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Environmental Restoration Program

REMEDIAL INVESTIGATION/FEASIBILITY STUDY OPERABLE UNIT 9, SITE-WIDE FIELD SAMPLING PLAN

MOUND PLANT
MIAMISBURG, OHIO

May 1992

FINAL

Department of Energy
Albuquerque Field Office

Environmental Restoration Program
Technical Support Office
Los Alamos National Laboratory

REFERENCE USE ONLY

ENVIRONMENTAL RESTORATION PROGRAM

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FINAL

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LIST OF ACRONYMS

AA	atomic absorption spectrometry
ASTM	American Society for Testing Materials
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CGI	combustible gas indicator
CLP	Contract Laboratory Program
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration (Program)
FFA	Federal Facility Agreement
FIDLER	field instrument for the detection of low-energy radiation
FS	feasibility study
FSP	field sampling plan
GC	gas chromatography
ICP	inductively coupled plasma
IT	International Technologies
MS	mass spectrometry
MSL	mean sea level
NAS	National Academy of Science
NPDES	National Pollutant Discharge Elimination System
OVA	organic vapor analyzer
PCB	polychlorinated biphenyl
PID	photoionization detector
PM-10	particulates less than 10 microns
PUF	polyurethane foam
QAPP	Quality Assurance Project Plan
RI	remedial investigation
SCS	Soil Conservation Service
SIM	selective ion monitoring
SM/PP	Special Metallurgical/Plutonium Processing
SOP	Standard Operating Procedure
SOW	statement of work
SRDS	storm water retention and discharge system
TAL	Target Analyte List
TCE	trichloroethylene
TCL	Target Compound List
TDS	total dissolved solids
TOC	total organic carbon
TSP	total suspended particulates
TSS	total suspended solids
USATHAMA	U. S. Army Toxic and Hazardous Materials Agency
USGS	U.S. Geological Service
VOC	volatile organic compound

1. INTRODUCTION

1.1. SITE-WIDE INVESTIGATION, OPERABLE UNIT 9

The purpose of this field sampling plan (FSP) is to provide the information necessary to perform the field investigations for the remedial investigations (RI)/feasibility study (FS) at all locations covered by the Operable Unit 9, Site-Wide Work Plan for Mound Plant. This plan follows the Comprehensive Environmental Restoration, Compensation, and Liability Act (CERCLA)/Superfund guidance for conducting RI/FSs (EPA 1988c).

The Site-Wide Investigation, Operable Unit 9, addresses nine separate investigations: surface features, geology, hydrogeology and groundwater, soils, surface water and sediments, meteorology and air quality, human population and land use, and ecological. These investigations can be divided into two groups: those that provide information that is required by the Mound Plant Environmental Restoration (ER) Program (specifically to comply with the Federal Facilities Agreement [FFA]) (EPA 1990), and those that must address the area of investigation on a site-wide basis. Each of these investigations has two major components: to describe the physical and chemical nature of the media, and to define the extent of contaminants (if any) within the media. The nine investigations are described fully in the sections below, including background information, figures showing locations of interest, and a summary of sampling activities that will be performed.

The Site-Wide Work Plan provides information concerning the past investigations performed at Mound Plant, the objectives of this investigation, data requirements, and the statistical sampling approaches. In addition, the Site-Wide Work Plan provides information applicable to Mound Plant as a whole, including comprehensive background information, potential contaminants, identification of other operable units, regional setting, and plant history. This FSP contains a brief discussion of investigation background information and sampling objectives as well as more detailed discussions of sample locations and frequencies, sample designations, sampling equipment and procedures, and sample handling and analysis. Many of the investigations will be phased. This FSP contains only the information for the current phases.

1.2. GENERAL FIELD PROCEDURES

The types of work covered in this FSP are quite varied (Table I.1). Sample media include biota, groundwater, sediment, soil, and surface water. Some of these media require special field procedures that are described in their specific sections of this FSP. The general field procedures described in section 1 are applicable to groundwater, surface water, stream sediment, and soil sampling. However, many of the procedures described are also appropriate for the other media.

Table I.1. Operable Unit 9 Site-Wide Field Sampling Plan Work Summary

Investigation	Characterize the Media	Characterize the Extent of Contaminants Within Media
Surface features	Data compilation Buildings, tanks, and other structures	No sampling planned
Geology	Data compilation Literature search	No sampling planned
Hydrogeology and groundwater	Well installation Borehole geophysics Aquifer testing Hydrograph data Geotechnical sampling Geochemical sampling	Groundwater sampling in all wells for all contaminants of concern
Residential wells	Locate wells Compile well log Geochemical sampling	Water sampling in a select number of wells for all contaminants of concern; sediment sampling in residential cisterns
Soil	Off-plant geochemical sampling of soil types similar to those found at Mound Plant Focused geochemical sampling	Soil sampling for chemical and radioactive constituents
Surface water and sediment	Describe drainage/depositional features Geochemical sampling of water and sediments	Water and sediment sampling for all contaminants of concern
Meteorology and air quality	Phase I Work Plan not compiled at this date	No sampling planned
Human population and land use	Data compilation Demography	No sampling planned
Ecology	Biota count Habitat evaluation Wetlands delineation	No sampling planned at this phase of investigation

1.2.1. Identifying and Surveying Sampling Locations

Before or during sampling at any of the locations covered in Operable Unit 9, the locations described below will be identified and staked in the field. The stakes will be labeled with the sample identification information and located by a licensed surveyor. After the locations have been identified, they will be inspected by members of the Mound Plant engineering department, and a digging/excavation permit will be issued. Off-plant locations of intrusive work will be cleared with local utility companies. If a location is too close to a utility line, the location will be adjusted slightly, under the direction of a Mound Plant engineer or local utility officials. Once this permit is issued and the locations are cleared with the utility company, work may proceed in the area in question. Under no circumstances will a location be moved without the approval of the Mound Plant Engineers or local utility officials. If the sample locations are adjusted, they will be re-staked and located by a surveyor after the sample has been collected. The establishment of horizontal and vertical controls will achieve a precision of ±0.01 ft for the horizontal and vertical positions of permanent locations (e.g., monitoring wells) and ±0.1 ft for non-permanent locations (e.g., soil sample locations). The horizontal locations will be reported using the Ohio State Plane Coordinate System.

1.2.2. Sampling Equipment and Procedures

The sampling equipment and procedures to be used during this RI/FS will be according to the requirements of the Mound Plant ER Program Standard Operating Procedures (SOPs). The SOPs applicable to this field investigation are listed in Table I.2 and provided in Appendix A of the Site-Wide Quality Assurance Project Plan (QAPP). A separately bound copy of all SOPs will be provided to all field personnel and will be followed by all members of the field team. Equipment and procedures will be discussed in the pertinent sections below.

1.2.3. Decontamination of Personnel and Equipment

Personnel and equipment will be decontaminated during the RI/FS sampling in order to prevent the cross-contamination of samples and locations, to protect field personnel, and to prevent the spread of contamination within Mound Plant and off-plant. Personnel will be decontaminated as specified in the Site-Wide Health and Safety Plan before leaving the work area for breaks or at the end of the day. Equipment decontamination will be according to Mound Plant ER Program SOP 1.6, General Equipment Decontamination (revision 2). Following these decontamination procedures will minimize the possibility of spreading contamination.

Table I.2. RI/FS Standard Operating Procedures

Section 1 - General	Effective Date	Revision Number	Purpose
1.1 General Instructions for Field Personnel	March 1992	2	To provide field personnel with instructions regarding activities to be performed before, during, and after field investigations.
1.3 Sample Control and Documentation	March 1992	1	To define the steps necessary for sample control and identification, data recording, and chain-of-custody documentation.
1.4 Sample Containers and Preservation	March 1992	2	To provide guidance in the selection and preservation of suitable containers for samples, container cleaning, required sample volumes, sample collection, times, and the recommended holding preservation techniques for water, wastes, sediments, sludges, and soil samples.
1.5 Guide to the Handling, Packaging, and Shipping of Samples	May 1991	1	To provide a general guide for packaging and shipping samples of environmental and hazardous materials to the laboratory. In addition, instructions are provided to select the correct category for packaging and shipping samples of unknown contents.
1.6 General Equipment Decontamination	March 1992	2	To describe methods for the decontamination of field equipment potentially contaminated during sample collection.
1.8 Personnel Decontamination --Level D Protection	March 1992	1	To describe the equipment and procedures required for the decontamination of persons who have performed field activities in Level D protective clothing.
1.9 Personnel Decontamination --Level C Protection	March 1992	1	To describe the equipment and procedures required for the decontamination of persons who have performed field activities in Level C protective clothing.
1.10 Personnel Decontamination --Level B Protection	January 1991	0	To describe the equipment and procedures required for the decontamination of persons who have performed field activities in Level B protective clothing.
1.15 Guide to Waste Management	December 1991	1	To provide a general guide for the management of investigation-derived materials at the Mound Plant.

Table I.2. (page 2 of 4)

Section 2 - Water Sampling	Effective Date	Revision Number	Purpose
2.1 Presample Purging of Wells	March 1992	1	To identify well-purging procedures for evacuation of stagnant water from the well bore and its replacement by groundwater in sufficient quantities so that a water sample representative of the formation of completion can be collected.
2.2 Field Measurements on Ground and Surface Water Samples	March 1992	2	To obtain reliable and accurate measurements of the field chemistry of water quality samples.
2.3 Sampling Monitoring Wells with a Bladder Pump	March 1992	3	To use a bladder pump to obtain representative groundwater samples at shallow depths that are beyond the capabilities of a peristaltic pump.
2.4 Sampling Monitoring Wells with a Bucket-Type Bailer	June 1991	1	To obtain a representative groundwater sample at depths beyond the range (or capability) of suction lift pumps when bailer volatile air stripping is of concern, well-casing diameters are too narrow to accept submersible pumps, or other difficult conditions are present.
2.5 Sampling Monitoring Wells with a Submersible Pump	January 1991	0	To obtain a representative sample of the groundwater at depths beyond the capabilities of peristaltic pumps when bailing and bladder pumps are ineffective.
2.6 Sampling Monitoring Wells with a Peristaltic Pump	June 1991	1	To obtain a representative groundwater sample from a shallow well (less than 26 ft deep).
2.7 Sampling Commercial/ Municipal/Domestic Wells	June 1991	1	To define guidelines for field personnel to follow in sampling commercial, municipal, and domestic wells.
2.8 Sampling for Volatile Organics	January 1991	0	To outline procedures for collecting a representative groundwater sample and transporting it from its original environment to the laboratory for analysis of trace volatile organics.

Table I.2. (page 2 of 4)

Section 2 - Water Sampling	Effective Date	Revision Number	Purpose
2.9 Surface Water Sampling	June 1991	1	To define guidelines followed by field personnel in sampling surface water bodies and documenting all aspects of surface water sample collection.
2.10 Stream Flow Measurements Using Flumes, Velocity - Cross Sectional Area, and Direct Volume	March 1992	0	To define guidelines that will be followed by field personnel for measuring surface water flow rates in ditches, creeks, and springs using flumes, velocity cross sectional area method, and the bucket and stopwatch method.
2.11 Stream Flow Measurements Using Weirs	March 1992	0	To define guidelines that will be followed by field personnel for measuring surface water flow rates in rivers, creeks, springs, and ditches using weirs.

Table I.2. (page 3 of 4)

Section 3 - Hydraulic Testing	Effective Date	Revision Number	Purpose
3.1 Water Level Measurement	March 1992	1	To determine the depth-to-water in an open borehole, cased borehole, monitoring well, or potentiometer.
3.3 Operational Check of Pressure Transducers Used in Measuring Water Levels in Wells	September 1992	1	To describe procedures for conducting office and field checks of pressure transducers.
Section 4 - Drilling and Logging			
4.1 Soil Boring	March 1992	2	To ensure acceptable, consistent soil-boring procedures for all pertinent aspects of hazardous waste investigations.
4.1.1 Methods to Control Communications of Subsurface Contaminants with Groundwater	September 1992	1	To insure that acceptable, consistent soil-boring procedures are used to prevent communication of subsurface contaminants in vadose zone soils or landfill materials with underlying groundwater.
4.2 Rock Boring	March 1992	1	To ensure acceptable, consistent rock boring procedures for all pertinent aspects of hazardous waste investigations.
4.3 Monitoring Well Installation	March 1992	1	To ensure acceptable, consistent monitoring well installation.
4.4 Monitoring Well Development	March 1992	1	To remove foreign materials that may have been introduced into the groundwater, well annulus, or well screen during well installation and to facilitate hydraulic communication between the screened formation and the monitoring well.
4.7 Piezometer Installation	September 1992	1	To ensure acceptable, consistent piezometer installation.
4.8 Piezometer Development	September 1992	2	To remove foreign materials that may have been introduced into the groundwater, well annulus, or well screen during well installation and to facilitate hydraulic communication between the screened formation and the piezometer.

Table I.2. (page 3 of 4)

Section 5 - Soil Sampling	Effective Date	Revision Number	Purpose
5.1 Soil and Rock Borehole Logging and Sampling	March 1992	1	To describe the physical nature of consolidated or unconsolidated subsurface earthen materials encountered during auger, rotary, or other drilling or trenching activities and collect samples of the earthen materials for further evaluation.
5.2 Soil Sampling with a Spade and Scoop	March 1992	3	To describe a method for collecting a soil sample less than 4 ft below the land surface.
5.3 Subsurface Solid Sampling with Hand Auger and Thin-Wall Sampler	March 1992	2	To define a method of collecting subsurface solid samples with a hand auger and thin-wall tube sampler.
5.4 General Soil Gas Sampling and Field Chemical Analysis	January 1992	0	To define a method that ensures acceptable, consistent soil gas sampling and on-plant analysis with a gas chromatograph for volatile organic contaminants.
5.8 Soil Sampling with a Stainless Steel Surface Soil Sampler	October 1991	1	To define procedures for collecting surface soil samples to determine the chemical and physical soil properties.
5.9 Sediment Sampling Procedures for Streams, Rivers, and Ponds	March 1992	0	To describe the methods for collecting deposited sediment samples in streams, rivers, and ponds.

Table I.2. (page 4 of 4)

Section 6 - Health and Safety	Effective Date	Revision Number	Purpose
6.1. Health and Safety Monitoring of Combustible Gas Levels	March 1992	1	To describe the equipment and proper method for monitoring combustible gas levels in order to determine when an explosion hazard exists in the work environment.
6.2. Health and Safety Monitoring of Organic Vapors with a Photoionization Detector	March 1992	1	To describe the equipment and proper method for environmental monitoring of toxic gases and vapors using a portable photoionization detector (PID).
6.4 Total Alpha Surface Contamination Measurements	May 1992	1	To provide guidance for determining levels of total surface alpha contamination on equipment, vehicles, and personnel that have been in contact with material that was potentially contaminated with alpha-emitting radionuclides.
6.7 Near Surface and Soil Sample Screening for Low-Energy Gamma Radiation Using the FIDLER	May 1992	1	To describe the procedure in which a field instrument for the detection of low-energy radiation (FIDLER) is used to monitor surfaces and soil samples for the presence of low-energy gamma radiations that accompany some alpha emissions.
6.11 Beta-Gamma Radiation-Measurements	September 1992	1	To describe the methodology for measuring beta-gamma radiation levels.
6.15 Measurement of Gamma-Ray Fields Using a Sodium Iodide (NaI) Detector	January 1991	0	To describe the procedure for making count-rate measurements of a gamma-ray field with a sodium iodide (NaI) detector.

The water collected from decontamination procedures after sampling events on-plant will be sampled and analyzed for all potential contaminants in order to document the presence or absence of these types of contaminants. At the end of each day, the decontamination water will be collected in 55-gallon drums provided by Mound Plant. At the completion of the RI/FS, each of these drums will also be sampled for the contaminants of concern specific to the site investigations.

1.2.4. Field Quality Control Samples

Trip blanks, equipment rinsate blanks, field ambient blanks, field duplicates, and bottle lot blanks, as described below, will be collected in order to assess field quality control. The field sample identification plan for field quality control samples is outlined in Table I.3.

1.2.4.1. Trip Blanks

Trip blanks are used to evaluate organic contamination that may be introduced into the samples during shipment. Two 40-mL vials of reagent grade ASTM Type II water will be placed in each shipping container with samples for analysis of volatile organic compounds (VOCs). These vials will then be analyzed for VOCs according to the methods described in the QAPP.

1.2.4.2. Equipment Rinsate Blanks

Rinsate blanks are used to evaluate the success of the equipment decontamination process. After decontamination, the sampling equipment is rinsed a final time with reagent grade ASTM Type II water. The rinsate is collected and analyzed for the contaminants of concern. One rinsate blank will be collected at a frequency of one per group of 10 or fewer investigative samples collected.

1.2.4.3. Field Ambient Blanks/Sample Bank Blanks

Field ambient blanks are used to evaluate contamination that may be introduced to the samples from the ambient work area. They are made by placing an open sample of reagent grade ASTM Type II water in the work area, sealing the container, then shipping it with the samples collected that day. One field blank will be collected per work area or one for every group of ten samples (whichever is greater) and analyzed for contaminants of concern specific to that area. These analytes will be identified in the following site-specific discussions.

Table I.3. Field Quality Control Samples

Sample	Identification Scheme
Trip Blank	MNDXX-YYYY-2ZZZ
Field Ambient Blank/Sample Bank Blank	MNDXX-YYYY-3ZZZ
Field Duplicate	MNDXX-YYYY-1ZZZ
Equipment Rinsate Blank	MNDXX-YYYY-4ZZZ
Field Blank (Air)	MNDXX-YYYY-5ZZZ
Bottle Lot Blank	MNDXX-YYYY-6ZZZ

Notes:

MND = Mound Plant
XX = area or investigation identifier
YYYY = sample location number
ZZZZ = sample round or sample depth (soils, sediments)

MND20 - Groundwater samples
MND21 - Surface water samples
MND22 - Sediment samples
MND23 - Soil samples
MND24 - Residential water samples
MND25 - Residential cistern sediment samples

Tentative

MND26 - Air samples
MND27 - Ecological samples

Field quality control samples will be assigned a sample location number, area or investigation identifier, and sample round of the last sample of the associated sample batch.

1.2.4.4. Field Duplicates

Field duplicates are prepared to evaluate sample and sampling technique reproducibility. Although true duplicate samples are not possible for sediments, soil, and biota because these media are not homogeneous, thorough mixing will help make a more homogeneous sample. Duplicates will be collected for all sample types and analyzed for the contaminants of concern. If a sediment, soil, or biota sample is being analyzed for VOCs, a portion of the original sample needed for VOC analysis will be removed before the sample is mixed and split to form the duplicate. One field duplicate will be collected at a frequency of one per group of ten or fewer investigative samples collected.

1.2.4.5. Bottle Lot Blanks

Bottle lot blanks are prepared to evaluate the cleanliness of analytical sample bottles. A bottle lot blank will be prepared if there is an indication from the analytical results that a non-CLP analyte is a bottle contaminant. At least one bottle for each lot number of non-CLP analyte sample bottles will be stored in the shipping box for this purpose. This sample will only be prepared by the sample document control administrator (as defined in the QAPP). Preparation consists of filling the sample bottle with organic-free, deionized water (ASTM Type II quality) and capping it.

1.2.4.6. Matrix Spike/Matrix Spike Duplicates

Matrix spike and matrix spike duplicates are collected, where feasible, at sample locations with known contaminants or at locations with an unusual sample matrix (e.g., soil with high organic content). This will provide usable spike recovery information, giving an indication of positive or negative effects from the sample matrix. If these types of sample locations are not identified for a task, the matrix spike and matrix spike duplicate will be randomly selected at the specified frequency. Matrix spike/matrix spike duplicates are prepared to evaluate the effects of the sample matrix on the laboratory analytical results. In general, matrix spike/matrix spike duplicates are collected in the same manner as field duplicates (subsection 1.2.4.4). A matrix spike/matrix spike duplicate will be collected at a frequency of one per group of twenty or fewer investigative samples collected.

1.2.5. Sample Handling and Shipment

The samples obtained from the locations included in this investigation will be handled according to Mound Plant ER Program SOPs 1.3, Sample Control and Documentation (revision 1); 1.4, Sample Containers and Preservation (revision 2); and 1.5, Guide to Handling, Packaging, and Shipping of Samples (revision 1). These SOPs are included in Appendix A of the Site-Wide QAPP. Figure 1.1 shows an example of the

sample labels that will be used for each sample obtained during the RI/FS and an example of the custody seals that will be fixed to each sample cooler. Figure 1.2 shows the chain-of-custody form that will be completed for each sample shipment. The samples will be containerized and preserved as appropriate for the intended analytes. Tables I.4, I.5, and I.6 give the container requirements for water, soil/sediment, and air, respectively.

For all soil and sediment samples from on-plant locations and both on-plant and off-plant groundwater samples, a portion of each sample (500 mL) obtained during the field investigation will be screened for radioactivity by the Mound Plant soil sample screening facility (Draper 1988). This screening is performed in order to identify the nature and concentrations of radionuclides present in accordance with the U.S. Department of Transportation (DOT) and U.S. Department of Energy (DOE) Order 5400.5. This on-plant screening must be performed before a sample is released from Mound Plant. It is not part of the analytical package; however, these screening results will be included with the corresponding samples shipped to the analytical laboratory in order to provide the laboratory with information concerning the radioactivity levels in the samples they are handling. The analytical laboratories will screen 1 out of every 10 samples (consisting of an additional 40-mL volatile organic analysis vial) to confirm the Mound Plant screening facility results.

SOIL SAMPLE IDENTIFICATION LABEL

FACILITY CODE _____ LOCATION ID _____

SAMPLE ID _____ LOG DATE _____

LAB CODE _____ LOG TIME _____

SAMPLER _____ LOGGER CODE _____

SAMPLE DEPTH INTERVAL FROM DATUM

BEGINNING DEPTH (FT FROM DATUM) _____

ENDING DEPTH (FT FROM DATUM) _____

ANALYSIS REQUESTED _____

COMMENTS _____

SSL-132

WATER SAMPLE IDENTIFICATION LABEL

FACILITY CODE _____ LOCATION ID _____

SAMPLE ID _____ LOG DATE _____

LAB CODE _____ LOG TIME _____

SAMPLER _____ LOGGER CODE _____

ANALYSIS REQUESTED _____

PRESERVATION METHOD _____

COMMENTS _____

WSL-133

WESTON

CUSTODY SEAL

_____ Date

_____ Signature

Figure 1.1. Soil sample, water sample, and chain-of-custody labels.

Custody Transfer Record/Lab Work Request

WESTON

WESTON Analytics Use Only

Client _____
Work Order _____
Date Rec'd. _____ Date Due _____
RFW Contact _____
Client Contact/Phone _____

			Refrigerator#								
			#/Type Container								
			Containers/Volume								
			Preservative								
			ANALYSES REQUESTED ➡								
WA Use Only Lab ID	Client ID/Description	Matrix	Date Collected								

Matrix:
S - Soil
SE - Sediment
SO - Solid
W - Water
O - Oil
A - Air
DS - Drum Solids
DL - Drum Liquids
F - Fish
X - Other

Special Instructions:

Item/Reason	Relinquished by	Received by	Date	Time	Item/Reason	Relinquished by	Received by	Date	Time

WESTON Analytics Use Only

Samples Were:
1 Shipped or Hand-Delivered
NOTES:

2 Ambient or Chilled
NOTES:

3 Received Broken/Leaking (Improperly Sealed)
Y N
NOTES:

4 Properly Preserved
Y N
NOTES:

5 Received Within Holding Times
Y N
NOTES:

COC Tape Was:
1 Present on Outer Package Y N
2 Unbroken on Outer Package Y N
3 Present on Sample Y N
4 Unbroken on Sample Y N
NOTES:

COC Record Was:
1 Present Upon Receipt of Samples Y N

Discrepancies Between Sample Labels and COC Record? Y N
NOTES:

RFW 21-21-001/A-5/88

7-115

Figure 1.2. Chain-of-custody record.

Table I.4. Sample Containers, Volumes, Preservation, and Holding Times: Groundwater/Surface Water Samples

Parameters	Analytical Method	Container[a]	Minimum Volume	Preservation	Holding Time[b]
Purgeable Halocarbons	SW5030/SW8010	Glass vial with Teflon-lined septum (No headspace)	Two 40 mL vials	Cool 4°C	14 days
Purgeable Aromatic Compounds	SW5030/SW8020	Glass vial with Teflon-lined septum (No headspace)	Two 40 mL vials	HCl to pH <2 Cool 4°C	14 days
Acrylonitrile, Acetonitrile	SW5030/SW8030	Glass vial with Teflon-lined septum (no headspace)	Two 40-mL vials	Cool 4°C	14 days
Volatile Organic Compounds	CLP SOW and 502.2	Glass vial with Teflon-lined septum (No headspace)	Two 40 mL vials	HCl to pH <2 Cool 4°C	14 days
Semivolatile Organic Compounds	CLP SOW	Amber glass bottle with Teflon-lined lid	Two 1000 mL bottles	Cool 4°C	7 days extraction/40 days analysis[c]
Pesticides/PCBs	CLP SOW	Amber glass bottle with Teflon-lined lid	Two 1000 mL bottles	Cool 4°C	7 days extraction/40 days analysis[c]

Table I.4. (page 2 of 3)

Parameters	Analytical Method	Container[a]	Minimum Volume	Preservation	Holding Time[b]
Metals or Lanthanides	CLP SOW Modifications A, B, or C	Polyethylene bottle	1000 mL	HNO_3 to pH <2, Cool 4°C	6 months, 28 days (Mercury)
Cyanide	CLP SOW	Polyethylene bottle	1500 mL	NaOH to pH >12 Cool 4°C	14 days
Nitrate-Nitrite	E353.2	Polyethylene bottle	500 mL	H_2SO_4 to pH <2 Cool 4°C	28 days
Fluoride	E340.2	Polyethylene bottle	500 mL	Cool 4°C	28 days
Ammonia	E350.1 or 350.3	Polyethylene bottle	500 mL	Cool 4°C H_2SO_4 to pH <2	28 days
Nitrite	E354.1	Polyethylene bottle	150 mL	Cool 4°C	48 hours
Sulfate Chloride	E375.2 E325.1	Polyethylene bottle	500 mL	Cool 4°C	28 days
Total Nitrogen Total Phosphorus	E351.3 E365.1	Polyethylene bottle	1000 mL	H_2SO_4 to pH < 2, Cool 4°C	28 days
Total Organic Carbon	E415.1/E415.2	Amber glass bottle with Teflon-lined lid	250 mL	H_2SO_4 or HCl to pH < 2, Cool 4°C	28 days
Total Dissolved Solids	E160.1	Polyethylene bottle	1000 mL	Cool 4°C	7 days

Table I.4. (page 3 of 3)

Parameters	Analytical Method	Container[a]	Minimum Volume	Preservation	Holding Time[b]
Total Suspended Solids	E160.2	Polyethylene bottle	1000 mL	Cool 4°C	7 days
Alkalinity	E310.1	Polyethylene bottle	200 mL	Cool 4°C	14 days
Explosives	USATHAMA	Amber glass bottle with Teflon-lined lid	1 liter	Cool 4°C	7 days extraction/ 30 days analysis[c]
Radionuclides	Nuclear Data, Inc.	Plastic cubetainer	2x4 liter	HNO_3 to pH < 2 (15 mL 1 N HNO_3 per liter)	NA
Gamma Spectrometry	1986				
Plutonium Isotopes	NAS 1965				
Thorium Isotopes	NAS 1960				
Radium-226	ASTM D2460-70				
Americium-241	EML Am-01				
Uranium-241	NAS 1962				
Strontium-90	NAS 1960				
Tritium	E906.0	Glass bottle	250 mL	None	None

NOTE: Holding times for CLP analyses are based on "Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses," EPA, February 1, 1988 and "Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses," EPA, July 1,1988.
[a]Sample containers will be certified cleaned by the manufacturer according to EPA standards.
[b]From date of collection.
[c]From date of extraction.

Table I.5. Sample Containers, Volumes, Preservation, and Holding Times: Soil/Sediment Samples

Parameters	Analytical Method	Container[a]	Minimum Volume/Weight	Preservation	Holding Time[b]
VOCs	CLP SOW	Glass vial with septum (Teflon-lined)	120 mL with no headspace	Cool 4°C	14 days
Semivolatile organic compounds	CLP SOW	Amber glass jar with Teflon-lined lid	100 grams	Cool 4°C	7 days extraction/ 40 days analysis[d]
Pesticides/PCBs	CLP SOW	Amber glass jar with Teflon-lined lid	100 grams	Cool 4°C	7 days extraction/ 40 days analysis[d]
Metals	CLP SOW	Wide-mouth poly-ethylene bottle	100 grams	Cool 4°C	6 months 28 days (mercury)
Total Organic Carbon	E415.1/E415.2	Amber glass jar with Teflon-lined lid	50 grams	Cool 4°C	28 days
pH	SW9045	Wide-mouth poly-ethylene bottle	50 grams	NA	48 hours
Cyanide	CLP SOW	Wide-mouth poly-ethylene bottle	100 grams	Cool 4°C	14 days
Fluoride	E340.2	Wide-mouth poly-ethylene bottle	50 grams	Cool 4°C	28 days
Nitrate/nitrite Chloride Sulfate	E353.2 SW9250 E375.2	Wide-mouth poly-ethylene bottle	100 grams	Cool 4°C	28 days
Cation exchange capacity	SW9081	Wide-mouth poly-ethylene bottle	100 grams	Cool 4°C	NA

MDFSPTI5.DOC

Table I.5. (page 1a of 2)

Parameters	Analytical Method	Container[a]	Minimum Volume/Weight	Preservation	Holding Time[b]
Explosives	USATHAMA	125-mL wide-mouth amber glass jar with Teflon-lined lid	100 grams	Cool 4°C	7 days extraction/ 30 days analysis[d]
Radionuclides					
Gamma spectrometry[e]	Nuclear Data, Inc. 1986	Wide-mouth nalgene bottle	750 grams	None	NA
Tritium	E906.0				
Plutonium isotopes	NAS 1965				
Thorium isotopes	NAS 1960				

Table I.5. (page 2 of 2)

Parameters	Analytical Method	Container[a]	Minimum Volume/Weight	Preservation	Holding Time[b]
Radionuclide (continued)					
Uranium isotopes	NAS 1962				
Strontium-90	NAS 1960				
Particle size distribution	ASTM D422-63	1-gallon wide-mouth plastic jar	5 lbs	NA	NA
Specific gravity	ASTM D854-83			NA	NA
Permeability	ASTM D2434-68				
Relative density	ASTM D4254-83				
Maximum density	ASTM D4253-83				
Moisture/organic content	ASTM D2974-87	Wide-mouth polyethylene bottle	500 grams	Air-tight Cool 4°C	7 days

NOTE: Holding times for CLP analyses are based on "Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses," EPA, February 1, 1988, and "Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses," EPA, July 1, 1988 (EPA 1988a; 1988b).

[a]Sample containers will be certified cleaned by the manufacturer according to EPA standards.
[b]From date of collection
[c]Footnote deleted in revision
[d]From date of extraction
[e]Gamma spectrometry for soils will include at least americium-241, actinium-227 by equilibrium with thorium-227, bismuth-207, bismuth-210m, cesium-137, cobalt-60, potassium-40, and radium-226 by equilibrium with radon-222, a daughter product.

ASTM -American Society for Testing Material
CLP - Contract Laboratory Program
EPA - U.S. Environmental Protection Agency
ER - Environmental Restoration
NA - not available
SOP - standard operating procedure
SOW - Statement of Work
USATHAMA - U.S. Army Toxic and Hazardous Materials Agency
VOC - volatile organic compound

Table I.6. (page 1 of 2) deleted from text. This page intentially left blank.

Table I.6. (page 2 of 2) deleted from text. This page intentially left blank

The radioactive shipping class will be determined in accordance with DOT requirements and will depend on the radionuclides present and their concentrations, which will be determined by the on-plant screening performed by Mound Plant. Samples with concentrations of radioactivity in excess of 2,000 picocuries/gram (pCi/g) (2 nanocuries [nCi]/g) will be shipped as radioactive samples according to DOT requirements (given in 49 CFR 172 and 173) (CFR 1989) and DOE Order 5400.5. In addition, the analytical laboratory will be notified in the unlikely event they are to receive samples with concentrations of radioactivity greater than 20,000 pCi/g (20 nCi/g).

2. SURFACE FEATURES

No field work is planned for the study of surface features. See the Site-Wide Work Plan for a discussion of the type of work planned for the study of surface features.

3. GEOLOGY

No field work is planned for the study of geology. See the Site-Wide Work Plan for a discussion of the type of work planned for the study of geologic features.

4. HYDROGEOLOGY AND GROUNDWATER INVESTIGATIONS

4.1. BACKGROUND INFORMATION

The hydrogeology and groundwater investigations are being conducted to evaluate the water-bearing formations and the nature and extent of groundwater contamination for Mound Plant and the surrounding area. The field work included in these investigations has been designed to answer these questions, as well as the specific objectives listed below (subsection 4.2). The types of field investigations include: continuous lithologic sampling and description; borehole sampling for geochemical, geotechnical, and mineralogical testing; borehole geophysics and seismic refraction studies; monitoring well installation; piezometer installation; hydrologic monitoring of groundwater levels; and groundwater sampling.

4.2. INVESTIGATION OBJECTIVES

The characterization of the physical properties of the groundwater systems at Mound Plant includes the following objectives:

- Refine the interpretation of the thickness and extent of lithologic and hydrostratigraphic units.
- Determine the geotechnical properties of hydrostratigraphic units.
- Determine groundwater flow patterns and seasonal variations in flow.
- Determine the hydraulic relationship of hydrostratigraphic units.
- Further evaluate the bedrock groundwater flow system.

The characterization of the extent and nature of contaminants in the groundwater includes the following objectives:

- Determine background levels of chemical constituents at locations unaffected by Mound Plant operations.
- Evaluate bedrock groundwater quality on the Main Hill, SM/PP Hill, in the tributary valley, and in the new property.
- Determine the extent of contaminants downgradient of Mound Plant, east of the Great Miami River.
- Further define the lateral and vertical extent of groundwater contamination from Area B and the tributary valley into the Buried Valley aquifer.

4.3. WELL AND PIEZOMETER INSTALLATION, BOREHOLE SAMPLES: LOCATION AND FREQUENCY

The following paragraphs explain, by well number then by piezometer number, the number of boreholes and the expected depths at each location. The samples required from each borehole are also described. The proposed wells are listed on Table IV.1. Piezometers are listed on Table IV.2. Figures 4.1 and 4.2 show the locations of wells and piezometers, respectively. Most piezometers will be installed at the water table. Predicted depths of wells are based on the lithology in nearby boreholes.

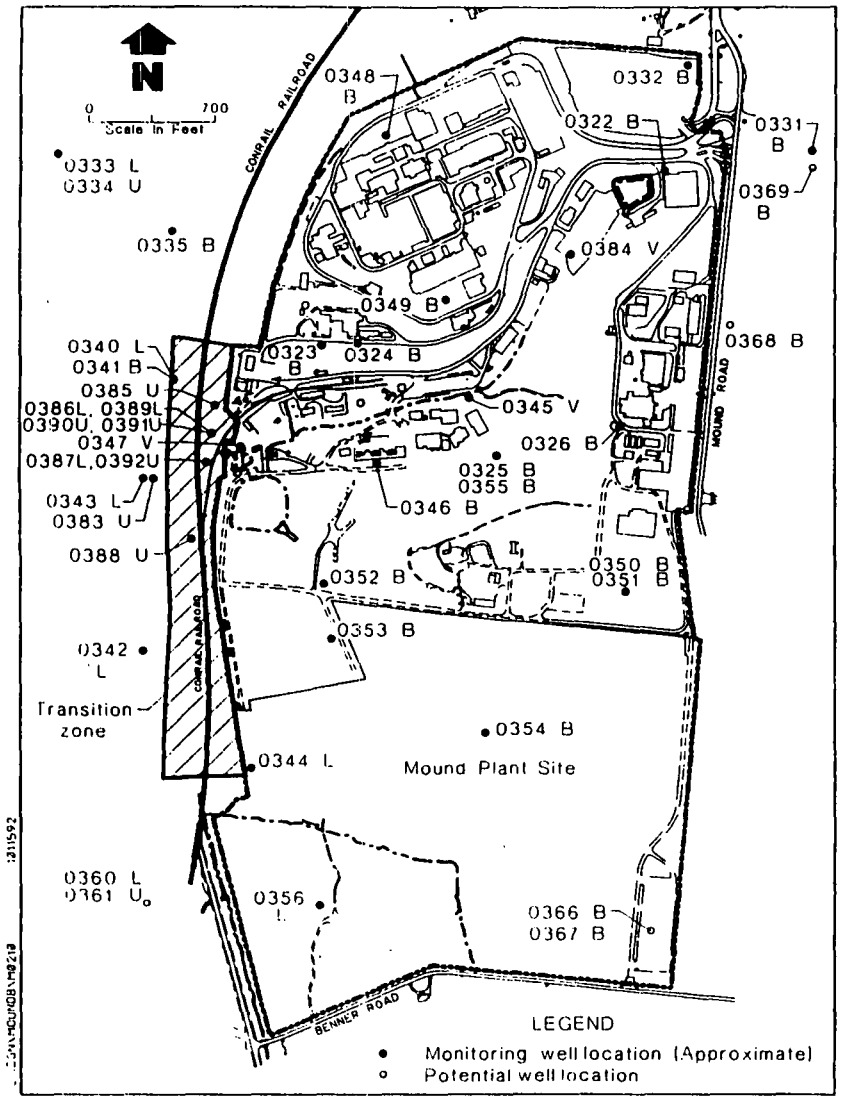
If there is no previous record of stratigraphy at a well location, the initial hole will be drilled to the top of bedrock to establish the thickness of each stratigraphic unit. Additional wells may be clustered with the initial if certain conditions exist that are described below. Generally, if an outwash unit is 50 ft thick, a vertical gradient may be measurable, depending on stratigraphy. Since the water table fluctuates up to 5 ft over the course of the year, well screens should be installed so they are always totally in the saturated zone.

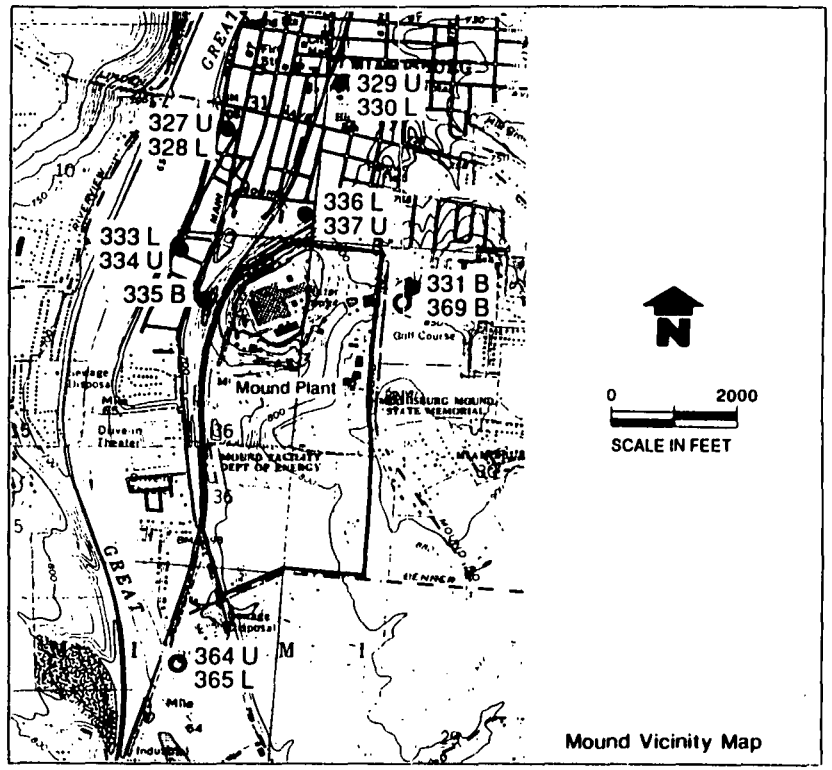
4.3.1. Well Installation

As part of this investigation, there will be 43 groundwater monitoring wells installed at various locations in and around Mound Plant; the installations of 5 of these are dependent on local conditions. The locations have been determined from the rationales listed in Table IV.1, and are shown in Figure 4.1. Proposed well and piezometer locations will be modified, as necessary, based on physical access and consent of landowners.

Well 0322 will be installed just north of the asphalt-lined pond. This well will be screened in the first saturated zone in the bedrock or at the bedrock contact. An expected 10 to 15 ft of unconsolidated material overlies the shale bedrock. The water table is expected in the first 5 ft of bedrock or at the bedrock contact. Required samples include continuous core for the total drilling depth and geochemical samples every 5 ft from the surface to the total depth of the well.

Wells 0323 and 0324, located south of the WD Building, will be used to monitor groundwater quality in the first saturated zone in the bedrock or at the bedrock contact. The wells will be installed in the tributary valley, on the southern slope of the Main Hill. Well 0324 will be installed adjacent to 0227, and well 0323 will be installed approximately 200 ft to the west of 0234. An expected 15 ft of unconsolidated material overlies weathered bedrock. Unweathered bedrock is probably 30 ft deep at this location. The water table is expected at a depth of 15 to 20 ft, probably at the bedrock contact. Required samples for both 0323 and 0324 include continuous core for the total drilling depth and geochemical samples every 5 ft from the surface to the total depth of the well.





LEGEND

Formation of Completion:

- U Upper Buried Valley Outwash
- L Lower Buried Valley Outwash
- B Bedrock
- V Tributary Valley Outwash
- T Till

Figure 4.1. Proposed locations of new monitoring wells.

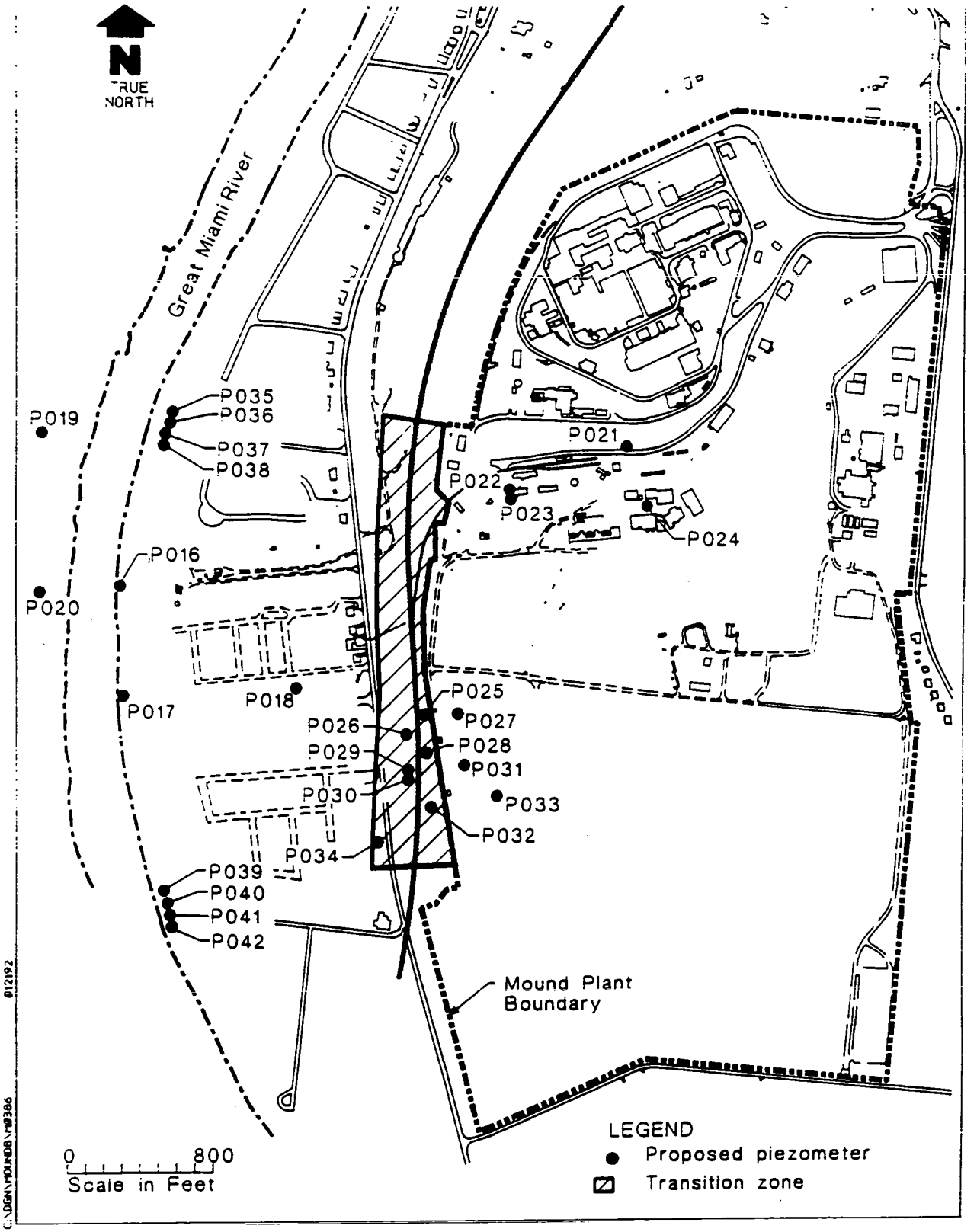


Figure 4.2. Proposed locations of new piezometers.

Well 0325 is paired with 0355. These wells will be located to the southeast of Building 49 on the north slope of the SM/PP Hill. There is a small surface depression at the head of a ditch at the location. Well 0325 will be screened in the first saturated zone in bedrock or the bedrock contact, although it is unlikely there is much unconsolidated material at this location on the SM/PP Hill. A single sample will be taken from the screened interval in well 0325 to confirm the stratigraphy. Well 0355 will be screened in deep bedrock at river stage in order to observe the effects of the Great Miami River on the deep groundwater flow. The depth, which is the elevation of the rig minus the elevation of the river (690 ft), is expected to be from 130 to 150 ft. Geochemical samples from the vadose zone and at the water table are required for 0355. During drilling of 0355, continuous core will be collected. In addition, a full suite of geophysical logs will be run on 0355 before it is cased. There are no adjacent wells, but the expected depth to a saturated zone is 30 ft.

Well 0326 will be drilled and screened in shallow bedrock (first saturated zone). It will be located east of the tributary valley at the top of the SM/PP Hill. Depth to water may be deep. The water table in 0121, located northeast of 0326, is at approximately 100 ft, but a shallow zone may be present in 0326. The required samples for 0326 include continuous core for the entire depth and geochemical samples every 5 ft from surface to 20 ft for possible shallow source characterization.

Two well pairs, 0327/0328 and 0329/0330, will be located in Miamisburg. Wells 0327 and 0328 will be installed near the Great Miami River just west of Main Street. Well 0327 will be screened at the water table at a depth of approximately 25 ft. Well 0328 will be screened in the Buried Valley aquifer at the top of bedrock, a depth of approximately 150 ft. Although there are no nearby wells, the expected lithology is an upper and lower outwash unit separated by till. During drilling of 0328, continuous core will be collected for the total drilling depth and geochemical samples will be taken from the vadose zone and at the water table. In addition, a natural gamma ray log will be run on 0328. A single core sample will be taken from the screened interval in well 0327 to confirm stratigraphy.

The second pair, 0329 and 0330, will be located at the Library Park in Miamisburg. The screened intervals and approximate depths are the same as for well pair 0327/0328. Required samples for 0330 include continuous core for the total drilling depth and geochemical samples from the vadose zone and at the water table. In addition, a natural gamma ray log will be run on 0330. A single core sample will be taken from the screened interval in well 0329.

Well 0331 will be installed east of Mound Plant's main entrance, in the Miamisburg Municipal Golf Course. This well will be screened in the first saturated zone in the bedrock or at the bedrock contact for information on how water moves in the shallow bedrock system. The predicted depth to water is 20 ft, but it may be deeper since depth to water in well 0121, to the southwest, is 100 ft. The required samples for

0331 include continuous core for the entire depth and a geochemical sample in the vadose zone and at the water table.

Well 0332 is located in the northeast corner of Mound Plant. This well will be screened in the first saturated zone in the bedrock. Its approximate drilling depth is 35 ft. It is possible that the first saturated zone is at a depth of 100 ft as it is in 0121 to the south. The required samples for 0332 include continuous core for the entire depth and a geochemical sample in the vadose zone and at the water table.

Well 0333 will be installed adjacent to the river, northeast of Mound Plant. It will be drilled to below the till layer, approximately 80 ft, and then screened at an approximate depth of 60 ft at the top of the lower outwash. Required samples for 0333 include continuous core for the total drilling depth and a geochemical sample in the vadose zone and at the water table. In most areas, the till layer is from 5 to 15 ft thick. It can occur at any depth from 20 to 90 ft. In addition, a natural gamma ray log will be run on well 0333. Well 0334 will be drilled in a cluster with 0333 and screened at the water table at an approximate depth of 25 ft. A single sample will be collected from the screened interval (about 25 ft deep) to confirm stratigraphy.

Well 0335 will be installed on the west slope of the Main Hill, on the west side of the Conrail Railroad, adjacent to the northern portion of the Miami-Erie Canal. The well will be drilled into bedrock to the depth of the Great Miami River's stage. The depth is expected to be about 60 ft. Some unconsolidated material may be encountered during the first 10 to 15 ft of drilling; however, most of the drilling will be in the bedrock. Required samples for 0335 include continuous core for the total drilling depth, geochemical samples in the vadose zone and at the water table, and a full suite of geophysical logs before the well is cased.

Another well pair, 0336 and 0337, will be installed on the north slope of the Main Hill near the intersection of the Conrail Railroad and Mound Avenue. The first hole at this location, well 0336, will be drilled to bedrock (50 to 100 ft) and continuously cored. If the total saturated thickness is less than 50 ft, 0336 will be screened at the water table. If the saturated thickness is great enough, 0336 will be screened just above bedrock, and 0337 will be drilled and then screened at the water table. Depth to water is probably 25 to 30 ft at this location; total depth is unknown. Well 0336 will be continuously cored from surface to total depth, and geochemical samples will be collected in the vadose zone and at the water table. A single sample will be taken from the screened interval in well 0337 to confirm stratigraphy. (Note: Additional wells may be considered at this location if more than one stratigraphic unit is encountered.)

Wells 0340 and 0341 will be installed west of the Conrail Railroad and west of well 0312. The purpose of these wells is to help define the complex lithology and groundwater flow system at the mouth of the tributary valley. Well 0340 will be completed in outwash, and well 0341 will be completed in the bedrock.

Based on the lithologic logs of other wells in the area, 0312 and 0123, the depth to bedrock is probably 50 to 60 ft. Depth to water is around 30 ft. Well 0341 will be drilled first in order to determine if there are two separate outwash units. Well 0341 will be screened in the first 10 ft of bedrock. Well 0340 should be screened in the lower outwash if it is present. Otherwise, 0340 will be screened in a transmissive unit above the bedrock. Well 0341 will be continuously cored, geochemical samples will be taken in the vadose zone and at the water table, and two geotechnical samples will be collected in the saturated unconsolidated deposits. A natural gamma ray log will also be run on 0341. A single sample will be taken in the screened interval in well 0340.

Well 0342 will be installed adjacent to 0156, 0157, and 0304, located west of the highway. It will be drilled to bedrock, an approximate depth of 150 ft, and finished at the base of the lower outwash unit. An adjacent well, 0304, shows a clay interval at about 90 ft, which may be the till that separates the two outwash units. The water table in these wells is from 15 to 20 ft below the surface. Required samples for 0342 include continuous core; geochemical samples from the vadose zone and at the water table; three samples for X ray diffraction from clay-rich zones: one in the upper outwash, one in the till, and one in the lower outwash; and six geotechnical samples. Two geotechnical samples should be collected from the upper outwash, two from the till, and two from the lower outwash. A natural gamma ray log will also be run on this well.

Wells 0343 and 0383 will be installed adjacent to the existing well 0303. The different screened depths in these wells will be used to collect information on vertical gradients in the Buried Valley aquifer. The approximate drilling depths are 150 and 40 ft, respectively. Well 0343 will be screened at the base of the lower outwash, and well 0383 will be screened in the upper outwash at the water table. Lithology in the adjacent well, 0303, indicates that more than one till layer may be present (one at 50 ft and one at 80 ft). Well 0343 will be drilled to bedrock. Required samples for 0343 are continuous core; geochemical samples from the vadose zone and at the water table; three samples for X ray diffraction analysis from clay-rich zones: one in the upper outwash, one in the till, and one in the lower outwash; and six geotechnical samples. Two geotechnical samples should be collected from the upper outwash, two from the till, and two from the lower outwash. A natural gamma ray log will also be run on this well. A single sample will be taken from the screened interval in well 0383 to confirm stratigraphy.

Well 0344 will be clustered with 0319, just south of the Mound Plant production wells. This well pair will provide information of the effects of the production wells on the groundwater flow system and possible downgradient contamination. Depth to water is approximately 20 to 25 ft. Well 0344 will be drilled to bedrock and screened in the lower outwash at the top of the bedrock. Its predicted depth is 150 ft. Required samples for 0344 are continuous core, geochemical samples from the vadose zone and at the water table, and six geotechnical samples. Two geotechnical samples should be collected from the upper

outwash, two from the till, and two from the lower outwash. A natural gamma ray log will also be run on this well.

Well 0345 will be installed north of Building 49. In order to monitor the area for possible contamination, well 0345 will be located at the confluence of the main valley and a small channel on the SM/PP Hill. This well will be drilled to bedrock, probably from 50 to 80 ft. Well 0345 will be screened in the upper outwash if sufficient saturated thickness exists; if not, it will be screened in the top of the bedrock. Required samples for 0345 are continuous core and geochemical samples, taken at 5-ft intervals from the water table to bedrock. A natural gamma ray log will also be run on this well.

Well 0346 will be installed on the northwest slope of the SM/PP Hill in the vicinity of the older well 0052. This well will be drilled to and screened in the first saturated zone in bedrock. Well 0052 is essentially dry and screened at 36 ft in the top of bedrock. The estimated depth for 0346 is 50 to 100 ft. Required samples for 0346 are continuous core, geochemical samples from the vadose zone and at the water table, and two geotechnical samples from the saturated unconsolidated deposits. A natural gamma ray log will also be run on this well.

Well 0347 will be clustered with 0137 and 0315 in order to monitor groundwater quality at the mouth of the tributary valley. It will be drilled to bedrock, estimated at 120 ft, and completed in the Buried Valley aquifer at the top of the bedrock. Adjacent well logs show from 0 to 20 ft of fill over a thin till layer (0 to 20 ft) and a thick section of outwash. There is no record of the stratigraphy deeper than 75 ft. Required samples for 0347 are continuous core and geochemical samples, taken at 5-ft intervals from the water table to bedrock. A natural gamma ray log will also be run on this well.

Well 0348 will be clustered with well 0113, north of the OS Building. The well will be drilled to and screened at river stage, approximately 200 ft, to establish the effect of the Great Miami River on the deep water pressure surface. The entire borehole will be in bedrock. The required samples for 0348 are continuous core, a geochemical sample in the vadose zone and at the water table, and a full suite of geophysical logs before the well is cased.

Well 0349, on the southern slope of the Main Hill, will be drilled to and screened in deep bedrock at the depth of the river stage, about 150 ft. Well 0349 will provide information on the effects of the Great Miami River on the deep water flow system. The entire borehole will be in bedrock. Water table is expected at about 17 ft. The required samples for 0349 are continuous core, geochemical samples taken at 5-ft intervals from the ground surface to 20 ft below ground surface, and a full suite of geophysical logs taken before the well is cased.

Well 0350 is paired with 0351 at the top of the SM/PP Hill just west of the guard shack. Well 0350 will be drilled to and screened at river stage, about 200 ft. The water level may be as deep as 100 ft in this area, but its depth is unknown. The required samples for 0350 are continuous core, a geochemical sample in the vadose zone and at the water table, and a full suite of geophysical logs before the well is cased. No samples are required for well 0351, which will be screened in the first saturated zone. Depth to water is predicted at 25 ft but may be as deep as 100 ft.

Well 0352 will be installed at the southeast corner of the site sanitary landfill. It will be drilled deep enough to hit both bedrock and river stage. The total depth must be about 50 ft for river stage and deeper if the drill hole is still in the unconsolidated sediments. The well will be screened at river stage. Well 0352 will be paired with a shallow well that is to be drilled as part of Area B, Operable Unit 1 (DOE in progress). Depth to water is expected to be 40 to 50 ft. The required samples for 0352 are continuous core, a geochemical sample in the vadose zone and at the water table, and a full suite of geophysical logs before the well is cased.

Well 0353 will be finished at the first saturated zone in the bedrock at the base of the SM/PP Hill, upgradient of the spoils area. This well will be used to monitor groundwater quality off the SM/PP Hill. Depth to water in this area is predicted to be 35 to 45 ft. The required samples for 0353 are continuous core and a geochemical sample in the vadose zone and at the water table.

Well 0354 will be installed on the south slope of the SM/PP Hill in the vicinity of well 0817 and seep 0609. It will be drilled to, and screened in, the first saturated zone in the bedrock. Depth to water is unknown, but well 0817 is essentially dry at 15 ft. After the first few feet, drilling will be completely in bedrock. The required samples for 0354 are continuous core and a geochemical sample in the vadose zone and at the water table.

Well 0356 will be clustered with 0320 in the southwest corner of the new property. It will be drilled to the top of bedrock and screened in the lower Buried Valley aquifer at the top of the bedrock. Depth to water is approximately 25 ft. The geologic log from 0320 shows alternating sands, gravels, and silts, with a 13- to 14-ft till layer starting at 22 ft. Well 0320 was drilled to 117 ft without reaching bedrock. The required samples for 0356 are continuous core and a geochemical sample in the vadose zone and at the water table.

Well 0384 is located in the parking lot south of Building 98, at the top of the tributary valley. The area has been documented through photos as a historical disposal area. The borehole will be in man-made fill for the first 20 to 30 ft. It is not known whether there is any outwash or till at this location below the fill; therefore, the well will be drilled to bedrock and screened at the top of bedrock if a saturated zone is

present. Otherwise, the well will be drilled to the first saturated zone in the bedrock. The water level in this well is expected to be around 50 ft. The required samples for 0384 are continuous core and geochemical samples every 5 ft from the surface to the total depth of the well.

Well 0385 is located at the mouth of the tributary valley. The thickness of the stratigraphic units increases rapidly in this area. The well will be drilled to bedrock, which may be up to 120 ft deep. The water level is expected to be about 30 ft. The well should be screened in the upper Buried Valley aquifer outwash at the water table. The required samples for 0385 are continuous core and a geochemical sample in the vadose zone and at the water table.

Well 0386 is located south of well 0385. There is a possibility of drilling three additional wells in a cluster with 0386. Figure 4.3 shows the decision process for the additional wells (0389, 0390, and 0391). If both the upper and lower outwash units are present, then one well will be finished in each. If either the upper or lower outwash unit is thick enough to measure vertical gradient, approximately 50 ft, then two wells will be finished in those units. Both upper and lower outwash units are probably present at this location. The first well, 0386, will be drilled to bedrock, estimated at 120 ft. The depths of the screens in all wells are dependent on the borehole lithologies found in 0386 (Figure 4.3). Depth to water is probably 30 to 40 ft. The required samples for 0386 are continuous core, two geotechnical samples from each stratigraphic unit (if present), and a geochemical sample in the vadose zone and at the water table. Single samples will be collected in the other wells (0389, 0390, and 0391) to confirm the stratigraphy in the screened intervals.

Well 0387 is located northwest of the Overflow Pond and west of the NPDES outfall. Depending on stratigraphy, well 0392 may be paired with this well. Figure 4.4 shows the decision process for the installation of 0392. Well 0387 will be drilled to bedrock, estimated at 120 ft. The placement of the screen is dependent on the lithologies encountered while drilling (Figure 4.4). The water level is probably at 30 to 40 ft in this well. The required samples for 0387 are continuous core and a geochemical sample in the vadose zone and at the water table. A single sample will be taken from the screened interval in 0392 to confirm stratigraphy.

Well 0388 is located west of the Overflow Pond and west of the Conrail Railroad, at the southern edge of the tributary valley mouth. The well will be drilled to bedrock, estimated at 120 ft, and screened at the water table, approximately 30 ft. This well will also be used to monitor groundwater quality and to provide information on the flow system at the mouth of the tributary valley. The required samples for 0388 are continuous core and a geochemical sample in the vadose zone and at the water table.

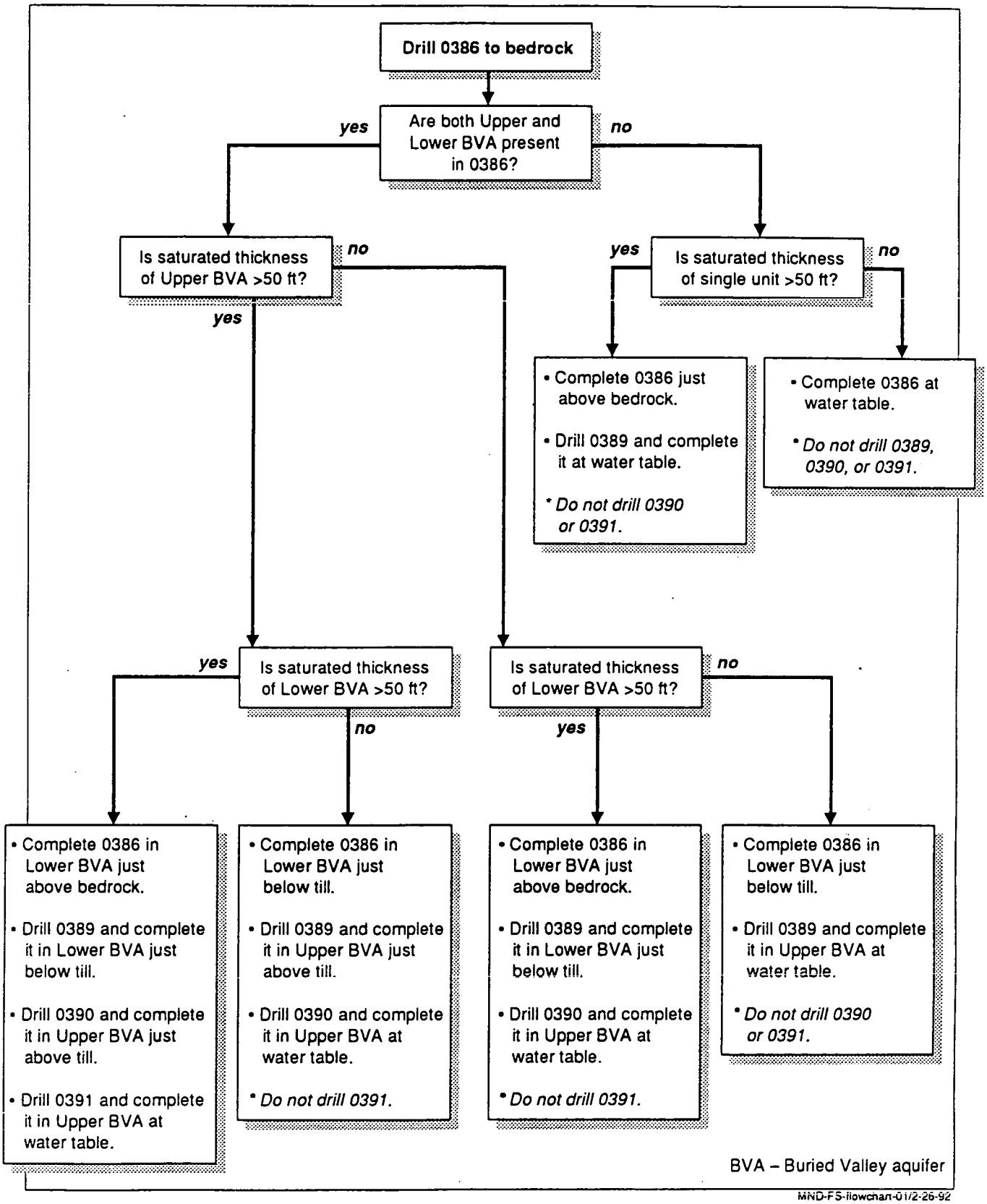


Figure 4.3. Flow chart for drilling options on wells 0386, 0389, 0390, and 0391.

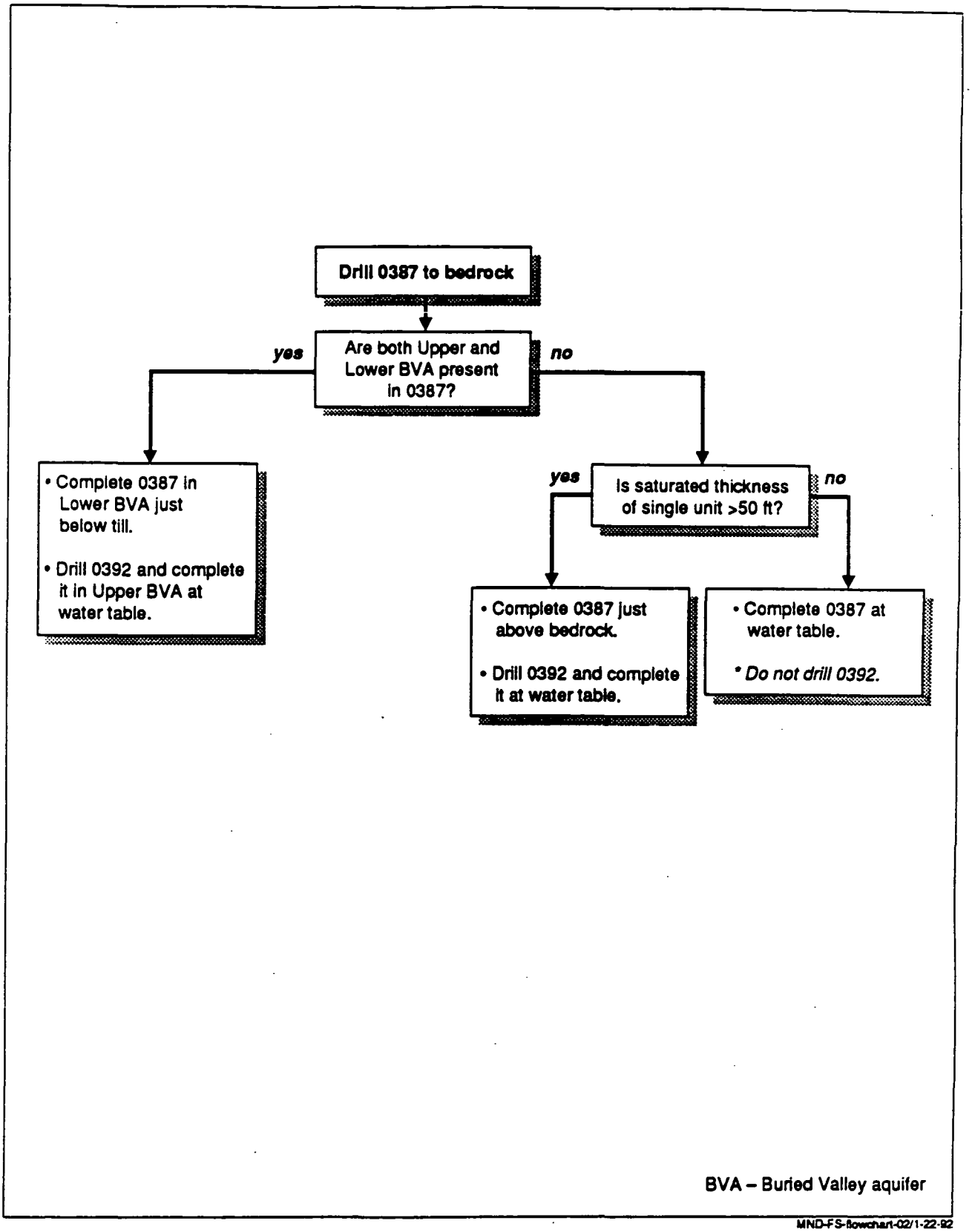


Figure 4.4. Flow chart for drilling options on wells 0387 and 0392.

4.3.2. Piezometer Installation

The main purpose of the installation of piezometers is to better define the groundwater flow systems west of the Mound Plant, in the tributary valley, and in the vicinity of the Mound Plant production wells. Most piezometers are screened at the water table, and some are clustered to provide data on vertical conditions. Since the water table fluctuates up to 5 ft over the course of the year, well screens should be installed so they are always totally in the saturated zone. Table IV.2 lists the piezometers, their locations, and the estimated drilling depths. No geochemical samples are scheduled, but cores will be screened with field instruments (PID or HNu); if any vapors or elevated readings are discovered, samples will be collected.

Piezometers P016 through P020 will provide information on the regional gradient in the upper outwash by completing two east-west lines between the Mound Plant and the Great Miami River. The piezometers located adjacent to the river will also provide information on the correlation of groundwater levels with the river stage, the effects of any groundwater mounding caused by the river, and the potential for groundwater flow from the east under the river. The five piezometers will be screened in the upper outwash at the water table. The depth to water in these boreholes is expected to be between 10 and 15 ft. Except for a thin layer of fill in some locations, drilling will be through the sands and gravels of the Buried Valley aquifer outwash. Continuous core will be collected during drilling at P016 through P020.

P021 will be used to monitor groundwater levels on the edge of the tributary valley on the south slope of the Main Hill. This piezometer will replace wells 0035, 0042, and 0242, which are either dry or were not cased according to ER procedures. P021 will be screened in the first saturated zone in the bedrock. Buried Valley aquifer till or outwash units are not expected at this site. The bedrock is overlain by a fill layer of varying thickness. During drilling of P021, continuous core will be collected and described.

P022 and P023 are located in the center of the tributary valley just west of Building 42. These piezometers are multipurpose. P022 will be screened at the water table and P023 will be screened at the bottom of the outwash or possibly in the bedrock if the outwash is very thin. Geologic logs from nearby wells indicate the unconsolidated material is from 25 to 40 ft thick. The purpose of the two screened intervals is to determine if there is a vertical gradient either into or out of the bedrock in the tributary valley. This information will indicate if the bedrock recharges the unconsolidated sediments in the valley. P022 and P023 will also be used to define the extent of the outwash. Current cross sections indicate that the outwash occurs as lenses in the till of the tributary valley. These piezometers will help establish if the outwash is continuous. During drilling of P023, continuous core will be collected. A sample will be collected of the screened interval from P022 to confirm stratigraphy.

P024 will be installed just north of Building 87. This piezometer will be used for stratigraphic and groundwater level information on the southern edge of the tributary valley. P024 will initially be drilled to bedrock and then screened in the first saturated interval (outwash or bedrock). Adjacent wells indicate there is a very thin outwash layer in the area, and the till is from 25 to 40 ft thick. During drilling of P024, continuous core will be collected.

Piezometers P025 through P028 will be installed west and east of the Mound Plant production wells. The purpose of these piezometers is to evaluate the effect of the production wells on the groundwater flow in the area. All four piezometers will be installed at the water table. Depth to water is about 30 ft depending on the land surface elevation. Geologic logs from adjacent wells indicate the lithology is Buried Valley Aquifer outwash. During drilling of P025 through P028, core samples will be collected from the screened interval to confirm stratigraphy.

The next two piezometers, P029 and P030, will be paired to provide information on the vertical gradient west of production well 0076. Cross sections from this area indicate the units have thickened to where there are two distinct outwash layers separated by till. The water table reaches just into the upper layer. This narrow layer apparently extends beneath the landfill. Although the layer is unsaturated until just north of well 0076, there is a potential for contaminants to be transported by seasonal or perched water in this zone. P030 will be drilled first to bedrock, an expected depth of 100 ft. It will be screened just below the till in the lower Buried Valley aquifer. During drilling of P030, continuous core will be collected. P029 will be installed at the water table. Core samples will be collected at the screened interval of P029 to confirm stratigraphy. Depth to water is approximately 30 ft.

P031, P032, P033, and P034 will also be located near the Mound Plant production wells. These, along with a piezometer to be installed as part of the Area B, Operable Unit 1 pump test (DOE in progress), will provide information on the influence of the production wells and the effects of the aquifer pump test. P033 will also provide information on the groundwater flow directions off the spoils area. P033 will be drilled to bedrock, approximately 80 ft, for information on the stratigraphy. All four piezometers will be screened at the water table. Continuous core will be collected during the boring of P031, P032, P033, and P034. Depth to water is approximately 30 ft.

Piezometers P035 through P042 will provide information on the regional gradient in the upper outwash. The piezometers located adjacent to the river will also provide information on the correlation of groundwater levels with the river stage and the effects of any groundwater mounding caused by the river. The piezometers, in two clusters of four, will also provide information on a vertical gradient and whether the till layer is an aquitard in the area. In each cluster, the four zones of completion are at the top of bedrock, top of the lower outwash, bottom of the upper outwash, and at the water table in the upper outwash.

P035 through P038 are located west of wells 0301 and 0311, adjacent to the Great Miami River. Depth to bedrock is approximately 150 ft in the area. The till layer may be quite thin, 5 ft, and at a depth of 90 to 95 ft. During the drilling of P038, continuous core will be collected. Depth to water in the area is 10 to 15 ft. During the drilling of P035 through P037, sediment samples will be collected for the screened interval only.

P039 through P042 are located west of the southernmost production wells, also adjacent to the river. During the drilling of P042, continuous core will be collected. The depths estimated for piezometer cluster P035-P038 are also appropriate for these four piezometers. During drilling of P039 through P041, sediment samples will be collected for the screened interval only.

4.3.3. Borehole Geophysics

To supplement lithologic descriptions of existing and proposed monitoring wells, natural gamma geophysical logging will be conducted on 36 wells (Table IV.3), including 21 existing wells and 15 new wells. The wells will be continuously logged from land surface to the total depth of each well for a to-be-determined total length.

Multiple Logging Techniques

For an initial evaluation of the bedrock groundwater flow system, a comprehensive suite of borehole geophysical techniques will be used in the six boreholes drilled for deep bedrock wells (Table IV.3). This open borehole geophysical survey will consist of the following down hole methods:

1) Borehole Video (axial and side scan)

   Provides a television image and videotaped record to visually identify bedrock features such as bedding and fractures.

2) Full Waveform Sonic

   Provides a digital record of acoustic properties of the borehole wall that identifies areas of open fractures.

3) Caliper

   Provides a digital record of the diameter of the borehole and the presence of large fractured zones.

4) Guard Resistivity

   Provides a digital record of the electrical properties of the rocks in the borehole wall to define shale and limestone beds. This log provides important data to aid in stratigraphic correlation between boreholes.

Table IV.3. Borehole Geophysical Investigation Summary

Well ID	Depth (ft)	Natural Gamma (only)	Full Geophysical Suite[a]
0001 (Existing)	67	X	
0002 (Existing)	67	X	
0005 (Existing)	56	X	
0006 (Existing)	120	X	
0007 (Existing)	80	X	
0008 (Existing)	143	X	
0111 (Existing)	67	X	
0113 (Existing)	56	X	
0116 (Existing)	81	X	
0121 (Existing)	109	X	
0137 (Existing)	75	X	
0154 (Existing)	47	X	
0301 (Existing)	88	X	
0302 (Existing)	120	X	
0303 (Existing)	94	X	
0304 (Existing)	104	X	
0307 (Existing)	50	X	
0308 (Existing)	70	X	
0317 (Existing)	60	X	
0319 (Existing)	55	X	
0320 (Existing)	40	X	
0328 (Proposed)	150	X	
0330 (Proposed)	150	X	
0335 (Proposed)	60		X
0341 (Proposed)	50	X	
0342 (Proposed)	150	X	
0343 (Proposed)	150	X	
0344 (Proposed)	150	X	

Table IV.3. (page 2 of 2)

Well ID	Depth (ft)	Natural Gamma (only)	Full Geophysical Suite[a]
0345 (Proposed)	80	X	
0346 (Proposed)	100	X	
0347 (Proposed)	120	X	
0348 (Proposed)	200		X
0349 (Proposed)	150		X
0350 (Proposed)	200		X
0352 (Proposed)	60		X
0355 (Proposed)	150		X
Total	3,569	31 Wells; 2,749 ft	6 Wells; 820 ft

[a]Full waveform sonic, caliper, guard resistivity, neutron, gamma density, natural gamma radiation, borehole fluid resistivity, and temperature.

5) Neutron

Provides a digital record of neutron capture by rock and the contained groundwater. The log is sensitive to moisture content in the unsaturated zone and is a measure of porosity in the saturated zone.

6) Gamma (density)

Provides a digital record of gamma radiation attenuation by the rocks in the borehole. The log is a quantitative measure of rock density.

7) Natural Gamma Radiation

Provides a digital record of the natural gamma radiation emitted by rocks in the borehole. The log can be used to differentiate between shale and limestone beds. This log is important for stratigraphic correlation between boreholes.

8) Borehole Fluid Resistivity and Temperature

Provides a digital record of temperature and fluid resistivity in the fluid-stemmed background. Variations in temperature and resistivity over vertical distances in the borehole are related to groundwater flow.

9) Borehole Flowmeter (heat pulse)

Provides a digital record of flow rates at discrete depth intervals in an open borehole. The record is used to calculate permeability of rocks at each depth interval.

These logs require that the borehole be filled with fluid. The water used to fill the borehole for acquisition of geophysical records will be groundwater from a public water supply. The water will have a chemistry compatible with the native groundwater at the borehole location, and the water will be analyzed to ensure that contaminants are not present.

4.3.4. Water Level Measurements

To better understand hydraulic relationships between hydrostratigraphic units, water levels in all wells and well clusters piezometers will be monitored. In some wells or well clusters, recorders will be installed to collect continuous water levels. Measurements will be taken at the following boreholes/well clusters every hour for 180 days:

- Piezometer P016
- Piezometer P017
- Wells 0127, 0128, and 0302
- Wells 0303, 0343, and 0383

- Well 0120
- Well 0335

The locations of these wells and piezometers are shown on Figure 4.5. Other locations may be required once the initial data have been analyzed.

A river stage recording station will be constructed on the Great Miami River due west of Mound Plant near piezometer P016 (Figure 4.5). The recording station will provide data related to changes in river stage that can be compared to changes in groundwater levels. The recording station will consist of a float well constructed of a 10-inch-diameter, steel perforated, corrugated pipe set at a depth lower than minimum river stage. The float well will extend approximately 6 ft above the annual average river stage and will be attached to the NPDES Outfall 001 concrete bulkhead. A Stevens water level recorder (or equivalent) or a pressure transducer will be used to measure water level changes within the float well. The Stevens recorder or data logger will be housed in a waterproof encasement attached to the top of the NPDES bulkhead or to the top of the float well. Staff gauges will be installed, by permission, at the downstream Conrail bridge and the first upstream county bridge. Measurements will be made periodically at both staff gauging stations and at the recording station in order to determine river stage correlations among the three locations. When the recording station is submerged by high flow, river stage will be measured at the two staff gauging stations, and river stage at the recording station will be interpolated.

Additionally, water levels will be measured manually at all new and existing wells once per month. Manual water level measurements will be done according to Mound Plant ER Program SOP 3.1, Water Level Measurement (revision 1). Water level measurements of the entire network will be completed within 48 hours. Water levels in well 0308 will be closely monitored to determine when sufficient water exists in the borehole to sample. The field crew should be prepared to sample well 0308 each time water levels are measured. When a sufficient volume of water exists, the well will be bailed. Since it is not expected that the well will recover quickly, any water that is bailed will immediately be placed in sample containers. If there is sufficient water within 24 hours after three well volumes have been purged, an attempt should be made to sample the well for the full analyte list (Table IV.4). The well should, at the least, be sampled for VOCs and semivolatile organic compounds.

4.3.5. Well Water Sampling and Analysis

At least two rounds of groundwater samples will be collected from all new and existing monitoring wells within four to six months after new well installations. A summary of sample parameters is given in Table IV.4. The existing monitoring wells that will be sampled for the analyte list are shown in Figure 4.5a and Table IV.5.

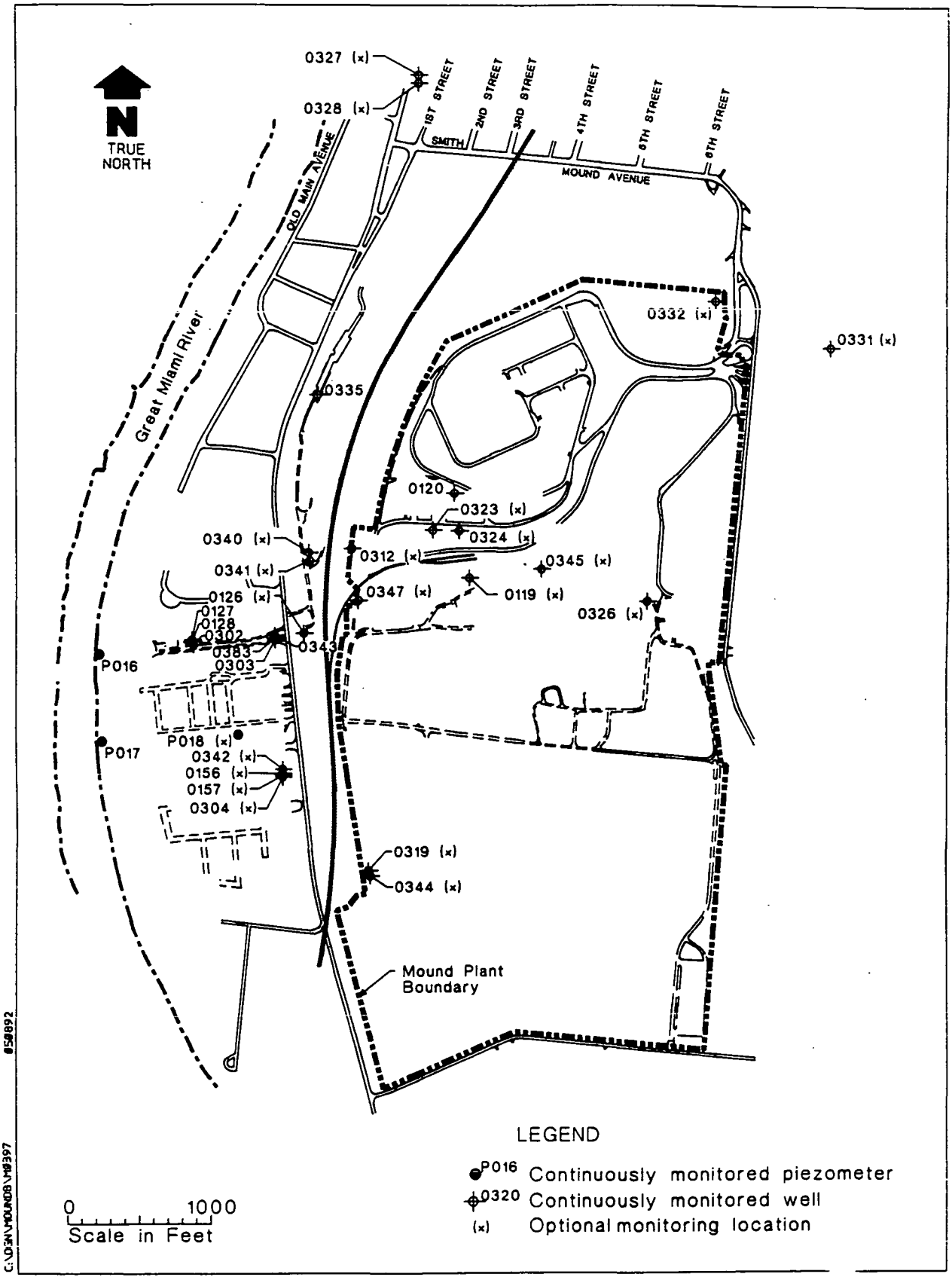


Figure 4.5. Locations of continuous water level measurements.

Table IV.4. Specifications for Hydrogeology and Groundwater Investigation Sampling

Drilling Program

Number of Boreholes:	43 (includes 6 deep bedrock wells and 5 optional wells that depend on local geologic conditions))
Drilling Technique:	Cable-tool, hollow stem auger, or a drilling method that advances casing during the drilling.
Drilling Locations and Depths:	See Table VI.15
Total Footage:	Approximately 4,000 ft

Environmental Samples

Subsurface soil samples--Geochemical

Number:	Minimum two per well or well pair; maximum to depend on field screening and proximity to source areas
Analytical Parameters:	Analytical parameter list, but only 20% of samples for VOCs, semivolatile organic compounds, bismuth, fluoride, USATHAMA explosives, and TCL pesticides/PCBs

Groundwater samples
(New Wells)

Number:	86 (43 locations sampled 2 times)
Analytical Parameters:	Analytical parameter list; analytical list for water; and field parameter list

Groundwater samples
(Existing Wells)

Number:	Approximately 112 (56 locations currently sampled quarterly or semiannually to be sampled 2 times)
Analytical Parameters:	Analytical parameter list; analytical list for water; and field parameter list.

Geotechnical

Subsurface soil samples

Number:	Approximately 28 (6 locations; 2 samples from each stratigraphic unit at each location; 1 to 3 stratigraphic units anticipated)
Parameters:	Particle size distribution, pH, relative density, maximum density, specific gravity, permeability, organic content, moisture content, and cation exchange capacity

Subsurface soil samples--X-ray diffraction

Number:	6 (2 in aquitard, 2 in upper water bearing zone, 2 in lower water bearing zone)
Analytical Parameters:	Clay mineralogy by X-ray diffraction

Quality Control Samples

Trip Blanks

Number:	1 per cooler containing VOC samples
Analytical Parameters:	VOCs

Equipment Rinsate Blanks

Number:	1 per 10 geochemical samples
Analytical Parameters:	Analytical parameter list

Table IV.4. (page 2 of 2)

Field Ambient Blanks

Number:	1 per 20 geochemical samples
Analytical Parameters:	VOCs

Field Duplicates

Number:	1 per 10 geochemical samples
Analytical Parameters:	Analytical parameter list

Matrix Spike/Matrix Spike Duplicates

Number:	1 per 20 geochemical samples
Analytical Parameters:	Analytical parameter list

ANALYTICAL PARAMETER LIST

VOCs
Semivolatile organic compounds
TAL inorganics[a]
Bismuth
Fluoride
USATHAMA-listed explosives (on plant locations only)
TCL pesticides/PCBs
Isotopic plutonium (238, 239/240)[a]
Isotopic thorium (228, 230, 232)[a]
Isotopic uranium (234/235, 238)[a]
Strontium-90[a]
Tritium[a]
Gamma spectrometry[a]
Nitrate/nitrite
Sulfate
Chloride
Total organic carbon

FIELD PARAMETER LIST (WATER)

Temperature
pH
Specific conductivity
Dissolved oxygen
Redox potential
Water level

ANALYTICAL LIST FOR WATER

Nitrite
Nutrients (TKN,TP)
Total dissolved solids
Total suspended solids
Alkalinity
TAL inorganics (dissolved)
Radium-226[a]
Americium-241[a]

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[a]In addition to samples collected for total TAL metals and total radionuclides, a filtered sample will be collected for dissolved TAL metals and dissolved radionuclides for comparison purposes.
CLP - Contract Laboratory Program
PCB - polychlorinated biphenyl
SOW - statement of work
TAL - target analyte list
TKN - total Kjeldahl nitrogen
TCL - target compound list
TP - total phosphorus
USATHAMA - U.S. Army Toxic and Hazardous Materials Agency
VOC - volatile organic compound

Table IV.5. Existing Wells to be Sampled Under Operable Unit 9

Onsite	Offsite	Seeps
0046	0116	0601
0063	0118	0602
0071	0123	0605
0076	0124	0607
0111	0126	0608
0112	0127	
0115	0128	
0117	0129	
0119	0130	
0120	0138	
0121	0156	
0122	0157	
0125	0159	
0137	0160	
0151	0301	
0152	0302	
0153	0303	
0154	0304	
0155	0311	
0158		
0271		
0305		
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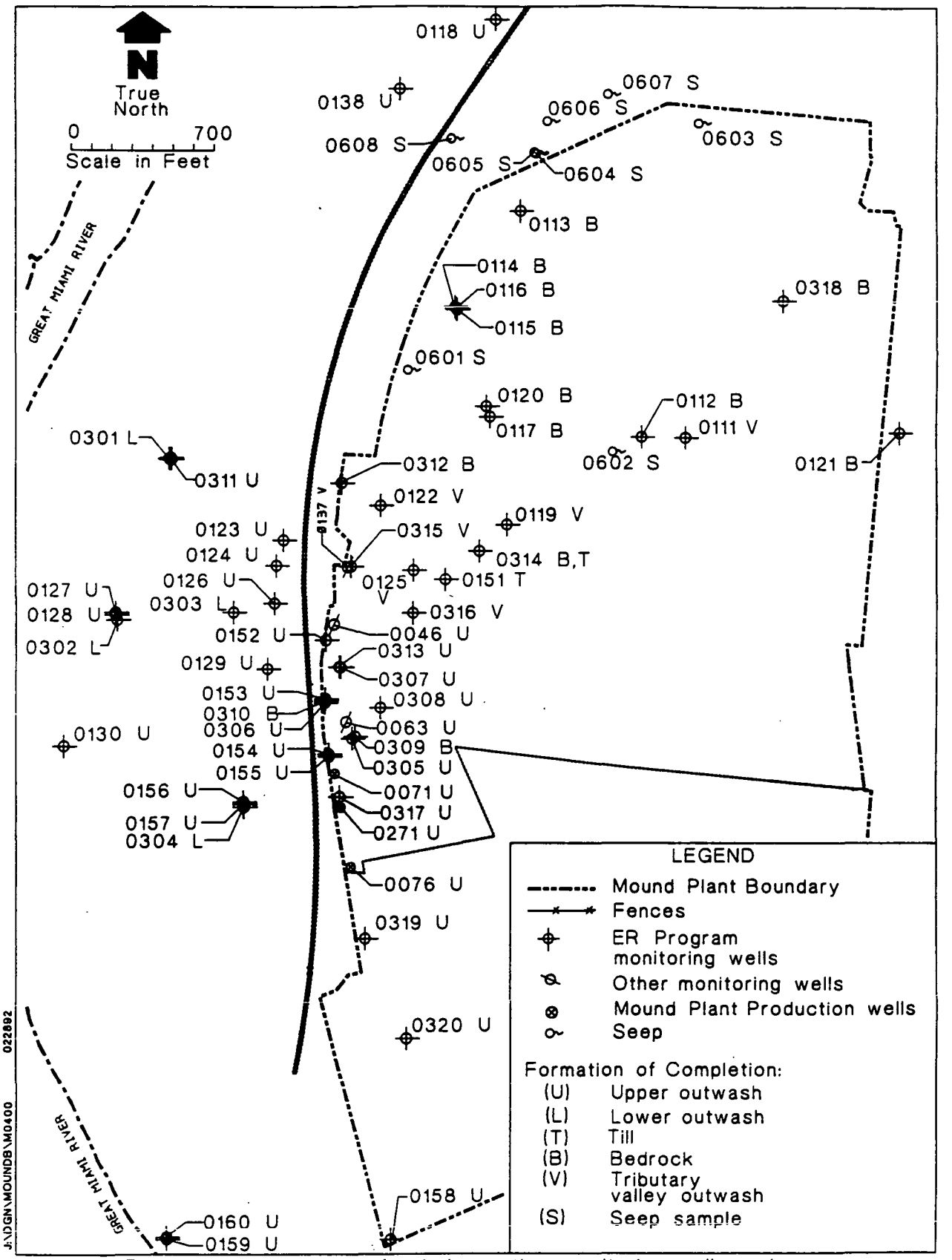


Figure 4.5a. Locations of existing active monitoring wells and seeps.

4.3.6. Railroad Cut Field Mapping

Good exposures of bedrock of the New Richmond Group are present on the steep face of a railroad cut along the west side of the Main Hill. The exposures are present along a lateral distance of approximately 1,200 ft. The north end of the bedrock exposures is at Seep 608. Rock exposures are present from the elevation of the railroad (approximately 720 ft mean sea level [MSL] to the top of the cut at approximate elevation 820 ft MSL).

Mapping will be performed at 10 vertical profiles spaced equidistant along the railroad cut. The profiles will be located in areas of prominent groundwater seeps from bedrock and in areas where seeps are absent. The mapping will include characterization of the vertical lithologic sequence with measurement of the thickness of shale and limestone beds. The nature of bedding features will be described and measured with regard to strike and dip. The persistence of discrete beds between adjacent profiles will be directly traced. The presence of thick, correlatable beds that may be important to the vertical or lateral flow of groundwater at Mound Plant will be investigated. If such thick, persistent units are mapped in the railroad cut, then the correlation of these beds to the lithologic description of core in the five deep bedrock core holes drilled across the site will be investigated.

The presence or absence of fractures, joints, or bedding surfaces will be mapped in the vertical profiles. The dimensions and orientations of these features will be measured and recorded. The presence or absence of coatings or clay fillings will be noted.

The physical properties of the bedrock associated with the emergence of groundwater seeps will be determined. In particular, it will be noted if the seep is restricted to a discrete fracture or joint or to a discrete shale or limestone bed.

Pertinent features, such as beds or fractures associated with groundwater seeps, large open fractures, and thick competent beds of shale or limestone, will be marked with numbered flagging that is keyed to the field notes. A land survey performed after the completion of mapping will determine the locations and elevations of the flagged features.

4.4. SAMPLE DESIGNATION

Samples collected at Mound Plant under the ER Program are numbered using a three-letter, ten-digit identifier (MNDXA-YYYY-ZZZZ). MNDXA is the area or investigation identifier, which for Operable Unit 9 is MND2A. The sample matrix in the hydrogeology and groundwater investigation includes groundwater (MND20) and soil (MND23). The next portion of the identifier, YYYY, designates the specific sample

location. The last four digits (ZZZZ) serve as the sample identifier, which documents the frequency of sampling (for repeatable sampling like groundwater) or the depth of sampling (for one-time multiple depth sampling locations like boreholes) or field quality control sampling during the same sampling episode. See Table I.3 for field quality control sample identification schemes.

Example: The soil sample collected from the first borehole location at well 0384 will be numbered as follows (area-location-sample):

MND23-0384-0001 for the 3- to 5-ft sample, and

MND23-0384-0002 for the 8- to 10-ft sample, and so on down the hole.

Example: The groundwater samples collected from monitoring well 0384 will be numbered as follows (area-location-sample):

MND20-0384-0001 for the first sample, and

MND20-0384-1001 for a duplicate sample (Table I.3).

4.5. SAMPLING EQUIPMENT AND PROCEDURES

The borehole geophysical studies will be conducted as directed by the subcontractor's SOPs. These SOPs are dependent on the equipment used and will reflect the manufacturer's specifications for correct use. The SOPs for natural gamma logging, water level monitoring, and borehole geophysical studies are included in the Operable Unit 9, Site-Wide QAPP and referenced under each section of work.

4.5.1. Well and Piezometer Installation Procedures

An air-rotary coring rig, cable-tool drill rig, or hollow-stem auger drill will be used to advance each boring to the approximate depth listed in Tables IV.1 and IV.2. The choice of drilling rig is optional, based on the anticipated completion depth, matrix to be drilled (rock or unconsolidated), and availability of each type of rig. In general, an auger drill or cable-tool drill rig will be used in unconsolidated sediments; the air rotary or cable-tool drill rigs will be used in bedrock. In any case, methods will be employed that advance casing during drilling.

To prevent cross contamination of aquifers, double casing may be used during drilling. There are two criteria for determining the need to double case: 1) when driling through areas of known contamination, and 2) where there is a concern with the transport of contamiannts to a lower aquifer. The intent of employing double casing during drilling is to prevent the transport of contaminants to a lower aquifer that may be naturally protected by barriers that are penetrated during drilling. At the present time, there are no

wells or piezometers scheduled for installation in the Site-wide investigations that fullfill both criteria. However, since organic vapors and radionuclides will be monitored during drilling, any readings above background will warrant notification of the project managers. The decision for installation of double casings will be mutually agreed upon by the project managers.

After each 5-ft interval is drilled, a combustible gas indicator (CGI) and a photoionization detector (PID) will be used to monitor volatile organic vapors down hole and in the breathing zone, as outlined in Mound Plant ER Program SOPs 6.1, Health and Safety Monitoring of Combustible Gas Levels (revision 1); and 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector (revision 1). Background levels will be established using these instruments before drilling commences. In addition, Mound Plant field screening with a field instrument for the detection of low level radiation (FIDLER) is required during any

intrusive activity inside the plant boundary. The FIDLER will be calibrated to detect the 17-keV X ray emitted when plutonium-238 decays to uranium-234. It will also detect the low energy gamma radiation emitted by the thorium decay chain.

Down-hole soil samples will be collected during the drilling of each well borehole. The drill rig will be equipped with a 2-inch-outside diameter, 5-ft-long, continuous-core sampler or split-spoon sampler. At single wells, soil samples will be collected at 5-ft intervals until total depth is attained. At clustered wells, only the deepest well will be continuously sampled. Grab samples will be collected rather than composite samples. Borings may penetrate bedrock at some point during drilling, which may prevent the advancement of the continuous sampler. If a bedrock well borehole is being drilled, a core barrel will be used to collect lithologic samples for description and analysis.

Geochemical samples will be collected immediately from the portion of the soil sample that emits the highest concentration of volatile vapors, as determined by PID screening. If no vapors are detected, the soil sample will be collected from the bottom 2 ft of the core sample (e.g., 3 to 5 ft, 8 to 10 ft). For all well borings within the plant boundary, a soil sample will be collected for Mound Plant plutonium-238 and thorium-232 radioactivity screening. Each core sample will be lithologically described by an onsite geologist (Mound Plant ER Program SOP 5.1, Soil and Rock Borehole Logging and Sampling [revision 1]).

Field quality control samples collected during the drilling of wells will include field duplicates. The portion of the original core needed for VOC analyses will be removed before the other field duplicate samples are divided. The analytical laboratory will perform the appropriate analysis on each field quality control sample, including duplicates and other quality assurance samples, as discussed below.

In some cases, the quantity of soil/rock recovered in the sampler will be insufficient to allow for the collection of all sample parameters specified. Therefore, the sample collection will be prioritized to ensure that samples for the most important parameters are collected. The quantity of soil sample required for each analysis and the appropriate sample containers are listed in Table IV.6 in order of priority.

Monitoring wells will be installed with a minimum borehole diameter of 8 inches. In general, each well will use the same type of well materials and employ the same basic design (Figure 4.6). A 4-inch-diameter, stainless steel, 0.010-inch slot, 10-ft (typical) well screen will be coupled with 4-inch-diameter, Schedule 40, stainless steel riser pipe. If conditions exist in which a 10-ft well screen is not appropoirate, then the field manager will consult with the project manager before proceeding. Each well will be completed to monitor groundwater from a specific water bearing zone (e.g., the lower unit of the Buried Valley aquifer).

Piezometers will be installed with a minimum borehole diameter of 6 inches. In general, each piezometer will use the same type of materials and employ the same basic design (Figure 4.6). A 2-inch-diameter,

Table IV.6. Summary of Geochemical Sampling for Proposed Well Boreholes

Sample Number and Location	Analytical List (A)	VOCs and Semivolatile Organic Compounds (B)(C)	TCL Pesticides/PCBs (D)	USATHAMA Explosives (E)	Fluoride (F)
MND23-0322 (Source)	6	6	6	1	1
MND23-0323 (Source)	6	6	6	1	1
MND23-0324 (Source)	6	6	6	1	1
MND23-0326 (Source)	4	4	4	1	1
MND23-0328 (Background)	2	2	2		2
MND23-0330 (Background)	2	2	2		2
MND23-0331	2		2		
MND23-0332	2		2	1	1
MND23-0333	2				
MND23-0335	2				
MND23-0336	2	2	2	1	1
MND23-0341	2	2	2	1	1
MND23-0342	2				2
MND23-0343	2				2
MND23-0344	2			1	1
MND23-0345	6	6	6	1	1
MND23-0346	2	2	2	1	1
MND23-0347	6	6	6	2	2
MND23-0348	2		1	1	1
MND23-0349	4	4	4	1	1
MND23-0350	2			1	1
MND23-0352	2			1	1
MND23-0353	2			1	1
MND23-0354	2			1	1
MND23-0355	2	2	2	1	1
MND23-0356	2			1	1
MND23-0384 (Source)	14	14	14	2	2
MND23-0385	2	2	2	1	1
MND23-0386	2	2	2	1	1
MND23-0387	2	2	2	1	1
MND23-0388	2	2	2	1	1
Total Number of Samples (excluding QA/QC)	98	72	77	26	34
Field Duplicates (1/10)	10	8	8	3	4
MS/MSD (1/20)	5	4	4	2	2
Ambient Blanks (1/20) to VOCs Only		4			
Rinsate Blanks (1/10)	10	8	8	3	4
Total Number of Samples (including QA/QC)	123	96	97	34	44

Table IV.6. (page 2 of 3)

SOIL

(A) Analytical parameters to be sampled from soil samples collected at all well boreholes on list:

Parameter	CLP SOW TAL Metals/CN	E353.2 Nitrate/nitrite, E325.1/ SW9250 Chloride, E375.2 Sulfate	NAS 1960 Isotopic Thorium	NAS 1965 Isotopic Plutonium	NAS 1962 Isotopic Uranium	Radium-226	NAS 1960 Strontium-90	Nuclear Data, Inc. 1986 Gamma Spec	E906.0 Tritium	E415.1/E415.2 Total Organic Carbon
Container	Wide-mouth polyethylene bottle	Wide-mouth polyethylene bottle	Wide-mouth Nalgene bottle							?
Minimum Volume/Weight	100 g	100 g	750 g							?
Preservation	Cool 4°C	Cool 4°C	None							Cool 4°C
Holding Time	6 months 28 days (mercury) 14 days (CN)	28 days	NA							28 days

(B-E) Parameters to be sampled from soil samples collected at selected well boreholes on list.

Parameter	CLP SOW VOCs (B)	CLP SOW Semivolatile Organic Compounds (C)	CLP SOW TCL Pesticides/ PCBs (D)	USATHAMA Explosives (E)	340.2 Fluoride (F)
Container	Glass vial with Teflon-lined septum	Wide-mouth amber glass jar with Teflon-lined septum	Wide-mouth amber glass jar with Teflon-lined septum	Wide-mouth amber glass jar with Teflon-lined septum	Wide-mouth polyethylene bottle
Minimum Volume/Weight	120 mL (no headspace)	100 g	100 g	100 g	50 g
Preservation	Cool 4°C	Cool 4°C	Cool 4°C	Cool 4°C	Cool 4°C
Holding time	14 days	7 days extraction 40 days analysis	7 days extraction 40 days analysis	7 days extraction 30 days analysis	28 days

ASTM - American Society for Testing Materials
CLP - Contract Laboratory Program
g - grams
mL - milliliter
NAS - National Academy of Sciences
PCB - polychlorinated biphenyl
QA/QC - quality assurance/quality control
SOW - Statement of Work
TAL - target analyte list
TCL - target compound list
USATHAMA - U.S. Army Toxic and hazardous Materials Agency
VOC - volatile organic compound

Table IV.6. (page 3 of 3)

WATER

(A) Analytical parameters to be sampled from groundwater samples collected at all wells on list:

Parameter	CLP SOW TAL Metals/CN	E353.2 Nitrate/nitrite, E325.1/ SW9250 Chloride, E375.2 Sulfate	NAS 1960 Isotopic Thorium	NAS 1965 Isotopic Plutonium	NAS 1962 Isotopic Uranium	Radium-226	NAS 1960 Strontium-90	Nuclear Data, Inc. 1986 Gamma Spec	E906.0 Tritium	E415.1/E415.2 Total Organic Carbon
Container	Wide-mouth polyethylene bottle	Wide-mouth polyethylene bottle	Plastic cubetainer						Glass bottle	Amber glass bottle with teflon-lined lid
Minimum Volume/Weight	1,000 mL	500 mL	2 x 4 liter						250 mL	250 mL
Preservation	HNO_3 to pH < 2 Cool 4°C	H_2SO_4 to pH > 12 Cool 4°C	HNO_3 to pH < 2 (15 mL 1N per liter)						None	H_2SO_4 or HCl to pH < 2 Cool 4°C
Holding Time	6 months 28 days (mercury) 14 days (CN)	28 days	NA						None	28 days

(B-E) Parameters to be sampled from groundwater samples collected at selected wells on list.

Parameter	CLP SOW VOCs (B)	CLP SOW Semivolatile Organic Compounds (C)	CLP SOW TCL Pesticides/PCBs (D)	USATHAMA Explosives (E)	340.2 Fluoride (F)
Container	Glass vial with Teflon-lined septum	Wide-mouth amber glass jar with Teflon-lined septum	Wide-mouth amber glass jar with Teflon-lined septum	Wide-mouth amber glass jar with Teflon-lined septum	Wide-mouth polyethylene bottle
Minimum Volume/Weight	Two 40-mL vials (no headspace)	2 1,000-mL bottles	2 1,000-mL bottles	1 liter	500 mL
Preservation	HCl to pH < 2 Cool 4°C	Cool 4°C	Cool 4°C	Cool 4°C	Cool 4°C
Holding time	14 days	7 days extraction 40 days analysis	7 days extraction 40 days analysis	7 days extraction 30 days analysis	28 days

ASTM - American Society for Testing Materials
CLP - Contract Laboratory Program
g - grams
mL - milliliter
NAS - National Academy of Sciences
PCB - polychlorinated biphenyl
QA/QC - quality assurance/quality control
SOW - Statement of Work
TAL - target analyte list
TCL - target compound list
USATHAMA - U.S. Army Toxic and hazardous Materials Agency
VOC - volatile organic compound

PVC, 0.010-inch slot, 5-ft (typical) well screen will be coupled with a 2-inch-diameter PVC riser pipe. For piezometer clusters, a 5-ft screen will be used for the piezometer completed at the water table, while 1-ft screens may be used for additional piezometers in the cluster that are completed below the water table. The field geologist will ensure that the well screen is set deep enough to remain below the water table throughout the year.

Prior to the beginning of the drilling program, water samples will be taken and analyzed for the analytical parameters listed in Table IV.4 to determine the quality of any water being introduced into the wellbores during well construction. The same analysis will be done at the completion of the drilling program. To be consistent, the same water source will be used throughout the drilling program.

A 10/20 quartz sand filter-pack will be placed in the annulus between the well string and the borehole wall from the bottom of the borehole to at least 2 ft above the top of the well screen. The filter-pack will be placed using water slurry through a tremie pipe to prevent bridging of the sand within the borehole annulus. During placement, the depth to the top of the filter-pack will be periodically tagged using a weighted measuring tape. A 3-ft to 8-ft interval of bentonite slurry will be emplaced on top of the filter-pack using a side discharge tremie pipe. Bentonite pellets may also be used at the discretion of the field geologist. The bentonite will adequately seal the zone of completion. The remaining borehole annulus will be filled to the ground surface using a cement/bentonite grout mixture placed with a side discharge tremie pipe filling from the bentonite seal upward (Figure 4.6).

Stainless steel centralizers will be used on all ER program well and piezometer installations to ensure the uniform and complete annular filling by granular backfill, seal, and grout materials. Locations of centralizers are to include: 1) a centralizer located 1 ft above the screen, 2) a centralizer located approximately 1 ft below the screen, and 3) centralizers located in intervals of 50 ft above the top screen centralizer to ground surface.

The appropriate Mound Plant ER Program SOPs that will be followed for borehole logging, well and piezometer installation, and well and piezometer development include: SOP 1.1, General Instructions for Field Personnel (revision 2); SOP 4.1, Soil Boring (revision 2); SOP 4.2, Rock Boring (revision 1); SOP 4.3, Monitoring Well Installation (revision 1); SOP 4.4, Monitoring Well Development (revision 1); SOP 4.7, Piezometer Installation (revision 0); SOP 4.8, Piezometer Development (revision 0); SOP 5.1, Soil and Rock Borehole Logging and Sampling (revision 1); SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels (revision 1); SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector (revision 1); and SOP 6.7, Near Surface and Soil Sample Screening for Low-Energy Gamma Radiation Using the FIDLER (revision 0). Excess soil from the boreholes will be managed according to SOP 1.15, Guide to Waste Management (revision 1).

Forty-eight hours after grouting is completed, the wells will be developed according to SOP 4.4 and until water is sediment-free and pH and Eh parameters have stabilized. Suitable equipment equipped with plastic outflow tubing will be used for development. Water pumped from the well will be placed in 55-gallon drums. After the completion of all wells, the water in the 55-gallon drums will be sampled to determine appropriate disposal methods.

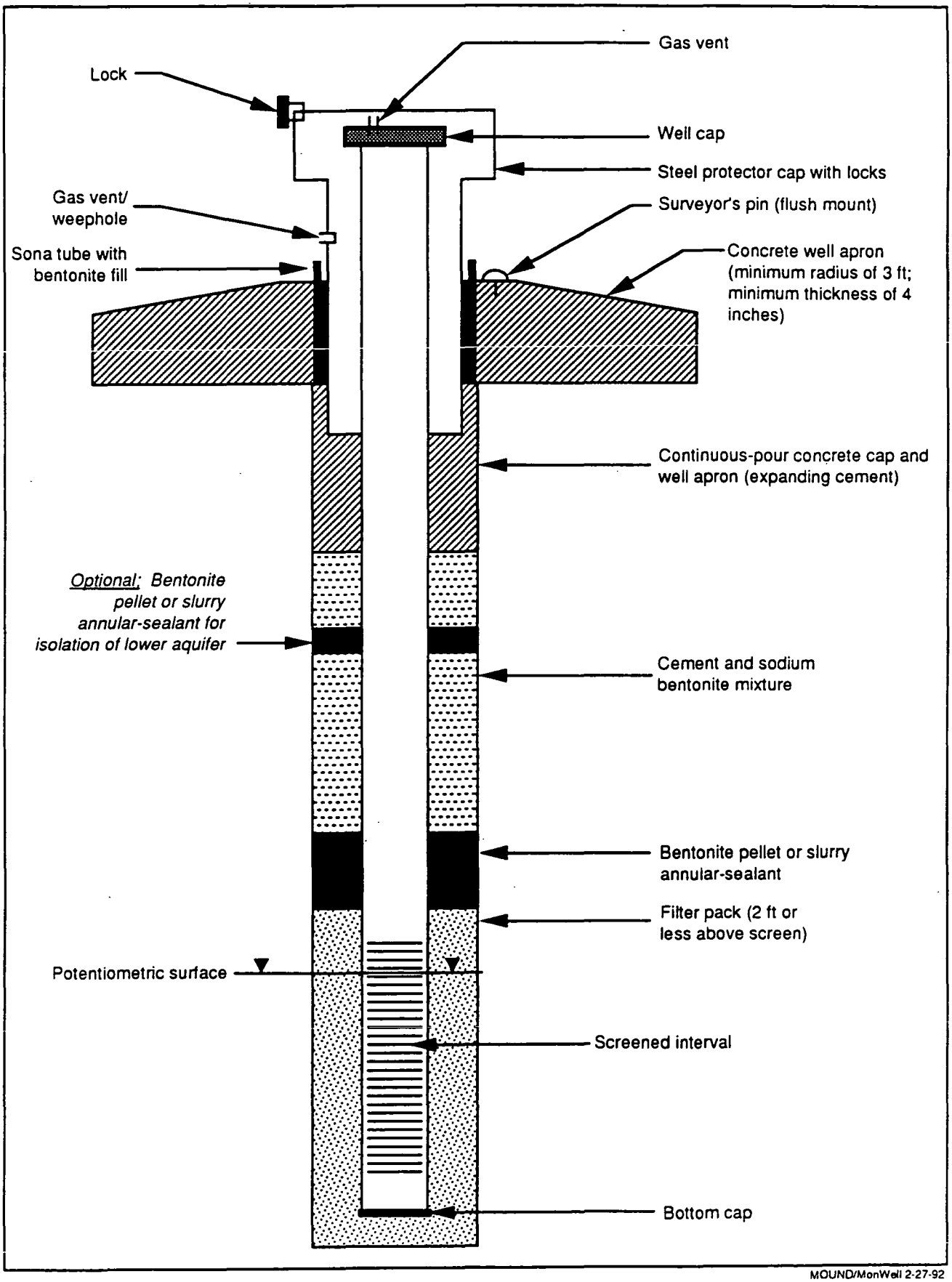


Figure 4.6. Typical monitoring well construction.

4.5.2. Groundwater Sampling

Upon completion of development, groundwater samples will be collected from all new monitoring wells within four to six months after well installations. The static water level in both new and existing monitoring wells will be measured prior to each quarterly sampling period. The groundwater sample will be collected using a bailer according to Mound Plant ER Program SOP 2.4, Sampling Monitoring Wells with a Bucket-Type Bailer (revision 1), or using a dedicated bladder pump according to SOP 2.3, Sampling Monitoring Wells with a Bladder Pump (revision 3).

Groundwater samples for certain analytical parameters such as dissolved TAL metals and dissolved radionuclides will require filtration. Separate grab samples will be collected for filtering. The filtering will be done in the field as defined in the procedures contained in the QAPP. Samples collected for total metals and total radionuclides must be unfiltered.

4.6. SAMPLE HANDLING AND ANALYSIS

4.6.1. Soil-Geotechnical and Mineralogical

Geotechnical and mineralogic samples will be collected from the specified boreholes (Table IV.1) and submitted to the laboratory for physical analysis. Two geotechnical samples will be collected from each stratigraphic unit encountered to characterize physical conditions. Three stratigraphic units are anticipated in boreholes drilled in the Buried Valley aquifer: an upper unit of outwash, a middle till unit, and a lower unit of outwash. Only two units are anticipated in boreholes drilled in the tributary valley: an outwash unit and a till unit. Conditions in the transition zone (Figures 4.1 and 4.2) will have to be determined in the field. No geotechnical samples are scheduled for boreholes that require sampling every 5 ft, as not enough core material may be available. The boreholes scheduled for geotechnical sampling require only limited geochemical sampling so sufficient material should be available. The analytical parameters for the geotechnical samples are listed in Table IV.4. Six additional samples will be collected for clay mineralogy from each of the three stratigraphic units encountered in boreholes for wells 0342 and 0343. Sample requirements are listed in Table IV.4.

Preservative and container requirements for the geotechnical samples are outlined in Table I.4. When a sample is collected, a chain-of-custody record will be started for that sample following the procedures in Mound Plant ER Program SOP 1.3, Sample Control and Documentation (revision 1). A custody seal will be placed on each sample container. Only the samples for moisture content will be packed on ice. When the samples are packaged for shipment, enough ice will be used so that they are maintained at a temperature of 4°C during shipment. Samples will be shipped the same day of collection by Federal Express™

overnight service. Packaging and shipment will follow Mound Plant ER Program SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples (revision 1).

4.6.2. Soil-Geochemical

Preservative and container requirements for the sub-surface soil samples are outlined in Table IV.6. When a sample is collected, a chain-of-custody record will be started for that sample following the procedures in Mound Plant ER Program SOP 1.3, Sample Control and Documentation (revision 1). All samples from on-plant and Miami-Erie Canal locations will be screened by the Mound facility before being shipped. A custody seal will be placed on each sample container, and the samples will be packed on ice. When the samples are packaged for shipment, enough ice will be used so that they are maintained at a temperature of 4°C during shipment. Samples will be shipped by Federal Express™ overnight service. Packaging and shipment will follow Mound Plant ER Program SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples (revision 1). The laboratory will follow the approved method guidelines for requested parameter analyses as specified in the Operable Unit 9 QAPP.

4.6.3. Groundwater-Chemical

Preservative and container requirements for the groundwater samples are outlined in Table IV.6. When a sample is collected, a chain-of-custody record will be started for that sample following the procedures in Mound Plant ER Program SOP 1.3, Sample Control and Documentation (revision 1). A custody seal will be placed on each sample container, and the samples will be packed on ice. When the samples are packaged for shipment, enough ice will be used so that they are maintained at a temperature of 4°C during shipment. Samples will be shipped the same day of collection by Federal Express™ overnight service. Packaging and shipment will follow Mound Plant ER Program SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples (revision 1).

Field measurements of groundwater include *in situ* monitoring of the following well water parameters: temperature, pH, specific conductivity, redox potential, and dissolved oxygen content. These parameters will be monitored during well purging and before and after well sampling to ensure parameter stability of the well water. Specific procedures for measuring field parameters of groundwater are outlined in Mound Plant ER Program SOP 2.1, Presample Purging of Wells (revision 1).

4.6.4. Field QA/QC Program

In addition to field duplicates, quality control samples will be collected. Each time a group of bottles is prepared for use in the field, one of each type container used for sampling VOCs in the field will serve as a trip blank. Each of these blanks will be filled with deionized water, transported to the site, and handled in the same fashion as the other sample bottles. The blanks will subsequently be sent to the laboratory for analyses. An equipment blank (i.e., rinsate blank) will be prepared for non-dedicated sampling equipment to ensure that the equipment has been effectively cleaned. The device will be filled or rinsed with ASTM Type II reagent grade water, and the water will then be transferred to a sample bottle and sent to the laboratory for analysis. Samples collected for matrix spikes and matrix spike duplicates will be explicitly labeled by the field team. The matrix spike/matrix spike duplicate samples will be triple the normal volume for VOCs and double the volume for semivolatile organic compounds and pesticides/PCBs. Quality assurance/quality control sampling procedures will follow the Site-Wide Quality Assurance Project Plan supplied as a companion document.

4.7. SEISMIC REFRACTION SURVEY

A seismic refraction survey will be performed at the Mound Plant as outlined in the Operable Unit 9 Work Plan. Approximately 27,000 ft of seismic refraction lines will be collected during the survey. Figure 4.7 shows the locations of the proposed seismic refraction lines and previously collected refraction lines. Results of the previous seismic refractions survey are presented in the Preliminary Report on the Seismic Refraction Survey at the Mound Plant (DOE 1990).

4.7.1. Equipment

- Seismograph - All seismic refraction data will be collected with a Model 2401 seismograph by EG&G Geometrics, Incorporated. This instrument is a 24-channel seismograph with instantaneous floating point gain, digital output, and advanced frequency filtering capabilities.

- Geophones - Vertical motion geophones with a center frequency of 14 Hz or less will be used for data acquisition.

- Energy Sources - Within the Mound Plant, seismic energy will be generated with a drop-weight source or the impact of a sledgehammer on a steel plate. In areas where bedrock is shallow, the sledgehammer sound source should provide sufficient energy. Where bedrock is deeper or ambient noise levels are high, the drop-weight sound source will be used.

- In areas to the south of the plant, electronically triggered 500-grain black powder shells, buried at 3 ft, will be used as a sound source. In areas where bedrock is deep,

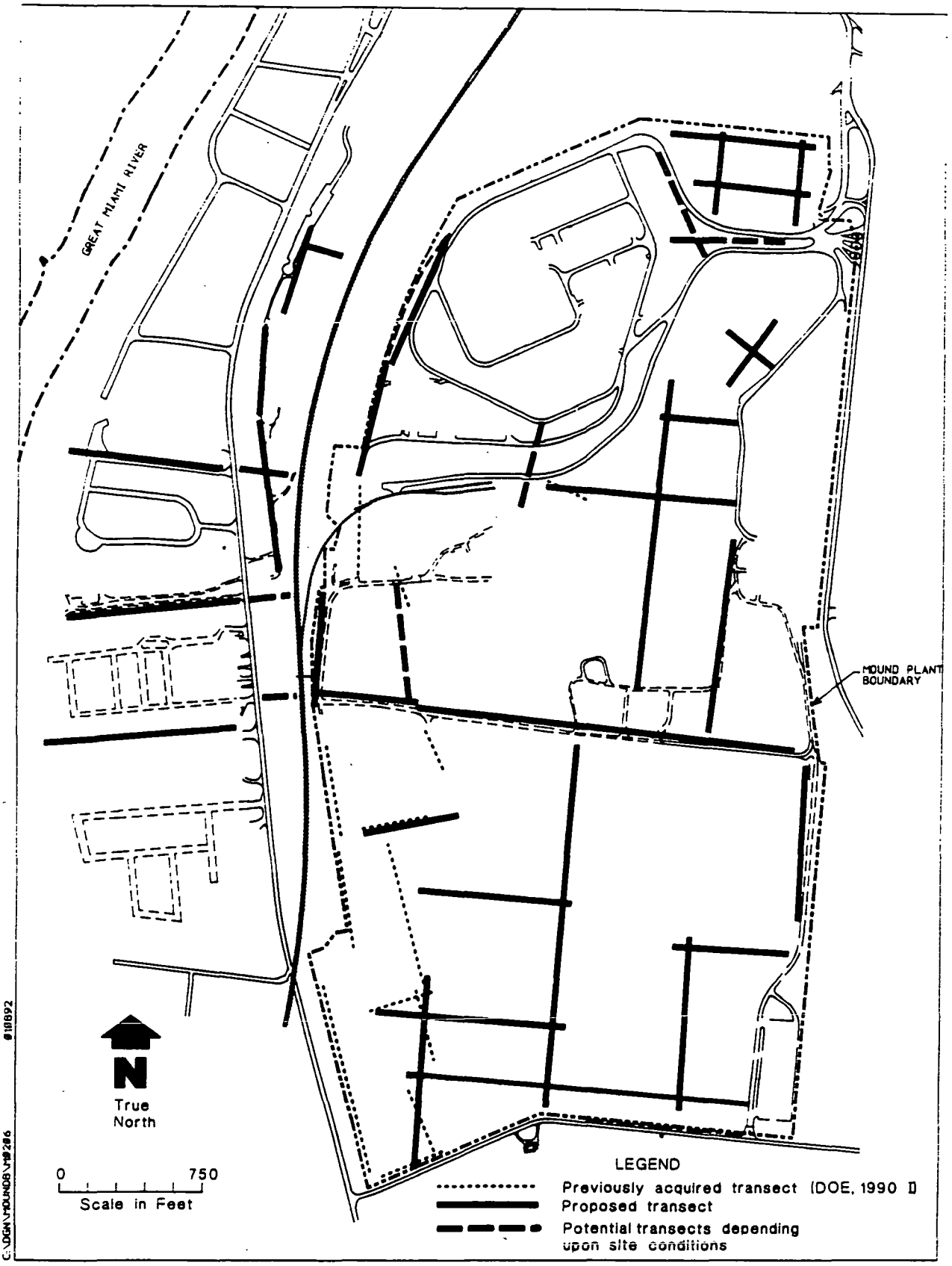


Figure 4.7. Proposed transect locations for seismic refraction study.

up to four shells may be required at each shot-point. In all cases, the supervising geophysicist will determine the sound source that will be employed, based on an assessment of site conditions and a first order analysis of field data.

- Surveying Equipment - An engineering level and tripod with a 25-ft rod will be used to measure elevations of geophones and shot-points to the nearest 0.01 ft.

4.7.2. Field Methods

- Spread Configuration - Figure 4.8 shows the typical geophone and shot-point configuration that will be used in the survey. Combinations of 5-ft and 20-ft geophone spacings are used in this example. The closely spaced phones at each end of the array and in the middle provide shallow information when combined with the near offset shots. The wider spaced geophones provide a 24-geophone seismic line length that is suited for characterizing refractors as deep as approximately 100 ft. Additional longer offset shots or wider geophone spacings will be added if the target refractor is deeper than 100 ft or is not adequately represented in the data. Other configurations with variable geophone spacing can be used if survey targets are shallower or deeper refractors. The supervising geophysicist will determine the exact spread configuration along each line, based on an assessment of site conditions and a first order analysis of field data.

  The configuration shown in Figure 4.7 is for a line consisting of 24 geophones. For a line consisting of 12 geophones, closely spaced geophones will be placed at the beginning and end of the line. For more than 24 geophones, closely spaced phones will be placed at the beginning of each 12-geophone spread, and at the beginning and end of the last 12-geophone spread in the line. In this way, accurate shallow information will be collected periodically along the entire length of the line.

  In shallow environments (bedrock depth less than approximately 50 ft) where the study area requires coverage beyond the two spreads, spread 1 will be moved after acquisition of data from shot E (Figure 4.8). Spread 1 is deployed beyond spread 2 to form a new spread (spread 3), and data acquisition is continued. This "leapfrogging" of 12-geophone spreads provides an efficient means of acquiring data without having to repeat shot-points. This system cannot, however, be used where longer offset shots are required or where interpretation as a single 24-geophone spread is required.

- Filtering - Low-cut filtering will not be used unless a proximal low-frequency noise source is present (such as construction equipment or water pumps). This is because of the low-frequency geophones and the greater propagation of low-frequency signals. High-cut filtering may be employed to eliminate high-frequency interference without compromising signal strength at the geophones. However, both low- and high-cut filtering should be minimized to the extent ambient noise levels allow.

- Surveying - All geophone and shot-point locations will be surveyed for elevation to the nearest 0.01 ft. Horizontal positions will be measured to the nearest 0.1 ft and referenced to structures such as buildings and fences. Seismic lines will be accurately plotted on a map as they are collected.

- Sound Sources - Auger holes with a maximum diameter of 4 inches will be used to bury the charges at a depth of 3 ft. Holes will be filled with soil materials and tamped with a wooden stick. Where more than one 500-grain charge is required, the shells

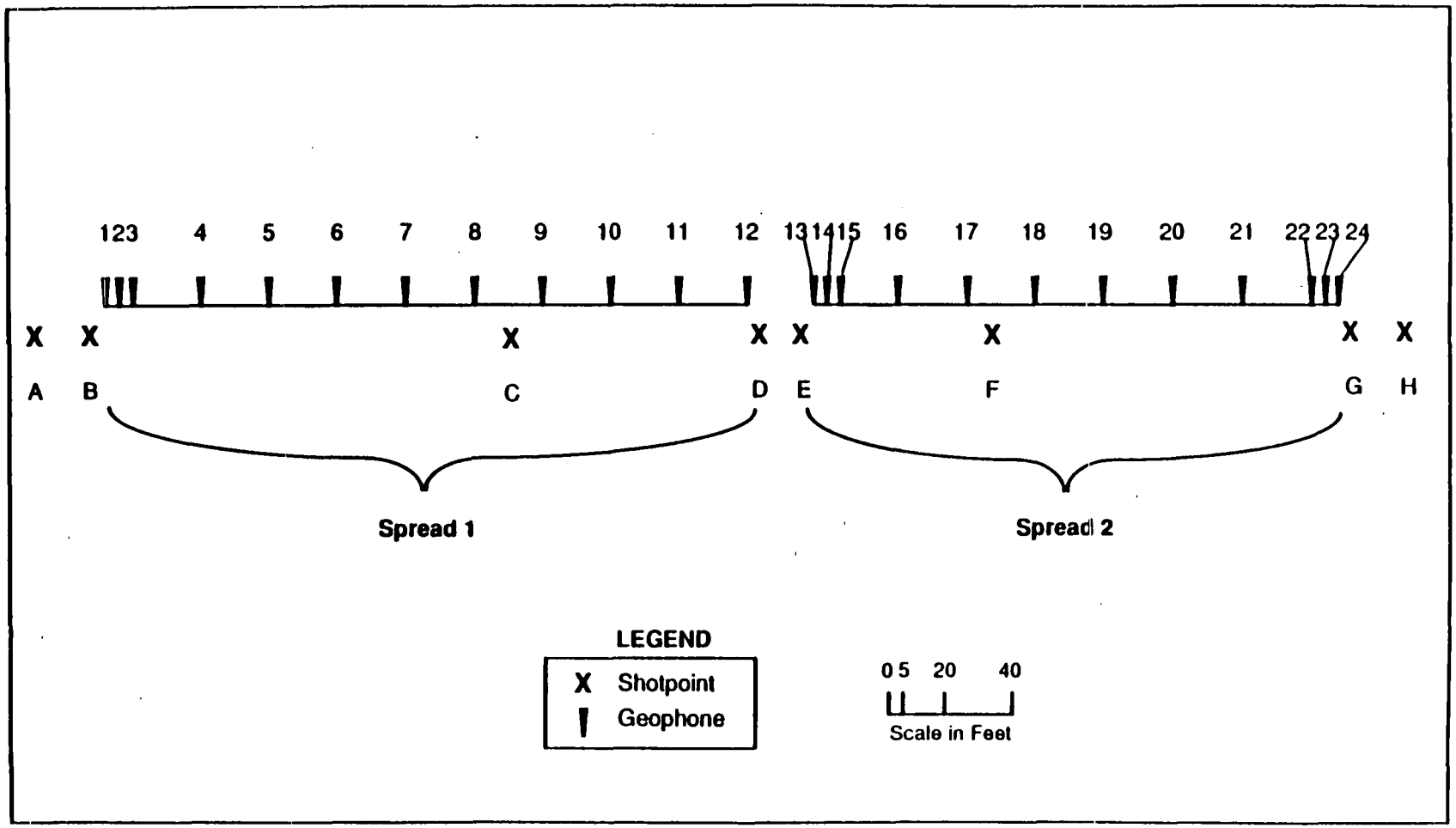


Figure 4.8. Typical spread configuration to be used in the seismic refraction survey.

will be wired in parallel to avoid misfires or delayed detonation of shells. Lead wires to shells will always be shorted until immediately before the buried shell is detonated. Shells will be fired with a portable detonator that simultaneously triggers the seismograph.

When the drop-weight and sledgehammer sources are used, the seismograph will be triggered with either a hammer switch or a starter geophone. In most cases, the hammer switch is the preferred method. However, a starter geophone used for end shots with the drop-weight sound source may provide more accurate results.

- Seismograph Operation - Gains do not need to be manually adjusted on the Geometrics 2401 seismograph. However, trace sizes are adjusted after acquisition of field records. Trace sizes will be adjusted in the field to optimize recognition of first arrivals. After traces are adjusted, the record will be digitally stored on a 3.5-inch, high-density computer disk. The file name for each record will begin with the line number and end with the shot number. Disks will be clearly labeled with the date, site identifier (MND), line number(s), shot numbers, and file names. An accurate record of all shot data and file names, along with sketches of spread locations and configurations, will be entered into the field log book.

  After a record is stored on disk, a hard copy will be produced in the field. The record will be annotated with the date, site identifier (MND), time, line number, shot number, and file name. A first-order analysis of field data will be performed, based on the hard-copy record. This will involve a velocity analysis to determine whether the bedrock surface and water table refractors are present in the data. Velocities for the water table refractors should range from 4,000 to 6,000 feet per second (ft/s), and velocities for the bedrock refractor should be greater than 8,000 ft/s. If these velocities are not measured along a refraction line, the supervising geophysicist will adjust shot-point and geophone positions accordingly.

4.7.3. Data Archiving and Processing

- Disk Back-Up - At the end of each field day, a copy of each disk will be made. The back-up copies will be organized and stored separately from the originals.

- First-Break Picks - The first arrivals of seismic energy will be digitally identified for each shot, using the SIPIK program by Rimrock Geophysics, Inc. Then, a hard-copy record with numeric picks will be produced. This process will be performed on all geophysical records before demobilization from the site. Hard-copy records from the seismograph and the SIPIK program will be copied, and the second copies will be organized and stored with the back-up disks.

- Survey Data - Ground surface elevations for geophones and shot-points along each line will be tabulated and stored with the hard-copy records at the end of each field day. In addition, accurate maps of seismic line positions must be checked for completeness at the end of each field day.

- Processing - A minimum of 10% of the seismic refraction profiles will be interpreted with the SIPT1 seismic interpretation program during the course of the field effort. When possible, the lines selected for processing will be near control points such as wells or exploratory borings. In this way, the results of the seismic refraction survey will be monitored during the field effort, and any problems in data acquisition parameters will be identified and corrected.

5. RESIDENTIAL WATER INVESTIGATION

5.1. BACKGROUND INFORMATION

This residential water investigation consists of three parts: identifying municipal and residential wells and cisterns within a 2-mile radius of Mound Plant (Figure 5.1), determining which ones will be sampled and analyzed for the contaminants of concern, and sampling a representative population of wells and cisterns. A comprehensive list of residential and municipal water users within a 2-mile radius of the Mound Plant will be compiled and information obtained about the wells/cisterns will be used to determine those wells/cisterns that will be sampled. Samples collected from wells will consist of groundwater, and samples collected from cisterns will consist of cistern reservoir water and accumulated sediments, if present, in the base of the cistern.

5.2. SAMPLING OBJECTIVES

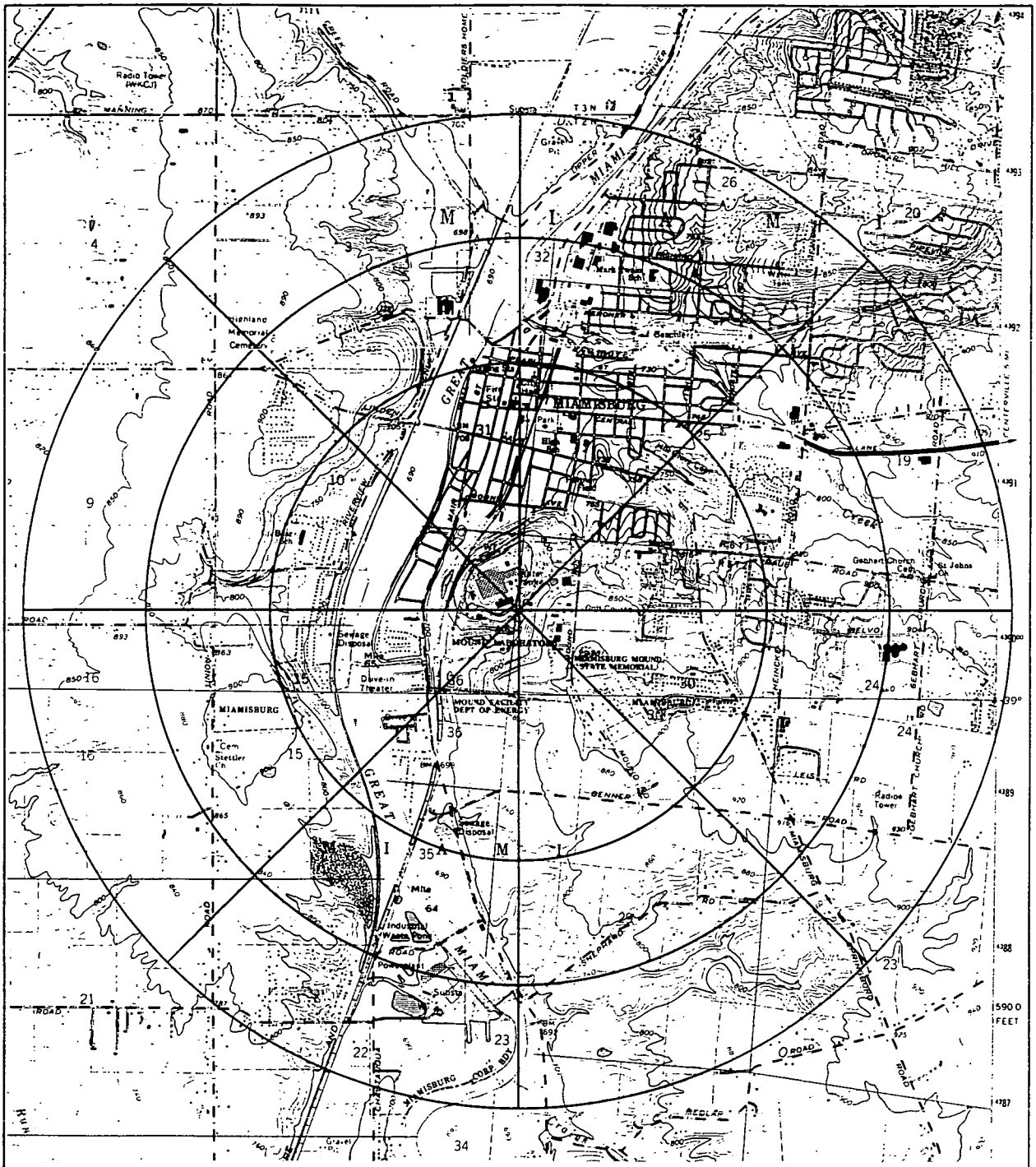
The residential water investigation will be initiated to

- identify the location of all residential and municipal wells and cisterns in the area of concern;
- determine the total depth, formation of completion, and water use of those residential wells for which that information is documented;
- determine the construction configuration of the cisterns and source of water;
- determine the residential wells and cisterns best suited to sample;
- identify the potential for contamination resulting from plant operations; and
- provide data for the risk assessment.

5.3. SAMPLE LOCATIONS AND FREQUENCY

All municipal and residential wells and cisterns within a 2-mile radius of Mound Plant will be located and identified. Limited information on wells is currently available from a public notice issued in the Miamisburg News in December 1990, and from past sampling conducted on residential wells (Site Scoping Report - Vol 2). Records on wells and cisterns from the Ohio Department of Health, Ohio Department of Natural Resources, City of Miamisburg Water Department, and the County of Montgomery water department will be collected and compiled. The minimum information to be compiled is presented in Table V.1. This

information may be supplemented by implementing a door-to-door survey. All wells will be assigned an ID number as well as sector location ID and proximity ID. The well ID number will be consistent with the current 0900 residential numbering system. The sector ID and proximity ID will be based upon the 8-radial vectors N, NW, W, SW, S, SE, E, and NE and distances of 0.5, 1, 1.5, and 2 miles from radius of the Mound Plant. Information obtained on the wells and cisterns will be incorporated into a data base. Criteria will be established to propose wells/cisterns for sampling. The proposed wells and cisterns to be sampled and the criteria for their selection will be submitted to EPA and OEPA for concurrence. The wells and cisterns that are selected will be sampled two times. Sample parameters for water and sediment are shown in Table V.2. After two rounds of sampling, the sampling program will be reevaluated for the need of additional sampling to support the risk assessment.



Note: 1, 1.5 and 2 mile radii shown, measured from plant locus.

Figure 5.1. Two mile radius for residential well investigation.

Table V.1. Residential Wells Inventory
Operable Unit 9

Geographical location relative to potential source areas
(Assign location ID by sectors and distance)
Hydrologic location - downgradient/upgradient
Proximity to source (ft)

Well/cistern function - Domestic Irrigation Stock Municipal Industrial Cistern Other

Functional - Y/N -If no, when last functional: 0-5 yrs. 5-10 yrs. >10 yrs.

Well/cistern owner consent - Y/N

Depth of well/cistern
When installed, how installed - drilled, hand dug

Depth to water
Log available - Y/N
Screened interval and lithology

Previous chemical sampling - Y/N Routine Nonroutine

Sample accessibility - well head tap

Water softener present - Y/N

Carbon filter present - Y/N

Source of water to cistern

Well/cistern construction - open or cased Type: Steel, PVC, Brick, Other Diam.: inches

Pump present - Y/N When installed:
Material:
GPM: Type:

Pressure tank present - Y/N Size:
Material:

Well/cistern condition - Good Poor

Well/cistern density in sector (spatial distribution)

Residence with children - Y/N

How identified - Records, Letter Reply, Interview

EPA concurrence - Y/N

Local influence - Industry, Gas Station, Highway, Farm

Table V.2. Specifications for the Residential Well Investigation Groundwater Sampling

Environmental Samples

Groundwater Samples

Number:	To be determined by criteria selection
Analytical Parameters:	Water analytical parameter list; field parameter list

Cistern Water Samples

Number:	To be determined by criteria selection
Analytical Parameters:	Water analytical parameter list; field parameter list

Cistern Sediment Samples

Number:	To be determined by criteria selection
Analytical Parameters:	Sediment analytical parameter list

Quality Control Samples

Trip Blanks

Number:	1 per cooler containing VOC samples
Analytical Parameters:	VOCs

Equipment Rinsate Blanks

Number:	1 for every 10 or fewer samples collected
Analytical Parameters:	Water and sediment analytical parameter lists

Field Ambient Blanks

Number:	1 for every 10 samples collected
Analytical Parameters:	VOCs

Field Duplicates

Number:	1 for every 10 samples collected
Analytical Parameters:	Sediment or water analytical parameter list, as appropriate; field parameter list

Matrix Spike/Matrix Spike Duplicates

Number:	1 for every 10 samples collected

WATER ANALYTICAL PARAMETER LIST

VOCs
Semivolatile organic compounds
TAL inorganics[a]
Fluoride
Bismuth
TCL pesticides/PCBs
Isotopic plutonium (238, 239/240)[a]

FIELD PARAMETER LIST

pH
Temperature
Redox potential
Dissolved oxygen
Specific conductivity
Water level

Table V.2. (continued)

WATER ANALYTICAL PARAMETER LIST (CONTINUED)

Isotopic thorium (228, 230, 232)[a]
Isotopic uranium (234/235, 238)[a]
Radium-226[a]
Americium-241[a]
Strontium-90[a]
Gamma spectrometry[a]
Nitrate/nitrite
Nitrite
Total suspended solids
Total dissolved solids
Alkalinity
Chloride
Sulfate
Tritium

SEDIMENT ANALYTICAL PARAMETER LIST

VOCs
Semivolatile organic compounds
TCL pesticides/PCBs
TAL inorganics
Bismuth
Fluoride
Nitrate/nitrite
Isotopic plutonium (238, 239/240)
Isotopic thorium (228, 230, 232)
Isotopic uranium (234/235, 238)
Strontium-90
Tritium
Gamma spectrometry

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[a]In addition to samples collected for total TAL metals and total radionuclides, a filtered sample will be collected for dissolved TAL metals and dissolved radionuclides for comparison purposes.
PCBs = polychlorinated biphenyls
TAL = Target Analyte List
TCL = Target Compound List
VOC = volatile organic compound

5.4. SAMPLE DESIGNATION

The sample designation system for all field and quality assurance/quality control samples is a three-letter and ten-digit unique identification for each sample (MNDXX-YYYY-ZZZZ). MNDXX is the facility identifier: MND identifies Mound Plant, and a two-digit number identifies the area or investigation, which is 24 for the residential well and cistern water investigations and 25 for cistern sediment samples. The next four digits (YYYY) represent the specific sampled location. In this case, each of the residential wells or cisterns chosen for sampling will be assigned a sequential 900 series number, beginning with 0930 and running through 0999. The last four digits (ZZZZ) are the sample identifier, which documents how many times the location has been sampled. Since water samples will be collected in two sampling events from each residential well or cistern, the last four digits will differentiate the sampling event. The field quality control samples will be given a specific sample identifier as outlined in Table I.3.

Example. The samples obtained from one of these residential well or cistern locations will be numbered as follows (area-location-sample):

MND24-0930-0001 for the first sampling event of cistern water;

MND24-0930-0002 for the second sampling event of cistern water;

MND25-0930-0001 for the first sampling event of cistern sediment; and

MND25-0930-1001 for the duplicate first cistern sediment sample.

The sample identification procedure is further explained in the Mound Plant ER Program SOP 1.3, Sample Control and Documentation (revision 1) found in the Operable Unit 9 QAPP.

5.5. SAMPLING EQUIPMENT AND PROCEDURES

The anticipated equipment and procedures that will be used for collecting groundwater samples from selected residential wells and reservoir water/accumulated sediment from selected cisterns are identified below. Further discussion of the procedures for sample collection, control, documentation, containers, preservation, handling, and shipping is presented in subsection 1.2.2, and in the Operable Unit 9 QAPP.

5.5.1. Measurement of Static Water Level

The static water elevation shall be measured, if possible, in each selected residential well before the groundwater is sampled. Residential wells selected for sampling will most likely contain a dedicated downhole pump. The presence of a dedicated pump may make it difficult to access the open well bore for a static water level measurement. Access to the inside of the well bore will be a criterion in the selection of residential wells for sampling. The procedures for measurement of static water elevations in a well are identified in Mound Plant ER Program SOP 3.1, Water Level Measurement (revision 1) found in the Operable Unit 9 QAPP.

Static water level measurements will include depth to standing water and total depth of the well to the bottom of the well screen, if possible. This information is required to calculate the volume of stagnant water in the well and to provide a check on the integrity of the well (e.g., identify siltation problems, well string collapse, etc.). The measurements will be taken to ± 0.01 ft. Each well should have a permanent, easily identified reference point from which the water level measurement is taken. The reference point at each residential well will be marked at the top of the well casing or, where applicable, at the top of the protective casing. This reference point will be located horizontally and vertically by a licensed surveyor. The elevation of the ground surface at each well will also be surveyed. The horizontal coordinates of the well will be presented using the Ohio State Plane Coordinate System.

5.5.2. Groundwater Sampling

If it is possible to measure the static water level and total depth of a selected well, the bore volume can be calculated. A total of three bore volumes will be purged from the well before samples are collected. If the

residential well is constructed such that the static water level or the total depth of the well cannot be measured, well water from the nearest discharge pipe or water faucet will be withdrawn for at least 10 minutes to ensure that pipes have been thoroughly flushed. The volume of water purged from the well will be recorded. Generally, samples will not be filtered. However, filtered samples for dissolved TAL metals and dissolved radionuclides will be collected for comparison purposes.

For residential wells equipped with a downhole pump, samples will be collected from a discharge pipe or water faucet. Non-inert materials in the well and pipes can alter the chemistry of the sample. Therefore, it is important to collect the sample as close to the wellhead as possible (Freeze and Cherry 1979). Under no circumstances will the field investigator attempt to remove the downhole pump. If the well does not contain a pump and consists of an open well bore, the well will be sampled using a dedicated Teflon™ bucket-type bailer. The field investigator will obtain prior approval from the project manager before inserting a sampling device into the well. Specific procedures for using a bailer and sampling of residential wells are outlined in Mound Plant ER Program SOP 2.7, Sampling Commercial/Municipal/Domestic Wells (revision 1).

Field measurements of groundwater include monitoring of the following well water parameters: temperature, pH, specific conductivity, redox potential, dissolved oxygen content, and water level. All parameters will be monitored during well purging and before and after well sampling to ensure parameter stability of the well water. Specific procedures for measuring field parameters of groundwater are outlined in Mound Plant ER Program SOP 2.2, Field Measurements on Ground and Surface Water Samples (revision 2).

Residential groundwater samples for certain analytical parameters such as dissolved TAL metals will require filtration. A separate grab sample will be collected for filtering. The filtering will be done in the field as defined in the procedures contained in the QAPP. Samples collected for total metals and TSS must be unfiltered.

In addition to samples collected for total TAL metals and total radionuclides, a filtered sample will be collected for dissolved TAL metals and dissolved radionuclides for comparison purposes.

5.5.3. Cistern Sampling

Field measurements of surface water from cisterns will include the following parameters: pH, temperature, redox potential, dissolved oxygen, and specific conductivity. Procedures for determining field chemistry of surface water samples are described in Mound Plant ER Program SOP 2.2, Field Measurements on Ground

and Surface Water Samples (revision 2). Proper sampling procedures for surface waters are documented in Mound Plant ER Program SOP 2.9, Surface Water Sampling (revision 1). Specific sampling procedures for the collection of cistern reservoir water and accumulated sediment samples cannot be determined until the cisterns are investigated.

5.6. SAMPLE HANDLING AND ANALYSIS

Preservative and container requirements for the groundwater and cistern samples are outlined in Table I.4. When a sample is collected, a chain-of-custody record will be started for that sample following the procedures in Mound Plant ER Program SOP 1.3, Sample Control and Documentation (revision 1). A

custody seal will be placed on each sample container, and the samples will be packed on ice. When the samples are packaged for shipment, enough ice will be used so that they are maintained at a temperature of 4°C during shipment. Samples will be shipped by overnight delivery service. Packaging and shipment will follow Mound Plant ER Program SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples (revision 1).

Results from these analyses will be presented and explained to the residential water users by a qualified representative from Mound Plant, their contractor, or both. Exact policy and format of the presentation is to be determined.

6. SOIL INVESTIGATIONS

6.1. BACKGROUND INFORMATION

As part of the Site-wide RI, samples will be collected from locations off the Mound Plant property that are believed to be unaffected by past and present disposal practices and from contaminant releases at the plant. These samples will be collected in order to determine background chemical soil parameters. Determination of background concentrations for the Mound Plant area is important for determining baseline risk assessments and developing soil cleanup criteria. At the present time, Mound Plant personnel do not routinely sample soils for physical and chemical parameters.

In addition to determining background chemical soil properties, off-plant soils will be sampled as part of an airborne emissions migration assessment and an investigation of potentially contaminated soils along National Pollutant Discharge Elimination System (NPDES) Outfall 001 and at the Main Hill seeps. In order to characterize the deposition of airborne radioactive particulates originating from emission stacks at the Mound Plant (located on SM/PP Hill and the Main Hill), surface soil samples will be collected along 16 radial compass vectors extending from the plant; sample density and analytical parameters will decrease with increasing distance from the plant. To investigate possible soil contamination associated with NPDES Outfall 001, subsurface soil samples will be collected at locations adjacent to the pipeline. To investigate possible soil contamination associated with contaminated seeps, surface and subsurface soil samples will be collected at and down-slope of the seeps.

6.2. SAMPLING OBJECTIVES

Off-plant soil samples will be collected in the vicinity of the Mound Plant in order to

- characterize deposition of airborne radionuclide particulates along 16 radial compass vectors leading from Mound Plant,
- determine background chemical parameters,
- investigate potential contamination of soils along the NPDES Outfall 001 pipeline, and
- investigate potential contamination of soils at known seeps.

6.3. SAMPLE LOCATIONS AND FREQUENCY

Four sets of soil samples will be collected as part of this study: up to 262 locations along 16 radial compass vectors from Mound Plant; 6 or 7 locations adjacent to the NPDES Outfall 001 pipeline; 16

locations within the Miamisburg area (<1.0 mile from the plant); and 24 locations adjacent to 8 seeps (3 locations per seep). Each of these sampling efforts will be performed once. Sampling specifications are summarized in Tables VI.1 through VI.4.

Table VI.1. Specifications for Investigation of Background Soil Conditions

PHASE I BACKGROUND LOCATIONS NEAR (< 1 MILE) MOUND PLANT:

Environmental Samples

Surface soil samples[a]

Number:	48 (3 at each of 16 locations)
Depth:	0 to 0.5 ft
Analytical parameters:	Analytical parameter list, plus molybdenum and lithium

Subsurface soil samples

Number:	48 (3 at each of 16 locations)
Depths:	1.5 to 2.0 ft
Analytical parameters:	Analytical parameter list, plus molybdenum and lithium

Quality Control Samples

Equipment Rinsate Blanks

Number:	1 per 10 geochemical samples
Analytical parameters:	Analytical parameter list

Field Duplicates

Number:	1 per 10 geochemical samples
Analytical parameters:	Analytical parameter list

Matrix Spike/Matrix Spike Duplicates

Number:	1 per 20 geochemical samples
Analytical parameters:	Analytical parameter list (double volume for all parameters)

PHASE II BACKGROUND LOCATIONS:

Surface soil samples[a]

Number:	To be determined
Depth:	0 to 0.5 ft
Analytical parameters to be considered:	To be determined

Subsurface soil samples[b]

Number:	To be determined
Depths:	1.5 to 2.0 ft
Analytical parameters to be considered:	To be determined

Analytical Parameter List

TCL pesticides/PCBs	Isotopic plutonium (238, 239/240)
TAL inorganics	Isotopic thorium (228, 230, 232)
Bismuth	Isotopic uranium (234/235, 238)
Fluoride	Strontium-90
Total organic carbon	Tritium
Nitrate/nitrite	Gamma spectrometry
Chloride	Sulfate
pH	

---

[a]Surface soil samples will be obtained according to Mound Plant ER Program SOP 5.2, Soil Sampling with a Spade and Scoop (revision 3).
[b]Subsurface soil sampling will be performed according to Mound Plant ER Program SOP 5.3, Subsurface Solid Sampling with Hand Auger and Thin-Wall Sampler (revision 2).
PCB - polychlorinated biphenyl
TAL - Target Analyte List
TCL - Target Compound List

Table VI.2. Specifications for Airborne Depositional Investigation

CHEMICAL AND MISCELLANEOUS RAD TABLE (AQUEOUS DEPOSITION)

Environmental Samples

Surface soil samples[a]

Number:	32
Location:	16 at security fence and 16 at 1,000 ft
Depth:	0 to 0.5 ft
Analytical parameters:	Analytical parameter list and 20% for USATHAMA explosives

Subsurface soil samples[b]

Number:	32
Location:	16 at security fenceline and 16 at 1,000 ft
Depths:	1.5 to 2.0 ft
Analytical parameters:	Analytical parameter list and 20% for USATHAMA explosives

Quality Control Samples

Trip Blanks

Number:	1 per cooler containing VOCs
Analytical parameters:	VOCs

Equipment Rinsate Blanks

Number:	1 per 10 geochemical samples
Analytical Parameters:	Analytical parameter list

Field Ambient Blanks

Number:	1 per 20 geochemical samples
Analytical parameters:	VOCs

Field Duplicates

Number:	1 per 10 geochemical samples
Analytical parameters:	Analytical parameter list

Matrix Spike/Matrix Spike Duplicates

Number:	1 per 20 geochemical samples
Analytical parameters:	Analytical parameter list (double volume for most parameters; triple volume for VOCs)

Analytical Parameter List

VOCs
Semivolatile organic compounds
TCL pesticides/PCBs
TAL inorganics
Bismuth
Fluoride
Strontium-90
Gamma spectrometry
Nitrate/nitrite
Chloride
Sulfate

TRITIUM TABLE (VAPOR DEPOSITION)

Environmental Samples

Surface soil samples[a]

Number:	211
Location:	500 ft intervals to 5,000 ft 1,000 ft intervals to 10,000 ft and 20% of locations from 25,000 ft to 100,000 ft at 25,000 ft intervals
Depth:	0 to 1.0 ft
Analytical Parameter:	Tritium

Subsurface soil samples[b]

Number:	211
Location:	500 ft intervals to 5,000 ft 1,000 ft intervals to 10,000 ft and 20% of locations from 25,000 ft to 100,000 ft at 25,000 ft intervals
Depth:	1.0 to 2.0 ft
Analytical parameter:	Tritium

Quality Control Samples

Equipment Rinsate Blanks

Number:	1 per 10 geochemical samples
Analytical parameters:	Tritium

Field Duplicates

Number:	1 per 10 geochemical samples
Analytical parameters:	Tritium

Matrix Spike/Matrix Spike Duplicates

Number:	1 per 20 geochemical samples
Analytical parameters:	Tritium (double volume)

RADIONUCLIDE TABLE TABLE (PARTICULATE DEPOSITION)

Environmental Samples

Surface soil samples[a]

Number:	262
Location:	500 ft intervals to 5,000 ft 1,000 ft intervals to 10,000 ft 25,000 ft intervals to 100,000 ft
Depth:	0 to 2 inches
Analytical parameter:	Isotopic plutonium (238, 239/240)

Subsurface soil samples[b]

Number:	262
Depth:	2 to 12 inches
Analytical parameter:	Isotopic plutonium (238, 239/240)

Table VI.2. (page 3 of 3)

Quality Control Samples

Equipment Rinsate Blanks

Number:	1 per 10 geochemical samples
Analytical parameters:	Isotopic plutonium (238, 239/240)

Field Duplicates

Number:	1 per 10 geochemical samples
Analytical parameters:	Isotopic plutonium (238, 239/240)

Matrix Spike/Matrix Spike Duplicates

Number:	1 per 20 geochemical samples
Analytical parameters:	Isotopic plutonium (238, 239/240) (double volume)

URANIUM/THORIUM

Environmental Samples

Surface soil samples[a]

Number:	77
Location:	At the security fence line, at 500 ft, at 1,000 ft, and at 20% of the additional 1000-ft intervals to a maximum of 10,000 ft.
Depth:	0 to 2 inches
Analytical Parameters:	Isotopic uranium (234/235, 238) and isotopic thorium (228, 230, 232)

Quality Control Samples

Rinsate Equipment Blanks

Number:	1 per 10 geochemical samples
Analytical parameters:	Isotopic uranium (234/235, 238) and isotopic thorium (228, 230, 232)

Field Duplicates

Number:	1 per 10 geochemical samples
Analytical parameters:	Isotopic uranium (234/235, 238) and isotopic thorium (228, 230, 232)

Matrix Spike/Matrix Spike Duplicates

Number:	1 per 20 geochemical samples
Analytical parameters:	Isotopic uranium (234/235,238) and isotopic thorium (228, 230, 232) (double volume)

---

[a]Surface soil samples will be obtained according to Mound Plant ER Program SOP 5.2, Soil Sampling with a Spade and Scoop (revision 3).
[b]Subsurface soil sampling will be performed according to Mound Plant ER Program SOP 5.3, Subsurface Solid Sampling with Hand Auger and Thin-Wall Sampler (revision 2).
PCB - polychlorinated biphenyl
TAL - Target Analyte List
TCL - Target Compound List
USATHAMA - U.S. Army Toxic and Hazardous Materials Agency
VOC - volatile organic compound

Table VI.3. Specifications for NPDES Outfall 001 Soil Investigation

Drilling Program

Number of Boreholes:	6 to 7
Drilling Technique:	Cable-tool or air-rotary
Depths:	15 - 30 ft
Total Footage:	90 - 210 ft

Environmental Samples

Subsurface soil samples -- Geochemical[a]

Number:	18 to 42
Analytical Parameters:	Analytical parameter list; plus 20% of samples biased for USATHAMA explosives

Subsurface soil samples -- Geotechnical/Mineralogical[a]

Number:	12 to 14 (assume 2 stratigraphic units expected/borehole)
Analytical Parameters:	Particle size distribution (sieve and hydrometer analysis), organic content, cation exchange capacity, permeability, clay mineralogy (by X-ray diffraction), specific gravity, moisture content, organic content, relative density, maximum density, and pH.

Quality Control Samples

Trip Blanks

Number:	1 per cooler containing VOCs
Analytical parameters:	VOCs

Equipment Rinsate Blanks

Number:	1 per 10 geochemical samples
Analytical Parameters:	Analytical parameter list

Field Ambient Blanks

Number:	1 per 20 geochemical samples
Analytical parameters:	VOCs

Field Duplicates

Number:	1 per 10 geochemical samples
Analytical parameters:	Analytical parameter list

Matrix Spike/Matrix Spike Duplicates

Number:	1 per 20 geochemical samples
Analytical parameters:	Analytical parameter list (double volume for most parameters; triple volume for VOCs)

Analytical Parameter List

VOCs
Semivolatile organic compounds
TAL inorganics
Bismuth
Fluoride
TCL pesticides/PCBs
Isotopic plutonium (238, 239/240)
Isotopic thorium (228, 230, 232)
Isotopic uranium (234/235, 238)

Table VI.3. (page 2 of 2)

Analytical Parameter List (continued)
Strontium-90
Tritium
Gamma spectrometry
Nitrate/nitrite
Chloride
Sulfate
Total organic carbon

---

[a]Subsurface soil sampling will be performed according to Mound Plant ER Program SOP 5.3, Subsurface Solid Sampling with Hand Auger and Thin-Wall Sampler (revision 2).
PCB - polychlorinated biphenyl
TAL - Target Analyte List
TCL - Target Compound List
USATHAMA - U.S. Army Toxic and Hazardous Materials Agency
VOC - volatile organic compound

Table VI.4. Specifications for Main Hill Seeps Soil Investigation

Environmental Samples

Surface soil samples[a]

Number:	24
Depth:	0 to 0.5 ft
Analytical Parameters:	Analytical parameter list plus 20% of samples biased for USATHAMA explosives

Groundwater (seeps) samples

Number:	8
Analytical Parameters:	Analytical parameter list plus total dissolved solids, total suspended solids, ammonia, nutrients (TKN, TP), alkalinity; field parameter list

Subsurface soil samples – Geochemical[b]

Number:	16
Depth:	1.5 to 2.0 ft; 3.5 to 4.0 ft
Analytical Parameters:	Analytical parameter list plus 20% of samples biased for USATHAMA explosives

Subsurface soil samples – Geotechnical/Mineralogical[b]

Number:	8
Analytical Parameters:	Particle size distribution (sieve and hydrometer analysis), organic content, cation exchange capacity, permeability, clay mineralogy (by X-ray diffraction), specific gravity, moisture content, relative density, maximum density, and pH.

Quality Control Samples

Trip Blanks

Number:	1 per cooler containing VOCs
Analytical parameters:	VOCs

Equipment Rinsate Blanks

Number:	1 per 10 geochemical samples
Analytical Parameters:	Analytical list below

Field Ambient Blanks

Number:	1 per 20 geochemical samples
Analytical parameters:	VOCs

Field Duplicates

Number:	1 per 10 geochemical samples
Analytical parameters:	Analytical list below

Matrix Spike/Matrix Spike Duplicates

Number:	1 per 20 geochemical samples
Analytical parameters:	Analytical list below (double volume for most parameters; triple volume for VOCs)

Analytical Parameter List
VOCs
Semivolatile organic compounds
TAL inorganics
TAL inorganics (dissolved in water)

Table VI.4. (page 2 of 2)

Analytical Parameter List (continued)	Field Parameter List (Water)
Bismuth	Temperature
Fluoride	pH
TCL pesticides/PCBs	Specific conductivity
Isotopic plutonium (238, 239, 240)[d]	Dissolved oxygen
Isotopic thorium (228, 230, 232)[d]	Redox potential
Isotopic uranium (234/235, 238)[d]	Flow rate
Radium-226 (water only)[d]	
Americium-241 (water only)[d]	
Strontium-90[d]	
Tritium[d]	
Gamma spectrometry[d]	
Nitrate/nitrite	
Chloride	
Sulfate	
Total organic carbon	
USATHAMA explosives[c]	

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[a]Surface soil samples will be obtained according to Mound Plant ER Program SOP 5.2, Soil Sampling with a Spade and Scoop (revision 3).
[b]Subsurface soil sampling will be performed according to Mound Plant ER Program SOP 5.3, Subsurface Solid Sampling with Hand Auger and Thin-Wall Sampler (revision 2).
[c]Seeps 0601 and 0607 will be sampled for USATHAMA explosives.
[d]Samples will be collected for both dissolved and total radionuclides.
PCB - polychlorinated biphenyl
TAL - Target Analyte List
TCL - Target Compound List
TOC - Total organic carbon
USATHAMA - U.S. Army Toxic and Hazardous Materials Agency
VOC - volatile organic compound

6.3.1. Background Soil Sampling

The background soil samples collected for Phase I are located off-plant but within the Miamisburg area (Figure 6.1), and the locations have been specifically selected to represent the soil series that are present at the Mound Plant site. There are 8 soil series that occur at the plant represented by 16 mapping units (Table VI.5). A ninth soil series occurs at Mound Plant (Urban Land [Um]), which is not found off-site, therefore will not be sampled. Figure 6.2 depicts the soil map index of Montgomery County, Ohio. These soil samples will most closely correlate to the soil chemical parameters of the Mound Plant soils. There is a potential that these soils may have been affected by Mound Plant operations by distribution of airborne contaminants from the facility. At each of the 16 locations, 3 surface samples will be collected from a depth of 0 to 0.5 ft, and 3 subsurface soil samples will be collected at a depth of 1.5 to 2.0 ft for the analytical parameters presented in Table VI.1. The sample location, SCS soil type, and lithologic and soil horizon data will also be collected by the field geologist. No geotechnical samples will be collected as part of the background soil investigations.

For Phase II of the background soil investigation, the number and location of background locations have yet to be determined. The locations will depend on the results of the regional depositional study and will be agreed upon by the program managers. Maps reproduced from the Montgomery and Warren County SCS soil survey manuals (SCS 1976) will be reviewed to identify approximate locations of the soil series to be sampled. The sample locations will be selected outside the zone of influence from Mound Plant based upon Phase I data and the regional soil deposition investigation. Sampling during Phase II will include requirements set forth in the state of Ohio "How Clean is Clean" policy (OEPA 1991). The policy is guidance toward selecting the number of samples to be taken to determine background conditions and provides computational procedures for making the determinations. The number of locations used for background soil sampling will be agreed upon by the project managers.

6.3.2. Regional Soil Sampling for Deposits from Stack Emissions

As part of an airborne particulate deposition assessment, soil samples will be collected along 16 radial compass vectors (N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, and NNW) from the security fenceline to a maximum of 100,000 ft, at 500-, 1,000-, or 25,000-ft increments, depending on analytical parameters. The maximum distance of 100,000 ft is based on the identification of plutonium-238 at concentrations above background (>0.0002 pCi/g) at distances of up to 11 miles (58,080 ft) from the plant (MRC 1978). Sampling will be related to process information and the two primary sources: the SM/PP Hill and Main Hill stacks. Sampling will be conducted radially from a midpoint between the SM/PP and Main Hill stacks.

Tentative sample locations within 10,000 ft are shown in Figure 6.3. Identified sample locations greater than 10,000 ft from the locus are shown in Figure 6.4. If samples cannot be collected at a given location because of cultural interference (e.g., a road or building), the sample location will be adjusted to the nearest acceptable location. Because airborne deposition is the prime focus, sample locations will target unobstructed areas away from trees, buildings, and any overhead lines. Locations will not be affected by surface runoff and will be located away from drainage effects.

Sampling for chemical constituents will be conducted at the security fenceline and at a distance of 1,000 ft from the fenceline along each of the 16 radial vectors. All of the chemicals suspected would have resulted from low concentration emissions from fumehoods, ventilation ducts or other low altitude sources. One surface (0 to 0.5 ft) and one subsurface (1.5 to 2.0 ft) sample will be collected at each location and screened with a PID. As screening dictates, an additional sample may be selected for sample analysis. No geotechnical samples will be collected as part of the background soil investigations. All geotechnical samples will be collected onsite.

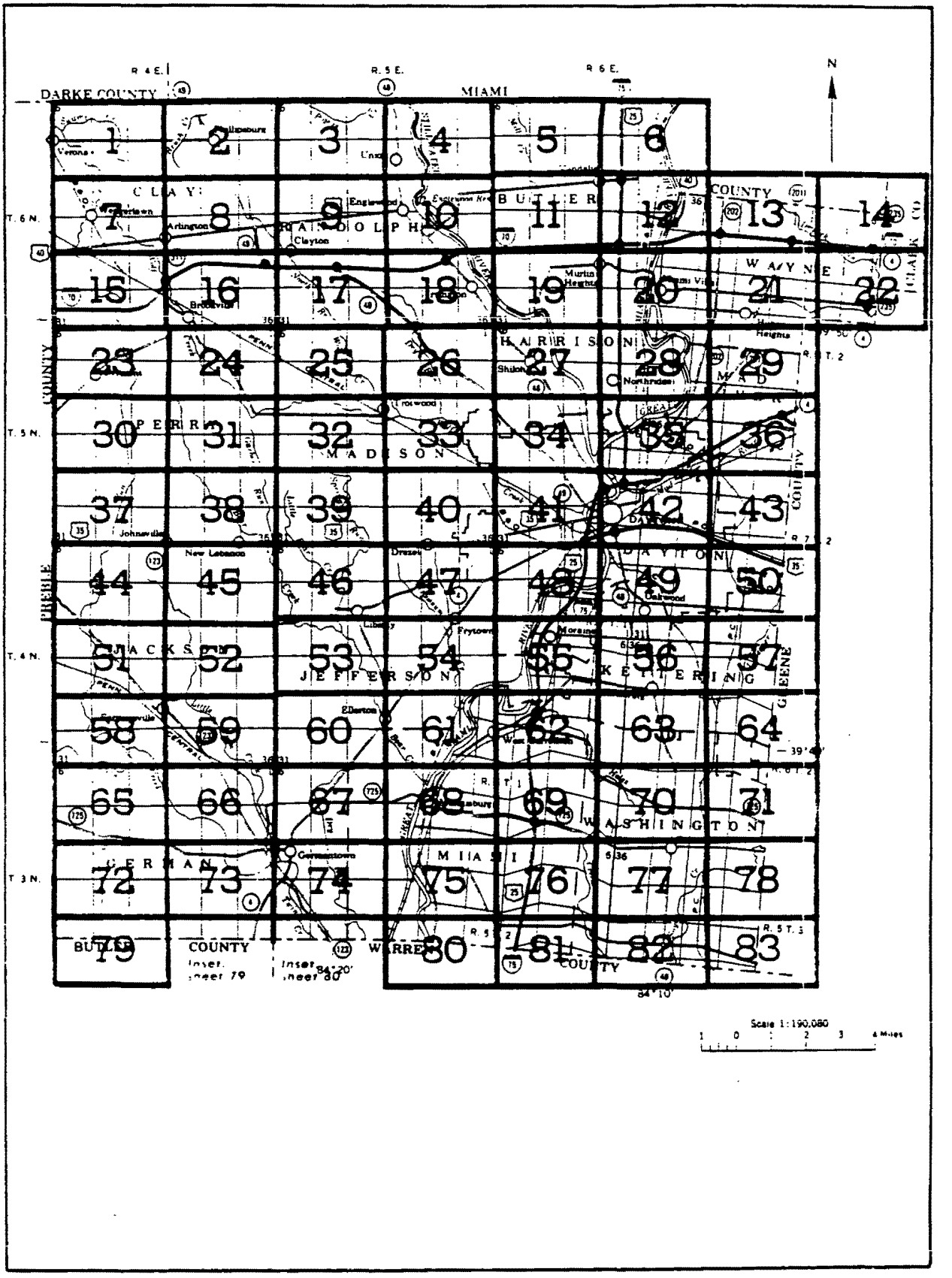


Figure 6.2. Index to soil map sheets for Montgomery County, Ohio.

Table VI.5. Soil Mapping Unit Symbols

Legend

Symbol	Mapping Unit
CoB	Corwin silt loam, 2 to 6% slopes
FaE2	Fairmont silty clay loam, 12 to 15% slopes, moderately eroded
FaF2	Fairmont silty clay loam, 25 to 50% slopes
HeF2	Hennepin and Miamian silt loam, 18 to 25% slope, moderately eroded
MlB	Miamian silt loam, 2 to 6% slopes
MnC3	Miamian silt loam, 6 to 12% slopes, severely eroded
MnD3	Miamian silt loam, 12 to 18% slopes, severely eroded
MoC	Miamian-Urban Land Complex
MtD3	Milton silty clay loam, 6 to 18% slopes, severely eroded
MsB	Milton silt loam, 2 to 6% slopes
MsC2	Milton silt loam, 6 to 12% slopes, moderately eroded
Mb	Made Land
ReB2	Ritchey silt loam, 2 to 6% slopes, moderately eroded
RfD3	Ritchey silty clay loam, 6 to 18% slopes
Rs	Ross silt loam
Um	Urban Land

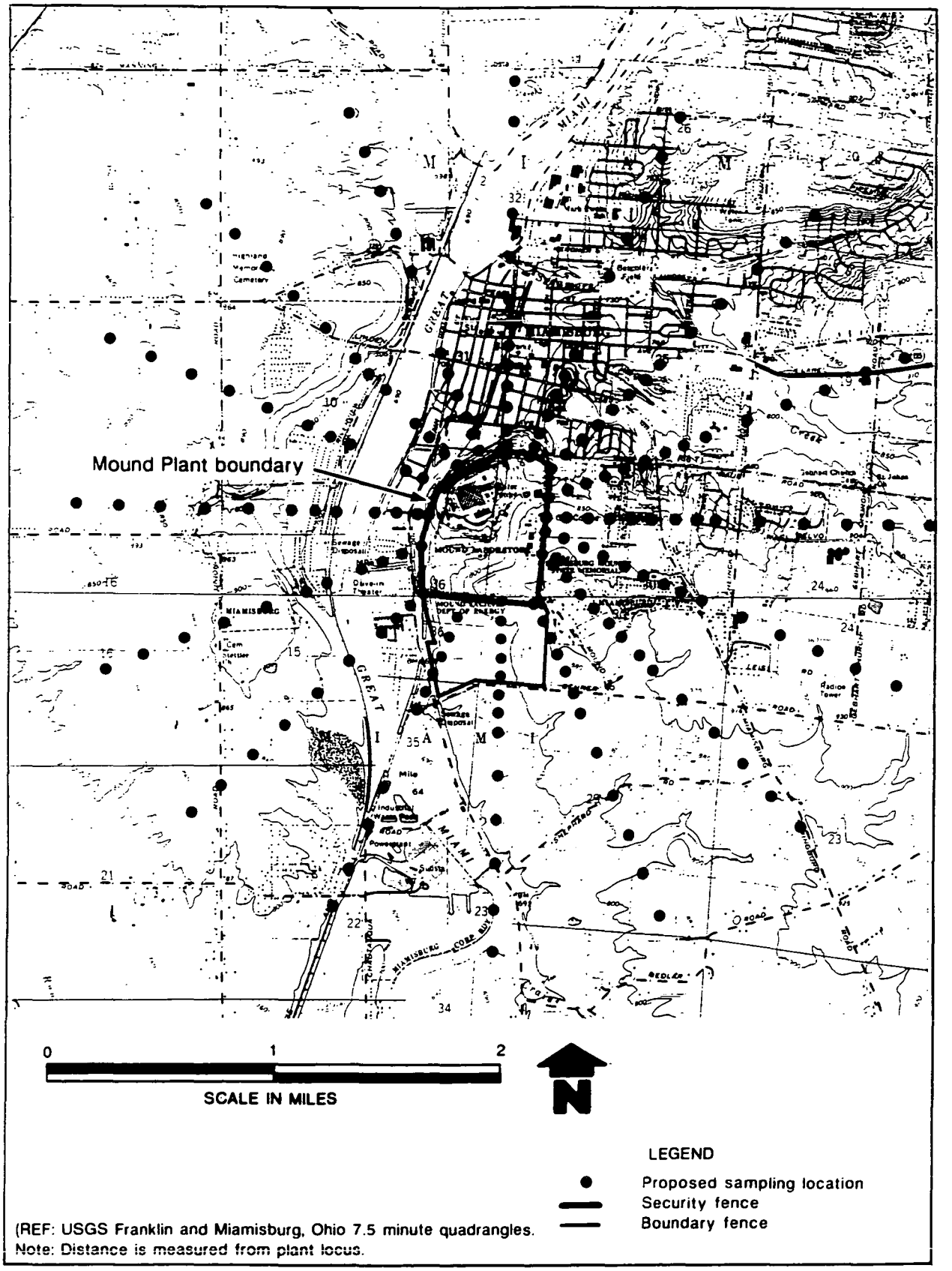
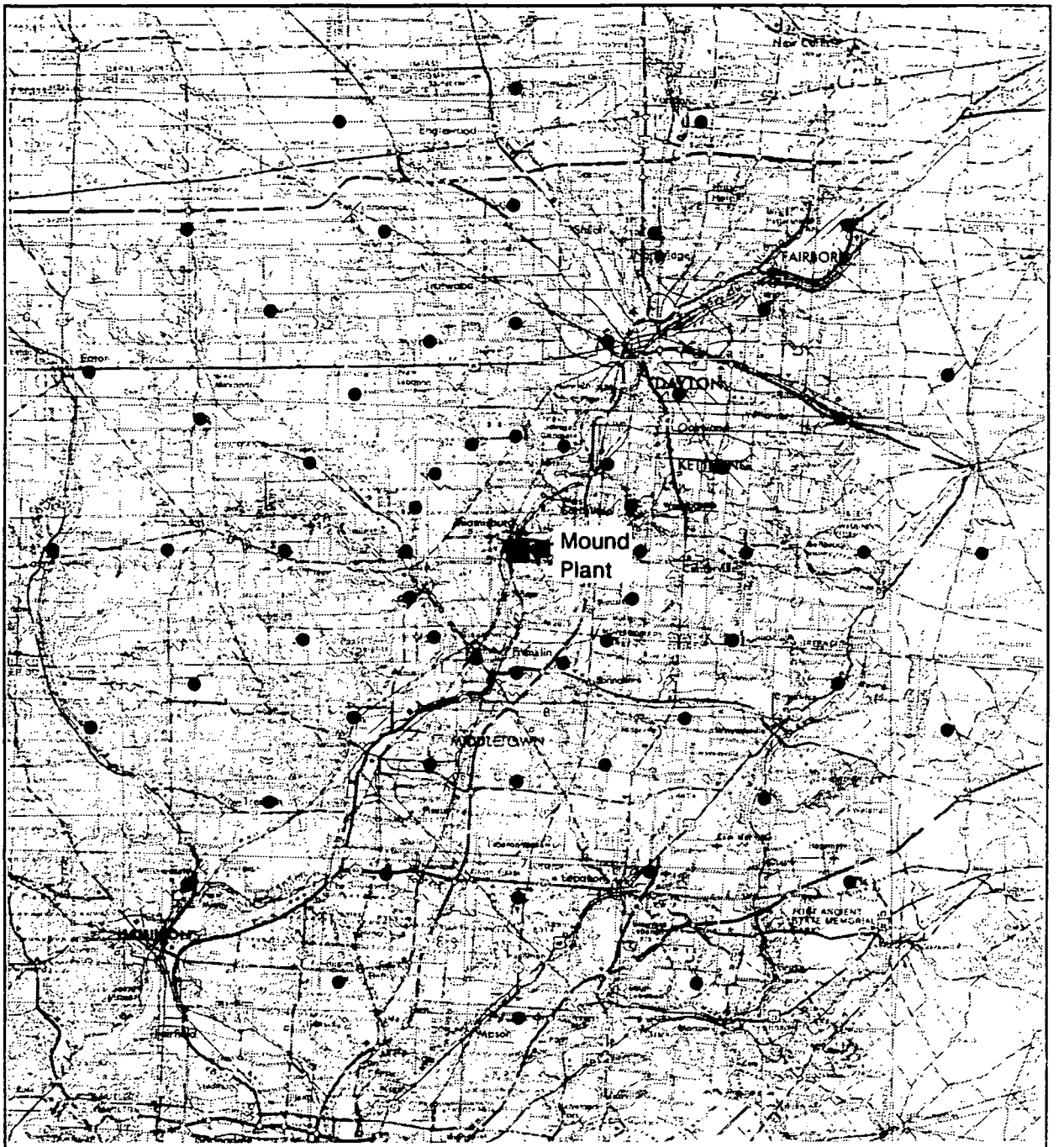


Figure 6.3. Proposed soil sampling locations at Mound Plant fence line to 10,000 feet.



● Propose sampling location

Ref: USGS, 1:250,000, Cinncinati and Columbus.
Note: Distance is measured from plant locus.

Figure 6.4. Proposed soil sampling locations at 10,000, 25,000, 50,000, 75,000 and 100,000 feet from Mound Plant.

A total of 32 surface and 32 subsurface samples will be submitted to the laboratory for chemical analysis. All of the 1,000-ft samples and the security fenceline samples will be analyzed for the analytical parameters shown on Table VI.2. Sampling and analyses will also be performed for a host of minor radionuclides that are not known to have been stacked. These radionuclides were involved with aqueous processes and are not expected to be found in the airborne depositional plume. Samples intended for the analysis of radium-226, strontium-90 and gamma spectrometry will be collected at the 32 locations described above for chemical constituents. The results of the analyses will be used to determine the presence or absence of such contamination and the possible impacts on the immediate population adjacent to the plant. If constituents are found, additional sampling will be considered.

Sampling for radionuclides will also be conducted along each of the 16 radial compass vectors at sample intervals of 500 ft, 1,000 ft or 25,000 ft out to a maximum distance of 100,000 ft, depending on the radionuclide. Polonium, tritium and plutonium were historically the dominant stack emissions. Since polonium has not been handled since the mid 1970s, and has a half-life of 138 days, it is not expected in the environment.

Sampling for tritium will be performed at the security fenceline, the ensuing locations at 500-ft intervals to a distance of 5,000 ft, and then at 1,000 ft intervals to a maximum of 10,000 ft. Tritium has been emitted as a tritium oxide, and vapor transport is the suspected dominant transport mechanism. One surface (0 to 1.0 ft) and one subsurface (1.0 to 2.0 ft) sample will be collected at each location. Beyond 10,000 ft, vapor transport of tritium is not suspected to be an effective transport process. As a test of this hypothesis, 20% of the locations between 25,000 and 100,000 ft (13 locations) were randomly selected (using a random number table) and will be analyzed for tritium. A total of 211 surface and 211 subsurface samples will be collected for tritium analysis. The sampling depths include the organic-rich surface and the root zone between the 6- and 12-inch depths, where soil moisture and associated tritium concentrations are likely to be highest.

Sampling for isotopic plutonium will be performed at the security fenceline, the ensuing locations at 500-ft intervals to a distance of 5,000 ft, at 1,000-ft intervals to 10,000 ft and at 25,000-ft intervals to a maximum of 100,000 ft. Plutonium was stacked as a particulate and has been previously mapped to about 70,000 ft. At all locations, one surface (0 to 2 inches) and one subsurface (2 to 12 inches) sample will be collected for a total of 262 surface and 262 subsurface samples that will be submitted for isotopic plutonium analysis. The results will be used to evaluate the concentration of resuspendable materials at the surface and the potential for vertical migration by leaching.

Sampling and analyses for isotopic uranium and thorium will also be performed within the 10,000-ft radius of the plant locus. The dominant processing activities were repackaging operations that resulted in fugitive dust emissions and localized contaminated areas on-plant. No stack emissions are known, and widespread areas of contamination are not suspected. Sampling will be performed at the security fence line, at 500 ft, at 1,000 ft, and at 20% of the additional 1,000-ft intervals to a maximum distance of 10,000 ft. All locations will include the collection of one surface sample (0 to 2 inches) for a total of 77 surface samples that will be submitted for analysis of isotopic uranium and thorium. Additional sampling may be required if widespread contamination is encountered.

6.3.3. NPDES Outfall Soil Sampling

A set of soil samples (six locations) will be collected adjacent to the NPDES Outfall 001 pipeline (Figure 6.5). This pipeline transmits permitted discharge from Mound Plant to the Great Miami River (Figure 6.1). Off of Mound Plant property, the pipe runs mostly east to west and consists of varying lengths of 10- and 12-inch vitric clay pipe, 12-inch steel, and 12-inch cast iron pipe. The pipe has known leaks and was fitted with a plastic liner in 1981 to curtail or preclude further leaks. The amount or extent of contamination of soils adjacent to the pipe are unknown. Six boreholes will be drilled and sampled adjacent to known or suspected pipeline leaks or at locations of construction or pipe material changes and transitions (Figure 6.5). Exact locations will be determined in the field and will be based on accessibility and utility clearance. If the area around manhole 4 is accessible, an optional seventh sampling location may be added to the program, due to changes in pipe material and size of pipe at this location.

Geochemical samples will be collected at the depth of the pipe (Figure 6.5) and every 5 ft until either bedrock or the water table is encountered (estimated to be 30 ft). Field screening will be performed with an organic vapor detector (photoionization detector or PID) instrument and radiation protection instrument. A sample will be taken from the bottom of the borehole, regardless of depth. One sample from each stratigraphic unit encountered will be selected for geotechnical/mineralogical analysis. These data will provide information on potential contaminant transport and attenuation through the soil profile. Sample collection, however, will depend on the physical availability of core samples. Since geochemical sampling retains highest priority and is scheduled for every 5-ft interval, there may not be enough material for geotechnical analysis in every borehole. If this is the case, the field team should ensure that each stratigraphic unit has had at least two samples collected from the entire suite of boreholes. Table VI.3 summarizes the sampling requirements for the soils along the NPDES Outfall 001 pipeline.

6.3.4. Soil and Water Sampling at the Main Hill Seeps

Although the water discharging from the Main Hill seeps is known to contain contaminants, the presence or extent of contaminants in the soils near these seeps is unknown. Therefore, geochemical samples will be collected at the seeps shown in Figure 6.6. At each seep, three surface samples (0 to 0.5 ft depth) will be collected: one at the seep, one at 10 ft, and one at 20 ft down-slope of the seep.

Subsurface samples will be collected at the sample location nearest the seep only, at depths of 1.5 to 2.0 ft and 3.5 to 4.0 ft. Final locations of surface and subsurface samples will be determined by the field team based on observations made at the seep (if the seep can be located).

Samples will be analyzed for the chemical parameters shown in Table VI.4. In order to assess the relationship of water chemistry to soil chemistry, a water sample will be collected from each seep at the same time the soil sample is collected. The seep water samples will be analyzed for the analytical parameters shown in Table VI.4.

One sample from each seep location will be collected for geotechnical/mineralogical analysis. This will provide information on soils as a medium for transporting contaminants introduced by the groundwater discharging at the seeps. Samples will be analyzed for the geotechnical parameters shown in Table VI.4. Selection of the geotechnical samples will be based on what appears to the field sampling team to be representative of soil types at each seep location. Samples will be collected with a hand-operated tube sampler. Samples will be submitted for analytical parameters listed in Table VI.4. Samples collected for geotechnical analysis should be collected within a few feet of the seep, but slightly removed from the area of suspected contamination to avoid sending highly contaminated samples to the laboratories typically suited for physical measurements.

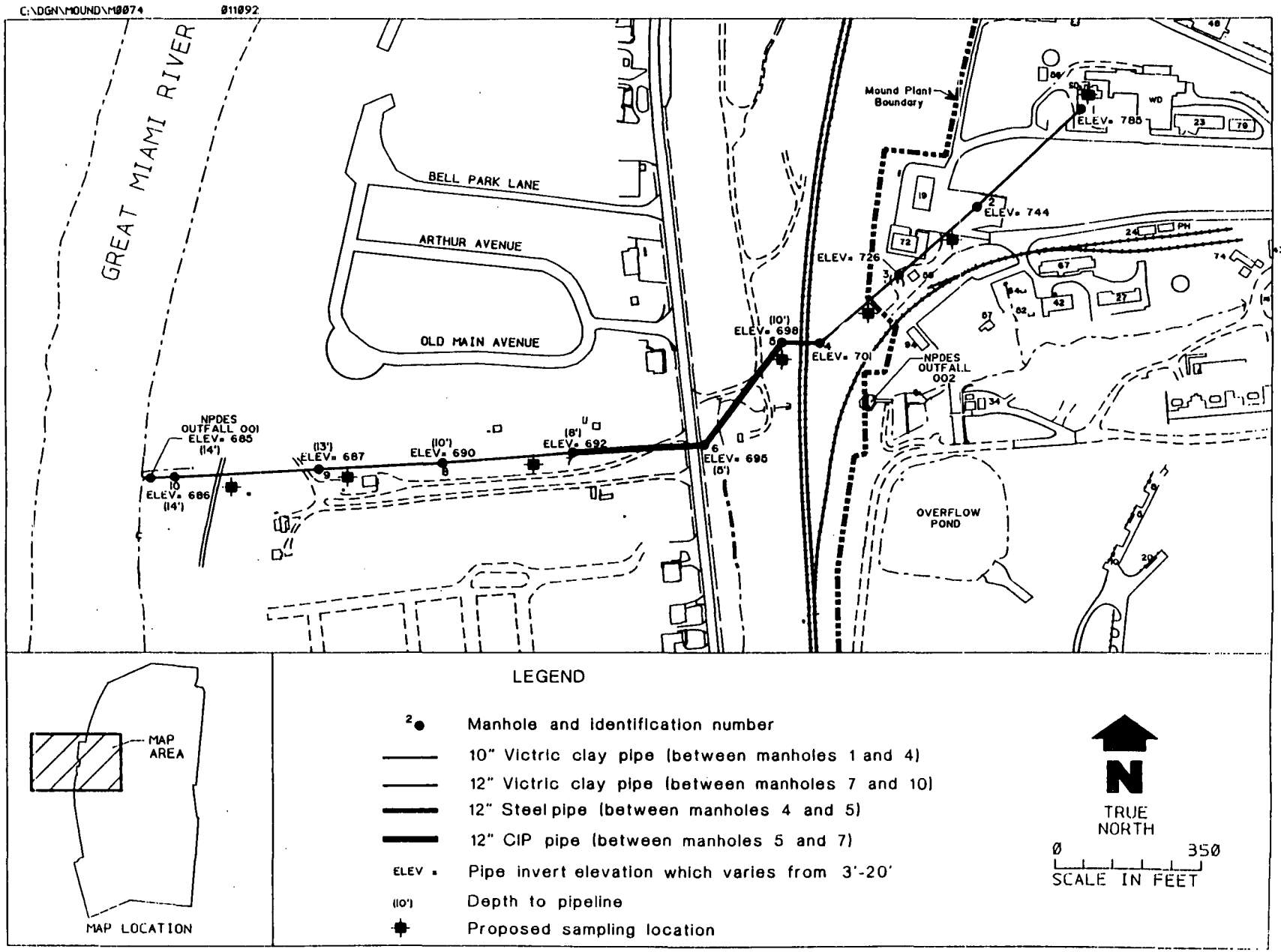


Figure 6.5. Proposed soil sampling locations along NPDES Outfall 001 pipeline.

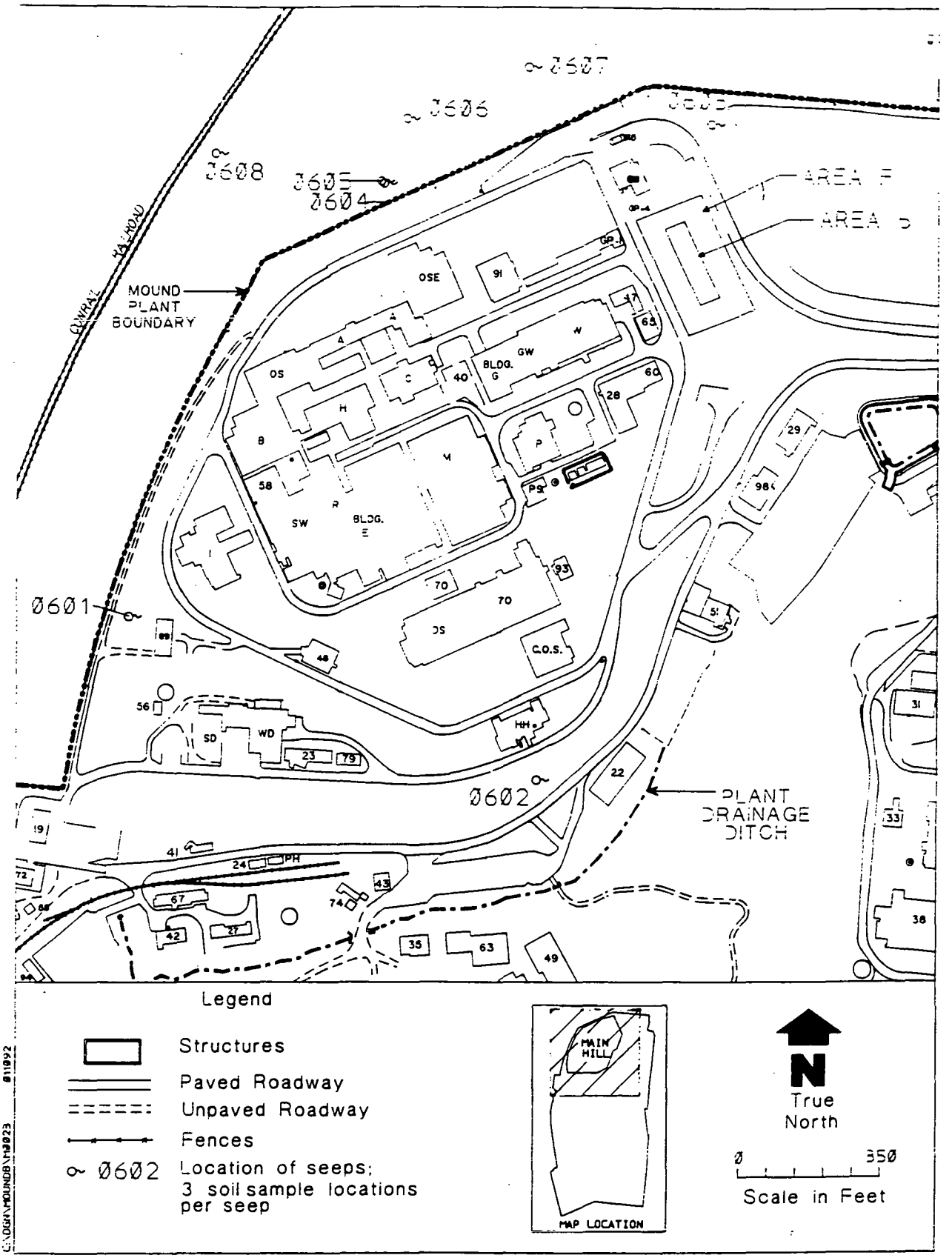


Figure 6.6. Groundwater seeps sampling locations on the Main Hill.

6.4. SAMPLE DESIGNATION

Samples collected at Mound Plant under the ER Program are numbered using a three-letter, ten-digit identifier (MNDXX-AYYY-ZZZZ). MNDXX is the area or investigation identifier, which for the soils investigations in Operable Unit 9 is MND23. The next portion of the identifier, AYYY, designates the type of investigation and the specific sample location. The types of investigation include the background soil investigation (1YYY), the airborne depositional investigation (2YYY), the NPDES outfall investigation (3YYY), and the Main Hill seeps soil and seep water investigation (6YYY). Seep water will use MND21 for an identifier. The last four digits (ZZZZ) serve as the sample identifier, which for surface samples (0 to 0.5 ft) will be 0001. The samples taken from the next depth will be 0002. Field quality control samples will also be identified in the last four digits (ZZZZ) as specified in Table I.3.

Example. The samples obtained from the first location sampled will be numbered as follows (area-location-sample):

MND23-1000-0001 for the surface sample;

MND23-1000-0002 for the next deepest sample; and

MND23-3001-1002 for the duplicate sample for the next deepest sample.

Tables VI.6 through VI.9 present the soil sample designation schemes for each of the four soil investigations. Table VI.7a presents an example of sample identifications for 1 of 16 radial compass vectors in the airborne depositional investigation. The sample numbers available for each radial compass vector are provided in Table VI.7e. Randomly selected locations of additional sampling for uranium/thorium, tritium, and USATHAMA explosives are found in Tables VI.7b, VI.7c, and VI.7d, respectively.

6.5. SAMPLING EQUIPMENT AND PROCEDURES

The QAPP of this Operable Unit 9 Site-Wide Work Plan details additional information concerning the quality assurance/quality control and analytical procedures that will be used during the Mound Plant background soil sampling program. All soil samples will be collected according to the procedures identified in the Mound Plant ER Program SOPs described in the Operable Unit 9 QAPP. The SOPs specific to this study include

- SOP 1.1, General Instructions for Field Personnel (revision 2);
- SOP 1.3, Sample Control and Documentation (revision 1);
- SOP 1.4, Sample Containers and Preservation (revision 2);

Table VI.6. Sample Designation for the Investigation of Background Soil Conditions

Sample Identification	Soil Series	Mapping Unit	Proposed Location[a]	Sample Depth
MND23-1001-0001	Corwin	CoB	South of Mound Plant	0 - 0.5 ft
MND23-1001-0002				1.5 - 2.0 ft
MND23-1002-0001				0 - 0.5 ft
MND23-1002-0002				1.5 - 2.0 ft
MND23-1003-0001				0 - 0.5 ft
MND23-1003-0002				1.5 - 2.0 ft
MND23-1004-0001	Fairmont	FaE2	Northwest of Mound Plant	0 - 0.5 ft
MND23-1004-0002				1.5 - 2.0 ft
MND23-1005-0001				0 - 0.5 ft
MND23-1005-0002				1.5 - 2.0 ft
MND23-1006-0001				0 - 0.5 ft
MND23-1006-0002				1.5 - 2.0 ft
MND23-1007-0001		FaF2	Northwest of Mound Plant	0 - 0.5 ft
MND23-1007-0002				1.5 - 2.0 ft
MND23-1008-0001				0 - 0.5 ft
MND23-1008-0002				1.5 - 2.0 ft
MND23-1009-0001				0 - 0.5 ft
MND23-1009-0002				1.5 - 2.0 ft
MND23-1010-0001	Hennepin	HeF2	West of Mound Plant	0 - 0.5 ft
MND23-1010-0002				1.5 - 2.0 ft
MND23-1011-0001				0 - 0.5 ft
MND23-1011-0002				1.5 - 2.0 ft
MND23-1012-0001				0 - 0.5 ft
MND23-1012-0002				1.5 - 2.0 ft
MND23-1013-0001		HmF3	Southwest of Mound Plant	0 - 0.5 ft
MND23-1013-0002				1.5 - 2.0 ft
MND23-1014-0001				0 - 0.5 ft
MND23-1014-0002				1.5 - 2.0 ft
MND23-1015-0001				0 - 0.5 ft
MND23-1015-0002				1.5 - 2.0 ft
MND23-1016-0001	Made Land	Mb	South of Mound Plant	0 - 0.5 ft
MND23-1016-0002				1.5 - 2.0 ft
MND23-1017-0001				0 - 0.5 ft
MND23-1017-0002				1.5 - 2.0 ft
MND23-1018-0001				0 - 0.5 ft
MND23-1018-0002				1.5 - 2.0 ft
MND23-1019-0001	Miamian	MlB	South of Mound Plant	0 - 0.5 ft
MND23-1019-0002				1.5 - 2.0 ft
MND23-1020-0001				0 - 0.5 ft
MND23-1020-0002				1.5 - 2.0 ft
MND23-1021-0001				0 - 0.5 ft
MND23-1021-0002				1.5 - 2.0 ft
MND23-1022-0001		MnC3	Southeast of Mound Plant	0 - 0.5 ft
MND23-1022-0002				1.5 - 2.0 ft
MND23-1023-0001				0 - 0.5 ft
MND23-1023-0002				1.5 - 2.0 ft
MND23-1024-0001				0 - 0.5 ft
MND23-1024-0002				1.5 - 2.0 ft

Table VI.6. (page 2 of 3)

Sample Identification	Soil Series	Mapping Unit	Proposed Location[a]	Sample Depth
MND23-1025-0001	Miamian	MnD3	South of Mound Plant	0 - 0.5 ft
MND23-1025-0002				1.5 - 2.0 ft
MND23-1026-0001				0 - 0.5 ft
MND23-1026-0002				1.5 - 2.0 ft
MND23-1027-0001				0 - 0.5 ft
MND23-1027-0002				1.5 - 2.0 ft
MND23-1028-0001		MoC	Northeast of Mound Plant	0 - 0.5 ft
MND23-1028-0002				1.5 - 2.0 ft
MND23-1029-0001				0 - 0.5 ft
MND23-1029-0002				1.5 - 2.0 ft
MND23-1030-0001				0 - 0.5 ft
MND23-1030-0002				1.5 - 2.0 ft
MND23-1031-0001	Milton	MsB	West of Mound Plant	0 - 0.5 ft
MND23-1031-0002				1.5 - 2.0 ft
MND23-1032-0001				0 - 0.5 ft
MND23-1032-0002				1.5 - 2.0 ft
MND23-1033-0001				0 - 0.5 ft
MND23-1033-0002				1.5 - 2.0 ft
MND23-1034-0001		MsC2	East of Mound Plant	0 - 0.5 ft
MND23-1034-0002				1.5 - 2.0 ft
MND23-1035-0001				0 - 0.5 ft
MND23-1035-0002				1.5 - 2.0 ft
MND23-1036-0001				0 - 0.5 ft
MND23-1036-0002				1.5 - 2.0 ft
MND23-1037-0001		MtD3	Southwest of Mound Plant	0 - 0.5 ft
MND23-1037-0002				1.5 - 2.0 ft
MND23-1038-0001				0 - 0.5 ft
MND23-1038-0002				1.5 - 2.0 ft
MND23-1039-0001				0 - 0.5 ft
MND23-1039-0002				1.5 - 2.0 ft
MND23-1040-0001	Ritchey	ReB2	East of Mound Plant	0 - 0.5 ft
MND23-1040-0002				1.5 - 2.0 ft
MND23-1041-0001				0 - 0.5 ft
MND23-1041-0002				1.5 - 2.0 ft
MND23-1042-0001				0 - 0.5 ft
MND23-1042-0002				1.5 - 2.0 ft
MND23-1043-0001		RfD3	West of Mound Plant	0 - 0.5 ft
MND23-1043-0002				1.5 - 2.0 ft
MND23-1044-0001				0 - 0.5 ft
MND23-1044-0002				1.5 - 2.0 ft
MND23-1045-0001				0 - 0.5 ft
MND23-1045-0002				1.5 - 2.0 ft
MND23-1046-0001	Ross	Rs	North of Mound Plant	0 - 0.5 ft
MND23-1046-0002				1.5 - 2.0 ft
MND23-1047-0001				0 - 0.5 ft
MND23-1047-0002				1.5 - 2.0 ft
MND23-1048-0001				0 - 0.5 ft
MND23-1048-0002				1.5 - 2.0 ft

Table VI.6. (page 3 of 3)

Samples will be analyzed for the following parameters:

Analytes	Analytical Method	Container (Size/Type)
TCL pesticides/PCBs	CLP SOW	125-mL wide-mouth amber glass jar, teflon-lined lid
TAL inorganics Bismuth	CLP SOW Mod A, B, or C CLP SOW Mod A, B, or C	500-mL wide-mouth polyethylene bottle
pH	SW 9045	125-mL wide-mouth polyethylene bottle
Total organic carbon	E415.1/E415.2	125-mL wide-mouth glass jar, teflon-lined lid
Fluoride Nitrate/nitrite Chloride Sulfate	E340.2 E353.2 SW9250d E375.2	250-mL wide-mouth polyethylene bottle
Isotopic plutonium (238,239/240) Isotopic thorium (228, 230, 232) Isotopic uranium (234/235, 238) Strontium-90 Tritium Gamma spectrometry	NAS 1965 NAS 1960 NAS 9162 NAS 1960 E906.0 Nuclear Data, Inc. 1986	950-mL wide-mouth polyethylene bottle

[a]Proposed locations are shown in Figure 6.1.

Note: Only one bottle is needed per group of analytes unless otherwise indicated. Bottle size may change depending upon selection of multiple laboratories for the analyses and availability from bottle suppliers.

CLP - Contract Laboratory Program
NAS - National Academy of Sciences
PCB - polychlorinated biphenyl
SOW - Statement of Work
TAL - Target Analyte List
TCL - Target Compound List

Table VI.7a. Sample Designation for Airborne Depositional Investigation[a]

Sample Identification	Distance from Security Fence[b]	Analytical Parameters[c]	Sample Depth
MND23-2001-0001	0 ft	Tritium	0 - 1.0 ft
MND23-2001-0002		Tritium	1.0 - 2.0 ft
MND23-2001-0003		Isotopic plutonium, uranium, and thorium	0 - 2 inches
MND23-2001-0004		Isotopic plutonium	2 - 12 inches
MND23-2001-0005		Analytical parameter list	0 - 0.5 ft
MND23-2001-0006		Analytical parameter list	1.5 - 2.0 ft
MND23-2002-0001	500 ft	Tritium	0 - 1.0 ft
MND23-2002-0002		Tritium	1.0 - 2.0 ft
MND23-2002-0003		Isotopic plutonium, uranium, and thorium	0 - 2 inches
MND23-2002-0004		Isotopic plutonium	2 - 12 inches
MND23-2003-0001	1,000 ft	Tritium	0 - 1.0 ft
MND23-2003-0002		Tritium	1.0 - 2.0 ft
MND23-2003-0003		Isotopic plutonium, uranium, and thorium	0 - 2 inches
MND23-2003-0004		Isotopic plutonium	2 - 12 inches
MND23-2003-0005		Analytical parameter list	0 - 0.5 ft
MND23-2003-0006		Analytical parameter list	1.5 - 2.0 ft
MND23-2004-0001	1,500 ft	Tritium	0 - 1.0 ft
MND23-2004-0002		Tritium	1.0 - 2.0 ft
MND23-2004-0003		Isotopic plutonium	0 - 2 inches
MND23-2004-0004		Isotopic plutonium	2 - 12 inches
MND23-2005-0001	2,000 ft	Tritium	0 - 1.0 ft
MND23-2005-0002		Tritium	1.0 - 2.0 ft
MND23-2005-0003		Isotopic plutonium	0 - 2 inches
MND23-2005-0004		Isotopic plutonium	2 - 12 inches
MND23-2006-0001	2,500 ft	Tritium	0 - 1.0 ft
MND23-2006-0002		Tritium	1.0 - 2.0 ft
MND23-2006-0003		Isotopic plutonium	0 - 2 inches
MND23-2006-0004		Isotopic plutonium	2 - 12 inches
MND23-2007-0001	3,000 ft	Tritium	0 - 1.0 ft
MND23-2007-0002		Tritium	1.0 - 2.0 ft
MND23-2007-0003		Isotopic plutonium	0 - 2 inches
MND23-2007-0004		Isotopic plutonium	2 - 12 inches
MND23-2008-0001	3,500 ft	Tritium	0 - 1.0 ft
MND23-2008-0002		Tritium	1.0 - 2.0 ft
MND23-2008-0003		Isotopic plutonium	0 - 2 inches
MND23-2008-0004		Isotopic plutonium	2 - 12 inches
MND23-2009-0001	4,000 ft	Tritium	0 - 1.0 ft
MND23-2009-0002		Tritium	1.0 - 2.0 ft
MND23-2009-0003		Isotopic plutonium	0 - 2 inches
MND23-2009-0004		Isotopic plutonium	2 - 12 inches
MND23-2010-0001	4,500 ft	Tritium	0 - 1.0 ft
MND23-2010-0002		Tritium	1.0 - 2.0 ft
MND23-2010-0003		Isotopic plutonium	0 - 2 inches
MND23-2010-0004		Isotopic plutonium	2 - 12 inches

Table VI.7a. (page 2 of 3)

Sample Identification	Distance from Security Fence[b]	Analytical Parameters[c]	Sample Depth
MND23-2011-0001	5,000 ft	Tritium	0 - 1.0 ft
MND23-2011-0002		Tritium	1.0 - 2.0 ft
MND23-2011-0003		Isotopic plutonium	0 - 2 inches
MND23-2011-0004		Isotopic plutonium	2 - 12 inches
MND23-2012-0001	6,000 ft	Tritium	0 - 1.0 ft
MND23-2012-0002		Tritium	1.0 - 2.0 ft
MND23-2012-0003		Isotopic plutonium	0 - 2 inches
MND23-2012-0004		Isotopic plutonium	2 - 12 inches
MND23-2013-0001	7,000 ft	Tritium	0 - 1.0 ft
MND23-2013-0002		Tritium	1.0 - 2.0 ft
MND23-2013-0003		Isotopic plutonium	0 - 2 inches
MND23-2013-0004		Isotopic plutonium	2 - 12 inches
MND23-2014-0001	8,000 ft	Tritium	0 - 1.0 ft
MND23-2014-0002		Tritium	1.0 - 2.0 ft
MND23-2014-0003		Isotopic plutonium	0 - 2 inches
MND23-2014-0004		Isotopic plutonium	2 - 12 inches
MND23-2015-0001	9,000 ft	Tritium	0 - 1.0 ft
MND23-2015-0002		Tritium	1.0 - 2.0 ft
MND23-2015-0003		Isotopic plutonium	0 - 2 inches
MND23-2015-0004		Isotopic plutonium	2 - 12 inches
MND23-2016-0001	10,000 ft	Tritium	0 - 1.0 ft
MND23-2016-0002		Tritium	1.0 - 2.0 ft
MND23-2016-0003		Isotopic plutonium	0 - 2 inches
MND23-2016-0004		Isotopic plutonium	2 - 12 inches
MND23-2017-0001	25,000 ft	Isotopic plutonium	0 - 2 inches
MND23-2017-0002		Isotopic plutonium	2 - 12 inches
MND23-2018-0001	50,000 ft	Isotopic plutonium	0 - 2 inches
MND23-2018-0002		Isotopic plutonium	2 - 12 inches
MND23-2019-0001	75,000 ft	Isotopic plutonium	0 - 2 inches
MND23-2019-0002		Isotopic plutonium	2 - 12 inches
MND23-2020-0001	100,000 ft	Isotopic plutonium	0 - 2 inches
MND23-2020-0002		Isotopic plutonium	2 - 12 inches

Table VI.7a. (page 3 of 3)

Analytical Parameter List:

Analytes	Analytical Method	Container (Size/Type)
VOCs	CLP SOW	125-mL wide-mouth glass jar, teflon-lined lid
Semivolatile organic compounds	CLP SOW	125-mL wide-mouth amber glass jar, teflon-lined lid
TCL pesticides/PCBs	CLP SOW	125-mL wide-mouth amber glass jar, teflon-lined lid
TAL inorganics Bismuth	CLP SOW Mod A, B, or C CLP SOW Mod A, B, or C	500-mL wide-mouth polyethylene bottle
Fluoride Nitrate/nitrite Chloride Sulfate	E340.2 E353.2 SW9250d E375.2	250-mL wide-mouth polyethylene bottle
Strontium-90 Gamma spectrometry Isotopic plutonium (238, 239/240) Isotopic uranium (234/235, 238) Isotopic thorium (228, 230, 232) Tritium	NAS 1960 Nuclear Data, Inc. 1986 NAS 1965 NAS 1962 NAS 1960 E906.0	905-mL wide-mouth polyethylene bottle

[a]This table presents sample numbers for 1 directional vector (north) as an example; the range of sample identifications for the other 15 directional vectors is presented in Table VI.7e.

[b]Locations are shown in Figures 6.3 and 6.4.

[c]Locations for uranium and thorium samples at distances greater than 1,000 ft are given in Table VI.7b.; locations for tritium samples at distances greater than 10,000 ft are given in Table VI.7c.; locations for USATHAMA explosives samples at distances of 0 and 1,000 ft are given in Table VI.7d.

Note: Only one bottle is needed per group of analytes unless otherwise indicated. Bottle size may change depending upon selection of multiple laboratories for the analyses and availability from bottle suppliers.

CLP - Contract Laboratory Program
NAS - National Academy of Sciences
PCB - polychlorinated biphenyl
SOW - Statement of Work
TAL - Target Analyte List
TCL - Target Compound List
USATHAMA - U.S. Army Toxic and Hazardous Materials Agency
VOC - volatile organic compound

Table VI.7b. Airborne Depositional Investigation: Locations to be Sampled for Uranium and Thorium (20% of Locations from 1,000 ft to 10,000 ft -- Randomly Selected)

Sample Location Identification	Directional Vector[a]	Distance from Security Fence[a]
MND23-2009	North	4,000 ft
MND23-2012	North	6,000 ft
MND23-2045	Northeast	2,000 ft
MND23-2049	Northeast	4,000 ft
MND23-2051	Northeast	5,000 ft
MND23-2053	Northeast	7,000 ft
MND23-2056	Northeast	10,000 ft
MND23-2072	East/Northeast	6,000 ft
MND23-2074	East/Northeast	8,000 ft
MND23-2076	East/Northeast	10,000 ft
MND23-2089	East	4,000 ft
MND23-2092	East	6,000 ft
MND23-2105	East/Southeast	2,000 ft
MND23-2107	East/Southeast	3,000 ft
MND23-2114	East/Southeast	8,000 ft
MND23-2133	Southeast	7,000 ft
MND23-2145	South/Southeast	2,000 ft
MND23-2169	South	4,000 ft
MND23-2176	South	10,000 ft
MND23-2196	South/Southwest	10,000 ft
MND23-2225	West/Southwest	2,000 ft
MND23-2232	West/Southwest	6,000 ft
MND23-2234	West/Southwest	8,000 ft
MND23-2253	West	7,000 ft
MND23-2256	West	10,000 ft
MND23-2267	West/Northwest	3,000 ft
MND23-2291	Northwest	5,000 ft
MND23-2292	Northwest	6,000 ft
MND23-2294	Northwest	8,000 ft

Analytical Parameter List:

Analytes	Analytical Method	Container (Size/Type)
Isotopic uranium (234/235, 238)	NAS 1962	950-mL wide-mouth
Isotopic thorium (228, 230, 232)	NAS 1960	polyethylene bottle

[a]Locations are shown in Figure 6.3.
Note: Only one bottle is needed for these two analytes. Bottle size may change depending upon selection of multiple laboratories for the analyses and availability from bottle suppliers.
NAS - National Academy of Sciences

Table VI.7c. Airborne Depositional Investigation: Locations to be Sampled for Tritium (20% of Locations from 25,000 ft to 100,000 ft--Randomly Selected).

Sample Location Identification	Directional Vector[a]	Distance From Security Fence[a]
MND23-2019	North	75,000 ft
MND23-2040	North/Northeast	50,000 ft
MND23-2057	Northeast	25,000 ft
MND23-2097	East	25,000 ft
MND23-2098	East	50,000 ft
MND23-2180	South	25,000 ft
MND23-2217	Southwest	25,000 ft
MND23-2218	Southwest	50,000 ft
MND23-2238	West/Southwest	50,000 ft
MND23-2239	West/Southwest	75,000 ft
MND23-2240	West/Southwest	100,000 ft
MND23-2317	North/Northwest	25,000 ft
MND23-2319	North/Northwest	75,000 ft

Analytical Parameter List:

Analyte	Analytical Method	Container (size/type)
Tritium	E906.0	950-mL wide-mouth polyethylene bottle

[a]Locations are shown in Figure 6.4.
Note: Bottle size may change depending upon selection of multiple laboratories for the analyses and availability from bottle suppliers.

Table VI.7d. Airborne Depositional Investigation: Locations to be Sampled for USATHAMA Explosives (20% of Locations at 0 ft and 1,000 ft--Randomly Selected)

Sample Location Identification	Directional Vector[a]	Distance From Security Fence[a]
MND23-2003	North	0
MND23-2043	Northeast	0
MND23-2141	South Southeast	0
MND23-2143	South Southeast	1,000
MND23-2181	South Southwest	0
MND23-2283	Northwest	1,000
MND23-2303	North Northwest	1,000

Analytical Parameter List:

Analyte	Analytical Method	Container (size/type)
USATHAMA explosives	USATHAMA	125-mL wide-mouth amber glass jar, telfon-lined lid

[a]Locations shown on Figure 6.3.
Note: Bottle size may change depending upon selection of multiple laboratories for the analyses and availability from bottle suppliers.
USATHAMA - U.S. Army Toxic and Hazardous Materials Agency

Table VI.7e. Airborne Depositional Investigation Sample Identification Scheme for All Directional Vectors

Directional Vector[a]	Sample Identification		
North	MND23-2001-ZZZZ	through	MND23-2020-ZZZZ
North/Northeast	MND23-2021-ZZZZ	through	MND23-2040-ZZZZ
Northeast	MND23-2041-ZZZZ	through	MND23-2060-ZZZZ
East/Northeast	MND23-2061-ZZZZ	through	MND23-2080-ZZZZ
East	MND23-2081-ZZZZ	through	MND23-2100-ZZZZ
East/Southeast	MND23-2101-ZZZZ	through	MND23-2120-ZZZZ
Southeast	MND23-2121-ZZZZ	through	MND23-2140-ZZZZ
South/Southeast	MND23-2141-ZZZZ	through	MND23-2160-ZZZZ
South	MND23-2161-ZZZZ	through	MND23-2180-ZZZZ
South/Southwest	MND23-2181-ZZZZ	through	MND23-2200-ZZZZ
Southwest	MND23-2201-ZZZZ	through	MND23-2220-ZZZZ
West/Southwest	MND23-2221-ZZZZ	through	MND23-2240-ZZZZ
West	MND23-2241-ZZZZ	through	MND23-2260-ZZZZ
West/Northwest	MND23-2261-ZZZZ	through	MND23-2280-ZZZZ
Northwest	MND23-2281-ZZZZ	through	MND23-2300-ZZZZ
North/Northwest	MND23-2301-ZZZZ	through	MND23-2320-ZZZZ

[a]Locations shown on Figure 6.4.

Table VI.8. Sample Designation for the NPDES Outfall 001 Soil Investigation

Sample Identification	Proposed Location[a]	Analytical Parameters	Comments
MND23-3001-0001 MND23-3001-0002 MND23-3001-0003 MND23-3001-0004	200 ft from outfall 001, between manholes 9 and 10	Geochemical, geotechnical[b], USATHAMA Geochemical Geochemical Geochemical, geotechnical	12 inch vitric clay pipe; thought to be 9 to 14 ft deep
MND23-3002-0001 MND23-3002-0002 MND23-3002-0003 MND23-3002-0004	500 ft from outfall 001, between manholes 8 and 9	Geochemical, geotechnical[b], USATHAMA Geochemical Geochemical Geochemical, geotechnical	12 inch vitric clay pipe; thought to be 9 to 10 ft deep
MND23-3003-0001 MND23-3003-0002 MND23-3003-0003 MND23-3003-0004	950 ft from outfall 001, between manholes 7 and 8	Geochemical, geotechnical[b], USATHAMA Geochemical Geochemical Geochemical, geotechnical	12 inch vitric clay pipe; thought to be 8 to 10 ft deep
MND23-3004-0001 MND23-3004-0002 MND23-3004-0003 MND23-3004-0004	1,600 ft from outfall 001, between manholes 5 and 6	Geochemical, geotechnical[b], USATHAMA Geochemical Geochemical Geochemical, geotechnical	12 inch cast iron pipe; thought to be 5 to 10 ft deep
MND23-3005-0001 MND23-3005-0002 MND23-3005-0003 MND23-3005-0004	1,850 ft from outfall 001, between manholes 3 and 4	Geochemical, geotechnical[b], USATHAMA Geochemical Geochemical Geochemical, geotechnical	10 inch vitric clay pipe; thought to be 5 to 10 ft deep
MND23-3006-0001 MND23-3006-0002 MND23-3006-0003 MND23-3006-0004	2,150 ft from outfall 001, between manholes 2 and 3	Geochemical, geotechnical[b], USATHAMA Geochemical Geochemical Geochemical, geotechnical	10 inch vitric clay pipe; thought to be 5 ft deep
MND23-3007-0001 MND23-3007-0002 MND23-3007-0003 MND23-3007-0004	2,600 ft from outfall 001, near manhole 1	Geochemical, geotechnical[b], USATHAMA Geochemical Geochemical Geochemical, geotechnical	10 inch vitric clay pipe; thought to be 5 ft deep

Table VI.8. (page 2 of 3)

Analytical parameter list:

Analytes: Geochemical	Analytical Method	Container (size/type)
VOCs	CLP SOW	125-mL wide-mouth glass jar, teflon-lined lid
Semivolatile organic compounds	CLP SOW	125-mL wide-mouth amber glass jar, teflon-lined lid
TCL pesticides/PCBs	CLP SOW	125-mL wide-mouth amber glass jar, teflon-lined lid
TAL inorganics	CLP SOW Mod A, B, or C	500-mL widemouth polyethylene bottle
Bismuth	CLP SOW Mod A, B, or C	
Fluoride Nitrate/nitrite Chloride Sulfate	E340.2 E353.2 SW9250d E375.2	250-mL wide-mouth polyethylene bottle
Isotopic plutonium (238,239/240) Isotopic thorium (228, 230, 232) Isotopic uranium (234/235, 238) Strontium-90 Tritium Gamma spectrometry	NAS 1965 NAS 1960 NAS 9162 NAS 1960 E906.0 Nuclear Data, Inc. 1986	950-mL wide-mouth polyethylene bottle
USATHAMA explosives (20% of samples only)	USATHAMA	125-mL wide-mouth amber glass jar, teflon-lined lid
pH	SW9045	125-mL wide-mouth polyethylene bottle
Total organic carbon	E415.1/E415.2	125-mL wide-mouth glass jar

Analytes: Geotechnical	Analytical Method	Container (size/type)
Cation exchange capacity Moisture content Organic content Particle size distribution Relative density[c] Maximum density[c] Specific gravity[c] Clay mineralogy[c] Permeability[c]	SW9080/SW9081 ASTM D2974-87 ASTM D2974-87 ASTM D422-63 ASTM D4254-83 ASTM D4253-83 ASTM D854-63 X-Ray Diffraction ASTM-D2434-68	1-gallon wide-mouth polyethylene bottle

Table VI.8. (page 3 of 3)

[a]Proposed locations are shown in Figure 6.5; sample collected at depth of the pipe or lower.
[b]Sample collected if sufficient material exists
[c]To be determined from same sample as particle size distribution
Note: Only one bottle is needed per group of analytes unless otherwise indicated. Bottle size may change depending upon selection of multiple laboratories for the analyses and availability from bottle suppliers.
ASTM - American Society for Testing Materials
CLP - Contract Laboratory Program
NAS - National Academy of Sciences
PCB - polychlorinated biphenyl
SOW - Statement of Work
TAL - Target Analyte List
TCL - Target Compound List
USATHAMA - U.S. Army Toxic and Hazardous Materials Agency
VOC - volatile organic compound

Table VI.9. Sample Designation for the Main Hill Seeps Groundwater and Soil Investigation

Sample Identification	Proposed Location[a]	Sample Depth	Analytical Parameters
MND20-6011-0001	0 ft downslope of seep 601	NA	Geochemical -- groundwater
MND23-6011-0001	0 ft downslope of seep 601	0 - 0.5 ft	Geochemical, geotechnical, USATHAMA
MND23-6011-0002	0 ft downslope of seep 601	1.5 - 2.0 ft	Geochemical
MND23-6011-0003	0 ft downslope of seep 601	3.5 - 4.0 ft	Geochemical
MND23-6012-0001	10 ft downslope of seep 601	0 - 0.5 ft	Geochemical
MND23-6013-0001	20 ft downslope of seep 601	0 - 0.5 ft	Geochemical
MND20-6021-0001	0 ft downslope of seep 602	NA	Geochemical -- groundwater
MND23-6021-0001	0 ft downslope of seep 602	0 - 0.5 ft	Geochemical, geotechnical, USATHAMA
MND23-6021-0002	0 ft downslope of seep 602	1.5 - 2.0 ft	Geochemical
MND23-6021-0003	0 ft downslope of seep 602	3.5 - 4.0 ft	Geochemical
MND23-6022-0001	10 ft downslope of seep 602	0 - 0.5 ft	Geochemical
MND23-6023-0001	20 ft downslope of seep 602	0 - 0.5 ft	Geochemical
MND20-6031-0001	0 ft downslope of seep 603	NA	Geochemical -- groundwater
MND23-6031-0001	0 ft downslope of seep 603	0 - 0.5 ft	Geochemical, geotechnical, USATHAMA
MND23-6031-0002	0 ft downslope of seep 603	1.5 - 2.0 ft	Geochemical
MND23-6031-0003	0 ft downslope of seep 603	3.5 - 4.0 ft	Geochemical
MND23-6032-0001	10 ft downslope of seep 603	0 - 0.5 ft	Geochemical
MND23-6033-0001	20 ft downslope of seep 603	0 - 0.5 ft	Geochemical
MND20-6041-0001	0 ft downslope of seep 604	NA	Geochemical -- groundwater
MND23-6041-0001	0 ft downslope of seep 604	0 - 0.5 ft	Geochemical, geotechnical, USATHAMA
MND23-6041-0002	0 ft downslope of seep 604	1.5 - 2.0 ft	Geochemical
MND23-6041-0003	0 ft downslope of seep 604	3.5 - 4.0 ft	Geochemical
MND23-6042-0001	10 ft downslope of seep 604	0 - 0.5 ft	Geochemical
MND23-6043-0001	20 ft downslope of seep 604	0 - 0.5 ft	Geochemical
MND20-6051-0001	0 ft downslope of seep 605	NA	Geochemical -- groundwater
MND23-6051-0001	0 ft downslope of seep 605	0 - 0.5 ft	Geochemical, geotechnical, USATHAMA
MND23-6051-0002	0 ft downslope of seep 605	1.5 - 2.0 ft	Geochemical
MND23-6051-0003	0 ft downslope of seep 605	3.5 - 4.0 ft	Geochemical
MND23-6052-0001	10 ft downslope of seep 605	0 - 0.5 ft	Geochemical
MND23-6053-0001	20 ft downslope of seep 605	0 - 0.5 ft	Geochemical
MND20-6061-0001	0 ft downslope of seep 606	NA	Geochemical -- groundwater
MND23-6061-0001	0 ft downslope of seep 606	0 - 0.5 ft	Geochemical, geotechnical, USATHAMA
MND23-6061-0002	0 ft downslope of seep 606	1.5 - 2.0 ft	Geochemical
MND23-6061-0003	0 ft downslope of seep 606	3.5 - 4.0 ft	Geochemical
MND23-6062-0001	10 ft downslope of seep 606	0 - 0.5 ft	Geochemical
MND23-6063-0001	20 ft downslope of seep 606	0 - 0.5 ft	Geochemical
MND20-6071-0001	0 ft downslope of seep 607	NA	Geochemical -- groundwater
MND23-6071-0001	0 ft downslope of seep 607	0 - 0.5 ft	Geochemical, geotechnical, USATHAMA
MND23-6071-0002	0 ft downslope of seep 607	1.5 - 2.0 ft	Geochemical
MND23-6071-0003	0 ft downslope of seep 607	3.5 - 4.0 ft	Geochemical
MND23-6072-0001	10 ft downslope of seep 607	0 - 0.5 ft	Geochemical
MND23-6073-0001	20 ft downslope of seep 607	0 - 0.5 ft	Geochemical
MND20-6081-0001	0 ft downslope of seep 608	NA	Geochemical -- groundwater
MND23-6081-0001	0 ft downslope of seep 608	0 - 0.5 ft	Geochemical, geotechnical, USATHAMA
MND23-6081-0002	0 ft downslope of seep 608	1.5 - 2.0 ft	Geochemical
MND23-6081-0003	0 ft downslope of seep 608	3.5 - 4.0 ft	Geochemical
MND23-6082-0001	10 ft downslope of seep 608	0 - 0.5 ft	Geochemical
MND23-6083-0001	20 ft downslope of seep 608	0 - 0.5 ft	Geochemical

Table VI.9. (page 2 of 3)

Analytical Parameter List for soil:

Analytes: Geochemical	Analytical Method	Container (Size/Type)
VOCs	CLP SOW	125-mL wide-mouth glass jar, teflon-lined lid
Semivolatile organic compounds	CLP SOW	125-mL wide-mouth amber glass jar, teflon-lined lid
TCL pesticides/PCBs	CLP SOW	125-mL wide-mouth amber glass jar, teflon-lined lid
TAL inorganics Bismuth	CLP SOW Mod A, B, or C CLP SOW Mod A, B, or C	500-mL wide-mouth polyethylene bottle
Fluoride Nitrate/nitrite Chloride Sulfate	E340.2 E353.2 SW9250d E375.2	250-mL wide-mouth polyethylene bottle
Isotopic plutonium (238,239/240) Isotopic thorium (228, 230, 232) Isotopic uranium (234/235, 238) Strontium-90 Tritium Gamma spectrometry	NAS 1965 NAS 1960 NAS 1962 NAS 1960 E906.0 Nuclear Data, Inc. 1986	950-mL wide-mouth polyethylene bottle
USATHAMA explosives (20% of samples only)	USATHAMA	125-mL wide-mouth amber glass jar, teflon-lined lid
pH	SW 9045	125-mL wide-mouth polyethylene bottle
Total organic carbon	E415.1/E415.2	125-mL wide-mouth glass jar

Analytes: Geotechnical	Analytical Method	Container (size/type)
Cation exchange capacity Particle size distribution Specific gravity Permeability Relative density Maximum density Moisture content Organic content Clay mineralogy	SW9080/SW9081 ASTM D422-63 ASTM D854-63 ASTM D2434-68 ASTM D4254-83 ASTM D4253-83 ASTM D2974-87 ASTM D2974-87 X-Ray Diffraction	1-gallon wide-mouth polyethylene bottle

[a]Locations of the seeps are shown in Figure 6.6.

Note: Only one bottle is needed per group of analytes unless otherwise indicated. Bottle size may change depending upon selection of multiple laboratories for the analyses and availability from bottle suppliers.

ASTM - American Society for Testing Materials
CLP - Contract Laboratory Program
NAS - National Academy of Sciences
PCB - polychlorinated biphenyl
SOW - Statement of Work
TAL - Target Analyte List
TCL - Target Compound List
USATHAMA - U.S. Army Toxic and Hazardous Materials Agency
VOC - volatile organic compound

Table VI.9. (page 3 of 3)

Analytical Parameter List for seep water:

Analytes: Geochemical	Analytical Method	Container (Size/Type)
VOCs	SW5030/SW8010; SW5030/SW8020; CLP SOW; SW5030/SW8030	Three 40-mL glass vials, teflon-lined septum lid
Semivolatile organic compounds	CLP SOW	Two 1-L amber glass bottles, teflon-lined lid
TCL pesticides/PCBs	CLP SOW	Two 1-L amber glass bottles, teflon-lined lid
TAL inorganics	CLP SOW Mod A, B, or C	1-L polyethylene bottle, HNO_3 to pH < 2
Bismuth	CLP SOW Mod A, B, or C	1-L polyethylene bottle, HNO_3 to pH < 2
Fluoride	E340.2	500-mL polyethylene bottle
Nitrate/nitrite	E353.2	500-mL polyethylene bottle, H_2SO_4 to pH < 2
Nitrite	E354.1	150-mL polyethylene bottle
Chloride	E325.1	500-mL polyethylene bottle
Sulfate	E375.2	500-mL polyethylene bottle
Isotopic plutonium (238,239/240)	NAS 1965	Two 4-L plastic cubetainers
Isotopic thorium (228, 230, 232)	NAS 1960	Two 4-L plastic cubetainers
Isotopic uranium (234/235, 238)	NAS 1962	Two 4-L plastic cubetainers
Radium-226	ASTM D2460-70	Two 4-L plastic cubetainers
Americium-241	EML AM-01	Two 4-L plastic cubetainers
Strontium-90	NAS 1960	Two 4-L plastic cubetainers
Tritium	E906.0	Two 4-L plastic cubetainers
Gamma spectrometry	Nuclear Data, Inc. 1986	Two 4-L plastic cubetainers
USATHAMA explosives (20% of samples only)	USATHAMA UW-11	1-L amber glass bottle, teflon-lined lid
Total organic carbon	E415.1/E415.2	250-mL amber glass jar, teflon-lined lid
Total dissolved solids	E160.1	1-L polyethylene bottle
Total suspended solids	E160.2	1-L polyethylene bottle
Ammonia	E350.1 or 350.3	500-mL polyethylene bottle, H^2SO_4 to pH < 2
Nutrients	E351.3/E365.1	1-L polyethylene bottle, H_2SO_4 to pH < 2
Alkalinity	E310.1	250-mL polyethylene bottle

[a]Locations of the seeps are shown in Figure 6.6.
ASTM - American Society for Testing Materials
CLP - Contract Laboratory Program
NA - not applicable
NAS - National Academy of Sciences
PCB - polychlorinated biphenyl
SOW - Statement of Work
TAL - Target Analyte List
TCL - Target Compound List
USATHAMA - U.S. Army Toxic and Hazardous Materials Agency
VOC - volatile organic compound

- SOP 1.5, Guide to the Handling, Packaging, and Shipping of Samples (revision 1);
- SOP 1.6, General Equipment Decontamination (revision 2);
- SOP 1.8, Personnel Decontamination--Level D Protection (revision 1);
- SOP 1.9, Personnel Decontamination--Level C Protection (revision 1);
- SOP 1.15, Guide to Waste Management (revision 1);
- SOP 2.2, Field Measurements on Ground and Surface Water Samples (revision 2);
- SOP 2.8, Sampling for Volatile Organics (revision 0);
- SOP 2.9, Surface Water Sampling (revision 1);
- SOP 2.10, Stream Flow Measurements Using Flumes, Velocity - Cross Sectional/Area, and Direct Volume (revision 0);
- SOP 5.1, Soil and Rock Borehole Logging and Sampling (revision 1);
- SOP 5.2, Soil Sampling with a Spade and Scoop (revision 3);
- SOP 5.3, Subsurface Solid Sampling with Hand Auger and Thin-Wall Sampler (revision 2);
- SOP 5.8, Soil Sampling with a Stainless Steel Surface Soil Sampler (revision 1).
- SOP 6.4, Total Alpha Surface Contamination Measurements (revision 0); and
- SOP 6.7, Near Surface and Soil Sample Screening for Low-Eenrgy Gamma Radiation Using the FIDLER (revision 0);

The exact locations of the soil samples for the characterization of basic soil conditions will be chosen in the field by the field sampling team, using the Montgomery County SCS Soil Maps as guides. The locations will be chosen based on visual indications of the site being undisturbed, 50 ft from roadways, out of drainages, and sparsely covered with (or lacking) vegetation. The field team, accompanied by a Mound Plant public relations specialist, will contact the land owner (if not on public property or right-of-way) for permission to access the sample site. At each location, three samples will be collected within 5 ft of each other. During sample collection, care will be taken to exclude vegetation and organic debris. Geochemical samples will be collected with a stainless steel spade and placed in appropriate containers (Table I.5). Samples collected for VOC analyses will be placed directly into the appropriate laboratory containers, without homogenization, to minimize volatilization. Soils collected for other requested analyses will be homogenized in a stainless steel pan and then placed in the appropriate containers. Samples will be collected at the prescribed surface and subsurface intervals at each of the three sites in each sample location for the analytical parameters as shown in Table VI.1. Lithologic and stratigraphic soil horizon data, including accurate descriptions of color, horizon thicknesses, contact relationship, pedogenic structure,

and texture, will be collected by a soil scientist or geologist in accordance with Mound Plant ER Program SOP 5.1, Soil and Rock Borehole Logging and Sampling.

Sampling for the airborne depositional investigation and the Main Hill seeps soil investigation will be conducted in a manner similar to the characterization of basic soil conditions method described above. The locations of these samples will be chosen in the field using Figures 6.4, 6.5, and 6.6 as guides. A groundwater sample will be collected at each seep identified in this investigation. In order to prevent sampling overland flow produced by rain, groundwater samples will not be collected from the seeps during rainstorms. The seep groundwater sample will be collected from the weir that is currently installed at a few of the seeps. If no weir is available, samples will be collected directly off of bedrock if possible, or a stainless steel channel will be installed as a sampling port. A channel (approximately 2 ft by 2 in by 2 in) will be driven directly into bedrock at the limestone/shale contact where groundwater flows laterally. Field parameters will be measured on the groundwater sample, and flow rate of the seep will be measured by a direct volume method (SOP 2.10).

For the soil sampling locations associated with the NPDES Outfall 001, an air-rotary coring rig or cable-tool drill rig will be used to advance each boring to the water table (about 30 ft). After each 5-ft interval is drilled, a CGI and PID will be used to monitor volatile organic vapors downhole and in the breathing zone (Mound Plant ER Program SOPs 6.1, Health and Safety Monitoring of Combustible Gas Levels [revision 1]; and 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector [revision 1], respectively). Background levels will be established using these instruments before drilling commences. In addition, Mound Plant field screening with a FIDLER is required during any intrusive activity (Mound Plant ER Program SOP 6.7, Near Surface and Soil Sample Screening for Low-Energy Gamma Radiation Using the FIDLER [revision 0]). The FIDLER will be calibrated to detect the 17-keV x-ray emitted when plutonium-238 decays to uranium-234. It will also detect the low energy gamma radiation emitted by the thorium decay chain.

Downhole soil samples will be collected during the drilling of each borehole. The drill rig will be equipped with a 2-inch-outside diameter, 5-ft-long, continuous core sampler. In each boring, soil samples will be collected at 5-ft intervals until total depth is attained. Geochemical samples will be collected immediately from the portion of the soil core that emits the highest concentration of volatile vapors, as determined by CGI and PID screening. If no vapors are detected, the soil sample will be collected from the bottom 2 ft of the core sample (e.g., 3 to 5 ft, 8 to 10 ft). For all soil borings, a soil sample will be collected for Mound Plant plutonium-238 and thorium-232 radioactivity screening. Each core sample will be lithologically described by a geologist at the sample site, as outlined in Mound Plant ER Program SOP 5.1, Soil and Rock Borehole Logging and Sampling (revision 1). All excess soil from the boreholes will be managed according to SOP 1.15, Guide to Waste Management (revision 1)

Field quality control samples collected during the drilling of soil borings will consist of field duplicates and field ambient blanks. The portion of the original core needed for VOC analyses will be removed before the other field duplicate samples are collected. The field ambient blank will consist of three 40-mL vials filled with reagent grade ASTM Type II water. The vials will be placed, open-topped, in the vicinity of soil sampling operations during drilling of boreholes. The laboratory will perform the appropriate analysis on each field quality control sample.

In some cases, the quantity of soil/rock recovered in the sampler may be insufficient to allow for the collection of all sample parameters specified. Therefore, the sample collection will be prioritized to ensure that samples for the most important parameters are collected. The quantity of soil samples required for each analysis and the appropriate sample containers are listed in Table I.5 in order of priority.

After the samples are successfully collected, the sample locations will be marked with a surveyor's hub and staked at each sampling site. The sample numbers will be written on the stakes. These locations will be accurately described by the field team and then surveyed as soon as possible by a surveyor licensed in the state of Ohio (survey stakes in remote areas may be disturbed very quickly).

6.6. SAMPLE HANDLING AND ANALYSIS

Preservative and container requirements of the surface and subsurface soil samples are outlined in Table I.5. When a sample is collected, a chain-of-custody record will be started for that sample following the procedures in Mound Plant ER Program SOP 1.3, Sample Control and Documentation (revision 0) (DOE 1991a). Samples from the seeps, NPDES pipeline, and perimeter fence investigations will be screened by the Mound facility before being shipped. A custody seal will be placed on each sample container, and the samples will be packed on ice. When the samples are packaged for shipment, enough ice will be used so that they will be maintained at a temperature of 4°C during shipment. Samples will be shipped by Federal Express™ overnight service. Packaging and shipment will follow Mound Plant ER Program SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples (revision 1).

The samples collected as part of the Site-wide soils investigation will be analyzed for the analytical and geotechnical parameters shown in Tables VI.1 through VI.4. The laboratory will follow approved method guidelines for requested parameter analyses, as specified in the Operable Unit 9 QAPP.

7. SURFACE WATER AND SEDIMENT INVESTIGATIONS

7.1. BACKGROUND INFORMATION

DOE has agreed to conduct investigations of the surface water and sediments on and adjacent to Mound Plant that include water bodies such as streams, ponds, and rivers and their associated sediments. The potential for the surficial erosion of radioactively contaminated soils on-plant to contribute to off-plant transport of contaminated sediments, although considerable engineering has gone into controlling the situation. The Operable Unit 9 Site-wide investigation will address all watersheds originating within the plant, the transport of surface water and sediments out of the plant, regional effects of redistribution of airborne deposits into ponds and streams, and effects of plant outfalls on the Great Miami River. Water and sediment sampling will be based on hydraulic considerations. These investigations will include sampling of

- the main plant drainage ditch and associated sediment settling basins and ponds (storm water retention and discharge system [SRDS]) and NPDES outfalls;
- surface water and sediments from the new property;
- surface water and sediments within watershed systems emanating from Mound Plant;
- surface water and sediments within the south part of the Miami-Erie Canal, the ephemeral stream from the new property and the overflow ditch to the Great Miami River;
- surface water and sediments within the Great Miami River above and below the plant;
- surface water and sediments in local and regional ponds, including seeps and streams affected by plant emissions; and
- surface water and sediments at river, stream, and pond locations outside the area affected by plant emissions.

Some sample locations have yet to be determined. Results of the regional soils investigation are required to identify additional locations for background sampling and maximum impact to the public. The background locations will be located outside the zone of influence from Mound Plant stack emissions, whereas locations within the zone are required to assess the maximum effects of erosion and sedimentation of contaminated soils on the public. The reconnaissance field investigation around the perimeter of the plant will determine what locations require sampling to assess the impact on the immediate community. The determination of these sampling locations will require the approval of the project managers.

This investigation studies the physical nature of the surface water and sediments, and defines the extent of contamination in surface water and sediments. Sampling locations are based on hydraulic conditions of

surface water flow. Hydraulic conditions of concern include presence or absence of water during the sampling event, flow velocity, depth of surface water, deposition or erosion of sediment, and water turbidity. These factors may have an impact on the location of a specific sampling point. Sampling locations in the field may be adjusted from those shown on the figures, as necessary. The physical characterization will describe the site surface water bodies including impoundments, streams, ditches, drains, swamps, wetlands (see section 10), and channels. Complete chemical and physical characterization of surface water and sediments onsite will include a complex suite of chemical and geotechnical parameters described below. Other than particle size distribution, which will be collected for all sediment samples for comparison purposes, geotechnical samples will only be collected from onsite locations and will not be required from background localities. Surface water characterization will also include the measurement of flow rate, if flow is present.

In addition to the physical and chemical descriptions of surface water sediments and subsurface soil, the horizontal extent, vertical extent, and concentration of contaminants in transported sediments will be defined. To accomplish a full characterization, a reconnaissance field investigation will be performed to evaluate areas of sediment deposition within and adjacent to Mound Plant. This reconnaissance field investigation will determine the 1) depositional area and depth of the sediments, 2) presence of stratification (suggesting changes in flow regime), 3) potential for sediment contamination, and 4) location of off-plant natural drainages in which infiltration of surface water runoff from the plant has occurred. Locations of some surface water and sediment analytical samples will be determined based on the findings of the reconnaissance field investigations.

7.2. OBJECTIVES

7.2.1. Surface Water and Sediment Characterization

The complete physical and chemical characterization of surface water and sediment at the Mound Plant Site requires

- describing natural and man-made ephemeral surface water drainages that flow off-plant within watershed systems not associated with the SRDS;
- characterizing surface water and sediments at the Mound Plant Site that are transported off-plant through drainages not routed through the NPDES outfalls and in regional areas affected by activities at Mound Plant;
- locating potential points of sediment deposition on-plant and off-plant to determine the extent of sedimentation and the best locations for sampling sediments for analysis; and

- determining the grain size, density, and cation exchange capacity of on-plant and off-plant stream sediments.

7.2.2. Surface Water and Sediment Contamination

The complete characterization of surface water and sediment contamination at the Mound Plant Site requires

- determining the extent and concentration of contamination in surface water and sediments at the NPDES outfalls, plant drainage ditch, and SRDS impoundments;
- determining the extent and concentration of surface water and sediment contamination from plant watershed drainages not controlled by Mound Plant NPDES outfalls;
- conducting a reconnaissance field investigation to locate areas of sediment deposition within and adjacent to Mound Plant and determining the sediment depth, stratification, and potential for contamination;
- determining specific concentrations of organic, inorganic, and radiological constituents in the surface water and sediment originating at Mound Plant;
- determining the effects of erosion of regionally contaminated soil on ponds and streams that may impact the public;
- determining the affects of Mound Plant outfalls on the Great Miami River; and
- collecting background samples from impoundments and drainages off-property that exhibit similar physical characteristics to those at Mound Plant.

7.3. SAMPLE LOCATIONS AND FREQUENCY

7.3.1. Physical and Chemical Characterization of Surface Water and Sediments

7.3.1.1. Reconnaissance Field Investigation

The purpose of the reconnaissance field investigation is to identify and evaluate surface water and sediment deposits that have been transported by surface water within a 1-mile radius and adjacent to the Mound Plant boundary. The reconnaissance sampling will collect a limited number of samples in the identified channels and impoundments. This investigation will determine 1) the location and extent of ephemeral drainages and ponds including seeps within each watershed, 2) the depositional area and thickness of transported sediments, 3) the presence of stratification (indicating multiple surface water flow/sediment transport events), and 4) the potential for sediment contamination. This investigation will also serve to locate natural drainages that contain little or no sediment deposition, but that show evidence that infiltration of surface water runoff has occurred. Information collected during the reconnaissance will

be used to select drainages or ponds for sampling. Details of these locations and sampling protocols are presented in subsections 7.3.3 and 7.3.4.

The Mound Plant can be divided into five subwatersheds, as shown in Figure 7.1. The general direction of drainage flow in relation to each subwatershed in shown in Figure 7.2. Rainfall runoff that flows along drainages related to each subwatershed has the potential to transport surface contaminants or contaminated surface sediments to other locations within the Mound Plant boundary or off-plant. Most of the drainage from subwatersheds 1 and 2 flows to the SRDS and is discharged through NPDES Outfall 002. Subwatershed 3 directs flow to the southwest beneath the Dayton-Cincinnati Pike and then to the Great Miami River. Localized areas of ponding, shown as topographic lows in Figure 7.1, occur within this watershed to the east of the railroad bed along the western plant boundary. Subwatershed 4 directs flow to the west boundary of the facility and then off-plant through NPDES Outfall 001. During high flow periods, water collecting at NPDES Outfall 001 may also be discharged via a bypass culvert to NPDES Outfall 002. Flow is also directed off-plant to the northwest along a steep hillside. Subwatershed 5 directs flow to the north across an asphalt parking lot and then off-plant where it combines with flow from the municipal golf course area.

For the reconnaissance field investigation, the field investigator will locate potential drainages, ponds and/or seeps in each subwatershed, on Mound Plant property and within a 1-mile radius of the Mound Plant, using a detailed, 2-ft-contour-interval topographic map. For each drainage or pond or seep that is identified, the field investigator will trace the following elements onto the topographic map:

- the path of each drainage to its discharge point or pond location,
- a drainage/pond/seep location and identification code, and
- the areal extent of sediment deposition or potential runoff infiltration along the length of each drainage/pond. These areas shall be given a designated identification code.

Potential areas of volatile or radioactive contamination will be determined using a PID and a FIDLER detector. The locations along each drainage or pond where instrument measurements are collected will also be identified on the topographic map using a location identification code. The location identification code and corresponding instrument readings will be recorded on the appropriate field forms. The evaluation of each drainage or pond will include information regarding the average thickness of transported sediment deposits and the presence of stratification within the deposit. This information, along with the corresponding area identification code, will be recorded in a field notebook.

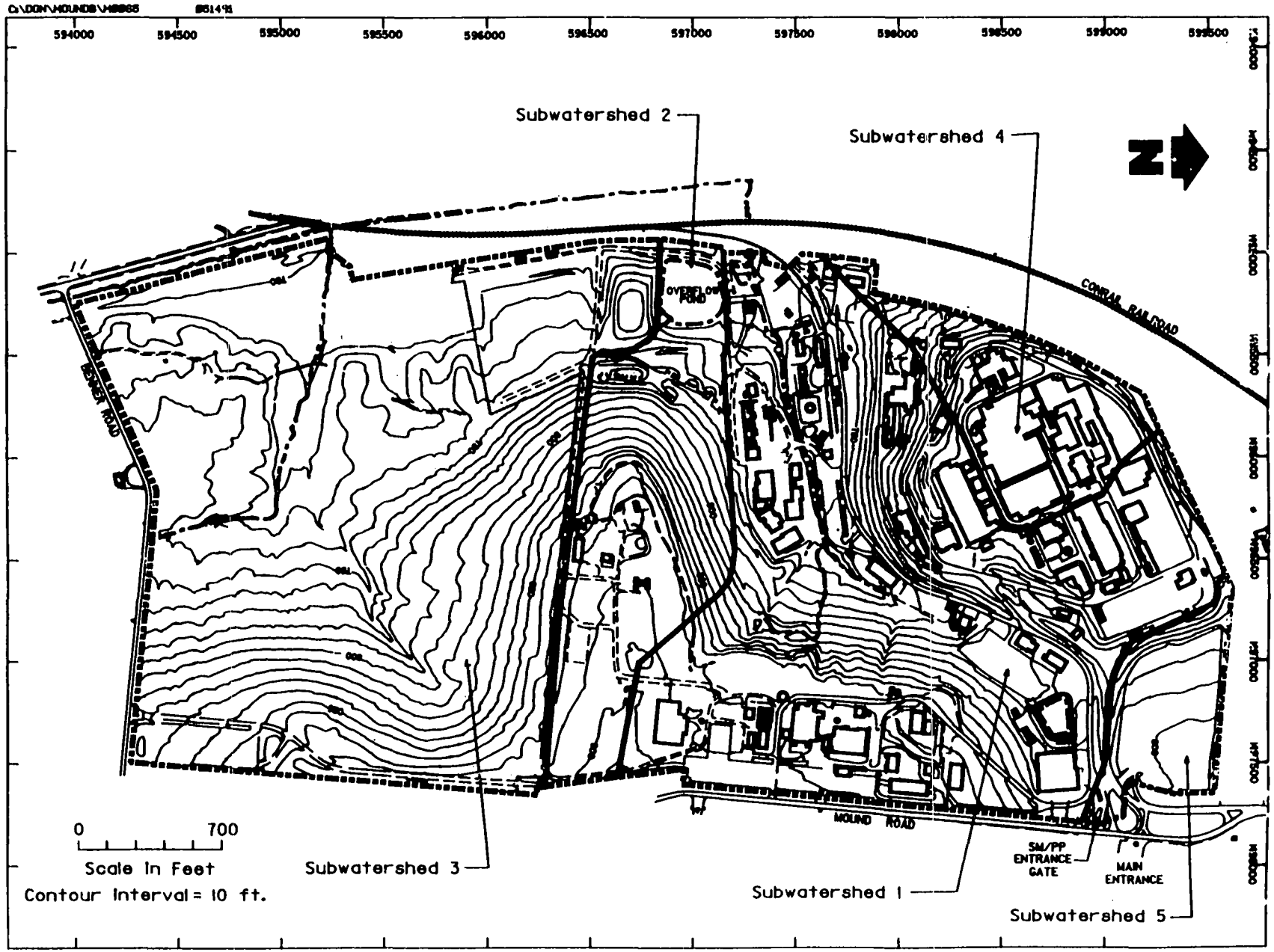


Figure 7.1. Location of subwatersheds at Mound Plant.

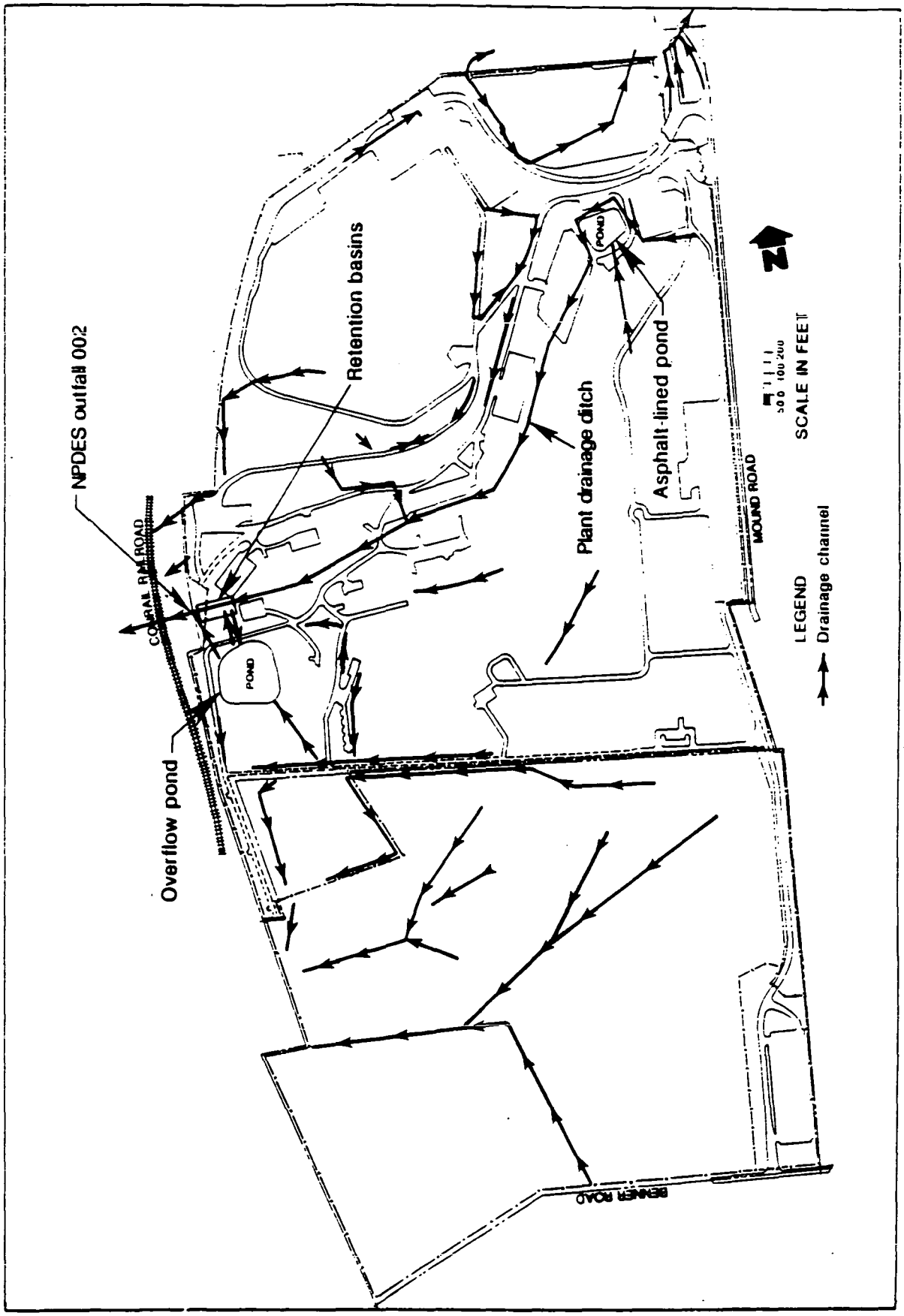


Figure 7.2. Drainage patterns at Mound Plant.

7.3.1.2. Background Investigation of Surface Water and Sediments

As part of the assessment of background concentrations in surface water and sediment at Mound Plant, surface water and sediment samples will be collected from four currently known off-plant locations (Figure 7.3). The sampling locations will be

- on the Great Miami River, approximately 17 miles north-northeast of the Mound Plant (39° 51' 18.5"N, 84° 10' 17"W);
- at an unnamed pond along Diamond Mill Road, approximately 6 miles northwest of Mound Plant (39° 41' 12"N, 84° 22' 00"W);
- in the creek above the unnamed pond along Diamond Mill Road (39° 41' 12"N, 84° 22' 00'W); and
- at the unnamed pond in the State Game Preserve, 32 miles southeast of the Mound Plant (39° 11' 12"N latitude and 83° 53'30"W longitude).

In addition to these four locations, two other sites will be identified for sampling of surface water and sediment to be conducted in a second phase. These locations, which will be identified in the field during the performance of the background sampling, are

- at a pond location outside the Mound Plant zone of airborne contaminant influence; and
- at a stream location outside the Mound Plant zone of airborne contaminant influence.

The four background surface water and sediment locations listed above were selected to represent different environmental settings that would be outside the airborne contaminant zone of influence of Mound Plant. The zone of influence of Mound Plant stack emissions may change from present understanding, based on results of the soil sampling being conducted (discussed in Section 6). Should it be found that any of the four background locations lie within the zone of influence, new location(s) may be selected outside the area of influence.

The Great Miami River location, the State Game Preserve pond, and the unnamed pond along Diamond Mill Road northwest of Mound Plant are locations where Mound Plant employees currently collect background samples for radionuclides. The coordinates of these locations were taken from the map of off-plant sampling points (DOE 1991b). The Diamond Mill Road pond and creek locations appear to be small watersheds of similar geomorphic settings as Mound Plant and appear to be easy to locate on a U.S. Geological Service (USGS) 7.5-minute topographic map.

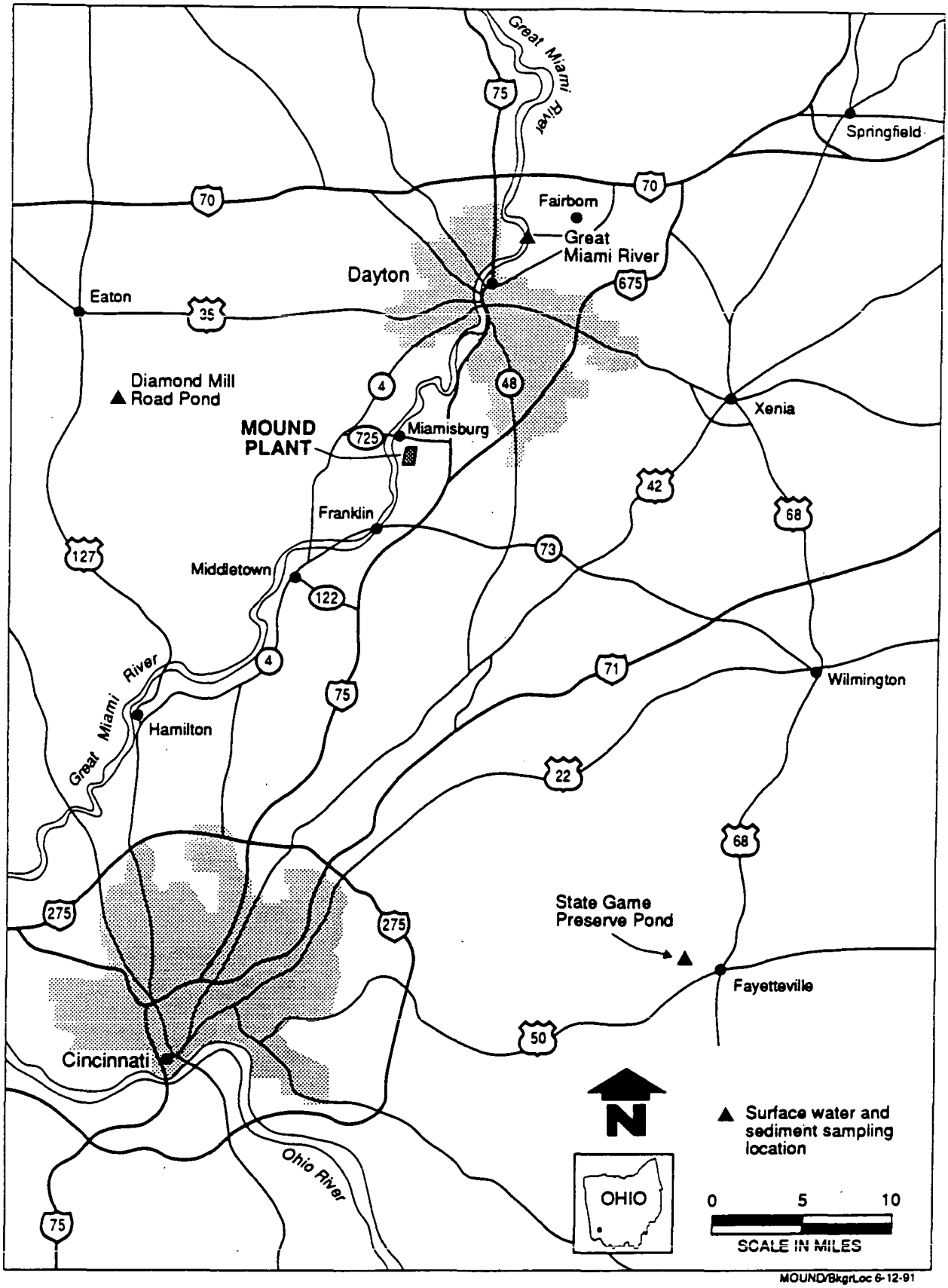


Figure 7.3. Proposed background surface water and sediment sampling locations.

The pond and stream locations for the second phase require the results of the regional soil investigation. These locations will be determined by mutual agreement of the project managers and will lie outside the Mound Plant zone of airborne contaminant influence.

The surface water and sediment samples will be collected seasonally: once during seasonal high flow conditions in April and once during seasonal low flow conditions in October. Surface water and sediment will be sampled twice because of their potential for high variability in the concentrations of chemical constituents. During high flow conditions, dissolved compounds may be diluted by rainfall, and suspended contaminants may have higher concentrations due to the increased sediment load. During low flow conditions, dissolved compounds may have higher concentrations from less dilution. Additionally, suspended sediments may have a different provenance, depending on water flow regime.

Specifications of the sampling program and analytical parameters for the background samples are summarized in Table VII.1. Sample numbers are listed in Table VII.2. The numbering system is described in subsection 7.4.

Surface water and sediment samples from the pond or stream would be collected at similar locations as those shown for the generic stream reach and generic pond displayed in Figure 7.4. Although the dimensions of each specific water body would be different, the generic sampling locations should provide for a consistent method to locate each sampling point in the water body of interest. Sediment samples will be collected near to the sampling point for surface water. Samples will be collected starting at downstream locations and proceeding upstream. Surface water samples will be collected prior to collection of sediment samples. This procedure will help to eliminate problems from disturbance and resuspension of pond or stream sediments.

Surface water samples from streams will be collected from just beneath the water surface, whereas samples from the Great Miami River will be collected at mid-depth of the water column. Surface water samples from standing bodies of water will be collected by one of two methods, depending on the presence of a thermocline. A thermocline is the horizontal plane in a thermally stratified lake located at the depth where temperature decreases most rapidly with depth. The thermocline can be detected by lowering a temperature probe through the water column. The presence of a thermocline may prevent mixing of waters vertically through the pond, producing two chemically distinct water layers. In this instance, a water sample will be collected from the mid-depth of each of the water layers above and below the thermocline. These water samples will be submitted for separate analysis. If a thermocline is not detected, the surface water sample will be collected at mid-depth of the entire water column. In either case, a sample will be collected by a sampling device capable of collecting a discrete sample (e.g., Kemmerer bottle).

Table VII.1. Analytical Specifications for Background Investigations of Surface Water and Sediment

Phase I

Environmental Samples

Surface Water Samples[a]

Sample Location/Number:	ALL LOCATIONS SAMPLED TWICE - Great Miami River (1) - Diamond Mill Road Pond (3-6) - Game Preserve Pond (3-6) - Diamond Mill Road Stream (2)
Analytical Parameters:	Analytical parameter list; field parameter list; and Great Miami River locations--analytical parameter list plus VOCs and semivolatile organic compounds

Sediment Samples

Sample/Location Number:	ALL LOCATIONS SAMPLED TWICE - Great Miami River (3) - Diamond Mill Road Pond (5) - Game Preserve Pond (5) - Diamond Mill Road Stream (3)
Analytical Parameters:	Analytical parameter list; Great Miami River locations--analytical parameter list plus VOCs and semivolatile organic compounds

Phase II

Surface Water Samples[a]

Sample Location/Number:	ALL LOCATIONS SAMPLED TWICE - Pond to be determined (3-6) - Stream to be determined (2)
Analytical Parameters:	Analytical parameter list; field parameter list

Sediment Samples

Sample Location/Number:	ALL LOCATIONS SAMPLED TWICE - Pond to be determined (5) - Stream to be determined (3)
Analytical Parameters:	Analytical parameter list

Table VII.1. (page 2 of 3)

QUALITY CONTROL SAMPLES

Trip Blanks

Number:	1 in every cooler containing VOCs
Analytical Parameters:	VOCs

Equipment Rinsate Blanks

Number:	1 per group of 10 or fewer geochemical samples
Analytical Parameters:	Analytical parameter list

Field Ambient Blanks

Number:	1 per group of 20 or fewer geochemical samples
Analytical Parameters:	VOCs

Field Duplicates

Number:	1 per group of 10 or fewer geochemical samples
Analytical Parameters:	Analytical parameter list

Matrix Spike/Matrix Spike Duplicates

Number:	1 per group of 20 or fewer geochemical samples
Analytical Parameters:	Consistent with primary sample

ANALYTICAL PARAMETER LIST
TAL inorganics[b]
Bismuth
Fluoride
Lithium
Molybdenum
TCL pesticides/PCBs
Isotopic plutonium (238, 239/240)[b]
Isotopic thorium (228, 230, 232)[b]
Isotopic uranium (234/235, 238)[b]
Strontium-90[b]
Tritium[b]
Gamma spectrometry[b]
Nitrate/nitrite
Chloride
Sulfate
Total organic carbon

FIELD PARAMETER LIST
pH
Temperature
Dissolved oxygen
Redox potential
Specific conductivity
Flow rate

Table VII.1. (page 3 of 3)

Surface Water Samples Only	Sediment Samples Only
Ammonia	Particle size distribution
Nutrients (TKN, TP)	pH
Total dissolved solids	
Total suspended solids	
Alkalinity	
TAL inorganics (dissolved)	
Radium-226[b]	
Americium-21[b]	

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[a]Surface soil samples will be obtained according to Mound Plant ER Program SOP 5.2, Soil Sampling with a Spade and Scoop (revision 3).

[b]In addition to samples collected for total TAL metals and total radionuclides, a filtered sample will be collected for dissolved TAL metals and dissolved radionuclides for comparison purposes.

ER - Environmental Restoration
PCBs - polychlorinated biphenyls
SOP - Standard Operating Procedure
TAL - Target Analyte List
TCL - Target Compound List
TKN - total Kjeldahl nitrogen
TP - total phosphorus
VOC - volatile organic compound

Table VII.2. Surface Water and Sediment Sample Designation for the Background Investigation

Sample Identification	Sample Matrix	Stream Flow Conditions	Proposed Location[a]
			Great Miami River:
MND21-1001-0001	Water[b]	High	Center Stream
MND22-1001-0001	Sediment[b]	High	Left Bank
MND22-1002-0001	Sediment[b]	High	Center Stream
MND22-1003-0001	Sediment[b]	High	Right Bank
MND21-1001-0002	Water[b]	Low	Center Stream
MND22-1001-0002	Sediment[b]	Low	Left Bank
MND22-1002-0002	Sediment[b]	Low	Center Stream
MND22-1003-0002	Sediment[b]	Low	Right Bank
			Diamond Mill Road Pond:
MND21-1101-0001	Water	High	Near Influent
MND21-1102-0001	Water	High	Center Pond
MND21-1103-0001	Water	High	Near Effluent
MND22-1101-0001	Sediment	High	Center Pond
MND22-1102-0001	Sediment	High	NE Quad
MND22-1103-0001	Sediment	High	SE Quad
MND22-1104-0001	Sediment	High	SW Quad
MND22-1105-0001	Sediment	High	NW Quad
MND21-1101-0002	Water	Low	Near Influent
MND21-1102-0002	Water	Low	Center Pond
MND21-1103-0002	Water	Low	Near Effluent
MND22-1101-0002	Sediment	Low	Center Pond
MND22-1102-0002	Sediment	Low	NE Quad
MND22-1103-0002	Sediment	Low	SE Quad
MND22-1104-0002	Sediment	Low	SW Quad
MND22-1105-0002	Sediment	Low	NW Quad
			Game Preserve Pond:
MND21-1201-0001	Water	High	Near Influent
MND21-1202-0001	Water	High	Center Pond
MND21-1203-0001	Water	High	Near Effluent
MND22-1201-0001	Sediment	High	Center Pond
MND22-1202-0001	Sediment	High	NE Quad
MND22-1203-0001	Sediment	High	SE Quad
MND22-1204-0001	Sediment	High	SW Quad
MND22-1205-0001	Sediment	High	NW Quad
MND21-1201-0002	Water	Low	Near Influent
MND21-1202-0002	Water	Low	Center Pond
MND21-1203-0002	Water	Low	Near Effluent
MND22-1201-0002	Sediment	Low	Center Pond
MND22-1202-0002	Sediment	Low	NE Quad
MND22-1203-0002	Sediment	Low	SE Quad
MND22-1204-0002	Sediment	Low	SW Quad
MND22-1205-0002	Sediment	Low	NW Quad

Table VII.2. (page 2 of 3)

Sample Identification	Sample Matrix	Stream Flow Conditions	Proposed Location[a]
			Diamond Mill Road Stream:
MND21-1301-0001	Water	High	Upstream
MND21-1302-0001	Water	High	Downstream
MND22-1301-0001	Sediment	High	Upstream
MND22-1302-0001	Sediment	High	Midway
MND22-1303-0001	Sediment	High	Downstream
MND21-1301-0002	Water	Low	Upstream
MND21-1302-0002	Water	Low	Downstream
MND22-1301-0002	Sediment	Low	Upstream
MND22-1302-0002	Sediment	Low	Midway
MND22-1303-0002	Sediment	Low	Downstream
			Pond--To Be Determined:
MND21-1401-0001	Water	High	Near Influent
MND21-1402-0001	Water	High	Center Pond
MND21-1403-0001	Water	High	Near Effluent
MND22-1401-0001	Sediment	High	Center Pond
MND22-1402-0001	Sediment	High	NE Quad
MND22-1403-0001	Sediment	High	SE Quad
MND22-1404-0001	Sediment	High	SW Quad
MND22-1405-0001	Sediment	High	NW Quad
MND21-1401-0002	Water	Low	Near Influent
MND21-1402-0002	Water	Low	Center Pond
MND21-1403-0002	Water	Low	Near Effluent
MND22-1401-0002	Sediment	Low	Center Pond
MND22-1402-0002	Sediment	Low	NE Quad
MND22-1403-0002	Sediment	Low	SE Quad
MND22-1404-0002	Sediment	Low	SW Quad
MND22-1405-0002	Sediment	Low	NW Quad
			Stream--To Be Determined:
MND21-1501-0001	Water	High	Upstream
MND21-1502-0001	Water	High	Downstream
MND22-1501-0001	Sediment	High	Upstream
MND22-1502-0001	Sediment	High	Midway
MND22-1503-0001	Sediment	High	Downstream
MND21-1501-0002	Water	Low	Upstream
MND21-1502-0002	Water	Low	Downstream
MND22-1501-0002	Sediment	Low	Upstream
MND22-1502-0002	Sediment	Low	Midway
MND22-1503-0002	Sediment	Low	Downstream

Table VII.2. (page 3 of 3)

All samples will be analyzed for the following parameters:

Analytes: Sediments	Analytical Method	Container (Size/Type)
VOCs (GMR only)	CLP SOW	125-mL wide-mouth glass jar, teflon-lined lid
Semivolatile organic compounds (GMR only)	CLP SOW	125-mL wide-mouth amber glass jar, teflon-lined lid
TCL pesticides/PCBs	CLP SOW	125-mL wide-mouth amber glass jar, teflon-lined lid
TAL inorganics	CLP SOW Mod A, B, or C	500-mL wide-mouth polyethylene bottle
Bismuth	CLP SOW Mod A, B, or C	
Fluoride	E340.2	
Lithium	CLP SOW Mod A, B, or C	
Molybdenum	CLP SOW Mod A, B, or C	
Total organic carbon	E415.1/E415.2	125-mL wide-mouth glass jar
Fluoride	E340.2	250-mL wide-mouth polyethylene bottle
Nitrate/nitrite	E353.2	
Chloride	SW9250d	
Sulfate	E375.2	
Isotopic plutonium (238,239/240)	NAS 1965	950-mL wide-mouth polyethylene bottle
Isotopic thorium (228, 230, 232)	NAS 1960	
Isotopic uranium (234/235, 238)	NAS 1962	
Strontium-90	NAS 1960	
Tritium	E906.0	
Gamma spectrometry	Nuclear Data, Inc. 1986	
Particle size distribution	ASTM D422-63	1-gallon wide-mouth polyethylene bottle
pH	SW9045	

Analytes: Water	Analytical Method	Container (Size/Type)
VOCs (GMR only)	CLP SOW	Three 40-mL glass vials, teflon-lined septum lid
Semivolatile organic compounds (GMR only)	CLP SOW	Two 1-L amber glass bottles, teflon-lined lid
TCL pesticides/PCBs	CLP SOW	Two 1-L amber glass bottles, teflon-lined lid

Table VII.2. (page 3a of 3)

Analytes: Water (continued)	Analytical Method	Container (Size/Type)
TAL inorganics	CLP SOW Mod A, B, or C	1-L polyethylene bottle, HNO_3 to pH<2
Bismuth	CLP SOW Mod A, B, or C	
Lithium	CLP SOW Mod A, B, or C	
Molybdenum	CLP SOW Mod A, B, or C	
Total organic carbon	E415.1/E415.2	250-mL amber glass jar, teflon-lined lid
Nitrate/nitrite	E353.2	500-mL polyethylene bottle, H_2SO_4 to pH<2
Chloride	E325.1	500-mL polyethylene bottle
Fluoride	E340.2	
Sulfate	E375.2	
Isotopic plutonium (238,239/240)	NAS 1965	Two 4-L plastic cubetainers
Isotopic thorium (228, 230, 232)	NAS 1960	
Isotopic uranium (234/235, 238)	NAS 1962	
Radium-226	ASTM D2460-70	
Americium-241	EML AM-01	
Strontium-90	NAS 1960	
Tritium	E906.0	
Gamma spectrometry	Nuclear Data, Inc. 1986	
Ammonia	E3500.1 or 350.3	500-mL polyethylene bottle, H_2SO_4 to pH<2
Nutrients: TKN, TP	E351.3/E365.1	1-L polyethylene bottle, H_2SO_4 to pH<2
Total dissolved solids	E160.1	1-L polyethylene bottle
Total suspended solids	E160.2	1-L polyethylene bottle
Alkalinity	E310.1	250-mL polyethylene bottle

[a]Proposed locations are shown in Figure 7.3; depths for water samples are mid-depth of the water column unless a thermocline is detected (see text for explanation); depths for sediment samples are 0 to 1 ft below the pond/stream/riverbottom.

[b]Great Miami River samples will also be analyzed for VOCs and semivolatile organic compounds.

Note: Only one bottle is needed per group of analytes unless otherwise indicated. Bottle size may change depending upon selection of multiple laboratories for the analyses and availability from bottle suppliers.

ASTM - American Society for Testing Materials
CLP - Contract Laboratory Program
GMR - Great Miami River
NAS - National Academy of Sciences
PCB - polychlorinated biphenyl
SOW - Statement of Work
TAL - Target Analyte List
TCL - Target Compound List
TKN - total Kjeldahl nitrogen
TP - total phosphorus
VOC - volatile organic compound

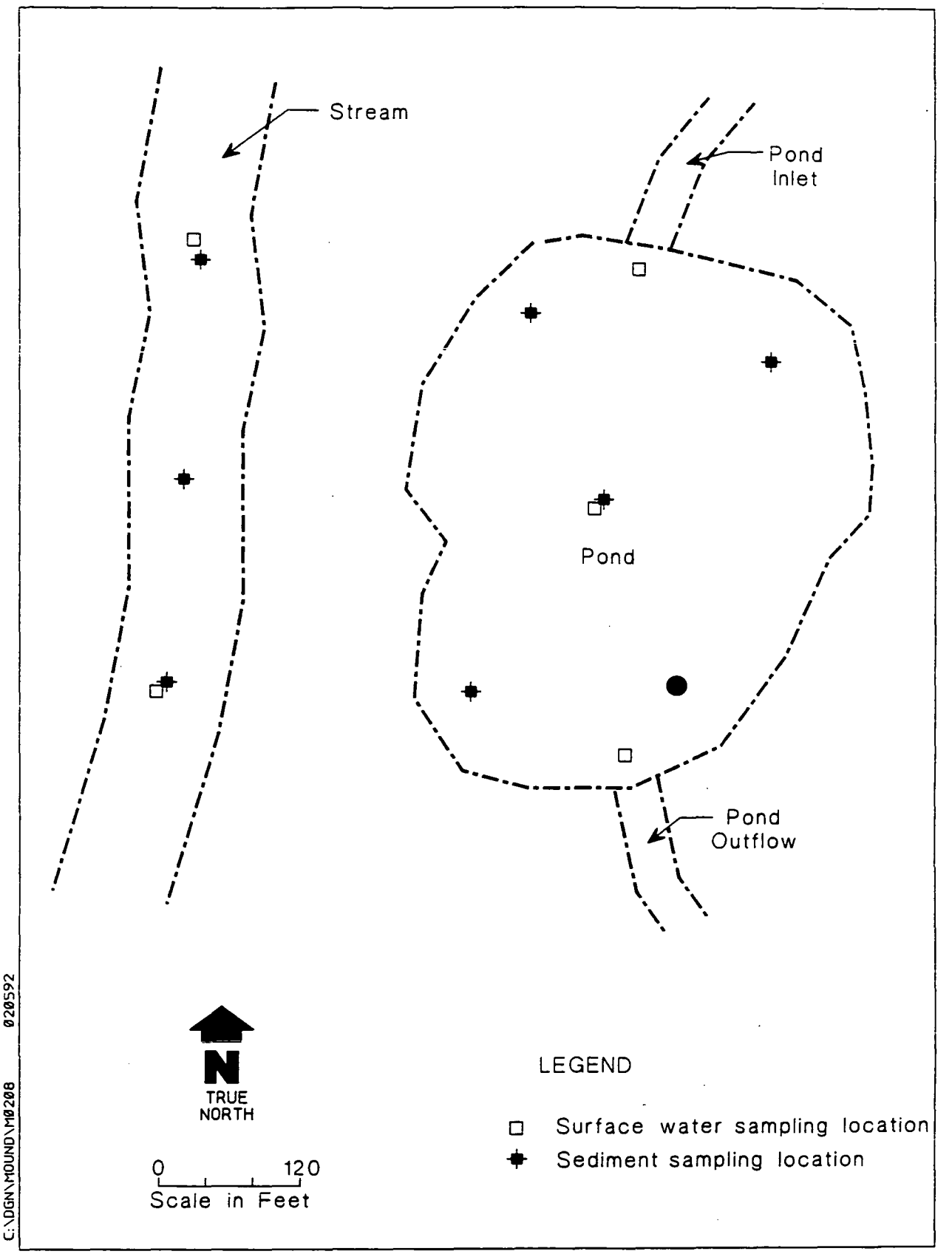

Figure 7.4. Proposed sampling locations on a typical background pond and stream (location to be determined).

The ponds selected for sampling will be divided into quadrants. Sediment samples will be collected as discrete grab samples from the center of each quadrant and the center of the pond. Three discrete surface water samples will be collected in each pond including the center of the pond, near the effluent (if known), and near the influent (if known). If the pond influent/effluent are not known or identifiable, the other two samples will be collected on either side of the pond, equidistant from the center. Field parameter measurements of pH, temperature, specific conductivity, dissolved oxygen and redox potential will be collected on surface water samples. If necessary, additional analysis may be conducted on selected discrete samples.

Three to six surface water and five sediment samples will be collected during the April and October sampling events from the Diamond Mill Road pond and the State Game Preserve pond. One surface water and three sediment samples will be collected from the stream above the Diamond Mill Road pond during both the April and October sampling events. Background samples from the Great Miami River will include one surface water and three sediment samples collected during the April and October sampling events. During the second phase, two to six surface water and two to five sediment samples will be collected from the unidentified pond and stream locations during the April and October sampling events.

7.3.2. Characterization of the Extent of Contamination in Surface Water and Sediments

7.3.2.1. Investigation of the Storm Water Retention and Discharge System (SRDS)

To characterize the nature and extent of contamination, surface water and sediment samples will be collected from the asphalt-lined pond, the retention basins, the overflow pond, NPDES Outfalls 001 and 002, and the plant drainage ditch. Subsurface soil samples will also be collected from the plant drainage ditch. The samples will be used to determine if the SRDS and NPDES features are receiving contaminants from plant runoff and if the SRDS and NPDES are potential sources for the transport of contaminants off-plant via discharge of surface water and sediments. All samples will be collected as discrete grab samples and not as composite samples, unless specified. Samples will be collected during both the April and October sampling events unless specifically stated otherwise. Analytical specifications and samples summaries are shown in Table VII.2. In some instances, the sediment and surface water samples will be collected at the same locations as the benthic macroinvertebrate sampling stations (described in subsection 10.3.3).

Investigation at the Asphalt-Lined Pond

The surface water samples (Tables VII.3 and VII.4) will be collected for laboratory analysis as discrete grab samples during two sampling events (April and October). Three surface water samples will be collected

Table VII.3. Analytical Specifications for the Surface Water and Sediment Investigations

ENVIRONMENTAL SAMPLES

SRDS/NPDES INVESTIGATION:

Surface Water Samples[a]

Sample Location/Number:	ALL LOCATIONS SAMPLED TWICE - Asphalt-lined pond (3 plus 1 influent) - Plant drainage ditch (3) - Retention basins (3) - Overflow pond (3 plus 2 possible influent) - NPDES Outfall 002 (1) - NPDES Outfall 001 (2) - Miami-Erie Canal (5)
Analytical Parameters:	Analytical parameter list plus molybdenum, lithium, and USATHAMA explosives; field parameter list

Sediment Samples--Geochemical

Sample Location/Number:	ALL LOCATIONS SAMPLED TWICE - Asphalt-lined pond (5) - Plant drainage ditch (8) - Retention basins (7) - Overflow pond (5) - NPDES Outfall 002 (4) - Miami-Erie Canal (7)
Analytical Parameters:	Analytical parameter list plus molybdenum, lithium, and USATHAMA explosives

Sediment Samples--Geotechnical

Sample Location/Number:	- Asphalt-lined pond (3) - Plant drainage ditch (3) - Retention basins (3) - Overflow pond (3) - NPDES Outfall 002 (2) - Miami-Erie Canal (7)
Analytical Parameters:	Particle size distribution, specific gravity, and cation exchange capacity

Table VII.3. (page 2 of 5)

Subsurface Soil Samples[b]--Geochemical

Sample Location/Number:	- Plant drainage ditch (6-18) - Miami-Erie Canal (7)
Depth:	- Plant drainage ditch: every 5 ft to water table or bedrock - Miami-Erie canal: 0.5 to 2.0 ft
Analytical Parameters:	Analytical parameter list plus molybdenum, lithium, and USATHAMA explosives

GREAT MIAMI RIVER AND SOUTH POND INVESTIGATIONS:

Surface Water Samples[a]

Sample Locations/Number:	ALL LOCATIONS SAMPLED TWICE - Great Miami River (4) - Miamisburg South Pond (3)
Analytical Parameters:	Analytical parameter list; field parameter list

Sediment Samples--Geochemical

Sample/Location Number:	ALL LOCATIONS SAMPLED TWICE - Great Miami River (12) - Miamisburg South Pond (3)
Analytical Parameters:	Analytical parameter list

Sediment Samples-Geotechnical

Sample Location/Number:	- Great Miami River (12) - Miamisburg South Pond (3)
Analytical Parameters:	Particle size distribution on all samples plus pH, specific gravity, and cation exchange capacity on South Pond samples

Table VII.3. (page 3 of 5)

INVESTIGATION OF OTHER DRAINAGES:

Surface Water Samples[a]

Sample Location/Number:	ALL LOCATIONS SAMPLED TWICE - Area watershed drainages (approx. 30) - Trunk stream (1) - Zone of influence - 2 ponds (6-12), 2 streams (4)
Analytical Parameters:	Analytical parameter list, but only 20% of samples for USATHAMA explosives and semivolatile organic compounds; field parameter list

Sediment Samples

Sample Location/Number:	ALL LOCATIONS SAMPLED TWICE EXCEPT LOW LYING AREA - Area watershed drainages (approx. 50) - Low lying areas (approx. 23) - Ephemeral stream (15) - Trunk stream (5) - Zone of influence - 2 ponds (10), 2 streams (6)
Analytical Parameters:	Analytical parameter list, but only 20% of samples for USATHAMA explosives and semivolatile organic compounds; samples greater than 15 pCi/g thorium for rare earths (not to exceed 3 samples)

Subsurface Soil Samples[b]--Geochemical

Sample Location/Number:	- Low lying area (approx. 12) - Ephemeral stream (approx. 12) - Trunk stream (approx. 12)
Depth:	Every 5 ft to water table or bedrock
Analytical Parameters:	Analytical parameter list, but only 20% of samples for USATHAMA explosives and semivolatile organic compounds

Subsurface Soil Samples--Geotechnical

Sample Location/Number:	One sample from each distinct stratigraphic horizon - Low lying area (approx. 4-6) - Ephemeral stream (approx. 4-6) - Trunk stream (approx, 4-6)
Depth:	Dependent on stratigraphy

Analytical Parameters:	Cation exchange capacity, moisture content, particle size distribution (sieve and hydrometer), organic content, permeability, relative density, maximum density, and specific gravity

QUALITY CONTROL SAMPLES

Trip Blanks

Number:	1 per cooler containing VOCs
Analytical Parameter:	VOCs

Equipment Rinsate Blanks

Number:	1 per 10 geochemical samples.
Analytical Parameters:	Analytical parameter list

Field Ambient Blanks

Number:	1 per 20 geochemical samples
Analytical Parameters:	VOCs

Field Duplicates

Number:	1 per 10 geochemical samples
Analytical Parameters:	Analytical parameter list

Matrix Spike/Matrix Spike Duplicates

Number:	1 per 20 geochemical samples
Analytical Parameters:	Analytical parameter list (double volume for most parameters; triple volume for VOCs).

ANALYTICAL PARAMETER LIST

VOCs
Semivolatile organic compounds
TAL inorganics[c]
Bismuth
Fluoride
TCL pesticides/PCBs
Isotopic plutonium (238, 239/240)[c]
Isotopic thorium (228, 230, 232)[c]
Isotopic uranium (234/235, 238)[c]
Strontium-90[c]
Tritium[c]

FIELD PARAMETER LIST

pH
Temperature
Dissolved oxygen
Redox potential
Specific conductivity
Flow rate (if available)

ANALYTICAL PARAMETER LIST (continued)

Gamma spectrometry[c]
Nitrate/nitrite
Chloride
Sulfate
Total organic carbon

Surface Water Samples Only

Ammonia
Nutrients (TKN, TP)
Total dissolved solids
Total suspended solids
Alkalinity
TAL inorganics (dissolved)
Radium-226
Americium-241

Sediment Samples Only

Particle size distribution
pH

---

[a]Surface soil samples will be obtained according to Mound Plant ER Program SOP 5.2, Soil Sampling with a Spade and Scoop (revision 3).

[b]Subsurface soil sampling will be performed according to Mound Plant ER Program SOPs 4.1, Soil Boring (revision 2), and 5.1, Soil and Rock Borehole Logging and Sampling (revision 1).

[c]In addition to samples collected for total TAL metals and total radionuclides, a filtered sample will be collected for dissolved TAL metals and dissolved radionuclides for comparison purposes.

ER - Environmental Restoration
NPDES - National Pollution Discharge Elimination System
PCBs - polychlorinated biphenyls
SOP - Standard Operating Procedure
TAL - Target Analyte List
TCL - Target Compound List
TKN - total Kjeldahl nitrogen
TP - total phosphorus
USATHAMA - U.S. Army Toxic and Hazardous Materials Agency
VOC - volatile organic compound

Table VII.4. Surface Water, Sediment, and Soil Sample Designation for the Investigation of the SRDS/NPDES

Sample Identification	Sample Matrix	Stream Flow Conditions	Proposed Location[a]
			Asphalt-lined Pond:
MND21-2001-0001	Water	High	Near Influent
MND21-2002-0001	Water	High	Center Pond
MND21-2003-0001	Water	High	Near Effluent
MND21-2004-0001	Water	High	Influent Pipe
MND22-2001-0001	Sediment[b]	High	Center Pond
MND22-2002-0001	Sediment[b]	High	NE Quad
MND22-2003-0001	Sediment	High	SE Quad
MND22-2004-0001	Sediment[b]	High	SW Quad
MND22-2005-0001	Sediment	High	NW Quad
MND21-2001-0002	Water	Low	Near Influent
MND21-2002-0002	Water	Low	Center Pond
MND21-2003-0002	Water	Low	Near Effluent
MND21-2004-0002	Water	Low	Influent Pipe
MND22-2001-0002	Sediment	Low	Center Pond
MND22-2002-0002	Sediment	Low	NE Quad
MND22-2003-0002	Sediment	Low	SE Quad
MND22-2004-0002	Sediment	Low	SW Quad
MND22-2005-0002	Sediment	Low	NW Quad
			Plant Drainage Ditch:
MND21-2101-0001	Water	High	East--Near Bldg. 22
MND21-2102-0001	Water	High	Central--Near Bldg. 49
MND21-2103-0001	Water	High	West--Near Bldg. 42
MND22-2101-0001	Sediment[b]	High	0 ft Downstream of Culvert Outfall
MND22-2102-0001	Sediment	High	200 ft Downstream of Culvert Outfall
MND22-2103-0001	Sediment	High	400 ft Downstream of Culvert Outfall
MND22-2104-0001	Sediment[b]	High	600 ft Downstream of Culvert Outfall
MND22-2105-0001	Sediment	High	800 ft Downstream of Culvert Outfall
MND22-2106-0001	Sediment	High	1000 ft Downstream of Culvert Outfall
MND22-2107-0001	Sediment	High	1200 ft Downstream of Culvert Outfall
MND22-2108-0001	Sediment[b]	High	1400 ft Downstream of Culvert Outfall
MND21-2101-0002	Water	Low	East--Near Bldg. 22
MND21-2102-0002	Water	Low	Central--Near Bldg. 49
MND21-2103-0002	Water	Low	West--Near Bldg. 42
MND22-2101-0002	Sediment	Low	0 ft Downstream of Culvert Outfall
MND22-2102-0002	Sediment	Low	200 ft Downstream of Culvert Outfall
MND22-2103-0002	Sediment	Low	400 ft Downstream of Culvert Outfall
MND22-2104-0002	Sediment	Low	600 ft Downstream of Culvert Outfall
MND22-2105-0002	Sediment	Low	800 ft Downstream of Culvert Outfall
MND22-2106-0002	Sediment	Low	1000 ft Downstream of Culvert Outfall
MND22-2107-0002	Sediment	Low	1200 ft Downstream of Culvert Outfall
MND22-2108-0002	Sediment	Low	1400 ft Downstream of Culvert Outfall
MND23-4001-0001	Soil	----	0 ft Downstream of Culvert Outfall--5 ft
MND23-4001-0002	Soil	----	0 ft Downstream of Culvert Outfall--10 ft
MND23-4001-0003	Soil	----	0 ft Downstream of Culvert Outfall--15 ft
MND23-4001-0004	Soil	----	0 ft Downstream of Culvert Outfall--20 ft
MND23-4001-0005	Soil	----	0 ft Downstream of Culvert Outfall--25 ft
MND23-4001-0006	Soil	----	0 ft Downstream of Culvert Outfall--30 ft

Table VII.4. (page 2 of 5)

Sample Identification	Sample Matrix	Stream Flow Conditions	Proposed Location[a]
			Plant Drainage Ditch (continued):
MND23-4002-0001	Soil	---	600 ft Downstream of Culvert Outfall--5 ft
MND23-4002-0002	Soil	---	600 ft Downstream of Culvert Outfall--10 ft
MND23-4002-0003	Soil	---	600 ft Downstream of Culvert Outfall--15 ft
MND23-4002-0004	Soil	---	600 ft Downstream of Culvert Outfall--20 ft
MND23-4002-0005	Soil	---	600 ft Downstream of Culvert Outfall--25 ft
MND23-4002-0006	Soil	---	600 ft Downstream of Culvert Outfall--30 ft
MND23-4003-0001	Soil	---	1200 ft Downstream of Culvert Outfall--5 ft
MND23-4003-0002	Soil	---	1200 ft Downstream of Culvert Outfall--10 ft
MND23-4003-0003	Soil	---	1200 ft Downstream of Culvert Outfall--15 ft
MND23-4003-0004	Soil	---	1200 ft Downstream of Culvert Outfall--20 ft
MND23-4003-0005	Soil	---	1200 ft Downstream of Culvert Outfall--25 ft
MND23-4003-0006	Soil	---	1200 ft Downstream of Culvert Outfall--30 ft
			Retention Basins:
MND21-2201-0001	Water	High	NE Retention Basin
MND21-2202-0001	Water	High	SE Retention Basin
MND21-2203-0001	Water	High	West Retention Basin
MND22-2201-0001	Sediment[b]	High	NE Retention Basin--East
MND22-2202-0001	Sediment	High	NE Retention Basin--Central
MND22-2203-0001	Sediment	High	NE Retention Basin--West
MND22-2204-0001	Sediment[b]	High	SE Retention Basin--North
MND22-2205-0001	Sediment	High	SE Retention Basin--South
MND22-2206-0001	Sediment[b]	High	West Retention Basin--North
MND22-2207-0001	Sediment	High	West Retention Basin--South
MND21-2201-0002	Water	Low	NE Retention Basin
MND21-2202-0002	Water	Low	SE Retention Basin
MND21-2203-0002	Water	Low	West Retention Basin
MND22-2201-0002	Sediment	Low	NE Retention Basin--East
MND22-2202-0002	Sediment	Low	NE Retention Basin--Central
MND22-2203-0002	Sediment	Low	NE Retention Basin--West
MND22-2204-0002	Sediment	Low	SE Retention Basin--North
MND22-2205-0002	Sediment	Low	SE Retention Basin--South
MND22-2206-0002	Sediment	Low	West Retention Basin--North
MND22-2207-0002	Sediment	Low	West Retention Basin--South
			Overflow Pond:
MND21-2301-0001	Water	High	Near Influent
MND21-2302-0001	Water	High	Center Pond
MND21-2303-0001	Water	High	Near Effluent
MND21-2304-0001	Water	High	Influent Channel--North
MND21-2305-0001	Water	High	Influent Channel--SE
MND22-2301-0001	Sediment[b]	High	Center Pond
MND22-2302-0001	Sediment[b]	High	NE Quad
MND22-2303-0001	Sediment	High	SE Quad
MND22-2304-0001	Sediment[b]	High	SW Quad
MND22-2305-0001	Sediment	High	NW Quad
MND21-2301-0002	Water	Low	Near Influent
MND21-2302-0002	Water	Low	Center Pond
MND21-2303-0002	Water	Low	Near Effluent
MND21-2304-0002	Water	Low	Influent Channel--North
MND21-2305-0002	Water	Low	Influent Channel--SE

Table VII.4. (page 3 of 5)

Sample Identification	Sample Matrix	Stream Flow Conditions	Proposed Location[a]
			Overflow Pond (continued):
MND22-2301-0002	Sediment	Low	Center Pond
MND22-2302-0002	Sediment	Low	NE Quad
MND22-2303-0002	Sediment	Low	SE Quad
MND22-2304-0002	Sediment	Low	SW Quad
MND22-2305-0002	Sediment	Low	NW Quad
			NPDES Outfall 002:
MND21-2401-0001	Water	High	at West Side of R.R. Culvert
MND22-2401-0001	Sediment[b]	High	at Wier
MND22-2402-0001	Sediment	High	10 ft West of R.R. Culvert
MND22-2403-0001	Sediment	High	30 ft West of R.R. Culvert
MND22-2404-0001	Sediment[b]	High	110 ft West of R.R. Culvert
MND21-2401-0002	Water	Low	at West Side of R.R. Culvert
MND22-2401-0002	Sediment	Low	at Wier
MND22-2402-0002	Sediment	Low	10 ft West of R.R. Culvert
MND22-2403-0002	Sediment	Low	30 ft West of R.R. Culvert
MND22-2404-0002	Sediment	Low	110 ft West of R.R. Culvert
			NPDES Outfall 001:
MND21-2501-0001	Water	High	at Great Miami River
MND21-2501-0002	Water	Low	at Great Miami River
			South Miami-Erie Canal:
MND21-2601-0001	Water	High	500 ft Downstream from Outfall 002
MND21-2602-0001	Water	High	2600 ft Downstream from Outfall 002
MND21-2603-0001	Water	High	3250 ft Downstream from Outfall 002
MND21-2604-0001	Water	High	Overflow Creek--400 ft from Canal
MND21-2605-0001	Water	High	Overflow Creek--1700 ft from Canal
MND22-2601-0001	Sediment[b]	High	500 ft Downstream from Outfall 002
MND22-2602-0001	Sediment[b]	High	1400 ft Downstream from Outfall 002
MND22-2603-0001	Sediment[b]	High	2600 ft Downstream from Outfall 002
MND22-2604-0001	Sediment[b]	High	3250 ft Downstream from Outfall 002
MND22-2605-0001	Sediment[b]	High	Overflow Creek--400 ft from Canal
MND22-2606-0001	Sediment[b]	High	Overflow Creek--1000 ft from Canal
MND22-2607-0001	Sediment[b]	High	Overflow Creek--1700 ft from Canal
MND21-2601-0002	Water	Low	500 ft Downstream from Outfall 002
MND21-2602-0002	Water	Low	2600 ft Downstream from Outfall 002
MND21-2603-0002	Water	Low	3250 ft Downstream from Outfall 002
MND21-2604-0002	Water	Low	Overflow Creek--400 ft from Canal
MND21-2605-0002	Water	Low	Overflow Creek--1700 ft from Canal
MND22-2601-0002	Sediment	Low	500 ft Downstream from Outfall 002
MND22-2602-0002	Sediment	Low	1400 ft Downstream from Outfall 002
MND22-2603-0002	Sediment	Low	2600 ft Downstream from Outfall 002
MND22-2604-0002	Sediment	Low	3250 ft Downstream from Outfall 002
MND22-2605-0002	Sediment	Low	Overflow Creek--400 ft from Canal
MND22-2606-0002	Sediment	Low	Overflow Creek--1000 ft from Canal
MND22-2607-0002	Sediment	Low	Overflow Creek--1700 ft from Canal

Table VII.4. (page 4 of 5)

Sample Identification	Sample Matrix	Stream Flow Conditions	Proposed Location[a]
			South Miami-Erie Canal (continued):
MND23-4101-0001	Soil	----	500 ft Downstream from Outfall 002 (0.5 - 2 ft)
MND23-4102-0001	Soil	----	1400 ft Downstream from Outfall 002 (0.5 - 2 ft)
MND23-4103-0001	Soil	----	2600 ft Downstream from Outfall 002 (0.5 - 2 ft)
MND23-4104-0001	Soil	----	3250 ft Downstream from Outfall 002 (0.5 - 2 ft)
MND23-4105-0001	Soil	----	Overflow Creek--400 ft from Canal (0.5 - 2 ft)
MND23-4106-0001	Soil	----	Overflow Creek--1000 ft from Canal (0.5 - 2 ft)
MND23-4107-0001	Soil	----	Overflow Creek--1700 ft from Canal (0.5 - 2 ft)

All samples will be analyzed for the following parameters:

Analytes: Sediments	Analytical Method	Container (Size/Type)
VOCs	CLP SOW	125-mL wide-mouth glass jar, teflon-lined lid
Semivolatile organic compounds	CLP SOW	125-mL wide-mouth amber glass jar, teflon-lined lid
TCL pesticides/PCBs	CLP SOW	125-mL wide-mouth amber glass jar, teflon-lined lid
TAL inorganics	CLP SOW Mod A, B, or C	500-mL wide-mouth polyethylene bottle
Bismuth	CLP SOW Mod A, B, or C	
Lithium	CLP SOW Mod A, B, or C	
Molybdenum	CLP SOW Mod A, B, or C	
Total organic carbon	E415.1/E415.2	125-mL wide-mouth glass jar
Fluoride	E340.2	250-mL wide-mouth polyethylene bottle
Nitrate/nitrite	E353.2	
Chloride	SW9250d	
Sulfate	E375.2	
Isotopic plutonium (238,239/240)	NAS 1965	950-mL wide-mouth polyethylene bottle
Isotopic thorium (228, 230, 232)	NAS 1960	
Isotopic uranium (234/235, 238)	NAS 1962	
Strontium-90	NAS 1960	
Tritium	E906.0	
Gamma spectrometry	Nuclear Data, Inc. 1986	
USATHAMA explosives	USATHAMA	125-mL wide-mouth amber glass jar, teflon-lined lid
Particle size distribution	ASTM D422-63	1-gallon wide-mouth polyethylene bottle
pH	SW9045	

Table VII.4. (page 5 of 5)

Analytes: Water	Analytical Method	Container (Size/Type)
VOCs	SW5030/SW8010; SW5030/SW8020; CLP SOW; SW5030/SW8030	Three 40-mL glass vials, teflon-lined septum lid
Semivolatile organic compounds	CLP SOW	Two 1-L amber glass bottles, teflon-lined lid
TCL pesticides/PCBs	CLP SOW	Two 1-L amber glass bottles, teflon-lined lid
TAL inorganics	CLP SOW Mod A, B, or C	1-L polyethylene bottle, HNO_3 to pH<2
Bismuth	CLP SOW Mod A, B, or C	
Lithium	CLP SOW Mod A, B, or C	
Molybdenum	CLP SOW Mod A, B, or C	
Total organic carbon	E415.1/E415.2	250-mL amber glass jar, teflon-lined lid
Nitrate/nitrite	E353.2	500-mL polyethylene bottle, H_2SO_4 to pH<2
Chloride	E325.1	500-mL polyethylene bottle
Fluoride	E340.2	
Sulfate	E375.2	
Isotopic plutonium (238,239/240)	NAS 1965	Two 4-L plastic cubetainers
Isotopic thorium (228, 230, 232)	NAS 1960	
Isotopic uranium (234/235, 238)	NAS 1962	
Radium-226	ASTM D2460-70	
Americium-241	EML AM-01	
Strontium-90	NAS 1960	
Tritium	E906.0	
Gamma spectrometry	Nuclear Data, Inc. 1986	
USATHAMA explosives	USATHAMA UW-11	1-L amber glass bottle, teflon-lined lid
Ammonia	E3501 or 350.3	500-mL polyethylene bottle, H_2SO_4 to pH<2
Nutrients (TKN, TP)	E351.3/E365.1	1-L polyethylene bottle
Total dissolved solids	E160.1	1-L polyethylene bottle
Total suspended solids	E160.2	1-L polyethylene bottle
Alkalinity	E310.1	250-mL polyethylene bottle

Table VII.4. (page 5a of 5)

Geotechnical samples will be analyzed for the following parameters:

Analytes: Water	Analytical Method	Container (Size/Type)
Particle size distribution Specific gravity Cation exchange capacity	ASTM D422-63 ASTM D854-63 SW9080/SW9081	1-gallon wide-mouth polyethylene bottle

[a]Proposed locations are shown in Figures 7.5, 7.6, 7.7, 7.8, 7.9, and 7.10; depths for water samples are mid-depth of the water column unless a thermocline is detected (see text for explanation); depths for sediment samples are 0 to 1 ft below the pond/stream bottom.

[b]Sample will also be analyzed for geotechnical parameters listed above.

Note: Only one bottle is needed per group of analytes unless otherwise indicated. Bottle size may change depending upon selection of multiple laboratories for the analyses and availability from bottle suppliers.

ASTM - American Society for Testing Materials
CLP - Contract Laboratory Program
NAS - National Academy of Sciences
NPDES - National Pollution Discharge Elimination System
PCB - polychlorinated biphenyl
SOW - Statement of Work
TAL - Target Analyte List
TCL - Target Compound List
TKN - total Kjeldahl nitrogen
TP - total phosphorus
USATHAMA - U.S. Army Toxic and Hazardous Materials Agency
VOC - volatile organic compound

from the center of the asphalt-lined pond, near the pond influent, and near the pond effluent. One surface water sample will be collected at each of the three locations. Samples will be collected using a sampling device capable of collecting a discrete sample (e.g., Kemmerer bottle, grab sampler, bomb sampler).

An additional surface water sample will be collected from the influent pipe before it reaches the asphalt-lined pond. A visual reconnaissance survey will be conducted to identify a feasible location (e.g., manhole, trap) to sample the influent.

Sediment samples (Tables VII.3 and VII.4) will also be collected as grab samples from the asphalt-lined pond in order to assess the possible spatial variability of contaminant concentrations. Five discrete sediment samples will be collected from the center of each quadrant and the center of the pond (see Figure 7.5) during both the April and October sampling events. At each sediment sample location, a measuring rod or coliwasa will be used to take a sediment/sludge depth measurement. The sediment sample will be collected using a core or tube sampler to collect a core of the sediment/sludge column present in the pond, if possible. If a core sample is not possible, then a dredge (e.g., Eckman or Ponar) will be used for sample collection. Three grab samples for geotechnical analysis will be collected at the center and two of the quadrant locations using the sample collection methods. The latter will be collected only once during the initial sampling event.

Investigation at the Plant Drainage Ditch

The investigation at the plant drainage ditch will include sampling subsurface soils, surface water, and sediment at various locations along the drainage ditch. Surface water samples (Tables VII.3 and VII.4) will be collected at three locations along the plant drainage ditch to characterize the water and to compare sediment surface water contaminant concentrations. The three surface water sample locations are shown in Figure 7.6 and include the culvert outfall in the upper reach (asphalt-lined pond effluent), the drainage ditch intersection below Building 49, and the lower reach. Samples will be collected twice, in April and October. The analytical suite is included in Table VII.2. Field parameters will include flow rate, temperature, pH, specific conductivity, dissolved oxygen, and redox potential. Samples will be collected with a device capable of retrieving shallow surface water (i.e., dipper or ladle).

Subsurface soil samples (Tables VII.3 and VII.4) will be collected in the plant drainage ditch from three boreholes to assess the vertical extent of the plutonium-238 and characterize other potential contaminants in the drainage ditch. Two of the boreholes are located in sections of the plant drainage ditch where previous investigations have identified average plutonium-238 concentrations at depths of 0 to 6 ft that exceed the Mound Plant cleanup goal of 25 pCi/g (Figure 7.6). The third borehole is located at the culvert outfall in the upper reach (asphalt-lined pond effluent). Each borehole will be sampled at a depth of

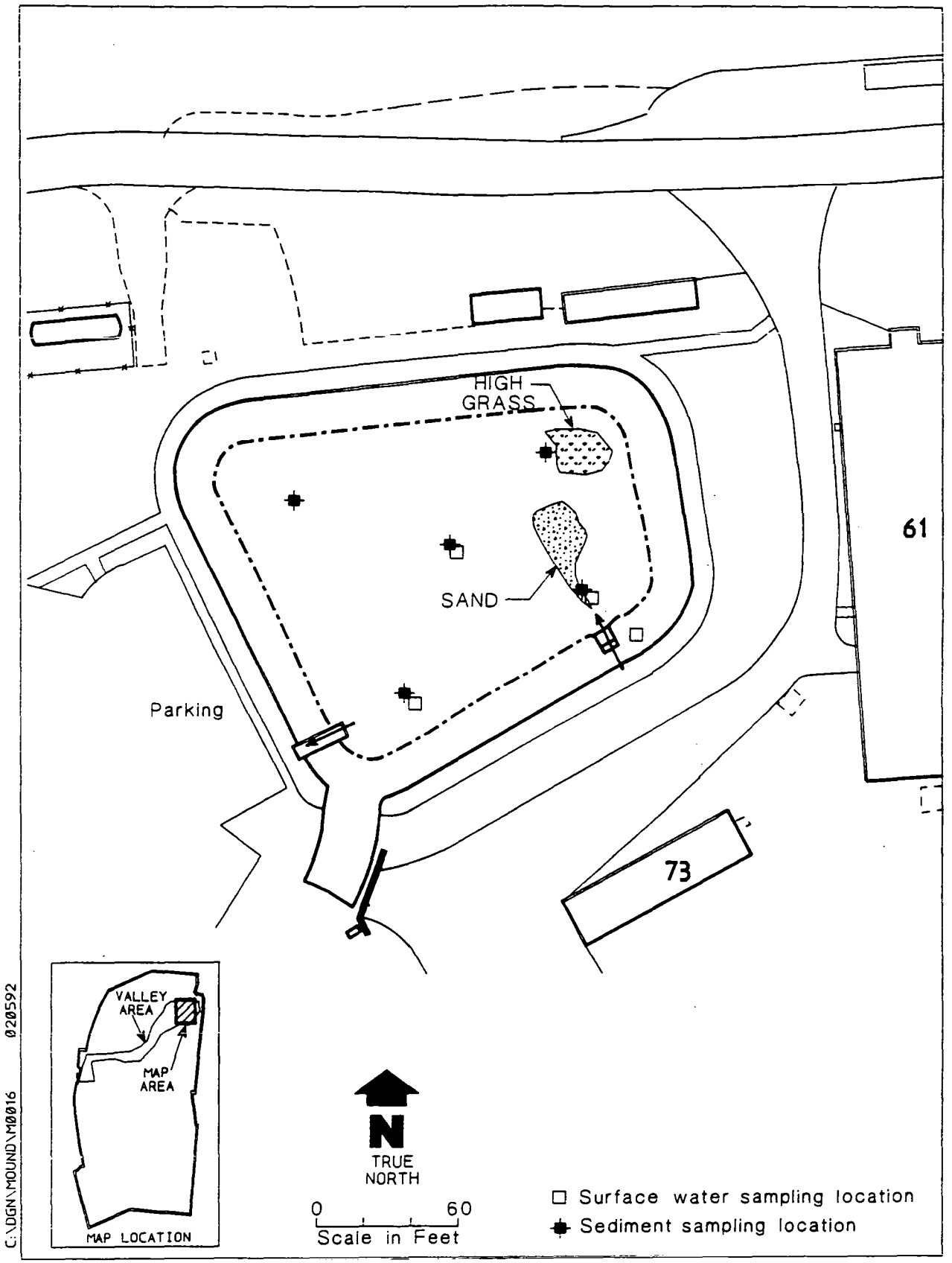

Figure 7.5. Asphalt-lined pond surface water and sediment sampling locations (proposed).

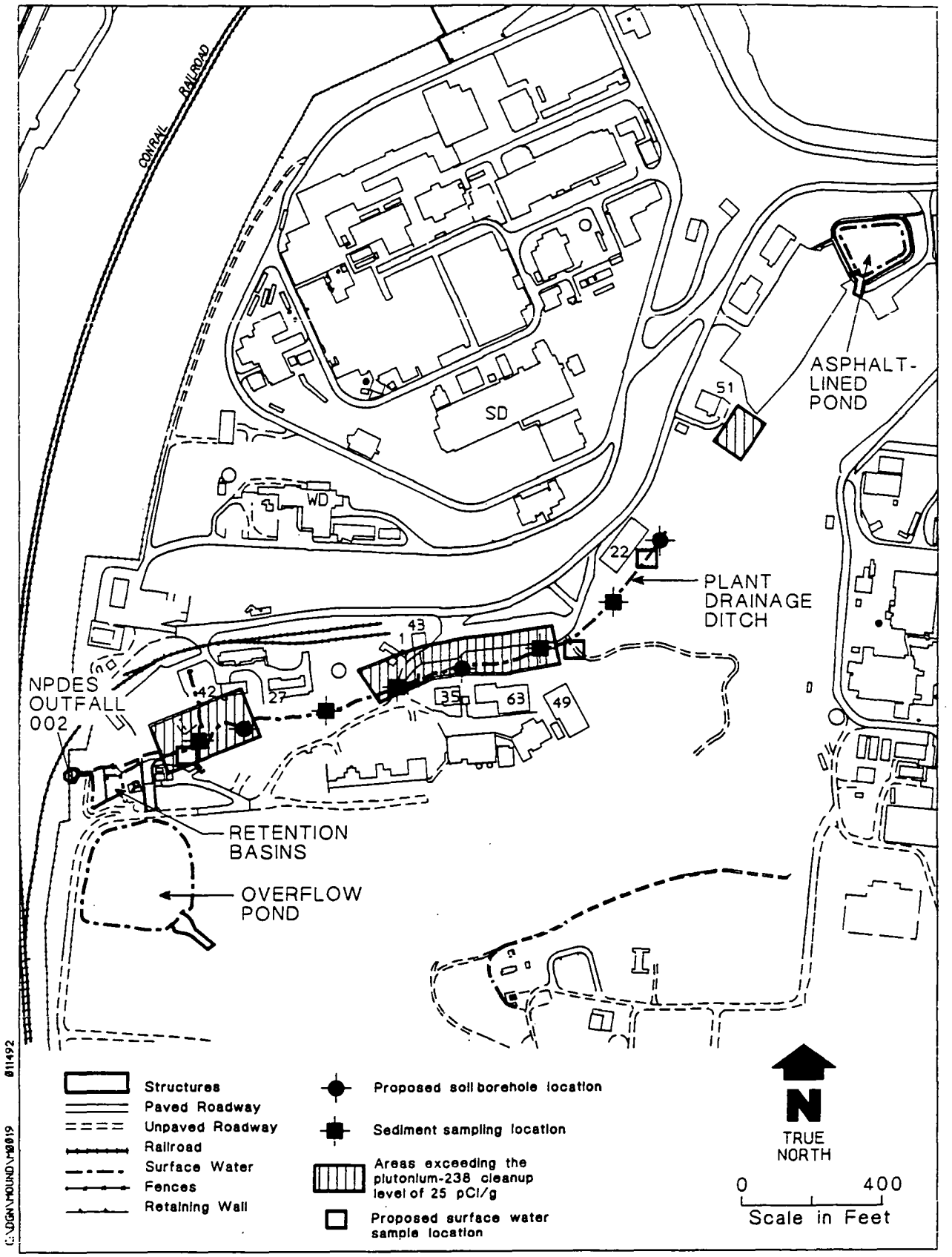

Figure 7.6. Plant drainage ditch sampling locations (proposed).

0 to 2 ft and then at 5-ft intervals beginning at 3 to 5 ft until the water table or bedrock is reached. Subsurface soil samples will be collected using a split-spoon sampler, and will only be collected during the first sampling event.

The samples collected at 0 to 2 ft at the three borehole locations will be considered sediment samples. Sediment grab samples will be collected at five additional locations along the Mound Plant drainage ditch from the asphalt-lined pond to the retention basins (Figure 7.6). The spacing of the sediment samples along the drainage ditch (including the soil boring locations) is approximately every 200 ft. Sediment samples will be collected with a trowel or core sampler as discrete grab samples during both the April and October sampling events. Three grab samples for geotechnical analysis will be collected at the center and two of the quadrant locations using the sample collection methods. The latter will be collected only once during the initial sampling event.

Investigation at the Retention Basins

One surface water sample (Tables VII.3 and VII.4) will be collected for laboratory analysis from each of the three retention basins during the April and October sampling events. Discrete surface water samples will be collected at the locations shown in Figure 7.7, and field parameters (temperature, pH, specific conductivity, dissolved oxygen, and redox potential) will be measured at each of the locations.

To collect a representative sample, the column of water at each sampling location will be sampled at mid-depth of the water column in each retention basin. Samples will be collected with a device capable of collecting a discrete sample (e.g., Kemmerer bottle).

Individual sediment samples (Tables VII.3 and VII.4) will be collected in the retention basin in order to assess the spatial variability of contaminant concentrations in the sediments. Sediment samples will be collected as discrete grab samples with a tube or dredge during the April and October sampling events. At each sediment sample location, a measuring rod or coliwasa will be used to take a sediment/sludge depth measurement. One geotechnical sample will also be collected from each basin during the initial sampling event.

Investigation at the Overflow Pond

Surface water and sediment samples will be collected from the overflow pond to characterize spatial variability in the pond sediments during the April and October sampling events. Surface water samples (Tables VII.3 and VII.4) will be collected as discrete samples from the center of the overflow pond, near the pond influent, and near the pond effluent (Figure 7.8). A thermocline is not expected, as the pond is less

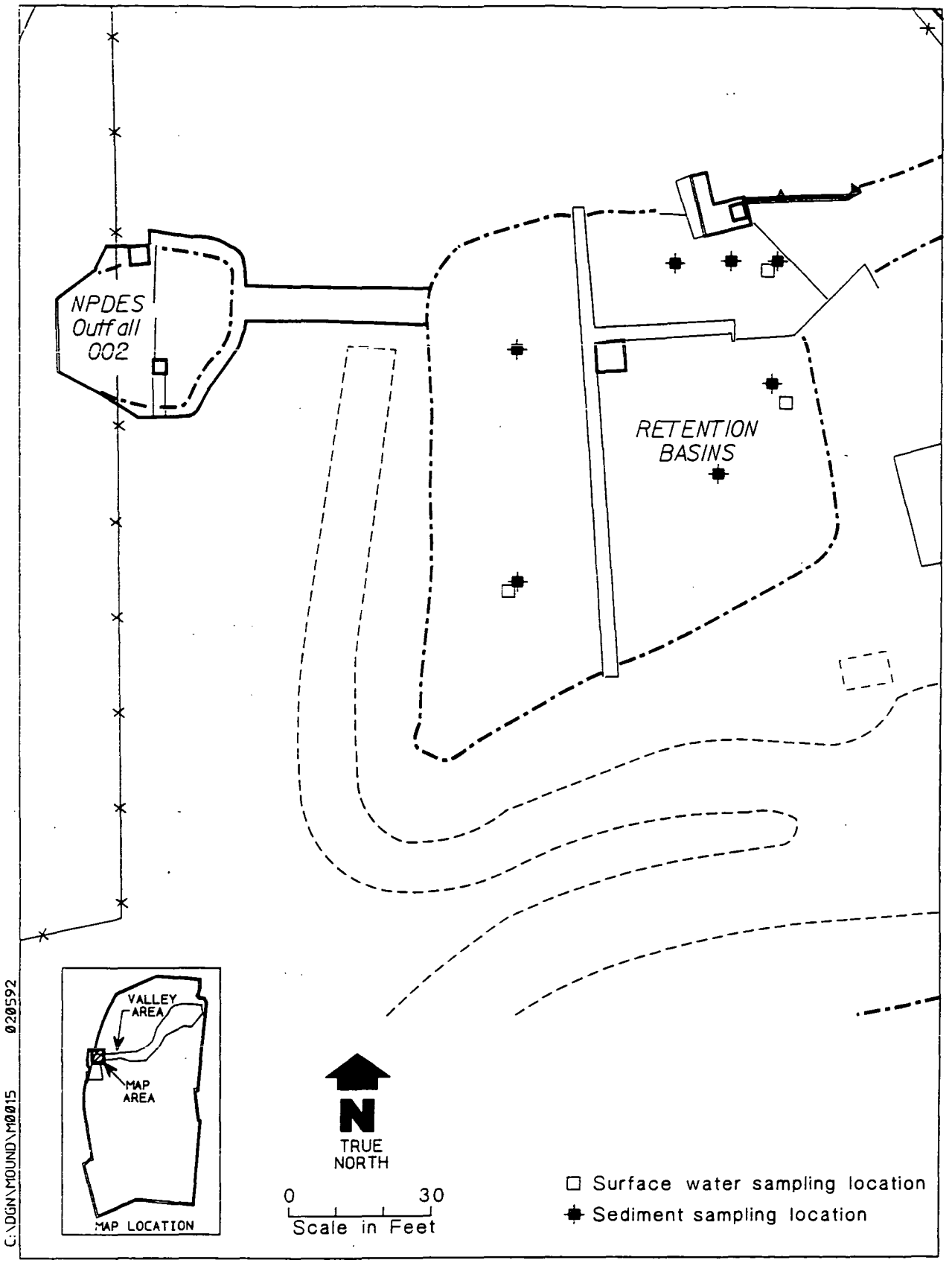

Figure 7.7. Retention basins surface water and sediment locations (proposed).

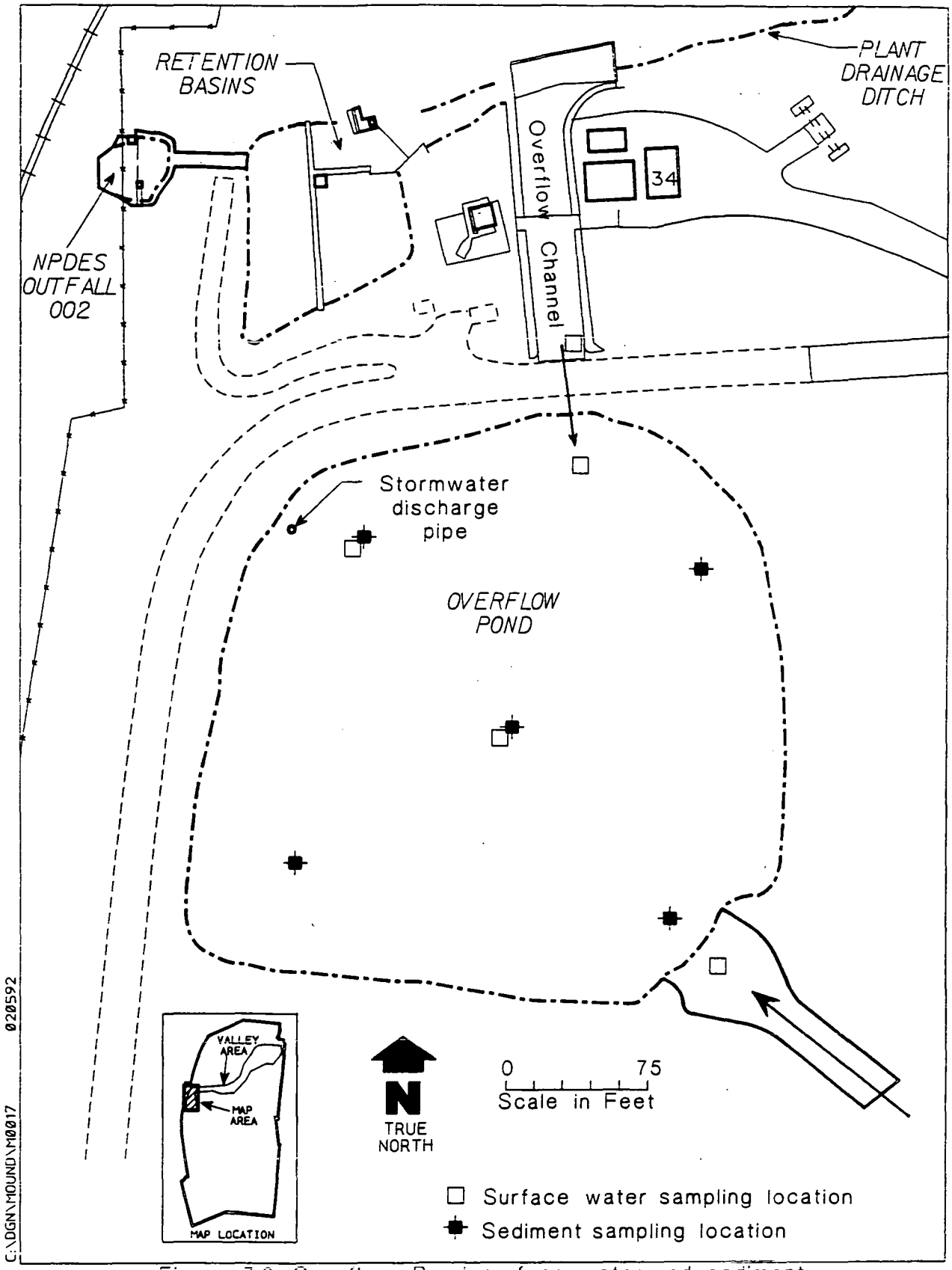

Figure 7.8. Overflow Pond surface water and sediment sampling locations (proposed).

than 8 ft deep. One surface water sample will be collected at each of the three locations. Samples will be collected with a device capable of collecting a discrete sample (e.g., Kemmerer bottle). Measurements of temperature, pH, specific conductivity, dissolved oxygen, and redox potential will be taken. Additional surface water samples will be collected to characterize the overflow pond influent. If surface water is flowing, samples will be collected immediately upstream of the overflow pond in the overflow channel (to the north) and in discharge from the landfill (to the southeast).

Individual sediment samples (Tables VII.3 and VII.4) will be collected from the overflow pond from five locations in order to assess the possible spatial variability of contaminant concentrations in the pond sediments. The sampling locations will be the center of the four quadrants and the center of the pond (Figure 7.8). Sediment samples will be collected, using a core type sampler or a dredge, as discrete grab samples during the April and October sampling events. Three grab samples for geotechnical analysis will be collected at the center and two of the quadrant locations using the sample collection methods. The latter will be collected only once during the initial sampling event.

Investigation at NPDES Outfall 002 and Outfall 001

One surface water sample (Tables VII.3 and VII.4) will be collected for laboratory analysis from the NPDES Outfall 002 during the April and October sampling events. Extra samples will also be collected during each event to measure field parameters. The discrete samples collected at the effluent point from NPDES Outfall 002 allow for an assessment of the effectiveness of the surface water control features at removing suspended solids and contaminants before the water is discharged from Mound Plant. Samples will be collected with a device capable of retrieving shallow surface water (e.g., dipper, ladle).

Three sediment samples (Tables VII.3 and VII.4) will also be collected from the NPDES Outfall 002 area at 10, 30, and 110 ft downstream of the discharge from the culvert (Figure 7.9). An additional sediment sample will be collected just upstream of the weir located at the Mound Plant boundary fence. Sediment samples will be collected as discrete grab samples during each of the April and October sampling events.

For comparability, two surface water samples (Tables VII.3 and VII.4) will be collected from the NPDES Outfall 001 at the Great Miami River (Figure 7.10) during the April and October sampling events. No sediment sample will be collected from the discharge point.

Investigation of the South Miami-Erie Canal

Mound Plant effluent discharged from NPDES Outfall 002 is directed below a raised railroad bed through a pair of concrete culverts to an abandoned section of the Miami-Erie Canal. Discharge then moves

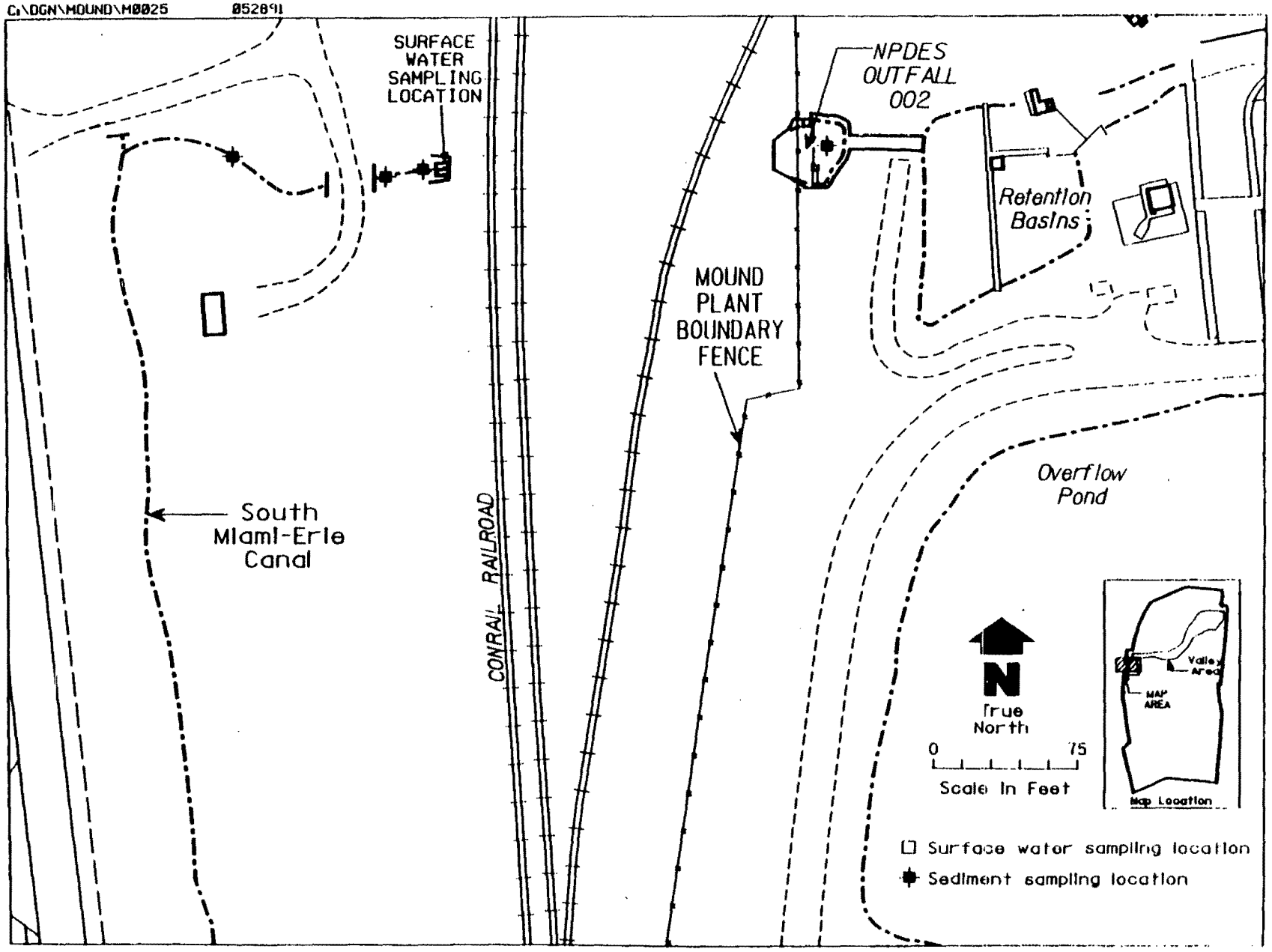

Figure 7.9. NPDES Outfall 002 surface water and sediment sampling locations (proposed).

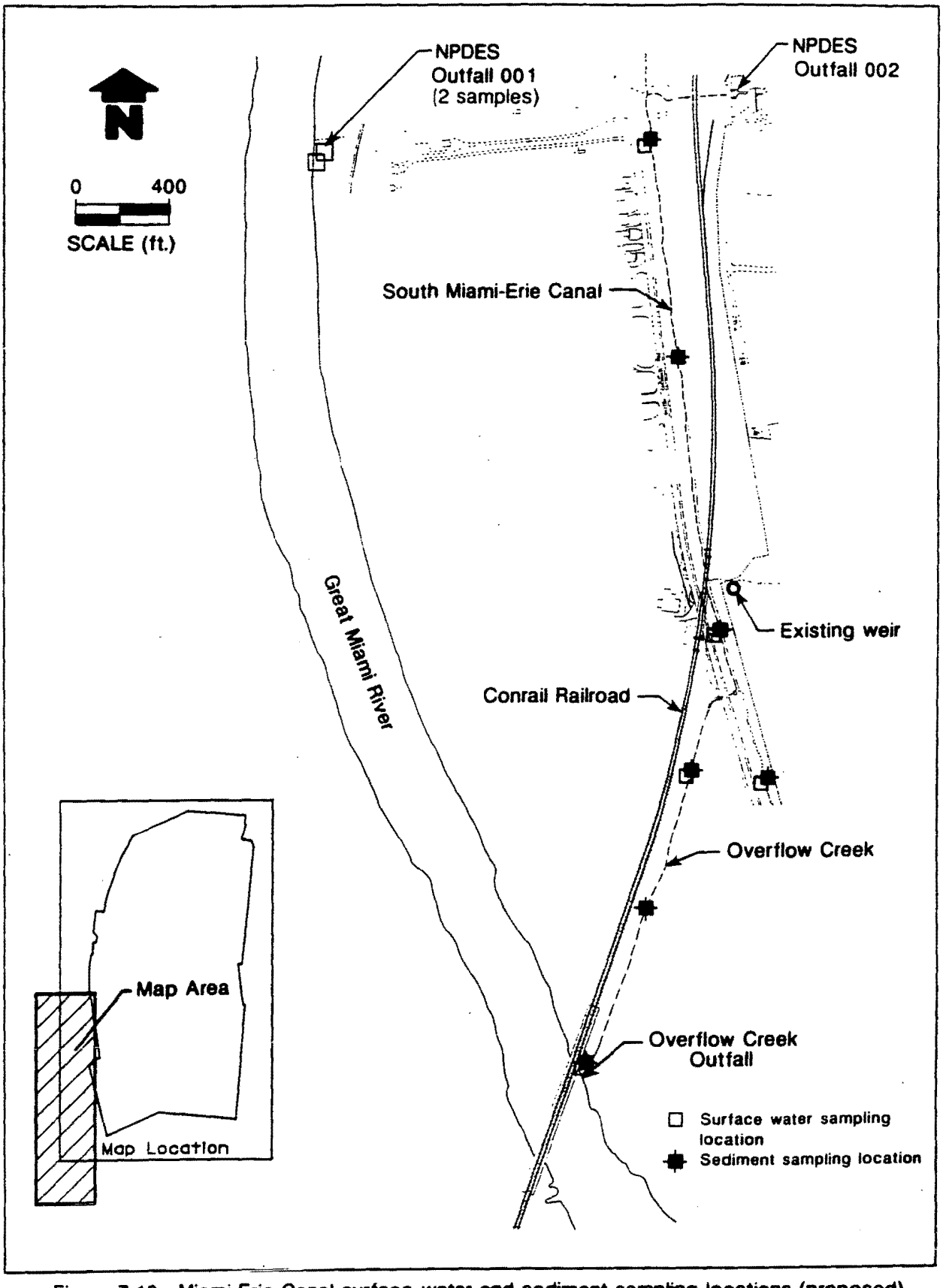

Figure 7.10. Miami-Erie Canal surface water and sediment sampling locations (proposed).

southward along the canal where it is diverted into an overflow creek and discharged into the Great Miami River (Figure 7.10).

For this field investigation, surface water and sediment samples will be collected to assess the vertical and horizontal extent of potential contaminants along the effluent flow path from the NPDES Outfall 002 culvert-discharge area to the Great Miami River. A pair of surface water samples (Tables VII.3 and VII.4) will be collected from each of three locations along the Miami-Erie Canal and two locations along the overflow creek (Figure 7.10). Samples of the surface water will be collected from each sampling location using a device capable of retrieving shallow surface water (i.e., dipper or ladle). Extra samples from each location will be used to measure field parameters. Surface water sampling events will take place in April and October.

Individual sediment samples (Tables VII.3 and VII.4) will be collected from the five locations used for surface water sampling. Two other sediment sampling locations will also be selected where no water sample was collected. At each sample location, one surface sediment grab sample will be collected from 0 to 0.5 ft, and one subsurface soil sample will be collected from 0.5 to 2.0 ft, for laboratory analyses. Surface sediment samples will be collected using a trowel during the April and October sampling events. Subsurface soil samples will be collected using a split-spoon during the October sampling event only. One geotechnical sample will be collected from each sediment sample location using the same collection methods. The geotechnical samples will be collected only once during the initial sampling event.

<u>Investigation of the Great Miami River</u>

Surface water and sediment samples will be collected at four locations in the Great Miami River in addition to the far upstream sample described above in the background investigation. These samples will be collected at locations (Figure 7.11) above and below the points of surface water discharge from the Mound Plant to the river. The surface water and sediment samples (Tables VII.3 and VII.5) will be collected at the following locations:

- The USGS gaging station located above Mound Plant on the east bank of the Great Miami River.
- The pool above the Hutchings Power Station weir located directly down river of the overflow creek outlet.
- The pool above a weir on the river near Chautauqua. This corresponds to the Mound Plant background location R-3 (Mound Plant Site Scoping Report, Volume 8, [DOE 1991b]).
- The pool above a weir at mile 56 on the river north of Middletown, Ohio (DOE 1991c).

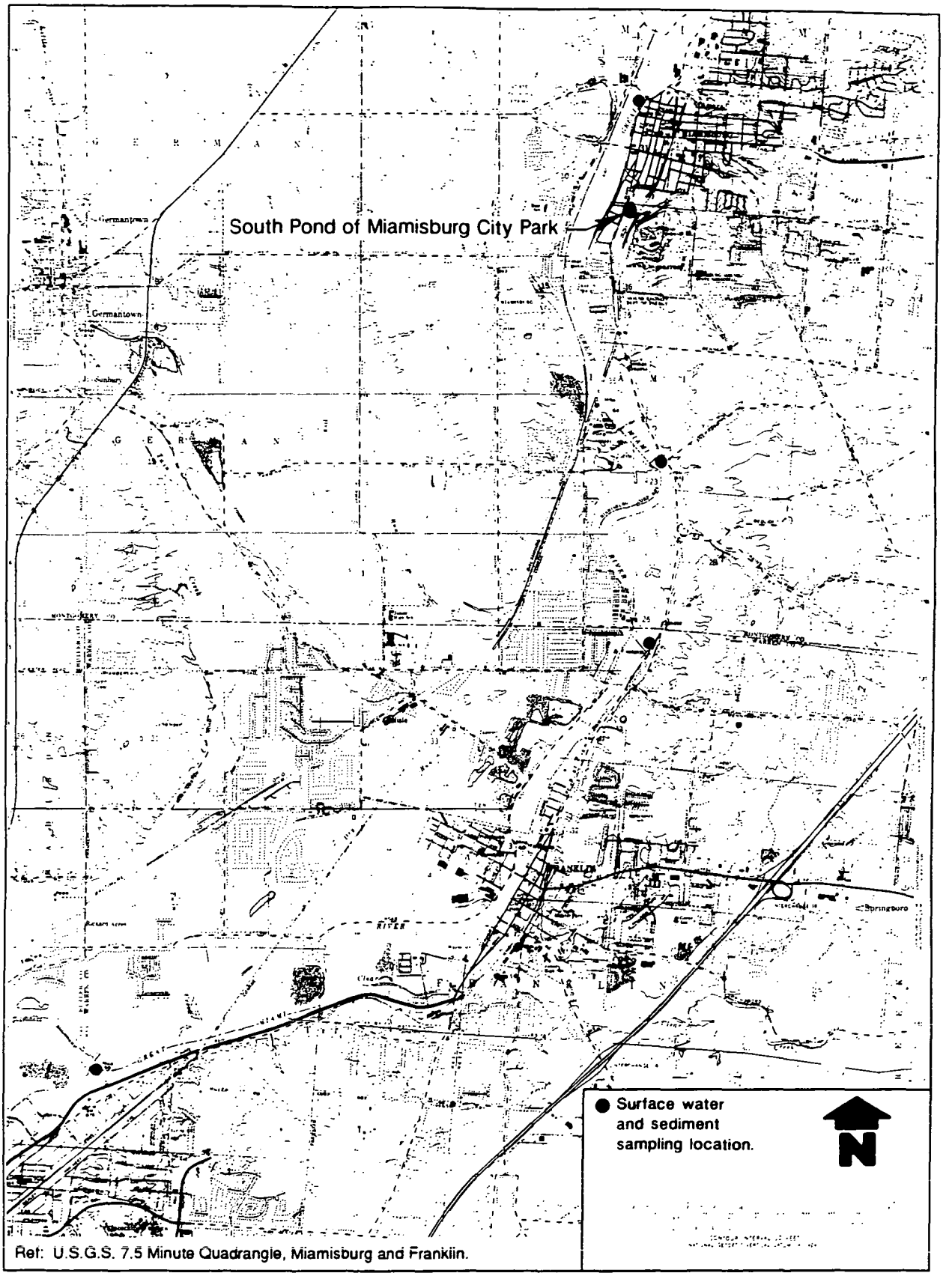

Figure 7.11. Sampling locations along the Great Miami River and in the South Pond of Miamisburg City Park (proposed).

Table VII.5. Surface Water and Sediment Sample Designation for the Investigation of the Great Miami River and the South Pond

Sample Identification	Sample Matrix	Stream Flow Conditions	Proposed River or Pond Study Area	Proposed Location[a]
MND21-3001-0001	Water	High	USGS Gaging Station	Center Stream
MND22-3001-0001	Sediment[b]	High		Left Bank
MND22-3002-0001	Sediment[b]	High		Center Stream
MND22-3003-0001	Sediment[b]	High		Right Bank
MND21-3001-0002	Water	Low		Center Stream
MND22-3001-0002	Sediment	Low		Left Bank
MND22-3002-0002	Sediment	Low		Center Stream
MND22-3003-0002	Sediment	Low		Right Bank
MND21-3101-0001	Water	High	Hutchings Power Station Weir	Center Stream
MND22-3101-0001	Sediment[b]	High		Left Bank
MND22-3102-0001	Sediment[b]	High		Center Stream
MND22-3103-0001	Sediment[b]	High		Right Bank
MND21-3101-0002	Water	Low		Center Stream
MND22-3101-0002	Sediment	Low		Left Bank
MND22-3102-0002	Sediment	Low		Center Stream
MND22-3103-0002	Sediment	Low		Right Bank
MND21-3201-0001	Water	High	Chautauqua Weir	Center Stream
MND22-3201-0001	Sediment[b]	High		Left Bank
MND22-3202-0001	Sediment[b]	High		Center Stream
MND22-3203-0001	Sediment[b]	High		Right Bank
MND21-3201-0002	Water	Low		Center Stream
MND22-3201-0002	Sediment	Low		Left Bank
MND22-3202-0002	Sediment	Low		Center Stream
MND22-3203-0002	Sediment	Low		Right Bank
MND21-3301-0001	Water	High	Middletown Weir	Center Stream
MND22-3301-0001	Sediment[b]	High		Left Bank
MND22-3302-0001	Sediment[b]	High		Center Stream
MND22-3303-0001	Sediment[b]	High		Right Bank
MND21-3301-0002	Water	Low		Center Stream
MND22-3301-0002	Sediment	Low		Left Bank
MND22-3302-0002	Sediment	Low		Center Stream
MND22-3303-0002	Sediment	Low		Right Bank
MND21-3401-0001	Water	High	South Pond (City Park)	Near Influent
MND21-3402-0001	Water	High		Center Pond
MND21-3403-0001	Water	High		Near Effluent
MND22-3401-0001	Sediment[b]	High		Near Influent
MND22-3402-0001	Sediment[b]	High		Center Pond
MND22-3403-0001	Sediment[b]	High		Near Effluent
MND21-3401-0002	Water	Low		Near Influent
MND21-3402-0002	Water	Low		Center Pond
MND21-3403-0002	Water	Low		Near Effluent
MND22-3401-0002	Sediment	Low		Near Influent
MND22-3402-0002	Sediment	Low		Center Pond
MND22-3403-0002	Sediment	Low		Near Effluent

Table VII.5. (page 2 of 3)

All samples will be analyzed for the following parameters:

Analytes: Sediment	Analytical Method	Container (Size/Type)
VOCs	CLP SOW	125-mL wide-mouth glass jar, teflon-lined lid
Semivolatile organic compounds	CLP SOW	125-mL wide-mouth amber glass jar, teflon-lined lid
TCL pesticides/PCBs	CLP SOW	125-mL wide-mouth amber glass jar, teflon-lined lid
TAL inorganics Bismuth	CLP SOW Mod A, B, or C CLP SOW Mod A, B, or C	500-mL wide-mouth polyethylene bottle
Total organic carbon	E415.1/E415.2	125-mL wide-mouth glass jar
Nitrate/nitrite	E353.2	250-mL wide-mouth polyethylene bottle
Chloride	SW9250d	
Fluoride	E340.2	
Sulfate	E375.2	
Isotopic plutonium (238,239/240)	NAS 1965	950-mL wide-mouth polyethylene bottle
Isotopic thorium (228, 230, 232)	NAS 1960	
Isotopic uranium (234/235, 238)	NAS 1962	
Strontium-90	NAS 1960	
Tritium	E906.0	
Gamma spectrometry	Nuclear Data, Inc. 1986	
Particle size distribution	ASTM D422-63	1-gallon wide-mouth polyethylene bottle
pH	SW9045	

Analytes: Water	Analytical Method	Container (Size/Type)
VOCs	SW5030/SW8010; SW5030/SW8020; CLP SOW; SW5030/SW8030	Three 40-mL glass vials, teflon-lined septum lid
Semivolatile organic compounds	CLP SOW	Two 1-L amber glass bottles, teflon-lined lid
TCL pesticides/PCBs	CLP SOW	Two 1-L amber glass bottles, teflon-lined lid
TAL inorganics	CLP SOW Mod A, B, or C	1-L polyethylene bottle, HNO_3 to pH<2
Bismuth	CLP SOW Mod A, B, or C	
Total organic carbon	E415.1/E415.2	250-mL amber glass jar, teflon-lined lid

Table VII.5. (page 3 of 3)

Analytes: Water	Analytical Method	Container (Size/Type)
Nitrate/nitrite	E353.2	500-mL polyethylene bottle, H_2SO_4 to pH<2
Chloride	E325.1	500-mL polyethylene bottle
Fluoride	E340.2	
Sulfate	E375.2	
Isotopic plutonium (238,239/240)	NAS 1965	Two 4-L plastic cubetainers
Isotopic thorium (228, 230, 232)	NAS 1960	
Isotopic uranium (234/235, 238)	NAS 1962	
Radium-226	ASTM D2460-70	
Americium-241	EML AM-01	
Strontium-90	NAS 1960	
Tritium	E906.0	
Gamma spectrometry	Nuclear Data, Inc. 1986	
Ammonia	E350.1, or 350.3	500-mL polyethylene bottle, H_2SO_4 to pH<2
Nutrients: TKN, TP	E351.3/E365.1	1-L polyethylene bottle, H_2SO_4 to pH<2
Total dissolved solids	E160.1	1-L polyethylene bottle
Total suspended solids	E160.2	1-L polyethylene bottle
Alkalinity	E310.1	250-mL polyethylene bottle

Geotechnical samples will be analyzed for the following parameters:

Analytes	Analytical Method	Container (Size/Type)
Specific gravity Cation exchange capacity	ASTM D865-63 SW9080/SW9081	1-gallon wide-mouth polyethylene bottle

[a]Proposed locations are shown in Figure 7.11; depths for water samples are mid-depth of the water column unless a thermocline is detected (see text for explanation); depths for sediment samples are 0 to 1 ft below the pond/river bottom.

[b]Sample will also be analyzed for geotechnical parameters listed above.

Note: Only one bottle is needed per group of analytes unless otherwise indicated. Bottle size may change depending upon selection of multiple laboratories for the analyses and availability from bottle suppliers.

ASTM - American Society for Testing Materials
CLP - Contract Laboratory Program
NAS - National Academy of Sciences
PCB - polychlorinated biphenyl
SOW - Statement of Work
TAL - Target Analyte List
TCL - Target Compound List
TKN - total Kjeldahl nitrogen
TP - total phosphorus
USGS - U.S. Geological Survey
VOC - volatile organic compound

Sediment samples will be collected during the April and October sampling events from three locations in a transect at the selected locations on the Great-Miami River. All samples will be collected as discrete grab samples. The sediment samples will be collected as core samples, if possible. If core sampling is unsuccessful, a dredge will be used.

The surface water samples will be collected from the middle of the Great-Miami River at the same locations as the second sediment sample along each transect (i.e., one surface water sample per transect). Samples will be collected with a device capable of collecting a discrete sample (e.g., Kemmerer bottle) at mid-depth in the river.

In support of the benthic macroinvertebrate study discussed in subsection 10.3.3, additional surface water and sediment samples will be collected from the South Pond in the Miamisburg City Park (Figure 7.11). Surface water and sediment samples (Table VII.5) will be collected from three locations in the pond during the April and October sampling events. Sediment samples will be collected as discrete core samples, if possible. If core sampling is unsuccessful, a dredge will be used. To collect a representative surface water sample, the column of water at each sampling location will be sampled at mid-depth with a device capable of collecting a discrete sample (e.g., Kemmerer bottle).

7.3.3. Investigation of Other Drainages

7.3.3.1. Zone of Airborne Influence - Surface Water Features

The distribution of airborne plutonium around Mound Plant was identified in the 1970s based on the collection of soil samples along several compass directions and at varying distances from Mound Plant (see section 8 of the work plan). A zone of plutonium-238 influence was identified that extended up to 11 miles from the plant. The zone of strongest influence was found to trend in a southwest to northeast direction from the Mound Plant (DOE 1991b).

During the second phase of this investigation, the impact of radiological species on surface water features in the zone of influence will be evaluated. Two ponds and two streams within this zone influence (one each southwest and northeast of Mound Plant) will be identified in the field for sampling. The ponds and the streams will be located such that maximum impact on the public will be evaluated, and they will be located within or equal to 3 miles from the plant. The locations will be mutually agreeable to the project managers. Three water samples and five sediment samples will be collected from each pond; and two water samples and three sediment samples will be collected from each stream. The samples will be collected as discrete grab samples during the April and October sampling events. The sampling strategy is the same as that used for the other ponds and streams being sampled during this

investigation. Sample methods and location selection will be consistent with methods discussed in this section.

7.3.3.2. Investigation of Watershed Drainages Within the Zone of Influence

For this field investigation, surface water and sediment samples will be collected from select drainages, ponds, or seeps identified in the reconnaissance survey within a 1-mile radius of the Mound Plant to assess the vertical and horizontal extent of potential contaminants along drainages and ponds emanating from the plant. The sampling locations will be located to assess the impact on the community immediately surrounding the plant. The locations will be selected in the field and will be mutually agreeable to the project managers. The specific drainages and ponds to be sampled and the sample locations within those drainages and ponds will be selected based on data collected from the reconnaissance field investigation (described above). The types of data that will be evaluated are prioritized below.

- Contaminated sediments within drainages and ponds (based on elevated instrument readings).
- The potential for significant runoff during rainfall events.
- Drainages that flow off-plant.
- Drainages or ponds that receive the most tributary flow.
- Areas of dominant sediment deposition or surface water infiltrations.
- Drainage discharge points.

Surface water and sediment samples will be collected in each drainage and pond. Because there may be ephemeral drainages or seasonal ponds, surface water may only be available for collection following a rainfall. For the purposes of this FSP, it will be assumed that no more than 10 drainages or ponds will be identified in the 1-mile radius and that no more than 30 surface water and 30 sediment samples will be collected. Sample numbers proposed are described in Table VII.6. Analytical parameters are listed in Table VII.3.

Surface water samples will be collected from each sampling location using a device capable of retrieving shallow surface water (i.e., grab sampler, ladle). Extra samples from each location will be used to measure field parameters (temperature, pH, specific conductivity, redox potential, dissolved oxygen, and flow rate if flow is occurring). The sampling strategy is the same as that used for the other ponds and streams being sampled during this investigation. Sampling will be conducted (if possible) in April and in October. All samples will be collected as discrete grab samples.

Table VII.6. Surface Water, Sediment, and Soil Sample Designation for the Investigation of Other Drainages

Sample Identification	Sample Matrix	Stream Flow Conditions	Proposed Stream or Pond Study Area	Proposed Location[a]
MND22-4001-0001	Sediment	----	Low-lying Area (new property)	Grid Nodes
MND22-4002-0001	Sediment	----		Grid Nodes
MND22-4003-0001	Sediment	----		Grid Nodes
MND22-4004-0001	Sediment[b]	----		Grid Nodes
MND22-4005-0001	Sediment	----		Grid Nodes
MND22-4006-0001	Sediment	----		Grid Nodes
MND22-4007-0001	Sediment	----		Grid Nodes
MND22-4008-0001	Sediment	----		Grid Nodes
MND22-4009-0001	Sediment[b]	----		Grid Nodes
MND22-4010-0001	Sediment	----		Grid Nodes
MND22-4011-0001	Sediment	----		Grid Nodes
MND22-4012-0001	Sediment	----		Grid Nodes
MND22-4013-0001	Sediment	----		Grid Nodes
MND22-4014-0001	Sediment[b]	----		Grid Nodes
MND22-4015-0001	Sediment	----		Grid Nodes
MND22-4016-0001	Sediment	----		Biased within Grid
MND22-4017-0001	Sediment	----		Biased within Grid
MND22-4018-0001	Sediment	----		Biased within Grid
MND22-4019-0001	Sediment[b]	----		Biased within Grid
MND22-4020-0001	Sediment	----		Biased within Grid
MND22-4021-0001	Sediment	----		Biased within Grid
MND22-4022-0001	Sediment	----		Biased within Grid
MND22-4023-0001	Sediment	----		Biased within Grid
MND23-5001-0001	Soil[c]	----		To Be Determined--5 ft
MND23-5001-0002	Soil	----		10 ft
MND23-5001-0003	Soil	----		15 ft
MND23-5001-0004	Soil	----		20 ft
MND23-5001-0005	Soil[b]	----		25 ft
MND23-5001-0006	Soil[d]	----		30 ft
MND23-5002-0001	Soil[c]	----		To Be Determined--5 ft
MND23-5002-0002	Soil	----		10 ft
MND23-5002-0003	Soil	----		15 ft
MND23-5002-0004	Soil[b]	----		20 ft
MND23-5002-0005	Soil	----		25 ft
MND23-5002-0006	Soil[d]	----		30 ft
MND22-4101-0001	Sediment[b]	High	Ephemeral Streams (new property)	To Be Determined
MND22-4102-0001	Sediment	High		To Be Determined
MND22-4103-0001	Sediment	High		To Be Determined
MND22-4104-0001	Sediment	High		To Be Determined
MND22-4105-0001	Sediment	High		To Be Determined
MND22-4106-0001	Sediment[b]	High		To Be Determined
MND22-4107-0001	Sediment	High		To Be Determined
MND22-4108-0001	Sediment	High		To Be Determined
MND22-4109-0001	Sediment	High		To Be Determined
MND22-4110-0001	Sediment	High		To Be Determined
MND22-4111-0001	Sediment[b]	High		To Be Determined
MND22-4112-0001	Sediment	High		To Be Determined
MND22-4113-0001	Sediment	High		To Be Determined
MND22-4114-0001	Sediment	High		To Be Determined
MND22-4115-0001	Sediment	High		To Be Determined

Table VII.6. (page 2 of 5)

Sample Identification	Sample Matrix	Stream Flow Conditions	Proposed Stream or Pond Study Area	Proposed Location[a]
MND22-4101-0002	Sediment[b]	Low	Ephemeral Streams (continued)	To Be Determined
MND22-4102-0002	Sediment	Low		To Be Determined
MND22-4103-0002	Sediment	Low		To Be Determined
MND22-4104-0002	Sediment	Low		To Be Determined
MND22-4105-0002	Sediment	Low		To Be Determined
MND22-4106-0002	Sediment[b]	Low		To Be Determined
MND22-4107-0002	Sediment	Low		To Be Determined
MND22-4108-0002	Sediment	Low		To Be Determined
MND22-4109-0002	Sediment	Low		To Be Determined
MND22-4110-0002	Sediment	Low		To Be Determined
MND22-4111-0002	Sediment[b]	Low		To Be Determined
MND22-4112-0002	Sediment	Low		To Be Determined
MND22-4113-0002	Sediment	Low		To Be Determined
MND22-4114-0002	Sediment	Low		To Be Determined
MND22-4115-0002	Sediment	Low		To Be Determined
MND23-5101-0001	Soil[c]	----		To Be Determined--5 ft
MND23-5101-0002	Soil	----		10 ft
MND23-5101-0003	Soil	----		15 ft
MND23-5101-0004	Soil	----		20 ft
MND23-5101-0005	Soil[b]	----		25 ft
MND23-5101-0006	Soil[d]	----		30 ft
MND23-5102-0001	Soil[c]	----		To Be Determined--5 ft
MND23-5102-0002	Soil	----		10 ft
MND23-5102-0003	Soil	----		15 ft
MND23-5102-0004	Soil[b]	----		20 ft
MND23-5102-0005	Soil	----		25 ft
MND23-5102-0006	Soil[d]	----		30 ft
MND21-4201-0001	Water[b]	High	Trunk Stream (new property)	0 ft East of Fenceline
MND22-4201-0001	Sediment[b]	High		0 ft East of Fenceline
MND22-4202-0001	Sediment	High		200 ft East of Fenceline
MND22-4203-0001	Sediment	High		400 ft East of Fenceline
MND22-4204-0001	Sediment	High		600 ft East of Fenceline
MND22-4205-0001	Sediment	High		800 ft East of Fenceline
MND21-4201-0002	Water	Low		0 ft East of Fenceline
MND22-4201-0002	Sediment[b]	Low		0 ft East of Fenceline
MND22-4202-0002	Sediment	Low		200 ft East of Fenceline
MND22-4203-0002	Sediment	Low		400 ft East of Fenceline
MND22-4204-0002	Sediment	Low		600 ft East of Fenceline
MND22-4205-0002	Sediment	Low		800 ft East of Fenceline
MND23-5201-0001	Soil[c]	----		To Be Determined--5 ft
MND23-5201-0002	Soil	----		10 ft
MND23-5201-0003	Soil	----		15 ft
MND23-5201-0004	Soil	----		20 ft
MND23-5201-0005	Soil[b]	----		25 ft
MND23-5201-0006	Soil[d]	----		30 ft
MND23-5202-0001	Soil[c]	----		To Be Determined--5 ft
MND23-5202-0002	Soil	----		10 ft
MND23-5202-0003	Soil	----		15 ft
MND23-5202-0004	Soil[b]	----		20 ft
MND23-5202-0005	Soil	----		25 ft
MND23-5202-0006	Soil[d]	----		30 ft

Table VII.6. (page 3 of 5)

Sample Identification	Sample Matrix	Stream Flow Conditions	Proposed Stream or Pond Study Area	Proposed Location[a]
MND21-4301-0001	Water	High	Zone of Influence	Near Influent
MND21-4302-0001	Water	High	Pond One	Center Pond
MND21-4303-0001	Water	High	(To Be Determined)	Near Effluent
MND22-4301-0001	Sediment[b]	High		Center Pond
MND22-4302-0001	Sediment	High		NE Quad
MND22-4303-0001	Sediment	High		SE Quad
MND22-4304-0001	Sediment	High		SW Quad
MND22-4305-0001	Sediment	High		NW Quad
MND21-4301-0002	Water[b]	Low		Near Influent
MND21-4302-0002	Water	Low		Center Pond
MND21-4303-0002	Water	Low		Near Effluent
MND22-4301-0002	Sediment[b]	Low		Center Pond
MND22-4302-0002	Sediment	Low		NE Quad
MND22-4303-0002	Sediment	Low		SE Quad
MND22-4304-0002	Sediment	Low		SW Quad
MND22-4305-0002	Sediment	Low		NW Quad
MND21-4401-0001	Water	High	Zone of Influence	Upstream
MND21-4402-0001	Water	High	Stream One	Downstream
MND22-4401-0001	Sediment[b]	High	(To Be Determined)	Upstream
MND22-4402-0001	Sediment	High		Midway
MND22-4403-0001	Sediment	High		Downstream
MND21-4401-0002	Water[b]	Low		Upstream
MND21-4402-0002	Water	Low		Downstream
MND22-4401-0002	Sediment	Low		Upstream
MND22-4402-0002	Sediment	Low		Midway
MND22-4403-0002	Sediment[b]	Low		Downstream
MND21-4501-0001	Water	High	Zone of Influence	Near Influent
MND21-4502-0001	Water	High	Pond Two	Center Pond
MND21-4503-0001	Water	High	(To Be Determined)	Near Effluent
MND22-4501-0001	Sediment	High		Center Pond
MND22-4502-0001	Sediment	High		NE Quad
MND22-4503-0001	Sediment	High		SE Quad
MND22-4504-0001	Sediment	High		SW Quad
MND22-4505-0001	Sediment[b]	High		NW Quad
MND21-4501-0002	Water[b]	Low		Near Influent
MND21-4502-0002	Water	Low		Center Pond
MND21-4503-0002	Water	Low		Near Effluent
MND22-4501-0002	Sediment	Low		Center Pond
MND22-4502-0002	Sediment	Low		NE Quad
MND22-4503-0002	Sediment	Low		SE Quad
MND22-4504-0002	Sediment	Low		SW Quad
MND22-4505-0002	Sediment[b]	Low		NW Quad
MND21-4601-0001	Water	High	Zone of Influence	Upstream
MND21-4602-0001	Water	High	Stream Two	Downstream
MND22-4601-0001	Sediment	High	(To Be Determined)	Upstream
MND22-4602-0001	Sediment	High		Midway
MND22-4603-0001	Sediment	High		Downstream
MND21-4601-0002	Water[b]	Low		Upstream
MND21-4602-0002	Water	Low		Downstream
MND22-4601-0002	Sediment	Low		Upstream
MND22-4602-0002	Sediment[b]	Low		Midway
MND22-4603-0002	Sediment	Low		Downstream

Table VII.6. (page 4 of 5)

Sample Identification	Sample Matrix	Stream Flow Conditions	Proposed Stream or Pond Study Area	Proposed Location[a]
MND21-4701-0001	Water[b]	High	Area Watershed	----
through	----	----	Drainages	----
MND21-47YY-0001	Water	High	(To Be Determined)	----
MND22-4701-0001	Sediment[b]	High		----
through	----	----		----
MND22-47YY-0001	Sediment	High		----
MND21-4701-0002	Water[b]	Low		----
through	----	----		----
MND21-47YY-0002	Water	Low		----
MND22-4701-0002	Sediment[b]	Low		----
through	----	----		----
MND22-47YY-0002	Sediment	Low		----

All samples will be analyzed for the following parameters:

Analytes: Sediments	Analytical Method	Container (Size/Type)
VOCs	CLP SOW	125-mL wide-mouth glass jar, teflon-lined lid
Semivolatile organic compounds	CLP SOW	125-mL wide-mouth amber glass jar, teflon-lined lid
TCL pesticides/PCBs	CLP SOW	125-mL wide-mouth amber glass jar, teflon-lined lid
TAL inorganics	CLP SOW Mod A, B, or C	500-mL wide-mouth polyethylene bottle
Bismuth	CLP SOW Mod A, B, or C	
Total organic carbon	E415.1/E415.2	125-mL wide-mouth glass jar
Nitrate/nitrite	E353.2	250-mL wide-mouth polyethylene bottle
Chloride	SW9250d	
Fluoride	E340.2	
Sulfate	E375.2	
Isotopic plutonium (238,239/240)	NAS 1965	950-mL wide-mouth polyethylene bottle
Isotopic thorium (228, 230, 232)	NAS 1960	
Isotopic uranium (234/235, 238)	NAS 1962	
Strontium-90	NAS 1960	
Tritium	E906.0	
Gamma spectrometry	Nuclear Data, Inc. 1986	
Particle size distribution	ASTM D422-63	1-gallon wide-mouth polyethylene bottle
pH	SW9045	
USATHAMA explosives (20% of samples)	USATHAMA	125-mL wide-mouth amber glass jar, teflon-lined lid

Table VII.6. (page 5a of 5)

Analytes: Water	Analytical Method	Container (Size/Type)
VOCs	SW5030/SW8010; SW 5030/SW8020; CLP SOW; SW5030/SW8030	Three 40-mL glass vials, teflon-lined septum lid
Semivolatile organic compounds	CLP SOW	Two 1-L amber glass bottles, teflon-lined lid
TCL pesticides/PCBs	CLP SOW	Two 1-L amber glass bottles, teflon-lined lid
TAL inorganics	CLP SOW Mod A, B, or C	1-L polyethylene bottle, HNO_3 to pH<2
Bismuth	CLP SOW Mod A, B, or C	
Total organic carbon	E415.1/E415.2	250-mL amber glass jar, teflon-lined lid
Nitrate/nitrite	E353.2	500-mL polyethylene bottle, H_2SO_4 to pH<2
Chloride	E325.1	500-mL polyethylene bottle
Fluoride	E340.2	
Sulfate	E375.2	
Isotopic plutonium (238,239/240)	NAS 1965	Two 4-L plastic cubetainers
Isotopic thorium (228, 230, 232)	NAS 1960	
Isotopic uranium (234/235, 238)	NAS 1962	
Radium-226	ASTM D2460-70	
Americium-241	EML AM-01	
Strontium-90	NAS 1960	
Tritium	E906.0	
Gamma spectrometry	Nuclear Data, Inc. 1986	
Ammonia	E350.1 or 350.3	500-mL polyethylene bottle, H_2SO_4 to pH<2
Nutrients (TKN, TP)	E351.3/E365.1	1-L polyethylene bottle
Total dissolved solids	E160.1	1-L polyethylene bottle
Total suspended solids	E160.2	1-L polyethylene bottle
Alkalinity	E310.1	250-mL polyethylene bottle
USATHAMA explosives (20% of samples)	USATHAMA UW-11	1-L amber glass bottle, teflon-lined lid

Table VII.6. (page 5a of 5)

Geotechnical samples will be analyzed for the following parameters:

Analytes	Analytical Method	Container (Size/Type)
Particle size distribution	ASTM D422-63	1-gallon wide-mouth polyethylene bottle
Relative density	ASTM D4254-83	
Maximum density	ASTM D4253-83	
Specific gravity	ASTM D854-63	
Moisture content	ASTM D2974-87	
Organic content	ASTM D2974-87	
Permeability (hydraulic conductivity)	ASTM D2434-68	

[a]Proposed locations are shown in Figures 7.12, 7.13, and 7.14; depths for water samples are mid-depth of the water column unless a thermocline is detected (see text for explanation); depths for sediment samples are 0 to 1 ft below pond/stream bottom.

[b]Sample will be analyzed for USATHAMA explosives in addition to the analytes listed below.

[c]A geotechnical sample will be collected from each distinct stratigraphic horizon; it is anticipated that there will be 2 to 3 per borehole (geotechnical analysis listed above).

[d]Boreholes will be advanced until groundwater or bedrock is encountered.

[e]20% of samples will be analyzed for USATHAMA explosives.

Note: Only one bottle is needed per group of analytes unless otherwise indicated. Bottle size may change depending upon selection of multiple laboratories for the analyses and availability from bottle suppliers.

ASTM - American Society for Testing Materials
CLP - Contract Laboratory Program
NAS - National Academy of Sciences
PCB - polychlorinated biphenyl
SOW - Statement of Work
TAL - Target Analyte List
TCL - Target Compound List
TKN - total Kjeldahl nitrogen
TP - total phosphorus
USATHAMA - U.S. Army Toxic and Hazardous Materials Agency
VOC - volatile organic compound

7.3.4. Subwatershed 3 Investigations

The three perspectives discussed below will be used to investigate subwatershed 3. Subwatershed 3 receives runoff from the SM/PP Hill area that is known to contain soils contaminated with plutonium-238 and thorium. In some instances, the sediment and surface water samples described below will be collected at the same locations as the benthic macroinvertebrate sampling stations (described in subsection 10.3.3). Within the Subwatershed 3 investigations, samples with the greatest thorium concentrations will also be analyzed for rare earth elements. A maximum of three soil/sediment samples with greater than 15 pCi/g thorium (as determined by onsite radiological screening) will be sent to a laboratory for determination of rare earth element concentrations.

7.3.4.1. Low-Lying Area - New Property - Subwatershed 3

The topographically low-lying area due south of the construction spoils disposal area (Figure 7.12) has the greatest possibility of having received radioactive contamination. This area most likely receives storm water runoff overflow from a number of potential release sites, including the construction spoils disposal area, Area 2, Area 18, Area 1, and possibly Area H. Any surface contaminants from these areas may have traveled with sediments in runoff overflow during a storm and been transported to the low-lying area south of the construction spoils disposal area. At this location, ponding water would deposit its sediment load before infiltrating or draining to the stream channel. Therefore, areas of sediment deposition in the low-lying area may exhibit similar levels of contamination as the source areas. For example, by design, the soils in the construction spoils disposal area may have up to 25 pCi/g of plutonium-238 and 5 pCi/g of thorium-232, and this area could have supplied the low-lying area with contaminated sediments.

The topographically low area south of the construction spoils area is approximately 350 ft (east-west) by 700 ft (north-south). A dual approach sampling strategy is proposed in order to initially characterize and to identify the maximum soil contamination in this area. A systematic sampling strategy will be used by dividing the area into eight equal parts (175 ft by 175 ft) and sampling the nodes of the grid (Figure 7.12). This strategy will produce 15 sampling locations. Surface sediment samples will be collected at each of the 15 locations. All samples will be collected as discrete grab samples during the first sampling event. Analytical parameters are listed in Table VII.3. Sample numbers are listed in Table VII.6.

To determine the maximum concentrations present in sediments, a biased sampling strategy will be superimposed over the systematic sampling. Within each of the eight sections of the grid, a surface sediment sample may be collected at the location considered most likely to exhibit the highest contaminant levels. These eight sampling locations (Table VII.6.) will be based on field observations of the areas that appear to be the low spots (elevation) in each grid or by other indications such as vegetation (e.g., cattails) or sediment size. A FIDLER detector will also be used to help select the sample locations.

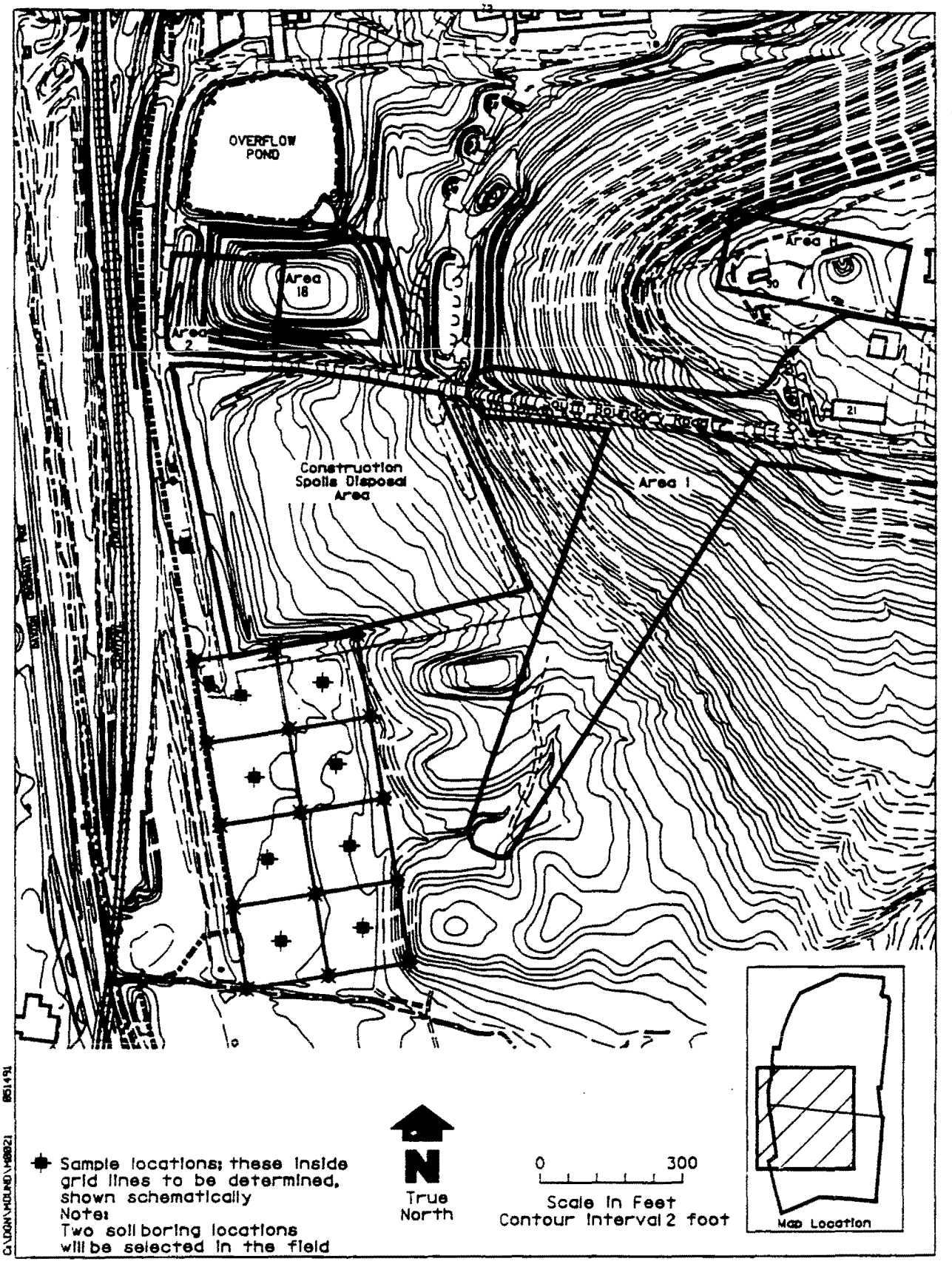

Figure 7.12. New property, low-lying area with 175-ft by 175-ft grid with systematic and biased sample locations (proposed).

At two of the eight biased sample locations, subsurface soil borings will be completed during the first sampling event in order to characterize the vertical extent of radioactive contamination. The two borehole locations will be based on the results of on-plant screening of surface soils, with the two most radioactive surface soil sample locations being drilled. If there are no anomalously radioactive surface locations, two locations will be chosen, based on accessibility. Samples will be collected at 5-ft intervals, starting at 0 to 2 ft and continuing until bedrock or the water table is reached. Soil samples will be collected using the split-spoon sampler. Soil will be monitored with an organic vapor monitor and radiation detector to screen potential contamination, and additional samples may be collected based on field screening results.

7.3.4.2. Ephemeral Stream on the New Property - Subwatershed 3

The system of surface water runoff channels that drain the southwest side of SM/PP Hill may have received surface contamination from storm water runoff that originates in or near Area 1. Biased sampling of these drainages will provide data to determine the maximum extent and level of contamination. The sampling strategy for this site is to sample immediately downstream of the intersections of stream channels that have been identified from the detailed topographic map (DOE 1991c). This map has 2-ft contour intervals and shows collection paths for storm water runoff (Figure 7.13). For lengths of streams without intersecting stream channels, stream sediments will be sampled approximately every 200 ft (Table VII.6). Samples that indicate greater than 15 pCi/g of thorium will be resampled for analysis of rare earths (Table VII.3).

Approximately 15 sediment samples will be collected during each sampling event in April and October (Table VII.6). At two of these locations, subsurface soil borings will be completed during the first sampling event in order to characterize the vertical extent of radioactive contamination. The two borehole locations will be based on locations of maximum radioactive contamination (as determined by onsite screening) or by accessibility. Due to limited accessibility of some remote locations, boreholes may have to be drilled and sampled with a hand auger or hand-held power auger. Samples will be collected at 5 ft intervals starting at 0 to 2 ft and continuing until bedrock or the water table is reached.

7.3.4.3. Trunk Stream Sampling on New Property - Subwatershed 3

All surface water runoff that collects from either of the two ephemeral runoff systems described above must feed into the main trunk stream that exits the Mound Plant property. This pathway is especially important to characterize due to the possibility of off-plant migration of contaminated stream sediments. For this reason, a more rigorous sampling strategy will be used. Monitoring of stream flow conditions at the property may be required on a regular basis after renovation of the existing weir. Surface water and sediment sampling will be performed during the April and October sampling events.

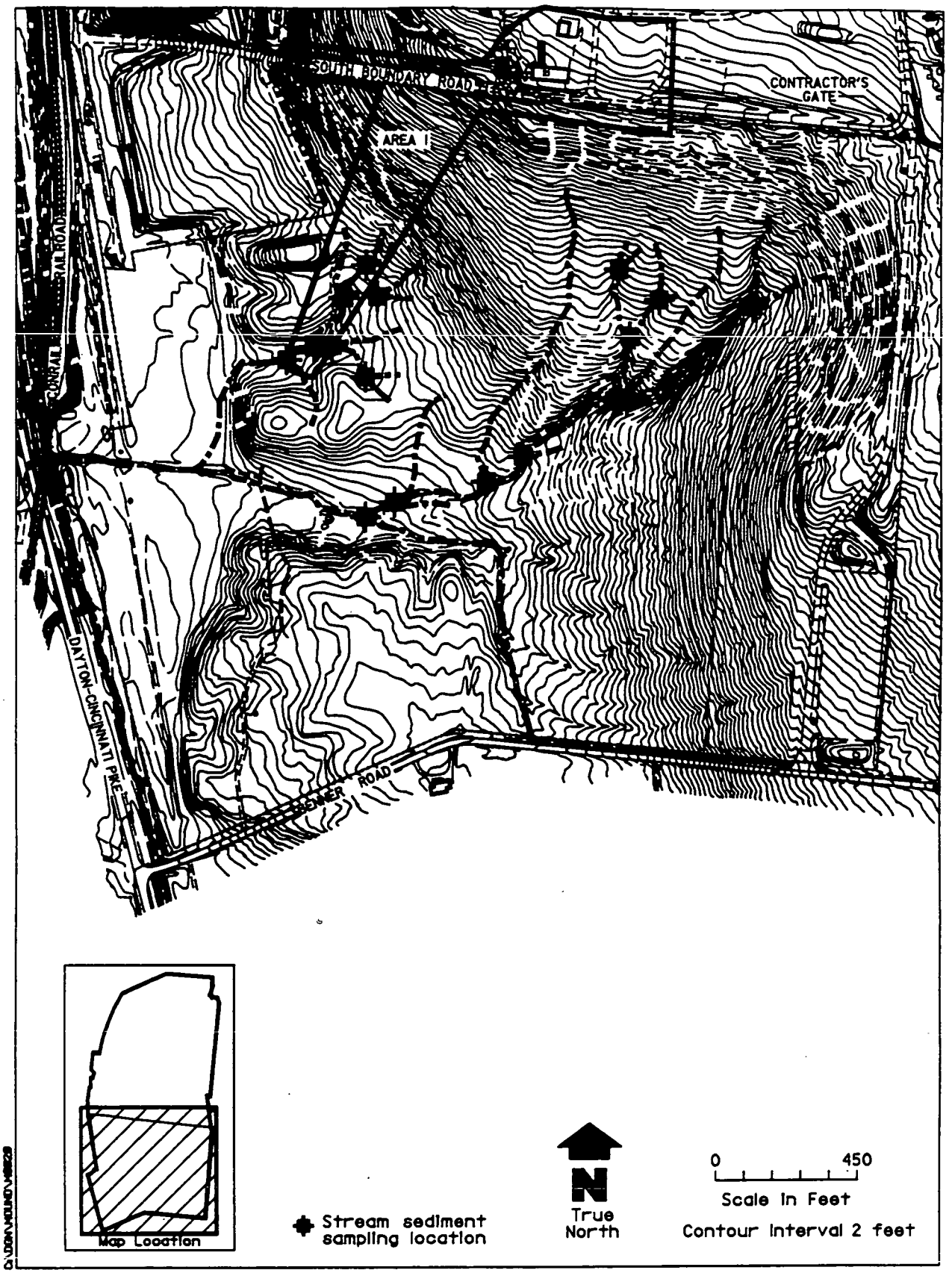

Figure 7.13. New property, ephemeral stream channels with stream sediment sampling locations (proposed).

The trunk stream sediments (Table VII.6) will be sampled beginning at the location nearest the property line and then every 200 ft upstream until the major tributary from the northeast is reached. This distance is approximately 900 ft; therefore, five sediment samples will be collected along the reach (Figure 7.14). All sediment samples will be collected as discrete grab samples during the April and October sampling events. Samples that indicate greater than 15 pCi/g of thorium will be resampled for analysis of rare earths (Table VII.3).

At two of the sample locations, subsurface soil borings will be completed during the first sampling event in order to characterize the vertical extent of radioactive contamination. The two borehole locations will be based on locations of maximum radioactive contamination (as determined by onsite screening) or by accessibility. Due to accessibility, the borings may have to be drilled and sampled with a hand auger or hand-held power auger. Samples will be collected at 5-ft intervals, starting at 0 to 2 ft and continuing until bedrock or the water table is reached (Table VII.6).

One discrete surface water sample (Table VII.6) will be collected from the trunk stream. The location of this sample corresponds with the sediment sample location at the existing, inactive weir. The surface water sample will be collected at this location during the April and October sampling events. A sample will also be collected for measurement of field parameters. Samples will be collected with a device capable of retrieving shallow surface water (e.g., dipper, ladle).

7.4. SAMPLE DESIGNATION

Samples collected at Mound Plant under the ER Program are numbered using a three-letter, ten-digit identifier (MNDXX-YYYY-ZZZZ). MNDXX is the area or investigation identifier, which for Operable Unit 9 is MND21 for surface water, MND22 for sediment, and MND23 for subsurface soils. The next portion of the identifier, YYYY, designates the specific sample location. The last four digits (ZZZZ) serve as the sample identifier that documents the frequency of sampling (for repeatable sampling like surface water). Field quality control samples will be given a specific sample identifier as outlined in Table I.3.

<u>Example.</u> The surface water and sediment samples collected at the first location will be numbered as follows (area-location-sample):

MND21-1001-0001 for the first (e.g., high-flow) sample;

MND22-1001-0001 for the sediment sample; and

MND21-1001-0002 for the second (e.g., low-flow) sample.

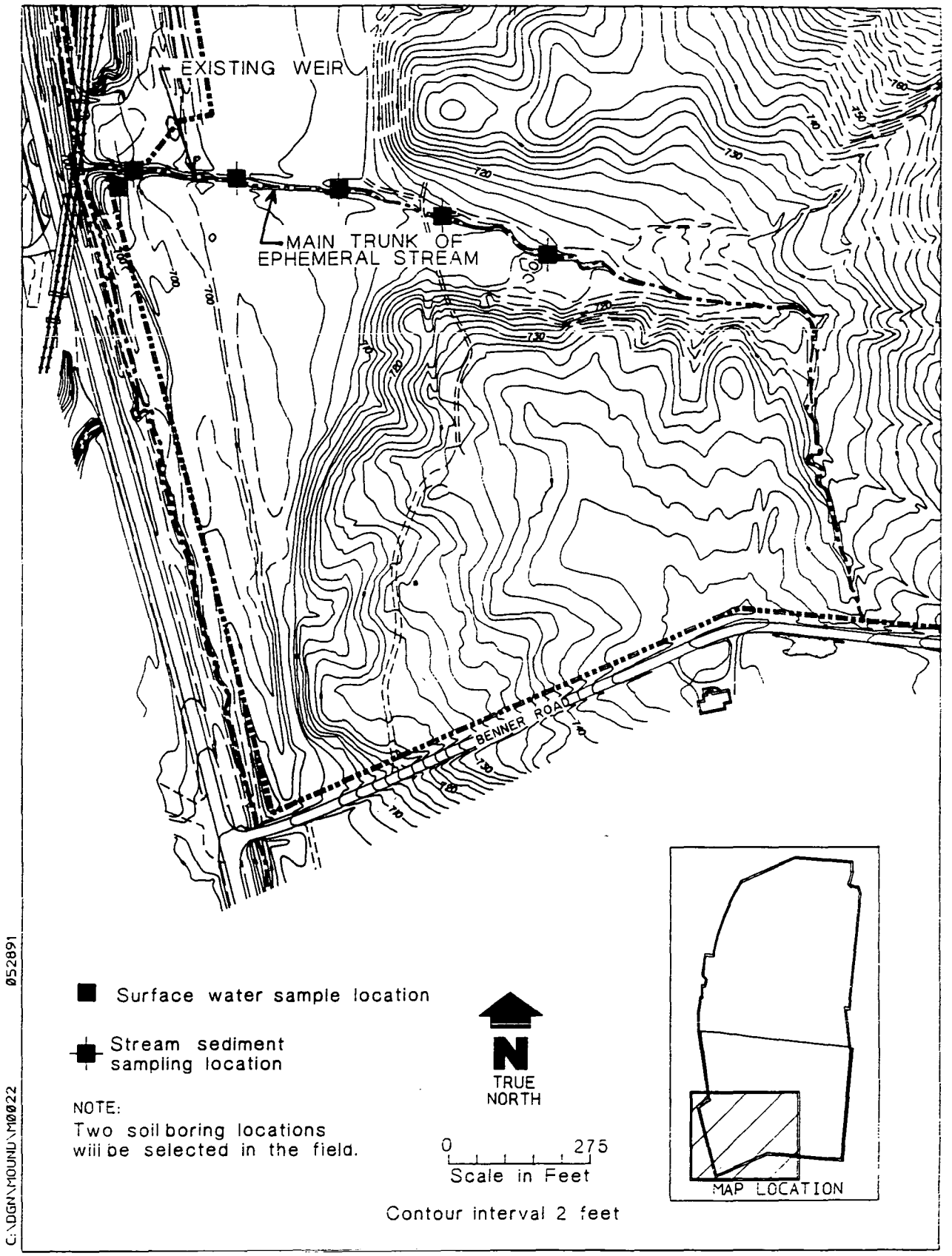

Figure 7.14. New property, main trunk of ephemeral stream sediment sampling locations (proposed).

7.5. SAMPLING EQUIPMENT AND PROCEDURES

The surface water and sediment samples collected as part of the surface water and sediment investigation will be collected from the same locations. Some locations may correspond with sample locations established during the ecological assessment (subsection 10.3.3). The sediment samples will be collected after the surface water samples have been collected. This will prevent sediments suspended in the water column during the sediment sampling from being collected with the surface water samples. In addition, sampling will always begin at the furthest downstream location and then proceed upstream to each successive location. This will eliminate possible problems caused by disturbance of sediments that would move downstream and compromise other locations. Sampling locations will be marked on a topographic map of suitable scale or a figure from the Work Plan or FSP. In the field, the location of each sample point will be marked with a wooden stake or some other type of visible marker. This will allow for consistency in sampling at locations during the April and October sampling events and for a reference point for surveying.

7.5.1. Collection Methods

Surface water samples will be collected using a device capable of collecting a discrete water sample at a selected point in the water column (e.g., Kemmerer bottle, grab sampler, bomb sampler). The device will be used to collect water samples at locations where water depth is greater than 6 inches. For shallow surface water, a device such as a dipper or ladle will be used. The sampling equipment will be composed of Teflon or stainless steel. At all sampling points, a weighted tape will be used to measure the depth of the water, with care being taken to avoid disturbing the sediments. Surface water samples from streams will be collected from just beneath the water surface, whereas samples from the Great Miami River will be collected at mid-depth of the water column. Surface water samples from standing bodies of water will be collected by one of two methods, depending on the presence of a thermocline. A thermocline is the horizontal plane in a thermally stratified lake located at the depth were temperature decreases most rapidly with depth. The thermocline can be detected by lowering a temperature probe through the water column. The presence of a thermocline may prevent mixing of waters vertically through the pond, producing two chemically distinct water layers. In this instance, a water sample will be collected from the mid-depth of each of the water layers above and below the thermocline. These water samples will be submitted for separate analysis. If a thermocline is not detected, the surface water sample will be collected at mid-depth of the entire water column. In either case, a sample will be collected by a sampling device capable of collecting a discrete sample (e.g., Kemmerer bottle). Extra samples from each surface water body will be used to conduct field measurements of pH, temperature, specific conductivity, alkalinity, redox potential, and dissolved oxygen.

Surface water samples for certain analytical parameters such as dissolved TAL metals and dissolved radionuclides will require filtration. Separate grab samples will be collected for filtering. The filtering will be done in the field as defined in the procedures contained in the QAPP. Samples collected for total metals, total radionuclides, and TSS must be unfiltered.

During low-flow conditions, the collection of surface water samples may be difficult at some locations, especially the ephemeral stream reaches. Should such conditions be encountered, conditions will be documented and no sample collected. Samples may be collected at a later date. A clean laboratory sample jar or similar container may be used to collect the surface water sample. Care shall be taken to minimize the agitation of sediment. This method may also be used if there is only a small trickle (low flow) of surface water in the ephemeral drainage. In this situation, the jar will be placed directly into the flow in order to capture the water. The surface water will then be poured into the laboratory sample jars following standard sampling protocol. The above procedure will be repeated until the required volume of surface water has been collected at each sampling point.

Sediment samples will be collected using a core sampler or a box-type grab sampler (e.g., dredge). Attempts will be made to collect a core sample. If no sediments can be recovered, the box-type grab sampler will be used to collect the sample. The box-type grab sampler will be attached to a steel cable and allowed to sink through the water column without resistance from the cable so that it can achieve maximum penetration into the sediments. After the sampler is retrieved, the sediment will be placed into a stainless steel bowl to homogenize and then transferred into the sample bottles. Any free water present will be decanted from the sampler before sample collection begins. This may require collecting several sediment samples at one point depending on the sediment recovery achieved by the grab sampler.

If surface water is absent at a sample location during a sampling event, the sediment sample will be collected with a spade or scoop. This sampling method will be according to the Mound Plant ER Program SOP 5.2, Soil Sampling with a Spade and Scoop (revision 3).

Samples for geotechnical analysis will be collected with a core sampler or a box-type grab sampler as required by field conditions. None of the geotechnical analyses scheduled require undisturbed samples. The subsurface samples for moisture content must simply be handled as little as possible and placed in an air-tight container. The analyses of density, specific gravity, and permeability (hydraulic conductivity) will be conducted on the same sample as submitted for particle size, so sufficient material must be packaged in the specified container (Table I.3).

Measurements of stream velocity and cross section will be taken to ensure documentation of the flow regime in which the samples were collected. Measurements will vary by location and the degree of existing information. Locations along the Great Miami River will include only the location, date and time of day.

Discharge data will be compiled from the US Geological Survey water resources data. Samples along the plant drainage ditch below the NPDES sampling station will be used to compile similar data and will utilize plant discharge records from the NPDES station. Stream reaches above the station and other outlying streams will require additional work. Flow rates in the latter will be estimated by measurements of channel cross section depth, and stream velocity. Width and depth measurements will be taken to the closest tenths of feet (0.1 ft). Velocity will be measured by the float method (USGS 1960).

Quality assurance/quality control samples, including field blanks, rinsate blanks, trip blanks, matrix spike and matrix spike duplicates, and field duplicate samples, will be collected at each locality, as appropriate. Field duplicates will be collected for every ten or fewer field samples and will be numbered according to Table I.3. Water samples collected for matrix spikes and matrix spike duplicates will be collected for every 20 or fewer field samples, and extra volume will be collected: triple for VOCs and double for semivolatile organic compounds and pesticides/PCBs. The matrix spike/matrix spike duplicate samples will be so marked on the container labels. Procedures in the Operable Unit 9 QAPP will be followed for quality assurance/quality control requirements.

7.6. SAMPLE HANDLING AND ANALYSIS

The sample container requirements for water, soil and sediment sampling are listed in Tables I.4 and I.5, as well as specific investigations (Tables VII.2, VII.4, VII.5, and VII.6). The collection and frequency of quality control samples is presented in the QAPP and Tables VII.1 and VII.3. When a sample is collected, a chain-of-custody record will be started for that sample, following the procedures in Mound Plant ER Program SOP 1.3, Sample Control and Documentation. A custody seal will be placed on each sample container, and the samples will be packed on ice. When the samples are packaged for shipment, enough ice will be used so that they are maintained at a temperature of 4°C during shipment. Samples will be shipped by overnight delivery service. Packaging and shipment will follow Mound Plant ER Program SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples. Excess soil from boreholes will be managed according to SOP 1.15, Guide to Waste Management (revision 1).

All surface water, sediment, and subsurface soil samples collected during the investigation will be analyzed for both laboratory and field parameters. Samples from all on-plant and Miami-Erie Canal locations will be screened by the Mound facility before being shipped. Field parameters will be measured using a separate grab sample from the same sampling point location. The list of analytical parameters for each matrix are presented in Tables VII.1 and VII.3, including the field parameters to be measured. The collection of field parameter data will be made with the appropriate instruments, in compliance with the performance standards for each instrument presented in the QAPP. Analytical methodology for the laboratory parameters are specified in the Operable Unit 9 QAPP.

8. METEOROLOGIC AND AIR QUALITY INVESTIGATIONS

The meteorologic and air quality investigations will be phased. There are no field investigations currently planned.

9. HUMAN POPULATION AND LAND USE

No field work is planned for the study of human population and land use. See the Site-Wide Work Plan for a discussion of the type of work planned for the study of human population and land use.

10. ECOLOGICAL INVESTIGATIONS

10.1. BACKGROUND INFORMATION

Activities at the Mound Plant have resulted in radioactive and non-radioactive contaminants in soil, surface water, and sediment on and in the vicinity of the plant property. Previous studies at Mound Plant that address these activities and the resulting levels of radioactive and non-radioactive contamination in the local environment are the following:

- "Environmental Monitoring at Mound Plant, 1988 Report." Daniel G. Carfagno and Bill M. Farmer. MLM-3589, U-C-41. Prepared by the Environmental Section of the Administration Department at EG&G Mound Applied Technologies for the U.S. Department Of Energy. May 1989.

- "Final Environmental Impact Statement, Mound Facility, Miamisburg, Ohio." DOE/EID-0014, U.S. Department of Energy. June 1979.

- "Final Report and Sediment Sampling/Analysis DOE - Mound Run-Off Ponds." MRC Quote #441016-9180, International Technology Corporation. April 1990.

- "Stability of Plutonium Contaminated Sediments in the Miami-Erie Canal." Billy M. Farmer and Daniel G. Carfagno. MLM-2483, UC-11. March 1978b.

- "Mound Laboratory Environmental Plutonium Study 1974." D. R. Rogers. MLM-2249, TID-4500, UC-11. Monsanto Research Corporation, U.S. Government Contract No. E-33-1-GEN-53. September 1975.

These studies provided the framework for this FSP and were used to identify the areas to be investigated as part of the RI/FS per the requirement of Attachment 1 of the CERCLA 120 FFA (EPA 1990).

The DOE has currently identified nine operable units at Mound. These operable units were identified on the basis of contaminants, physical location, environmental pathway affected, technical approach, or funding source. Each operable unit includes one or more potential release sites that are being addressed as a group. As discussed in the work plan, seven of the nine operable units contain environmental features that require examination per the CERCLA 120 FFA (EPA 1990). The contaminants associated with each of the seven operable units are also presented in the work plan.

Where possible, sampling for ecological characterization has been oriented towards examination of all or part of these seven operable units. However, because of the mobility of many species of wildlife, some terrestrial sampling locations may overlap more than one operable unit. Size and location of sampling plots, transects, etc., will ultimately be determined in the field during a reconnaissance investigation prior to sampling. The appropriate review agencies will be requested to provide input during the reconnaissance investigation so that performance of the ecological assessment meets with agency approval. Locations

presented in this sampling plan are based on observations made at the Site on October 11, 1990, in conjunction with discussions with personnel from Mound Plant, Oak Ridge National Laboratories, and with biologists familiar with the CERCLA Site from the Ohio Department of Natural Resources. The "CERCLA Site" as defined in Part IV of the CERCLA 120 FFA (EPA 1990) includes the area or areas where hazardous substances, pollutants, or contaminants have come to be located, due to the activities at the Mound Plant. Accordingly, several of the areas of concern for biological sampling at Mound are located outside the plant boundaries.

10.2. SAMPLING OBJECTIVE

The objective of the ecological investigation at Mound Plant is to obtain biological and ecological information to describe the features of the ecological system. This information is to include, but not be limited to, the following principal components:

- identification of the flora and fauna in and around the Site;
- identification of sensitive environments in and around the Site (e.g., wetlands, floodplains, wildlife breeding areas, etc.);
- identification of endangered species and their habitats in and around the Site;
- identification of those species consumed by humans or found in human food chains; and
- bioaccumulation data on food chain organisms, such as aquatic invertebrates and fish.

Accordingly, the intents of the first three components above are to describe the ecological system by developing a complete list of animal and plant species occurring on the CERCLA Site and to locate habitats considered valuable to the CERCLA Site's flora and fauna. For the most part, the study will be aimed at collecting semi-quantitative data; detailed population density information will not be collected although estimates of relative abundance may be extrapolated through survey results. This information will be used to perform an ecological risk assessment which, using data from the surface water, soil, and sediment investigations, will provide information on the nature and extent of contamination and the potential for contaminant transport.

The ecological assessment will take place in three phases. Phase I is described in Operable Unit 9, Site-Wide Work Plan. In conjunction with and as an appendix to this FSP, SOPs are presented describing methods for use in Phase I by the field personnel to characterize the Site's flora and fauna (Appendix A). The results of Phase I, along with data from the surface water, soil, and sediment investigations, will be used to perform an ecological risk assessment, Phase II. Phase II will, among other things,

provide information on the nature and extent of contamination and the potential for contaminant transport. The approach for Phase II, the ecological risk assessment, is also presented in

Operable Unit 9, Site-Wide Work Plan; however, this approach may be refined based on the preliminary and/or final results of Phase I. Only the Phase I needs are described in the FSP.

Based on the results of Phase II, recommendations for a future study, Phase III, will be made. The recommendations may include, but may not necessarily be limited to, chemical and radiological tissue analysis, toxicity testing, genetic analysis, and sampling of offsite habitats for comparison. Subsequent to the completion of the ecological risk assessment, an addendum to this FSP will be submitted for review as befits the recommendations arising from the risk assessment findings. For example, if it is recommended that tissue sampling be conducted, SOPs will be submitted detailing the actual procedures to be used for collecting tissue samples, sample handling, preservation packaging and shipment, sample preparation, analysis, and quality assurance/quality control considerations.

10.3. SAMPLING LOCATIONS AND FREQUENCY

The components of the ecological system will be described by observing and cataloging the terrestrial and aquatic flora and fauna and their habitats at the CERCLA Site. The ecological system will be further described by the identification of sensitive environments. The potential nature and extent of contamination within the ecological system will be identified from the results of the ecological risk assessment. Those organisms that are part of the food chain and/or that have the potential for migration will be identified. A complete description of sampling frequency is presented in the SOPs (Appendix A). For most aspects of the ecological characterization, sampling locations will be determined during the Site reconnaissance. An overview of sampling locations and frequency is presented in the subsections that follow.

10.3.1. Terrestrial Fauna

The occurrence of small and large mammals, birds, reptiles, and amphibians will be documented through semi-quantitative, seasonal surveys. These surveys will be performed Site-wide (except in restricted areas) and will be concentrated in areas where sufficient vegetative cover is likely to support greater and more diverse animal populations (e.g., woods, wetlands, shrub/scrub, etc.) and in areas where known chemical and radiological contamination exists. Surveys for large mammals and birds will be performed in the spring, summer, fall, and winter; reptile and amphibian surveys will be performed in the spring, summer, and fall. In addition to resident populations, attention will be given to nonresident, migratory terrestrial fauna, including waterfowl, raptors, and songbirds. Incidence of tumors, silage conditions, malformed growth, etc., will be recorded on field sheets.

In addition, the Site will be identified to the Ohio Department of Natural Resources, the Ohio Biological Survey, the Ohio Natural Heritage Program, and any other appropriate government or private organization

in order to search for records concerning common, rare, threatened, and endangered species in the area around Mound Plant.

10.3.2. Terrestrial and Aquatic Flora

A series of seasonal plant surveys, using a combination of random searches in all habitats and line transects in selected habitats, will be performed to document the flora on the Site. A botanical expert from one of the local colleges or universities will be enlisted to assist in the inventory. Surveys will take place in spring, early summer, late summer, and fall to coincide with peak flowering times so that species-level identifications can be made. To the extent possible, the entire Mound facility grounds will be examined; less disturbed habitats will receive closer scrutiny since they are likely to support denser and more diverse plant communities. Major and minor habitats will be identified and their boundaries delineated.

10.3.3. Aquatic Fauna

Aquatic fauna sampling at selected water bodies will involve the collection of fish and benthic macroinvertebrates (macrobenthos). Fish and macrobenthos will be collected in the spring and fall. For the geographical region including Mound Plant, these seasons are wet and dry periods, respectively, and represent the periods in which naturally occurring variations in community structure are greatest. To the extent possible, benthic stations will be located near sediment and water quality stations.

A total of twelve locations will be sampled for fish and/or macrobenthos, as follows:

1) Miami-Erie Canal (south section), just downstream of the confluence with the plant drainage ditch (Figure 10.1);

2) Miami-Erie Canal (south section), in the vicinity of the confluence with the overflow creek (Figure 10.1);

3) The overflow creek below the confluence with the south canal;

4) plant drainage ditch, downstream of retention basins (Figure 10.2);

5) plant drainage ditch, upstream of retention basins (Figure 10.2);

6) unnamed stream on the south (new) property near Mound Road (Figure 10.3);

7) unnamed stream on the south property near the western property boundary (Figure 10.3);

8) the South Pond in the Miamisburg Municipal Park;

9) the overflow pond;

10) the retention basins;

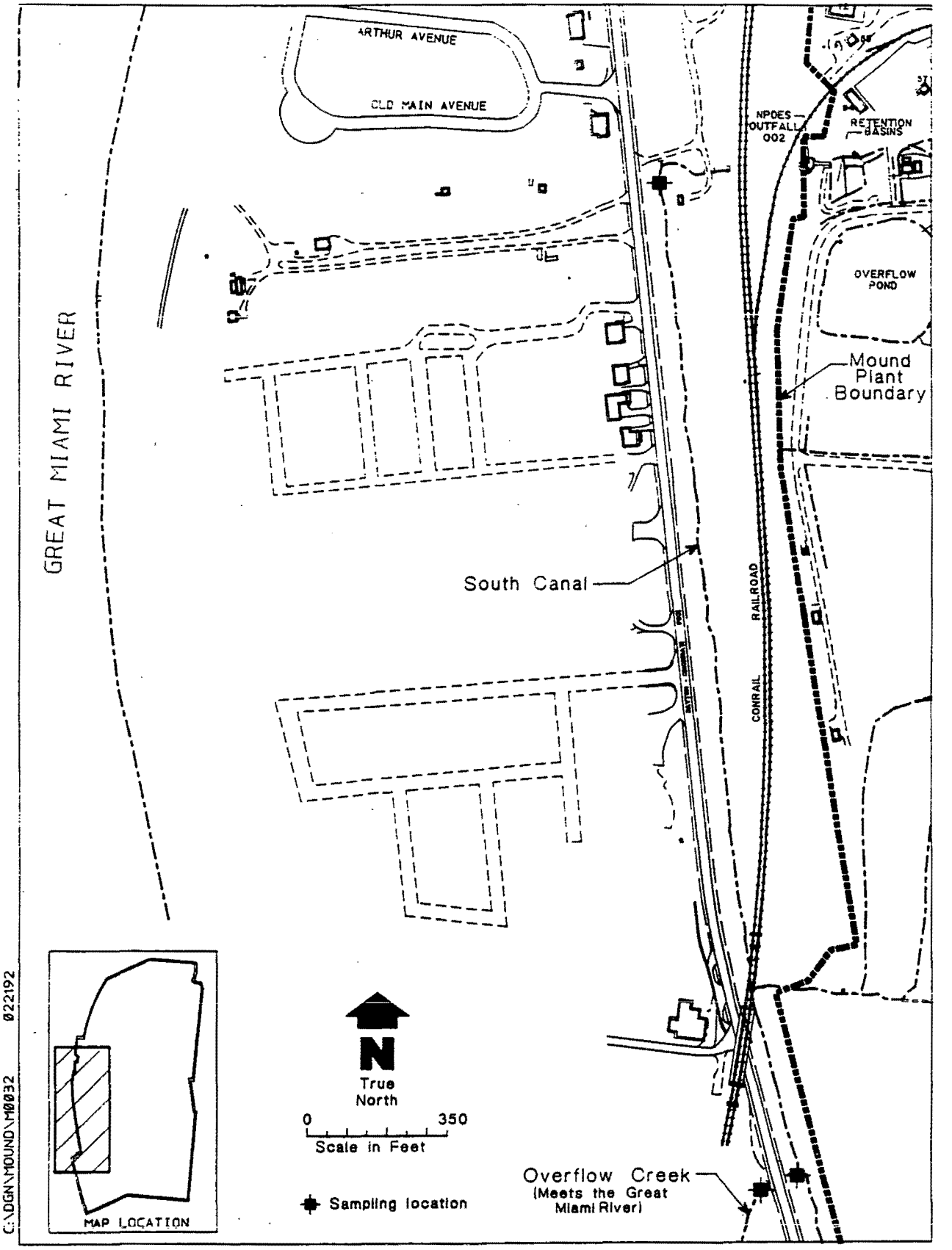

Figure 10.1. Aquatic sampling locations: south canal downstream of plant drainage ditch; south canal near overflow creek.

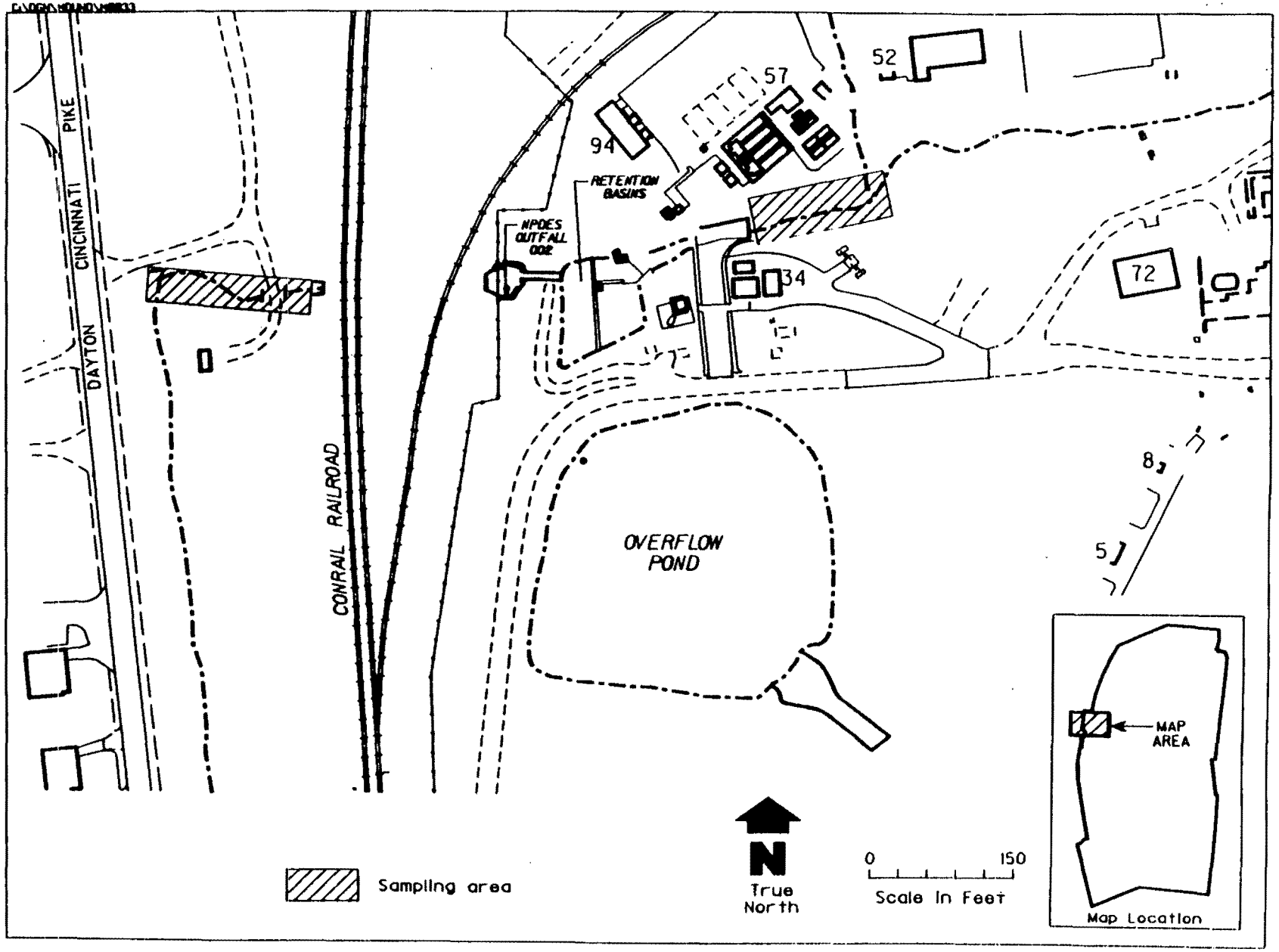

Figure 10.2. Aquatic sampling locations at the plant drainage ditch.

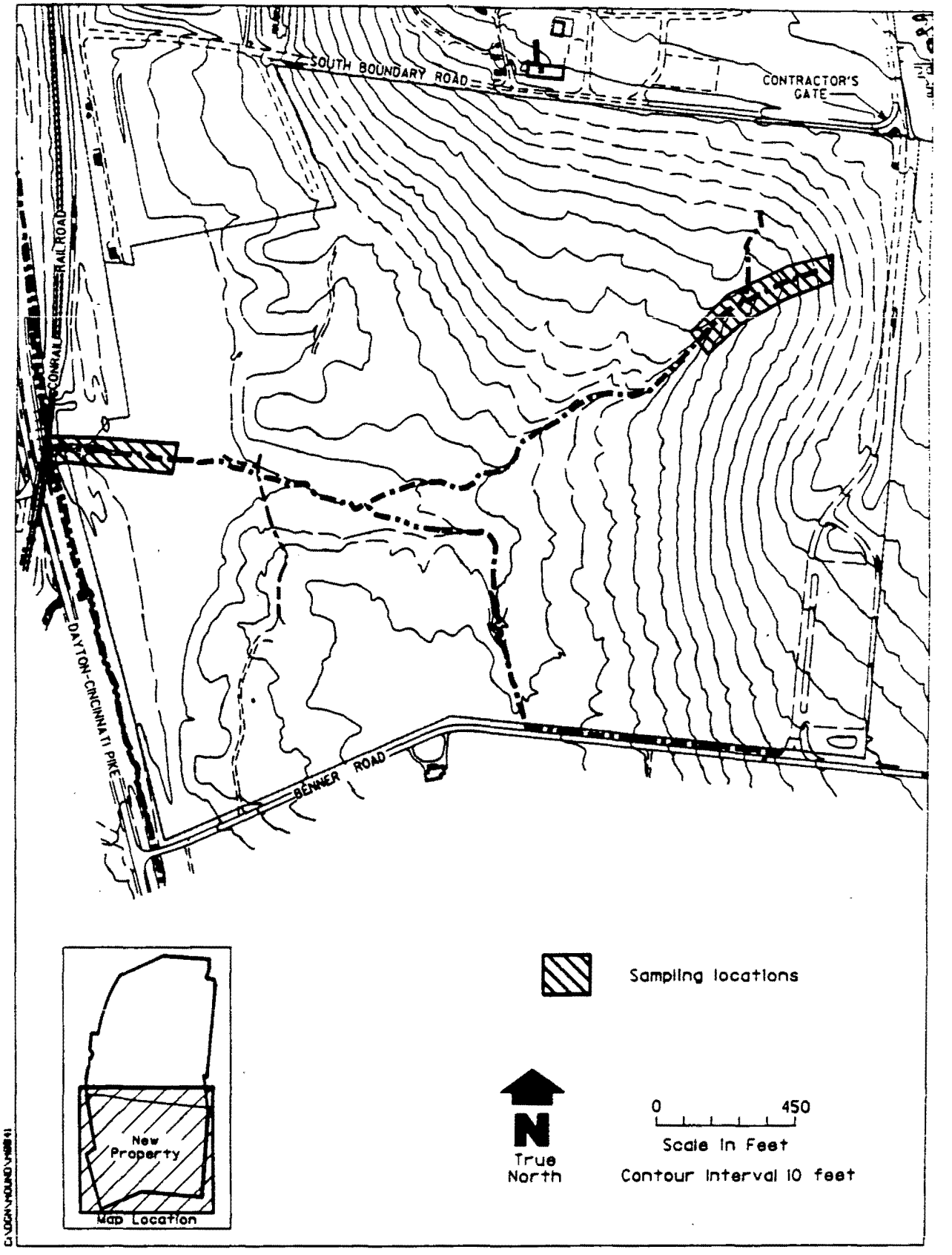

Figure 10.3. Macrobenthos sampling locations: Drainage channel on the new property.

11) the overflow creek near its mouth.

12) Asphalt-Lined Pond

10.3.4. Sensitive Environments

Sensitive environments are considered to include wetlands, floodplains and wildlife breeding areas. For the most part, the search for, and examination of, sensitive environments will be done Site-wide in conjunction with the floral and faunal surveys. Wetlands identification and delineation will be performed as a separate task because it can be completed in a single season; whereas, the floral and faunal surveys must be done over several seasons.

A portion of the Mound Plant property may be in the 100-year floodplain of the Great Miami River. The floodplain as well as other areas of the CERCLA Site will be included in the floral and faunal inventory. The presence of rare, threatened, and endangered species and unique or unusual habitats such as wildlife breeding or nursery areas and resting/feeding grounds for migratory birds will be documented and located on Site maps. A qualitative measure of habitat uniqueness or sensitivity will be provided based on the number and kinds of plants and animals using the habitat and the role the habitat plays in the particular plant or animal's life history.

10.4. SAMPLING EQUIPMENT AND PROCEDURES

Appendix A of this FSP presents SOPs developed for use in the ecological characterization of the Site. Included in Appendix A are individual SOPs that address sampling equipment and procedures for terrestrial flora, terrestrail fauna, and aqautic biota. An overview of equipment and procedures is presented in the following subsections.

10.4.1. Terrestrial Fauna

10.4.1.1. Mammals

Populations of small mammals (e.g., mice, voles, and shrews) will be sampled within each vegetative cover type with live traps and pitfall traps arranged in grids or along transects. These traps are specifically designed for collection purposes. The purpose will be to establish the presence of a species as a component of the food web within a vegetative community. Each trap will be baited with a mixture of peanut butter and rolled oats. Trapping grids and/or transects will be monitored three times per day and allowed to remain overnight.

Larger mammals such as raccoon, muskrat, opossum, groundhog, fox, deer, squirrel, and rabbit will be studied using techniques other than trapping. These mammals and their sign (e.g., tracks, scats, and dens) will be recorded as casual observations during other phases of the field study such as bird and vegetative surveys.

10.4.1.2. Birds

The relative abundance of avian species will be examined using timed cover surveys. Vegetative types will be covered by observers on foot. The objective of the surveys will be to cover all parts of the vegetative type, with special emphasis on the most suitable habitat for bird life within each type. The time spent in each type will be in proportion to its size (relative to the size of the total Site area). Short stops will be made occasionally to watch and audit bird calls. All birds sighted or heard will be recorded, and abundance for each species observed will be expressed on a per hour basis.

Casual observations of avian fauna will be recorded while performing other phases of the field study; e.g., vegetative surveys. All observations made without specific time duration will be recorded as general observations.

10.4.1.3. Reptiles and Amphibians

Vegetative cover types within the study area will be actively sampled for herpetofauna by turning over rocks, logs, and other objects during quadrat sampling. Casual observations of reptiles and amphibians made during other flora and fauna sampling activities will be recorded relative to habitat. Nocturnal visits to the CERCLA Site will be made to identify hard-to-find species using call or vocal identification.

In addition, drift fence sampling will be performed at appropriate locations according to the procedures presented in Vogt and Hine (1982). At a minimum, three drift fences and quadrats will be established at locations on the main property and on the south property. Final drift fence and quadrat locations will be identified from aerial photographs and site reconnaissance. Drift fences will be placed parallel to diverse habitat boundaries to capture animals moving across vegetation gradients.

10.4.2. Terrestrial and Aquatic Flora

Color aerial photographs of the CERCLA Site will be used to create a map from which can be drawn major and minor vegetation communities. This map, together with field data gathered during a preliminary site evaluation, can be used to establish vegetation line transects for the CERCLA Site. Where possible, the transects will be established perpendicular to the slope and drainage of the area to be studied. While the use of transects will serve to concentrate the field effort and at the same time provide qualitative data on the vegetative composition of distinct cover types on the Site, the Site investigators are not restricted to the collection and identification of plants from the transect lines only. Random or specific searches in areas not falling on a transect line are also allowable for the purpose of cataloging the Site's flora and floral communities to the greatest degree possible.

Plants will be identified in the field but may be removed from the CERCLA Site for shipment to the laboratory if microscopic examination is necessary for species-level identification. References used in the identification of the Mound Plant flora will include those appropriate for the region. Results of the floral inventory will be compared to the list of threatened and endangered plants that are protected by the state of Ohio, pursuant to Ohio Administrative Rules 1501, 18-1-01; through 1501, 18-2-05; and to the list of species protected by Department of Interior, U.S. Fish and Wildlife Service (Federal Register, Vol. 45, No. 242, or most recent publication).

10.4.3. Aquatic Fauna

10.4.3.1. Macroinvertebrates

Benthic macroinvertebrates will be sampled in flowing waters using Hester-Dendy multiple plate samplers. A total of three replicates will be collected at each location. Standing waters will be sampled using an Eckman or Ponar dredge. Sieve size for the Eckman and Ponar dredge samples will be the same at each location. Field and laboratory procedures used in the collection of benthic macroinvertebrates will follow the State of Ohio Environmental Protection Agency guidelines (Biological Criteria for the Protection of Aquatic Life, Volume III, 1989).

10.4.3.2. Fish

Fish will be collected for community analysis using a seine net, backpack or boat electroshocker, trap nets, and/or hook and line. Fish collected for the species inventory will be identified in the field and released or preserved in 10 percent formalin at the time of capture. Field and laboratory procedures used in the collection of fish will follow the State of Ohio Environmental Protection Agency guidelines (Biological Criteria for the Protection of Aquatic Life, Volume III, 1989).

10.4.4. Sensitive Environments

No specific mechanical equipment is required for the investigation of sensitive environments, except for a hand auger and Munsell soil chart for use in describing soil conditions as part of the wetlands investigation. Wetlands identification will follow the "Federal Manual for Identifying and Delineating Wetlands" (FICWD 1989). The appropriate field guides and reference documents (including but not limited to the procedures in Appendix A of this FSP) will be carried by the field team to identify and classify vegetation as to the hydrophytic status (i.e., wetland, facultative, upland). The federal manual provides procedures for several different methods of wetlands delineation. On the Mound Site, wetlands will be identified using a modified routine procedure. The modified routine procedure involves detailed documentation to better

characterize wetlands and uplands communities. A licensed surveyor will be used to survey each wetland line. The approach involves using documented remote sensing information such as National Wetlands Inventory (NWI) maps, U.S. Geological Survey (USGS) maps, and Soil Conservation Service (SCS) maps, as well as lists of hydric soils to determine possible locations of wetlands.

The field procedure, which follows the information search, involves checking areas indicated by the published data, determining the boundary, and recording the information necessary to document and submit the information to the appropriate regulatory agencies.

10.5. SAMPLE HANDLING AND ANALYSIS

Generally, the information required to describe the ecological system can be compiled by observation or capture and release of organisms and does not require the collection of specimens. In Appendix A, field and laboratory procedures for sample handling and analysis are discussed in detail. An overview of those procedures is presented in the subsections that follow.

10.5.1. Terrestrial Fauna and Flora

No special handling or analysis is necessary for terrestrial fauna and flora samples collected for the species inventory since most animals will be documented through visual observations or captured and released alive in the field. In certain instances, plants may be collected if microscopic examination is required for species identification.

10.5.2. Aquatic Fauna

10.5.2.1. Macrobenthos

Macrobenthos samples collected for the purpose of community analysis will be preserved in the field and returned to the laboratory for sorting, picking, identification, and analysis. All samples will be sorted in a white enamel pan, illuminated with a circline lamp, using a dissecting microscope with magnification as necessary. After sorting, all organisms will be placed into properly labeled jars containing 70 percent isopropanol.

Macroinvertebrates will be enumerated and identified to at least genus, using appropriate current systematic keys and the data recorded on a laboratory bench sheet shown in Figure 10.4. Samples may be split to expedite processing. Procedures for subsampling are defined in Elliot (1977) and in EPA (1973). In addition, a plankton splitter may be employed to subsample large numbers of chironomid larvae.

10.5.2.2. Fish

Where possible, fish collected for the species inventory will be identified and released in the field. For certain groups of fish (e.g., Cyprinidae), it may be necessary to preserve specimens in the field for subsequent identification in a laboratory. In these instances, fish will be sorted to species in a white enamel pan, illuminated with a circline lamp, using a dissecting microscope with magnification as necessary. For each species, specimens will be measured to the nearest millimeter standard, and total length and the size

range (smallest to largest) will be reported. Fish identifications will follow the procedures presented by Troutman (1981). Common and scientific names will be presented as in Robins, et al. (1980). Specimens collected will be made available to a local college or university for inclusion into their research collection after the specimens have been cleared for off-plant removal.

BENTHOS LAB BENCH SHEET

Site Name _____ TIMS No. _____

Body of Water _____ Replicate No. _____

County and State _____ Station No. _____

Type Sample _____ Date Collected _____

Collector(s) _____ Identified by _____ Date(s) Identified _____

Diptera	L(N)	P	Total	Dry Wt. (mg)
Chironomidae				
Trichoptera				
Ephemeroptera				
Plecoptera				
Odonata				
Coleoptera				

Heteroptera		
Megaloptera		
Crustacea		
Bivalvia		
Gastropoda		
Annelida		
Oligochaeta		
Other		

Total No. of Individuals _____

Total No. of Taxa _____

Diversity Index (d) _____

Equitability (e) _____ Signed By _____

Biotic Index (B.I.) _____ Date Signed _____

Figure 10.4. Benthos Laboratory Bench Sheet.

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APPENDIX A

ECOLOGY PROCEDURES

PROCEDURES FOR

TERRESTRIAL FLORA SURVEY

1. INTRODUCTION

1.1. PURPOSE AND SCOPE

The purpose of this Standard Operating Procedure (SOP) is to describe the methods for use by the field personnel to characterize the vegetation at the Mound Site. Seasonal field surveys will be used in conjunction with aerial photography to develop a vegetation map of major plant communities. Where wetland communities are identified, delineations will be performed.

A site reconnaissance will be performed prior to the implementation of this SOP. The purpose of the reconnaissance will be to identify unique and unusual areas that may provide habitat for rare, threatened and endangered species, identify major habitat types to guide the sampling effort in establishing the transects and plots mentioned in this SOP, and to identify areas that need intensive wetland delineation efforts.

2. APPLICABILITY

The procedures described will apply to all subcontractors.

This SOP applies to the characterization of terrestrial flora communities and the delineation of wetlands. Information from these activities will be used to address the following ecological components of the CERCLA 120 agreement:

- identification of flora and fauna in and around the site,
- identification of sensitive environments in and around the site (e.g., wetlands, floodplains, wildlife breeding areas, etc.),
- identification of endangered species and their habitats in and around the site, and
- identification of those species consumed by humans or found in human food chains.

Data collected during the terrestrial flora surveys and wetlands delineation will be used in the ecological risk assessment to identify species of concern. Ultimately, these species may be collected and analyzed during the next phase of the study for chemical and/or radiological content. Implementation of the terrestrial flora program may also require attention be given to the other SOPs for the ecological assessment.

Because subcontractors may be used for some or all of the terrestrial flora program, this SOP also applies to subcontractors chosen for such work.

3. DEFINITIONS

3.1. BRYOPHYTES

Member of the division in the plant kingdom of nonflowering plants comprising mosses (Musci), liverworts (Hepaticae), and hornworts (Anthoarotae).

3.2. CANOPY

The vegetation layer consisting of trees with a diameter at breast height greater than 4 inches.

3.3. DIAMETER AT BREAST HEIGHT (DBH)

The width of a plant stem (e.g., tree trunk) as measured at a point 4.5 feet above the ground surface.

3.4. DOMINANCE

Control within a community over environmental conditions influencing associated species by condition or area, or several species, plant or animal, because of their number, density, or growth form.

3.5. DOMINANCE THRESHOLD MEMBER

The number at which 50 percent of the total dominance number (i.e., sum of cover class mid-points) is represented by one or more plant species when ranked in descending order of abundance.

3.6. FORBS

Herbaceous plants other than grass and grasslike plants.

3.7. HERBS

Nonwoody (herbaceous) plants, including graminoids (grass and grasslike plants), forbs, ferns, fern allies, nonwoody vines, and for the purposes of this SOP, woody seedlings less than three feet in height.

3.8. HORIZON

A distinct layer of soil, more or less parallel with the soil surface, having similar properties such as color, texture, and permeability; the soil profile is subdivided into the following major horizons:

A. Horizon characterized by an accumulation of organic material.

B. Horizon characterized by relative accumulation of clay, iron, organic matter, or aluminum.

C. Horizon that is less subject to soil formation factors but may contain weathered parent material.

3.9. THREATENED AND ENDANGERED PLANTS

Those plants that are protected by the Department of Interior, U.S. Fish and Wildlife Service in the Federal Register, Vol. 45, No. 242, or most recent publication, and by the state of Ohio pursuant to Ohio Administrative Rules 1501, 18-1-01; through 1501, 18-2-05.

4. RESPONSIBILITIES

The Ecological Assessment (EA) Team Leader will be responsible for overseeing site activities to ensure that the field procedures described in this SOP are being followed. The results of the survey will be documented in the appropriate field notebook and data sheets. The EA Team Leader will have a degree in field biology and a minimum of four years experience. He/she has overall responsibility for the technical quality and management of all biological characterization activities at the site. The EA Team Leader reports to the Site Manager (SM) who is responsible for overall scheduling and coordination of site characterization activities.

The EA Team Leader or his/her designee will direct all terrestrial flora characterization sampling and wetlands delineations. The EA Team Leader will be assisted by field staff having specific training in the procedures outlined in this SOP. All personnel responsible for the execution of this SOP will be indoctrinated, trained, and qualified to perform floral and/or wetlands studies.

Before the terrestrial flora sampling team leaves for the site, it will be the responsibility of the EA Team Leader to coordinate schedules/actions with the Site Manager (SM) to ensure that appropriate permission has been obtained for property access.

5. PROCEDURES

This section describes the field methodology and estimation procedures for terrestrial flora analysis and wetlands delineations, together with the methods of analysis of raw data. Vegetation surveys will be conducted in the spring, early and late summer, and fall. Wetlands delineations will be performed once during the growing season.

5.1. VEGETATION SURVEY

The vegetation surveys will include identification and analyses of major community types and an inventory of the site flora. A voucher collection of each plant species found on the site will be made. Methodology for collection of voucher specimens will follow the procedures presented in Observing, Photographing, and Collecting Plants (Robertson, 1980).

5.1.1. Method Summary

Rectangular plots with the sides constructed in a 1:2 ratio will be used to sample vegetation. These plots will differ in size, depending on the strata layer to be sampled. Specific plot sizes are given in Subsection 5.1.4. All sampling plots will be nested, the smaller plots lying within the larger plots, and marked by flags.

Plot locations for community analysis will be determined by the EA Team Leader during reconnaissance with assistance from a botanical expert from a local college or university. Recent aerial photographs may be used as an aid in selecting locations. At least one plot will be located within each vegetation community identified during the site reconnaissance.

Plot positions will be marked with flags, plants occurring within each plot will be identified to the lowest practical taxonomic unit, diameter or circumference measured, and trees aged. From these data plant communities will be mapped and characterized by age, density, relative density, frequency, relative frequency, coverage, relative coverage, and importance value. Each plot will be assigned a unique code or number and the

location of the flags will be surveyed to facilitate accurate integration into the Geographical Information System (GIS).

5.1.2. Apparatus

A checklist for flora sampling equipment and supplies is shown in Table V.1.

5.1.3. Cleaning of Apparatus

Field equipment will be cleaned of field dirt to keep instruments working freely.

5.1.4. Field Procedures

5.1.4.1. Community Analysis

The community analysis will be conducted as follows:

A. Locate the transect position and flag and label the starting point with a transect number. Using the compass and measuring tape locate the sampling plot positions in the field and mark them on an aerial photograph.

   1. Sampling plots may be relocated if there are endangered or threatened species previously identified during the reconnaissance survey in an area that would not be recorded otherwise, or if there are other unusual characteristics that should be recorded. Sampling plots will not be relocated because of denseness of vegetation or other obstacles.

B. At each sampling plot, the canopy, understory, and herbaceous species will be sampled, where present, in the following manner:

   1. A rectangular sampling plot will be delineated with the dimensions of seven meters along the transect and 14 meters perpendicular to the transect. The four corners will be flagged as will the rectangular sides where siting is difficult, e.g., dense vegetation.

   2. Where present, canopy species will be identified within the boundaries of the sampling plot.

   3. A plot for understory and subcanopy species will be nested within the sampling plot and will be approximately 2 meters along the transect and 5 meters perpendicular to the transect.

   4. Plots for herbaceous species will be nested within the sampling plot. Four plots, one meter square, will be randomly located within the sampling plot. This will be accomplished by tossing an object to randomly locate the position. The plots will be centered around the tossed object. The positions within the larger sampling plot may differ with each seasonal sampling effort.

C. Within the sampling plot, trees with a DBH >4 inches will be identified to genus and, where possible, to species, and the diameter measured using the diameter tape. This information will be recorded on the Terrestrial Flora Raw Data Sheet (see Figure 5.1).

Table V.1.

Flora Sampling Equipment and Supplies Checklist

_____	Increment borer
_____	Diameter tape
_____	Tape measure
_____	Flagging
_____	Ziplock bags, labels
_____	Data sheets
_____	Aerial maps
_____	Logbooks
_____	Compass
_____	Permanent markers
_____	Wire flags
_____	Field data sheets

TERRESTRIAL FLORA RAW DATA SHEET

Date_____ Time_____ Observers_____ Signature_____

Habitat and Stratum_____ Location_____

Plot Identification Number_____ Plot Size_____ Operable Unit_____

	Species:		Species:		Species:		Species:	
Plant Number	Diameter or Circumference (cm)	Area Covered (cm^2) (a)	Diameter or Circumference (cm)	Area Covered (cm^2) (a)	Diameter or Circumference (cm)	Area Covered (cm^2) (a)	Diameter or Circumference (cm)	Area Covered (cm^2) (a)
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
Totals								

Type of Species Recorded (check one) ___Canopy ___Shrubs ___Subcanopy ___Herbaceous

Figure 5.1. Terrestrial Flora Raw Data Sheet.

D. Within the subcanopy plot, tree saplings with a DBH <4 inches and shrubs will be identified to genus, and, where possible, to species, and the crown diameter measured with a tape measure. This information will be recorded on the Terrestrial Flora Raw Data Sheet.

E. Within each herbaceous plot, plant species will be identified to the most specific taxonomic level possible within the field.

Diameters will be measured according to the following:

1. Grasslike plants -- Measure at a height of 3 cm.

2. Forbs -- Measure the leaf length and double.

3. Bryophytes -- Measure the surface diameter in perpendicular directions and use the average.

This information will be recorded on the Terrestrial Flora Raw Data Sheet.

F. Record litter layer depth and composition, i.e., partially decomposed leaves, grass, unrecognizable, etc., in logbook.

G. Record the presence of snags or fallen trees present in sampling plot and their diameter or length in logbook accordingly.

H. Using an increment borer, record in the logbook the age of four trees within the sampling plot. An average of these four will be recorded as the average age of the forest.

I. This procedure will be followed at each sampling location. Sampling in the summer and fall will include only herbaceous species and changes, such as fallen trees within the sampling plot.

5.1.5. Raw Data

5.1.5.1. Community Analysis

The following information will be recorded on the Terrestrial Flora Raw Data Sheet during the community analysis survey conducted in the field:

(a) Date.

(b) Time recording started.

(c) Operable unit (if appropriate).

(d) Signature of the EA Team Leader or his designee.

(e) Transect number.

(f) Plot number and size.

(g) Tree DBH and taxonomic name.

(h) Shrub and sapling foliage diameter and taxonomic name.

(i) Habitat and stratum.

(j) Location.

(l) Herbaceous species diameter.

5.1.6. Analysis

Community analysis will involve using diameter measurement to determine

Area $(A) = (x)(y)$

Where: x = One dimension of plot.
y = Perpendicular dimension of plot.

Coverage $C_i = \frac{a_i}{A}$

Where: ai = Area covered by species i.
A = Total plot area.

Frequency $f_i = \frac{j_i}{K}$

Where ji = Number of plots where species i occurs.
K = Total number of plots.

Density $D_i = \frac{n_i}{A}$

Where: ni = Number of species i.

The following also apply:

Relative coverage $RC_i = \frac{C_i}{\Sigma C}$

Relative frequency $Rf_i = \frac{f_i}{\Sigma f}$

Relative density $RD = \frac{n_i}{\Sigma n}$

From these data an important value will be determined according to the procedure of Brower and Zar (1977) using the Terrestrial Flora Summary Data Sheet (Figure 5.2) and the Terrestrial Flora Class Summary Data Sheet (Figure 5.3). These sheets will be signed

TERRESTRIAL FLORA SUMMARY DATA SHEET

Date_____ Observers_____ Signature_____

Habitat and Stratum

Location_____

Species (i)	Unit	Plot 1	2	3	4	5	6	7	8	9	Total for 10	Species
		$n_i a_i$	$n_i a_i$	$n_i a_i$	$n_i a_i$	$n_i a_i$	$n_i a_i$	$n_i a_i$	$n_i a_i$	$n_i a_i$	$n_i a_i$	$n_i a_i$

Note: 1. The data entered on this data sheet are from the totals recorded on Figure 5.1.
2. Both numbers (n_i) and area (a_i) should be recorded for each species and plot.

Figure 5.2. Terrestrial Flora Summary Data Sheet.

TERRESTRIAL FLORA CLASS SUMMARY DATA SHEET

Date_____ Observers_____ Signature_____

Habitat and Stratum_____

Location_____

Total Area Sampled (A)[1]_____ Total Number of Plots (k)_____

Species (i)	Number of Individuals (n_i)[2]	Density (D_i)	Relative Density (RD_i)	Present in How Many Plots (j_i)[2]	Frequency (f_i)	Relative Frequency (Rf_i)	Relative Coverage (C_i)	Coverage (RC_i)	Importance Value (IV_in)
Totals	δn =	δD =	δRD = 1.0		δf =	δRF =	δC =	δRC = 1.0	

[1]Plot size X number of plots (k).

[2]The data in these columns are from the totals in Figure 5.1. The data in the other columns are calculated using the equations in subsection 5.1.6.

Figure 5.3. Terrestrial Flora Class Summary Data Sheet.

by the EA Team Leader or his/her designee. The age of the forested areas will be determined using increment boring data as described in Subsection 5.1.4.1.

5.1.7. Reporting

Upon completion of the final sampling effort, the seasonal field data will be incorporated with the information obtained from agency contacts, historic published records, etc., to map the vegetation communities and, where applicable, characterize the community based on the following:

A. Species present, density, frequency, coverage, and age.

B. Presence of rare, threatened or endangered species.

C. Presence of snags, logs, or litter later.

5.2. WETLANDS DELINEATION

5.2.1. General

The criteria required by Federal regulating agencies to perform wetlands delineations are contained in the Federal Manual for Identifying and Delineating Jurisdictional Wetlands, herein referred to as the "wetlands manual." Methodologies to perform wetlands delineations are also listed in the wetlands manual. A modified routine procedure will be used to delineate and document wetlands. This modified procedure involves more detailed documentation to better characterize wetlands and upland communities. A licensed surveyor will be used to survey each wetland line.

The approach involves using documented information, such as National Wetland Inventory (NWI) maps, U.S. Geological Survey (USGS) maps, and Soil Conservation Service (SCS) maps, and lists of hydric soils to determine possible locations of wetlands.

The field procedure, which follows the information search, involves checking areas indicated by the published data, determining the boundary, and recording the information necessary to document and submit the information to the appropriate regulatory agencies.

5.2.2. Method Summary

A tract of land is regarded as a wetland if obligate, facultative-wet and/or facultative plant species comprising greater than 50 percent of the dominant vegetation are present in combination with hydric soils and evidence of standing water or soil saturation within six to 18 inches of the surface.

5.2.3. Apparatus

A checklist for wetlands delineation equipment and supplies is shown in Table V.2.

5.2.4. Cleaning of Apparatus

Field equipment will be cleaned as necessary to remove dirt before proceeding to the next sampling location.

Table V.2.

Wetlands Delineation Equipment and Supplies Checklist

_____	Hand auger
_____	Soil probe
_____	Flagging
_____	Munsell Color Chart
_____	Compass
_____	Permanent marker
_____	Aerial or topographic map
_____	Field guides to plant identification
_____	Data sheet
_____	Ziplock bags
_____	Panama angle gauge

5.2.5. Field Procedures

The procedures to be followed in making wetlands determinations are summarized in Figure 5.4. In some cases best professional judgement may be used to make wetlands determinations. The following items (letters A through D) correspond to the diagram.

A. Identify dominant plant species and note wetlands indicator status.

B. Examine soils to a depth of 20 inches using a hand auger or soil probe. If hydric soil characteristics (see wetlands manual) are present at 10 to 12 inches or the B horizon, whichever is encountered first, hydric soil conditions exist.

C. Examine the area for water, either ponded or flowing on the surface, or within the depth of the soil auger hole.

   Water may not be present, depending on the season in which sampling occurs. If water is not present, evidence of water saturation such as sediment deposits, water lines on trees, etc. (see wetlands manual for details) can be used to infer hydrology.

D. If indicators or wetlands hydrology are not present, the wetlands manual states that hydrology may be inferred from the soils information (including soil mottling and gleying).

The following steps specifically describe the procedure for determining wetlands boundaries:

A. The diagrammed procedure will be used to determine wetlands and nonwetlands boundaries.

B. Once this boundary has been established it will be flagged at approximately every 100 feet or less, depending on the denseness of vegetation. As a general guide, an observer should be able to see the previous flag from the present flag.

C. Documentation will occur at approximately 300-foot intervals or at major vegetation community changes; e.g., forest to old field or coniferous forest to deciduous forest using data from item B. Plot center points should be located in upland and wetlands communities approximately 40 to 50 feet from the delineated wetlands line.

D. Trees will be sighted from the center point using the Panama basal area angle gauge, and should be identified to the lowest taxonomic level and counted (see Methodology below).

   The Panama angle gauge is an instrument used to determine is a tree should be counted.

   The sampler must look in every direction through the instrument, and count the number of tress whose DBH appears larger than the crosspiece or aperture. The eyepiece (or vertex) or the angle-gauge should pivot on the sampling point until the count is completed, except that it may be temporarily moved sideways perpendicular to the line of sight to clear nearby brush or trees likely to mask other qualifying trees.

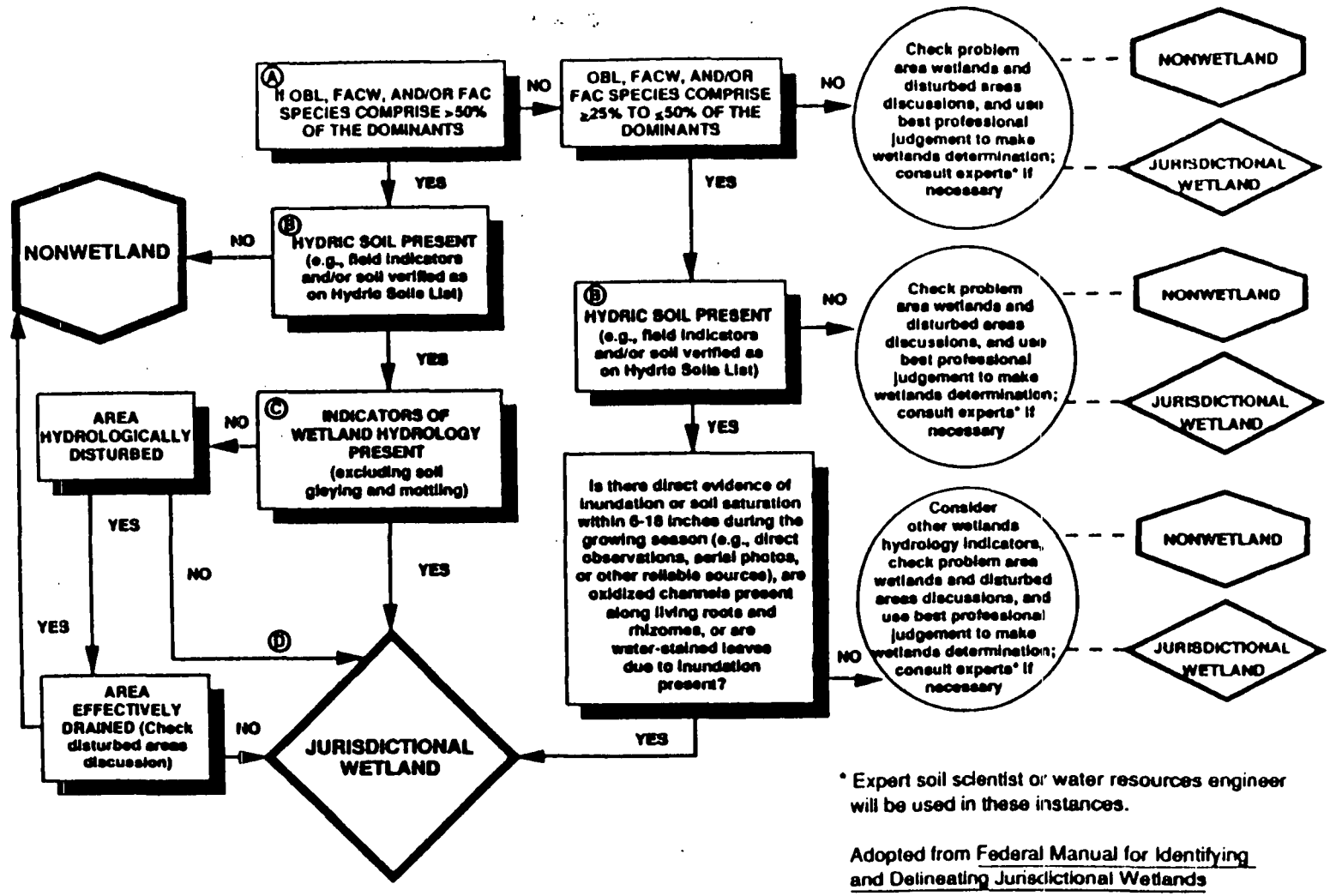

Figure 5.4. Wetlands Identification Flow Diagram.

The relative basal area will be used to determine cover class, which will be recorded on the data form (see Figure 5.5). The relative basal area used to determine cover classes for trees can be determined as shown in the following example:

A sampler has tallied three red oaks out of a total of seven trees:

Relative basal area of

$$\text{red oak} = \frac{(100)\,(\text{Number of red oaks})}{(\text{Total number of trees per plot})}$$

100 (3/7) = 43 relative basal area/plot, or cover class 4.

The cover classes, and corresponding mid-points in parentheses, are defined as:

Cover Class	Relative Basal Area
1	1 to 5% (3)
2	6 to 15% (10.5)
3	16 to 25% (20.5)
4	26 to 50% (38)
5	51 to 75% (63.0)
6	76 to 95% (85.5)
7	96 to 100% (98)

E. A circular plot will be laid out with a radius of 30 feet from the identified center point in nonwetlands and wetlands communities. The outer points of the plot will be marked with flags as necessary to visualize plot position.

F. Saplings within each plot will be identified to genus or species and percent areal cover visually estimated and a cover class assigned (see Wetlands Inventory Data Form, Figure 5.5). Each species and cover class will be recorded on the Wetlands Inventory Data Form.

G. Shrubs within each plot will be identified to genus or species and percent areal cover visually estimated and a cover class assigned. Each species will be recorded with appropriate cover class on the Wetlands Inventory Data Form.

H. Herbs within each plot will be identified to genus or species and percent areal cover visually estimated and cover classes assigned. Each species will be recorded with appropriate cover class on the Wetlands Inventory Data Form.

I. Soil series and phase will be identified and recorded on the Wetlands Inventory Data Form. Consult the soils survey for Montgomery County prior to conducting the field investigation. Soil will be examined in the center of each plot and to a depth of 20 inches. Soil horizons will be described by depth, matrix, and mottle color based on the Munsell Color Chart. This information will be recorded in the soils section of the Wetlands Inventory Data Form. Additional hydric soil indicators as described in the wetlands manual will also be recorded.

WETLANDS INVENTORY DATA FORM [1]

Project/Site: _____ Plant Community Name/Flag #: _____

Date: _____ Observer: _____ Signature: _____

VEGETATION

Plant Species	Indicator Status	Stratum[2] Cover[3]	Plant Species	Indicator Status	Stratum Cover
1.			11.		
2.			12.		
3.			13.		
4.			14.		
5.			15.		
6.			16.		
7.			17.		
8.			18.		
9.			19.		
10.			20.		

Percent of dominant species that are OBL, FACW, and/or FAC _____

Is the hydrolytic vegetation criterion met? Yes___ No___

Rationale: _____

_____

Figure 5.5. Wetlands Inventory Data Form (page 1 of 3).

WETLANDS INVENTORY DATA FORM [1]

(Continued)

SOILS

Series/phase: Subgroup:

Is the soil on the hydric soils list? Yes____ No____ Undetermined

Profile Description:

Depth	Matrix Color	Mottle Color

Other hydric soil indicators:_____

Is the hydric soil criterion met? Yes____ No

Rationale:_____

HYDROLOGY

Depth to free-standing water_____; depth to saturation_____

List other field evidence of surface inundation or soil saturation.

_____

Is the wetland hydrology criterion met? Yes____ No____

Rationale:_____

Figure 5.5. (page 2 of 3).

WETLANDS INVENTORY DATA FORM [1]

(Continued)

JURISDICTIONAL DETERMINATION AND RATIONALE

Is a the plant community a wetland? Yes_____ No

Rational for jurisdictional decision: _____

_____

[1]Data form adopted from Federal Manual for Identifying and Delineating Jurisdiction Wetlands, 1989.

[2]Stratum: Ca - canopy; Sb - subcanopy; Sp - sapling; Sh - shrub; Hb - herbaceous.

[3]Cover class midpoint: T = <1% 1 = 1-5% (3,0); 2=6-15% (10.5); 3 = 16-25% (20.5); 4 = 26-50% (38.0); 5 = 51-75% (63.0); 6 = 76-95% (85.5); 7 = 96-100% (98).

Figure 5.5. (page 3 of 3).

J. The auger hole within each plot will be examined for free standing water or soil saturation. This information will be recorded in the hydrology section of the Wetlands Inventory Data Form. Other hydrology characteristics, as described in the wetlands manual, will be noted and recorded.

K. Date, site name, plant community name (e.g., mixed deciduous wetlands, old field, wet meadow, coniferous forest), and the number of the flags on the wetlands line that correspond to the sample plot will be recorded.

Steps (c) through (k) will be repeated at every sampling location in nonwetlands and wetlands. Steps (a) through (k) should be repeated at every potential wetland identified from published data review and site reconnaissance.

The entire site should be walked over to investigate any areas that may not have been visible on NWI maps, soil surveys, or aerial photographs.

5.2.6. Raw Data

The following raw data will be obtained:

A. Plant species with corresponding strata layer and cover class.

B. Soil horizon, depth, matrix, and mottle color.

C. Other hydric soil indicators.

D. Free standing water or saturation.

E. Hydrology indicators.

5.2.7. Analysis

The following procedures will be used:

A. For each stratum, species will be ranked according to their mid-points, from highest to lowest.

B. Mid-point values of all species will be summed.

C. The dominance threshold number will be determined.

1. Mid-point values for ranked species will be summed, beginning with most abundant, until the dominance threshold number is immediately exceeded; these species are considered dominants, plus any additional species representing 20 percent or more of the total mid-point values.

2. Dominants will be identified with an asterisk (*) on the Wetlands Inventory Data Form.

D. The wetlands indicator status of each dominant will be designated.

A determination of whether the hydrolytic vegetation criteria have been met will be made using all strata.

A. When more than 50 percent of the dominant species in the sample plot are OBL, FACW, and/or FAC, hydrolytic vegetation is present.

B. If hydrolytic vegetation criteria are not met see Figure 5.5.

5.2.8. Reporting

Upon completion of the wetlands delineation, a report will be written, which will include a map of surveyed wetlands lines, data forms, and text to explain the rationale used to make the wetlands determination.

The report will follow guidelines recommended by the Army Corps of Engineers to make jurisdictional wetlands determinations.

6. QA RECORDS

All logbooks, data sheets, and computer disks containing data files generated by the terrestrial flora sampling team will be transmitted to the EA Team Leader upon conclusion of each sampling phase and the wetlands delineation.

7. SOURCES

Brower, J.E. and J.H. Zar. 1984. Field and Laboratory Methods for General Ecology.

Wildlife Techniques Manual. 1980. Sanford D. Schemitz, Ltd. 4th Edition. Wildlife Society.

Federal Interagency Committee for Wetland Delineation. 1989. Federal Manual for Identifying and Delineation of Jurisdictional Wetlands. U.S. Army Corps of Engineers.

Robertson 1980. "Observing, Photographing, and Collecting Plants." Kenneth R. Robertson, published by the Illinois Natural History Survey, State of Illinois, Circular 55, Urbana, Illinois. August 1980.

U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S. Department of Agriculture. Soil Conservation Service, Washington, D.C. Cooperative technical publication. 77 pp plus appendixes.

PROCEDURES

CONDUCTING TERRESTRIAL FAUNA SURVEY

1. INTRODUCTION

This Standard Operating Procedure (SOP) covers procedures for terrestrial habitat surveys for the Mound Site. Section 5 of this SOP describes procedures for sampling terrestrial habitats.

1.1. Purpose and Scope

The purpose of the terrestrial program is to assemble an accurate, site-specific inventory of terrestrial vertebrates and their habitats, identify important species, and determine seasonal variations in the abundance and distribution.

The study will include small mammals, game animals, birds, reptiles, and their habitats. In addition to resident populations, attention will be given to nonresident, migratory wildlife including waterfowl, raptors, and song birds. Information on threatened and endangered species will also be gathered.

Qualitative field sampling will be done on a seasonal basis using the terrestrial vertebrate sampling techniques described in this SOP. The data obtained from the field sampling and from historic records will provide a database for the ecological risk assessment. Where direct observations are impossible, unnecessary, or uneconomical, field signs and historic records will be used. The presence of threatened or endangered species will be determined in the field, if possible.

2. APPLICABILITY

2.1. Applicability of Procedure

This SOP applies to terrestrial fauna sampling and observations associated with

- collection and identification of small mammals and reptiles;
- survey of major game and migratory wildlife;
- survey and identification of resident and migratory avian species; and
- habitat characterization.

Information collected during all phases of terrestrial vertebrate sampling will also be used to address the following ecological components of the CERCLA 120 agreement:

- identification of the flora and fauna in and around the site;
- identification of sensitive environments in and around the site (e.g., wetlands, floodplains, wildlife breeding areas, etc.);

- identification of endangered species and their habitats in and around the site; and

- identification of those species consumed by humans or found in human food chains.

Data collected during the terrestrial fauna surveys will be used in the ecological risk assessment to identify species of concern to be collected and analyzed for chemical and/or radiological content during the next phase of the study. Implementation of the aquatic sampling program may also require giving attention to the other SOPs for the ecological study.

2.2. Limitations

Amphibians and reptiles indigenous to Ohio hibernate in winter and will not be sampled during that season. Winter site conditions (primarily low temperatures) will be such that many small mammals will become relatively inactive and not amenable to a trapping effort that is comparable to the other three seasons and will, therefore, not be sampled at this time.

Quantitative estimates of local population parameters are sample-size limited; therefore, the type of estimates and their precision will be dictated by seasonal sample sizes.

3. DEFINITIONS

3.1. Absolute Density

Number of organisms per unit area.

3.2. Abundance

The number of individuals of a taxon or taxa in an area.

3.3. Confidence

An interval set to define the proportion of cases in which, on average, the assertion made is true.

3.4. Diversity

A measure of the number of species and their relative abundance in a community; low diversity refers to few species or unequal abundances.

3.5. Threatened and Endangered Species

These species listed by the Department of Interior, U.S. Fish and Wildlife Services, in the Federal Register, Vol. 45, No. 242, or most recent publication; and by the State of Ohio pursuant to Ohio Administrative Rules 1501; 18-1-01 through 1501; 18-2-05.

3.6. Game

Species of vertebrate wildlife hunted by man for sport.

- identification of endangered species and their habitats in and around the site; and

- identification of those species consumed by humans or found in human food chains.

Data collected during the terrestrial fauna surveys will be used in the ecological risk assessment to identify species of concern. Ultimately, these species may be collected and analyzed for chemical and/or radiological content during the next phase of the study. Implementation of the aquatic sampling program may also require giving attention to the other SOPs for the ecological study.

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3.6. Game

Species of vertebrate wildlife hunted by man for sport.

3.7. Habitat

The locality, site, and particular type of local environment occupied by an organism.

3.8. Index

The proportional relation of counts of objects or signs associated with a given species to counts of that species in a given area; or counts of individuals reflecting changes in relative abundance in a specified area, or just locally.

3.9. Line Transect

A sampling route followed by an observer that bisects a surveyed area while counting contacts over a measured distance.

3.10. Migratory

An organism or group that moves from one habitat or location to another, periodically or seasonally.

3.11. Quadrat

A small sample plot, usually square or rectangular.

3.12. Raptor

Any kind of bird of prey (e.g., falcons, hawks, eagles, owls).

3.13. Relative Density

Density of one population relative to another; usually obtained with some biological index that is correlated with absolute density.

3.14. Robust

An estimation that is little affected by the failure of one or more assumptions.

3.15. Standard Error

The standard deviation of the sampling distribution of a statistic; in the case of sample mean, calculated as SE = ü√n.

3.16. Threatened Species

Any species that meets one of the following criteria:

A. Native species likely to become an endangered species within the foreseeable future in Ohio.

B. Species listed as threatened by the U.S. Department of Interior in the Code of Federal Regulations.

4. RESPONSIBILITIES

4.1. Ecological Assessment (EA) Team Leader

The EA Team Leader will be responsible for conducting surveillance of the terrestrial fauna sampling to ensure that field procedures are being followed in accordance with this SOP. The results of this survey will be documented in the appropriate field notebook. The EA Team Leader will have a degree in field biology and a minimum of 4 years experience. The EA Team Leader has overall responsibility for the technical quality and management of all biological characterization activities at the site. The EA Team Leader will report to the Site Manager (SM) who is responsible for overall scheduling and coordination of site characterization activities.

The EA Team Leader or his/her designee will direct all terrestrial sampling. The EA Team Leader will be assisted by field staff having specific training in the procedures implemented. The assignment of these individuals will be the responsibility of the Site Manager in conjunction with the EA Team Leader. Before the terrestrial fauna sampling team leaves for the site, it will be the responsibility of the EA Team Leader to coordinate schedules/actions with the Site Manager and to ensure that appropriate permission has been obtained for property access.

5. PROCEDURES

This section describes the field sampling and estimation procedures for small mammals, birds, amphibians, reptiles, and game animals, together with the methods for analysis of raw data. It should be noted that all plots, transects, etc. will be marked with stakes or flags so that they can be surveyed. This will facilitate mapping by the Geographical Information System (GIS) and will facilitate accurate depiction of sampling locations in the subsequent reports. In addition, a voucher collection of each small mammal, amphibian and retile species will be made. Procedures for the preparation of voucher specimens will follow the methodology presented in Wildlife Management Techniques Manual, Fourth Edition (Schemnitz 1980).

5.1. Small Animals

5.1.1. Method Summary

Live traps (e.g., Have-a-Heart, Longworth, Sherman, pitfall) will be set in large and small grids and lines. Each individual trap represents a station. Each individual grid or line represents a sampling site. Optimum sampling sites, station configuration (i.e., number of traps/site), and station spacing will be determined from aerial photographs and a site reconnaissance so that major landcover types are sampled. Large cover areas will be sampled using a large grid configuration. Smaller cover areas will be sampled using smaller grids. Large grids should involve between 25 and 50 stations, and small grids

should involve between 5 and 25 stations. Traps will be located within one (1) meter of each station in a location likely to be used by small mammals, such as runways or parallel to logs. For linear habitats, such as riparian areas along seeps, drainage ditches, canals, and ponds/settling basins, a single line of traps (transect) will be employed. Transect length will generally depend on the length of the linear habitat, but in most cases the number of stations should not be less than ten.

Traps will be set and checked at least three times a day. In the evening, traps will be set no more than three hours and no less than .5 hour before sunset. Traps will be checked the following morning, and the animals removed for examination beginning at least 0.5 hour after sunset and completed within four hours after sunrise. All sampling sites will be operated for a minimum of five consecutive days during the spring, summer, and fall sampling period. At the beginning of each sampling period, each trap will be deployed unbaited with the doors wired open for at least 24 hours at the designated locations. During this familiarization period, pitfall traps will be deployed with a covering over the opening to preclude capture of animals. At the end of this familiarization period, the traps will be baited, and the trap doors will be set. A small amount of polyester stuffing will be placed in each trap to provide bedding material.

Captured animals will be gently removed from the trap and placed in a clear plastic bag perforated with reinforced holes to avoid asphyxiation. Each animal will be identified to genus (or species, if possible), weighed to the nearest gram, and its sex and age class determined. Observations of tumors, pelage condition, malformed growth, etc. will be recorded on the field sheet. Individual marking with food color dye may be performed to estimate recapture rate as well as population number; however, it should be kept in mind that the emphasis of the program is to determine species composition rather than quantitative population analysis. Nonetheless, relative abundance information will be useful should collection for tissue analysis be necessary at a later date, since minimum sample mass requirements will dictate in some measure those species which should be targeted. To this end, a different color dye for each day will provide additional insight to population dynamics.

5.1.2. Apparatus

The following items will be required for small mammal sampling:

A. live traps,

B. polyester "stuffing" (bedding material for the traps),

C. peanut butter,

D. oatmeal,

E. flagging,

F. wire stakes,

G. metric ruler,

H. Pesola scales (0 to 50g, 0 to 500g),

I. sample bags and labels,

J. field pack,

K. field guide to small mammals,

L. gloves,

M. compass,

N. field data sheets, and

O. camera.

5.1.3. Cleaning of Apparatus

Upon completion of a trapping session, all bait material will be removed from traps manually and with warm tap water. Pesola scales will be kept in a dry environment and wiped with a clean cloth should moisture accumulate on the surface.

5.1.4. Field Procedures

Once trapping locations have been determined, trapping grids can be established with two people as follows:

A. Determine the corners of each trapping grid with a compass and measuring tape, place a flagged stake at each corner, and label it with the appropriate x,y coordinates (see Figure 5.1). (Differently colored flags will be used for the grid corners.)

B. The proper position for each trapping station will be determined with a compass and measuring tape. A stake will be placed at each station, and the flags on each stake will be labeled with the appropriate x,y coordinates.

C. One live trap will be placed at each station.

   1. Traps will be baited with a mixture of oatmeal and peanut butter (50/50) and all traps will be placed on an even surface and, if possible, near naturally occurring cover.

   2. All traps will be set and baited within three hours of sunset and checked the following morning.

   3. Animals captured will be identified by morphological and pelagic characteristics, sex will be determined by examination of the genitialia, and weight measurements will be taken with Pesola spring-balanced scales. Small mammals captured in pitfall traps will be extracted by an observer wearing leather gloves.

   4. The number and location of funnel traps or pitfall traps will also be recorded (see Subsection 5.9, Herptiles).

5.1.5. Raw Data

The data will be collected and recorded on the Animal Trapping Data Sheet, as shown in Figure 5.2.

5.1.6. Analysis and Reporting

The following information on small mammal populations will be reported:

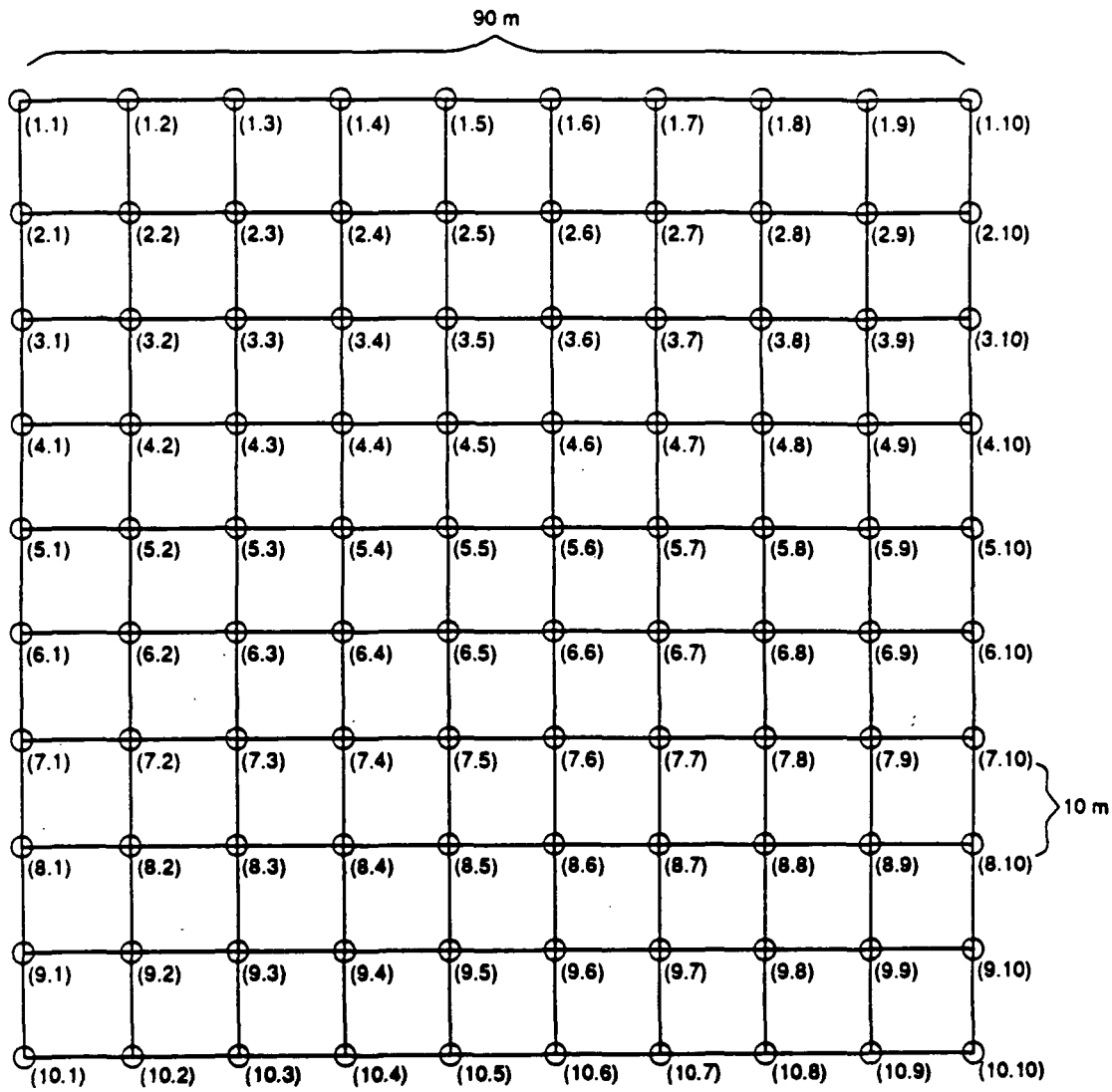

Figure 5.1. Example of a large small mammal trapping configuration and associated coordinate system.

ANIMAL TRAPPING DATA SHEET

Transect/Grid No. _____ Location _____
Date _____
Trap Spacing (m) _____ Trap Types _____ No. of Traps _____
No. Traps Sprung _____
Weather _____
Description of Transect/Grid: _____
(cover type, terrain, etc.) _____

Trap No.	Species	Sex	Weight (g)	Total Length (cm)	Tail Length (cm)	Identification No.	Comments

Name(s): _____ Signature(s): _____ Date: _____

Figure 5.2. Animal Trapping Data Sheet.

A. Age and sex distributions of all species captured.

B. Mean and standard error (SE) of the weight (g) of all species, by age and sex group.

C. An estimation of the small mammal population size (N), the SE of (N), and a 95% confidence interval for N.

5.2. White-Tailed Deer

5.2.1. Method Summary

Relative population estimates of white-tailed deer for the site will be obtained during five evening spotlight counts conducted in the spring, summer, and fall and two winter counts. Counts will be conducted by shining a spotlight from paved and unpaved roads towards known areas of deer occurrence within the site. This will only be performed during evenings when there is little or no precipitation. The number of deer observed will serve as a relative population estimate. The highest value of this ratio obtained during each season will be used for seasonal comparisons.

5.2.2. Apparatus

The field apparatus will be the following:

A. 100,000-candle-power spotlights,

B. four-wheel drive vehicle,

C. field binoculars, and

D. field data sheet.

5.2.3. Cleaning of Apparatus

All spotlights will be checked daily for potential malfunctions and will be stored in a dry environment. The only cleaning required will be the maintenance of the lens surface of the spotlights and binoculars. All moisture or debris that accumulates on lenses will be removed with a clean cloth or lens paper.

5.2.4. Field Procedures

Spotlight survey routes will be established along paved and unpaved roads within the site. The evaluation of deer population levels will proceed as follows:

A. Surveys will begin immediately after local sunset, provided there is no appreciable precipitation or fog. Two biologists/ecologists will conduct the survey.

B. The survey vehicle will proceed along roads or tracks at a speed of approximately 5 mph until deer are encountered.

C. When deer are observed, the herd (group) size will be determined by two separate counters and recorded. The vehicle will then proceed until the next encounter.

D. Spotlights will be shown simultaneously from both sides of the vehicle throughout the count and special attention will be given to forest openings (i.e., herbaceous openings and fields). A reasonable effort will be employed to limit duplicate counting of deer during each survey.

E. Spotlight surveys will be conducted five times during the spring, summer, and fall sampling seasons and twice during the winter sampling period.

F. Any observations of other wildlife will be recorded and, if necessary, this information will be transferred to the field sheets used for documentation of those species.

5.2.5. Raw Data

The number of deer seen on the site will be recorded for each survey. When possible, sex ratio information will also be determined (see Figure 5.3).

5.2.6. Analysis and Reporting

The highest number of deer seen on the site per season will be used as the "best" index to the population level. Index means and variances will also be calculated to illustrate the variability in the technique.

5.3. Birds (Transect Sampling)

5.3.1. Method Summary

Several straight transect lines, delineated with poles and markers, will be established in suitable homogeneous cover types at the site. The length, number, and position of each line will be determined from aerial photographs and site reconnaissance and will be based on cover type configurations. Transect lines will be sampled within a time period beginning 0.5 hour before sunrise and ending no later than 3 hours after sunrise. All avian species (as well as squirrels and other medium-sized mammals) encountered will be identified and sexed if possible. A minimum of three surveys, preferably five, will be conducted along each transect during the spring, summer, and fall sampling periods. A minimum of two surveys will be conducted during the winter.

5.3.2. Apparatus

The field apparatus will be the following:

A. field binoculars,

B. compass,

C. metric tape,

D. stakes,

E. flags,

F. field data sheets, and

WHITE-TAILED DEER FIELD DATA SHEET

Route Length (km) _____

Odometer Start _____ Odometer Finish _____

Start Time _____ Finish Time _____

Weather _____

Group Characteristics

Group No.	No. Male	No. Female	No. Immature	Total	Habitat Type	Comments
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

Name(s): _____ Signature(s): _____ Date: _____

Figure 5.3. White-tailed Deer Field Data Sheet.

G. field guides

H. Tape records and tapes of owl vocalizations.

5.3.3. Cleaning of Apparatus

A clean, soft cloth or lens paper, in the case of binoculars, will be used to remove moisture or debris as it accumulates on binocular lenses, compasses, or metric tapes.

5.3.4. Field Procedures

5.3.4.1. Establishing Transect Lines

A simple approach to defining the transect line is to locate an end point and then follow a specified compass heading, marking the line with flagged stakes placed at convenient intervals. A metric tape or measuring wheel will be used to determine the exact length of each line. All transect lines will be placed a minimum of 100 meters apart to avoid duplication of observations.

5.3.4.2. Survey Methods

The order in which transects are sampled and their starting points will be rotated daily to avoid confounding time-of-day effects. All surveys will begin at 0.5 hour before local sunrise. Surveys will only be conducted on days with little or no precipitation and when the average wind speed is $\leq$ 15 mph. The conditions used to estimate wind speed are included in Table V.1. The observer will travel along the transect at a slow walk and will scan both sides of the transect for avian species and squirrels (see subsection 5.3). Once an object is sighted or heard, it will be identified as to species, sexed (if possible), and its perpendicular distance to the transect line estimated directly or by recording the sighting distance and sighting angle. The observer will then continue the survey until all lines are sampled.

A nocturnal survey will be conducted between 10:00 p.m. and 2:00 a.m., and vocalizations of owls indigenous to Ohio will be played. Broadcasting stops along survey routes will be spaced at predetermined intervals. Several calls will be played at each stop, followed by a 30- to 60-second period of silence, after which the sequence will be repeated. Investigators will stay at each stop for 10 minutes, and all raptors responding to calls will be recorded by species, stop number, and direction of vocalization. A minimum of three surveys (both nocturnal and diurnal) will be conducted during the spring, summer, and fall; at least one winter survey will be conducted.

Any raptor seen soaring over the study area during any phase of the terrestrial sampling will be identified as to species (if possible) and its location recorded. Active or abandoned raptor nests encountered during the fall, winter, and spring surveys will be plotted on a map of the study area and detailed information recorded. Any regurgitated pellets encountered during field work will be collected and placed in a plastic bag with labels of the time and location where sampled for subsequent determination of the species that produced them. All pellets will be retained in the study archive collection for future analysis. These pellets may also be analyzed at a later date for radionuclide analysis.

Table V.1. The Beaufort Wind Scale

U Number	Wind	Knots	mph	m/s	Wind on Land
0	Calm	<1	<1	<0.2	Air still; smoke rises vertically.
1	Light air	1-3	1-3	0.3-1.5	Smoke drifts downwind but vanes remain stationary.
2	Light breeze	4-6	4-7	1.6-3.3	Wind felt on face; leaves rustle, vanes moved.
3	Gentle breeze	7-10	8-12	3.4-5.3	Leaves and twigs move constantly; wind extends small flag.
4	Moderate breeze	11-16	13-18	5.5-7.9	Wind raises dust and loose paper and moves small twigs and branches.
5	Fresh breeze	17-21	19-24	8.0-10.7	Small trees in leaf begin to sway. Crested wavelets form on inland waters.
6	Strong breeze	22-27	25-31	10.8-13.8	Large branches move, telegraph wires whistle, umbrellas difficult to control.
7	Strong breeze	28-33	32-38	13.9-17.1	Whole trees move; some wind resistance offered to walkers.
8	Fresh gale	34-40	39-46	17.2-20.7	Twigs break off trees; greatly impedes progress of walkers.
9	Strong gale	41-47	47-54	20.8-24.4	Slight structural damage; chimney pots and roof tiles removed.

Table V.1.
(continued)

Beaufort Number	Effects Caused by Wind	Wind Speed: Knots	Wind Speed: mph	Wind Speed: m/s	Wind on Land
10	Whole gale	48-55	55-63	24.5-28.4	Much structural damage; trees uprooted; seldom experienced inland.
11	Storm	56-65	64-75	28.5-32.6	Widespread damage; very rarely experienced inland.

5.3.5. Raw Data

The raw data recorded for the avian transect survey include:

- species,
- sex (if possible),
- sighting angle,
- sighting distance,
- perpendicular distance,
- transect identifying location, and
- length.

Figure 5.4 illustrates which data will be collected and how the data will be recorded. Detailed information on raptors' nests will be recorded on the Raptor Nest Field Sheet (see Figure 5.5).

5.3.6. Reporting

Information on the number of individuals and the species composition of each cover type sampled will be presented by season. The abundance and diversity of raptors encountered during the surveys will be presented in raw form. All other data collected will be presented in raw tabular form.

5.4. Amphibians and Reptiles

5.4.1. Method Summary

A minimum of three drift fences and three quadrats will be used to sample amphibian and reptile fauna at the Mound site. The sampling locations will be identified from aerial photographs and site reconnaissance. Drift fences will be placed parallel to diverse habitat boundaries to capture animals moving across vegetation gradients. If any surface water is present, a drift fence will be positioned between the water and the adjacent habitat types.

Animals captured in pitfall and funnel traps or during quadrat searches will be identified, weighed, sexed (if possible), and released. Selected animals will be preserved with a 10% formalin solution, and kept in the archive collection (provided they are not a threatened or endangered species). If data permit, diversity indices will be calculated by major cover types. The ratio of amphibian and reptile observations per search effort will also be calculated for each quadrat. Amphibians and reptiles associated with surface water will be identified during the aquatic sampling and collected with dip nets and/or seines.

In an effort to record hard-to-find species, information on herptiles seen or heard during the nocturnal raptor survey will also be recorded.

AVIAN/SQUIRREL TRANSECT SURVEY FORM

Survey No. _____ Location _____
Sky Condition _____ Wind Start _____ Wind Finish _____
Time Start _____ Time Finish _____
Transect Length (m): L_1 = ___ L_2 = _____ L_3 = _____ L_4 = _____ L_5 = _____
Transect Length (m): L_6 = ___ L_7 = _____ L_8 = _____ L_9 = _____ L_{10} = _____
Description of Survey: _____
(cover type, terrain, etc.)

Object Number	Species	Transect Number	Perpendicular Distance	Sighting Distance	Sighting Angle	Comments

Name(s): _____ Signature(s): _____ Date: _____

Figure 5.4. Avian and Squirrel Transect Survey Form.

RAPTOR NEST FIELD DATA SHEET

Project _____ Site No. _____

Location _____

Species _____

_____

Description of Nest Site: _____

Nest Substrate _____
(Tree species, cliff, etc.)

Height of Substrate (m) _____

Height of Nest Above Ground (m)_____

Active _____ Inactive_____

No. of Eggs or Young_____

Elevation _____

Exposure _____

Vegetation Type_____

Comments:

_____

_____

_____

_____

_____

Name(s): _____

Signature(s): _____

Date: _____

Figure 5.5. Raptor Nest Field Data Sheet.

5.4.2. Apparatus

The field apparatus will be the following:

A. pitfall traps,

B. funnel traps,

C. aluminum flashing,

D. metal stakes,

E. flagging,

F. snake staff,

G. specimen jars,

H. 10% formalin solution,

I. specimen labels,

J. field guide to herptiles,

K. gloves,

L. cloth handling bags,

M. Pesola scales (0 to 50 grams, 0 to 500 grams),

N. metric ruler and tape,

O. field data sheets,

P. masonite or plywood covers,

Q. pick,

R. shovel,

S. tape recorder, and

T. blank tapes.

5.4.3. Cleaning of Apparatus

All pitfall an funnel traps will be wash with tap water and dried completely after each sampling session. Aluminum flashing will be hosed off and dried after each sampling session. Cloth specimen bags will be washed in detergent and dried after each sampling session. Pesola scales will be cared for and cleaned following guidelines provided by the manufacturer.

5.4.4. Field Procedures

5.4.4.1. Drift Fences and Pitfall and Funnel Traps

Drift fences made from aluminum flashing (50 cm wide and 30 meters long) will be placed in a 10-cm trench with galvanized metal stakes set at each end of the flashing. Two 19 L pitfall traps and two funnel traps will be placed on each side of the fence. The pitfall traps will be buried flush with the soil surface and positioned at each end of the fence. Aluminum funnel rims will be inserted into each pitfall trap, and a masonite or plywood cover (1 to 2 inches above the surface) will be placed over all traps to provide shade and to attract animals. All traps will be checked daily.

5.4.4.2. Quadrats (50 m x 50 m)

At predetermined locations 50-m x 50-m quadrats will be established with the aid of a compass and metric tape. The four corners of the plate will be located, and a flagged stake will be placed in each corner. Nylon string will be used to delineate the quadrat boundaries. Quadrats will be searched for herptiles by systematically walking through each plot, removing surface litter, and inspecting all possible retreats such as logs, flat rocks, etc.

Individuals captured by trap or during quadrat searching will be weighed, sexed (if possible), and their length measured (tip of snout to tip of tail). Individuals observed, but not captured, will be recorded with as much detail as possible.

Amphibians and reptiles associated with surface water will be identified by walking the perimeter of the water body and collecting with dip nets.

In an effort to record hard-to-find species, tape recordings of evening calls will be recorded during the nocturnal raptor surveys. Amphibians and reptiles observed on or along roadways during night surveys for deer will also be recorded.

5.4.5. Raw Data

The data collected will include:

A. The number, sex (if possible), weight, length, and location of all species captured.

B. The number of species observed during sampling, but not collected, and their locations.

C. Species identified during the nocturnal raptor surveys (either visually or based on vocalizations) and their locations.

5.4.6. Analysis and Reporting

The abundance and diversity of species trapped or observed will be used to generate a species list and to indicate the relative abundance among cover types and sites. Species diversity indices, Shannon-Wiener and/or Brillouin, will be calculated for each site and major cover type, if sample size permits.

6. QA RECORDS

All documentation generated as a result of this procedure will be retained as quality assurance records in accordance with the QAPP. At a minimum, the following will be retained as QA records:

A. field data collection sheets,

B. field maps, and

C. field notebooks.

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PROCEDURES FOR CONDUCTING

AQUATIC BIOLOGICAL SURVEYS

1. INTRODUCTION

This Standard Operating Procedure (SOP) covers field surveys of aquatic habitats, including streams and ponds, for the Mound Site using a combination of qualitative and quantitative techniques.

1.1. PURPOSE AND SCOPE

The aquatic program is designed to assemble an accurate, site-specific inventory of aquatic organisms and their habitats. The program will also provide data on seasonal variation in abundance, diversity, distribution, and dominance of selected groups of aquatic organisms. Existing environmental stresses influencing population and community structure in the aquatic systems will also be identified where possible.

The study will include sampling of fish and benthic macroinvertebrates and will seek to identify State and Federal threatened and endangered species where prior information suggests they may be present.

The aquatic sampling techniques described in this SOP represent standard and approved field methods, which will ensure that sound quantitative comparative analyses may subsequently be made. Selection of specific techniques appropriate to each sample location will be made on the basis of site conditions found during site reconnaissance.

2. APPLICABILITY

2.1. APPLICABILITY OF PROCEDURE

This SOP applies to aquatic sampling activities associated with:

A. Fish collection, preservation, and identification.

B. Macroinvertebrate collection, preservation, and identification.

C. Habitat characterization.

Information from the foregoing activities will also be used to address the following ecological components of the CERCLA 120 agreement:

- identification of the flora and fauna in and around the site;
- identification of sensitive environments in and around the site (e.g., wetlands, floodplains, wildlife breeding areas, etc.);
- identification of endangered species and their habitats in and around the site;
- identification of those species consumed by humans or found in human food chains.

Data collected during the aquatic biological surveys will be used in the ecological risk assessment to identify species of concern to be collected and analyzed during the next phase of the study for chemical and/or radiological content. Implementation of the aquatic sampling program may also require attention be given to the other SOPs for the ecological assessment.

Because subcontractors may be used for some or all of the sorting and identification of macroinvertebrate samples, this SOP also applies to subcontractors chosen for such work.

2.2. LIMITATIONS

The limitations associated with fish sampling using electroshocking gears, include the following:

A. The equipment does not work well in water temperatures below 50°F.

B. The equipment is somewhat selective in its ability to stun fish relative to species and size.

C. Some fish may be injured or killed during collection.

D. The equipment does not work well in waters of extremely low or high specific conductance.

2.3. HAZARDS

Hazards in the implementation of the aquatic program involve the use of high-voltage electricity to stun and capture fish (electroshocker), the use of boats on open water, and the use of preservatives to fix and preserve fish and macroinvertebrates. Preservatives to be used are formalin, ethanol, and isopropanol.

All field sampling personnel will be trained in the proper and safe use of all fish sampling equipment, especially, but not limited to, the safe use of the electrofishing equipment. At no time will field personnel operate equipment alone or without prior safety training. Each person sampling from a boat will be equipped with an appropriate flotation device. Processing of samples fixed with preservatives will occur under appropriate laboratory hoods or outdoors.

3. DEFINITIONS

3.1. AQUATIC MACROINVERTEBRATES

Animals that are large enough to be seen by the unaided eye and can be retained by a U.S. Standard No. 30 sieve (28 meshes per inch, 0.595-mm openings) and live at least part of their life cycles within or upon available substrates in a body of water or water transport system. The major taxonomic groups to be found in freshwater are the insects, annelids, molluscs, flatworms, roundworms, and crustaceans.

3.2. ESTIMATED CAPTURE PROBABILITY

The probability of capturing all fish in a stream reach on two removal passes using the removal method as described by the U.S. Fish and Wildlife Service (1983). Estimated capture probability is computer as follows:

$$P = 1 - \frac{U_2}{U_1}$$

U_1 = The number of fish removed (captured) on the first pass.

U_2 = The number of fish removed (captured) on the second pass.

3.3. THREATENED AND ENDANGERED SPECIES

Those species listed by the Department of the Interior, U.S. Fish and Wildlife Service, in the Federal Register, Vol. 45, No. 242, or most recent publication; and by the State of Ohio pursuant to Ohio Administrative Rules 1501; 18-1-01 through 1501; 18-2-05.

3.4. FORAGE FISH

Those species of fish, which, because of their size, diet, feeding habits, and reproductive strategy, are preyed upon by game fish and are generally not pursued by sport fisherman except for use as bait. Typical forage fish include minnows (Cyprinidae) and suckers (Catostomidae).

3.5. GAME FISH

Those species of fish for which there are usually state regulations governing seasons, size limit, and/or creel limit and which are routinely sought by sport fishermen for consumption. Typical game fish include, but are not limited to, black bass, crappie, sunfish (Centrarchidae), temperate bass (Percichthyidae), perch (Percidae), and catfish (Ictaluridae).

3.6. INDICATOR SPECIES

Species whose presence or absence may be characteristic of environmental conditions in a particular habitat.

3.7. INTERMITTENT STREAM

A stream that does not have perennial flow and does not meet the definitions of perennial stream (see definition for perennial stream). This also applies to stream reaches, which during all or part of the year, are present as isolated pools.

3.8. LENTIC SYSTEM

Lentic systems are those with standing water and its various intergrades, such as lakes, ponds, and swamps.

3.9. LIMITING FACTOR

Any condition that approaches or exceeds the limits of tolerance of an organism or group of organisms.

3.10. LIMNETIC ZONE

An area within a lake or pond with sufficient light extinction due to depth or turbidity to prevent encroachment of rooted vegetation.

3.11. LOTIC SYSTEM

Lotic systems are those found in running/moving water, such as streams or rivers.

3.12. MACROBENTHOS

Aquatic macroinvertebrates, which, at the time of sampling, are living within or upon the substrate.

3.13. PERENNIAL STREAM

A body of water flowing in a channel or bed composed primarily of substrates associated with flowing waters and is capable, in the absence of pollution or other manmade stream disturbances, of supporting a benthic macroinvertebrate community composed of two or more recognizable taxonomic groups of organisms that are large enough to be seen by the unaided eye and that can be retained by a U.S. Standard No. 30 sieve (28 meshes per inch, 0.595-mm openings) and live at least part of their life cycles within or upon available substrates in a body of water or water transport system.

3.14. SEASONAL STREAM

A stream that is present as either an intermittent or perennial stream for any period of time of less than one year.

3.15. SPECIES

A unit of classification of organisms, consisting of those individuals actually or potentially sharing a common gene pool.

3.16. SUBSTRATE

The surface on or in which aquatic organisms live.

4. RESPONSIBILITIES

The Ecological Assessment (EA) Team Leader will be responsible for overseeing site activities to ensure that the field procedures described in this SOP are being followed. The results of the survey will be documented in the appropriate field notebook. The EA Team Leader will have a degree in field biology and a minimum of four years experience. He/she has overall responsibility for the technical quality and management of all biological characterization activities at the site. The EA Team Leader reports to the Site Manager (SM) who is responsible for overall scheduling and coordination of site characterization activities.

The EA Team Leader or his/her designee will direct all aquatic sampling. The EA Team Leader will be assisted by field staff having specific training in the procedures to be implemented. The assignment of those individuals will be the responsibility of the Site Manager in conjunction with the EA Team Leader.

It will be the responsibility of the EA Team Leader to secure an Ohio scientific collecting permit prior to any fish sampling activities. Permits will be secured for those streams and ponds in which sampling activities will be conducted. All conditions of the collecting permit will be strictly adhered to during all sampling activities. Permits will be secured from the Ohio Department of Natural Resources.

It will be the responsibility of the EA Team Leader or his/her designee to inspect sampling apparatus prior to field use to ensure that it is in proper and safe working order. This will be done before leaving the office or site trailer.

The results of the equipment check will be recorded in the appropriate logbook. It will also be the responsibility of the EA Team Leader or his/her designee to obtain containers and the preservatives before sampling and to ensure that samples are preserved properly and are not contaminated. Before the aquatic sampling team leaves for the site, it will be the responsibility of the EA Team Leader to coordinate schedules/actions with the Site Manager (SM) and to ensure that appropriate permission has been obtained for property access.

5. PROCEDURES

The subsections that follow describe the field sampling and estimation procedures for fish and macroinvertebrates together with the methods for analysis of raw data. Sampling will be performed in the spring and fall.

5.1. FISH

5.1.1. Method Summary

The primary methods to be used to collect fish at Mound will be the electroshocking and sieving methods. The sampling team may also want to consider the use of trap nets and hook and line.

Because each sampling location will be sampled iteratively over the course of two seasons, all captured fish, except for those retained for the voucher collection, will be returned unharmed to the water after length measurements have been taken.

Any observations or collections of herptiles during stream or pond sampling will be noted, and this information will be given to the terrestrial fauna sampling team. This information will include, but may not necessarily be limited to, number of specimens, species, sex (when identifiable), and any applicable physical measurements such as length, identifying marks, etc., and will be consistent with the information requirements specified in the SOP for terrestrial fauna sampling.

5.1.2. Apparatus

A list of equipment and supplies needed to perform fish sampling at the potential sites is provided in Table V.1.

5.1.3. Cleaning of Apparatus

All fish sampling apparatus will be rinsed as necessary with water from the sampling area before proceeding to the next sampling area.

5.1.4. Field Procedures

5.1.4.1. General

Both streams and ponds will be sampled at the site and control areas. It is recommended that a voucher collection of representative species be established and archived, with the

TABLE V.1.

EQUIPMENT AND SUPPLIES CHECKLIST FOR FISH SAMPLING

_____	Seine nets
_____	Boat-mounted electroshocker
_____	Backpack electroshocker with two fully charged batteries
_____	Scoop nets
_____	Boat and engine
_____	Waders
_____	Life jackets
_____	Camera and film
_____	Logbook
_____	Waterproof pen
_____	Label paper
_____	Sample containers
_____	Formaldehyde
_____	Measuring board
_____	Weight scales
_____	Velocity meter
_____	Measuring stick
_____	Live bucket
_____	Cooler
_____	Wet ice
_____	Tape measure
_____	Watch with second hand
_____	Appropriate references
_____	pH meter
_____	Conductivity meter
_____	Dissolved oxygen meter
_____	Thermometer
_____	Spare gas can with gas
_____	Engine oil
_____	Tool box with appropriate tools
_____	Battery charger
_____	Outboard fuel tank with gas line
_____	Spare gas line
_____	Outboard engine oil

exception of any threatened or endangered species that are identified. Representative samples will be preserved at the sample site in 10 percent buffered formalin in plastic jars. A label will be placed in each sample container and will contain the following information.

A. Site designation (e.g., stream or pond designation, sample location designation, and replicate number).

B. Date.

C. Preservative.

D. Signature of collector(s).

E. Sampling device.

Numbers and species of fish observed but not collected during sampling will be noted on the Field Data Sheet (see Figure 5.1) as will any recognized spawning or nursery areas. Recognized symptoms of parasitism, disease, malformation, tumors, and general physical condition will also be noted. A general diagram of the sampling area, including distances from the shore, will be recorded on the Field Data Sheet.

The occurrence of threatened or endangered species will be reported to appropriate authorities. In the event large numbers of fish are captured and are at risk because of the time necessary to weigh and measure each individual fish, subsampling may be performed for length frequency measurements. Captured fish will be measured for standard length, i.e., the length from the tip of the snout to the end of the caudal peduncle along the mid-lateral line, and total length. Sampling for fish in streams and ponds requires different approaches, as detailed in the subsections that follow.

5.1.4.1. Streams and Ditches

Reaches will be sampled in each stream and ditch having a resident population of fish. The number and location of the sampling areas (ponds) or reaches (streams) has been identified in the work plan but may be revised during the site reconnaissance. Sample locations will be established in such a way that a comparable estimate of fish in each stream reach is obtained. Accordingly, fish sampling in streams will be performed as follows:

A. The sample location, or reach, will be stop-netted at the downstream end, using a 1/4-inch mesh seine net. If the upstream portion of the sample area is located at a fish passage restriction area, the upstream end does not have to be stop-netted. The upstream and downstream stop-nets will have the same mesh size. The sample reach or reaches will be long enough to include a representation of the habitats found in the stream within the site boundary. Sample reaches may or may not be contiguous.

B. Two or more field personnel equipped with a backpack electroshocker and long-handled dip-nets will make a removal pass by going first upstream and then downstream. At least two passes will probably have to be made for adequate sampling, and three or more passes may be needed unless the efficiency of the sampling gear is very high.

FIELD DATA SHEET FOR THE AQUATIC PROGRAM

Site Name_____ Date_____
Station No._____ Arrival Time_____
Methods and Equipment_____ Depart Time_____
Team Members_____

Weather: Clear, Partly Cloudy, Overcast, Drizzle, Rain.
Wind: Still, Breeze, Stiff, Storm.
Air Temperature _____°C.

STREAM/POND DESCRIPTION

Stream/Pond Name_____
Tributary to_____
River System_____ River/Stream Flow_____ ft/cu ft
Access Road_____ Pond Surface Area_____ sq ft
County_____
State_____
USGS Quad Map_____
Other Maps_____
Description of Access_____

Type/Volume	Distance from Station
Source_____	____ ft Up/Down ____ °C
Tributaries_____	____ ft Up/Down ____ °C
Springs_____	____ ft Up/Down ____ °C
Barriers_____	____ ft Up/Down ____ ft high
Diversions/Channels_____	____ ft Up/Down ____ ft long
Point-Source Pollution_____	____ ft Up/Down ____
Nonpoint-Source Impacts_____	____ ft Up/Down ____

Watershed %: Canyon_____ Mountains_____ Hills_____ Rolling_____ Flat____
Swampy____ Wooded____ Open Cultivated____ Open Fallow____ Suburban____
Urban_____ (= 100%).
Subsoil_____

STATION DESCRIPTION

Station Length _____ ft
Upper Boundary _____
Lower Boundary _____

Figure 5.1. Field Data Sheet for the Aquatic Program

FIELD DATA SHEET FOR THE AQUATIC PROGRAM

(Continued)

Distance to Other Stations ____No. ____ft Up, ____No. ____ft Down
Photographs: Picture No.____ Roll No.____ Date Developed_____
Altitude____
Gradient____
Stream Condition: Overflowing, Full, Summer Pool, Low
Average Width ____ ft
Depth (1/4)____ft, (1/2) ____ft, (1/4)____ft, Average ____ft, Maximum Depth ____ft
Volume ____ cu ft
Velocity ____ ft/sec
Estimated Depth Fluctuation ____ ft

Bank %: Overhang____ Steep____ Sloping____ Flat____ (= 100%).

Diking: Rock____ Dirt____ Sand____ Grass____ Trees____ (= 100%).

		Length	Width	Depth	
Pools No._____	Average	___ft	___ft	___ft	Lower Hydraulic Control Depth___ft
Area %_____	Maximum	___ft	___ft	___ft	
Riffles No._____	Average	___ft	___ft	___ft	
Area %_____	Maximum	___ft	___ft	___ft	

Substrate %: Bedrock____ Boulder____ Large Cobble____
Small Cobble____ Gravel____ Sand____ Detritus____
Vegetation____ (= 100%)

Water Temp._____ °C
Color_____
Turbidity: _____ ft (Secci disk)
pH_____
Conductivity_____
Alkalinity_____

Figure 5.1. (page 2 of 3)

FIELD DATA SHEET FOR THE AQUATIC PROGRAM

(Continued)

Plants

Emergent:
Submergent:
Algae:

Invertebrates

Caddisflies:
Mayflies:
Diptera:
Stoneflies:
Beetles:
Other Insects:
Crustacea:
Miscellaneous:

	Species	Number	Size Range (Standard Length/Total Length)
Fish:			

Figure 5.1. (page 3 of 3)

C. Fish collected in each pass will be placed in 5-gallon plastic buckets filled site water and returned unharmed to the stream or ditch after physical measurements have been taken.

During sampling, fish observed but not collected will be noted on the Field Data Sheet (Figure 5.1), as will any spawning or nursery areas.

5.1.4.3. Ponds, Basins and Other Standing Water

Fish sampling will be performed in each pond, basin, etc. identified in the work plan as capable of supporting or known to support a fish population. These include, but may not necessarily be limited to the overflow pond, the retention basins, the south pond in the Miamisburg Municipal Park, and offsite control waterbodies selected during the reconnaissance investigation. For larger bodies of water, such as the overflow pond, the use of a boat may be necessary. Personnel involved with the collection of fish from boats must be equipped with personal flotation devices and be experienced with the operation of small boats.

Electrofishing will be the primary method used to collect fish from standing water. Backpack electrofishing units may be used along the shores, but deeper areas (greater than 1.5 m) will require the use of a properly equipped boat. Personnel involved with the use of electrofishing equipment must be experienced with the use of such equipment and will be required to read and understand the manufacturer's manual for specific operating instructions. The operator and supporting personnel must wear rubber gloves while operating a boat-mounted electroshocker and wear hip or chest waders while using the backpack unit.

In addition to electrofishing equipment, trap nets and hook-and-line may be used, especially if initial efforts at electrofishing are unsuccessful due to high or low specific conductance of the water. Trap net is a general term used to describe a net or device which works in a passive manner, i.e., they are dependent on unprecipitated, natural fish movement. Trap nets which are appropriate to the types of habitat present at the Mound Site include crayfish traps, minnow traps, hoop nets, and gill nets. All trap nets will be deployed in such a way to be consistent with their design and intended use. Hook-and-line refers to sport fishing equipment and trotlines. All traps and trotlines developed outside of the controlled property boundaries will be identified with a tag stating Ohio scientific collection permit number, and name, company and phone number of person(s) to whom permit is issued. Traps and trotlines will be checked at least twice a day and captured specimens, if alive, will be returned unharmed to the water subsequent to collecting weight, length, and general appearance information.

Electrofishing will be performed in each pond, basin, etc., until no new species are encountered and the EA team leader feels assured that an adequate representation of the fish population has been obtained. For those areas requiring a boat, at a minimum, two complete revolutions will be made around the littoral area and a thorough sampling will be made in the limnetic zone.

5.1.5. Raw Data

The following raw data will be recorded during the fish sampling on the Field Data Sheet, shown in Figure 5.1:

A. Meteorological conditions.

B. Water temperature.

C. Dissolved oxygen.

D. Ph.

E. Species found.

F. Number of fish of each species per removal pass (steam/ditch only).

G. Relative abundance of individual species.

H. Standard and total length of captured fish.

5.1.6. Analysis

Species lists, numbers present, and length frequencies in each fish sample will be prepared for abundance and species composition. Estimated rapture probability will be computed where appropriate.

5.1.7. Reporting

Upon completion of the final sampling effort, the seasonal field data will be incorporated with the information obtained from agency contacts, a records search, etc., to determine, where applicable, the condition of the fish community based on the following:

A. Abundance and species composition within the community.

B. Size distribution of important species populations.

C. Limiting factors such as point and nonpoint source impacts, altered stream channels, etc.

D. General condition of fish, i.e., relative occurrence of ectoparasites, tumors, hook wounds, etc.

E. Presence of threatened or endangered species.

5.2. MACROINVERTEBRATES

5.2.1. Method Summary

The benthic macroinvertebrate population present in the sediments of rivers, streams, and ponds may be quantitatively estimated by removing a known volume or sampling a known area, using standard equipment, and identifying and counting the organisms contained in the sample. Replicate samples are taken to avoid bias resulting from patchiness induced by local differences in bottom structure and composition. The data derived may be statistically analyzed to provide insight into species diversity, abundance, similarity between sample stations, and different water bodies. This also provides the basis for

future comparison in the event that alterations are made to the environment. When compared to the results from the control station(s), some assessment may be possible as to the biological integrity of the study area.

Where quantitative sampling is not possible, qualitative sample techniques may be used. Methods such as kick-net sampling provide information on species diversity and relative abundance.

5.2.2. Apparatus

A list of equipment and supplies needed to perform macroinvertebrate sampling at the site is presented in Table V.2.

5.2.3. Cleaning of Apparatus

All macroinvertebrate sampling equipment will be rinsed as necessary with water from the sampling area before proceeding to the next sampling area. All samplers will be inspected between replicate samples to ensure that they have been cleaned of collected material that could compromise the integrity of subsequent samples.

5.2.4. Field Procedures

5.2.4.1. General

Macroinvertebrate sampling will be performed in perennial streams and ponds at the site and control areas. Streams or stream reaches on-site will be sampled only if water is present for a sufficient period of time to support a reproducing, indigenous community (see definition of perennial stream, Section 3).

Stream and pond samples will be preserved in the field with 70 percent ethanol and placed in plastic containers. A label will be placed in each replicate container and will contain the following information:

A. Site data (e.g., stream or pond designation, sample location designation, and replicate number).

B. Date.

C. Preservative.

D. Signature of collector(s).

E. Sampling device.

5.2.4.2. Qualitative Sampling

Riffles, pools, undercut banks, macrophyte or algal beds, roots, mats, and other major habitats will be sampled in streams and ponds, where applicable, with a triangular kick net and by selectively hand-picking sticks, leaf packs, rocks, etc. Sampling will be terminated when available habitats have been sampled and no new species are encountered.

TABLE V.2.

EQUIPMENT AND SUPPLIES CHECKLIST FOR MACROINVERTEBRATE SAMPLING

_____	Ponar dredge (petite)
_____	Ekman dredge
_____	Hester-Dendy multiple plate samplers
_____	Portable invertebrate box sampler
_____	Surber sampler
_____	Hess sampler
_____	Triangular or D-frame kick net
_____	Tweezers
_____	No. 30 mesh sieve
_____	Buckets
_____	Small brush
_____	Squeeze bottle
_____	Ethanol
_____	Tape measure
_____	Velocity meter
_____	pH meter
_____	Conductivity meter
_____	Dissolved oxygen meter
_____	Thermometer
_____	Logbook
_____	Waterproof pen
_____	Boat and engine
_____	Waders
_____	Life jackets
_____	Camera and film
_____	Label Paper
_____	Sample containers
_____	Measuring stick
_____	Cooler

5.2.4.3. Quantitative Sampling

Streams. Quantitative data will be obtained in each perennial stream or ditch using either a Hester-Dendy multiple-plate artificial substrate sampler. Deployment and retrieval of the Hester-Dendy samplers will be as described in Biological Criteria for the Protection of Aquatic Life, Volume III (Ohio EPA, 1989). All samplers will be exposed for a six-week period. If conditions such as shallow water prevent the use of these samplers, triangular-frame kick nets may be substituted. The type of gear, dimensions, and mesh size will be recorded on the Field Data Sheet, as shown in Figure 5.1. Three replicates will be collected at each sampling area. Sample locations have been identified in the work plan, but may be revised based on the site reconnaissance. Exact sample locations will be chosen to represent distinct stream reaches, as determined by habitat according to the U.S. Fish and Wildlife Service Methods for Evaluating Stream, Riparian, and Biotic Conditions (Platts et al. 1983).

Ponds. Quantitative data will be obtained in each pond, retention basin, etc., using either an Ekman or Ponar dredge having a jaw opening of 152 x 152 cm. A transect of a least three dredge samples will be taken. All dredge samples will be washed in a No. 30 mesh (520 microns) in the field. The type of gear used and number of dredge samples collected will be recorded on the Field Data Sheets.

5.2.5. Raw Data

The following raw data will be recorded:

A. Meteorological conditions.

B. Water temperature.

C. Dissolved oxygen.

D. pH.

E. Habitat description.

Macroinvertebrate samples preserved in the field will be returned to the laboratory for sorting, picking, identification, and analysis. Sample preparation will be as follows:

A. All samples will be sorted in a white enamel pan illuminated with a circline lamp and using a dissecting microscope with magnification as necessary.

B. All organisms will be sorted into properly labeled jars containing 70 percent isopropanol.

C. Sample analysis will include the following:

1. Taxonomy -- The macroinvertebrates will be enumerated and identified to at least genus using appropriate current systematic keys and the data recorded on a laboratory bench sheet, shown in Figure 5.2. Samples may be split to expedite processing. Procedures for subsampling are defined in Elliot (1977) and in EPA (1973). In addition, a plankton splitter may be employed to subsample large numbers of chironomid larvae. A voucher collection of each taxon will be maintained in 70% isopropanol.

2. Historical data -- When available, historical data obtained during contacts with agencies will be compared to data derived from the site-specific study.

BENTHOS LAB BENCH SHEET

Site Name _____ TIMS No. _____

Body of Water _____ Replicate No. _____

County and State _____ Station No. _____

Type Sample _____ Date Collected _____

Collector(s) _____ Identified by _____ Date(s) Identified _____

Diptera	L(N)	P	Total	Dry Wt. (mg)
Chironomidae				
Trichoptera				
Ephemeroptera				
Plecoptera				
Odonata				
Coleoptera				

Heteroptera		
Megaloptera		
Crustacea		
Bivalvia		
Gastropoda		
Annelida		
Oligochaeta		
Other		

Total No. of Individuals _____

Total No. of Taxa _____

Diversity Index (d) _____

Equitability (e) _____ Signed By _____

Biotic Index (B.I.) _____ Date Signed _____

Figure 5.2. Benthos Lab Bench Sheet

5.2.6. Analysis

The quantitative numerical data will be subjected to parametric statistical analyses after data transformation (e.g., $4\sqrt{X}$) where this is appropriate. These analyses will include Student's t-test or analysis of variance (alpha = 0.05) of the number of individuals per unit area and number of taxa.

To further define the characteristics of the macroinvertebrate community, a number of nonparametric community analyses will be applied to both quantitative and qualitative data including the following:

A. Diversity index (Shannon-Wiener or Brillouin).

B. Evenness.

C. Percentage similarity of community (PCS).

D. Jaccard coefficient.

E. Sorensen coefficient.

F. Morisita-Horn index.

G. Hilsenhoff biotic index.

5.2.7. Reporting

The following will be reported:

A. A taxonomic list and abundance data will be reported for each sample site by season.

B. The results of the parametric analyses will be reported by season in relation to habitat.

C. The results of the nonparametric analyses will be reported by season in relation to habitat.

D. The presence of threatened or endangered species.

6. QA RECORDS

All field data sheets, laboratory bench sheets, logbooks, and maps generated as part of the aquatic biological surveys will be transferred to the EA Team Leader upon completion of the survey.

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APPENDIX A

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Table IV.1. Summary of Proposed Monitoring Wells

Well Number	State Plane Coordinates X (ft)	State Plane Coordinates Y (ft)	Proposed Location	Approximate Drilling Depth (ft)	Formation at Total Depth	Location of Well Screen	Objectives	Continuous Sediment/ Bedrock Sampling	Estimated Number of Geochemical Samples (a)	Number of Geotechnical Samples	Borehole Geophysical Logging
0322	1497453.0	598875.0	Near asphalt-lined pond	30.0	Bedrock (first water)	Bedrock (first water)	- Determine groundwater quality in a potential source area. - Investigate changing stratigraphy at the northern edge of the tributary valley. - Sample soil every 5 ft from surface to total well depth to monitor possible contamination.	X	6 (b)		
0323	1495541.0	597894.0	South of WD Building	30.0	Bedrock (first water)	Bedrock (first water)	- Determine groundwater quality in a potential source area. - Investigate stratigraphy changes on the border of the Main Hill and the tributary valley. - Sample soil every 5 ft from surface to total well depth to monitor possible contamination.	X	6 (b)		
0324	1495741.0	597097.0	South of WD Building	30.0	Bedrock (first water)	Bedrock (first water)	- Determine groundwater quality in a potential source area. - Investigate stratigraphy changes on the border of the Main Hill and the tributary valley. - Sample soil every 5 ft from surface to total well depth to monitor possible contamination.	X	6 (b)		
0325	1496751.89	597281.47	Slope of SM/PP Hill, east of Building 49	35.0	Bedrock (first water)	Bedrock (first water)	- Determine shallow bedrock groundwater quality on the SM/PP Hill. - Investigate shallow water levels in fractured bedrock in cluster with deep bedrock well 0355.				
0326	1497206.0	597433.0	SM/PP Hill	30.0	Bedrock	Shallow bedrock (first water)	- Determine stratigraphy in bedrock at SM/PP Hill. - Determine shallow bedrock groundwater quality on the SM/PP Hill. - Investigate water levels in fractured bedrock.	X	4 (h)		
0327	1493858.0	600775.0	City of Miamisburg	25.0	Upper BVA (water table)	Upper BVA (water table)	- Determine background groundwater quality in Upper BVA upgradient of Mound. - Determine vertical hydraulic gradients between Upper and Lower BVA (cluster with well 0328). - Flush-mount casing.				
0328	1493858.0	600775.0	City of Miamisburg	150.0	Top bedrock	Lower BVA (just above bedrock)	- Determine background groundwater quality in Lower BVA upgradient of Mound. - Determine vertical hydraulic gradients between Upper and Lower BVA (cluster with well 0327). - Determine stratigraphy in BVA. - Sample to determine geotechnical properties of the Upper BVA, till, and Lower BVA. - Use borehole geophysics to investigate lithologies in the Buried Valley. - Flush-mount casing.	X	2 (c)		X (f)
0329	1497046.0	602194.0	Library Park - City of Miamisburg	25.0	Upper BVA (water table)	Upper BVA (water table)	- Determine background groundwater quality in Upper BVA upgradient of Mound. - Determine vertical hydraulic gradients between Upper and Lower BVA (cluster with well 0330). - Flush-mount casing.				
0330	1497046.0	602194.0	Library Park - City of Miamisburg	150.0	Top bedrock	Lower BVA (just above bedrock)	- Determine background groundwater quality in Lower BVA upgradient of Mound. - Determine vertical hydraulic gradients between Upper and Lower BVA (cluster with well 0329). - Determine stratigraphy in BVA. - Sample to determine geotechnical properties of the Upper BVA, till, and Lower BVA. - Use borehole geophysics to investigate lithologies in the Buried Valley. - Flush-mount casing.	X	2 (c)		X (f)
0331	1498269.0	599008.0	City of Miamisburg, Muncipal Golf Course	20.0	Weathered bedrock (first water)	Weathered bedrock (first water)	- Determine groundwater quality in shallow bedrock east of Mound deposits. - Determine stratigraphy and investigate water level in shallow weathered bedrock or unconsolidated deposits. - Flush-mount casing.	X	2 (c)		
0332	1497244.26	598887.22	NE corner of Plant	35.0	Bedrock (first water)	Bedrock (first water)	- Determine groundwater quality in shallow bedrock on northeast border of Mound. - Determine stratigraphy and investigate water level in shallow fractured bedrock.	X	2 (c)		
0333	1494067.0	598966.0	Near river west of well 0138. Location dependent on site access.	50.0–80.0	Lower BVA	Lower BVA (just below till)	- Determine groundwater quality in Lower BVA. - Determine stratigraphy of unconsolidated sediments. - Flush-mount casing.	X	2 (c)		X (f)
0334	1494067.0	598966.0	Near river west of well 0138. Location dependent on site access.	30.0	Upper BVA	Upper BVA (water table)	- Determine groundwater in Upper BVA. - Cluster with well 0333. - Flush-mount casing.				
0335	1494705.0	598535.0	Adjacent to northern portion of Miami-Erie Canal	60.0	Deep bedrock (river stage)	Deep bedrock (river stage)	- Determine effects of river stage on deep bedrock water levels. - Determine stratigraphy and deep groundwater quality in bedrock. - Use borehole geophysics to investigate lithologies in the fractured bedrock. - Flush-mount casing.	X	2 (c)		X (g)

Table IV.1. (Page 2 of 4)

Well Number	State Plane Coordinates X (ft)	State Plane Coordinates Y (ft)	Proposed Location	Approximate Drilling Depth (ft)	Formation at Total Depth	Location of Well Screen	Objectives	Continuous Sediment/ Bedrock Sampling	Estimated Number of Geochemical Samples (a)	Number of Geotechnical Samples	Borehole Geophysical Logging
0336	1496197.12	600346.45	NW of plant in area of seep water ponding near railroad tracks.	50.0–100.0	Top bedrock	Upper BVA or Lower BVA * Contingent	– Determine background groundwater quality in BVA northwest of Mound. – Determine stratigraphy to bedrock by continuous core. – If saturated thickness great enough, monitor vertical hydraulic gradients (cluster with well 0337); if BVA is relatively thin, complete at water table. – Flush–mount casing. – Optional: to be drilled if thick saturated BVA is found at 0336.	X	2 (c)		
0337	1496201.52	600403.51	NW of plant in area of seep water ponding near railroad tracks.	35.0	Upper BVA (water table) * Contingent	Upper BVA (water table) * Contingent	– Determine background groundwater quality in Upper BVA northwest of Mound. – Monitor vertical hydraulic gradients between the Upper and Lower BVA, if they both exist when clustered with well 0336. – Flush–mount casing.				
0340	1494716.0	597699.0	West of well 0312	30.0–50.0	Top bedrock	Lower BVA (just above bedrock)	– Determine groundwater quality in Lower BVA. – Determine bedrock–BVA interaction (cluster with well 0341). – Possible flush–mount casing.				
0341	1494716.0	597699.0	West of well 0312	50.0	Bedrock (approx. 10 ft into it)	Bedrock (approx. 10 ft into it)	– Determine stratigraphy of the BVA as it develops to the west of the Main Hill. – Determine groundwater quality in bedrock. – Determine bedrock–BVA interaction (cluster with well 0340). – Sample to determine geotechnical properties of the Upper BVA, till, and Lower BVA. – Use borehole geophysics to investigate the stratigraphy of the Buried Valley and the lithologies of the fractured bedrock. – Possible flush–mount casing.	X	2 (c)	2 (d)	X (f)
0342	1494543.0	596171.0	Adjacent to wells 0156, 0157, and 0304	150.0	Top bedrock	Lower BVA (just above bedrock)	– Complete cluster with wells 0156, 0157, and 0304 to determine vertical hydraulic gradients in and between the Upper and Lower BVA. – Determine stratigraphy of the BVA and geotechnical properties of the Upper BVA, till, and Lower BVA. – Investigate clay mineralogy with XRD. – Determine groundwater quality in the Lower BVA just above bedrock. – Use borehole geophysics to investigate the lithologies in the Buried Valley. – Flush–mount casing.	X	2 (c)	6 (d,e)	X (f)
0343	1494497.67	597140.92	Adjacent to 0303	150.0	Top bedrock	Lower BVA (just above bedrock)	– Complete cluster with wells 0303 and 0383 to determine vertical hydraulic gradients in and between the Upper and Lower BVA. – Determine stratigraphy of the BVA and geotechnical properties of the Upper BVA, till, and Lower BVA. – Investigate clay mineralogy with XRD. – Determine groundwater quality in the Lower BVA just above bedrock. – Use borehole geophysics to investigate the lithologies in the Buried Valley. – Flush–mount casing.	X	2 (c)	6 (d,e)	X (f)
0344	1495144.0	595512.0	Adjacent to well 0319	150.0	Top bedrock	Lower BVA (just above bedrock)	– Cluster with well 0319 to determine vertical hydraulic gradients between the Upper and Lower BVA. – Determine stratigraphy of the BVA and geotechnical properties of the Upper BVA, till, and Lower BVA. – Determine groundwater quality in the Lower BVA just above bedrock. – Use borehole geophysics to investigate the lithologies in the Buried Valley. – Flush–mount casing.	X	2 (c)	6 (d)	X (f)
0345	1496360.53	597596.09	South of plant drainage ditch north of Building 49	80.0	Top bedrock	Outwash just above bedrock	– Determine stratigraphy and geotechnical properties of the unconsolidated sediments in the tributary valley. – Determine groundwater quality coming from the SM/PP Hill to the unconsolidated sediments of the tributary valley. – Use borehole geophysics to investigate the lithologies in the Buried Valley.	X	6 (b)		X (f)
0346	1496008.0	597591.0	South of plant drainage ditch in test–fire area	100.0	Bedrock (approx. 10 ft into it)	Bedrock (approx. 10 ft into it)	– Determine stratigraphy and geotechnical properties of the unconsolidated sediments in the tributary valley. – Determine groundwater quality coming from the SM/PP Hill into the tributary valley. – Use borehole geophysics to investigate the lithologies in the Buried Valley.	X	2 (c)	2 (d)	X (f)

Table IV.1. (Page 3 of 4)

Well Number	State Plane Coordinates X (ft)	State Plane Coordinates Y (ft)	Proposed Location	Approximate Drilling Depth (ft)	Formation at Total Depth	Location of Well Screen	Objectives	Continuous Sediment/ Bedrock Sampling	Estimated Number of Geochemical Samples (a)	Number of Geotechnical Samples	Borehole Geophysical Logging
0347	1495088.0	597322.0	North of plant drainage ditch; adjacent to wells 0137 and 0315	120.0	Top bedrock	BVA just above bedrock	- Cluster with wells 0137 and 0315 to determine vertical gradients in the unconsolidated deposits at the mouth of the tributary valley. - Determine stratigraphy and geotechnical properties of the unconsolidated sediments in the tributary valley. - Determine groundwater quality in the deep unconsolidated deposits at the mouth of the tributary valley. - Use borehole geophysics to investigate the lithologies in the Buried Valley.	X	6 (b)		X (f)
0348	1495753.31	599033.04	Next to well 0113	200.0	Deep bedrock (river stage)	Deep bedrock (river stage)	- Determine stratigraphy of the fractured bedrock beneath the Main Hill. - Determine river stage effects on deep bedrock groundwater levels. - Determine groundwater quality in deep bedrock. - Use borehole geophysics to investigate lithologies in fractured bedrock.	X	2 (c)		X (g)
0349	1496174.75	598084.23	Southwest of C.O.S. Building	150.0	Deep bedrock (river stage)	Deep bedrock (river stage)	- Determine stratigraphy of the fractured bedrock beneath the Main Hill. - Determine river stage effects on deep bedrock groundwater levels. - Determine groundwater quality in deep bedrock. - Use borehole geophysics to investigate lithologies in fractured bedrock.	X	4 (h)		X (g)
0350	1497093.27	596458.5	South of Building 105 near road	200.0	Deep bedrock (river stage)	Deep bedrock (river stage)	- Determine stratigraphy of the fractured bedrock beneath the SM/PP Hill. - Determine river stage effects on deep bedrock groundwater levels. - Determine groundwater quality in deep bedrock. - Use borehole geophysics to investigate lithologies in fractured bedrock.	X	2 (c)		X (g)
0351	1497091.13	596395.95	Cluster with 0350	25.0	Bedrock (first water)	Bedrock (first water)	- Determine shallow bedrock water levels and water quality in a cluster with well 0350. - Complete in first saturated zone in weathered bedrock or above bedrock contact.				
0352	1495457.22	596587.84	Along road east of well 0063	60.0	Deep bedrock (river stage)	Deep bedrock (river stage)	- Determine stratigraphy of the unconsolidated deposits and bedrock west of the SM/PP Hill. - Determine river stage effects on deep bedrock groundwater levels. - Determine groundwater quality in deep bedrock. - Use borehole geophysics to investigate lithologies in fractured bedrock. - Cluster with Operable Unit 1 – well 0382.	X	2 (c)		X (g)
0353	1495615.12	596242.85	Spoils area at base of SM/PP Hill	35.0	Bedrock (first water)	Bedrock (first water)	- Determine stratigraphy of the shallow bedrock in the spoils area southeast of the SM/PP Hill. - Determine shallow bedrock water levels and groundwater quality. - May need an extended length of well casing and an extended length of protective casing due to the potential for addition of materials to the spoils area.	X	2 (c)		
0354	1496935.34	595670.72	South slope of SM/PP Hill near well 0817 and seep 0609	120.0	Shallow bedrock (first water)	Shallow bedrock (first water)	- Determine stratigraphy of the fractured bedrock south of the SM/PP Hill. - Determine groundwater quality in deep bedrock.	X	2 (c)		
0355	1496747.68	597225.89	Cluster with 0325	150.0	Deep bedrock (river stage)	Deep bedrock (river stage)	- Clustered with well 0325 to give water levels in the shallow and deep bedrock on the SM/PP Hill. - Determine stratigraphy of the fractured bedrock south of the SM/PP Hill. - Determine groundwater quality in deep bedrock. - Use borehole geophysics to investigate lithologies in fractured bedrock.	X	2 (c)		X (g)
0356	1495345.62	594970.45	Near well 0320 on SW edge of plant	150.0	Top bedrock	Lower BVA (just above bedrock)	- Cluster with well 0320 to determine vertical hydraulic gradients between the Upper and Lower BVA. - Determine stratigraphy of the BVA to bedrock. - Determine groundwater quality in the Lower BVA. - Provide control point for seismic survey; deep.	X	2 (c)		
0383	1494461.96	597116.98	Adjacent to wells 0303 and 0343	40.0	Upper BVA (water table)	Upper BVA (water table)	- Complete cluster with wells 0303 and 0343 to determine vertical hydraulic gradients in and between the Upper and Lower BVA. - Determine groundwater quality in the Upper BVA at water table.				
0384	1496888.6	598394.88	Upper parking lot near Building 98	70.0	Top bedrock	Outwash just above bedrock	- Complete at the boundary of the unconsolidated deposits and bedrock to monitor groundwater levels and quality in a potential source area. - Determine stratigraphy, and sample soil every 5 ft from the surface to the total depth of the well to monitor possible contamination.	X	14 (b)		

Table IV.1. (Page 4 of 4)

Well Number	State Plane Coordinates X (ft)	State Plane Coordinates Y (ft)	Proposed Location	Approximate Drilling Depth (ft)	Formation at Total Depth	Location of Well Screen	Objectives	Continuous Sediment/ Bedrock Sampling	Estimated Number of Geochemical Samples (a)	Number of Geotechnical Samples	Borehole Geophysical Logging
0385	1494925.68	597595.05	Southwest of Building 72	120.0	Top bedrock	Upper BVA (water table)	- Determine stratigraphy in the transitional area between the tributary valley and the BVA. - Determine water level and groundwater quality in the Upper BVA at water table. - Possible flush-mount casing.	X	2 (c)		
0386	1494905.39	597412.43	West of well cluster 0137, 0315, and 0347	120.0	Top bedrock	* Contingent (see Figure 4.3)	- Pilot well for wells 0389, 0390, and 0391. - Determine stratigraphy in the transitional area. - Will be clustered to determine vertical gradients and vertical changes in groundwater quality in and between the Upper and Lower BVA.	X	2 (c)	6 (d)	
0387	1494901.72	597233.4	West of NPDES Outfall 0002	120.0	Top bedrock	* Contingent (see Figure 4.4)	- Pilot well for well 0392. - Determine stratigraphy in the transitional area. - Will be clustered to determine the vertical gradient and vertical changes in groundwater quality in the Upper BVA or between the Upper and Lower BVA.	X	2 (c)		
0388	1494822.52	596881.16	Across railroad tracks west of overflow pond	120.0	Top bedrock	Upper BVA (water table)	- Determine stratigraphy in the transitional area. - Determine water level and groundwater quality in the Upper BVA at water table. - Flush-mount casing.	X	2 (c)		
0389	1494904.54	597385.53	Clustered with 0386	* Contingent	* Contingent	* Contingent (see Figure 4.3)	- Will be clustered with well 0386 to determine vertical changes in hydraulic gradient and groundwater quality. - Optional: Drilling contingent on lithologies found in well 0386. See Figure 4.3 for drilling options.				
0390	1494904.96	597359.4	Clustered with 0386	* Contingent	* Contingent	* Contingent (see Figure 4.3)	- Will be clustered with well 0386 to determine vertical changes in hydraulic gradient and groundwater quality. - Optional: Drilling contingent on lithologies found in well 0386. See Figure 4.3 for drilling options.				
0391	1494904.54	597334.05	Clustered with 0386	* Contingent	* Contingent	* Contingent (see Figure 4.3)	- Will be clustered with well 0386 to determine vertical changes in hydraulic gradient and groundwater quality. - Optional: Drilling contingent on lithologies found in well 0386. See Figure 4.3 for drilling options.				
0392	1494897.83	597185.21	Clustered with 0387	* Contingent	* Contingent	* Contingent (see Figure 4.4)	- Will be clustered with well 0387 to determine vertical changes in hydraulic gradient and groundwater quality. - Optional: Drilling contingent on lithologies found in well 0387. See Figure 4.4 for drilling options.				

(a) See Table IV.5 for details of geochemical analytical parameters.
(b) Take geochemical samples every 5 ft from surface to the top of bedrock (area of suspected source).
(c) Take one geochemical sample in vadose zone and one at water table (boreholes not expected to have contaminated soil).
(d) Take two geotechnical samples from the Upper BVA, two from the Lower BVA, and two from the glacial till aquitard; if unconsolidated deposits are thin, take two samples below the water table and above bedrock.
(e) Take three samples from clay-rich horizons: one from the till, one from a clay-rich unit in the upper outwash, and one from a clay-rich unit in the lower outwash.
(f) Natural gamma ray logs only.
(g) Borehole video, full waveform sonic, caliper, guard resistivity, neutron, gamma density, natural gamma radiation, resistivity, temperature, and borehole flowmeter.
(h) Take one geochemical sample every 5 ft from ground surface to 20 ft below ground surface.

BVA - Buried Valley aquifer

NPDES - National Pollution Discharge Elimination System

XRD - X ray diffraction

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Table IV.2. Summary of Proposed Piezometers

Piezometer Number	State Plane Coordinates X (ft)	State Plane Coordinates Y (ft)	Proposed Location	Approximate Drilling Depth (ft)	Formation at Total Depth	Location of Well Screen	Objectives	Comments	Continuous Sediment/ Bedrock Sampling
P016	1493268.71	5969551.78	At old wells 0008 and 0108 along river.	20	Upper BVA (water table)	Upper BVA (water table)	- Provide correlation of water level with river stage - Regional water gradients - Part of continuous water level monitoring network	River gauge to be installed next to well to provide information of river influences. Completed at water table.	X
P017	1493287.70	596412.0	West of well 0130 along river.	20	Upper BVA (water table)	Upper BVA (water table)	- Provide correlation of water level with river stage - Regional water gradients	River gauge to be installed next to well to provide information of river influences. Completed at water table.	X
P018	1494211.37	596457.11	East of well 0130.	20	Upper BVA (water table)	Upper BVA (water table)	- Water level in BVA	Completed at water table.	X
P019	1492970.13	597751.65	West of river.	20	Upper BVA (water table)	Upper BVA (water table)	- Determine if river serves as a hydraulic barrier	Completed at water table.	X
P020	1492957.55	596965.0	West of river.	20	Upper BVA (water table)	Upper BVA (water table)	- Determine if river serves as a hydraulic barrier	Completed at water table.	X
P021	1496019.71	597760.98	Tributary valley north of Building 43.	30	Bedrock (first water)	Bedrock (first water)	- Replace 0242 and 0042 - Determine stratigraphy - Water level on northern edge of tributary valley	Completed in first water in bedrock.	X
P022	1495410.83	597537.93	North of plant drainage ditch near Building 42.	25	Upper BVA (water table)	Upper BVA (water table)	- Water level and flow directions on western end of tributary valley - Pair with P023 to determine vertical gradients between outwash and bedrock	Completed at water table.	
P023	1495417.71	597472.67	North of plant drainage ditch near Building 42.	60	Bedrock (approx. 10 ft into it)	Bedrock (approx. 10 ft into it)	- Pair with P022 to determine vertical hydraulic gradients between bedrock and outwash caused by water flowing from the Main Hill - Stratigraphy	Will be completed at top of bedrock.	X
P024	1496165.61	597435.06	Test fire area north of Building 87.	60	Bedrock	Upper BVA (water table)	- Water level - Stratigraphy	Completed at water table.	X
P025	1494933.04	596282.0	West of well 0071.	40	Upper BVA (water table)	Upper BVA (water table)	- Water level - Determine effect of production wells on groundwater flow	Completed at water table.	
P026	1494830.50	596172.26	West of well 0071.	40	Upper BVA (water table)	Upper BVA (water table)	- Water level - Determine effect of production wells on groundwater flow	Completed at water table.	
P027	1495122.63	596313.48	East of well 0071.	40	Upper BVA (water table)	Upper BVA (water table)	- Water level at base of spoils area - Determine effect of production wells on groundwater flow	Completed at water table.	
P028	1494964.70	596075.31	West of well 0271.	40	Upper BVA (water table)	Upper BVA (water table)	- Water level - Determine effect of production wells on groundwater flow	Completed at water table.	
P029	1494840.69	595963.79	West of well 0271.	40	Upper BVA (water table)	Upper BVA (water table)	- Clustered with P030 - Water level - Determine effect of production wells on groundwater flow - Determine vertical gradient between Upper and Lower BVA	Completed at water table.	
P030	1494853.64	595920.13	West of well 0271.	100	Bedrock	Lower BVA (just below till)	- Clustered with P029 - Determine how production wells affect hydraulic gradients - Determine vertical gradient between Upper and Lower BVA - Stratigraphy	Completed at top of lower BVA; drill P038 first to bedrock to determine completion depths for P035, P036, and P037.	X
P031	1495174.37	596030.73	Northeast of well 0076.	40	Upper BVA (water table)	Upper BVA (water table)	- Water level at base of spoils area - Determine effect of production wells on groundwater flow	Completed at water table.	X
P032	1494985.56	595766.06	Southwest of well 0076.	40	Upper BVA (water table)	Upper BVA (water table)	- Water level - Determine effect of production wells on groundwater flow	Completed at water table.	X
P033	1495364.57	5958843.90	East of well 0076.	80	Bedrock	Upper BVA (water table)	- Determine effect of production wells on groundwater flow from spoils area - Stratigraphy	Drill to bedrock. Completed at water table.	X

Table IV.2. (page 2 of 2)

Piezometer Number	State Plane Coordinates X (ft)	State Plane Coordinates Y (ft)	Proposed Location	Approximate Drilling Depth (ft)	Formation at Total Depth	Location of Well Screen	Objectives	Comments	Continuous Sediment/ Bedrock Sampling
P034	1494694.35	595602.43	West of well 0076 and old Route 25.	40	Upper BVA (water table)	Upper BVA (water table)	- Monitor groundwater flow southwest of well 0076 in BVA	Completed at water table.	X
P035	1493449.24	597861.70	Along river west of well 0301.	20	Upper BVA (water table)	Upper BVA (water table)	- Determine regional gradient and vertical gradients in Upper BVA and between Upper and Lower BVA	Completed at water table.	
P036	1493443.59	597828.68	Along river west of well 0301.	80	Upper BVA (just above till)	Upper BVA (just above till)	- Determine regional gradient and vertical gradients in Upper BVA and between Upper and Lower BVA	Completed at base of Upper BVA.	
P037	1493440.14	597795.88	Along river west of well 0301.	120	Lower BVA (just below till)	Lower BVA (just below till)	- Determine regional gradient and vertical gradients in Lower BVA and between Upper and Lower BVA	Completed at top of Lower BVA.	
P038	1493433.88	597764.45	Along river west of well 0301.	150	Bedrock	Lower BVA (just above bedrock)	- Determine regional gradient and vertical gradients in Lower BVA - Stratigraphy	Completed at base of Lower BVA; drill P038 first to bedrock to determine completion depths	X
P039	1493524.69	595219.16	Along river west of Saxony Road.	20	Upper BVA (water table)	Upper BVA (water table)	- Determine regional gradient and vertical gradients in Upper BVA and between Upper and Lower BVA	Completed at water table.	
P040	1493537.84	595184.13	Along river west of Saxony Road.	80	Upper BVA (just above till)	Upper BVA (just above till)	- Determine regional gradient and vertical gradients in Upper BVA and between Upper and Lower BVA	Completed at base of Upper BVA.	
P041	1493549.56	595153.28	Along river west of Saxony Road.	120	Lower BVA (just below till)	Lower BVA (just below till)	- Determine regional gradient and vertical gradients in Lower BVA and between Upper and Lower BVA	Completed at top of Lower BVA.	
P042	1493564.33	595116.48	Along river west of Saxony Road.	150	Bedrock	Lower BVA (just above bedrock)	- Determine regional gradient and vertical gradients in Lower BVA - Stratigraphy	Completed at base of Lower BVA; drill P042 first to bedrock to determine completion depths for P039, P040, and P041.	X

BVA - Buried Valley aquifer

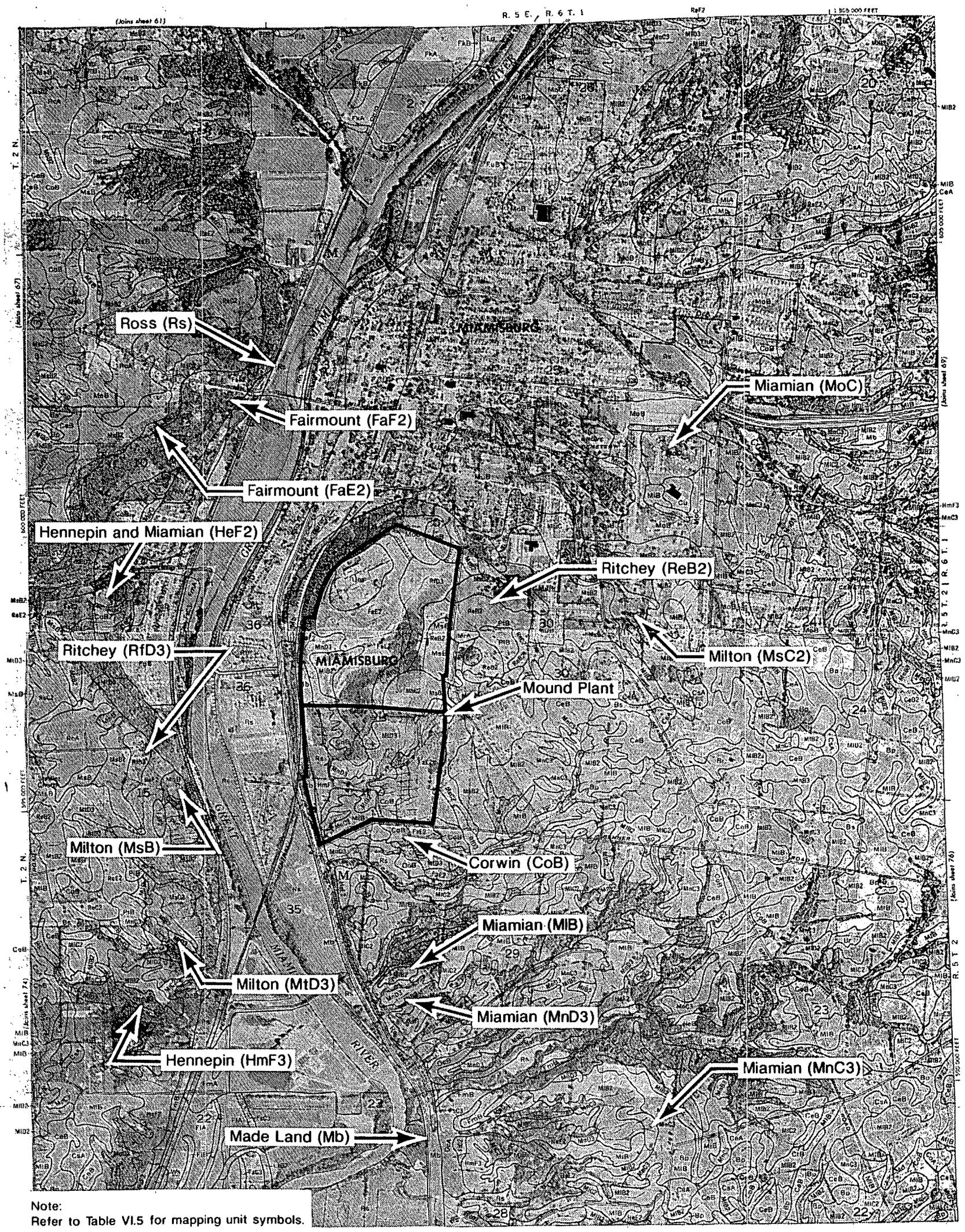

Figure 6.1. Background soil sampling locations ≤ 1.0 mile from Mound Plant.