samples are collected and containerized in the order of the volatilization sensitivity of the parameters. The collection order is as follows:

(1) Volatile organic compounds (VOCs)
(2) Semi-Volatile organics (not routinely taken)
(3) Phenols
(4) Total metals
(5) Dissolved metals
(6) Cyanide
(7) Sulfate, Chloride, and Fluoride
(8) Ammonia, Nitrate, and Phosphorous

All sampling conforms to the RI/FS QAPP (DOE, 1988, Section 6.0) and the FEMP SCQ (DOE, 1991). Immediately following is a summary of sampling protocols used for all parameters. The procedures below conform to the QAPP, but may be more specific due to RCRA requirements. Sampling events are considered the purging and sampling of one monitoring location.

7.6.6 Volatile Organic Compounds

If volatile constituents are of concern and a positive gas displacement stainless steel pump or a teflon bladder pump is being used, pumping rates will not exceed 100 milliliters per minute.

* Three clean screw-cap vials with Teflon-lined silicone rubber septa (USEPA approved vials) will be filled to overflowing and closed without any entrapped air bubbles. Each vial will be visually checked for air bubbles and sealed with custody tape. These vials will be 40 milliliters or larger.

* Hydrochloric acid will be used as preservatives for the volatile organic compound samples where necessary.

7.6.7 Acid and Base-Neutral Extractable Compounds and Pesticides/PCBs

Groundwater samples for semivolatile testing are not routinely collected. When samples are collected, the following procedure will be followed:

* Appropriate clean glass sample bottles will be filled to capacity and sealed with custody tape.

7.6.8 Phenols

* A clean amber glass bottle (containing H_2SO_4 preservative) will be filled to capacity. Care will be taken to avoid overfilling the container so that the preservative remains in the container.

* The sample pH will be checked with pH paper or a pH meter to verify that the pH is < 2. If the pH of the sample is not below 2, acid will be added to the sample to reach the required pH. The bottle will then be closed and sealed with custody tape.

7.6.9 Metals (Total)

* A clean plastic container (containing HNO_3 preservative) will be filled to capacity. Care will be taken to avoid overfilling the container so that the preservative remains in the container.

* The sample pH will be checked with pH paper or a pH meter to verify that the pH is < 2. If the pH of the sample is not below 2, acid will be added to the sample to reach the required pH. The bottle will then be closed and sealed with custody tape.

7.6.10 Metals (Dissolved)

* Dissolved metal samples will be filtered in the field, as soon as possible after collection, through a 0.45-micron filter using a Millipore filtration apparatus or equivalent equipped with a hand or electrical vacuum pump.

* The filtering apparatus will be decontaminated and rinsed thoroughly with deionized water before filtering each sample.

* The first 100 to 150 milliliters of filtrate from each sample will be used to rinse the filter and filtration apparatus.

* The filtered sample will be immediately transferred to a plastic container containing HNO_3 preservative. Care will be taken to avoid overfilling the container so that the preservative remains in the container.

* The sample pH will be checked with pH paper or a pH meter to verify that the pH is < 2. If the pH of the sample is not below 2, acid will be added to the sample to reach the required pH. The bottle will be closed and sealed with custody tape.

7.6.11 Cyanide

* A clean plastic container containing NaOH preservative will be filled to capacity. Care will be taken to avoid overfilling the container so that the preservative remains in the container.

* The sample pH will be checked with pH paper or a pH meter to verify that the pH is > 12. If the pH of the sample is not above 12, a basic solution will be added to the sample to reach the required pH. The bottle is then closed and sealed with custody tape.

7.6.12 Sulfate, Chloride, Fluoride, and Nitrate

* A clean plastic bottle will be filled to capacity, closed and sealed with custody tape. Care will be taken to avoid overfilling the container so that the preservative remains in the container.

7.6.13 Ammonia/Phosphorous

* A clean plastic container containing H_2SO_4 preservative will be filled to capacity. Care will be taken to avoid overfilling the container so that the preservative remains in the container.

* The sample pH will be checked with pH paper or a pH meter to verify that the pH is < 2. If the pH of the sample is not below 2, acid will be added to the sample to reach the required pH. The bottle is then sealed with a plastic cap fitted with a polyethylene liner.

7.7 Sample Field Preservation

Samples collected in the field are placed in coolers packed with artificial ice while field activities continue. Samples are transferred to refrigerators for cooling prior to shipment to the analytical laboratory.

7.8 Equipment and Site Cleanup

When the pump and lines are removed from a well, they will be placed on plastic sheeting to avoid contact with the ground. Decontamination of submersible sampling pump(s), bailer(s), and other sampling equipment is performed at a designated central staging area at the FEMP site by decontamination worker personnel. All equipment is decontaminated and cleaned prior to use at another location. The pump and lines are drained and decontaminated with a high pressure water wash and deionized water rinse. The internal surfaces are decontaminated by pumping deionized water through the pump system.

In the case of inorganic contaminants, the equipment is first washed off with a nonphosphate detergent and then rinsed with dilute (0.1 Normal) hydrochloric acid followed by two separate deionized water rinses. In the case of organic contamination, the equipment is first washed with a nonphosphate detergent and then rinsed with tap water, methanol, and two separate deionized water rinses. The equipment is thoroughly rinsed with two deionized water rinses to remove traces of hydrochloric acid, detergent, and methanol. Sampling equipment is only placed upon clean plastic sheets. The final deionized water rinse is sampled and analyzed at a frequency of one per every set of ten samples to check for cross contamination between monitoring wells.

All sampling locations are policed for refuse prior to leaving the site. All sampling equipment and materials will be removed. All refuse and plastic sheets will be removed.

7.9 Sample Containers / Preservation / Handling and Shipment

Sample containers are purchased pre-cleaned from the receiving laboratory or an independent vendor. Sample containers are stored in a locked cabinet until they are required for sample collection. Containers are not opened prior to use.

After a sample is placed in a container, the sample container is secured with a custody seal and placed in a plastic bag to minimize the potential for contamination from vermiculite or other packing material. Upon arrival at the laboratory, the QC coordinator or designee will examine the contents of the shipping container and document on the chain-of-custody record if any sample containers did not have the custody tape affixed.

Shipping containers are filled with approximately three inches of vermiculite or suitable substitute (non-combustible, absorbent packing material). Under no circumstances will locally obtained material (sawdust, sand, etc.) be used.

The secured sample containers are arranged in the cooler in such a way so as not to touch each other. The cooler is kept closed except for when the sample is inserted. Commercially available artificial ice will be used to cool the contents of the cooler. The remaining space in the cooler is filled with inert packing material. The container is filled so that no loose space remains. The shipping container is secured shut with filament tape. The cooler is sealed shut with tamper proof seals.

Groundwater samples are normally shipped to contract labs in plastic picnic type coolers. Maximum/minimum thermometers are used to record the temperature extremes encountered by the samples. Sampling personnel secure the Chain of Custody Record and the Request for Analysis Record to the inner lid of the cooler.

7.10 Laboratory Analytical Procedures

Test methods used at the FEMP are documented in the RI/FS QAPP. Groundwater is analyzed per methods outlined in SW-846 Test Methods for Evaluating Solid Waste-Physical/Chemical Methods, 2nd edition, (Revised), and other EPA-approved methods (e.g., Standard Methods for the Examination of Water and Wastewater, American Public Health Association and America Waterworks Association; 15th Ed., 1981). The method used is recorded on the lab reports submitted by the analytical lab. Methods chosen by the regulatory agency are designed to limit chemical interference in laboratory methods.

A description of the analytical lab used for the RCRA plan, its sample tracking and controls, and analytical procedures is provided in Appendix E. The analytical lab follows approved analytical methods and observes the interferences listed in SW-846 for each method. Lab reports received from the lab contain a listing of the methods used and the date that the sample was analyzed. The maximum allowable holding times are listed in Table 7.2. The test methods used are tabulated in Table 7.3.

TABLE 7.2

Maximum Holding Times by Parameters for Groundwater Samples

Parameter	Maximum Holding Times*
Inorganics	
Chloride	28 days
Fluoride	28 days
Hydrogen Ion (pH)	analyze immediately
Mercury[a]	28 days
Metals, except Hexavalent Chromium and Mercury[a]	6 months
Nitrate	48 hours
Phenols (Total)	7 days until extraction 40 days after extraction
Specific Conductance	analyze immediately
Sulfate	28 days
Temperature	measure immediately
Gross Alpha/Gross Beta	6 months
Radium 226-228	6 months
Volatile Organic Compounds[b]	7 days[c]

* Samples will be analyzed as soon as possible after collection.
The times listed are maximum times that samples should be held in the laboratory before analysis.

[a] Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before pH adjustment to determine if sulfide is present.

[b] Guidance applies to samples to be analyzed by GC, LC or GC/MS for specific compounds.

[c] If acid preservation (HCl to pH less than 2) is used, the maximum holding time can be extended from 7 days to 14 days.

Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, SW-846
Methods For Chemical Analysis of Water and Waste EPA-60014-79-020
Standard Methods For the Examination of Water and Wastewater

RCRA Groundwater Monitoring Plan

TABLE 7.3

Analytical Methods to be Used in the Groundwater Monitoring Program

Analysis of samples is performed as per the following methods from U.S. EPA SW-846, unless otherwise noted:

PARAMETER	METHOD
Chloride	9252
Fluoride	340.2[a]
Nitrate	353.2[a]
Phenols	9065
Sulfate	9038
Aluminum	7020
Barium	7080
Beryllium	7090
Calcium	7040
Copper	7210
Iron	7380
Magnesium	7450
Manganese	7460
Mercury	7470
Sodium	D-1428[b]
Zinc	7950
Arsenic	7061
Cadmium	7131
Chromium	7191
Cobalt	7201
Lead	7421
Gross Alpha/Gross Beta	302[c]
Radium	304[c]
Nickel	249.2[a]
Selenium	7741
Silver	272.2[a]
Uranium	Laser Phosphorimetry Method
Vanadium	7911
Volatile Organics	8240

[a] Methods of Chemical Analysis EPA-600/4-79-020
[b] American Society of Testing and Materials
[c] Standard Methods for the Examination of Water and Wastewater, 13th edition, American Public Health Association, New York, N.Y., 1971

8.0 ORGANIZATION OF DATA

All well construction and development records will be kept for each monitoring location in the RCRA plan. Records will be stored in fire-resistant file cabinets.

Data collected for this RCRA plan includes water quality data and water level data. Field analysis data and water level data are documented on Water Quality Field Collection Records (see example form as Figure 7.1) by the field technicians. Laboratory analytical reports and field collection reports are stored in fire-resistant file cabinets along with Chain-of-Custody and Request-for-Analyses forms. Data collected from sampling events are entered into a database and verified prior to use in groundwater evaluations.

In accordance with OAC 3445-65-94(B)(1)/40 CFR 265.94(b)(1), all records of the analyses and evaluations specified in this plan will be maintained throughout the active life of the facility. Data and supporting paperwork include; original field data sheets, Chain-of-Custody Records, Request for Analysis Forms, laboratory data reports, and data evaluation reports.

The OEPA and DOE are currently developing a program for the electronic transfer of data. Once this program is adopted, data developed for this GMP will be electronically transferred to the OEPA.

9.0 ASSESSMENT OF GROUNDWATER ANALYTICAL RESULTS

All test results will be evaluated by comparing them to results obtained from accompanying QC samples (trip blanks, field blanks, method blanks, and duplicates) to determine their validity and to previous results to determine if they are within acceptable variation.

Groundwater elevations will be evaluated for each month to determine the presence and flow direction of groundwater monitored by the RCRA program. The evaluation of groundwater elevations will include;

* Groundwater elevation maps contouring the surface elevations in the sand and gravel aquifer.
* A spacial and vertical study of perched groundwater elevations to determine connectivity or similarity in perched groundwater zones.
* An assessment of cluster well groundwater elevations to determine the presence of vertical gradients.

9.1 Data Evaluations and Action Levels

The previous RCRA GQAPP for Waste Pit 4 compared water quality from upgradient wells to that of downgradient wells. The data was compared via a Student's T-test. When statistically significant differences in water quality were identified, the assumption was made that the regulated unit had affected

water quality and the well from which the water sample was extracted is within the "plume" emanating from the regulated unit. An alternate statistical approach is proposed under this plan.

The guidance document entitled Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Interim Final Guidance, U. S. Environmental Protection Agency; April, 1989, allows for the use of a number of statistical methods. Generally, the methods require a comparison of well data to either background constituent levels or some agreed upon standard. As part of the site-wide RI/FS, a health based risk assessment is under development. The outcome of the risk assessment will include establishment of acceptable action levels and cleanup levels.

The Great Miami Aquifer RCRA GMP action levels for parameters that have a PRG will be established as follows:

1. For a constituent with detectable concentrations in background groundwater the action level will be the background 95% upper tolerance limit (UTL) plus the PRG.

2. For constituents that do not have detectable concentrations in background groundwater the action level will be the PRG.

3. If the constituent is not detectable in background groundwater and the PRG is less than the method detection limit then the PRG will be the method detection limit.

A PRG based on the RAGs guidance cannot be established if a reference dose factor for a parameter is not available. Several constituents included in the RCRA GMP do not have established reference dose factors. The action levels for those parameters have been established as follows:

1. The action level for constituents occurring in background groundwater that have no PRG is the 95% UTL of the constituents background concentration.

2. The action level for constituents not detected in background groundwater that have no PRG is the Maximum Contaminant Level (MCL), if an MCL has been promulgated.

3. If no MCL is avialable for the constituent, then the RCRA GMP action level will be the method detection limit.

Analytical data collected through the RCRA Monitoring Program will be evaluated by comparing quarterly results to the action levels. The Great Miami Aquifer action levels for parameters to be sampled as part of this plan are listed in Table 9.1. The comparison to action levels will be completed on a quarterly basis when all of the analytical results are available for the sampling round. Comparisons will be made using laboratory sample results and the applicable action levels. Validated sample results will be used for the comparison to action levels when the validation program is implemented.

9.2 Rate and Extent of Migration Determinations

For the Great Miami Aquifer, when quarterly monitoring results indicate that the action levels have been exceeded the FEMP will determine the rate and extent of contaminant migration. The FEMP believes that sufficient wells exist on the FEMP property to estimate the extent of contamination should a "triggering" of the action levels occur at the downgradient boundary of either the Waste Pit Area or Production Area. The FEMP does not anticipate the need to install additional monitoring points to document the extent of on-property contamination. If however, a "trigger" occurs at the facility property boundary the FEMP anticipates the use of the hydropunch or other sampling methods, as necessary, to determine the extent of contamination. Once the extent of contamination has been determined off-property, a monitoring point will be located at the downgradient boundary of the plume to monitor changes over time.

As agreed upon with the USEPA and OEPA and documented in the RI/FS Risk Assessment Work Plan Addendum (June 12, 1992) the FEMP does not anticipate additional field activities to document the extent of essential human nutrients that are toxic only at high concentrations. The parameters that will not trigger additional field activities have been identified in Table 9.1.

The rate of migration in the Great Miami Aquifer will be estimated using Darcy's law for groundwater flow. Groundwater flow is a conservative estimate of migration rates because most constituents migrate at slower rates then groundwater due to attenuation and retardation factors. Diffusion may cause theoretical migration rates that are slightly faster than groundwater movement, but the magnitude of this effect is small compared to FEMP groundwater velocities.

The effort to determine the rate of migration under the RCRA GMP is preliminary because the CERCLA process currently assessing the site will develop rates of migrations for all contaminants of concern. The purpose of the RCRA GMP rate of migration determination is to provide a prompt and conservative estimate of contaminant migration.

RCRA Groundwater Monitoring Plan

TABLE 9.1

RCRA GMP ACTION LEVELS FOR
THE GREAT MIAMI AQUIFER

CHEMICAL	ACTION LEVEL (ppm except where noted)	TAKEN FROM:	TRACKING REQUIRED
1,1,1-Trichloroethane	0.7	PRG, no background	yes
1,1-Dichloroethane	0.7	PRG, no background	yes
1,2-Dichloroethane	0.001	Method Detection Limit	yes
1,1-Dichloroethene	0.07	PRG, no background	yes
trans-1,2-Dichloroethene	0.1	PRG, no background	yes
1,2-Dichloroethene (Total)	0.03	Method Detection Limit	yes
Acetone	0.7	PRG, no background	yes
Benzene	0.001	PRG, no background	yes
Carbon Disulfide	0.7	PRG, no background	yes
Chloroform	0.006	PRG, no background	yes
Methylene Chloride	0.01	Method Detection Limit	yes
Tetrachloroethane	0.005	MCL	yes
Toluene	1.0	PRG, no background	yes
Trichloroethene	0.003	PRG, no background	yes
Vinyl Chloride	0.005	Method Detection Limit	yes
Aluminum	0.303	Background UTL	no
Arsenic	0.392	Background UTL + PRG	yes
Barium	1.447	Background UTL + PRG	yes
Beryllium	0.004	Background UTL + PRG	yes
Cadmium	0.011	Background UTL + PRG	yes
Calcium	136	Background UTL	no
Chromium	0.079	Background UTL + PRG	yes
Chloride	250	MCL	no
Cobalt*	0.02	PRG, no background	yes
Copper	1.00	MCL	no
Fluoride	2.00	MCL	no
Iron	4.13	Background UTL	no

CHEMICAL	ACTION LEVEL (ppm except where noted)	TAKEN FROM:	TRACKING REQUIRED
Gross Alpha*	24.3 (pCi/l)	Background UTL	no
Gross Beta*	38.3 (pCi/l)	Background UTL	no
Lead	0.056	Background UTL + PRG	yes
Magnesium	47.0	Background UTL	yes
Manganese	0.965	Background UTL + PRG	yes
Mercury	0.003	Background UTL + PRG	yes
Nickel	0.126	Background UTL + PRG	yes
Nitrate	10.0	MCL	no
Phenols	0.061	Background UTL	no
Radium 226+228**	3.82 (pCi/l)	Background UTL + 2xPRG	yes
Selenium	0.17	Background UTL + PRG	yes
Silver	0.034	Background UTL + PRG	yes
Sodium	100	Background UTL	no
Sulfate	250	MCL	no
Uranium	0.022	Background UTL + PRG	yes
Vanadium	0.084	Background UTL + PRG	yes
Zinc	1.109	Background UTL + PRG	yes

Notes: Background data taken from Shandon Background in Table M-6 of the Sitewide Characterization Report, Appendix M.

The PRG values were taken from the Sitewide Characterization Report.

Method detection limits are based on the analytical method used for each parameter.

* The background UTL for these parameters was determined through the use of RCRA GQAPP assessment monitoring program data.

** The action level for Radium 226+228 was generated by determining a combined UTL background value and adding the PRG for Radium 226 and the PRG for Radium 228. The PRGs for these parameters happen to be the same (0.2).

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9.3 Statistical Analysis of Data

A trend analysis will be performed to monitor changes in groundwater quality. Trend analysis will involve tabulation, summary statistics, statistical formulas used to identify trends in data, and graphing time versus concentration for specific wells.

Tabulation of the well data will be performed to provide visual observations of well concentrations. Tables can provide a quick method of observing large changes in concentration between sampling rounds and can identify obvious trends in data over time. Tabulation will include, at a minimum: 1) well identification, result from sample round 1, result from sample round 2, result from sample round 3, result from sample round 4, and units; and in a second table; well identification, minimum, maximum, average, and standard deviation.

A test for outliers will be performed on the data. The specific test method for outliers can be found in EPA/530-SW-89-026, Section 8.2. Outliers determined through this method will not be included in the mean, standard deviation, or maximum determinations, and the outlier will not be used in the in-depth statistics to be identified below.

Summary statistics will include a test for normality, minimum, maximum, mean, and standard deviation values. This will provide a more accurate interpretation of changes in well concentrations. Trends can be noticed if well concentration maximums are being exceeded or averages are increasing. Potentially affected wells may indicate standard deviations above normal. A test for normality will be performed on the data; the skewed test or Shapiro/Welkes test are preferred. Minimum values will be chosen for a group of data that includes minimum detection limits. Maximum will be the highest detected or non-detected value. The mean will be calculated using all observations, if non-detects are present, then one half the detection limit will be used as the observation. The standard deviation will be calculated by the following formula:

$$s=\sqrt{\frac{\sum_{i=1}^{n}(x_i-\bar{x})^2}{n-1}}$$

Where;

n = number of observations

x_i = each observation

$\bar{x}$ = average of observations

If non-detects are present in the population then one half of the detection limit will be used as the observation value.

Statistical tests for determination of trends in the data over time will be performed. Some statistical methods that can be used are; Sen's Nonparametric Estimator of Slope (Gilbert, 1987, pg. 217), the Mann-Kendall Test (Gilbert, 1987, pg. 208), and the Seasonal Kendall Test (Gilbert, 1987, pg. 225). Statistical trend analysis using one of the above methods (appropriateness dependent on analytical results) will help determine increasing concentrations with time even though the increase is not visually apparent. Statistics other than the specific methods above may be used if an evaluation of the data determines that another specific method will produce more accurate results. For constituents that indicate increasing concentrations in a well, a time versus concentration plot will be constructed. Time versus concentration plots will involve plotting constituent concentrations on a time scale. The plot is inspected for obvious features such as sudden or gradual changes in contaminant concentrations.

A complete documentation of all statistical analyses performed on the data will be provided in the annual report. The above data evaluation techniques will satisfy the statistical evaluation requirements of the RCRA Program while providing time dependent information to the CERCLA Program for prioritization of Remedial Design/Remedial Action investigations.

10.0 REPORTING OF DATA

Reporting for this RCRA plan will be accomplished through the RCRA Annual Report, supplementary groundwater section, submitted yearly by March 1. The contents of the annual report will be a summary of the activities performed, and the analytical and assessment data collected during the calendar year. A major focus of the report will be the reporting of any confirmed concentrations that are above the action levels. Any activities planned, in process, or completed to determine the rate and extent of confirmed contaminants will be reported in the annual report. Analytical data and large tables can be provided in electronic form to reduce the volume of paper used on the report. The data would be provided on 3.5" floppy disk in either a delimited, Dbase, or Lotus format. Other formats can be achieved if necessary.

11.0 SCHEDULE OF IMPLEMENTATION

The FEMP is moving forward to begin installing the monitoring locations identified in this plan. Existing monitoring wells will be monitored beginning the first quarter of 1992. The installation of the additional monitoring wells needed to complete the RCRA Groundwater Monitoring Program will require approximately one year of field work. The program will, therefore, be implemented in phases.

Phase 1 - The first phase of monitoring well installation will complete the property boundary 2000, 3000, and 4000-series monitoring network and will be initiated in 1992. After each new monitoring well is constructed in the facility boundary network, sampling under this RCRA Plan will begin. The property boundary network will be completed first to provide assurance that hazardous waste constituents, in concentrations exceeding the proposed action levels, are not exiting the site boundaries.

Phase 2 - The second phase of monitoring well installation will complete the Production Area 2000, 3000, and 4000-series monitoring well network and will be initiated subsequent to phase 1. After each new monitoring well is constructed in the Production Area network, sampling under this RCRA plan will begin. The Production Area is not currently monitored on a continual basis. This area has been assigned second priority for completion of the monitoring network so that a continual monitoring program can be implemented as soon as practical.

Phase 3 - The Waste Pit Area 2000, 3000, and 4000-series monitoring network will be installed as the final phase of the RCRA Groundwater Monitoring Program and will be initiated subsequent to phase 2. After each new monitoring well is constructed in the Waste Pit Area network, sampling under this RCRA plan will begin. The Waste Pit Area is currently monitored on a continual basis under the Waste Pit 4 GQAPP. The monitoring provided through the RCRA GQAPP for Waste Pit 4 will remain in effect until the new monitoring network has been installed. This will provide continuous monitoring for Waste Pit 4 through the transition between RCRA monitoring programs.

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APPENDICES

APPENDIX E

Laboratory Analytical Procedures

Groundwater samples, collected for the RCRA GMP, are currently analyzed by the National Environmental Testing (NET) Laboratory in Dayton, Ohio. NET currently operates many independent environmental divisions in the United States. NET offers analytical services for metals, extractable and organic compounds, and other conventional pollutants in support of various federal, state, and local regulations and policies. The FEMP is in the process of obtaining the use of a CLP Mixed Waste Laboratory.

The National Environmental Testing Laboratory Quality Assurance Program Plan is included as Attachment 1 of this document. All analytical protocols used at NET are documented in established analytical procedures that are taken from the following sources where applicable: Standard Methods for the Examination of Water and Wastewater, 16th ed., 1985; EPA 600; SW 846, 3d edition, Code of Federal Regulations; ASTM; Surface Mining Procedures, USGS. NET reports that their quality control program meets all the requirements of the current EPA procedures for potable water, wastewater, hazardous waste, and priority pollutant analysis.

The laboratory has its own courier service. The courier will sign off on the chain-of-custody forms for each sample. Sample coolers are stored in a large, walk-in refrigerator maintained at 4°C. Building security is maintained at all hours by a commercial system.

The laboratory utilizes a computerized sample log-in procedure to guarantee sample integrity. Chain-of-Custody and Request for Analysis are compared to confirm agreement. Individual seals are checked for security. Readings from the maximum/minimum thermometers are recorded on the corresponding Request for Analysis documents. The lab maintains historical documentation of all testing activity including hard copy reports, magnetic disc, and tape archives. All GC/MS data is archived on nine-track magnetic tape per USEPA protocol.

Overview of NET QA Protocols for Wet Chemistry Analyses

Instruments at NET are calibrated with three levels of QC standards that cover the linear working range of the parameter analysis. After calibration, an accuracy check standard is analyzed. If all of these standards meet the acceptance criteria, then samples are analyzed. After every five samples, a continuing calibration standard is run. If the samples have undergone a digestion prior to instrumental analysis, a digested standard is also analyzed after every five samples. If the standards fail to meet acceptance criteria, the samples must be repeated. Standards are analyzed after every five samples. Method blanks, spikes, and duplicates are run a minimum of one per twenty samples for routine parameters.

RCRA Groundwater Monitoring Plan

APPENDIX E (Cont.)

Overview of NET QA Protocols for Metals Analyses

Instruments at NET are calibrated over the linear working range of the parameter analysis with a minimum of three levels of standards. Three calibration check standards made from a separate stock solution are run as QA standards to verify calibration. A continuing calibration standard is run after every fifth analysis. If acceptance criteria are not met, the instrument is recalibrated and the affected samples are repeated. Reagent blanks, duplicate samples, and spiked samples are prepared and analyzed at a minimum of one per twenty samples.

Overview of NET QA Protocols for Organic Analyses

At NET, Organochlorine Pesticides, PCBs, and Herbicides are analyzed by gas chromatography (GC). The instruments are calibrated with five to six levels of standards prior to the start of sample analysis. The calibration is followed by the analysis of a GC standard. If the protocol acceptance criteria are met, sample analysis begins. After every ten samples a QC standard is analyzed, with recovery of true value to be +-20 %. One reagent blank is analyzed and one spiked sample is prepared for every ten samples. USEPA standards are analyzed as QA checks of the external standards. Aqueous samples are extracted within seven days of sampling. All analyses are performed within 28 days of extraction.

Volatile organic compounds are analyzed by GC/mass spectroscopy (MS). The instruments are calibrated with five levels of calibration standards. The relative standard deviation (RSD) of the Response Factors (RF) over the range of the calibration cannot exceed 25%. Three internal standards are added to every sample, as well as three surrogate compounds whose percent recoveries are monitored for QC purposes. A method blank is run with each sample group. A spiked sample or a USEPA standard is analyzed after every ten samples. A Bromofluorobenzene (BFB) tune check is performed with each sample analysis. The instruments are auto-tuned if the tune check acceptance criteria are not met, and a calibration check standard is run to verify calibration. All samples are analyzed within 14 days of sampling.

A reagent blank is extracted with each set of samples. One spiked sample or one USEPA standard is analyzed per ten samples. A calibration check standard is run per ten samples analyzed. A minimum of one DFTPP/BFB tune check is performed on each instrument per day. If the tune check criteria are not met, the instrument is auto-tuned and a calibration check standard is run to verify calibration. Aqueous samples are extracted within seven days of sampling. All analyses are performed within 28 days of extraction.

The analytical method is chosen based on the level of contamination of the samples. All QA/QC criteria established for other GC and GC/MS procedures are followed during the analysis of these samples. Aqueous samples are extracted within seven days of sampling. All analyses are performed within 28 days of extraction. Volatile TOX analyses are performed within 14 days of sampling.

SECTION J
SOLID AND HAZARDOUS WASTE MANAGEMENT UNITS

UNIT NO. — OPERABLE UNIT 3

PLANT 1 — SAMPLING PLANT
SOLID WASTE MANAGEMENT UNITS

1 - COPPER METAL SCRAP PILE
2 - MAGNESIUM FLUORIDE TITAN MILL
3 - PLANT 1 ORE SILOS
4 - PLANT 1 SAMPLE LINE
5 - PLANT 1 SUMP SYSTEM
6 - PLANT 1 THAW TUNNEL
7 - SAFE GEOMETRY DIGESTION SUMP
8 - SLOP STORAGE TANK

HAZARDOUS WASTE MANAGEMENT UNITS

9 - DETREX STILL
10 - PLANT 1 PAD
11 - PLANT 1 STORAGE BLDG. (BLDG. 67)

PLANT 2/3 — REFINERY
SOLID WASTE MANAGEMENT UNITS

12 - INCINERATOR BUILDING SATELLITE ACCUMULATION AREA
13 - MAINTENANCE SHOP FLOOR DRAIN
14 - PLANT 2/3 SUMP SYSTEM
15 - RAFFINATE STORAGE TANK F1-400
16 - RAFFINATE STORAGE TANK F1-401
17 - RAFFINATE STORAGE TANK F1-402
18 - RAFFINATE STORAGE TANK F1-403
19 - REFINERY SUMP, FILTER WASH TANK F1-608
20 - REFINERY SUMP, FILTER WASH TANK F1-609
21 - REFINERY SUMP, FILTER WASH TANK F1-610
22 - REFINERY SUMP, FILTER WASH TANK F2E-601
23 - REFINERY SUMP, FILTER WASH TANK F2E-602
24 - REFINERY SUMP, THICKENER SLURRY TANK F1-612
25 - SATELLITE ACCUMULATION AREA (CURRENT)
26 - SATELLITE ACCUMULATION AREA (PRIOR)
27 - TRIBUTYL PHOSPHATE/KEROSENE HOLDING TANK 17A
28 - TRIBUTYL PHOSPHATE/KEROSENE HOLDING TANK 17B
29 - TRIBUTYL PHOSPHATE/KEROSENE HOLDING TANK 17C
30 - TRIBUTYL PHOSPHATE/KEROSENE HOLDING TANK F1-512
31 - UNH STORAGE TANK F1-30
32 - UNH STORAGE TANK F1-31
33 - UNH STORAGE TANK F1-32
34 - UNH STORAGE TANK F1-37
35 - URANYL NITRATE TANK F1-405
36 - URANYL NITRATE RAFFINATE TANK F3E-405
37 - WASTEWATER STORAGE TANK F1-25A
38 - WASTEWATER STORAGE TANK F1-26A

HAZARDOUS WASTE MANAGEMENT UNITS

39 - NAR SYSTEM COMPONENTS
40 - TRANE THERMAL LIQUID INCINERATOR
41 - URANYL NITRATE TANKS (DIGESTION AREA (2 LOCATIONS))
42 - URANYL NITRATE TANKS (KFS STORAGE AREA)
43 - URANYL NITRATE TANKS (NORTH OF PLANT 2)
44 - URANYL NITRATE TANKS (RAFFINATE BLDG.)
45 - URANYL NITRATE TANKS (SOUTHEAST OF PLANT 2)

PLANT 4 — GREEN SALT PLANT
SOLID WASTE MANAGEMENT UNITS

46 - PLANT 4 SUMP SYSTEM

HAZARDOUS WASTE MANAGEMENT UNITS

47 - DRUMMED HF RESIDUE/ASSOCIATED STORAGE AREAS INSIDE PLANT 4
48 - DRUMMED HF RESIDUE/ASSOCIATED STORAGE AREAS N.W. OF PLANT 4
49 - DRUMMED HF RESIDUE/ASSOCIATED STORAGE AREAS S. OF COOLING TOWERS

PLANT 5 — METALS PRODUCTION PLANT
SOLID WASTE MANAGEMENT UNITS

50 - HOFFMAN DUST COLLECTOR SYSTEM 101
51 - HOFFMAN DUST COLLECTOR SYSTEM 256
52 - HOFFMAN DUST COLLECTOR SYSTEM 258
53 - HOFFMAN DUST COLLECTOR SYSTEM 260
54 - HOFFMAN DUST COLLECTOR SYSTEM 261
55 - HOFFMAN DUST COLLECTOR SYSTEM 262
56 - MAINTENANCE SHOP FLOOR DRAIN AND SUMP
57 - MAINTENANCE SHOP STEAM BOOTH
58 - METALS PLANT SATELLITE ACCUMULATION AREA
59 - PLANT 5 SUMP SYSTEM

HAZARDOUS WASTE MANAGEMENT UNITS

60 - HLCB OIL RECOVERY

PLANT 6 — METALS FABRICATION PLANT
SOLID WASTE MANAGEMENT UNITS

61 - ELECTROSTATIC DUST COLLECTOR SYSTEM, NORTH DC
62 - ELECTROSTATIC DUST COLLECTOR SYSTEM, SOUTH DC
63 - OPERATIONS AREA SATELLITE ACCUMULATION AREA
64 - PLANT 6 SUMP SYSTEM
65 - SPENT COOLING WATER FOR NU-SAL HEAT TREATMENT TANK #1
66 - SPENT COOLING WATER FOR NU-SAL HEAT TREATMENT TANK #2
67 - SPENT NITRIC ACID STORAGE TANK F6-3
68 - UNDERGROUND STORAGE TANK (UST) #4
69 - WASTEWATER STORAGE TANK F6E-700
70 - WATER TREATMENT SATELLITE ACCUMULATION AREA

HAZARDOUS WASTE MANAGEMENT UNITS

71 - PLANT 6 WAREHOUSE (BLDG. 79)
72 - STORAGE PAD NORTH OF PLANT 6

PLANT 7 — URANIUM HEXAFLUORIDE REDUCTION PLANT
SOLID WASTE MANAGEMENT UNITS

73 - ABANDONED SUMP TANK G7 - UNDESIGNATED
74 - HYDROGEN FLUORIDE SCRUBBER AREA SUMP PONT

PLANT 8 — SCRAP RECOVERY PLANT
SOLID WASTE MANAGEMENT UNITS

75 - EAST OLIVER FILTER
76 - EIMCO FILTER (EAST)
77 - EIMCO FILTER (WEST)
78 - FILTRATE TANK 408-4005-THK
79 - FILTRATE TANK 408-4006-THK
80 - FILTRATE TANK 408-4007-THK
81 - OXIDATION FURNACE #2
82 - PLANT 8 SUMP SYSTEM
83 - ROTARY KILN
84 - ROTEX SCREENING UNIT

HAZARDOUS WASTE MANAGEMENT UNITS

85 - BOX FURNACE
86 - OXIDATION FURNACE #1
87 - PLANT 8 EAST DRUM STORAGE PAD
88 - PLANT 8 WEST DRUM STORAGE PAD
89 - PLANT 8 WAREHOUSE (BLDG. 80)
90 - PRIMARY CALCINER

PLANT 9 — SPECIAL PRODUCTS PLANT
SOLID WASTE MANAGEMENT UNITS

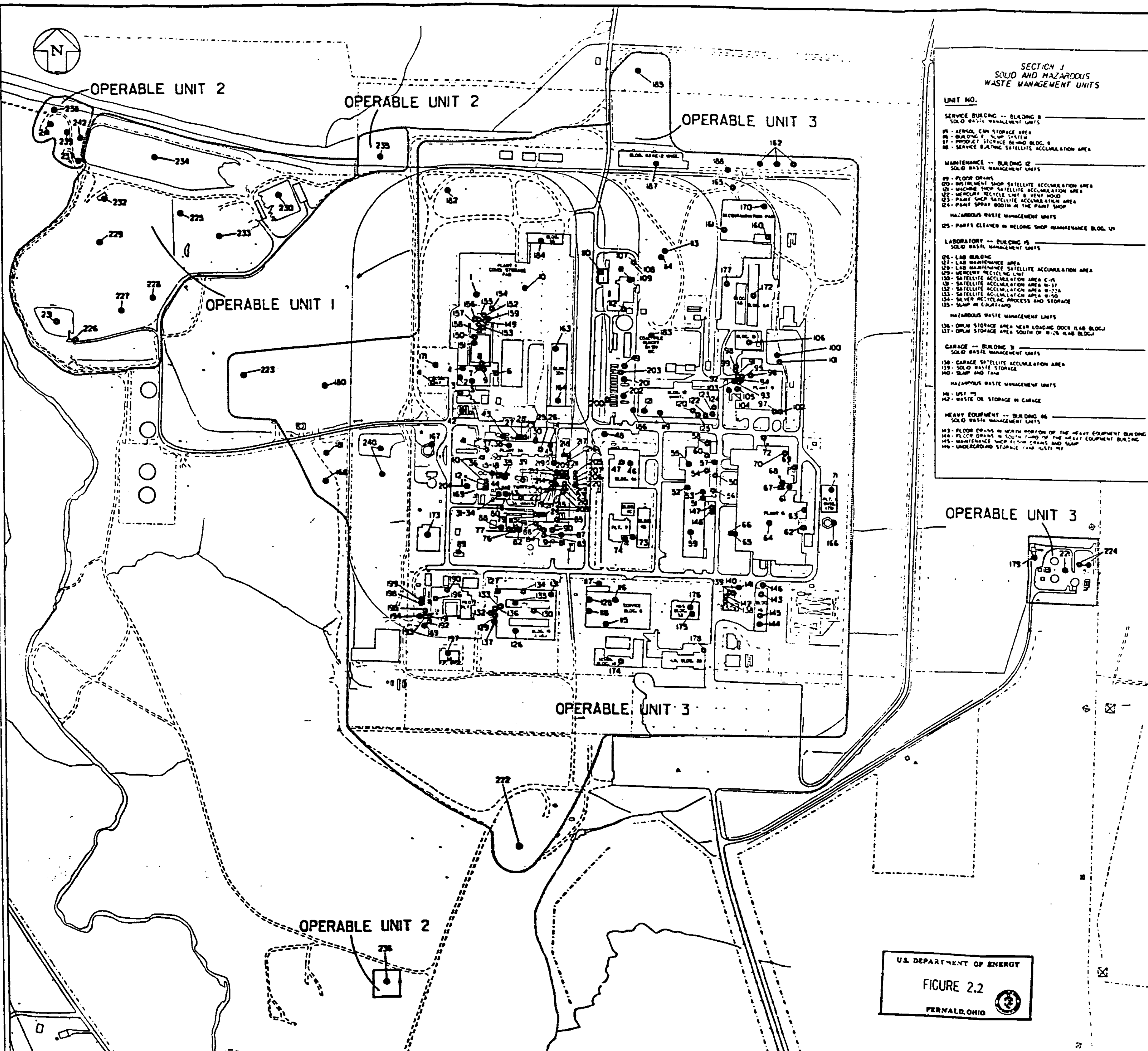
91 - DILUTE HYDROFLUORIC ACID (DHF) DUMPSTER TANK (SPCC 21 AST)
92 - FILTRATE WATER SUMP TANK - F9-1
93 - FILTRATE WATER SUMP TANK - F9-2
94 - FILTRATE WATER SUMP TANK - F9-3
95 - LIME SLURRY DUMPSTER TANK (SPCC 21 WEST)
96 - PLANT 9 SUMP SYSTEM
97 - SPENT NITRIC ACID TANK (SPCC 20A WEST)
98 - SPENT NITRIC ACID TANK (SPCC 46 TANK 1)
99 - SPENT NITRIC ACID TANK (SPCC 46 TANK 2)
100 - UNDERGROUND STORAGE TANK (UST) #7
101 - USED CUTTING OIL TANK (SPCC 7D)
102 - WASTEWATER STORAGE TANK F-9D-700
103 - WASTEWATER STORAGE TANK 2429 (SPCC 23)
104 - WATER TREATMENT AMMONIA TANK (SPCC 24)
105 - WEST PORTABLE OIL/WATER RESIDUE TANK (SPCC 10)

HAZARDOUS WASTE MANAGEMENT UNITS

106 - PLANT 9 WAREHOUSE (BLDG. 81)

BOILER PLANT — BUILDING 10
SOLID WASTE MANAGEMENT UNITS

107 - ASH RECEIVING TANK, 10-8004A
108 - ASH RECEIVING TANK, 10-8004B
109 - ASH SYSTEM, AIR WASH SPRAYER, 10-8004C
110 - BOILER PLANT MAINTENANCE SATELLITE ACCUMULATION AREA
111 - BOILER PLANT SATELLITE ACCUMULATION AREA
112 - CHEMICAL FEED SUMP
113 - GRAPHITE BURNER
114 - OIL BURNER



U.S. DEPARTMENT OF ENERGY
FIGURE 2.2
FERNALD, OHIO

SECTION J
SOLID AND HAZARDOUS WASTE MANAGEMENT UNITS

UNIT NO.

SERVICE BUILDING -- BUILDING 8
SOLID WASTE MANAGEMENT UNITS

115 - AEROSOL CAN STORAGE AREA
116 - BUILDING 8 SUMP SYSTEM
117 - PRODUCT STORAGE BEHIND BLDG. 8
118 - SERVICE BUILDING SATELLITE ACCUMULATION AREA

MAINTENANCE -- BUILDING 12
SOLID WASTE MANAGEMENT UNITS

119 - FLOOR DRAINS
120 - INSTRUMENT SHOP SATELLITE ACCUMULATION AREA
121 - MACHINE SHOP SATELLITE ACCUMULATION AREA
122 - MERCURY RECYCLE UNIT & VENT HOOD
123 - PAINT SHOP SATELLITE ACCUMULATION AREA
124 - PAINT SPRAY BOOTH IN THE PAINT SHOP

HAZARDOUS WASTE MANAGEMENT UNITS

125 - PARTS CLEANER IN WELDING SHOP (MAINTENANCE BLDG. 12)

LABORATORY -- BUILDING 15
SOLID WASTE MANAGEMENT UNITS

126 - LAB BUILDING
127 - LAB MAINTENANCE AREA
128 - LAB MAINTENANCE SATELLITE ACCUMULATION AREA
129 - MERCURY RECYCLING UNIT
130 - SATELLITE ACCUMULATION AREA C-15
131 - SATELLITE ACCUMULATION AREA N-37
132 - SATELLITE ACCUMULATION AREA W-22A
133 - SATELLITE ACCUMULATION AREA W-50
134 - SILVER RECYCLING PROCESS AND STORAGE
135 - SUMP IN COURTYARD

HAZARDOUS WASTE MANAGEMENT UNITS

136 - DRUM STORAGE AREA NEAR LOADING DOCK (LAB BLDG.)
137 - DRUM STORAGE AREA SOUTH OF W-26 (LAB BLDG.)

GARAGE -- BUILDING 31
SOLID WASTE MANAGEMENT UNITS

138 - GARAGE SATELLITE ACCUMULATION AREA
139 - SOLID WASTE STORAGE
140 - SUMP AND TANK

HAZARDOUS WASTE MANAGEMENT UNITS

141 - UST #5
142 - WASTE OIL STORAGE IN GARAGE

HEAVY EQUIPMENT -- BUILDING 46
SOLID WASTE MANAGEMENT UNITS

143 - FLOOR DRAINS IN NORTH PORTION OF THE HEAVY EQUIPMENT BUILDING
144 - FLOOR DRAINS IN SOUTH THIRD OF THE HEAVY EQUIPMENT BUILDING
145 - MAINTENANCE SHOP FLOOR DRAINS AND SUMP
146 - UNDERGROUND STORAGE TANK (UST) #7

SECTION J
SOLID AND HAZARDOUS WASTE MANAGEMENT UNITS

UNIT NO.

MAIN SLAG BUILDING -- BUILDING 55-A
SOLID WASTE MANAGEMENT UNITS

147 - BUILDING 55 CONVEYOR, MAGNESIUM FLUORIDE RECOVERY UNIT
148 - BUILDING 55 CONVEYOR, DRUM-OUT STATION

BUILDING 66
SOLID WASTE MANAGEMENT UNITS

149 - AEROSOL CAN PUNCTURE UNIT
150 - COPPER SHREDDER
151 - COPPER SHREDDER BAGHOUSE
152 - DRUM BALER
153 - DRUM BALER SUMP
154 - DRUM BALER HYDRAULIC FLUID TANK, 66-0009A-THK
155 - OVEN
156 - PAINT/SOLVENT STORAGE AREA
157 - PAINT SPRAY BOOTH

HAZARDOUS WASTE MANAGEMENT UNITS

158 - WHEELABRATOR - BLDG. 66
159 - WHEELABRATOR DUST COLLECTOR - BLDG. 66

DECONTAMINATION BUILDING — BUILDING 69
SOLID WASTE MANAGEMENT UNITS

160 - DECONTAMINATION BUILDING FLOOR DRAINS
161 - DECONTAMINATION BUILDING SUMP
162 - WASTE PILES AND CLEAN/LOADOUT PAD

MISCELLANEOUS OU3 UNITS
SOLID WASTE MANAGEMENT UNITS

163 - CHEMICAL WAREHOUSE NORTHEASTERN AREA
164 - CHEMICAL WAREHOUSE SOUTHERN AREA
165 - FERROUS METAL SCRAP PILE
166 - GRIT BLAST STORAGE AREA, EAST TOWER
167 - GRIT BLAST STORAGE AREA, WEST TOWER
168 - K-65 AREA, HIGH LEVEL NITRATE STORAGE TANK (8-ACO)
169 - KELLY SOLID WASTE INCINERATOR
170 - OTHER SCRAP PILES/SALVAGE MATERIALS/AREAS
171 - PLANT 1 BUILDING 67 AREA
172 - RI/FS 90 DAY STORAGE
173 - RUST BUILDING SATELLITE ACCUMULATION AREA
174 - SATELLITE ACCUMULATION AREA - ADMINISTRATION BUILDING, EOC
175 - SATELLITE ACCUMULATION AREA - HEALTH AND SAFETY BUILDING, 1-RAY/PHOTO
176 - SATELLITE ACCUMULATION AREA - HEALTH AND SAFETY BUILDING, INSTRUMENT SHOP
177 - SCRAP PILE WEST OF BUILDING 65
178 - SECURITY SOLID WASTE INCINERATOR
179 - SEWAGE TREATMENT PLANT INCINERATOR
180 - TEMPORARY STORAGE TANK 48-A004
181 - TEMPORARY STORAGE TANK 48-A005
182 - THIRD STREET WASTE PILE

HAZARDOUS WASTE MANAGEMENT UNITS

183 - COAL PILE RUNOFF BASIN
184 - CP STORAGE WAREHOUSE - BLDG. 56 (BUTLER BLDG.)
185 - FIRE TRAINING FACILITY
186 - HF TANK CAR
187 - KC-2 WAREHOUSE (BLDG. 63)
188 - NITRIC ACID RAIL CAR AND AREA

PILOT PLANT
SOLID WASTE MANAGEMENT UNITS

189 - PILOT PLANT CONTAINER STORAGE AREA
190 - PILOT PLANT SUMP SYSTEM
191 - SOLVENT TANK (SPCC 40B TANK 1)
192 - SOLVENT TANK (SPCC 40B TANK 2)
193 - WASTEWATER HOLDING TANK F-100
194 - WASTEWATER HOLDING TANK F-101

HAZARDOUS WASTE MANAGEMENT UNITS

195 - ABANDONED SUMP WEST OF PILOT PLANT
196 - BARIUM CHLORIDE SALT TREATMENT FACILITY
197 - PILOT PLANT WAREHOUSE STORAGE PAD (BLDG. 68)
198 - TANK FOR BULK STORAGE OF SOLVENTS, T-5
199 - TANK FOR BULK STORAGE OF SOLVENTS, T-6

TANK FARM
SOLID WASTE MANAGEMENT UNITS

200 - CONSTRUCTION WASTE STORAGE AREA
201 - TANK 17
202 - TANK 18

HAZARDOUS WASTE MANAGEMENT UNITS

203 - TANK FARM SUMP

WASTEWATER TREATMENT SYSTEM
SOLID WASTE MANAGEMENT UNITS

204 - BIODENITRIFICATION TREATMENT SYSTEM
205 - GENERAL SUMP, BOILER WATER TANK FB-6A
206 - GENERAL SUMP, FILTERED WATER TANK FB-4
207 - GENERAL SUMP, FILTERED WATER TANK FB-6B
208 - GENERAL SUMP, LIME SLURRY TANK F3A-5
209 - GENERAL SUMP, NEUTRALIZED RAFFINATE TANK T-18X-2500
210 - GENERAL SUMP, RAFFINATE NEUTRALIZATION TANK F2E-603
211 - GENERAL SUMP, RECEIVING TANK F8F-2
212 - GENERAL SUMP, RECEIVING TANK F8E-3
213 - GENERAL SUMP, WATER TANK F8-2
214 - GENERAL SUMP, WATER TANK F8-3
215 - GENERAL SUMP, WATER TANK F8-4
216 - GENERAL SUMP, WATER TANK T-18X-4000
217 - GENERAL SUMP, WATER TANK T-18X-100
218 - GENERAL SUMP, WATER TANK T-18X-4300
219 - GENERAL SUMP, WATER TANK T-18X-4500
220 - GENERAL SUMP, WATER TANK T-18X-2900
221 - SANITARY SEWAGE TREATMENT PLANT
222 - STORMWATER RETENTION BASINS

HAZARDOUS WASTE MANAGEMENT UNITS

223 - BIO-SURGE LAGOON
224 - SLUDGE DRYING BEDS

OPERABLE UNIT 1
SOLID WASTE MANAGEMENT UNITS

225 - BURN PIT
226 - K-65 SATELLITE ACCUMULATION AREA
227 - WASTE PIT NO. 1
228 - WASTE PIT NO. 2
229 - WASTE PIT NO. 3
230 - WASTE PIT NO. 6

HAZARDOUS WASTE MANAGEMENT UNITS

231 - CLEARWELL
232 - EXPERIMENTAL TREATMENT FACILITY (ETF)
233 - WASTE PIT NO. 4
234 - WASTE PIT NO. 5

OPERABLE UNIT 2
SOLID WASTE MANAGEMENT UNITS

235 - SANITARY LANDFILL
236 - SOUTHFIELD DISPOSAL AREA

CERCLA REMEDIATION STORAGE AREA

237 - DECONTAMINATION PAD AND TANKS
238 - EMPTY DRUM STORAGE AREA
239 - OIL STORAGE SHED

HAZARDOUS WASTE MANAGEMENT UNITS

240 - LIME SLUDGE PONDS

CERCLA REMEDIATION STORAGE AREA

241 - EQUIPMENT STORAGE AREA
242 - WELL DRILLING STORAGE AREA