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REPORT

PERMEABILITY AND EFFECTIVE MATERIAL PROPERTIES CENTER

OF THE

DEPARTMENT OF ENERGY

OPERATIONS

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

FEED MATERIALS PRODUCTION CENTER
FERNALD, OHIO

TASK 2 REPORT
WORK PLAN REQUIREMENTS

REVISION 3 OF:
WORK PLAN

VOLUME I: SAMPLING PLAN

VOLUME II: HEALTH AND SAFETY PLAN
VOLUME III: COMMUNITY RELATIONS PLAN
VOLUME IV: DATA MANAGEMENT PLAN
VOLUME V: QUALITY ASSURANCE PROJECT PLAN

☐ CONTAINED HEREIN

SECTION I.0

INTRODUCTION

6

INTRODUCTION

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I.0 INTRODUCTION

I.1 DATA QUALITY OBJECTIVES

The process of developing data quality objectives (DQOs) is intended to provide a level and extent of sampling and analysis to be conducted during the Remedial Investigation (RI) consistent with the need to produce data adequate for the evaluation of remedial alternatives in the Feasibility Study (FS). In the case of the sitewide RI/FS for the U.S. Department of Energy's (DOE) Feed Materials Production Center (FMPC), a three-phased approach was utilized to develop the DQOs. The three phases, which are summarized in Figure I-1, consisted of an initial identification of overall informational needs, the development of a field program to satisfy any data needs remaining once existing information had been reviewed, and the selection of appropriate sampling and analytical methods to achieve the investigative objectives of the field program. As indicated in Figure I-1, the products of the three phases can be linked to the preliminary evaluation of the sitewide problems reported in Section 3.0 of the Work Plan, the Sampling Plan reported herein, and the Quality Assurance Project Plan (QAPP), respectively. Each phase of the process is described below.

I.1.1 PRELIMINARY EVALUATION

In the Work Plan submitted in response to Task 2 of the RI/FS, informational needs to be satisfied in the RI were related to both the investigative tasks to be performed and the remedial actions to be evaluated. The process began with a predetermination of the most plausible remedial action alternatives. Once the potential actions were identified, the types of technical, environmental, and health risk information to be addressed in determining the relative cost-effectiveness of the actions in the FS were developed. In turn, the field and analytical tasks necessary to establish the data base were structured.

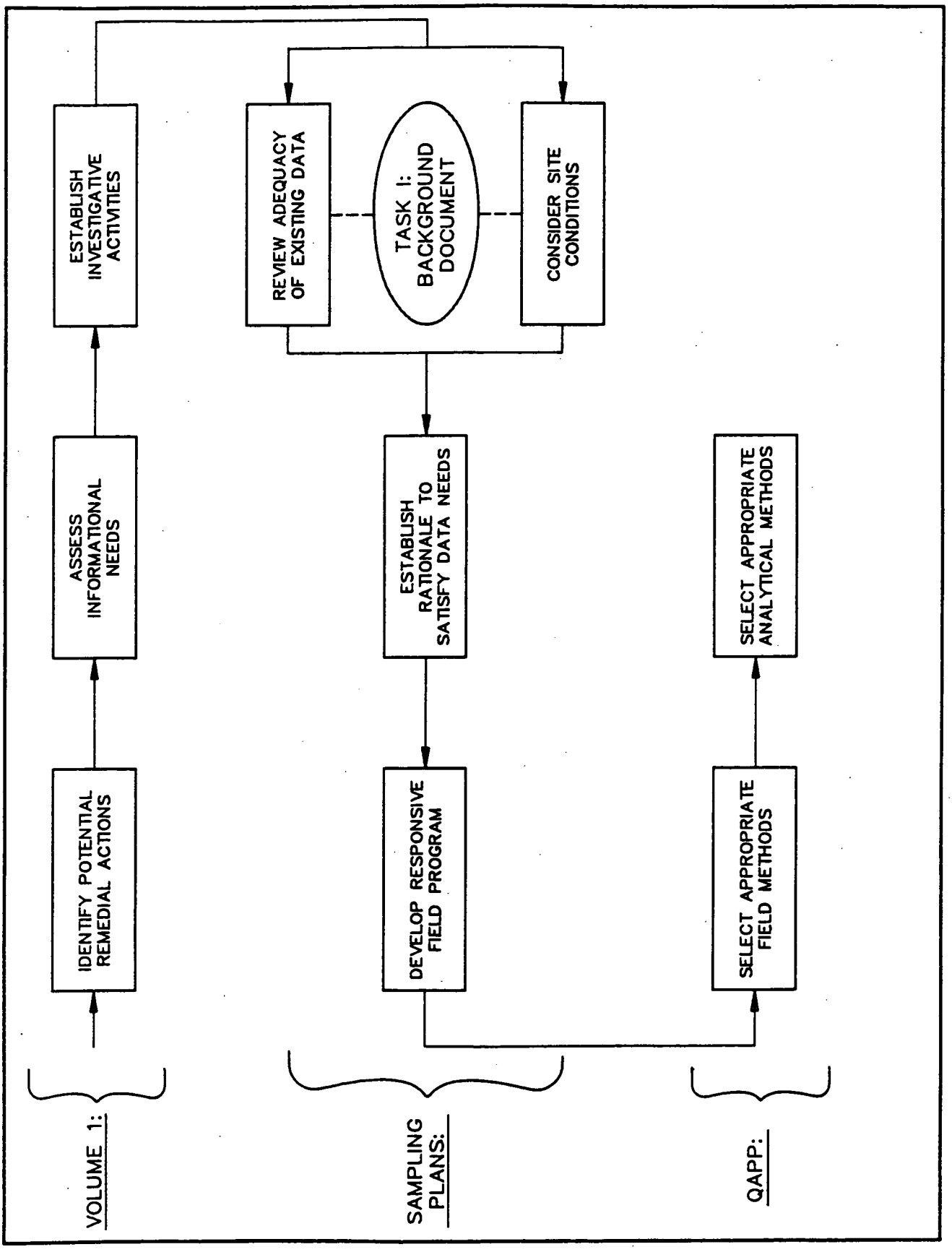

FIGURE I-1
DATA QUALITY OBJECTIVES PROCESS

The outcome of that earlier effort, which represents the first phase of the DQO process, was the development of five matrices (Figures I-2 through I-6) that integrated potential remedial actions, related informational needs to perform an assessment of the actions, and investigative tasks to satisfy the informational needs for each of the potential sources, pathways, and receptors identified at the FMPC.

I.1.2 SAMPLING PLANS

In accordance with the results of the preliminary evaluation (as illustrated in Figures I-2 through I-6), 17 investigative tasks were considered necessary to satisfy the informational needs of the RI/FS. These tasks are identified in Table I-1.

As indicated in Table I-1, five investigative tasks are being provided by other ongoing or completed programs. The first, termed the Characterization Investigation Study (CIS), involved sampling wastes presently stored in Pits 1 through 6, the Burn Pit, the lime sludge ponds, the sanitary landfill, the fly ash piles, and Silos 1, 2, and 3 (i.e., K-65 silos and metal oxide tank). Each waste storage unit was cored to its full depth at several locations. Samples for physical and chemical analysis were composited from the cores.

In the same study, surface geophysical surveys were used to provide information regarding relatively shallow subsurface conditions throughout the central and southwest portions of the FMPC. The three techniques used were:

	ASSESSMENT INFORMATIONAL NEEDS	NATURE OF WASTES STORED	VOLUME, DEPTH, AREAL EXTENT OF WASTES	LEAKAGE POTENTIAL (LINER ?)	LOCAL HYDROGEOLOGIC SETTING	POTENTIAL FOR FLOODING	CURRENT VS. RESIDUAL RISK	RISK DURING IMPLEMENTATION	REGULATORY CONSTRAINTS	NATURE OF WASTES PRESENT	VOLUME, DEPTH, AREAL EXTENT OF WASTES	POTENTIAL FOR FLOODING	LEAKAGE POTENTIAL	LOCAL HYDROGEOLOGIC SETTING	SURFACE WATER RUNOFF PATTERNS	CURRENT VS. RESIDUAL RISK	RISK DURING IMPLEMENTATION		(SEE WASTE PITS)		DEGREE OF CONTAMINATION BY RADIONUCLIDES AND ORGANICS	POTENTIAL FOR METALS RELEASE IN LEACHATE	SURFACE WATER RUNOFF PATTERNS	ADEQUACY OF PRESENT COVER	VOLUME, DEPTH, AREAL EXTENT OF WASTES	REGULATORY CONSTRAINTS	CURRENT VS. RESIDUAL RISK		NATURE OF WASTES STORED	POTENTIAL FOR RADON RELEASE	POTENTIAL FOR LEAKAGE TO GROUND WATER	CURRENT VS. RESIDUAL RISK	RISK DURING IMPLEMENTATION	REGULATORY CONSTRAINTS
INVESTIGATIVE TASKS	PUBLIC HEALTH/ENVIRONMENTAL RISK ASSESSMENT						●	●								●	●		●							●					●	●	
	AIR MODEL						●	●								●			●											●		●	●	
	GROUND WATER MODEL						●	●					●			●	●		●							●					●		
	FACILITIES TESTING PLAN																																
	WASTE STREAM SAMPLING																																
	DRUM SAMPLING																																
	TERRESTRIAL / AQUATIC ORGANISM SAMPLING																																
	FLORA SAMPLING																																
	DEEP BOREHOLES				●					●				●					●														
	GEOPHYSICS		●	●							●		●						●		●			●						●			
	GROUND WATER WELLS / MONITORING			●	●								●	●					●		●									●	●		
	AIR SAMPLING	●					●	●		●						●	●		●							●		●	●		●	●	
	SURFACE WATER SAMPLING	●					●	●											●														
	SEDIMENT SAMPLING																																
	SURFACE SOIL SAMPLING						●	●		●						●	●		●		●	●		●			●						
	WASTE SAMPLING	●	●	●			●	●	●	●	●		●			●	●		●		●	●			●	●	●		●		●	●	●
	RADIATION MEASUREMENT	●					●	●		●						●	●		●		●						●			●		●	●	
POTENTIAL REMEDIAL ACTIONS	NON-REMOVAL WITH RADON EMISSION CONTROLS																												●	●	●	●	●
	REMOVAL WITH OFF-SITE DISPOSAL	●	●				●	●	●	●	●					●	●		●		●	●			●	●	●		●	●		●	●	●
	REMOVAL WITH ON-SITE TREATMENT (& DISPOSAL)	●	●		●		●	●	●	●	●			●		●	●		●		●	●			●	●	●		●	●		●	●	●
	REMOVAL WITH ON-SITE COMPLIANCE DISPOSAL	●	●		●		●	●	●	●	●			●		●	●		●		●	●			●	●	●							
	NON-REMOVAL WITH SURFACE WATER DIVERSION																				●	●	●	●		●	●							
	NON-REMOVAL WITH SUBSURFACE FLOW CONTROL	●	●	●	●		●		●	●	●		●	●		●			●										●		●	●	●	●
	NON-REMOVAL WITH INFILTRATION CONTROL	●	●	●		●	●		●	●	●	●	●		●	●			●		●	●	●	●	●	●	●							
	NON-REMOVAL WITH IN-PLACE STABILIZATION	●	●	●			●	●	●	●	●		●			●	●		●										●	●	●	●	●	●
	SOURCE	WASTE PITS								BURN PIT									LIME SLUDGE PONDS		FLY ASH PILES								K-65 SILOS				

FIGURE I-2
POTENTIAL SOURCES: WASTE AREAS

	ASSESSMENT INFORMATIONAL NEEDS	NATURE OF WASTES STORED	POTENTIAL FOR CONTAMINANT LEAKAGE TO GROUND WATER	CURRENT VS. RESIDUAL RISK	RISK DURING IMPLEMENTATION	REGULATORY CONSTRAINTS		(SEE FLY ASH PILES)
INVESTIGATIVE TASKS	PUBLIC HEALTH/ENVIRONMENTAL RISK ASSESSMENT			●	●			●
	AIR MODEL							●
	GROUND WATER MODEL		●	●				●
	FACILITIES TESTING PLAN							
	WASTE STREAM SAMPLING							
	DRUM SAMPLING							
	TERRESTRIAL / AQUATIC ORGANISM SAMPLING							
	FLORA SAMPLING							
	DEEP BOREHOLES							
	GEOPHYSICS							●
	GROUND WATER WELLS / MONITORING		●	●				●
	AIR SAMPLING							●
	SURFACE WATER SAMPLING							
	SEDIMENT SAMPLING							
	SURFACE SOIL SAMPLING							
	WASTE SAMPLING	●		●	●	●		●
	RADIATION MEASUREMENT	●		●				●
POTENTIAL REMEDIAL ACTIONS	NON-REMOVAL WITH RADON EMISSION CONTROLS							
	REMOVAL WITH OFF-SITE DISPOSAL	●	●	●	●	●		
	REMOVAL WITH ON-SITE TREATMENT (& DISPOSAL)	●	●	●	●	●		●
	REMOVAL WITH ON-SITE COMPLIANCE DISPOSAL	●	●	●	●	●		●
	NON-REMOVAL WITH SURFACE WATER DIVERSION							●
	NON-REMOVAL WITH SUBSURFACE FLOW CONTROL	●		●	●	●		
	NON-REMOVAL WITH INFILTRATION CONTROL							●
	NON-REMOVAL WITH IN-PLACE STABILIZATION	●	●	●	●	●		
	SOURCE	METAL OXIDE TANK						SANITARY LANDFILL

FIGURE I-2

POTENTIAL SOURCES: WASTE AREAS (CONTINUED)

	ASSESSMENT INFORMATIONAL NEEDS	CHARACTERIZATION OF RELEASES	DEPOSITION PATTERNS	REGULATORY COMPLIANCE	NATURE OF MATERIALS STORED	CONDITION OF MATERIAL/POTENTIAL FOR LEAKAGE	POTENTIAL FOR ENVIRONMENTAL MIGRATION	REGULATORY CONSTRAINTS	NATURE OF MATERIAL STORED	CONDITION OF MATERIAL/POTENTIAL FOR LEAKAGE	POTENTIAL FOR ENVIRONMENTAL MIGRATION	REGULATORY CONSTRAINTS	NATURE OF TANK CONTENTS	CONDITION OF MATERIAL/POTENTIAL FOR LEAKAGE	POTENTIAL FOR ENVIRONMENTAL MIGRATION	REGULATORY CONSTRAINTS	NATURE OF WASTE MATERIAL	POTENTIAL FOR LEACHATE FORMATION/MIGRATION	REGULATORY CONSTRAINTS	NATURE OF WASTE STREAMS	POTENTIAL FOR LEAKAGE OR OTHER ENVIRONMENTAL RELEASES	REGULATORY CONSTRAINTS	ULTIMATE SOURCE OF WASTE STREAM	NATURE OF MATERIALS	POTENTIAL FOR LEAKAGE OR OTHER ENVIRONMENTAL RELEASES	PROCESS FLOW DIAGRAM FOR MATERIALS	REGULATORY CONSTRAINTS	ULTIMATE SOURCE OF WASTE STREAM	(SEE METAL STORAGE AREA)
INVESTIGATIVE TASKS	PUBLIC HEALTH/ENVIRONMENTAL RISK ASSESSMENT																													
	AIR MODEL		●																											
	GROUND WATER MODEL						●				●				●															
	FACILITIES TESTING PLAN									●			●	●	●	●	●		●		●					●				
	WASTE STREAM SAMPLING	●		●	●	●	●	●												●		●	●	●			●	●		
	DRUM SAMPLING								●	●	●	●																		
	TERRESTRIAL / AQUATIC ORGANISM SAMPLING																													
	FLORA SAMPLING																													
	DEEP BOREHOLES																													
	GEOPHYSICS														●															
	GROUND WATER WELLS / MONITORING						●				●				●			●			●				●					●
	AIR SAMPLING	●	●	●																										
	SURFACE WATER SAMPLING					●	●			●	●							●			●				●					●
	SEDIMENT SAMPLING																													
	SURFACE SOIL SAMPLING		●			●	●			●	●							●			●				●					●
	WASTE SAMPLING																													
	RADIATION MEASUREMENT		●			●	●			●	●							●			●				●					●
POTENTIAL REMEDIAL ACTIONS	WASTE STREAM SEGREGATION																			●		●	●					●		
	WASTE MINIMIZATION																			●			●					●		
	NON-REMOVAL WITH IMPROVED CONTAINMENT				●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●			●	●		●			
	SOURCE REMOVAL AND OFF-SITE DISPOSAL				●	●		●	●	●		●	●	●		●	●		●	●	●	●								●
	FLOW DIVERSION AND CONTROLS						●				●										●									
	REPLACE/MODIFY EXISTING UNITS												●	●	●	●									●		●			●
	EMISSIONS COLLECTION AND TREATMENT	●	●	●																										
	PARTICULATE EMISSION CONTROLS	●	●	●																										
	SOURCE REMOVAL AND ON-SITE TREATMENT (AND DISPOSAL)				●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●							●
	SOURCE	AIR EMISSIONS			THORIUM INVENTORY				STORED WASTE INVENTORY				UNDERGROUND STORAGE TANKS				METAL STORAGE AREAS			CURRENTLY GENERATED WASTES				IN-PROCESS MATERIALS					DEACTIVATED FACILITIES		

FIGURE I-3

POTENTIAL SOURCES: PRODUCTION AREA

	ASSESSMENT INFORMATIONAL NEEDS	NATURE AND EXTENT OF SEDIMENT CONTAMINATION	POTENTIAL FOR CONTAMINATION OF GROUND WATER	LEAKAGE POTENTIAL	RELATIVE SOURCE CONTRIBUTIONS	POTENTIAL FOR OVERTOPPING	MASS FLOW RATE TO RECEIVING STREAM	POTENTIAL FOR CONTAMINANT RESUSPENSION	(SEE STORM WATER SYSTEM)		NATURE AND EXTENT OF SEDIMENT CONTAMINATION	CONDITION OF LINE/POTENTIAL FOR LEAKAGE	LOCAL HYDROGEOLOGIC SETTING	POTENTIAL FOR SURCHARGING/OVERTOPPING	MASS FLOW RATE TO RECEIVING STREAM		NATURE ADN EXTENT OF SOIL CONTAMINATION	POTENTIAL FOR CONTAMINATION OF GROUND WATER	CONTAMINANT ATTENUATION AND TRANSFORMATION	IMPACTS ON INDIGENOUS FLORA AND FAUNA		HYDROGEOLOGIC SETTING	NATURE & EXTENT OF GROUND WATER CONTAMINATION	EFFECTS OF OTHER PUMPING STRESSES	RELATIVE CONTRIBUTION FROM SOURCES	RATE OF GROUND WATER FLOW	CONTAMINANT ATTENUATION AND TRANSFORMATION			(SEE MAIN EFFLUENT LINE)			NATURE AND EXTENT OF SOIL CONTAMINATION	POTENTIAL FOR CONTAMINATION OF GROUND WATER	CONTAMINANT ATTENUATION & TRANSFORMATION	HYDROGEOLOGIC SETTING
INVESTIGATIVE TASKS	PUBLIC HEALTH/ENVIRONMENTAL RISK ASSESSMENT																																				
	AIR MODEL																																				
	GROUND WATER MODEL																						●	●		●	●					●	●				
	FACILITIES TESTING PLAN			●		●					●	●		●																							
	WASTE STREAM SAMPLING																																				
	DRUM SAMPLING																																				
	TERRESTRIAL / AQUATIC ORGANISM SAMPLING																			●																	
	FLORA SAMPLING																			●																	
	DEEP BOREHOLES																					●										●	●	●	●		
	GEOPHYSICS	●		●					●			●	●					●				●			●					●					●		
	GROUND WATER WELLS / MONITORING		●										●									●	●	●	●	●	●			●		●	●	●	●		
	AIR SAMPLING																																				
	SURFACE WATER SAMPLING		●		●		●	●	●						●															●						
	SEDIMENT SAMPLING	●	●		●			●	●		●																			●						
	SURFACE SOIL SAMPLING				●				●								●	●	●																	
	WASTE SAMPLING																																				
	RADIATION MEASUREMENT	●		●					●			●					●	●												●						
POTENTIAL REMEDIAL ACTIONS																																					
	CLEAN SOIL COVER																●	●	●																		
	GROUND WATER PUMPING AND TREATMENT																					●	●	●	●	●	●					●	●	●	●		
	REPAIR/REPLACE UNIT		●	●		●						●	●	●																●							
	SURFACE RUNOFF DIVERSION AND CONTROL				●	●	●	●	●					●	●		●	●												●							
	SOIL/SEDIMENT REMOVAL	●	●					●	●		●						●	●	●	●										●		●	●	●	●		
	CHANNEL LINING	●	●	●			●	●	●																												
	ON-SITE RECEPTOR AND/OR PATHWAY	STORM WATER SYSTEM							SURFACE DRAINAGE		MAIN EFFLUENT LINE						SURFACE SOILS					GROUND WATER BELOW THE FMPC							CLEAR-WELL			SUBSURFACE SOILS			

FIGURE I-4

ON-SITE RECEPTORS AND PATHWAYS

	ASSESSMENT INFORMATIONAL NEEDS	NATURE & EXTENT OF SEDIMENT CONTAMINATION	POTENTIAL FOR CONTAMINATION OF GROUND WATER	LOCAL HYDROGEOLOGIC SETTING	RELATIVE CONTRIBUTION FROM SOURCES	MASS FLOW RATE TO THE GREAT MIAMI RIVER	IMPACTS ON INDIGENOUS FLORA AND FAUNA	RESUSPENSION POTENTIAL	NATURE & EXTENT OF SEDIMENT CONTAMINATION	POTENTIAL FOR CONTAMINATION OF GROUND WATER	LOCAL HYDROGEOLOGIC SETTING	RELATIVE CONTRIBUTION FROM SOURCES	MASS RATE OF FLOW	IMPACTS ON INDIGENOUS FLORA AND FAUNA	RESUSPENSION POTENTIAL	NATURE AND EXTENT OF CONTAMINATION	DEGREE OF ECOLOGICAL STRESS	IMPORTANCE TO ENVIRONMENTAL PATHWAYS	RELATIVE CONTRIBUTION FROM SOURCES	(SEE AIR EMISSIONS, FIGURE I-3)	(SEE GROUND WATER BELOW THE THE FMPC, FIGURE I-4)
INVESTIGATIVE TASKS	PUBLIC HEALTH/ENVIRONMENTAL RISK ASSESSMENT						●							●			●	●		●	●
	AIR MODEL																			●	
	GROUND WATER MODEL		●	●						●	●										●
	FACILITIES TESTING PLAN											●									
	WASTE STREAM SAMPLING																			●	
	DRUM SAMPLING																				
	TERRESTRIAL / AQUATIC ORGANISM SAMPLING						●							●							
	FLORA SAMPLING						●							●		●	●				
	DEEP BOREHOLES																				
	GEOPHYSICS			●	●																
	GROUND WATER WELLS / MONITORING		●	●						●	●										●
	AIR SAMPLING																			●	
	SURFACE WATER SAMPLING		●		●	●		●		●		●	●		●				●		●
	SEDIMENT SAMPLING	●	●					●	●	●					●				●		●
	SURFACE SOIL SAMPLING																			●	●
	WASTE SAMPLING																				
	RADIATION MEASUREMENT	●			●															●	
POTENTIAL REMEDIAL ACTIONS																					
	PLANT/ORGANISM REMOVAL						●							●		●	●	●			
	CHANNEL LINING	●	●	●			●														
	SEDIMENT REMOVAL	●	●				●	●	●	●				●	●						
	GROUND WATER PUMPING AND TREATMENT																				●
	PATHWAY ELIMINATION				●	●						●	●						●	●	●
	SOURCE CONTROLS				●	●						●	●						●	●	●
	ENVIRONMENTAL RECEPTORS	PADDY'S RUN							GREAT MIAMI RIVER							FLORA AND FAUNA				ATMOSPHERE	REGIONAL AQUIFER

FIGURE I-5

OFF-SITE PATHWAYS (ENVIRONMENTAL RECEPTORS)

INVESTIGATIVE TASKS	PUBLIC HEALTH/ENVIRONMENTAL RISK ASSESSMENT		●				●				●				●															
	AIR MODEL					●	●							●	●															
	GROUND WATER MODEL									●	●																			
	FACILITIES TESTING PLAN																													
	WASTE STREAM SAMPLING																													
	DRUM SAMPLING																													
	TERRESTRIAL / AQUATIC ORGANISM SAMPLING	●								●																				
	FLORA SAMPLING	●								●																				
	DEEP BOREHOLES																													
	GEOPHYSICS																													
	GROUND WATER WELLS / MONITORING									●																				
	AIR SAMPLING					●								●																
	SURFACE WATER SAMPLING	●																												
	SEDIMENT SAMPLING	●																												
	SURFACE SOIL SAMPLING	●																												
	WASTE SAMPLING																													
	RADIATION MEASUREMENT	●								●				●																
ASSESSMENT INFORMATIONAL NEEDS		NATURE OF CONTAMINATION AT RECEPTOR LOCATION	CURRENT VS. RESIDUAL RISK	(MISC. NEEDS IDENTIFIED IN PREVIOUS SECTIONS)		NATURE OF CONTAMINATION AT RECEPTOR LOCATION	CURRENT VS. RESIDUAL RISK	(MISC. NEEDS IDENTIFIED IN PREVIOUS SECTIONS)		NATURE OF CONTAMINATION AT RECEPTOR LOCATION	CURRENT VS. RESIDUAL RISK	(MISC. NEEDS IDENTIFIED IN PREVIOUS SECTIONS)		NATURE OF CONTAMINATION AT RECEPTOR LOCATION	CURRENT VS. RESIDUAL RISK	(MISC. NEEDS IDENTIFIED IN PREVIOUS SECTIONS)												
POTENTIAL REMEDIAL ACTIONS																														
	ACCESS/USE RESTRICTIONS	●	●							●	●			●	●															
	TREATMENT AT THE TAP									●	●																			
	ALTERNATE WATER SUPPLY									●	●																			
	PATHWAY ELIMINATION	●	●	●		●	●	●		●	●	●		●	●	●														
	SOURCE CONTROLS	●	●	●		●	●	●		●	●	●		●	●	●														
	EXPOSURE PATHWAYS	DIRECT CONTACT				INHALATION				INGESTION				DIRECT RADIATION																

FIGURE I-6

POTENTIAL EXPOSURE PATHWAYS TO THE PUBLIC

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TABLE I-1
IDENTIFICATION OF POTENTIAL RI ACTIVITIES

INVESTIGATIVE TASK	CORRESPONDING ACTIVITY
Radiation Measurement	Task 3: Site Investigation (Radiation Measurement Plan)
Waste Sampling	(Provided by Characterization Investigation Study)
Surface Soil Sampling	Task 3: Site Investigation (Surface Soils Sampling Plan)
Sediment Sampling	Task 3: Site Investigation (Surface Water and Sediment Sampling Plan)
Surface Water Sampling	Task 3: Site Investigation (Surface Water and Sediment Sampling Plan)
Air Sampling	(Provided by ongoing WMCO program)
Ground Water Wells/ Monitoring	Task 3: Site Investigation (Ground Water Sampling Plan)
Geophysics	(Performed Under Separate Contract)
Deep Boreholes	Task 3: Site Investigation (Subsurface Soils Sampling Plan)
Vegetation Sampling	Task 3: Site Investigation (Biological Resources Sampling Plan)
Wildlife/Aquatic Resource Sampling	Task 3: Site Investigation (Biological Resources Sampling Plan)
Drum Sampling	(Provided by WMCO)
Waste Stream Sampling	(Provided by WMCO)
Facilities Testing	Task 3: Site Investigation (Facilities Testing Plan)
Ground Water Model	Task 4: Site Investigation Analysis
Air Model	Task 4: Site Investigation Analysis
Risk Assessment	Task 4: Site Investigation Analysis

- Magnetometry, to locate areas in which buried metals occur;
- Ground Penetrating Radar (GPR), to define the boundaries of the covered waste pits (i.e., Pits 1, 2, and 3) and to verify indications of buried metals (e.g., drums) from the magnetometer survey; and
- Electromagnetic Conductivity (EM), to detect anomalously high conductivity in ground water as an indicator of where contaminated ground water may be present.

In terms of air sampling, a comprehensive air monitoring program is conducted by WMCO as part of routine operations at the FMPC. This monitoring network was audited in April 1985. Deficiencies noted in the audit report have since been corrected and three off-site monitoring stations have been added to the network. At the present time, the monitoring of ambient concentrations of uranium and radon being performed by WMCO is adequate and satisfies DOE requirements for ambient monitoring of these constituents. The results of the ongoing monitoring program, when combined with historic information, will provide an adequate data base for both the air modeling study and the risk assessment tasks of the RI/FS. A previous air modeling study conducted by IT Corporation (IT) at the FMPC for NLO, as well as an ongoing modeling study by IT for purposes of supporting the Center for Disease Control's dose effects study, are being used to further test the adequacy of the data base.

The remaining studies, including composite sampling of the stored drums and a program of waste stream sampling, are being performed by WMCO. Data from these sampling activities will be evaluated and incorporated into the RI/FS data base in accordance with the QAPP. The completeness of the data collected from these programs will be reviewed for responsiveness to the RI/FS data needs before additional work is considered under these activities.

The second phase of the DQO process was to translate the remaining 10 informational needs identified in Table I-1 into meaningful field data collection efforts that would be consistent with both the currently available data base (to achieve cost-effectiveness while avoiding redundancy) and site-specific conditions. The result was the development of seven sampling plans, as specified in the table and described in the following sections. The seven sampling plans represent a responsive scope of field investigations, reflective of the current understanding of the FMPC, and associated environmental concerns. Additional data collection and evaluation efforts now underway may contribute to refinements in the sampling plans. The progressive findings of the field activities proposed in the plans may also reveal a need to increase the scope of the data collection efforts.

I.1.3 MEASUREMENT TECHNIQUES

The sampling plans provide specific guidance on the field methods to be utilized for the collection, preservation, and handling of various types of samples from each environmental medium. The final phase of the DQO process was to select and document the appropriate field and laboratory methods for the radiological, chemical, and physical analysis of the samples. This phase of the process provides that individual data types are adequate for their intended purposes.

With few exceptions (as discussed below), all samples collected as part of the sampling plans reported herein will be analyzed by an approved Contract Laboratory Program (CLP) laboratory in accordance with CLP protocols. All radiological samples will be analyzed at a radiological testing laboratory at a level of control consistent with CLP protocols (as detailed in the QAPP). The decision to produce Type IV and Type V data will provide flexibility in utilizing the data (for example, to support the risk assessment and the eventual Record of Decision).

Other types of sample analyses being proposed in the sampling plans are summarized in Table I-2. As indicated, all such testing will be performed for a specific purpose, utilizing instruments and protocols consistent with the designated data quality objective. The detailed procedures to be followed in the performance of these tests are provided in the QAPP.

I.2 OVERVIEW OF SAMPLING PLANS

Table I-1 identifies seven sampling plans necessary for the execution of the RI/FS. The seven sampling plans have been developed in accordance with the DQOs and are reported in Sections 1.0 through 7.0 of this document. The overall nature and scope of the sampling plans vary considerably depending on the sampling objectives, the level of current understanding of the problem in relation to the respective media, and the adequacy of the existing data base.

The Radiation Measurement Plan (Section 1.0) has as its underlying objective the collection of screening-level soils data to delimit areas of elevated radionuclide concentrations for purposes of focusing surface soil samples to contaminated areas. The companion Surface Soils Sampling Plan (Section 2.0) has been designed to extend the previous work completed by IT Corporation at off-site locations onto and throughout the FMPC. Through a stratified random sampling approach and biased sampling based on the results of the Radiation Measurement Plan, the results of the Surface Soils Sampling Plan are expected to be sufficient to produce isoconcentration plots and other types of statistically based summaries of the soils data at a high level of statistical confidence.

The Ground Water Sampling Plan (Section 3.0) represents the most comprehensive of the sampling plans. The reasons are: (1) elevated levels of uranium have been detected in ground water at

TABLE I.2

SAMPLE ANALYSES NOT SUBJECT TO CLP PROTOCOLS

SAMPLE TYPE	PURPOSE	INSTRUMENT OR METHOD
Soil	Locate elevated levels of radionuclides to target locations for soil sampling	Gamma scintillation detector FIDLER
Subsurface Soils	Radiological screening to select samples for full radiological analysis	Gamma scintillation detector
Subsurface Soils	Screen for presence of volatile organics to select samples for organics analysis	HnU or PID
Water	Field measurement of pH	EPA 150.1
Water	Field measurement of temperature	EPA 170.1
Water	Field measurement of conductivity	EPA 120.1
Water	Field measurement of dissolved oxygen	EPA 360.1/360.2
Subsurface Soils	Modified proctor compaction test	ASTM D1557
Subsurface Soils	Vertical permeability	ASTM D2434
Subsurface Soils	Unconfined compression	ASTM D2166
Subsurface Soils	Triaxial shear test	ASTM D2850
Subsurface Soils	Vertical consolidation	ASTN D2166

off-site locations, thereby dictating that the source-pathway-receptor analysis for ground water be a principal investigative issue; (2) the large number of potential sources and pathways for ground water contaminant migration result in a relatively extensive investigative scope; and (3) the current understanding of the ground water system in relation to FMPC operations is sufficient to pinpoint the technical uncertainties important to the problem but is not sufficient to resolve the uncertainties without a concentrated data collection program. As a consequence of the nature of the ground water program, combining regional information with a problem-specific focus, the results are expected to resolve many of the current uncertainties regarding sources and pathways and their integration into remedial action decisions.

The Subsurface Soils Sampling Plan (Section 4.0) is closely tied to the Ground Water Sampling Plan. It takes advantage of the subsurface soil samples collected during well installation to expand the current understanding of subsurface conditions at the FMPC. The testing of subsurface soils will provide information on the following: (1) the nature and extent of contamination of the subsurface horizons; (2) the geochemical properties of those soils that are important to contaminant migration and attenuation; and (3) the geotechnical (engineering) properties of the soils that will prove useful in the assessment of remedial actions.

The Surface Water and Sediment Sampling Plan (Section 5.0) is a data collection program that is based on historical data and makes use of ongoing WMCO monitoring programs on Paddy's Run and the Great Miami River. The scope of the surface water and sediment sampling program is intended: (1) to augment the current spatial coverage by monitoring at intermediate locations near specific points of interest; (2) to sample on-site drainageways that have not been currently, or previously integrated into other

monitoring programs; and (3) to periodically analyze for parameters not included in WMCO's program to confirm their presence or absence during sampling.

The purpose of the Biological Resources Sampling Plan (Section 6.0) is similar to that of the Surface Water and Sediment Sampling Plan in that a limited number of floral and faunal samples will be collected at preselected locations to confirm the presence or absence of an effect of environmental releases on the biological resources of the FMPC. In either case, positive detections will likely result in additional field investigations or other types of response actions.

The final sampling plan, the Facilities Testing Plan (Section 7.0), is designed to test several elements of the Production Area as potential sources of contaminant release. The sources include the underground storage tanks and the main effluent line, as well as numerous other facilities (e.g., sumps) and suspect areas. If leakage is detected, or if the Production Area as a whole is found to be a significant source of contaminant release, additional testing of Production Area facilities will be required.

I.3 SAMPLE IDENTIFICATION

For each sample collected during the field investigation, a coding system will be used to identify information concerning the sample. All media samples require proper identification to indicate project, sample or measurement type, location, and number. The following identification system will be used:

- Project Identification
  FMP will be used to designate the FMPC.

- Sample or Measurement Type
  A two-letter designation following the project identification code will be used to identify the sample type. The sample types and corresponding codes for this investigation consist of the following:

SS - Surface Soil Samples
SW - Surface Water Samples
SD - Surface Sediment Samples
SL - Subsurface Soil Samples
GW - Ground Water Samples From New Wells
AR - Air Samples
MW - Ground Water Samples From Existing Monitoring Wells
RM - Radiation Measurements
BR - Biological Resources Samples

- Sample Location
  A three-digit designation indicating the sample location will be used following the sample type code. Final locations and corresponding sample code numbers will be established prior to collecting samples. Sample codes will be assigned to integrate proposed sampling plan codes with sampling codes being utilized by present WMCO contractors. The following establishes a proposed numbering system:

Sample Measurement Location	Three-Digit Code Number
Monitoring Wells (New and Existing)	100-499*
Plant 1 - Sampling Plant	050
Plant 1 - Pad	051
Plant 2 - Refinery	052
Plant 3 - Refinery	053
Plant 4 - Green Salt Plant	054
Plant 5 - Metals Production Plant	055
Plant 6 - Metals Fabrication Plant	056
Plant 7 - Hexafluoride Reduction Plant	057
Plant 8 - Scrap Recovery Plant	058
Plant 9 - Special Products Plant	059
Refinery Storage Pad	060
Pilot Plant	061
Pilot Plant Warehouse	062
Pilot Plant Bulk Storage Tanks	063
Sanitary Sewage Treatment Plant	064
Tank Farm	065
KC-2 Warehouse	066
Underground Storage Tanks	067
Sanitary Landfill	068
Lime Sludge Ponds	069
Other Areas	(To be assigned)

* Individual monitoring well number.

- Sample Number
  A five- or six-digit code as specified below will be used to uniquely identify samples taken for each sample type and location. For each sample collected during the field investigation, a unique number will be

assigned identifying the sample. The following unique numbering system will be assigned:

00000 - 00999	Ecological
01000 - 02999	Surface Water
03000 - 04999	Ground Water
05000 - 06999	Surface Soils
07000 - 08999	Subsurface Soils
09000 - 09999	Sediment
10000 - 10999	Main Effluent Line
11000 - 14999	Radiological Measurements (Node Readings)
70000 - 79999	Miscellaneous
99000 - 99100	Background Radiation Readings
100000 - 999999	FIDLER Walkover Survey, SPA-3 Walkover Survey, and Elevated Radiation Readings

1.0

SECTION 1.0

RADIATION MEASUREMENT PLAN

6

SECTION 1.0

RADIATION MEASUREMENT PLAN

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1.0 RADIATION MEASUREMENT PLAN

1.1 OBJECTIVES AND JUSTIFICATION

Direct radiation measurements were performed in 1976 and 1985 at the FMPC site and its immediate environs by EG&G Energy Measurements, Inc., using the Aerial Measuring System (AMS). The results of these studies indicate that external radiation exposure rates at the site boundary and for much of the site do not exceed two times background levels for the area. Direct radiation measurements made at the site boundary by WMCO, using thermoluminescent dosimeters, confirm that external radiation exposure rates are at or near background levels for the area.

Although these survey results indicate that there is no direct radiation hazard at or beyond the site boundary, valuable information can be obtained by performing direct radiation measurements on the FMPC site. Such direct radiation measurements are an essential element of the on-site assessment of radioactive contamination of surface soils.

The Radiation Measurement Plan will focus on characterizing the surface radiation fields within the FMPC. These measurements are primarily needed as a screening tool to direct where surface soil samples will be taken. Specifically, the objectives for taking radiation measurements are to:

- Collect sufficient data to quantify surface radiation fields;
- Develop exposure rate contours for selected areas;
- Develop uranium concentration contour estimates for selected areas;
- Locate anomalies in both exposure rate contours and uranium concentration contours for further investigation; and
- Indicate the locations for biased surface soil sampling.

Monitoring for the presence of radionuclides in soils or other solids is designed to detect levels that exceed predetermined reference levels. Such levels have not been developed for all radionuclides, but recommended concentration limits have been published by the U.S. Environmental Protection Agency (U.S. EPA) for selected radionuclides. For depleted uranium in or on soil, the reference level is 35 pCi of uranium-238 per gram of soil (46 CFR 2556). Reference levels are not intended to be goals for remediation at the FMPC and are not intended to provide action levels for soil sampling, but they will be used as action levels to initiate more extensive radiation measurements.

In areas where uranium ore or other uranium residues are or may have been present, a reference level of 5 pCi Ra-226/g soil above background levels in the first 15 centimeters of soil below the soil surface, as averaged over any 100 square meters, will be used. In addition, for subsurface soil contamination, a reference level of 15 pCi Ra-226/g soil averaged over 15-centimeter-thick layers of soil that are more than 15 centimeters below the soil surface will be used (40 CFR 192).

1.2 MEASUREMENT PLAN

In order to assess the levels of radioactive contamination, radiation detection/measurement instruments must be chosen that can detect the type and energy of the radiations of concern. To assess radiation levels in the Production Area and other FMPC environs, radiation measurements will be performed using photon detectors coupled to survey meters. These will detect and quantify radiation emitted by uranium, thorium, and their daughter radionuclides. The principal goal of performing the radiation measurements in these areas is to provide a graphic identification of the areal extent of above-background surface radiation levels. From this information, the need for further sampling and analysis to determine radioactive contamination levels for surface soils can be identified.

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1.2.1 ESTABLISH GRID AND MEASUREMENT LOCATIONS

Previous radiation measurements have been performed along Paddy's Run, in the storm sewer outfall ditch, and in waste storage areas. Measurements from these areas and any other areas for which radiation measurement data are available will be evaluated for quality and completeness following the guidance presented in U.S. EPA's draft Data Quality Objectives, 1986. Areas with sufficient radiation measurement data will not undergo additional radiation measurements as a part of this phase of the RI. The areas anticipated to be surveyed are: the Production Area, the sewage treatment and incineration areas, the perimeter of the waste storage areas (including the area west of the Production Area and the Southfield area), the northern and eastern property boundaries, and two general areas off site.

Prior to beginning radiation measurements, a 100-foot grid pattern will be established and marked for each area, as identified on Figure 1-1. The grid will conform to the pattern previously developed for field measurements in the Waste Storage Area. The grid will extend beyond these areas by at least 300 feet. Should subsequent radiation measurements near the boundary of any area indicate soil concentrations of uranium in excess of the reference level, the grid will be extended an additional 300 feet beyond the areas of elevated concentrations of radioactive materials. A 1,000-foot grid pattern will be established and marked for the remainder of the FMPC site. Figure 1-1 shows the areal extent of radiation measurements to be performed for the FMPC area.

1.2.2 QUANTIFY THE GAMMA-RAY FIELD

Measurements with a Pressurized Ionization Chamber (PIC) will be made at selected locations to determine the magnitude of the gamma-ray field (exposure rate) and to calibrate the hand-held, large-volume scintillation survey instruments. At least fifty locations will be selected on FMPC property for measurements with

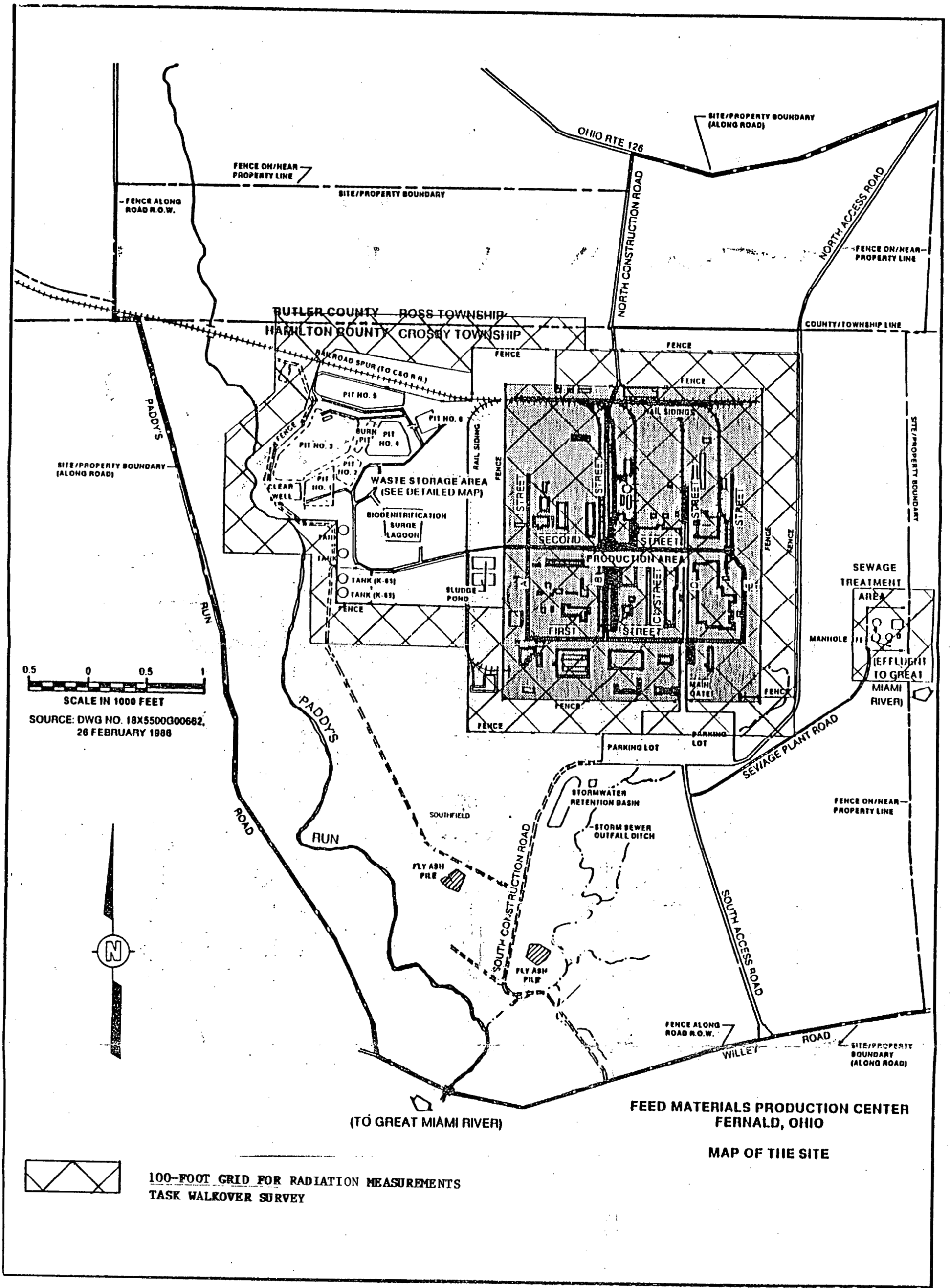

FIGURE 1-1
AREAL COVERAGE: RADIATION MEASUREMENT LOCATIONS

the PIC to determine the radiation exposure rate and to calibrate the large volume scintillation detectors. These locations will be uniformly spaced on the FMPC property and will be representative of radiation fields. The locations for PIC measurements will be dispersed throughout the radiation measurement locations identified on Figure 1-1 and will be selected to span the full range of exposure rates encountered at the site.

1.2.3 WALKOVER OF GRIDS

There will be a walkover of each 100-foot grid using portable scintillation survey instruments to detect and measure the gamma-ray field and the X-ray field. Both large-volume and thin, large-area sodium iodide probes will be used. These detectors are described in Section 1.3 and in the QAPP. Each grid will be surveyed in the manner described in Section 1.3. Measurements will be performed over each grid area and at grid points (intersection of grid lines), when possible. Grid areas and grid points that occur on buildings or paved areas will not be surveyed. Instead, measurements will be made at the surface of the ground on each grid line adjacent to the buildings or paved areas. Measurements will be made with a field instrument for detecting low-energy radiation (FIDLER) and a large-volume scintillation detector (such as an Eberline SPA-3 or equivalent).

Each 100-foot grid will be subdivided into 25-foot grids. An integrated instrument reading will be obtained during the walkover of each 25-foot grid and recorded on the field log forms. Elevated (peak) values within each grid will be marked during the walkover and evaluated for subsequent soil sampling after the walkover of that grid is complete. Field procedures for all sampling efforts are contained in the QAPP and the Radiation Measurements Task Procedures. The method of assignment of instrument readings for each grid are as specified in those procedures.

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1.2.4 FOLLOW-UP INVESTIGATION

Grids in which instrument surveys indicate uranium concentrations exceeding the reference level (as flagged on the walkover survey sheets) will be further characterized by additional radiation survey instrument measurements to better define the areal extent of the contamination of that grid and adjacent grids. This will be done by performing a walkover survey of the area centered on the flagged location. The determination of the necessity and number of soil samples to be collected in any grid with a uranium concentration greater than the reference level will be made according to the Surface Soils Sampling Plan (Section 2.0).

1.3 MEASUREMENT METHODOLOGY

The radiation measurement protocol for the site characterization effort will include: gamma-ray exposure rate measurements using a PIC and a large-volume sodium iodide scintillation detector at preselected locations at the FMPC site; a walkover survey using a FIDLER detector to identify uranium concentrations in the soil in excess of the reference level; a walkover survey of selected areas outside of the Production Area using a large-volume scintillation detector; and follow-up measurements using the FIDLER detector and large-volume sodium iodide detectors to determine the lateral extent of locations with elevated concentrations of radioactive materials and to further estimate the uranium concentration in the soil. The methodology for each procedure is listed below, with actual measurement procedures described in the QAPP and the Radiation Measurements Task Procedures. Additionally, data developed by other ongoing radiation measurement programs at the FMPC site will be evaluated for inclusion in the RI/FS.

1.3.1 GAMMA-RAY EXPOSURE RATE MEASUREMENTS

Gamma-ray exposure rate measurements will be performed to determine the gamma-ray exposure rate at locations specified in Section 1.2.1. The PIC readings will be obtained at 50 or more

locations by setting the detector at a height of one meter from the surface of the ground and integrating for one hour. During this integration period, each scintillation detector will be calibrated adjacent to the PIC for one minute, then used in the walkover of grids in the vicinity of the PIC.

As part of the calibration procedure, the PIC reading and each scintillation detector reading will be recorded for each calibration location. The relationship between PIC reading (exposure rate) and scintillation detector reading (pulse count rate) will be plotted, and a linear, least-squares fit of the data will be used to determine the calibration factor of each scintillation detector. At least ten percent of the PIC reading locations will be repeated at the completion of the radiation survey to determine whether there are temporal variations in the radiation field.

The remainder of the FMPC site grid points will be measured with the gamma-ray scintillation detector. This device is a lighter, more portable detector for assessing ambient exposure rates. The sensitive area of the scintillation detector will also be held one meter above the ground surface to permit ready correlation with the PIC data.

1.3.2 ESTIMATION OF URANIUM CONCENTRATIONS IN SITU

The site (walkover) survey of ground surfaces at the FMPC will identify the average estimated soil concentration of uranium within each grid by surface scans. The survey will be accomplished by moving a FIDLER probe in a serpentine pattern over the entire grid. During this walkover scan, the detector window will be held as close to the ground surface as practical.

The relationships between uranium concentrations, surface soils, and the corresponding FIDLER readings will be determined at several locations on site with the field calibration procedure

described in Section 1.4.2 and in the QAPP. These measurements will also be made at locations within the grids that have soil concentrations of uranium in excess of the reference level.

Each 100-foot grid will be subdivided into 25-foot grids. An integrated instrument reading will be obtained in the walkover of each 25-foot grid and recorded on the field log forms. Each 25-foot grid will be traversed in a parallel path so all surface areas of the soil are surveyed. The paths will be no further apart than the acceptance angle (or view) of the detector.

During the walkover of each 25-foot grid, any areas with elevated readings will be flagged on the field log form. At the completion of the walkover of each grid, a decision will be made as to the number and locations of the flagged areas from which soil samples will be taken.

1.3.3 IDENTIFICATION OF AREAS WITH ELEVATED CONCENTRATIONS OF GAMMA-RAY EMITTERS

A walkover survey with the large volume scintillation detector will be performed for the grids shown in Figure 1-1. The probe will be moved in a serpentine pattern over the entire grid with the detector as close to the ground surface as practical. This large-volume probe will detect and identify areas which have elevated concentrations of gamma-ray emitters such as uranium daughters (including Ra-226) and thorium daughters.

At any locations where scattered gamma radiation or direct gamma radiation from nearby structures prevents acquisition of suitable data using the large-volume scintillation detector, a differential measurement technique referred to as the "delta-gamma measurement" will be used. With this technique, two readings are taken with the large-volume scintillation detector at each measurement point where the walkover survey indicated high ambient gamma-ray background readings. One reading is taken without a filter and one with a half-inch lead filter inserted

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between the detector and the ground surface. The difference between the two readings is proportional to the activity of gamma-ray emitters located directly beneath the detector.

1.4 INTERPRETATION OF MEASUREMENTS

Direct radiation measurements indicate the magnitude of the radiation field at the location of the detector. Portable radiation survey instruments are used to locate and quantify radioactive materials in the field. Radiation measurements obtained in this investigation will be used in three principal ways:

- To develop exposure rate contours for selected areas of the FMPC site;
- To develop uranium concentration contour estimates for selected areas of the FMPC site; and
- To locate anomalies in both exposure rate contours and uranium concentration contours for further investigation.

1.4.1 GAMMA-RAY EXPOSURE RATE MEASUREMENTS

The PIC provides a direct reading of the exposure rate at a measurement site; on the other hand, the large-volume scintillation detector yields only a count rate proportional to the exposure rate. A correction factor must be applied to the large-volume scintillation detector measurements to correlate them to data acquired by the PIC. This correlation is performed by taking PIC and scintillation detector measurements at a number of specific locations on site with a wide range of exposure rates. Areas on the FMPC site to be used for these correlation measurements will be chosen to subdivide the areas shown in Figure 1-1 into regions where, within each subdivision the photon energy spectrum is relatively constant. The measurement locations will also be chosen so that the exposure rate does not vary significantly with slight differences in positioning of both detectors. Measurements will be performed with the active area of each detector located one meter above the ground.

After performing these measurements at the selected sites, the mathematical relationship (linear, if possible) between the PIC reading (microroentgen per hour) and the scintillation detector reading (counts per minute) will be determined. Once this relationship has been determined, all scintillation detector readings will be converted to exposure rate values. These values will be plotted on a site map and contours will be constructed to show the lines of approximately equal exposure rates. Anomalously high readings will be investigated to determine the cause.

1.4.2 ESTIMATION OF URANIUM CONCENTRATION IN SITU

The response of the FIDLER to radioactivity concentration in soil is site specific and can be influenced by several parameters such as the presence of radioactivity other than uranium in the soil, a layer of clean soil between a subsurface deposit of uranium and the ground surface, or nearby radioactive sources. Therefore, the FIDLER detector, calibrated for estimation of uranium concentrations in soil, serves only as an indicator of concentration. Subsequent soil sampling is necessary to quantify the concentration values.

Approximately five "test areas" at the FMPC site will be chosen to include the full range of FIDLER readings expected at the site. At each test area, five one-minute measurements will be taken with the FIDLER detector as close as possible to the ground surface. A soil sample will be collected at that location (two- to three-inch diameter and within zero to two inches of the surface) and submitted to the analytical laboratory for gamma spectral analysis and total uranium analysis.

After laboratory analyses of the soil sample from the test areas are complete, the calibration factor (or functional relationship) for each FIDLER will be determined. Anomalously high readings

will be the principal indicators for biased soil sampling and subsequent investigations.

The five test areas will be selected as locations which have been previously analyzed for uranium concentrations in soil and which have concentrations which range from the highest to the lowest values measured on site. Samples will be collected and analyzed at the start of the radiation measurement program.

1.4.3 IDENTIFICATION OF AREAS WITH ELEVATED CONCENTRATIONS OF GAMMA-RAY EMITTERS

The FIDLER detector responds to a narrow range of low-energy photons such as the low-energy gamma rays (63 keV) emitted by the short-lived daughter of uranium-238 (thorium-234). Few other radionuclides emit significant numbers of photons within the response range of the FIDLER. For this reason, the FIDLER is well suited for detection/measurement of uranium in the environment. It can be calibrated (as described in Section 1.3.2 and in the QAPP) to yield a response which can be directly related to the concentration of uranium in the surface layer (top few centimeters) of soil.

The sensitivity of the large-volume scintillation detector for low-energy photons is much less than the sensitivity of the FIDLER detector. Conversely, the large-volume scintillation detector is the most sensitive survey instrument for the detection/ measurement of intermediate and high-energy gamma rays such as those emitted by uranium-235, radium-226, and thorium-232 daughters.

The sensitivity of the large-volume scintillation survey meter to photons is a complex function of the photon energy. Although the survey meter can be calibrated to measure the exposure rate in field locations (as described in Section 1.4.1 and in the QAPP), it cannot be used to measure concentrations of specific gamma-ray emitters in the environment. Techniques for field determination

of the concentration of gamma-ray emitters require the use of a gamma-ray spectroscopy system.

The walkover survey described in Section 1.3.3 for selected areas of the FMPC site using the large-volume scintillation detector will provide data to identify and locate areas of elevated concentrations of gamma-ray emitters. The survey instrument data cannot be used to identify specific radionuclides or to determine the concentrations of radionuclides present in the soil. The response of the survey instrument will be used, therefore, as a guide to locate areas which have elevated concentrations of gamma-ray emitters. Similarly, in areas with high ambient background radiation levels, the delta-gamma measurements will be used as a guide to locate areas with elevated soil concentrations of gamma-ray emitters for subsequent sampling.

2.0

SECTION 2.0

SURFACE SOILS SAMPLING PLAN

6

SECTION 2.0

SURFACE SOILS SAMPLING PLAN

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2.0 SURFACE SOILS SAMPLING PLAN

2.1 OBJECTIVES AND JUSTIFICATION

The data on surface soil contamination associated with the FMPC has been previously collected primarily near the boundary of the site and off site. With the exception of 12 samples collected in 1984, uranium was the sole parameter of analysis. The data collected in these studies suggest that the presence of uranium in surface soils off site appears to be through the air pathway. The following problems and data gaps are indicated:

- The areal and vertical extent of on-site soil contamination by radionuclides and hazardous substances has not been defined; and
- The areal and vertical extent of possible off-site soil contamination, as reported in previous investigations, requires confirmation in several critical areas.

Surface soil sampling will be performed to characterize on-site contamination of soils by radionuclides or hazardous substances, as well as to augment the characterization of off-site contamination of soils by uranium isotopes. The Surface Soils Sampling Plan will focus on determining the effect that operations and waste disposal at the FMPC have had on the near surface soils and the degree that contaminated soils contribute to off-site migration of contaminants. Specifically, the objectives for surface soil sampling are to:

- Collect sufficient data to determine the extent of contamination of surface soils by radioactive substances on site;
- Confirm areas of surface radiological contamination identified in the radiation measurements survey and quantify the types and concentration of radionuclides found;
- Provide data to characterize the source term for all radionuclides which have the potential to contribute to off-site environmental dose;

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- Provide additional sampling to characterize surface soil contamination along the FMPC perimeter and off-site locations;
- Identify the types and determine the concentrations and areal extent of hazardous substance contamination in surface soils on site; and
- Provide data that will determine where future subsurface soil sampling will be necessary.

The collected data will be used, along with previously collected data, to:

- Develop a graphic representation of radiological contamination on and near the FMPC;
- Evaluate the potential pathways for surface migration of radiological and chemical constituents away from the FMPC;
- Evaluate the actual and potential risk to public health and the environment resulting from surface soil contamination; and
- Identify the need for remedial action alternatives for contaminated surface soils.

2.2 SAMPLING FREQUENCY

Previous soil sampling work in the area of the FMPC has demonstrated that a single boring at each soil sampling location is adequate to support the mapping of soil contamination in the site environs (IT Corporation, 1986). To obtain an estimate of the variability of the measurement system, duplicate samples will be collected at 10 percent of the identified sample locations. The locations to be sampled in duplicate will be chosen at random.

2.3 SAMPLING LOCATIONS

Surface soil samples will be taken in several general areas within the FMPC (as shown on Figure 2-1), as well as along the site boundary and in two general areas off site. The areas within the FMPC are: (1) Production Area, sewage treatment area,

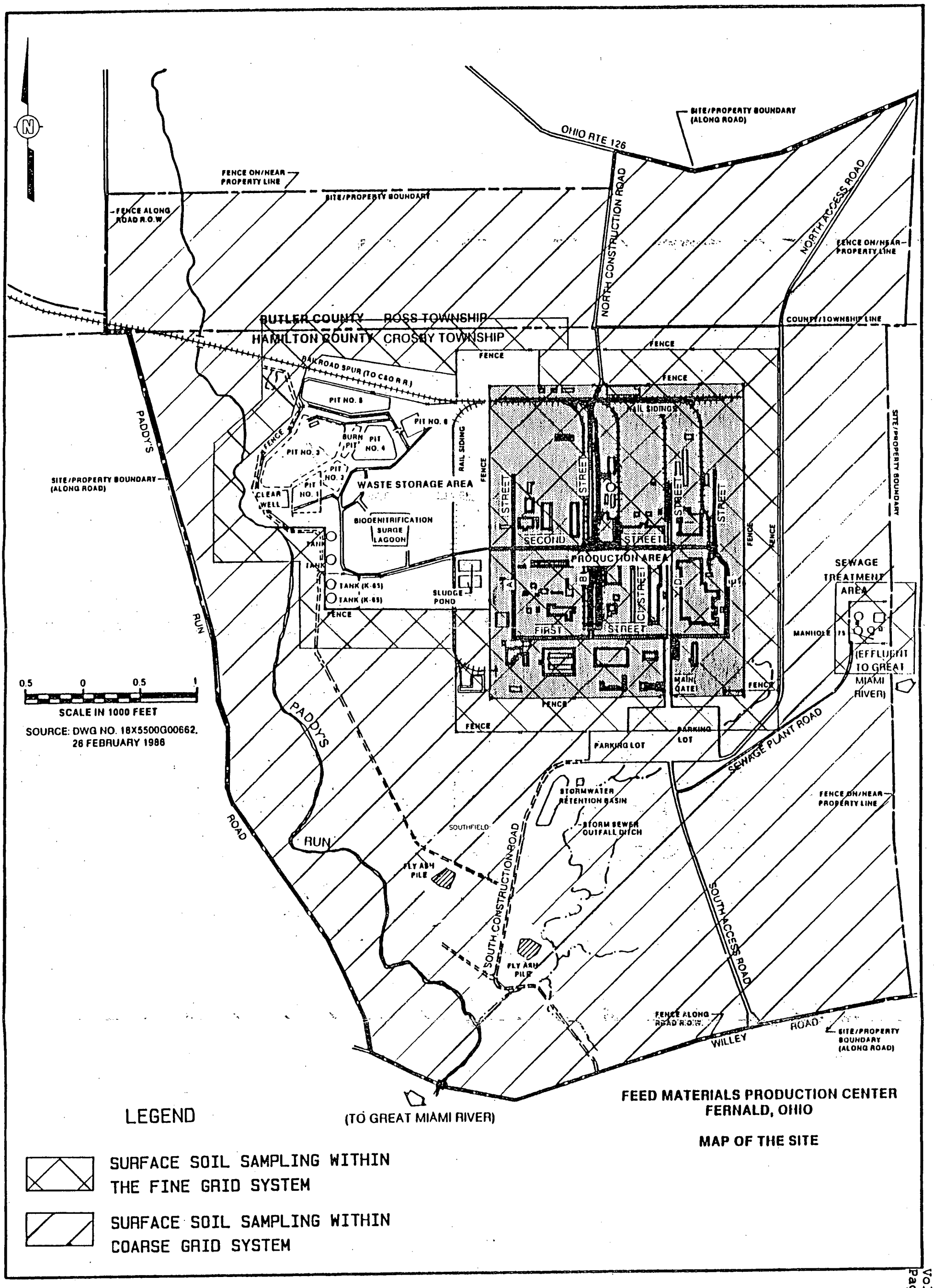


FIGURE 2-1
AREAL COVERAGE: SURFACE SOIL SAMPLING LOCATIONS

and perimeter of the Waste Storage Area; and (2) remaining areas within the FMPC site boundary at 1,000-foot grid points. The boundary and off-site areas are: (1) locations at 250-foot intervals along the northern and eastern property boundaries; (2) eight locations at 200-foot intervals along a line extending due east from the eastern property boundary at the sewage treatment area; and (3) 16 additional off-site locations in areas where previous sampling programs did not provide sufficient sample density. In addition, surface soil samples will be taken off site at locations where vegetation samples will be collected and on site where required to provide data for field calibration of radiation measurement instruments.

In particular, samples will be collected at the following locations:

- <u>Production Area, Sewage Treatment Area, and Perimeter of the Waste Storage Area</u>

  Sample locations for radiological analyses will be determined upon conclusion of the radiation measurement survey. The radiation isopleth maps will be used to define areas where surface soil samples will be taken. Areas that exhibit radioactive contamination exceeding the reference levels defined in the Radiation Measurement Plan will be selected for surface soil sampling (Section 1.0). Such areas identified for collecting surface soil samples are biased since soil samples will be taken in areas known to contain elevated soil concentrations.

  Within the defined biased sampling areas, the two methods to determine specific locations for surface soil sampling include: (1) if the radiation survey indicates specific areas with elevated concentrations of radionuclides, the flagged area corresponding to the highest reading within a grid will be sampled; (2) if there are uniform, elevated readings across entire 100-foot grids, then a random sample will be taken within the grids. The location of the random sample will be determined by generating random values of the (X,Y) coordinates for the location within the grids. It is estimated that 200 soil sample locations will be required to adequately characterize the radiological contamination of surface soil in these areas.

Biased soil samples for chemical analysis will be collected at any anomalous areas, including: known accidental spill sites, areas adjacent to storage tanks, areas adjacent to railroad tracks, and areas adjacent to transformer pads. Samples will be analyzed for chemical constituents to determine the presence of soil contamination. It is estimated that 10 soil samples will be collected for chemical analysis.

- Remaining Areas Within the FMPC Site Boundary

  Samples in other areas of the FMPC will be collected for radiological analysis only. Sample locations in this area will be at each grid point of the 1,000-foot grid established for the Radiation Measurement Plan. Selection of a 1,000-foot spacing as a sampling frequency is based on a statistical sampling approach, "kriging," which optimizes the information which can be obtained from sampling in areas expected to have atmospheric deposition of contaminants. Approximately 35 sample locations will be identified in these areas.

- Northern and Eastern Property Boundaries

  Samples will be performed at 250-foot intervals along the northern and eastern property boundary lines of the FMPC. Approximately, 30 samples will be taken along these property boundary lines.

- Off Site East of the Sewage Treatment Area

  Eight sampling locations will be established in undisturbed areas beginning at the eastern property boundary at the sewage treatment area and extending along a line due east of the site at 200-foot intervals.

- Additional Off-Site Locations

  Sixteen sampling locations will also be established at the approximate state plane coordinates shown below:

N-S	E-W	N-S	E-W
491250	1384500	485000	1374250
491250	1382000	482500	1374250
488750	1387000	480000	1374250
488750	1384500	487500	1371750
488750	1382000	4850000	1371750
488750	1379500	4825000	1371750
482250	1387000	4725000	1385750
487500	1374250	4740000	1376500

Samples will be collected from undisturbed areas as close as possible to these coordinates, but always within a 300-foot radius of the specified locations.

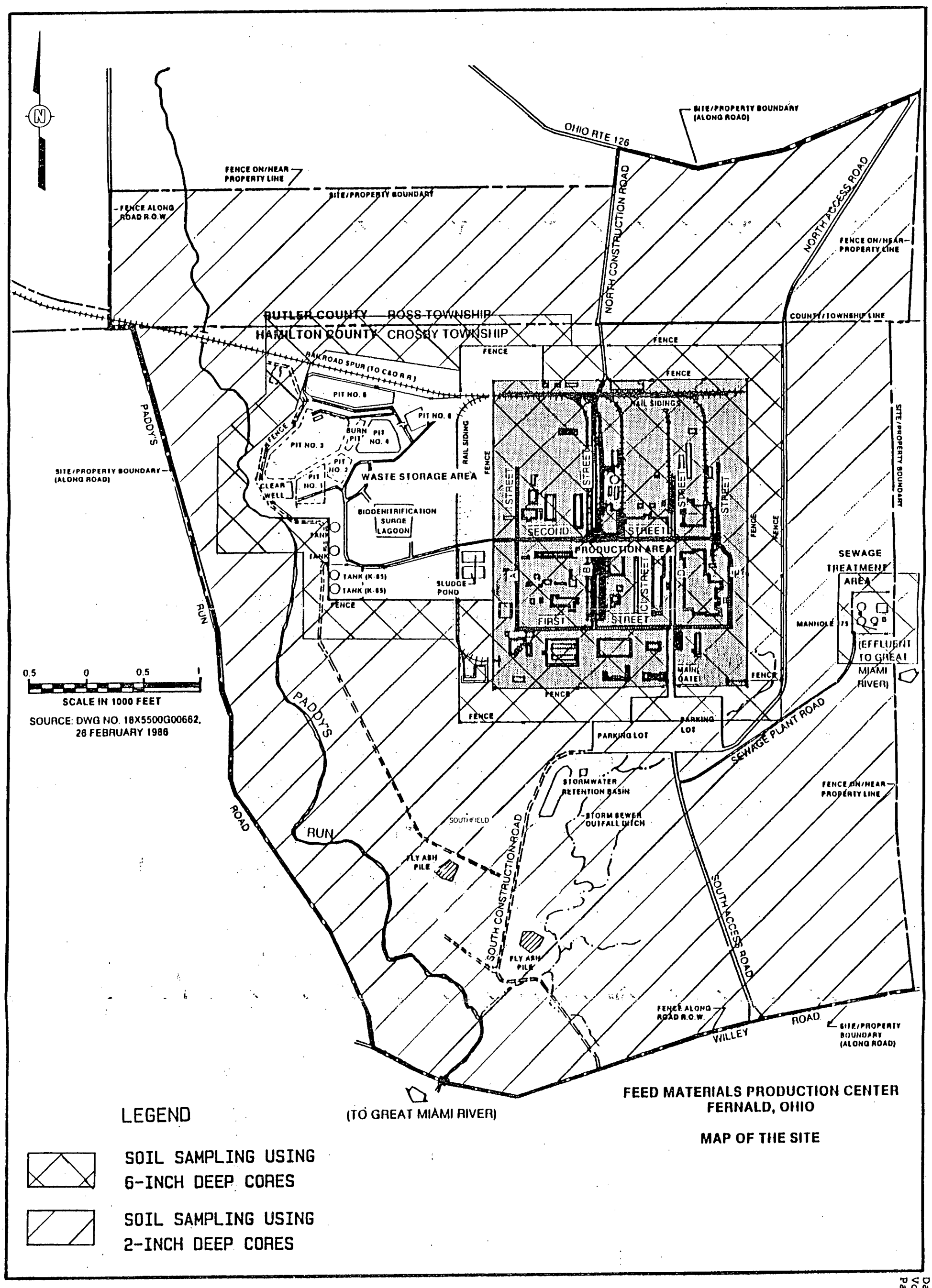
All off-site sampling is contingent upon obtaining approval of the affected property owners. If approval cannot be obtained, then a location will be selected as close as possible to the initially specified location. Sampling methodology will be the same as for the random sampling program performed at 1,000-foot intervals on site. Laboratory analysis will be for isotopic uranium.

Samples for radiological analysis will be taken at three specified depths at each identified sampling point. The uppermost soil sample will be analyzed prior to the lower two samples. The lower samples will be analyzed only if radionuclides above reference levels of radiological parameters are detected in the uppermost soil sample. Should contaminants be detected in all three samples, the location will be noted as a potential location for deeper soil sampling.

In accordance with the Facilities Testing Plan (Section 7.0), investigations of suspect areas in the Production Area will include soil sampling and analysis for specific materials of concern in each of the areas. The sampling locations and analytical parameters will be selected based on the historic use and the materials handled in each area. These areas will include, but may not be limited to, the old oil incinerator, the fire training area, and the graphite incinerator. The need for further analysis of soil samples for HSL parameters will be evaluated based upon results of the current sampling program.

2.4 SAMPLING METHODOLOGY

At each sampling location shown in Figure 2-2, three samples will be taken at the specified depths. Samples will be taken at six-inch-depth increments within the fenced Production Area and



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MAP OF THE SITE

FIGURE 2-2
SURFACE SOIL SAMPLING METHODS

sewage treatment areas, and at two-inch-depth increments outside the fenced areas within the FMPC site boundary and off site. The purpose of the six-inch incremental sampling methodology is to provide greater sampling detail and vertical extent in areas of suspected higher radionuclide concentrations such as found in the Production Area. The two-inch deep samples in the remaining areas will be consistent with existing data and methodology employed for off-site samples used to determine areas of surface contamination resulting from airborne particulate transport.

Six-inch core samples for radiological analysis will be taken using methods described in GJ/TMC-13, UC-70, Procedures for Sampling Radium Contaminated Soils, 1985. Methods for two-inch cores will be those in ASTM C998-83, Standard Method for Sampling Surface Soil For Radionuclides, 1983. Samples for chemical analysis will be taken using methods described in SW-846, Test Methods for Evaluating Solid Waste, Physical/ Chemical Methods, U.S. EPA, 1986, 3rd edition.

Sufficient sampling equipment will be taken into the field to avoid the need for decontaminating equipment between field sample sites. Field equipment will be decontaminated after each use in accordance with the procedures outlined in Section 6.4 of the QAPP. Spent decontamination solution and rinsewaters will be containerized and managed as directed by WMCO. Field sample collection procedures are provided in Section 6.4 of the QAPP and in the Surface Soils Sampling Procedures Manual. Section 7.1 of the QAPP presents procedures for sample control and documentation.

2.5 CONTAINERS FOR SHIPPING

Table 2-1 provides a list of appropriate shipping containers and preservative methods for surface soil samples. Samples for HSL parameters will be placed in an amber glass bottle with a Teflon

TABLE 2-1
SURFACE SOILS SAMPLE CONTAINERS AND PRESERVATIVES

SPECIFIED ANALYSIS	SAMPLE CONTAINER	CONTAINER SIZE	PRESERVATION TIME	HOLDING	REPORTING UNITS
HSL Volatile	Glass	40 ml	Cool, 4°C	10 Days	ug/kg
HSL Extractable Organics (Base/Neutral/ Acid/Pesticide/ PCB)	Amber Glass	1 L	Cool, 4°C	10/40[a]	ug/kg
HSL Inorganic[b]	Glass or Plastic	500 ml	Cool, 4°C	Indefinite	ug/kg
Radiological	Polyethylene Bags/ Cardboard	Variable	None	Indefinite	pCi/gm

[a] Extract within 10 days; analyze within 40 days of extraction

[b] Does not include tin

lined lid. Care will be taken to minimize headspace in samples collected for volatile organics determination.

Section 6.9 of the QAPP presents the shipping and packaging requirements. The chain-of-custody procedures are described in Section 7.1 of the QAPP.

2.6 SAMPLE IDENTIFICATION

Details of the sampling numbering system were provided in the Introduction to the Sampling Plan, Section I.3 of the volume.

The following information will be included in the sample description in the field log as the sample is taken:

- Name of collector;
- Date and time of collection;
- Location of sampling site by grid location;
- Sample depth interval;
- Sample number; and
- Remarks regarding unusual aspects of sample.

The chain-of-custody forms will be completed when the sample is taken and will accompany the samples in accordance with Section 7.1 of the QAPP.

A preprinted form label with an adhesive backing will be attached to each sample container as described in Section 7.1.1 of the QAPP. All sampling locations and associated sample numbers will be identified using the sample collection log as described in Section 7.1.3 of the QAPP. This information will be documented on the sample container label and in the field log.

2.7 SAMPLE ANALYSIS

Soil samples designated for radiological analysis will be analyzed for the following parameters that are representative of the materials found at the FMPC. The soil samples taken at the site boundary and off site will be analyzed only for uranium isotopes. Analytical methods for these analyses can be found in

Section 9.4 of the QAPP. The parameters for radiological analysis are:

- Gamma Spectral Analysis
- Isotopic uranium
- Isotopic thorium
- Isotopic plutonium
- Total uranium
- Sr-90
- Tc-99
- Cs-137
- Ru-106
- Np-237
- Ra-226
- Ra-228.

Soil samples designated for chemical analysis will be analyzed for the following extended HSL parameters for which analytical methods are presented in Section 9.4 of the QAPP:

- HSL Inorganics
- HSL Volatiles
- HSL Semivolatiles
- HSL Pesticides/PCBs
- Primary Drinking Water Substances
- Organophosphorus Pesticides.

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3.0

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SECTION 3.0

GROUND WATER SAMPLING PLAN

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SECTION 3.0

GROUND WATER SAMPLING PLAN

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SECTION 3.0

GROUND WATER SAMPLING PLAN

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3.0 GROUND WATER SAMPLING PLAN

3.1 OBJECTIVES AND JUSTIFICATION

The hydrogeological field program will focus on determining the effect of operations and waste disposal practices at the FMPC on ground water. The overall objective of the Ground Water Sampling Plan is to satisfy identified data gaps in order to:

- Determine if subsurface water-bearing zones below the FMPC have been contaminated both on site and off site, and determine the extent (both vertically and horizontally) of any contamination.
- Determine the concentrations and sources of contaminants on site and indicate migration of radiological and hazardous substances off site;
- Characterize the rate and direction of ground water flow within each separate hydrologic unit;
- Determine the effects of pumping ground water and what effects the resulting recharge/discharge relationships have on ground water flow and contaminant transport; and
- Define areas of subsurface migration and ground water discharge for contaminants.

The Ground Water Sampling Plan will focus on identifying sources of ground water contamination, pathways for contaminant transport, and receptors or potential receptors of the contaminants. The study will focus on these issues because one of the most critical determinations to be made in relation to the FMPC site is to determine the need for and extent of ground water remediation. Initial definition of the ground water system and identification of the sources and pathways of contamination can allow remedial actions to be considered and their public health impacts to be assessed.

To achieve the objectives listed above, a phased approach to field activities is planned. The first major phase of work will concentrate on filling the principal data gaps in the ground

water quality and flow patterns in this region with respect to specific potential sources, pathways, and receptors. The Ground Water Sampling Plan represents a responsive plan reflective of the current understanding of the FMPC and associated ground water conditions. Additional data collection and evaluation efforts now underway will contribute to refinements of and possible additions to the final plan. Other proposed ground water studies may also reveal the need to increase the scope of the ground water program.

3.2 MONITORING WELL LOCATIONS AND RATIONALE

Figures 3-1 through 3-5 show the locations of existing and proposed monitoring wells on site and off site. Proposed well locations were selected on the basis of data gaps identified from previous ground water studies and on sampling results from the existing wells. Existing well locations were used to the maximum extent possible in establishing the monitoring network for this investigation. Well depths at each location were selected to provide necessary information on the four different water-bearing zones of concern.

A total of 89 monitoring wells are proposed for installation during the RI/FS. Four different water-bearing zones will be intercepted by the proposed monitoring wells. The shallowest wells (100 series) will be completed primarily in the till and will screen either the water table aquifer or isolated perched water. Based on stratigraphic logs from existing borings on site, it is estimated that the wells in the till will be up to 35 feet deep. A total of 42 new shallow wells are proposed.

The intermediate depth wells (200 series) will be approximately 70 feet deep and will screen the upper portion of the upper sand and gravel aquifer. A series of deep wells in the upper sand and gravel aquifer (300 series) will be approximately 120 feet deep and will screen the lower portion of the upper sand and gravel

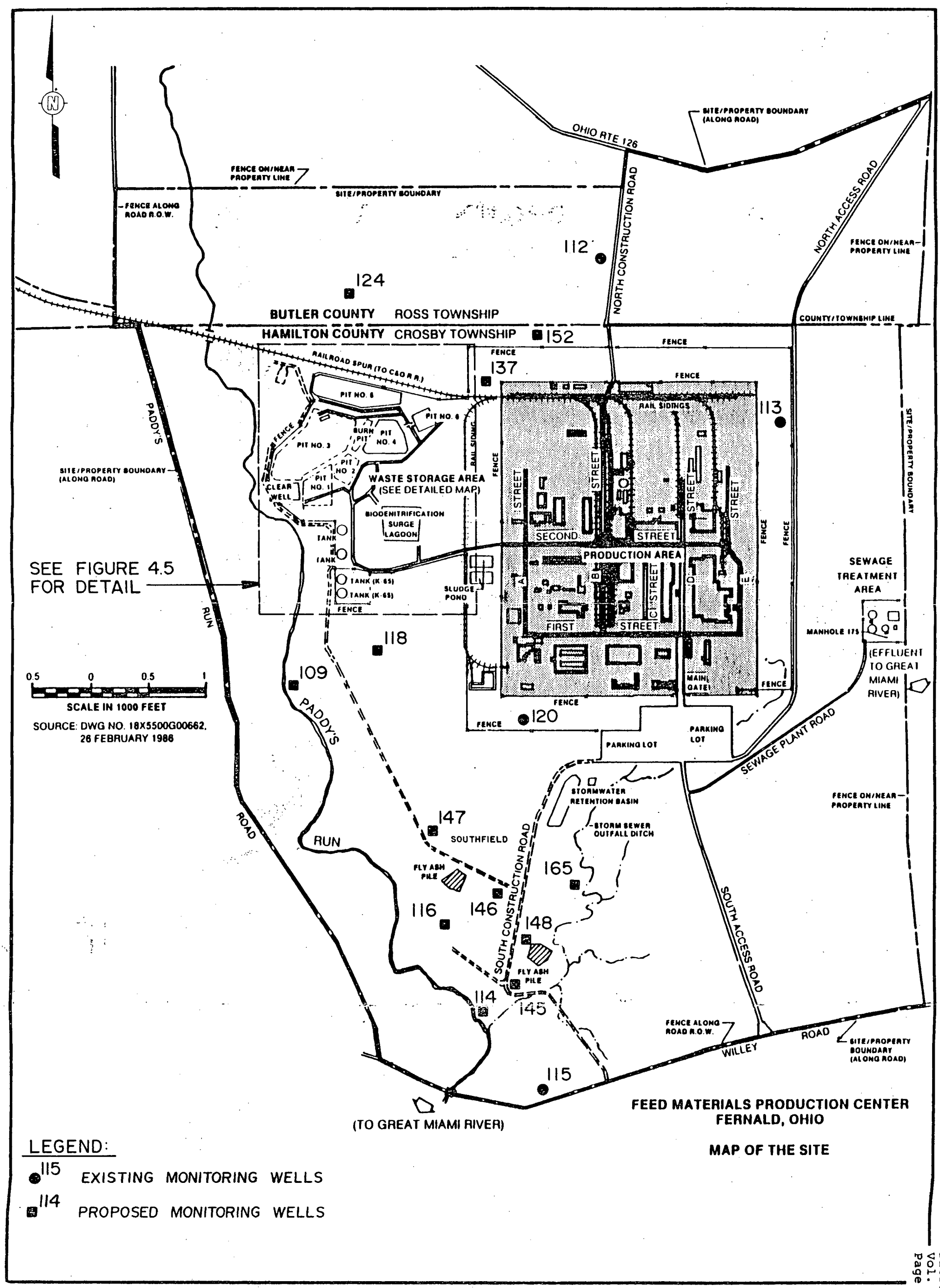
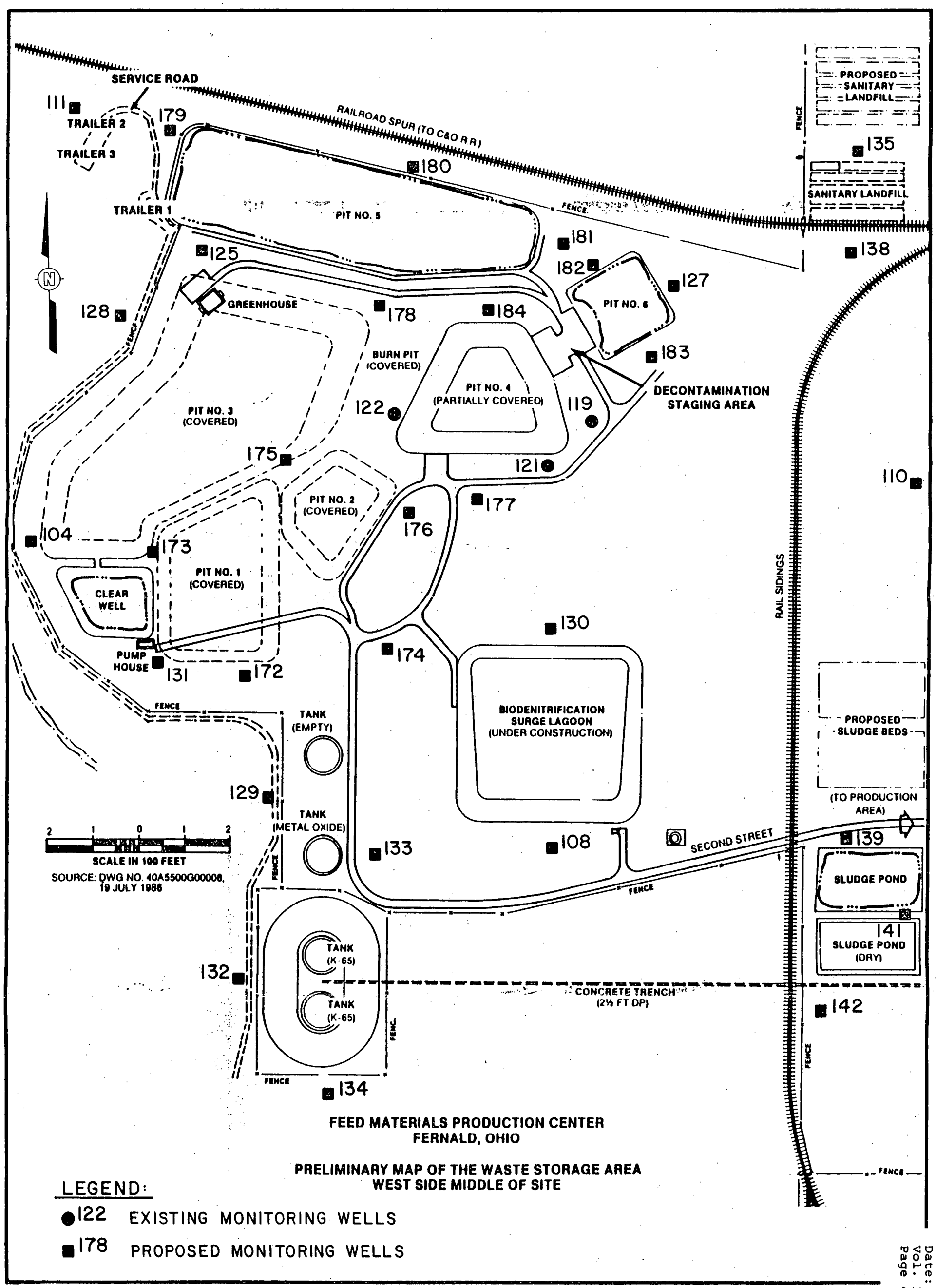


FIGURE 3-1
100-SERIES WELLS-GLACIAL TILL FMPC FACILITY



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PRELIMINARY MAP OF THE WASTE STORAGE AREA
WEST SIDE MIDDLE OF SITE

FIGURE 3-2
100-SERIES WELLS - WASTE STORAGE AREA

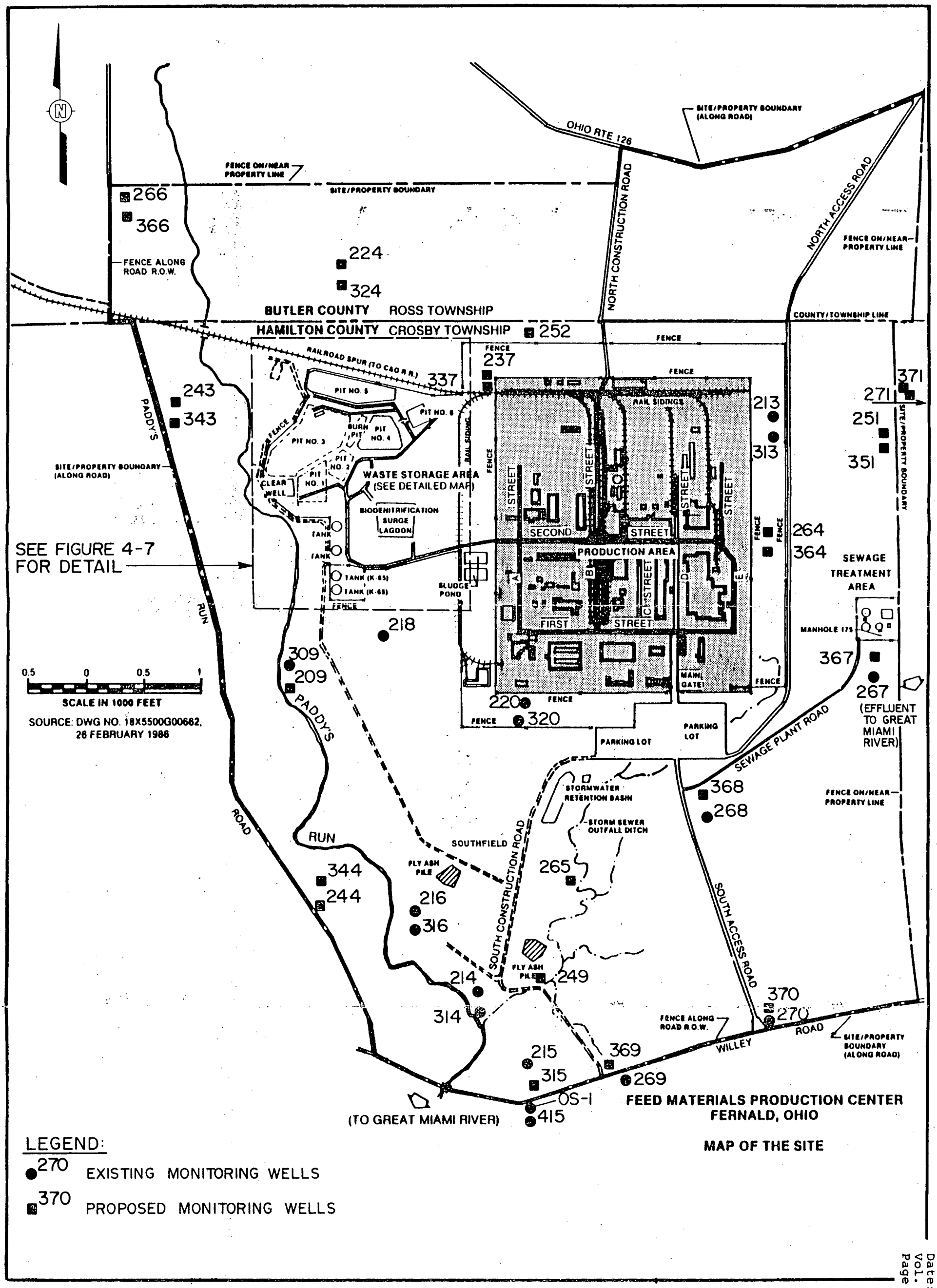


FIGURE 3-3
200-SERIES AND 300-SERIES WELLS
SAND AND GRAVEL AQUIFER FMPC FACILITY

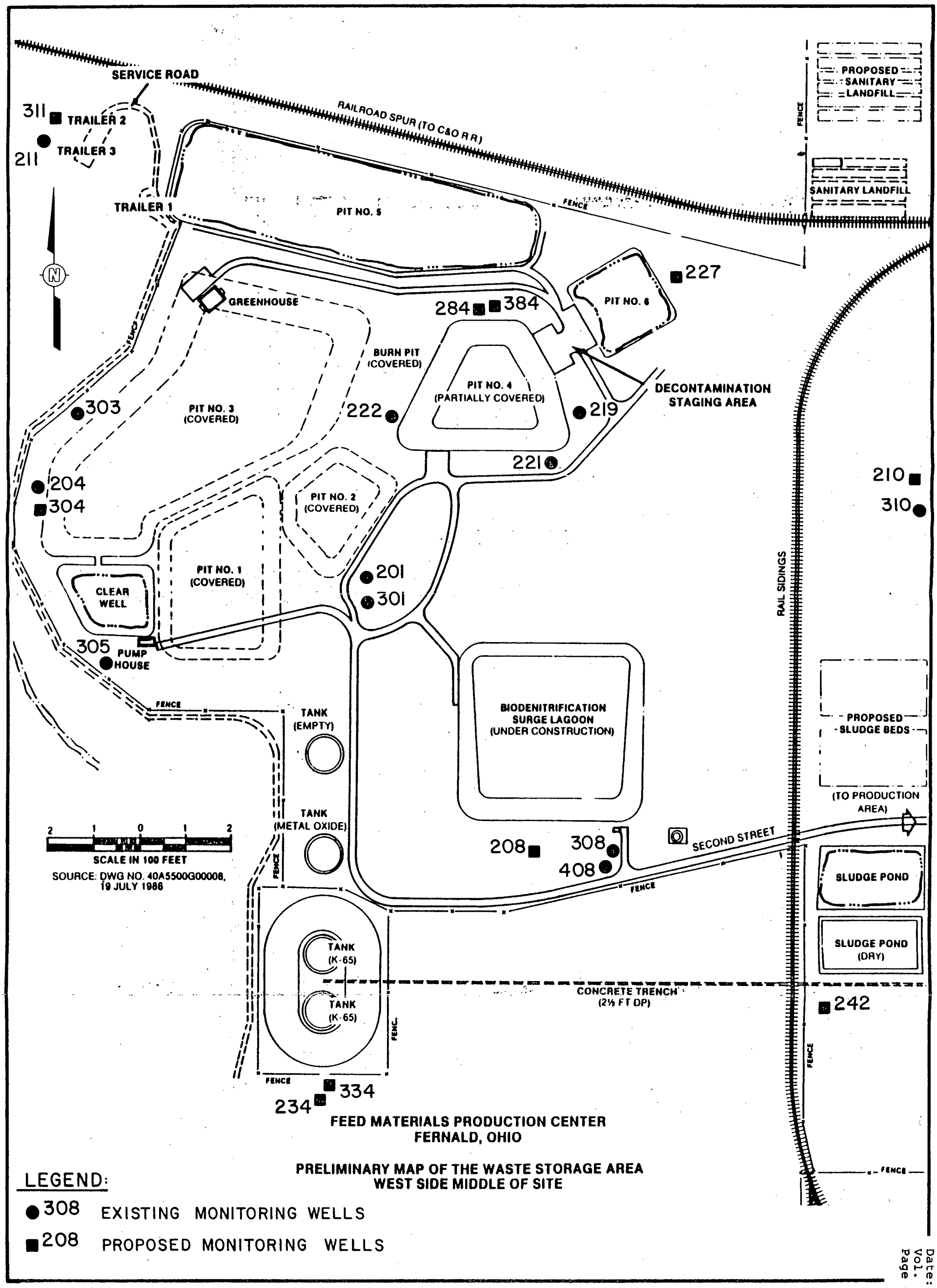
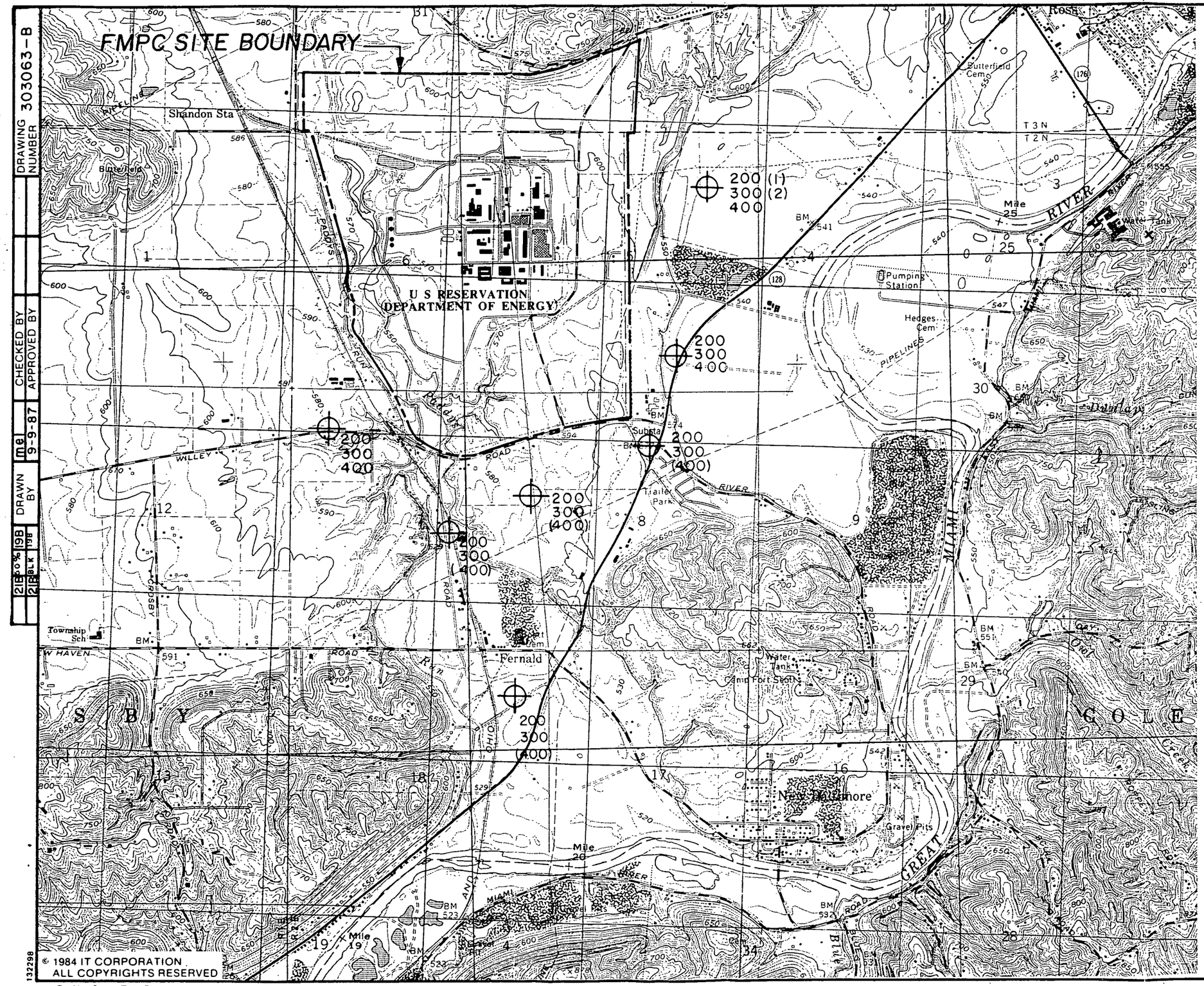


FIGURE 3-4
200-SERIES AND 300-SERIES WELLS - WASTE STORAGE AREA



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LEGEND

- PROPOSED OFF-SITE WELL LOCATION
- 200, 300, 400 — SERIES WELLS
- (400) — ONLY IF CONTAMINATION IS FOUND IN 300 SERIES WELLS
- (1) — ALREADY INSTALLED
- (2) — ALREADY PROPOSED

REFERENCES:

7.5 MINUTE USGS TOPOGRAPHIC MAPS OF HARRISON, OHIO – IND., SHANDON, OHIO, GREENHILLS, OHIO, CINCINNATI WEST, OHIO, ADDYSTON, OHIO – KY, AND HOOVEN, OHIO. DATED: 1955 (PR1981), 1965 (PR1981), 1965 (PR1981), 1961 (PR1981), 1982 AND 1981. SCALE: 1" = 2000'.

SCALE
0 2000 4000 FEET

FIGURE 3-5

FMPC RI/FS OFFSITE GROUND WATER MONITORING WELL LOCATIONS

aquifer. A total of 44 wells are proposed for the upper sand and gravel aquifer, 22 as 200-series and 22 as 300-series wells. The deepest wells (400 series) will be screened in the lower portion of the lower sand and gravel aquifer so that the bottom of the screen is 10 feet above the top of bedrock. Three off-site 400-series wells will be installed.

Data from existing wells completed in the lower sand and gravel aquifer do not indicate elevated levels of any radiological or chemical constituents. In fact, the existing data do not indicate that contaminants have reached the lower sand and gravel unit that directly underlies the blue clay. Because the blue clay may impede the downward migration of contaminants to the underlying aquifer and no contamination is known to be present, the penetration of this layer with borings and wells on site will be avoided. The investigative approach will be, therefore, to install the 300-series wells as part of this sampling plan to determine the quality of ground water in the lower portion of the upper sand and gravel unit which overlies the blue clay. If contamination is detected, then deeper wells that penetrate through the blue clay (400 series) will be proposed on site. Some 400-series wells may also be proposed if it is determined that information on the underlying aquifer is necessary for the computer modeling study.

The number and specific locations of the new wells have been formulated around 17 unresolved technical issues and related data needs identified from the data quality objectives process. Table 3-1 relates each new well (as identified by its well number) to the issue or issues that its specific placement will address. Most wells address multiple issues; each issue is addressed by at least one well. Also indicated in Table 3-1 are the existing wells at each location to highlight the two- or three-well clusters being formed by the new wells. The individual issues or data needs identified in Table 3-1 are

EXISTING WELLS				MONITOR GROUND WATER IN TILL NEAR WASTE AREAS	PROVIDE RING OF WELLS AROUND POTENTIAL SOURCE	EXAMINE FLOW AND QUALITY IN UPPER SAND AND GRAVEL	EXAMINE FLOW AND QUALITY IN LOWER SAND AND GRAVEL	EXAMINE VERTICAL FLOW COMPONENT IN SAND AND GRAVEL	CHARACTERIZE GROUND WATER EAST OF THE PRODUCTION AREA	EXAMINE POTENTIAL FLOW DIVIDE AND EASTWARD FLOW COMPONENT	PROVIDE ADDITIONAL DATA ON SOUTHERN FLOW COMPONENT	EXAMINE REGIONAL FLOW PATTERNS	PROVIDE BACKGROUND (UPGRADIENT) CONTROL POINTS	EXAMINE EFFECTS OF MAIN EFFLUENT LINE	EXAMINE EFFECTS OF FLY ASH PILES	EXAMINE EFFECTS OF STORM WATER OUTFALL DITCH	EXAMINE GROUND WATER QUALITY NEAR PADDY'S RUN	EXAMINE FLOW PATTERNS NEAR PADDY'S RUN	EXAMINE PRODUCTION AREA AS POTENTIAL SOURCE	EXAMINE GROUND WATER QUALITY AT FMPC BOUNDARY AND OFF-SITE
100 SERIES	200 SERIES	300 SERIES	400 SERIES																		
	201	301																			
		303																			
	204			104	104		304	304													
		305																			
		308	408	108	108	208		208			208	208									
		309				209		209									109	109			
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		310		110	210	210		210		210										210	
	211			111			311	311				311	111								
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113	213	313																			
	214	314															114	114			
115	215		415				315	315			315	315				315					315
	216	316													116		116	116			
	218	318		118																	
119	219																				
120	220	320																			
121	221																				
122	222																				
				124	124	224	324	224			224	224	224								
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				125	125																
				127	127	227															
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						251	351	251	251	251		251								251	251
									351	351		351								351	351
						252							152								
													252							252	
						264	364	264	264	264		264								264	
									364	364		364								364	
						265					265					165					
																265					
						266	366	266				266	266								266
													366								366
	267						367	367	367	367		367		367						367	367
	268						368	368		368	368	368								368	
	269						369	369			369	369									369
	270						370	370			370	370									370
	271						371	371	371	371											371
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				179	179																
				180	180																
				181	181																
				182	182																
				183	183																
				184	184	284	384														

TABLE 3-1
PLACEMENT RATIONALE FOR PLANNED ON-SITE MONITORING WELL LOCATIONS

addressed in the following sections, along with a statement about corresponding well placements.

3.2.1 MONITOR GROUND WATER IN TILL NEAR WASTE AREAS

The till material is the unit most likely to be contaminated by direct contact with wastes and by surface water infiltrating through waste areas and adjacent contaminated soils. In order to examine the extent of the potential impact in the soils overlying the regional aquifer, it will be necessary to place a grouping of shallow wells immediately around the waste storage units and other potentially contaminated areas. This approach is necessary because stratigraphy within the till and near surface soils is variable and subsurface interpretations cannot be extended accurately across large areas. Only local interpretations of the flow system within this near-surface unit are reliable.

Most of the wells in this area will be completed in till; however, the till may be very thin or absent in some locations proposed for shallow wells. Such a condition will not necessarily reduce the value of the shallow well, however, and a 100-series well will still be installed in the upper 35 feet of the unit. An example of where this condition may occur and where a 100-series well would provide valuable information about local flow conditions is the area to the west of Pit 3, where erosion and deposition caused by Paddy's Run has reworked the till unit (i.e., at Wells 104 and 131). An exception would be locations where the shallow soils represent an extension of the upper sand and gravel unit, and a 200-series well already exists or is planned at the same location.

Only three 100-series wells (e.g., Wells 119, 121, and 122) currently exist in the waste storage area of the FMPC. Therefore, a large portion of all proposed shallow wells will be located within the waste storage and adjacent areas. In particular, the following wells are proposed:

6

- Waste Storage Area
  The proposed 24 wells in this group include; 104, 108, 110, 111, 118, 124, 125, 127, 128, 129, 130, 131, and 172 through 183. Generally, the goal of this group is to define the extent of contamination in the area of the waste disposal pits. The information obtained from the wells in this group will also contribute to the understanding of ground water flow in the shallow hydrologic zone;

- K-65 Silo Area
  The proposed three wells in this group include Wells 132, 133, and 134. The primary goal of this group is to determine the extent of contamination resulting from the storage of materials in the K-65 silos. Information obtained from Well 133 will also provide evidence of any potential leakage from the concrete trench historically used for materials transfer to the silos;

- Sanitary Landfill Area
  The three wells proposed in this area include 135, 137, and 138. The primary goal of these wells is to identify ground water contamination, if it exists, that is attributable to the sanitary landfill; and

- Lime Sludge Pond Area
  Wells 139, 141, and 142 will be completed in the till zone near the lime sludge pond area. The foremost concern is to identify the impacts on ground water quality, if any, resulting from the sludge ponds. Information from these wells will also be used to better define the flow system in the till in this area.

3.2.2 PROVIDE RING OF WELLS AROUND POTENTIAL SOURCES

The shallow monitoring well program described in Section 3.2.1 will be of value in characterizing the overall hydrogeological setting and ground water quality of the till in the Waste Storage Area. The proposed distribution of 100-series wells has also been designed to isolate the effects from the Waste Storage Area and other waste storage units at the FMPC. By collecting ground water data from various points around each storage unit within the Waste Storage Area, specific portions of individual geological units within the till may be identified as significant pathways of contaminants migrating to the underlying aquifier. The layout of existing and proposed wells around the Waste Storage Area and other individual waste storage units at the FMPC

is illustrated in Figure 3-2. Wells not previously identified in Section 3.2.1 are Wells 145, 146, 147, and 148, which have been planned to evaluate any potential effects from the fly ash piles (see Section 3.2.12).

3.2.3 EVALUATE FLOW AND QUALITY IN UPPER PORTION OF UPPER SAND AND GRAVEL AQUIFER

The sand and gravel outwash deposits which underlie the glacial till are hydrologically less complex than the till. These deposits are also more extensive and represent a regional-scale, buried channel aquifer used for water supply purposes. Within the outwash sands, there is a blue clay unit which has been identified in enough locations to be considered as a stratagraphically significant unit in the vicinity of the FMPC. Throughout the remainder of the Ground Water Sampling Plan, the sand and gravel aquifer above the blue clay, or above the projected elevation of the blue clay where this unit is absent, will be known as the upper sand and gravel aquifer. The sand and gravel aquifer below the blue clay or its projected elevation will be called the lower sand and gravel aquifer. The regional sand and gravel aquifer includes both the upper and lower sand and gravel aquifers.

The results of ground water quality analysis of previously collected samples from the existing wells indicate contamination in this aquifer in the area immediately downgradient of the waste pit area. Analysis of water samples from off-site wells to the south of the FMPC have also exhibited elevated levels of uranium in the upper sand and gravel aquifer. The present data does not allow the nature or vertical and horizontal extent of this contamination to be adequately defined. Additionally, the regional vertical and horizontal components of ground water flow must be more completely defined (see Section 3.2.5).

Based on existing well locations and depths, 22 additional wells are proposed for the upper portion of the upper sand and gravel

aquifer. The first criterion for selection is to install wells at each of the three current locations of 300-series wells that did not have a 200-series couplet well (i.e., Wells 208, 209, and 210). The next criterion is to provide a 200-series well downgradient of any currently unmonitored potential source or pathway of concern. These include, for example, well 249 near the fly ash area and well 265 near the storm sewer outfall ditch. Other wells were located to satisfy regional coverage, to monitor the FMPC boundary, to provide a background monitoring point, and to expand the off-site monitoring program.

3.2.4 EVALUATE FLOW AND QUALITY IN LOWER PORTION OF UPPER SAND AND GRAVEL AQUIFER

The 22 new 300-series wells proposed for the lower portion of the upper sand and gravel aquifer are intended to expand the knowledge of both regional and local flow patterns and ground water quality. The well locations closely match both the existing and proposed 200-series wells, and were selected for reasons similar to those discussed in Section 3.2.3. The resulting well clusters will greatly improve the understanding of the three-dimensional ground water flow system.

A secondary objective of installing 300-series wells is to determine if the blue clay layer is present under the FMPC site and if its presence is influencing the migration of contaminants or ground water flow. If the blue clay is not encountered at the target elevation, the borehole will be extended a maximum of 15 feet to verify that the blue clay is not present. Whether or not the blue clay is present, these wells will provide water samples and hydrologic data at a consistent elevation. The evaluation of the boring logs, chemical analyses, and hydrologic data will determine if additional wells are required to further define the presence of the blue clay.

3.2.5 EXAMINE VERTICAL FLOW COMPONENT IN THE UPPER SAND AND GRAVEL AQUIFER

Very little information is currently available on the potential downward transport of contaminants from the upper portion of the sand and gravel aquifer into deeper zones. Because this aspect of contaminant transport is important to an assessment of the current and future effects of ground water flow, the proposed well locations for the sand and gravel aquifer were developed to maximize the number of well couplets in the upper and lower portions of the upper sand and gravel aquifer. The resultant information will provide a sitewide depiction of the magnitude and variability of vertical flow components, thereby lending support to both the modeling and assessment efforts.

3.2.6 CHARACTERIZE GROUND WATER EAST OF THE PRODUCTION AREA

Much of the ground water quality data collected to date has focused on southern portions of the FMPC due to the southerly ground water flow pattern. Information from the previous GeoTrans and IT studies indicates the potential for an easterly component of flow near the Production Area of the FMPC. Consequently, a more comprehensive data base on flow patterns and ground water quality to the east of the Production Area is deemed necessary for the RI/FS.

Six new on-site wells are proposed for the region east of the Production Area (251, 264, 351, 364, 367, and 371). These wells are designed to augment the existing monitoring well network, with an emphasis on detecting any contaminant plumes in the regional sand and gravel aquifer that would originate in the Waste Storage Area or Production Area. Wells will be located near the Production Area, at the FMPC boundary, and at an off-site location near the Southwestern Ohio Water Company well that significantly influences local ground water flow patterns.

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3.2.7 EXAMINE POTENTIAL FLOW DIVIDE AND EASTWARD FLOW COMPONENT

An issue related to ground water conditions to the east of the Production Area is the possible existence of a ground water flow divide that trends southeast-northwest near the Production Area and Waste Storage Area. This concept was first introduced as a result of a modeling study conducted by GeoTrans, and recent work completed by IT generally supports this possibility. Due to the importance of this divide to potential contaminant migration pathways from the Production Area and Waste Storage Areas, the placement of wells to the east and southeast of these areas has the additional objective of further evaluating this divide. All wells in the overall monitoring well network in the upper sand and gravel aquifer will contribute to this evaluation.

3.2.8 PROVIDE ADDITIONAL DATA ON SOUTHERN FLOW COMPONENT

The observation of elevated uranium levels in off-site wells to the south of the FMPC has directed attention to a southern flowing contaminant pathway. The existing data base has several deficiencies with respect to the identity of particular sources and pathways of these contaminants. As indicated in Table 3-1, thirteen of the proposed on-site wells are located to contribute additional information on flow patterns between the various potential sources and the southern off-site locations. Together with existing wells, this network is expected to be sufficient to evaluate the regional aquifer system.

3.2.9 EXAMINE REGIONAL FLOW PATTERNS

Sections 3.2.7 and 3.2.8 deal with specific components of ground water flow that have been identified as likely contaminant pathways. Beyond these specific concerns is the overall question of ground water flow patterns and potential off-site migration pathways. Not only is this important to a full assessment of risks, but the assessment of any ground water remedial actions will necessitate an understanding of the regional aquifer system.

The proposed wells are generally located for other purposes; nevertheless, the resultant lateral and vertical coverage of the overall monitoring network will be sufficient to assess regional flow patterns. Therefore, no additional wells are proposed solely for this purpose. When the data from these wells is analyzed, there may develop a need for a few additional wells to resolve specific uncertainties remaining in the interpretation of the flow system.

3.2.10 PROVIDE BACKGROUND (UPGRADIENT) CONTROL POINTS

The evaluation of both the water quality data and the associated public health and environmental risks requires that the concentrations found in the ground water samples be compared to levels expected in ground water not influenced by the facility operations. This requires establishing background concentrations for various chemical constituents. Wells 243, 343, 266, and 366 are proposed for this purpose. In addition, existing Well 211, and proposed Wells 311, 224, 324, and 252 will provide data on upgradient ground water levels. There is a risk, however, that the proximity of the latter wells to the waste areas may prohibit their use for background quality purposes.

Additional ground water samples will be collected from existing, off-site wells in each aquifer upgradient from and outside the influence of the facility. The number and location of wells to be sampled will be determined from the synthesis of existing data. It is currently estimated that at least four samples will be collected from six wells in the till, and from both the upper and lower portions of the upper sand and gravel aquifer.

3.2.11 EXAMINE EFFECTS OF MAIN EFFLUENT LINE

The main effluent line could be a dispersed carrier of ground water contamination since it crosses the entire facility. This line carries the treated wastewater leaving the FMPC; a leak anywhere in the line could introduce contaminants to the underlying

water-bearing zones. The trench underlying and surrounding the pipe could also serve as a preferential flow path if the backfilled material is more permeable than the undisturbed subsurface soils. As a result of either of these scenarios, contaminants could be conveyed across ground water divides via the main effluent line, then be released to ground water at locations not otherwise hydraulically connected to the original source of the contaminants.

To assess the possible leakage and the potential mounding of water beneath the effluent line, testing of the pipeline will be conducted. Well 367 will be located at the sewage treatment plant. The installation of additional monitoring wells along the effluent line will depend upon results of the facilities testing plan (Section 7.0).

3.2.12 EXAMINE EFFECTS OF FLY ASH PILES

There are five new wells proposed for the fly ash piles and adjacent Southfield area. Included are four till Wells (145, 146, 147, and 148) and one well in the upper portion of the upper sand and gravel aquifer (Well 249). The intent is to identify any potential plume from the piles and to define the local ground water flow patterns. Since Well 249 is located to the south of the majority of the other 200-series wells, it will also be valuable as an intermediate point in defining regional flow directions in the upper portion of the upper sand and gravel aquifer.

3.2.13 EXAMINE EFFECTS OF STORM WATER OUTFALL DITCH

Excess storm water has historically been discharged into a drainage ditch south of the Production Area which flows to Paddy's Run. Storm water in this drainage ditch could infiltrate the surficial sediments and possibly recharge the sand and gravel aquifer.

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Monitoring wells will be installed along the drainage ditch to assess this area as a potential pathway for contaminated water reaching the sand and gravel aquifer (Wells 165 and 265). Wells 249 and 315 located nearby will also be used in this evaluation. Water-level data and water-quality samples from these four wells will be used to determine the hydraulic gradient and quality of the ground water beneath the drainage ditch area.

3.2.14 EXAMINE GROUND WATER QUALITY NEAR PADDY'S RUN

Paddy's Run is a potential pathway for contaminant transport to the regional aquifer. Radionuclides or hazardous substances could enter the stream near the waste pits from direct discharges or from ground water discharge, and then infiltrate through the stream bed to the upper sand and gravel aquifer to downstream locations. The fact that Pit 3 was constructed on the floodplain of Paddy's Run, and possibly within a zone where the till has been removed by the meandering stream, creates a favorable condition for such discharges. The scenario of a ground water to surface water and back to ground water transport path could be important to an explanation of ground water contamination in the southern areas of the site. This is particularly true if a ground water divide exists near the waste disposal areas. Such information is critical to a pathway analysis and the assessment of remedial alternatives.

To assess the potential impacts of Paddy's Run on ground water quality, four new wells will be installed next to existing wells at three locations along Paddy's Run to create three complete three-well clusters. These include a point approximately halfway between the Waste Storage Area and the southern FMPC boundary (Wells 109 and 209), and a point near the confluence with the storm water outfall ditch (Wells 114 and 214). In addition to these wells, two well couplets will be installed to the west of Paddy's Run (Wells 243, 343, 244, and 344).

3.2.15 EXAMINE FLOW PATTERNS NEAR PADDY'S RUN

The effects of Paddy's Run on local ground water flow patterns, including the possible existence of both recharge and discharge zones, is a critical issue in determining past and present contaminant migration pathways. In addition to monitoring water levels during sampling events, installation of continuous water-level recorders in Paddy's Run and in Wells 109, 209, 309, 114, 214, and 314 is proposed. As short-term fluctuations and long-term trends occur, the comparison of the responses of the water surface elevations in the stream to the water levels in the wells will be used to assess the degree of interaction between the stream and the underlying aquifers.

3.2.16 EXAMINE PRODUCTION AREA AS POTENTIAL SOURCE

The Production Area is the main operating center at the FMPC. It is the area where most chemicals and some wastes are stored, and where all chemical use takes place. The area is a potential source of contaminants which could directly enter the ground water system. Additionally, the buried effluent line leading to Manhole 175 crosses the Production Area.

Very little is known about the quality of ground water directly beneath the Production Area. Three existing 100-series and three existing 300-series wells will be included in the ground water sampling program. To further evaluate the Production Area as a distinct source of ground water contamination, new monitoring wells will be placed in the till and the upper sand and gravel aquifer in upgradient and downgradient directions. No wells are currently proposed within the active Production Area. However, wells may be proposed after the soils and radiological surveys are completed for the area, and once the detailed evaluation of existing data and the modeling study resolve local ground water patterns. It is also anticipated that borings and possibly wells will be installed in the till under the Production Area as the Facilities Testing Plan (Seciton 7.0) is carried out.

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Figures 3-1, 3-2, and 3-3 show the existing and proposed till and sand and gravel aquifer wells which will encircle the Production Area. Proposed wells likely to be upgradient of the Production Area include Wells 210, 237, 337, 242, and 252. New downgradient wells, under the assumption of eastward and southward flow components, are Wells 251, 351, 264, 364, 367, and 368. Ground water flow in the till is not expected over significant distances, and thus no new 100-series wells are proposed at the identified locations. Existing Wells 113 and 120 are downgradient and in the immediate vicinity of the Production Area.

3.2.17 EXAMINE GROUND WATER QUALITY AT FMPC BOUNDARY AND OFF SITE

Nine new wells will be installed to create or complete eight couplets in the upper and lower portion of the upper sand and gravel aquifers near the FMPC boundary. These locations include both upgradient and downgradient areas. These wells will provide detection of contaminant plumes potentially leaving the FMPC facility in either aquifer. In addition, the couplets will be used to develop a better understanding of vertical components of flow in areas possibly affected by the extensive off-site pumping operations.

The purpose of the off-site ground water monitoring program is to provide additional information about possible impacts of FMPC operations to the hydrogeologic environment outside the facility boundary. Presently one monitoring well (Well 271) is located off site (Figure 3-5). This is a 200-series well located east of the facility, installed during litigation support activities. At the same site, a 300-series well (Well 371) is proposed for installation during initial RI/FS field activities (Figure 3-5).

Fifteen additional off-site monitoring wells at seven locations are also proposed for inclusion in the RI/FS monitoring well network. Proposed monitoring wells are located southwest, south, southeast, and east of the FMPC facility (Figure 3-5). These

well locations were selected after reviewing available information on the site hydrogeology, ground water flow conditions and directions, and water quality data. The location of known or suspected contaminant source areas, and the results of the preliminary ground water modeling performed by GEOTRANS were also taken into consideration.

The well locations were selected for the following reasons:

- To provide background water quality data southwest of the facility in both the upper and lower sand and gravel aquifers;
- To provide vertical hydraulic head data in this area to better define regional ground water flow rates and directions;
- To define the magnitude and extent of known ground water contamination south of the FMPC; and
- To provide downgradient water quality information southeast and east of the facility so off-site impacts in these directions can be evaluated.

The 200-, 300-, and 400-series monitoring wells proposed for locations east of the facility will also be used to evaluate ground water quality and vertical hydraulic gradients throughout the full depth of the aquifer. This is necessary because of the potential for large pumping stresses to induce downward migration of contaminants into the deeper aquifer zones. The 400-series well in the southwest cluster will provide additional background water quality data for the deep aquifer. No 400-series wells are proposed for well clusters south and southeast of the facility since no major vertical stresses due to deep pumping are expected in these areas.

3.3 MONITORING WELL CONSTRUCTION

3.3.1 INSTALLATION SEQUENCING

No drilling will be initiated in the Waste Storage Area until the results of the surficial geophysical investigation being conduct-

ed under the Characterization Investigation Study (CIS) have been reviewed in sufficient detail to allow confirmation of all drilling locations.

All boreholes for monitoring wells will be drilled with cable tool equipment. The cable tool technique advances steel casing as the borehole is deepened. This casing maintains an open borehole without the use of drilling muds and provides a barrier against the downward migration of contaminants from shallower aquifers. Cable tool drilling will be used throughout the drilling program. Therefore, the deeper well in each cluster can be drilled first to determine the target depths of the other wells in the cluster.

3.3.2 DRILLING

Boreholes for wells in the till and sand and gravel aquifers will be drilled using casing-advance drilling methods and will follow the general procedures presented in Section 5.2 of the QAPP. A soil auger drill rig may be used to collect samples for geotechnical (engineering) analysis. Any boreholes or portions of boreholes which are not completed as monitoring wells will be backfilled with American Colloid Company Volclay grout mixed to manufacturer's specifications.

During monitoring well drilling, a temporary steel casing will be drilled, driven, or pushed as the borehole is advanced to the bottom of the hole. The temporary casing will be nominal ten-inch diameter to allow for construction of the monitoring well. Cuttings will be removed from the borehole using a sand pump or dart valve bailer, whichever proves more effective. All cuttings will be containerized until analysis is completed; then the cuttings will be disposed of properly.

Once the borehole reaches the desired depth, the well will be constructed according to procedures described in Section 3.3.3,

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and the temporary casing will be removed. The drilling tools and temporary casing will be thoroughly decontaminated before moving to the next well location (see Section 5.2 of QAPP: Drilling Procedures).

During the process of drilling monitoring wells, relatively undisturbed soil samples will be collected with a split-spoon sampler using the Standard Penetration Test (ASTM D1586-84). The sampling and logging of subsurface materials have been incorporated into the Subsurface Soils Sampling Plan and are discussed in detail in Section 4.0.

As described in Section 5.2 of the QAPP, drilling tools, casing, and well screens for each monitoring well will be cleaned with a high-pressure, hot-water wash before drilling and well completion. Decontamination will be performed on constructed pads where all wastewater will be collected and disposed of properly.

Where potable water is used as a drilling fluid, samples of the water will be taken from the on-site source and the hose of the water tank or truck. The water will be analyzed for the full list of organic, inorganic, and radiological parameters to document that "clean" drilling water is used during well construction.

3.3.3 WELL INSTALLATION

The monitoring wells will be constructed in accordance with the well design and installation procedures detailed in Section 5.3 of the QAPP. Four-inch inside diameter (ID), threaded, flush joint, 316 stainless steel pipe will be used for well construction. Well screens will also be 316 stainless steel, and will have 0.01-inch slot size with a minimum of three square inches of open area per lineal foot.

Shallow wells (100-Series) will be screened with two to ten foot lengths of screen in the water table aquifer or in localized perched water zones in the till. The length of the screen will be dependent on the thickness of the water-bearing zone. Intermediate depth wells (200 Series) will be screened at the water table using 15 feet of screen installed so that five feet of screen is above the water table and 10 feet of screen is below the water table. The deep wells (300 Series) in the lower portion of the upper sand and gravel aquifer will be screened with 10 feet of screen at the top of the clay layer. In the event that the blue clay is not encountered, the well will be screened at a depth approximately equal to the elevation of the blue clay as it exists beneath the Production Area. The 400-series deep wells in the lower sand and gravel aquifer will be completed with 10 feet of screen. The bottom of the screen will be 10 feet above the top of the bedrock.

The 100- and 200-series wells will be backfilled with a sand pack to a height of two feet above the screen, followed by five feet of bentonite pellets above the sand pack and grout from the bentonite to the surface. All grout will be a pumpable American Colloid Company Volclay grout mixture. The 300- and 400- series wells will not utilize a bentonite plug. The wells will be backfilled with sand pack to a height of five feet above the screen. The Volclay grout will be placed directly above the sand pack. All grout material will be placed using pumps and tremie line methods.

Screen sand pack material will be well-sorted medium or coarse quartz sand. Sodium bentonite pellets and commercial Volclay grout will be used in backfill. Representative samples of all sand pack materials, grouts, and cement will be retained for chemical analysis in the event that contamination of samples is indicated by the ground water analytical data.

Upon completion, the monitoring wells will be developed by pumping and flushing with water to remove fines from the area around the sensing zone and to enhance communication between the water-bearing zone and the monitoring well. Development will follow the guidelines described in the Technical Enforcement Guidance Document (U.S. EPA, 1986), in which the recommended acceptance/rejection value of five NTU for turbidity is followed. Detailed procedures for well completion and development are presented in the QAPP.

Well development in the Waste Storage Area will be initiated at Wells 138, 173, 176, and 184. Development waters from these wells will be transferred to the General Sump for treatment in WMCO's wastewater treatment system. A composite sample of the development waters will be analyzed for the extended HSL parameters (Section 3.10), as well as dioxins, 2,3,7,8-TCDD/TCDF, and PCDD/PCDF.

No further well development activity in the Waste Storage Area will be conducted until analysis results on the composite sample are obtained. During the interim time period, development activities will continue on wells outside of the Waste Storage Area. All development waters from these wells will be collected and transferred to the FMPC General Sump for treatment.

Analytical results from the composite sample will be transmitted immediately to the U.S. EPA for review. After review of these results, the U.S. EPA will provide prompt direction to the FMPC as to the necessary disposition of the purge water from wells within the Waste Storage Area. All future purge water from well development and sampling activities from the Waste Storage Area or the Production Area will be handled in a manner consistent with this direction.

3.3.4 WELL SECURITY

All well risers will be permanently marked to indicate the well number using the numbering system developed for the site. The riser will be protected by an outer black iron or galvanized pipe (minimum thickness - 1/4 inch) implanted in the cement grout cap which will be constructed to provide a three-foot diameter cement apron. A locking, hinged, steel cover (minimum thickness - 1/4 inch) will be provided and secured to the top of each protective casing. Each protective casing will be painted high-visibility orange to permit easy identification. Additional descriptions of well security are included in Section 5.3 of the QAPP.

3.3.5 WELL SURVEY

All the new monitoring wells will be surveyed to establish the horizontal location of each well according to the Ohio State Plane Coordinate System. The elevation at the top of the well casing, land surface elevation, and the length of well stickup above land surface will also be surveyed to provide vertical control for ground water level measurements. Horizontal coordinates will be accurate to within 0.5 feet. Elevation will be accurate to within 0.01 feet. This information will be recorded in the surveyor's notebook, and the well location will be plotted on the site map.

The existing wells, which are to be included in the monitoring well network, will also be surveyed to ensure elevation and location accuracy. Much of this effort for existing wells has recently been completed in support of another DOE investigation.

3.3.6 GEOPHYSICAL WELL LOGGING

Borehole geophysical logging will not be performed at this time on borings that are to be completed as monitoring wells. If geophysical well logging is conducted, the types of logs to be obtained in the till zone include:

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- Natural gamma radiation;
- Gamma-gamma density for bulk density measurement; and
- Neutron porosity for water content.

Only natural gamma logs will be obtained below the till due to the relative homogeneity of the sand and gravel units. Procedures for the borehole geophysics program are provided in Section 5.5 of the QAPP.

The purpose of geophysical logs is to provide a complementary informational source for the interpretation of subsurface soil samples and for filling in any gaps in the vertical borehole profile when continuous sampling is not performed.

3.3.7 EQUIPMENT DECONTAMINATION

The drilling equipment will be decontaminated after the completion of each borehole/monitoring well in accordance with the procedures outlined in Section 5.2 of the QAPP.

3.4 HYDROLOGIC DATA COLLECTION

3.4.1 WATER LEVEL MEASUREMENTS

After all new monitoring wells have been installed and have fully recovered from any well development or aquifer testing programs (as determined by the project site geologist), static water levels will be measured in all wells, including those from the previous surveys included in the network. The purpose of these measurements is to map the water table and potentiometric levels in the aquifers. Measurements will be completed within a two-day period. At the completion of the last well measurement on the second day, the first five wells measured the previous day will be remeasured to determine if a range of water-level fluctuations during the two-day measurement period exists. Water level measurements will be made in all wells in the network on a monthly basis for one year to evaluate the effects of seasonal variations on water levels.

Water-level measurements will be measured to the nearest 0.01 foot with an electrical probe, referenced to the top of the measuring point on the well casing. All data will be recorded in a field logbook or on an appropriate form. Specific procedures are documented in Section 6.1.2 of the QAPP.

In addition, an electronic data logger (Hermit) with three transducers will be installed at Well Locations 9 and 14 along Paddy's Run. One transducer will be installed in each of the three wells 109, 209, and 309. Wells 114, 214, and 314 will also be each fitted with a transducer. Water levels in Paddy's Run will also be continuously recorded. Data from these recorders will be used to detect patterns in water level changes. Water levels will be measured continuously during a dry season and a wet season to determine the stream stage/ground water level relationships. A specific measurement period will be determined once the project is initiated and a final schedule is developed.

3.4.2 AQUIFER TESTING

Two types of aquifer tests may be performed at the FMPC. These include long-term pumping tests and short-term slug tests. Pumping tests are specifically suited to determining transmissivity and storativity of leaky or confined aquifers. These tests provide measurements over a relatively large volume of the aquifer and are useful in identifying recharge/discharge zones and/or barrier boundaries. Slug tests are suited to measurements of hydraulic conductivity in the subsurface material in the vicinity of the well screen. A more detailed description of the testing procedures is contained in Section 5.6 of the QAPP.

As part of the characterization program for the till, short-term slug tests will be performed at 14 sites selected from the following wells: upgradient Wells 112 (existing) and 135; Wells 104, 122 (existing), and 131 in the area of the waste pits; Well 108 in the vicinity of the biodenitrification surge lagoon;

Well 134 in the vicinity of the K-65 Silo 1; Well 141 in the vicinity of the sludge ponds; Wells 145 and 148 in the fly ash pile areas; Well 165 near the storm water outfall ditch; and Wells 109, 114, and 116 along Paddy's Run.

There is a definite possibility that the diameter and rate of discharge of any potential pumping well will not be conducive to a long-term pumping test in the relatively permeable and extensive sand and gravel aquifer. For example, even the large flow pumped from the main production wells at the FMPC has not created a cone of depression in the potentiometric surface that is detectable in any existing monitoring wells. Therefore, the need for a long-term pumping test will be determined only after the preliminary modeling study can be used to predict the level of aquifer response that would be expected.

The discharge water from any well testing will be collected and transferred to the General Sump for treatment in WMCO's wastewater treatment system.

3.5 GROUND WATER SAMPLING METHODOLOGY

Ground water samples will be collected from new and selected existing wells, using proper sampling procedures to make sure that no contaminants or bias are introduced into the sample. The new wells will include forty-two 100-series, twenty-two 200-series, twenty-two 300-series, and three 400-series wells. Forty-five additional monitoring wells that exist on site (including three new RCRA wells), along with five off-site wells, will be included in the sampling network. Additionally, approximately six till wells, six top of upper sand and gravel aquifer wells, and six bottom of upper sand and gravel aquifer wells will be selected at upgradient locations and sampled to establish background concentrations.

Sampling during this hydrogeologic investigation will be performed after all wells are installed and on three later occasions during different seasonal conditions. Additional well sampling will not be proposed until the resultant data base is evaluated. Proper ground water sampling procedures, contained in Section 6.1 of the QAPP, will be used to make sure that no contamination or bias is introduced into the sample.

3.6 FIELD QA/QC PROGRAM

During ground water sampling, duplicate samples will be collected on a routine basis for QA/QC purposes. Rinsate samples and trip blanks will also be routinely collected and analyzed. Trip blanks are used to determine if contamination is introduced from the sample containers. Rinsate samples are used to determine if contamination is introduced from the sample collection equipment. The total number of field samples collected for QA/QC purposes will represent 10 to 15 percent of all samples collected.

All field equipment will be calibrated prior to field use and recalibrated periodically in accordance with QA/QC procedures. Other QA/QC practices such as decontamination procedures and chain-of-custody procedures are described in the QAPP.

3.7 LABORATORY QA/QC PROGRAM

Section 9.0 of the QAPP describes laboratory procedures to be used for sample analysis. This includes laboratory QA/QC procedures and analytical performance standards to be achieved and reported.

3.8 SAMPLE CONTAINERS FOR SHIPPING

A summary of containers and sample preservatives required for samples being analyzed for organic and inorganic compounds is presented in Table 3-2. Chain-of-custody documentation will be completed prior to shipping samples.

TABLE 3-2

GROUND WATER SAMPLE CONTAINERS AND PRESERVATIVES

SPECIFIED ANALYSIS	SAMPLE CONTAINER	SAMPLE SIZE	PRESERVATION	HOLDING TIME DAYS	REPORT-ING UNITS
HSL Volatile	40 Vial w/ Teflon-lined silicon rubber septum	40 ml	cool, 4°C	14	ug/L
HSL Base/ Extractable Organics (Base/Neutral/ Acid/Pesticide/PCB)	Amber glass	1 L	cool, 4°C	10/40[a]	ug/L
HSL Inorganic	Plastic	500 ml	pH <2,HNO_3	180	ug/L
Radio-logical	Cubitaner	4 L	pH <2,HNO_3	6 mo.	pCi/l

[a]Extract within seven days; analysis within 40 days of extraction.

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Water quality samples collected from ground water monitoring wells will be shipped to off-site laboratory locations. Proper handling and containerization will assure the integrity of the samples throughout the shipping process. All samples will be shipped following the procedures and chain-of-custody guidelines described in the QAPP.

3.9 SAMPLE IDENTIFICATION

Ground water samples will be identified by the monitoring well number and a sample number. Details of the sample numbering system were provided in the Introduction to the Sampling Plan.

3.10 SAMPLE ANALYSIS

A total of 157 wells has been identified for sampling. During Phase I activities, samples will be collected quarterly from each of these wells for one year. All samples will be analyzed in the field for pH, temperature, conductivity, and dissolved oxygen.

Since the selection of each new well was specifically justified within the context of the existing monitoring well network (as discussed in Section 3.2), it is necessary to analyze all ground water samples for a full suite of radiological parameters and a more focused set of general water quality indicators to achieve the overall study objectives. All ground water samples will be analyzed for a set of radiological parameters that include radionuclides or materials handled at the FMPC. These parameters, which are consistent with those being tested under the ongoing RCRA monitoring program, include:

- Total Uranium
- Isotopic Uranium
- Isotopic Plutonium
- Radium-226
- Radium-228
- Neptunium-237
- Total Thorium
- Isotopic Thorium
- Technetium-99
- Cesium-137
- Strontium-90
- Ruthenium-106.

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All samples will also be analyzed for the following parameters that are being used as indicators of drinking water quality under the ongoing RCRA program:

- Arsenic
- Barium
- Cadmium
- Chromium (Hexavalent;-Total)
- Fluoride
- Lead
- Mercury
- Nitrate
- Selenium
- Silver
- Alkalinity as $CaCO_3$
- Carbonate/Bicarbonate
- Ammonia
- Calcium
- Magnesium
- Potassium
- Copper
- Molybdenum
- Nickel
- pH
- Specific Conductance
- Chloride
- Iron
- Manganese
- Phenols (Total)
- Sodium
- Sulfate
- Gross Alpha
- Gross Beta
- Total Organic Nitrogen
- Sodium
- Phosphate.

The analysis of ground water samples for Hazardous Substance List (HSL) organics and other toxic metals will be performed on a limited basis. The reason for this reduced scope is twofold:

- The ongoing RCRA ground water monitoring program is already testing for organics and metals on a quarterly basis at 44 on-site and off-site wells and will be continued on at least a semiannual basis in the future.

- The frequency and levels of detection of these species during the RCRA program indicate that a problem worthy of a comprehensive testing program in the RI/FS (in comparison to the radiological problem) does not exist in the ground water underlying the FMPC and adjacent areas.

To confirm that the conclusions from the RCRA program are the case, 36 selected ground water samples will be analyzed for HSL volatile and semivolatile organics, HSL inorganics including cyanide, HSL pesticides/PCBs, primary drinking water substances, and organophosphorus pesticides. These analyses are termed the extended HSL parameters.

The wells to be sampled for the extended HSL parameters have been selected to augment the quarterly RCRA monitoring program. These

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include the following 29 wells in or near the Waste Storage Area:

100 Series		200 Series	
104	172	201	221
110	173	204	222
119	174	208	227
121	175	210	234
125	176	211	237
128	178	219	242
129	183	220	252
131			

Wells 116, 214, 215, and 216 near the fly ash piles, as well as Wells 113, 264, and 265 near the Production Area, will also be sampled and analyzed for the extended HSL parameters. All well locations are shown in Figures 3-1 through 3-4.

Additionally, samples from six wells in the waste pit area will be analyzed for dioxins, 2,3,7,8-TCDD/TCDF, and PCDD/PCDF. The specific well locations will be selected following well development, with emphasis on their proximity to the Burn Pit, Pit 4, and the landfill, and on the likelihood of having received chlorinated hydrocarbons. A sample of treated water from the FMPC production well will also be analyzed for the extended HSL parameters and dioxin. This water is being used in the drilling operation.

4.0

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SECTION 4.0

SUBSURFACE SOILS SAMPLING PLAN

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SECTION 4.0

SUBSURFACE SOILS SAMPLING PLAN

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4.0 SUBSURFACE SOILS SAMPLING PLAN

4.1 OBJECTIVES AND JUSTIFICATION

The overall objective of the Subsurface Soils Sampling Plan is to provide additional detail on subsurface conditions within the FMPC that may define or influence contaminant migration pathways. The subsurface soils investigation will provide additional information on:

- The subsurface stratigraphy in the site area and its relationship to the distribution of ground water;
- The lateral and vertical extent of radionuclide and hazardous substance contamination of subsurface soils to assess the nature and extent of potential subsurface pathways to ground water contamination;
- The geochemical properties of the subsurface soils that may retard or enhance contaminant movement or define potential pathways; and
- The geotechnical properties of the subsurface soils, for use in evaluating the feasibility of remediation alternatives.

4.2 SAMPLING STRATEGY AND RATIONALE

The subsurface soils sampling program is an integral part of the ground water monitoring well installation program. However, it is addressed separately in the Subsurface Soils Sampling Plan due to the difference in underlying objectives and the specificity of methods and equipment. The locations of boreholes for sampling subsurface soils coincide with the locations proposed for the wells. Although these locations were primarily dictated by ground water issues (as summarized in Table 3-1), the general selection criterion of location near potential contamination sources, pathways, and receptors that are distributed across the FMPC also satisfies the informational needs of the subsurface soils program.

Continuous sampling of subsurface soils will be performed during the drilling of the boreholes for all 100-series wells and

through the till where 100-series wells will not be installed. At locations where more than one well is to be installed (i.e., couplets and three-well clusters), subsurface soil samples will be collected only once through the geologic column. This sampling will provide a complete profile of the geologic material from ground surface to the bottom of the deepest borehole.

Subsurface soils will be sampled at 61 locations both on and off site. The locations of subsurface soil sampling sites (i.e., monitoring well locations) are shown in Figures 3-1 through 3-4, as well as in the off-site well location map (Figure 3-5). At all locations where monitoring wells already exist, subsurface soils will be resampled to the depth of the proposed new boring regardless of the availability of geologic logs. This will allow samples at all locations to be collected in a manner consistent with this RI Sampling Plan. The geologic logs along with past subsurface information will be used to construct at least four hydrogeologic cross sections to evaluate the site.

4.3 SAMPLING METHODS

Borings will be drilled using methods described in Section 3.3.2. During the monitoring well drilling program, standard penetration tests will be conducted and subsurface soil samples will be collected using an 18-inch drive split-spoon sampler in accordance with ASTM Method D1586-84. Soils will be sampled continuously in the till. Split-spoon sampling beyond the base of the till will be conducted every five feet and at each change in lithology, as determined by the project site geologist.

All samples will be examined and described by the project site geologist. The geologist will describe and classify all samples based on their color (Munsell Soil Color Charts), texture (Unified Soil Classification System), estimated water content, and depth from land surface, in accordance with Section 6.6 of the QAPP.

In addition, up to two Shelby tubes will be collected in the till borings in the first and second clay layers. If the clay or silt layer is continuous, it will be sampled at 5-foot and 15-foot depths. Shelby tube samples will be collected from the blue clay layer (if present) at the bottom of monitoring well borings 311, 334, and 337. The clay will be analyzed for contamination and permeability and will be classified according to the Unified Soil Classification System. Conventional 30-inch Shelby tubes will be used if subsurface conditions permit. The tubes will be pushed in advance to the bottom of the hole to collect the sample.

Following waxing, capping, and taping, the Shelby tube cores will be field screened for possible radioactivity. The undisturbed cores will then be shipped to the laboratory for extrusion prior to radiological screening and subsequent geotechnical testing.

Existing boring logs do not include blow counts; therefore, it is not possible to estimate whether the fine-grained soils are too dense to sample with conventional Shelby tubes. If soil conditions on site make it impossible to use the Shelby tubes, an alternative method such as a pitcher-type device or Dennison sampler will be used to collect "undisturbed" samples.

All field observations will be recorded on the standard forms provided in Section 5.0 of the QAPP. Detailed descriptions of borehole logging requirements are included in Section 5.2 of the QAPP.

4.4 FIELD SCREENING OF SUBSURFACE SOIL SAMPLES

Immediately upon opening each split-spoon sample, the samples will be screened for volatile organics using OVA or HNu field instruments. If a volatile release is detected, a soil sample of the core will be transferred to a standard VOA vial. Vials will be filled completely to minimize head space within the containers.

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The field screening procedure for radionuclides will utilize a large volume scintillation detector (SPA-3) (QAPP, Section 6.6.2). The sample with the highest reading within each geologic horizon for each boring location will be selected for radiological analysis. If more than one sample has the same high reading, then the project site geologist will select one of these samples for radiological analysis.

4.5 SAMPLE HANDLING AND SHIPPING

Representative soil samples from each split spoon will be placed in 500-ml glass jars with self-sealing, screw-type lids and stored in individual compartments of sectioned cardboard boxes. Each sample container will be labeled to identify sample location (boring number), sample depth, time of collection, sampling personnel, and special comments. Samples collected will follow chain-of-custody procedures and will be stored to prevent freezing. All pertinent field data will also be recorded in the field log of the geologist.

Subsurface soil samples collected for volatile organics analysis will be transferred to standard VOA vials. Vials will be filled completely to minimize head space within the containers. Subsurface soil samples collected for other organic or inorganic analyses will be transferred to glass containers with screw-cap closures.

Samples to be tested for physical characteristics requiring undisturbed soil will be left in the Shelby tubes. These samples will be recorded in the field log and the tubes will be marked with the boring number, Shelby tube number, depth of sample, and indicator of top and bottom. Shelby tubes will be stored on site in an upright position until sent for analysis.

Table 4-1 lists the appropriate containers and preservatives to be used for sample storage and shipment to off-site laboratories.

TABLE 4-1
SURFACE SOILS SAMPLE CONTAINERS AND PRESERVATIVES

SPECIFIED ANALYSIS	SAMPLE CONTAINER	SAMPLE SIZE	PRESERVATION	HOLDING TIME DAYS	REPORTING UNITS
HSL Volatile	Vial w/ Teflon-lined septum	40 ml	Cool, 4°C	10	ug/kg
HSL Extractable Organics (Base/Neutral/ Acid/Pesticide/ PCB)	Amber Glass	1 ℓ	Cool, 4°C	10/40[a]	ug/kg
HSL Inorganic[b]	Glass or Plastic	500 ml	Cool, 4°C	Indefinite	ug/kg
Radiological	Polyethylene Bags	Variable	None	Indefinite	pCi/gm

[a] Extract within ten days; analyze within 40 days of extraction.

[b] Does not include tin.

A sample label, chain-of-custody records, a field collection report, and a laboratory request-for-analysis form will be filled out in the field and will accompany (except for the field collection report) each subsurface soil sample to the laboratory (Section 7.1 of the QAPP). Detailed descriptions of packaging, marking, and shipping requirements are provided in Section 6.8 of the QAPP.

After each sample is collected and sealed within the container, sample containers will be washed on the exterior with a detergent, rinsed with deionized water, and dried with paper towels. Decontamination solutions and rinse waters will be containerized and stored with the equipment decontamination solutions and disposed using WMCO-approved procedures.

4.6 SAMPLE IDENTIFICATION

Geotechnical and geological samples will be inventoried and identified using the procedures defined in the Introduction to the Sampling Plan.

4.7 LABORATORY ANALYSIS

Subsurface soil samples will be collected from 61 separate locations, including thirty 100-series borings, eight 200-series borings, twenty 300-series borings, and three 400-series borings. The laboratory analysis program associated with these samples will be comprised of four elements, as follows:

- Radiological analysis;
- Geochemical analysis;
- Geotechnical/engineering properties testing; and
- Organic/inorganic analysis (contingent).

It is estimated that over 1,500 split-spoon or Shelby tube samples will be collected during the subsurface program. An analysis of all samples is neither feasible nor necessary to achieve a satisfactory understanding of the overall site conditions. The final analytical program depends on field

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results, as described below. All samples will be archived for additional testing, as deemed appropriate, based on the initial testing results.

4.7.1 RADIOLOGICAL ANALYSIS

Subsurface soil samples will be selected for radiological analysis based on the results of the field screening described in Section 4.4. At least one sample per horizon (till, upper portion of upper sand and gravel, lower portion of upper sand and gravel, and lower sand and gravel) per location will undergo radiological analysis, yielding a minimum of 118 analyses. The sample selected for laboratory analysis will be that which exhibits the highest relative reading above the screening criterion for the given location and horizon.

All samples sent to the laboratory will be tested for a set of radionuclides historically used, stored, or produced at the FMPC. These parameters are the same as those being analyzed under RCRA compliance monitoring, and include:

- Gamma Spectral Analysis
- Total Uranium
- Uranium 234
- Uranium 235
- Uranium 236
- Uranium 238
- Radium 226
- Radium 228
- Technetium 99
- Thorium 228
- Thorium 230
- Thorium 232
- Cesium 137
- Strontium 90
- Ruthenium 106
- Neptunium 237
- Plutonium 238
- Plutonium 239
- Plutonium 240.

4.7.2 GEOCHEMICAL ANALYSIS

The purpose of the geochemical analysis program is to gain quantitative information on parameters that can be used as indicators of the potential for contaminant migration through (or adsorption to) subsurface soils. As such, the information gained from the analytical program will provide a measure of the migration potential of contaminants through the porous media. The soil properties selected as indicators of contaminant

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migration and attenuation include: total cation exchange capacity, total organic carbon (TOC), grain-size, and leachable iron and manganese.

Samples will be selected for analysis, based on differences in visual properties (i.e., color, texture), with spatial distribution being a second criterion. Since the degree of variability is expected to decrease as one proceeds downward through the soil horizons, more samples for geochemical analysis will be taken in the till than in the sand and gravel aquifer. In particular, it is estimated that 20 samples will be obtained from the till, 10 from the upper portion of the upper sand and gravel aquifer, and five from the lower portion of the upper sand and gravel aquifer. The resultant information will be used, along with published information on the properties of local soils, to compute or estimate representative modeling parameters (e.g., the retardation coefficient) that control the numerical computation of contaminant transport.

4.7.3 GEOTECHNICAL ANALYSIS

Engineering properties to be tested include:

- Modified Proctor Compaction Test (ASTM D1557);
- Vertical Permeability;
- Unconfined Compression (ASTM D2166);
- Triaxial Shear Test (consolidated isotropically undrained, C.I.U., with pore pressure - ASTM D2850); and
- Vertical Consolidation (dial reading/log time technique - ASTM D2166).

Geotechnical (engineering) properties testing will be performed on a minimum of 20 undisturbed Shelby tube samples. Samples for modified proctor compaction testing will be collected with a backhoe because of the volume of material required for the test. Modified proctor compaction tests will be performed on

soils proposed for capping waste areas, if this remedial alternative is identified during the FS. The inclusion of only the clay till samples for physical testing is based on the importance of the upper zone when addressing engineering issues such as in situ stabilization, on-site disposal, and suitability as cover material.

4.7.4 ORGANIC/INORGANIC ANALYSIS

The presence of organic and toxic inorganic compounds in subsurface soils has not been documented as a problem at the FMPC. Even if cases had been reported, it would be difficult to pinpoint locations of elevated levels through a borehole subsurface soils program if sample locations are randomly selected. The proposed approach is to subject a sample to a full HSL analysis if one of the following two observations is made: (1) the sample has unusual odor or visual evidence of organic or inorganic contamination; or (2) a relatively high reading occurred during the field screening for volatile organics. Any samples meeting either of these criteria (with a minimum of two samples per borehole where either one or both criteria are met) will be subjected to a full HSL analysis for volatile organics, semi-volatile organics, and inorganic metals.

Under the Facilities Testing Plan of the RI (Section 7.0), several areas where organic chemicals or fuels have been stored, used, or incinerated will be investigated. As the individual subtasks are developed for each of these areas, alternate and innovative investigative techniques will be considered for examining these areas. The techniques to be considered will include geophysics, soil gas surveys, soil sampling with field analysis, and shallow borings. The methods applied to each site will be determined by what is known about the individual site and the intended use of the site after testing. Additional HSL analyses may result.

5.0

SECTION 5.0

SURFACE WATER AND SEDIMENT SAMPLING PLAN

SECTION 5.0

SURFACE WATER AND SEDIMENT SAMPLING PLAN

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5.0 SURFACE WATER AND SEDIMENT SAMPLING PLAN

5.1 OBJECTIVES AND JUSTIFICATION

The surface water and sediment sampling programs have been combined into a single Surface Water and Sediment Sampling Plan due to a similarity of objectives. These objectives are to:

- Characterize the radiological and hazardous substances and their spatial distributions in surface water at one point in time along drainage pathways from the site towards Paddy's Run, discharge points into Paddy's Run, as well as in Paddy's Run.
- Identify the distribution and extent of radiological constituents in sediments from Paddy's Run and site drainage systems leading into Paddy's Run.
- Determine the presence of radiological constituents and their concentrations at a given point in time at several locations in the Great Miami River both upstream and downstream of the FMPC outfall and the confluence of Paddy's Run with the Great Miami River.
- Identify radiological constituents in the sediments of the Great Miami River at locations upstream and downstream of the FMPC NPDES outfall, at the confluence of Paddy's Run with the Great Miami River, and at two depositional locations in the Great Miami River.
- Determine if the FMPC is a source of organics and selected inorganics to the Great Miami River and Paddy's Run.

In addition to the investigative scope described herein, a companion study being performed in response to Order 14 of the OEPA's June 26, 1987, Director's Findings and Orders, will contribute valuable information and insight into those objectives dealing with the Great Miami River. The principal objective of the companion study is the determination of whether the main effluent line from the FMPC is a source of contamination to the Great Miami River, underlying aquifers, and nearby pumping wells. A key component of the investigation is the effects of the main effluent line on river water quality, and in turn the interactions between the water column, sediments, and underlying

aquifer. The field work and hydrologic analysis associated with this study will provide considerable additional information on the reach of the river nearest to and most likely affected by the main effluent line.

Table 5-1 is a summary of the Surface Water and Sediment Sampling Plan. The plan has two primary components. The first is associated with the four principal surface water courses (Great Miami River, Paddy's Run, storm water outfall ditch, and the main effluent line), and involves a multi-element sampling plan designed to make use of ongoing WMCO monitoring programs and previous study results. The second component involves a variety of surface water drainage paths, conveyance facilities, and ponding areas in the waste storage areas and Production Area. The sampling plan for these locations is designed to provide characterization of surface water and sediments at one point in time. The samples will be collected at a point in time which will attempt to capture the first flush of a significant rainfall event. This limited effort could pinpoint any significant contaminant sources or problems that would otherwise continue undetected. The results of either of these components of the sampling plan could indicate that additional sampling is required to fully evaluate the respective source or pathway of concern.

Since the identification and preliminary characterization of potential sources and pathways is the principal goal of the Surface Water and Sediment Sampling Plan, the supporting analytical programs will have a common comparative basis in a specific set of radiological parameters. These parameters, hereinafter referred to as the base set of radiological parameters, have been selected to achieve consistency with WMCO's ongoing monitoring program and include total uranium, Ra-226, Ra-228, and gross alpha and beta content. Some surface water samples will undergo

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TABLE 5-1

SUMMARY OF SURFACE WATER
AND SEDIMENT SAMPLING PLAN

LOCATION	SURFACE WATER SAMPLING PLAN*	SEDIMENT SAMPLING PLAN*
Great Miami River	Quarterly at seven locations: FR, O/WQ[1]	Quarterly at seven locations: FR; Quarterly at one location: GS
Paddy's Run	Quarterly at three locations: FR, O/WQ[2]	Quarterly at three locations: U, A/B, R; Quarterly at one location: FR, GS; One sample at four locations: extended HSL
Storm Water Outfall Ditch	Four locations during a storm event: U, A/B, R; One location FR, O/WQ[3]	One sample at three locations: FR, GS; One sample at two locations: extended HSL
Main Effluent Line (Manhole 175)	Quarterly: FR, O/WQ[4] One sample: extended HSL	Quarterly: FR, GS One sample: extended HSL
Waste Storage Areas		
• Two drainage paths to Southwest	One sample from each: U, A/B, R	One sample at one location: extended HSL
• Abandoned drainage pipes along west	One sample at three locations (if flowing): U, A/B, R	None[5]
• Drainage north of Pit 5	One sample at three locations (if flowing): U, A/B, R	One sample at one location: expanded HSL
• Drainage north of railroad tracks	One sample at two locations: U, A/B, R	One sample at one location: expanded HSL
• Drainage south of Pit 1 and Clear Well	One sample at two locations: U, A/B, R	None[5]
• Drainage north of surge lagoon	One sample at two locations: U, A/B, R	None[5]

TABLE 5-1
(Continued)

LOCATION	SURFACE WATER SAMPLING PLAN*	SEDIMENT SAMPLING PLAN*
• Drainage south of Pit 4 and 6	One sample at three locations: U, A/B, R	None[5]
• Seep near greenhouse (plus any other identified seeps)	One sample from each seep: U, A/B, R, extended HSL	One sample from each seep: extended HSL
• Drainages from upper fly ash pile	One sample at four locations: U, A/B, R, O/WQ	One sample at four locations: U, A/B, R; One sample from one location: extended HSL
Production Area		
• Two drainages southeast of substation	One sample at two locations in each: U, A/B, R	One sample at two locations in each: U, A/B, R
• Drainage near rail siding	One sample at two locations: U, A/B, R	One sample at two locations: U, A/B, R
• Six culverts	One sample from each: U, A/B, R	One sample from each: U, A/B, R
• Manholes and catch basins	One sample at 12 locations: U, A/B, R	One sample at 12 locations: U, A/B, R

*U = Total Uranium
A/B = Gross Alpha and Beta
R = Ra-226 and Ra-228
O = TOC and TOX
WQ = General Water Quality Parameters
FR = Full Radiological Analysis
GS = Grain Size
Extended HSL = HSL Organics and Inorganics, HSL Pesticides/PCB's, Primary Drinking Water Substances, and Organophosphorus Pesticides

[1]Ongoing WMCO Monitoring Program: Monthly (Composite) at three locations: U, R, A/B
[2]Ongoing WMCO Monitoring Program: Weekly at five locations: U, A/B; Bimonthly: R
[3]Ongoing WMCO Monitoring Program: Weekly at one location: U, A/B; Bimonthly: R (when flowing)
[4]Ongoing WMCO Monitoring Program: Daily: U, A/B; Monthly: R, Ru-106, Th-232
[5]Sampling and radiological testing of sediments in drainage ditches recently performed as part of the CIS

additional analyses, as indicated in Table 5-1. The parameters to be tested under the full radiological and general surface water quality categories referenced in Table 5-1 are listed in Section 5.8.

TOC and TOX have been chosen as indicator parameters of potential organic contamination in waters from selected drainages, Paddy's Run, and the Great Miami River. In addition, based on the detection of various organics in the waste storage units in the CIS, selected surface water and sediment samples will be analyzed for the extended HSL parameters (Table 5-1).

The following sections have been prepared to further explain the sampling locations and the corresponding samples to be collected and analyses to be performed. Specific justification for each is also provided.

5.2 SAMPLING STRATEGY AND RATIONALE

5.2.1 GREAT MIAMI RIVER

Surface water sampling locations on the Great Miami River will coincide with the sampling stations established by WMCO, and will include four additional sampling locations (Figure 5-1). WMCO currently is collecting daily grab samples from sampling points W1 (upstream from the main effluent line) and W3 (downstream from the effluent discharge). In addition, weekly grab samples are collected at point W4, approximately 7.6 km downstream from the confluence of Paddy's Run with the Great Miami River. The daily and weekly samples are composited monthly for a determination of uranium, Ra-226 and Ra-228, and gross alpha and beta concentrations. As indicated on the figure, the additional locations are immediately opposite the SOWC well on the west bank, just downstream from the point of discharge of the main effluent line, within the depositional area at the bend in the river downstream

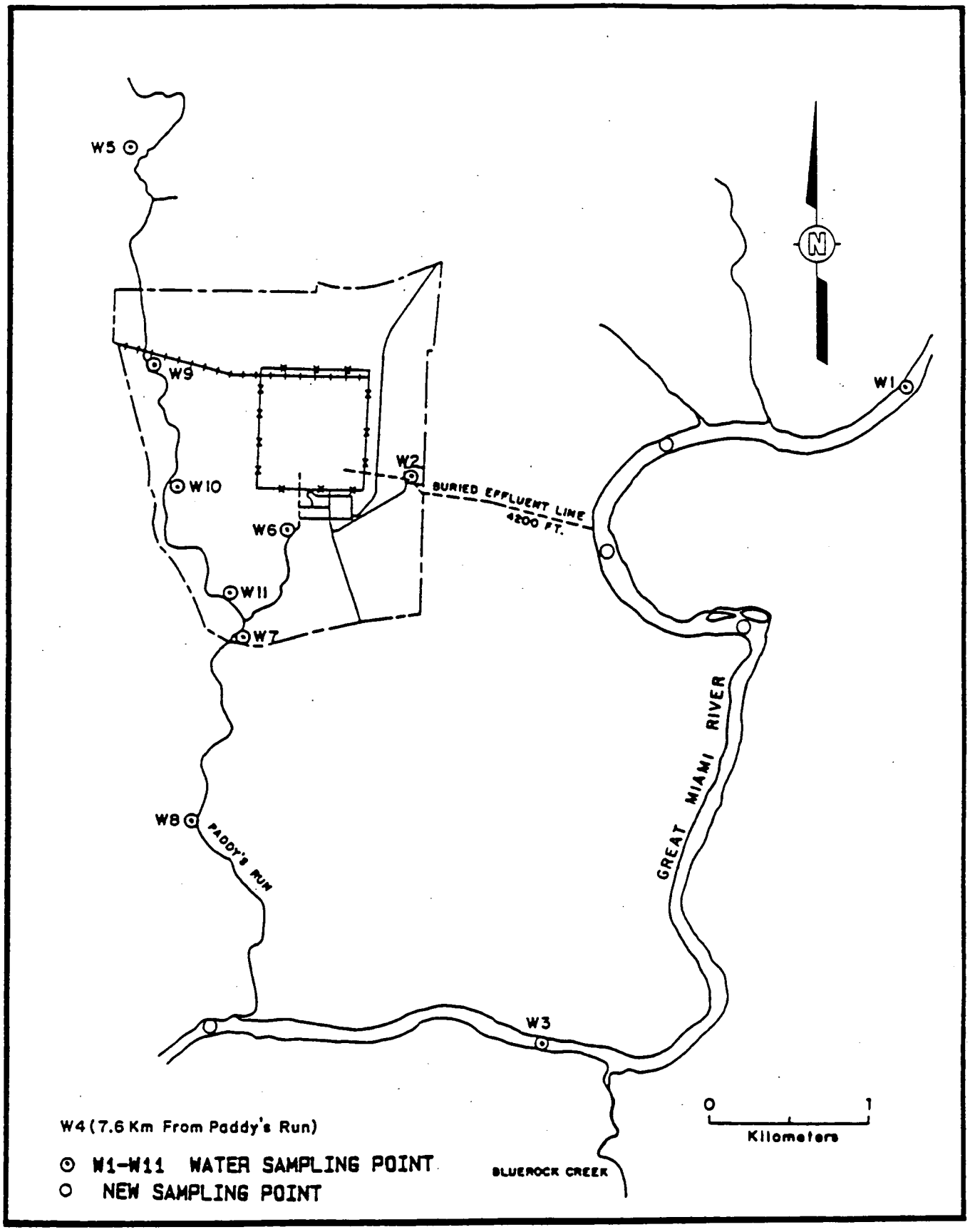

FIGURE 5-1

SURFACE WATER SAMPLING LOCATIONS

from the previous point, and immediately downstream from the confluence with Paddy's Run.

The surface water sampling plan will augment WMCO's ongoing program through the collection of samples from the three established locations and four new locations on a quarterly basis for one year, with analysis for the full set of radiological parameters, TOX, TOC, and general water quality parameters. This quarterly sampling plan will characterize seasonal flow and water quality variations for an extended list of indicator radiological parameters. If consistent with the overall project schedule, samples will be obtained in April, July, October, and January. Approximate flow rates will be obtained from an existing U.S.G.S. Great Miami River gaging station at Hamilton, Ohio, with an appropriate correction for differences in drainage areas.

Sediment samples will be collected on a quarterly basis from the same locations on the Great Miami River. Samples will be collected at the quarter points in the channel and from depositional and floodplain areas at each location. One sample from the most prominent depositional area at each location will undergo full radiological analysis to determine if the potential for a long-term release of contaminants exists, and grain-size testing will be performed at one location to assist in determining if sorption is an important process. All other sediment samples from the Great Miami River will be archived within their original containers in an environmentally controlled area at IT's Radiological Sciences Laboratory (RSL) in Oak Ridge, Tennessee. If the single sample analyzed from each location exhibits a concentration of any parameter exceeding twice background, all archived samples from that location and sampling event will also be subjected to a full radiological analysis. An exception to this strategy is that all sediment samples from the background location (W1) will be analyzed during the first round of sampling to better establish background conditions.

5.2.2 PADDY'S RUN

Surface water flow in Paddy's Run is monitored at WMCO stations W5, W9, W10, W11, W7, and W8 (Figure 5-1). Station W5 provides an upstream control, Stations W9 and W10 represent upstream and downstream locations with respect to the Waste Storage Area, Stations W11 and W7 provide a similar upstream/downstream pair for the confluence of the storm water outfall ditch with Paddy's Run, and Station W8 is a downstream off-site location. Weekly samples are analyzed by WMCO for uranium content and gross alpha and beta activity. Bimonthly composites of weekly samples are analyzed for Ra-226 and Ra-228.

The spatial distribution provided by these six stations is considered adequate for monitoring surface water effects in Paddy's Run. The ongoing program will be supported in the RI/FS, however, by quarterly sampling at Stations W10, W11, and W7, with analysis for the full radiological program, TOC, TOX, and the general water quality parameters. The selected stations are the closest downstream locations from the two principal sources of contaminants to Paddy's Run (i.e., the Waste Storage Area and the storm water outfall ditch), and a control point upstream from the confluence with the outfall ditch. The surface water program in Paddy's Run, as with the program in the Great Miami River, will yield quantitative data on the presence or absence of the contaminants of concern. The program will also include relative contributions and seasonal variability of the sources.

Sediment samples will be collected from Paddy's Run at Stations W10, W11, and W7 on a quarterly basis. Station W5 will also be included in the sediment sampling program to provide a background comparison. Samples from Stations W5, W11, and W10 will be analyzed only for the base set of parameters (uranium, Ra-226, Ra-228, gross alpha and beta), whereas a full complement of radiological parameters will be tested along with grain size for sediment samples from Station W7. In addition, sediment

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samples from the same four locations will be analyzed on one occasion for the extended HSL parameters.

5.2.3 STORM WATER OUTFALL DITCH

Station W6 is used by WMCO to monitor effluent associated with the storm water drainage ditch. Weekly samples are collected for uranium and gross alpha and beta analyses, while a bimonthly composite is analyzed for Ra-226 and Ra-228. The proposed program will involve a single sampling episode during a storm event at five locations along the ditch. Four samples will be analyzed only for the base set of radiological parameters, while the sample collected furthest downstream will be analyzed for the full radiological parameter list, TOC, TOX, and the general water quality parameters. The distribution of sampling points along the length of the ditch will document either significant gains or losses of radiological constituents as one proceeds downstream. The one extended set of analyses will be for purposes of confirming the presence or absence of the additional parameters.

Information provided in the background document indicates a noticeable change in sediment characteristics and contaminant concentrations along the ditch. For this reason, three sediment samples will be collected along the length of the ditch. A full set of radiological parameters and grain size will be tested to document these conditions and to establish any correlation with grain size. In addition, sediment samples will be collected for the extended HSL analysis at two locations. These include a point just upstream from the confluence with Paddy's Run (downstream from the fly ash piles), and a point of depression in the channel pathway near the midpoint of the ditch length (upstream from the fly ash piles).

5.2.4 MAIN EFFLUENT LINE (MANHOLE 175)

Wastewater discharges are also being monitored by WMCO at Station W2 (Figure 5-1). Station W2 is the sampling point at

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Manhole 175 that is used to monitor effluent from the Production Area and is the specified compliance point for the NPDES permit. Continuous samples are currently being collected in proportion to the total flow. Samples are collected daily (24-hour composites) and analyzed for uranium content and alpha/beta radioactivity. Monthly composites of the daily samples are analyzed for Ra-226, Ra-228, Ru-106, and Th-232. Two semi-annual composites are analyzed for other radionuclides.

In support of the data base being generated by WMCO, quarterly surface water samples will be obtained from Station W2 for one year and analyzed for the full set of radionuclides, TOX, TOC, and general water quality parameters. This initial sample will also be analyzed for the extended HSL parameters. This program will provide confirmatory data as to whether organics and selected inorganics are being discharged to the Great Miami River via the main effluent line.

Sediment samples will be collected from Manhole 175 concurrently with the quarterly surface water samples. The samples will be analyzed for the full set of radiological parameters and grain size. One sediment sample will also be analyzed for the extended HSL parameters during the initial round of sampling.

5.2.5 WASTE STORAGE AREA: MISCELLANEOUS DRAINAGES

Numerous surface water run-off drainageways exist within or near the Waste Storage Area. These drainages may have been in the past, or may currently remain, receptors of contaminants from spills, leaks, overtoppings, or other kinds of releases associated with the waste storage units and plant operations. As part of the Surface Water and Sediment Sampling Plan, single surface water and sediment samples will be collected at various locations along the drainageways. Each sample will be analyzed for the base set of radiological parameters in order to flag any elevated concentrations or contamination patterns. These

findings could result in source identification and focused remediation actions. The drainages and locations to be sampled and the parameters to be analyzed are listed in Table 5-1.

Sediment samples were collected for radiological analysis at numerous locations along these same drainages as part of the CIS. The proposed RI effort is to collect a single sediment sample from four key drainages to Paddy's Run at a point downstream from any potential releases from the waste storage areas, and to subject these samples to an extended HSL analysis. These locations include the southwest drainage ditch near the K-65 silos, the drainage ditch north of Pit 5, the drainage ditch from near the sanitary landfill north of the railroad tracks, and a drainage from the upper fly ash pile.

Descriptions of these and other drainageways to be sampled follow:

- Two Drainage Paths Southwest of Waste Storage Area During the site visit, two drainages flowing southwest of the Waste Storage Area were identified. Water was flowing in one of these; the other contained standing water. Both discharged into Paddy's Run. If standing or flowing water is present during the field work (i.e., after significant rainfall), one sample from each drainage will be collected at a downstream location.

- Abandoned Drainage Pipes Exiting West Perimeter of Waste Storage Area These areas were dry during the site visit. If standing or flowing water is present during the field work (i.e., after significant rainfall), three locations will be identified by site hydrology personnel and sampled.

- Drainage North of Pit 5 This drainage was dry during the site visit. If standing or flowing water is present during the field work, three samples will be taken. These will include a sample immediately downstream from the Sanitary Landfill, one immediately upstream of Pit 5, and one between Pit 5 and the confluence with Paddy's Run.

- Drainage North of Railroad Tracks This drainage flows north of the Sanitary Landfill and follows the railroad right-of-way towards Paddy's Run. Samples will be

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taken above and immediately below the Sanitary Landfill.

- Drainage South of Pit 1 and Clearwell Two samples will be taken from the drainage that flows south of Pit 1 and the Clearwell. These will include a sample taken as far upstream as possible from the Clearwell (and Pit 1) and a sample immediately downstream from the Clearwell.

- Drainage North of Surge Lagoon Two samples will be taken from the drainage flowing just north of the maintenance road near the new Biodenitrification Surge Lagoon. These will include a sample upstream from the Biodenitrification facility, and a sample immediately east of the metal oxide sites.

- Drainage South of Pits 4 and 6 Three samples will be taken from the drainage flowing south of the maintenance road next to Pits 4 and 6. These will include a sample as far upstream as possible from Pit 6, one immediately downstream from Pit 6, and one immediately downstream from Pit 4.

- Seep Near Greenhouse A single sample will be obtained from the seep at the northwest corner of Pit 3 near the evaporation greenhouse. Additional drainages and seeps will be identified during the field work. If standing or flowing water is present during the characterization, up to five additional samples will be collected.

- Drainages From Fly Ash Piles A sample will be collected at four locations within the drainage leading from the upper fly ash pile to the storm water outfall ditch and Paddy's Run. Two other drainages from the inactive fly ash pile will be sampled. Locations of the two additional sampling points will be based on:

  - Location of the sampling site relative to the fly ash piles;

  - Presence of fly ash in the ditches;

  - Size of the drainage ditch;

  - Observable drainage patterns from the piles.

5.2.6 PRODUCTION AREA

Several drainages and storm water run-off conveyance facilities exist within the Production Area that will be sampled and ana-

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lyzed in a manner consistent with the program described in Section 5.2.5 and shown in Table 5-1. These units will include the following:

- Two Drainages Southeast of Substation A sample will be taken near the junction of two drainage pathways southeast of the main electric substation, between the two perimeter fences.

- Drainage Near Rail Siding Two samples will be taken in the drainage pathway adjacent to a rail siding in the southwest corner of the Production Area

- Culverts Six culverts have been identified within the Production Area perimeter fence. Since culverts often collect sediments due to changes in the flow pattern, surface water and sediment samples will be collected in these culverts.

- Manholes and Catch Basins Sediment samples will be taken at approximately 12 manholes or catch basins in the storm water system. Locations will be identified by field personnel.

5.3 SAMPLING METHODOLOGY

5.3.1 SURFACE WATER

Storm sewer flows, waste effluent, storm water run-off, and natural surface water discharges will be sampled in accordance with standard sampling methods outlined in Section 6.3 of the QAPP. Flow measurements will be made at each sampling location at the time of sample collection, with the exception of the Great Miami River and Manhole 175. Flows for these sampling sites will be obtained from the USGS Hamilton gage and WMCO, respectively. All sampling equipment will be decontaminated prior to use and calibrated in accordance with the manufacturer's criteria. Samples will be transferred to the appropriate container as listed in Table 5-2.

The existing drainages and seeps in and around the Waste Storage Area are quite small with little flow. These areas will be sampled by hand using a pond or dip sampler. The Great Miami River,

TABLE 5-2

SURFACE WATER SAMPLE CONTAINERS AND PRESERVATIVES

SPECIFIED ANALYSIS	SAMPLE CONTAINER	SAMPLE CONTAINER SIZE	PRESERVATION	HOLDING TIME DAYS	REPORT-ING UNITS
HSL Volatile	Glass w/Teflon-lined lid	40 ml	Cool, 4°C	7	ug/l
TOC	Amber Glass	250 ml	pH <2, H_2SO_4 Cool, 4°C	28	ug/l
TOX	Amber Glass	250 ml	Cool, 4°C	7	ug/l
HSL Inorganics (Metals)	Plastic	1,000 ml	pH <2, HNO_3	180	ug/l
(Cyanide)	Plastic	1,000 ml	pH>12, NaOH, 4°C	14	ug/l
HSL Base/ Extractable Organics (Base/Neutral/ Acid/Pesticide/PCB)	Amber Glass	1,000 ml	Cool, 4°C	7/40a	ug/l
Chromium, Hexavalent	Plastic	250 ml	Cool, 4°C	1	ug/l
Fluoride, Chloride	Plastic	1,000 ml	None	28	ug/l
Nitrate	Plastic	250 ml	Cool, 4°C	2	ug/l
Phenols	Glass	500 ml	pH <2, H_2SO_4 Cool, 4°C	28	ug/l
Radiological	Plastic	Variable	pH<2, HNO_3	6 mos.	pCi/l

a) Extract within seven days; analysis within 40 days of extraction

Paddy's Run, and existing drainages will be sampled at mid-depth in the mid-section or deepest flow channel. Samples will be collected directly into the sample container if the water is deep enough. The pits will be sampled either with the dip sampler attached to the end of a pole, or samples will be taken from various depth increments using a Kemmerer water sampler.

The sampling program will progress from downstream to upstream to avoid any bottom sediment disturbance. Procedures for obtaining these samples are presented in Section 6.3 of the QAPP.

5.3.2 SEDIMENT

Standard Operating Procedures and all sample documentation procedures for sediment sampling are presented in Section 6.5 of the QAPP. Sediment samples from flowing water courses or areas of ponded water will be collected below the water surface using a stainless steel scoop or Ponar dredge. Surface sediment samples from dry stream channels or drainages will be collected by using a stainless steel scoop to scrape away and collect the upper inch of sediments. Five scoopfuls of sediment (or the maximum obtainable) will be collected at each location. For stream channel and principal drainageways, sediment samples will be collected at quarter-points across the channel and composited.

Stainless steel scoops decontaminated at an off-site location will be dedicated to a single sampling location to the extent practical (i.e., dependent on the number of samples to be collected during a single shift). Each sediment sample will be placed in an appropriate container.

5.4 SAMPLE CONTAINERS AND PRESERVATIVES

Table 5-2 lists the appropriate containers and preservatives to be used for the storage and shipment of surface water samples to off-site laboratories. Sediment samples that will undergo radiological and grain size analysis will be placed in Ziplock bags

and cardboard containers. No special preservation procedures are required. Packaging, labeling and shipping of samples is addressed in Section 6.9 of the QAPP. Chain of custody forms and procedures are presented in Section 7.1 of the QAPP. These must accompany the samples at all times to document sample transfer from the field to the laboratory.

To protect shipping and laboratory personnel from potential exposure to hazardous or radioactive contaminants, all sample bottles and containers will be decontaminated prior to packaging. After each sample is collected, sample containers will be washed on the exterior with a detergent, rinsed with tap or deionized water, and dried with paper towels. Decontamination solutions and rinse water will be contained and stored with the equipment decontamination solutions. These solutions will be disposed in accordance with WMCO-approved disposal procedures.

5.5 SAMPLE IDENTIFICATION

All surface water and sediment sampling locations are identified in Section 5.2. Associated sample numbers will be assigned in accordance with the system established in the Introduction to the Sampling Plan.

5.6 SURVEY CONTROL

All surface water and sediment sample locations in open channels (streams, drainages, ditches, etc.) will be located by placing stakes on opposite banks of the sampling location. The number of the sampling location will be marked on each stake and recorded. The sampling points will be located on a U.S.G.S. topographic map or site map, whichever is appropriate. The coordinates for these sites will then be measured from these map locations. The distance from the stake to the actual sampling point(s) will then be measured in line with the opposite stake to an accuracy of 1.0 foot and recorded.

5.7 FIELD ANALYSIS

All surface water samples will be taken in accordance with established sampling protocols outlined in Section 6.3 of the QAPP. Random field sample splits, random field blanks, and blind duplicates will be sent to the laboratory on a 10 to 15 percent frequency. The frequency of collection of the above samples will be one field sample split, one field blank, and one blind duplicate for every 10 to 15 samples, or fraction thereof, collected. Thus, the frequency of 10 to 15 percent refers to the total frequency for all QA/QC samples.

The following field analyses will be performed:

- pH
- Temperature
- Conductivity
- Dissolved Oxygen.

On-site hydrology personnel will select a single sample from each location to be split so that one part can be filtered before analysis and the other analyzed unfiltered. This technique, using laboratory screening analytical methods, will provide a basis for determining whether potential contaminant migration is in solution or being carried off site as suspended matter. Following the procedures outlined in Section 6.3 of the QAPP, water samples requiring filtration will be filtered in the field immediately following collection.

The field screening procedures for radionuclides in sediment will utilize a large volume scintillation detector (SPA-3). The sample with the highest SPA-3 reading at each location will be selected for further laboratory analysis. The other samples at each location will be archived. Section 6.6.2 of the QAPP describes the field screening procedure of subsurface soil samples for radioactive contamination. This same procedure will be used for screening of sediment samples.

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5.8 LABORATORY ANALYSIS

Under the assumption that field screening will indicate the need for further analysis of all sediment samples, the surface water and sediment sampling program summarized in Table 5-1 will yield the following number of samples for analysis:

- Total Uranium, Gross Alpha and Beta, Ra-226, Ra-228

  - 55 surface water samples
  - 38 sediment samples

- Full Radiological Program

  - 45 surface water samples
  - 39 sediment samples

- TOC, TOX, and General Water Quality Parameters

  - 49 surface water samples

- Extended HSL Parameters (Organic Volatiles, and Semi-Volatiles, Inorganics, HSL Pesticides/PCBs, Primary Drinking Water Substances, and Organophosphorus Pesticides)

  - 7 surface water samples (assumes 6 seeps)
  - 17 sediment samples (assumes 6 seeps)

- Grain Size Analysis

  - 15 sediment samples.

In addition, random field sample splits, random field blanks, and blind duplicates will be analyzed on a 10 to 15 percent frequency for quality assurance/quality control purposes.

Based on information available on the FMPC waste inventory, the following parameters will be selected for the full radiological program:

- Total Uranium
- Uranium 234
- Uranium 235
- Uranium 236
- Uranium 238
- Radium 226
- Radium 228
- Thorium 230
- Thorium 232
- Cesium 137
- Strontium 90
- Ruthenium 106
- Neptunium 237
- Plutonium 238

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- Technetium 99
- Thorium 228
- Plutonium 239
- Plutonium 240.

The general water quality parameters will include the following:

- pH
- Specific Conductance
- Chloride
- Iron
- Manganese
- Phenols (total)
- Sodium
- Sulfate
- Gross Alpha
- Gross Beta
- Copper
- Molybdenum
- Ammonia
- Alkalinity
- Magnesium
- Potassium
- Arsenic
- Barium
- Cadmium
- Chromium (hexavalent, total)
- Fluoride
- Lead
- Mercury
- Nitrate
- Selenium
- Silver
- Nickel
- Total Organic Nitrogen
- Carbonate/Bicarbonates.
- Calcium
- Sodium
- Phosphate.

Following analysis, samples with indefinite holding times will be archived at IT's Radiological Sciences Laboratory in Oak Ridge, Tennessee. All other samples will be retained at IT's laboratory in Oak Ridge until the expiration of their respective holding times, then returned to the FMPC for disposal.

6.0

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SECTION 6.0

BIOLOGICAL RESOURCES SAMPLING PLAN

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SECTION 6.0

BIOLOGICAL RESOURCES SAMPLING PLAN

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6.0 BIOLOGICAL RESOURCES SAMPLING PLAN

6.1 OBJECTIVES AND JUSTIFICATION

There are four objectives to the Biological Resources Sampling Plan:

- To determine if any radiological or hazardous substance release to the FMPC environs results in significant uptake, assimilation, and transfer through ecological habitats, including surface water sediments and adjacent wetlands;
- To determine if any radiological or hazardous substance release to the FMPC environs results in uptake and assimilation in agricultural products and crops;
- To determine if the above represent significant pathways to human receptors; and
- To determine if federal or state threatened or endangered species exist within the FMPC environs, and the potential risk which is posed to their existence or welfare through contaminant release from the FMPC.

Sampling of ecological parameters is necessary to identify the pathways by which humans may be exposed to hazardous, toxic, or radioactive substances and to determine if there are any effects on the area ecosystem. The U.S. EPA "Guidance on Remedial Investigations Under CERCLA" (1985) states that these investigations should focus on the contaminant levels found in site flora and fauna, and should identify resident endangered species.

On-site sampling will be used to evaluate existing conditions at the FMPC, whereas off-site sampling will be used to evaluate the extent of off-site conditions as well as to establish background levels for control areas. A determination of radiological substances in food chain species will be used to evaluate risk to human health relative to environmental fate and transport.

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6.2 THREATENED AND ENDANGERED SPECIES SURVEY PROGRAM

Discussions with Federal and State endangered species experts resulted in the identification of two species that could occur on the FMPC. Surveys will be conducted to verify the presence or absence of these species and their habitat as described below.

6.2.1 THREATENED OR ENDANGERED SPECIES

One species of mammal, the Indiana bat (*Myotis sodalis*), is recognized as Federally endangered and occurs in Butler and Hamilton Counties, Ohio. Indiana bats roost on trees with loose bark in close proximity to perennial streams. Habitat along Paddy's Run is considered marginal for Indiana bats. It will be surveyed to determine if this species is present on the FMPC; however, the Indiana bat is not expected to occur on the FMPC.

One species of amphibian, the cave salamander (*Eurycea lucifuga*), is recognized as state endangered and is known to occur in the vicinity of the FMPC in the Mount Airy Forest, Groesbeck, one mile northeast of New Baltimore, and Sheits Road near Blue Rock Road. Habitat that may potentially support the cave salamander will be surveyed to determine if this species is present on the FMPC.

6.2.2 SPECIES OF SPECIAL CONCERN

In addition to the above, two raptor species of state concern have been observed at the FMPC: the Coopers hawk (*Accipiter cooperi*) and the northern harrier (*Circus cyaneus*). Although these species have no legal status, their breeding habitat in Ohio may be endangered. Consequently, their presence on site will be monitored. Surveys will also be conducted for additional plant or animal species of Federal or State concern if they are discovered on the FMPC.

6.3 SAMPLING PROGRAM

Samples of vegetation, agricultural products, garden produce, and terrestrial and aquatic organisms will be collected for analysis on and near the FMPC.

6.3.1 SAMPLING METHODOLOGY

6.3.1.1 Vegetation and Agricultural Products

Forbs, grasses, agricultural crops, and produce will be removed with roots and above-ground parts intact from within a one-half square meter circular quadrat at each sampling point. A corresponding soil sample will be taken at each sample site. Roots and above-ground parts from each sample site will be separated in the field and by life form (e.g, grass, forb, shrub), placed in aluminum foil and Ziplock bags or whirlpacks, labeled according to Section 6.3.4, and placed in a shipping container. The root samples and samples of above-ground parts will be analyzed separately for each life form collected. Depending on availability, up to three samples of each life form will be collected at each location. Samples will be shipped and archived according to the instructions of Section 6.9 and 7.1 of the QAPP.

6.3.1.2 Terrestrial Wildlife

Wildlife species will be collected over a two-week period, in conjunction with other biota sampling. Wildlife species will be captured using live traps, snap traps, or other appropriate techniques. Live animals will be killed using the thoracic crush method or an appropriate stunning device. Specimens will be placed in aluminum foil and Ziplock bags or whirlpacks, labeled according to Section 6.3.4, placed in a shipping container, and frozen prior to shipment to the laboratory. Skeleton, muscle, adipose tissue, and organs such as liver, gonad, and/or kidney will be removed, stored separately, and shipped per laboratory requirements and as outlined in Section 6.9 and 7.1 of the QAPP. If all these organs cannot be analyzed, then one of the

organs will be analyzed for all animals collected so that results of analyses are comparable.

A minimum of 100 gm of tissue per sample will be required for analysis. Samples will be collected within the same time period and location as vegetation samples.

6.3.1.3 Aquatic Organisms

Fish will be collected with an electroshocker or with nets. The electroshocker and/or nets will be applied/dragged at each location until an adequate sample (Section 6.3.2) has been collected. The fish will be segregated by species, placed in aluminum foil and Ziplock bags or whirlpacks, labeled according to Section 6.3.4, and frozen prior to shipment. Larger game fish will be filleted in the laboratory as for human consumption, and the fillets and internal organs will be analyzed separately. Small game and/or nongame fish will be analyzed with internal organs intact (whole organisms).

An analysis of the benthic macroinvertebrate community structure will be performed to evaluate the effects of effluent from the FMPC into the Great Miami River and Paddy's Run. Methods to conduct benthic macroinvertebrate community structure studies are currently being developed.

Benthic macroinvertebrates will be sampled using a Surber sampler. This method allows a determination of orders present and their numbers per square meter. Samples of benthic macroinvertebrates will be composited by order; placed in aluminum foil and Ziplock bags or whirlpacks, and frozen prior to shipment. Each sample may consist of from one to several organisms. To facilitate efficiency in the field, benthos and fish will be sampled concurrently. Field storage, sample shipment, and chain-of-custody procedures will be followed as outlined in Section 6.9 and 7.1 of the QAPP.

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6.3.1.4 Wetland Communities

Riparian areas along Paddy's Run and other wetland areas that may occur on the FMPC will be sampled in order to evaluate the impacts of radiological or hazardous substances on these communities, or the forbs and grasses growing on the borders of wetland areas. Emergent and submergent species (when present) will be removed with roots and above-ground parts intact from within a 0.2 square meter quadrat at each sample site.

Roots and above-ground parts from each sample site will be separated in the field and treated as described in Section 6.3.1.1. If aquatic organisms are present in wetlands, they will be sampled as described in Section 6.3.1.3.

6.3.2 SAMPLING LOCATION

Samples of vegetation, agricultural products, garden produce, and terrestrial and aquatic organisms on and near the FMPC will be collected for analysis. The type, location, and frequency of each sample grouping will necessarily vary in order to reflect anticipated contaminant pathways and to satisfy the overall study objectives.

Vegetation will be systematically sampled on site and off site in both upwind and downwind directions, using 1,000 foot centers of the state plane coordinate system. The WMCO off-site control area located in Indiana will be used as a control area to conduct sampling for background levels. Three samples of each vegetation life form will be collected from each on-site and off-site location. It is estimated that 100 to 150 vegetation samples will be collected for analysis. If subsequent surface soil sampling results indicate areas of elevated concentration in important crop or livestock locations, additional vegetation samples will be collected from these areas if they differ from the original sampling locations.

The downwind site immediately adjacent to the FMPC, along with the control area, will be used for the sampling of agricultural crops and garden produce. Four species will be sampled at each location to represent the full range of growth patterns. A preliminary determination based on field observations includes potatoes, corn, soybeans, and beets. Three composite samples of each species will be collected at each location, resulting in a total of approximately 50 samples. Individual sample sites will be chosen on a random basis by pacing off randomly selected coordinates within the agricultural field or plot being investigated.

Forbs, grasses, agricultural crops, and produce samples will be removed, with roots and above-ground parts intact, from within a one-half square meter circular quadrant at each sampling point. A corresponding soil sample will be taken at each 1,000 foot center on the FMPC and at each supplemental sampling site (e.g., wetlands). Roots and above-ground parts from each sample location will be separated in the field and analyzed separately.

Milk and eggs represent additional agricultural products of interest to the Biological Resources Sampling Plan. However, due to the existing data base and the ongoing routine monitoring of such products by WMCO, no additional sampling is proposed for the RI/FS.

Wildlife species will be captured for analysis at two sites--within the controlled Production Area or Waste Storage Area of the FMPC and within the open space near the southwest corner of the FMPC property. The capture will be achieved using live traps, snap traps, or other appropriate techniques. Two samples each of two game species and one nongame species will be collected at each location, yielding a total of twelve samples. Game species could include, for example, the eastern cottontail, gray or red squirrels, or quails. Mice will likely be the nongame species.

Fish and benthic macroinvertebrates will be sampled, if present, at a total of seven stations on Paddy's Run and the Great Miami River. Three locations on Paddy's Run include the railroad crossing upstream from the FMPC, just upstream from the point of discharge from the stormwater outfall ditch, and near the confluence with the Great Miami River. The four river locations include points four river-miles upstream and downstream from the FMPC, at the outfall from the main effluent line, and near the confluence with Paddy's Run. Three fish samples and three macroinvertebrate samples will be collected for analysis at each location, resulting in approximately 30 samples of each. Fish samples will be collected with an electroshocker or with nets. Larger game fish will represent a single sample; smaller fish samples will be composited. Samples of benthic macroinvertebrates will be composited by order following collection. Samples not sent for analysis will be archived. Biological resources sampling locations are shown in Figure 6-1.

6.3.3 SAMPLE IDENTIFICATION

The biological samples identified in this section will have unique sample numbers assigned in accordance with the system established in the Introduction to the detailed Sampling Plan.

The following information will be included in the sample description:

- Name of collector;
- Date and time of collection;
- Location of sampling site by ecological habitat and geographic location;
- Remarks regarding unusual aspects of sample; and
- Species identification, when possible.

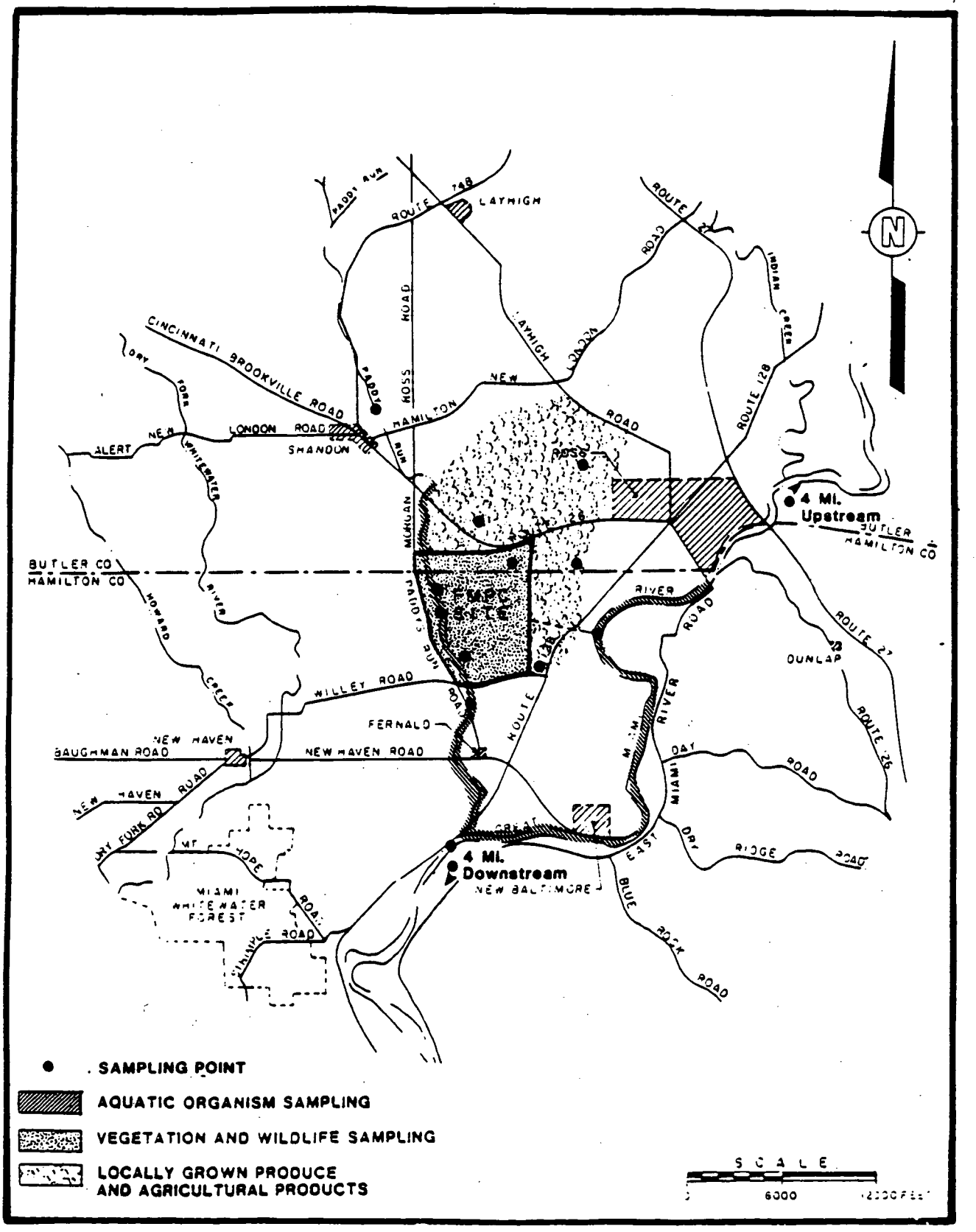

FIGURE 6-1

BIOLOGICAL RESOURCES SAMPLING LOCATIONS

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The chain-of-custody forms will be completed when the sample is taken and will accompany the samples to the laboratory (Section 7.1 of the QAPP).

6.3.4 SAMPLE CONTAINERS FOR SHIPPING

Samples will be placed in aluminum foil and Ziplock bags or whirlpacks, stored in coolers, and frozen. At the end of each sampling day, samples will be transported to the laboratory following procedures of Section 6.9 of the QAPP.

6.3.5 SAMPLE ANALYSIS

Roots and above-ground plant tissue samples will be washed prior to tissue analysis. The resulting liquor from the washing processes will be stored and a subsample of the root liquor and above-ground liquor may be analyzed separately. The weight of plant material and volume of wash liquor collected will be recorded on the analysis form.

All samples collected will be analyzed for isotopic uranium, strontium, and cesium. Isotopic uranium is a very common radiological parameter at the FMPC, whereas strontium and cesium are known bioaccumulators. If any biological samples are found to contain elevated levels of these indicator parameters, a newly collected sample from the same location will be analyzed for the following extended list of radiological parameters:

- Uranium-234
- Uranium-238
- Radium-228
- Technetium-99
- Thorium-230
- Cesium-137
- Strontium-90
- Ruthenium-106
- Neptunium-237
- Plutonium-238
- Plutonium-239
- Plutonium-240.

Ten percent of the biological samples will also be analyzed for organic and inorganic substances. The 10 percent will include, at a minimum, samples from the drainage downstream from seeps and downstream from the main effluent line. The following organic

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and inorganic substances currently known to be present in the Waste Storage Area, as determined by the CIS, will be analyzed for in biological tissue samples:

ORGANIC SUBSTANCES		INORGANIC SUBSTANCES	
Anthracene	+	Aluminum	?
Butyl Benzyl Phthalate	+	Arsenic	+
Chlordane	+	Barium	?
Chloroform	+	Cadmium	+
Chrysene	?	Calcium	?
DDT	+	Chloride	?
Dichloroethane	no	Cyanide (Metal)	+
Fluoranthene	+	Fluoride	?
Malathion	+	Lead	+
Nitrophenol	no	Magnesium	?
Organo-Pesticides	+	Mercury	+
PCBs	+	Nitrates	?
Phenanthrene	+	Phosphate	?
Pyrene	?	Potassium	?
TCE	+	Silver	+
		Sodium	?
		Sulfate	?
		Vanadium	?
		Zinc	+

+ = Bioaccumulator
? = Unknown, but may bioaccumulate
no = Not known to bioaccumulate significantly

6.4 SPECIAL STUDIES

Toxicity testing using FMPC effluent for acute and chronic effects on aquatic organisms will be carried out according to EPA guidance documents on these subjects (EPA/600/4-85/014 and EPA/600/4-85/013). A minimum of three groups of organisms, including vertebrates, invertebrates, and algae will be examined in the course of toxicity testing. An analysis of the benthic macroinvertebrate community structure will also be used to evaluate the effects of effluent from the FMPC into the Great Miami River and Paddy's Run. A detailed work plan for these studies will be prepared prior to the initiation of the work.

0.7

SECTION 7.0

FACILITIES TESTING PLAN

SECTION 7.0

FACILITIES TESTING PLAN

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7.0 FACILITIES TESTING PLAN

7.1 OBJECTIVES AND JUSTIFICATION

The objective of the Facilities Testing Plan is to determine if any leakage of radiological or hazardous materials has occurred, is occurring, or has the potential to occur from the underground storage tanks located in the Production Area, the line from the Clearwell to Manhole 175, Production Area storage pads, hazardous waste storage pads, dikes, ancillary below-ground piping, and sumps. These facilities have been in use for nearly 36 years; consequently, they may be nearing the end of their design life and may have an increased probability of failure. Failure in an underground storage tank (or its related piping) could result in either the gradual or sudden release of tank contents. Testing the integrity of these facilities by methods described herein will identify those areas requiring further investigation. Subsequent investigations will identify the extent of any contaminant release should testing indicate that an integrity failure has occurred.

Under the Facilities Testing Program, the FMPC will also perform sampling for suspect areas in the Production Area and other areas within the FMPC, and will include soil and other pertinent sampling and analysis for specific materials of concern in each of the areas. The sampling locations and analytical parameters will be based on the historic use of the areas and the materials handled in each area. These areas will include, but may not be limited to, the old oil incinerator area, the fire training area, and the graphite incinerator area.

Another facility involving related concerns is the main effluent line which conveys treated wastewater from Manhole 175 to the Great Miami River. The integrity of and potential leakage from this conveyance line is being evaluated by WMCO under a separate contract in response to Order 14 of the OEPA's June 26, 1987

Director's Findings and Orders. The results of this work will be reviewed and incorporated into the RI/FS as appropriate.

7.2 TESTING FREQUENCY

Testing of the underground tanks, the line from the Clearwell to Manhole 175, Production Area storage pads, hazardous waste storage tanks, dikes, ancillary below-ground piping, and sumps will be conducted once during the sampling program. The detailed Facilities Testing Plan will contain a description of a plantwide program for evaluating risk, prioritizing testing, and scheduling testing for all facilities.

7.3 FACILITY LOCATIONS

The underground storage tanks which will be tested are located in the Production Area, and are listed in Table 7-1. Their approximate locations are shown in Figure 7-1.

7.4 TEST METHODOLOGY

The general approach to accomplish the work plan objective is to identify the facility groups to be considered, rank and prioritize the risk of a release from each facility, and field test the facilities following a schedule based on the risk prioritization. Sufficient information is available to rank certain facility groups, whereas additional information needs to be obtained to evaluate and prioritize other facility groups.

The testing program will be preceded by a preliminary data collection step. This will include:

- Assemble existing drawings and reference material;
- Identify lines, pads, tanks, dikes, piping, and sumps to be tested;

TABLE 7-1

TYPES AND LOCATIONS OF UNDERGROUND STORAGE TANKS

TANK NO.	AGE	LOCATION	TOTAL CAPACITY (GALLON)	CONSTRUCTION MATERIAL	TANK STATUS	SUBSTANCE
1	6	Garage	1,500	Fiberglass	In use	Gasoline
2	6	Garage	1,500	Fiberglass	In use	Gasoline
3	34	Engine house	12,250	Steel	In use	Diesel fuel
4	34	Truck dock at Plant 1	3,000	Steel	In use	Kerosene
5	34	Tank farm at Plant 4	13,525	Steel	In use	Kerosene
6	34	Garage	200	Steel	Not in use	Waste oil
7	34	Maintenance Shops Building Change	1,000	Steel	In use	Gasoline
8	34	Plant 9 (North-side)	5,000	Steel	In use	Soluble oil mechanical coolant
9	34	Garage	1,000	Steel	Not in use	Gasoline
10	34	Garage	1,000	Steel	Not in use	Gasoline
11	34	Garage	3,000	Steel	Not in use	Gasoline
12	34	Garage	3,000	Steel	Not in use	Gasoline
13	34	Garage	3,000	Steel	Not in use	Gasoline

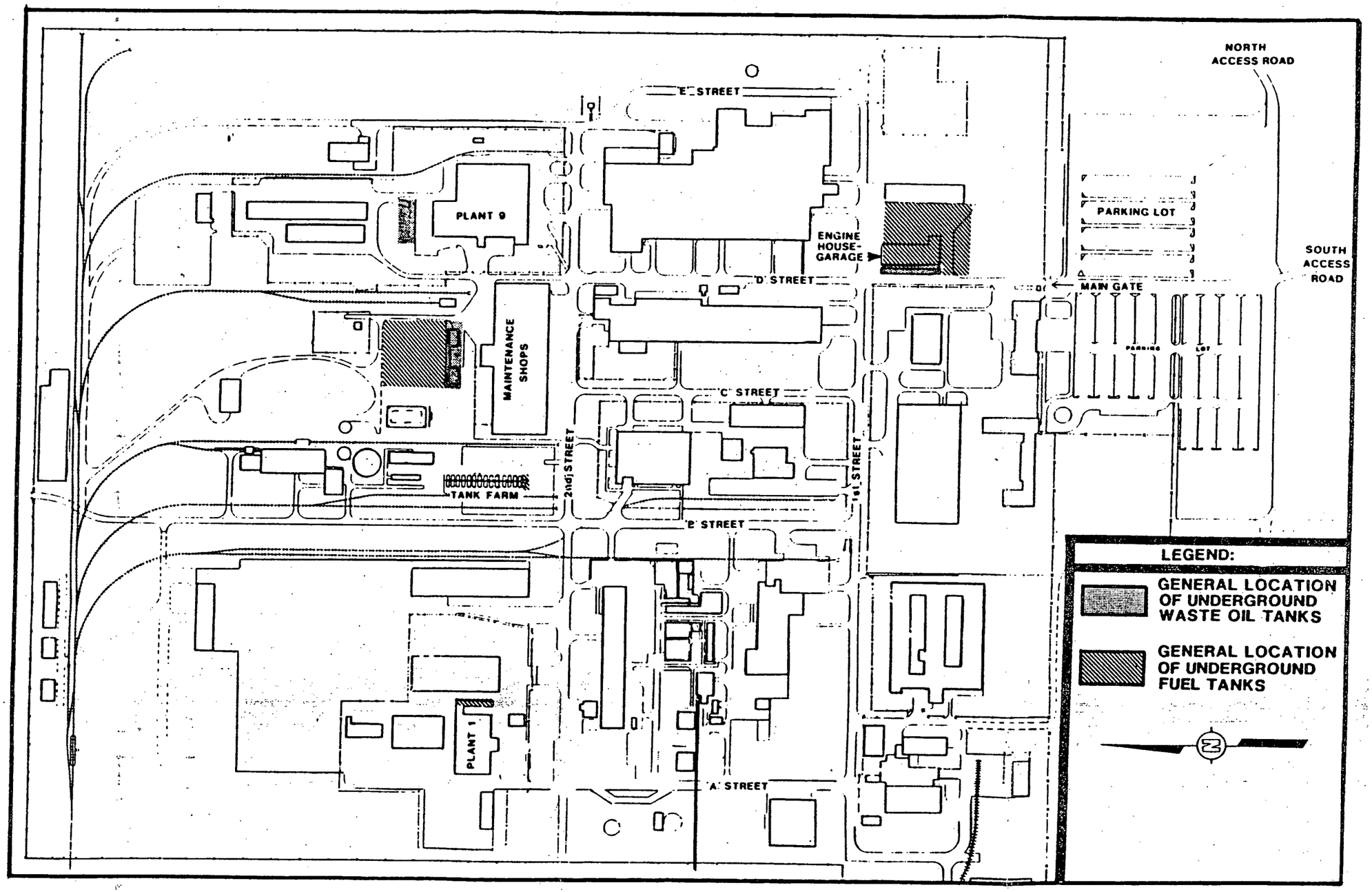

FIGURE 7.1 FACILITIES TESTING LOCATIONS: UNDERGROUND STORAGE TANKS

- Determine all operational characteristics, including flow rates and pressures;
- Examine detailed engineering drawings of each tank and line showing existing joints, flanges, fittings, valves, branches, and construction features, with notation showing sectionalizing points, and proposed test sections; and
- Prioritize the testing and investigative program to address those facilities with the highest potential for having created an environmental problem first.

Underground tanks and lines will be tested using the proprietary Petroleum Tank and Line Testing method (Petro-Tite). This method will comply with the requirements of Ohio Fire Code and NFPA 329, Recommended Practice for Handling Underground Leakage of Flammable and Combustible Liquids. This phase is expected to require six months, and testing is scheduled to begin in the spring of 1988. This procedure was selected because product circulation during the Petro-Tite testing provides better temperature compensation than other tests. The following general procedures will be used:

- The tank under test is filled completely with a compatible product or water; all air pockets and bubbles are carefully located and bled. Lines connecting to the tank are valved off, or otherwise isolated.
- A standpipe is set up to increase the static pressure in the tank by a measured amount, thus slightly displacing the ends of the tank.
- A recirculating pump system is used to thoroughly mix the product in the tank, eliminating temperature gradations or stratification. The temperature of the tank contents is measured and recorded.
- The product that was added to maintain a constant level of fuel for a specified time (i.e., replacing any leakage) is measured using a graduated beaker.
- The leakage rate of product per unit of time is computed.

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The integrity testing of the line from the Clearwell to Manhole 175, production storage pads, hazardous waste storage tanks, dikes, ancillary below-ground piping, and sumps will consist of the following procedures:

- Visual examination wherever possible;
- Pressure testing of storage tanks and underground piping;
- TV camera inspection of underground piping where feasible; and
- Volumetric level testing for sumps.

The main effluent line will be investigated by examining water flow gain or loss in the effluent line. This will be accomplished by installing flow measurement devices in the line at each of the four manholes between Manhole 175 and the Great Miami River. Flow measurement devices could consist of weirs installed in the channel, or ultrasonic flow meters. The following general procedures are used:

- The flow measurement devices are installed in the pipe at each manhole and calibrated.
- The flow from Manhole 175 is controlled so that it is steady, and flow in the pipe is allowed to come to steady state.
- Measurements are made and the flow at each manhole is calculated. Since no flow is added to or removed from the pipe, the flow at each manhole should remain the same.

The measurements are conducted under different ground water and flow conditions so that possible flow changes can be detected. The tests cannot be conducted when the pipe is flowing full.

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Sections of pipe with major losses or gains in flow indicate a high probability of cracking or other pipe failure, and will be investigated in greater detail.

7.5 TEST RESULTS

An underground tank leakage rate of more than 0.05 gallons per hour per tank is unacceptable (NFPA, Bulletin No. 329). Soils overlying tanks which show a higher rate of loss will be excavated for visual inspection of the tanks, and appropriate repair or replacement of the tank or its connecting lines will be considered. Tank features that do not comply with RCRA Subtitle I, Proposed Regulations, will be identified.

Any compromise to the integrity of the systems will necessitate the development of a sampling program to determine the nature and extent of any potential contamination and the possible need for remediation.