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ERM-MIDWEST, INC., REMEDIAL INVESTIGATION & RISK ASSESSMENT, PADDYS RUN ROAD SITE, CROSBY TOWNSHIP, HAMILTON, OHIO, REV 1 VOL 1 OF 5 SECTIONS 1-3, - (USED AS A REFERENCE IN THE OU 5 RI REPORT)

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Remedial Investigation and Risk Assessment Report

Paddys Run Road Site (PRRS)
Crosby Township, Hamilton, Ohio

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Volume 1 of 5: Sections 1 through 3
1.0 Introduction
2.0 PRRS Investigation
3.0 Physical Characteristics of the Study Area

Revision 1
May 27, 1994

Submitted to:

The Ohio EPA,

Southwest District Office

401 E. Fifth Street
Dayton, Ohio 45402-2911

Submitted by:

The PRRS Companies

P.O. Box 26683
Richmond, Virginia 23261-6683

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VOLUME 1

TABLE OF CONTENTS

Section	Title	Page
1.0	INTRODUCTION	1-1
1.1	Purpose of the Report	1-4
1.2	Study Area Background	1-4
1.2.1	Study Area Description	1-4
1.2.2	Study Area History of the Companies' Facilities	1-6
1.2.3	Summary of Previous Investigations in the General Area by Governmental Agencies	1-12
1.2.4	Summary of Investigations by the Companies Prior to the AOC	1-13
1.2.5	Summary of Phase I RI Investigations Previously Reported by the Companies	1-15
1.3	Overview of Existing Reports Related to Field Investigations	1-19
1.3.1	Phase I Investigations	1-19
1.3.2	Phase II Investigations	1-22
1.4	Organization of the RI/RA Report	1-23
2.0	PRRS INVESTIGATIONS	2-1
2.1	Surface Features	2-1
2.1.1	PRRS Setting	2-1
2.1.2	Facilities Setting	2-3
2.2	Meteorological Investigations	2-16
2.3	Land Use and Population	2-17
2.4	Ecological Investigations	2-17
2.5	Chemical Source Investigations	2-18
2.6	Surface Water Investigations	2-19
2.6.1	March 1990 Surface Water Sampling Event	2-20

VOLUME 1 (Continued)

Section	Title	Page
	2.6.2 May 1991 Surface Water Sampling Event	2-23
2.7	Sediment Sampling	2-25
	2.7.1 March 1990 Sediment Sampling Event	2-27
	2.7.2 May 1991 Sediment Sampling Event	2-27
2.8	Geological Investigations	2-30
2.9	Unsaturated and Saturated Soil Investigations	2-30
2.10	Groundwater Investigations	2-38
2.11	Groundwater Modeling	2-69
	2.11.1 Regional Flow Model Development	2-71
	2.11.2 Local Flow Model Development	2-73
	2.11.3 Solute Transport Model Development	2-73
2.12	Determination of Chemical Backgrounds at PRRS	2-78
3.0	PHYSICAL CHARACTERISTICS OF THE STUDY AREA	3-1
3.1	Results of Surface Features Investigation	3-1
	3.1.1 Companies' Sumps, Underground Pipelines and USTs	3-2
	3.1.2 Non-Company USTs and Specialty Paint Mixing Facility	3-6
3.2	Meteorology	3-7
3.3	Population and Land Use	3-10
	3.3.1 Population	3-10
	3.3.2 Industry, Farmland and Recreational Areas	3-13
	3.3.3 Surface Waters as Potential Exposure Routes	3-14
	3.3.4 Groundwater as a Drinking Water Source	3-15
	3.3.5 Direction of Groundwater Flow and Location of Wells Associated with the Study Area	3-19
	3.3.6 Availability of Alternate Water Sources	3-20
	3.3.7 Human Use of or Access to the Companies' Properties and Adjacent Areas	3-20
	3.3.8 Future Population Growth and Land Use	3-21

VOLUME 1 (Continued)

Section	Title	Page
3.4	Source Area Characterization	3-23
3.5	Background Comparison Values of Chemicals	3-51
3.6	Surface Water Characterization	3-61
3.6.1	Physical Characteristics of Paddys Run	3-61
3.6.2	Physical Characteristics of the Cooling Pond	3-68
3.6.3	Paddys Run and Pond Chemical Characteristics	3-68
3.7	Sediment Characterization	3-71
3.7.1	Physical and Chemical Properties of Sediments in Paddys Run	3-73
3.7.2	Physical and Chemical Properties of Sediments in the Drainage Ditches	3-74
3.7.3	Physical and Chemical Properties of Sediments in the Cooling Pond	3-76
3.8	Geology	3-76
3.8.1	Geologic Setting	3-81
3.8.2	Bedrock Formations	3-81
3.8.3	Chemistry and Mineralogy	3-83
3.8.4	Composition above Bedrock	3-86
3.9	Characterization of the Unsaturated and Saturated Soils	3-89
3.9.1	Surface Soils	3-90
3.9.2	Unsaturated Subsurface Soils	3-100
3.9.3	Saturated Subsurface Soils	3-110
3.10	Hydrogeologic Investigations	3-128
3.10.1	Regional Hydrogeology	3-128
3.10.2	Study Area Hydrogeology	3-166
3.11	Groundwater Flow Modeling	3-196
3.11.1	Regional Flow Model	3-196
3.11.2	Local Flow Modeling	3-231

VOLUME 1 (Continued)

LIST OF FIGURES

Figure	Title	Page
1-1	Summary Schedule of PRRS Project Investigations - RI Phase I	1-2
1-2	Summary Schedule of PRRS Project Investigations - RI Phase II	1-3
1-3	Study Area Location Map	1-5
1-4	A&W Facility	1-8
1-5	RNC Facility	1-11
1-6	Well/Cistern Map-1989	1-16
1-7	Locations of Organic Vapors Detected Along the Perimeter of A&W and RNC Properties-1989	1-18
1-8	Total Concentration of Benzene, Toluene, Xylene and Cumene Measured During the Soil Gas Survey of the RNC Property-1989	1-20
2-1	Paddys Run Road Site	2-2
2-2	A&W Facility	2-5
2-3	Topographical Features of the A&W Facility	2-7
2-4	RNC Facility	2-12
2-5	Topographic Features of the RNC Facility	2-14
2-6	March 1990 Surface Water Sample Locations	2-22
2-7	May 1991 Surface Water Sample Locations	2-24
2-8	March 1990 Sediment Sample Locations	2-28
2-9	May 1991 Sediment Sample Locations	2-29
2-10	Locations of Surface Soil and Particle Size Distribution Sample Collection	2-31
2-11	Overlay Showing Various Plant Areas	2-33a
	Unsaturated and Saturated Soil Investigations - Monitoring Wells, Piezometers and Soil Borings; Companies' Facilities	2-33b
2-12	Unsaturated and Saturated Soils Investigations - Monitoring Well, Piezometer, and Soil Boring Locations Surrounding Companies' Facilities	2-34
2-13	Groundwater Investigations - Monitoring Wells and Soil Borings Companies' Facilities	2-57
2-14	Groundwater Investigations - PRRS, DOE, Residential and Industrial Well Locations Surrounding Companies' Facilities	2-58
2-15	Wells Sampled for Treatability Parameters	2-59
3-1	A&W/Mobil Property - Locations of Active and Inactive Pipelines and Sumps	3-3

VOLUME 1 (Continued)

Figure	Title	Page
3-2	Ruetgers-Nease Corporation Property Locations of Active and Inactive Pipelines and Sumps	3-4
3-3	Approximate Locations of USTs Close to Companies' Properties	3-8
3-4	Location of Former Specialty Paint Mixing Facility	3-9
3-5	Wind Rose Diagram and Yearly Precipitation Totals at FEMP	3-11
3-6	Population and Land Use Study Area within a 1.5 Mile Radius of Companies' Properties	3-12
3-7	Well/Cistern Map and Direction of Groundwater Flow April 1992	3-16
3-8	Area within a 1.5 Mile Radius of the Companies' Properties Divided into Traffic Zones	3-22
3-9	Locations of Stream Sampling Points (Locations 1 and 2) in Mobil's 1983 Study of Paddys Run and Water Level Gauges SG-1 through SG-5	3-65
3-10	Flood Boundaries within the Study Area for a 100 Year Flood and a 500 Year Flood	3-67
3-11	Surface Water and Sediment Collection Locations for Phase I and Phase II	3-72
3-12	Geologic Map and Cross Section of Ohio and Location of the Cincinnati Arch	3-82
3-13	Rock Formations in and around Study Area	3-84
3-14	Top of Bedrock and Distribution of Alluvium	3-85
3-15	Relationship of the New Haven Trough with the Paddys Run Road Site	3-88
3-16	Locations of Surface Soil and Particle Size Distribution Sample Collection and Soil Types	3-91
3-17	Soil Type Based on Particle Size	3-93
3-18	Geologic Cross-Section Location Map	3-103
3-19	Cross Section A-A'	3-104
3-20	Cross Section B-B'	3-105
3-21	Cross Section C-C'	3-106
3-22	Cross Section D-D' and Cross Section E-E'	3-107
3-23	Locations of Soil Borings that had Samples Submitted for Particle Size Analysis and Cation Exchange Capacity	3-126
3-24	Five Hydrogeologic Environments within a 1.5 Mile Radius of the Site	3-130
3-25	Regional Flow Model Net Precipitation Recharge Distribution	3-156

VOLUME 1 (Continued)

Figure	Title	Page
3-26	Water Level Elevation vs. Rainfall	3-157
3-27	Observed 1986 Groundwater Level Elevations	3-161
3-28	Great Miami/Little Miami River Basins Buried Valley Aquifer System	3-163
3-29	Locations of Major Groundwater Withdrawals in the Area	3-165
3-30	Subsurface Geology Shown in Relation to Soil Boring Elevations on the Companies' Properties	3-168
3-31	Piezometric Contour Map Groundwater Elevations, June 1990	3-172
3-32	Piezometric Contour Map Groundwater Elevations, August 1990	3-173
3-33	Piezometric Contour Map Groundwater Elevations, January 1991	3-174
3-34	Piezometric Contour Map Groundwater Elevations, April 1991	3-175
3-35	Piezometric Contour Map Groundwater Elevations, July 1991	3-176
3-36	Piezometric Contour Map Groundwater Elevations, October 1991	3-177
3-37	Piezometric Contour Map Groundwater Elevations. January 1992	3-178
3-38	Piezometric Contour Map Groundwater Elevations April 1992	3-179
3-39	Piezometric Contour Map Groundwater Elevations August 1992	3-180
3-40	PRRS Water Level Measurements, February 13-24, 1992	3-183
3-41	PRRS Water Level Measurements, February 24-March 7, 1992	3-184
3-42	PRRS Water Level Measurements, March 31-April 15, 1992	3-185
3-43	PRRS Water Level Measurements, April 15-22, 1992	3-186
3-44	PRRS Water Level Measurements, May 15-17, 1992	3-187
3-45	PRRS Water Level Measurements, July 7-9, 1992	3-188
3-46	PRRS Water Level Measurements, August 7-18, 1992	3-189
3-47	PRRS Water Level Measurements, August 18-September 21, 1992	3-190
3-48	PRRS Water Level Measurements, November 23-December 15, 1992	3-191
3-49	PRRS Water Level Measurements, December 15, 1992-January 20, 1993	3-192
3-50	PRRS Water Level Measurements, January 20-February 25, 1993	3-193
3-51	Regional Flow Model - Planar Node Specifications	3-218
3-52	Comparison of Observed and Simulated 1986 Groundwater Level Elevations	3-220
3-53	Local Flow Model - Planar Node Specification	3-232
3-54	Comparison of Observed and Simulated 1991 Groundwater Table Elevations	3-235

VOLUME 1 (Continued)

LIST OF PLATES

Plate	Title	Page
1	October 1956 Paddys Run Road Site	3-24
2	1963 Paddys Run Road Site	3-25
3	March 1966 Paddys Run Road Site	3-26
4	May 1, 1968 Paddys Run Road Site	3-27
5	1973 Paddys Run Road Site	3-28
6	1981 Paddys Run Road Site	3-29
7	November 1988 Paddys Run Road Site	3-30

LIST OF TABLES

Table	Title	Page
2-1	Location and Parameters Analyzed for March 1990 and May 1991 Surface Water Investigations	2-21
2-2	Location and Parameters Analyzed for March 1990 and May 1991 Sediment Investigations	2-26
2-3	Boring Location, Depth, Parameters Analyzed for Phase I Investigations, A&W Property	2-35
2-4	Boring Location, Depth, Parameters Analyzed for Phase II Investigations, A&W Property	2-39
2-5	Boring Location, Depth, Parameters Analyzed for Phase I Investigations, RNC Property	2-47
2-6	Boring Location, Depth, Parameters Analyzed for Phase II Investigations, RNC Property	2-51
2-7	Summary of Round 1 Groundwater Sampling Parameters	2-60
2-8	Summary of Round 2 Groundwater Sampling Parameters	2-62
2-9	Summary of Round 3 Groundwater Sampling Parameters	2-64
2-10	Summary of Round 4 Groundwater Sampling Parameters	2-66
2-11	Summary of Supplemental 1 and Supplemental 2 Groundwater Sampling Parameters	2-68
2-12	Summary of Groundwater Sampling Parameters from Phase II Boring Program	2-70
2-13	Primary Calibration Evaluation Criteria for Transport Modeling	2-77

VOLUME 1 (Continued)

Table	Title	Page
3-1	Summary of the Residential and Industrial Well Inventory Survey Conducted within the Study Area PRRS RI/RA - August 1989	3-17
3-2	1980 Census vs. 2010 Population Projections	3-21
3-3	Chronological Listing of Spills and Releases at the Site	3-31
3-4	Storage Tank Characteristics at A&W	3-39
3-5	Storage Tank Area Characteristics at RNC	3-45
3-6	Summary of Analytical Testing Parameters	3-53
3-7	Dissolved CLP Metals Background Concentration Summary	3-54
3-8	Total CLP Metals Background Concentration Summary	3-55
3-9	CLP Volatile Organic Background Concentration Summary	3-56
3-10	CLP Semi-Volatile Organic Background Concentration Summary	3-57
3-11	CLP Pesticides/PCB Background Concentration Summary	3-59
3-12	General and Radiological Background Concentration Summary	3-60
3-13	Paddys Run Stream Characteristics	3-64
3-14	Paddys Run Surface Water - Chemicals Detected above Background	3-69
3-15	Pond Surface Water - Chemicals Detected above Background	3-70
3-16	Paddys Run Sediment - pH and TOC Results	3-73
3-17	Paddys Run Road Sediments - Chemicals Detected above Background	3-75
3-18	Drainage Ditch Sediments - pH and TOC Results	3-76
3-19	Drainway Sediments - Chemicals Detected above Background	3-77
3-20	Pond Sediments - Chemicals Detected above Background	3-79
3-21	Chemical Components in Limestone and Shale	3-87
3-22	Mineral Components in Limestone and Shale	3-87
3-23	Surface Soil Summary of Chemicals Detected above Background	3-97
3-24	Total Metals Detected above Background in Soil Borings	3-111
3-25	Volatile Organic Compounds Detected above Background in Soil Borings	3-117
3-26	Semivolatiles Detected above Background in Soil Borings	3-122
3-27	Pesticides/PCB, General Parameters and Radiological Parameters Detected above Background in Soil Borings	3-124
3-28	Soil Physical Parameter Analyses	3-127
3-29	Reported Groundwater Flow Parameter Values (Including RI Field Data)	3-132
3-30	Groundwater Flow Parameter Values Used in Calibrated Regional Model	3-149
3-31	Yearly Precipitation Collected by MCD and FEMP	3-154

VOLUME 1 (Continued)

Table	Title	Page
3-32	Major Water Users - Hamilton-New Baltimore Area	3-164
3-33	Dissolved Metals Detected above Background in the Groundwater	3-197
3-34	Total Metals Detected above Background in Groundwater Samples	3-202
3-35	Volatile Organic Compounds Detected above Background in the Groundwater	3-206
3-36	Semivolatile Organic Compounds Detected above Background in the Groundwater	3-209
3-37	Pesticides/PCBs Detected above Background in the Groundwater	3-212
3-38	General Parameters Detected above Background in the Groundwater	3-213
3-39	Radiological Parameters Detected above Background in the Groundwater	3-216
3-40	Primary Calibration Evaluation Criteria for Flow Modeling	3-219
3-41	1986 Regional Flow Model Calibration Performance	3-221
3-42	1991 Regional Flow Model Calibration Performance	3-224
3-43	Calibrated Regional Groundwater Flow Model Input Parameters	3-227
3-44	Regional Flow Model Sensitivity Analysis Summary	3-230
3-45	Local Flow Model Calibration Performance - April 1986	3-236
3-46	1991 Local Flow Model Calibration Performance	3-237

VOLUME 2

TABLE OF CONTENTS

4.0 NATURE AND EXTENT OF CHEMICALS OF CONCERN 4-1

4.1 Nature of Chemicals 4-1

4.2 Extent of Chemicals of Concern 4-101
4.2.1 Extent of Chemicals in the Groundwater 4-102
4.2.2 Extent of Chemicals in the Companies' Subsurface Soils and Drainageway Sediments 4-117
4.2.3 Extent of Chemicals in the Companies' Surface Soils 4-132
4.2.4 Extent of Chemicals Found in Surface Waters 4-140
4.2.5 Extent of Chemicals Found in Sediments 4-143
4.2.6 Extent of Free-Floating Hydrocarbon Phase 4-146

4.3 Solute Transport Modeling 4-147

4.4 Consideration of Tentatively Identified Compounds (TICs) 4-166

5.0 ENVIRONMENTAL FATE AND TRANSPORT 5-1

5.1 Interactive Processes Influencing Fate and Transport 5-1
5.1.1 Transport Processes 5-2
5.1.2 Physical Transformation 5-3
5.1.3 Chemical Transformation 5-4
5.1.4 Biological Transformation 5-6

5.2 Fate and Transport of Study Area Chemicals of Concern by Medium 5-6
5.2.1 Surface Soils 5-6
5.2.2 Soil Borings and Drainageway Sediments 5-8
5.2.3 Groundwater 5-10
5.2.4 Surface Water 5-14
5.2.5 Sediment 5-15

VOLUME 2 (Continued)

6.0 BASELINE RISK ASSESSMENT 6-1

6.1 Human Health Assessment 6-3

6.1.1 Identification of Chemicals of Concern 6-3
6.1.1.1 Analytical Data Evaluated for PRRS Risk Assessment 6-3
Surface Soils 6-4
Soil Borings and Drainageway Sediments 6-4
Groundwater 6-5
6.1.1.2 Chemicals Selected for Risk Assessment 6-6
6.1.2 Human Health Exposure Assessment 6-6
6.1.2.1 Characterization of Exposure Setting 6-10
PRRS Study Area 6-10
Potentially Exposed Populations 6-10
Current Land Use 6-12
Groundwater as a Drinking Water Source 6-13
6.1.2.2 Identification of Exposure Pathways and Scenarios 6-14
Industrial Scenario 6-17
Trespassing Scenario 6-23
Hypothetical Farm/Residential Scenario 6-25
Future Farm/Residential Scenario 6-25
Future Farm/Residential (Worst Case) Scenario 6-25
Pathways Removed from Further Evaluation 6-26
6.1.2.3 Quantification of Potential Exposure 6-27
Exposure Point Concentrations 6-27
Estimation of Chemical Intakes 6-31
Estimation of Exposure to Airborne Fugitive Dust and Volatile Emissions 6-32

6.1.3 Human Health Toxicity Assessment 6-44
6.1.3.1 Toxicity Assessment 6-44
Toxicity Information for Noncarcinogenic Effects 6-44
Toxicity Information for Carcinogenic Effects 6-46
Toxicity Value Adjustments 6-49
Polynuclear Aromatic Hydrocarbon Toxicity 6-49
Arsenic, Benzene and Manganese Toxicity 6-52
Chemicals for Which No U.S. EPA Toxicity Values Are Available 6-52
Essential Nutrients 6-52

VOLUME 2 (Continued)

Section	Title	Page
	Summary of Chemicals for Quantitative Assessment	6-55
	6.1.3.2 Standards and Health Guidelines	6-55
	Health Advisories	6-55
	Maximum Contaminant Level (MCL) and Maximum Contaminant Level Goal (MCLG)	6-55
	Ambient Water Quality Criteria (AWQC)	6-60
	Drinking Water Equivalent Level (DWEL)	6-60
	6.1.3.3 Uncertainties Related to Toxicity Information	6-60
6.1.4	Human Health Risk Characterization	6-62
	6.1.4.1 Methodology for Estimating Noncarcinogenic Risk	6-62
	6.1.4.2 Methodology for Estimating Carcinogenic Risk	6-63
	6.1.4.3 Estimates of Risk for the Primary Chemicals of Concern for Each Exposure Scenario	6-64
	6.1.4.4 Magnitude of Risk Estimates for the Chemicals of Concern	6-71
	Noncarcinogenic Risks	6-71
	Carcinogenic Risks	6-74
	Risk Due to Radionuclides	6-77
	6.1.4.5 Comparison to Applicable Standards and Guidelines	6-77
	Recommended Daily Allowances	6-77
	Health Guidelines	6-78
	Maximum Contaminant Limits (MCL)	6-78
	6.1.4.6 Uncertainties and Limitations in the Risk Assessment Process	6-79
	Reasonable Maximum Exposure	6-79
	Exposure Pathways and Assumptions	6-79
	Modeled Air Data	6-79
	Risk to Sensitive Populations for Potassium/Potassium-40	6-80
	Risk Characterization Uncertainty	6-80
	Uncertainty of Mathematical Solute Transport Modeling	6-80
6.2	Ecological Risk Assessment	6-81
6.2.1	Characterization of Baseline Ecology	6-81
	6.2.1.1 Habitat Assessment	6-81
	6.2.1.2 Resource Characterization	6-90

VOLUME 2 (Continued)

Section	Title	Page
6.2.2	Exposure Assessment	6-98
	6.2.2.1 Selection of Chemicals of Concern	6-98
	6.2.2.2 Exposure Pathway Analysis	6-101
	6.2.2.3 Exposure Point Concentrations	6-102
6.2.3	Ecotoxicity Assessment	6-103
6.2.4	Risk Characterization	6-105
	6.2.4.1 Potential Risks to Aquatic Biota and Other Receptors	6-106
	6.2.4.2 Limitations in the Ecological Assessment Process	6-111
7.0	SUMMARY AND CONCLUSIONS	7-1
7.1	Summary of Study Area Characterization	7-2
7.2	Summary of Nature and Extent of Chemicals of Concern	7-5
	7.2.1 Extent of Inorganics	7-7
	7.2.2 Extent of Organics	7-8
	7.2.3 Extent of General Parameters	7-10
	7.2.4 Extent of Potassium-40	7-11
	7.2.5 Extent of Free-Floating Phase Hydrocarbons	7-11
7.3	Summary of Baseline Risk Assessment	7-12
	7.3.1 Assessment of the Human Health Risk	7-12
	7.3.2 Assessment of the Ecological Risk	7-18
7.4	Summary of Conclusions	7-20
	7.4.1 Study Area Characterization	7-20
	7.4.2 Nature and Extent of Chemicals of Concern	7-21
	7.4.3 Risk Assessment	7-21
BIBLIOGRAPHY		

VOLUME 2 (Continued)

LIST OF FIGURES

Figure	Title	Page
4-1	Isoconcentration Maps and Cross Sections Showing Dissolved Arsenic in the Groundwater	4-103
4-2	Isoconcentration Maps and Cross Sections Showing Dissolved Sodium in the Groundwater	4-104
4-3	Isoconcentration Maps and Cross Sections Showing Dissolved Potassium in the Groundwater	4-106
4-4	Isoconcentration Maps and Cross Sections Showing Ethylbenzene in the Groundwater	4-108
4-5	Isoconcentration Maps and Cross Sections Showing Xylene in the Groundwater	4-110
4-6	Isoconcentration Maps and Cross Sections Showing Cumene in the Groundwater	4-112
4-7	Isoconcentration Maps and Cross Sections Showing 2-4 Dimethylphenol in the Groundwater	4-113
4-8	Isoconcentration Maps and Cross Sections Showing Dissolved Phosphorus in the Groundwater	4-115
4-9	Isoconcentration Maps and Cross Sections Showing Dissolved Potassium-40 in the Groundwater	4-116
4-10	Isoconcentration Maps for Arsenic in the Subsurface Soils at Depths of 2-4 Feet, 6-8 Feet, and 10 Feet into the Water Table	4-118
4-11	Isoconcentration Maps for Sodium in the Subsurface Soils at Depths of 2-4 Feet, 6-8 Feet, and 10 Feet into the Water Table	4-121
4-12	Isoconcentration Maps for Potassium in the Subsurface Soils at Depths of 2-4 Feet, 6-8 Feet, and 10 Feet into the Water Table	4-122
4-13	Isoconcentration Maps for Ethylbenzene in the Subsurface Soils at Depths of 2-4 Feet, 6-8 Feet, 10-12 Feet, and 12-14 Feet	4-124
4-14	Isoconcentration Maps for Cumene in the Subsurface Soils at Depths of 2-4 Feet, 6-8 Feet, 10-12 Feet, and 12-14 Feet	4-126
4-15	Isoconcentration Maps for Xylene in the Subsurface Soils at Depths of 2-4 Feet, 6-8 Feet, 10-12 Feet, and 12-14 Feet	4-128
4-16	Location and Extent of 2-4-Dimethylphenol in the Subsurface Soils	4-130
4-17	Isoconcentration Maps for Phosphorus in the Subsurface Soils at Depths of 2-4 Feet, 6-8 Feet, 10-12 Feet, and 12-14 Feet	4-131

VOLUME 2 (Continued)

Figure	Title	Page
4-18	Location and Concentration of Potassium-40 Detected Above Site Background in the Subsurface Soils	4-133
4-19	Isoconcentration Map Showing Arsenic in the Surface Soils	4-134
4-20	Isoconcentration Map Showing Sodium in the Surface Soils	4-137
4-21	Isoconcentration Map Showing Potassium in the Surface Soils	4-139
4-22	Isoconcentration Map showing Xylene and Cumene in the Surface Soils	4-141
4-23	Surface Water Locations and Results of Analyses for Parameters Evaluated During the Risk Assessment	4-142
4-24	Sediment Locations and Results of Analyses for Parameters Evaluated in the Risk Assessment	4-144
4-25	Average 1991 Floating Hydrocarbon-Extent and Thickness	4-148
4-26	Source Loading Conceptualization	4-152
4-27	1991 Standardized Observed Average Sodium Concentrations in Groundwater	4-159
4-28	1991 Standard Observed Average Ethylbenzene Concentrations in Groundwater	4-160
4-29	1991 Computed Sodium Concentrations (Layer 4)	4-164
4-30	1991 Computed Ethylbenzene Concentrations (Layer 4)	4-165
4-31a	Prediction of Future (1994) Sodium Concentration Distribution (Layer 4)	4-167
4-31b	Prediction of Future (1997) Sodium Concentration Distribution (Layer 4)	4-168
4-31c	Prediction of Future (2000) Sodium Concentration Distribution (Layer 4)	4-169
4-31d	Prediction of Future (2003) Sodium Concentration Distribution (Layer 4)	4-170
4-32a	Prediction of Future (1994) Ethylbenzene Concentration Distribution (Layer 4)	4-171
4-32b	Prediction of Future (1997) Ethylbenzene Concentration Distribution (Layer 4)	4-172
4-32c	Prediction of Future (2000) Ethylbenzene Concentration Distribution (Layer 4)	4-173
4-32d	Prediction of Future (2003) Ethylbenzene Concentration Distribution (Layer 4)	4-174
4-32e	Prediction of Future (2006) Ethylbenzene Concentration Distribution (Layer 4)	4-175
4-33a	Production of Future Inorganic Chemical Concentrations	4-176

VOLUME 2 (Continued)

Figure	Title	Page
4-33b	Production of Future Inorganic Chemical Concentrations	4-177
4-34	Production of Future Organic Chemical Concentrations	4-178
6-1	Paddys Run Road Site	6-11
6-2	Covertype Locations within the Study Area	6-84
7-1	Areas of Past or Present Chemical Manufacturing or Handling Operations	7-4

LIST OF TABLES

Table	Title	Page
4-1	Summary of Analytical Testing Parameters	4-2
4-2A	Chemicals Sampled in Surface Water	4-3
4-2B	Chemicals Sampled in the Pond Surface Water	4-7
4-2C	Chemicals Sampled in Paddys Run Sediment	4-11
4-2D	Chemicals Sampled in the Pond Sediment	4-15
4-2E	Chemicals Sampled in Paddys Run Surface Soil	4-19
4-2F	Chemicals Sampled in Soil Borings and Drainageway Sediments	4-23
4-2G	Chemicals Sampled in Groundwater	4-27
4-3	Analytical Testing Parameters Found above the Established Site Background (Highlighted)	4-32
4-4A	Chemicals Above Background in Paddys Run Surface Water Evaluated for Risk Assessment	4-33
4-4B	Chemicals Above Background in Pond Water Evaluated for Risk Assessment	4-35
4-4C	Chemicals Above Background in Paddys Run Sediment Evaluated for Risk Assessment	4-38
4-4D	Chemicals Above Background in Pond Sediment Evaluated for Risk Assessment	4-41

VOLUME 2 (Continued)

Table	Title	Page
4-4E	Chemicals Above Background in Surface Soil Evaluated for Risk Assessment	4-50
4-4F	Chemicals Above Background in Soil Borings and Drainage Sediments Evaluated for Risk Assessment	4-56
4-4G	Chemicals Above Background in Groundwater Evaluated for Risk Assessment	4-72
4-5	Chemicals of Concern (Highlighted) for Further Evaluation in the Risk Assessment	4-95
4-6	Summary of Chemicals of Concern by Medium for Evaluation in the Risk Assessment	4-96
4-7	Measured Floating Hydrocarbon Thickness and Chemical Concentrations of the Free Floating Phase Hydrocarbon	4-149
4-8	Preliminary Criteria for Solute Transport Modeling	4-155
4-9	Transport Parameter Values Used in Modeling	4-161
4-10	Volatile and Semivolatile Organic Analyses	4-180
6-1	Groundwater Wells and Soil Borings within the Inorganic and Organic Plumes	6-7
6-2	Chemicals of Concern	6-8
6-3	Summary of Chemicals of Concern by Medium for Evaluation in the Risk Assessment	6-9
6-4	Exposure Scenario Summary - Comparison of Conservative and Unrealistic Land Use Assumptions	6-16
6-5	Conceptual Exposure Scenario Summary Industrial Scenario	6-18
6-6	Conceptual Exposure Scenario Summary Trespassing Scenario	6-19
6-7	Conceptual Exposure Scenario Summary Hypothetical Farm/Residential Scenario	6-20
6-8	Conceptual Exposure Scenario Summary Future Farm/Residential Scenario	6-21
6-9	Conceptual Exposure Scenario Summary Future Farm/Residential (Worst Case) Scenario	6-22
6-10	RNC Air Permits and Permit Limits	6-28
6-11	Exposure Point Concentrations	6-30
6-12	Intake Assumptions for Ingestion of Chemicals in Drinking Water	6-33

VOLUME 2 (Continued)

Table	Title	Page
6-13	Intake Assumptions for Dermal Contact with Chemicals in Water	6-34
6-14	Intake Assumptions for Ingestion of Chemicals in Soil and Dust	6-35
6-15	Intake Assumptions for Dermal Contact with Chemicals in Soil and Dust	6-36
6-16	Intake Assumptions for Ingestion of Chemicals in Surface Water	6-37
6-17	Intake Assumptions for Dermal Contact with Chemicals in Surface Water	6-38
6-18	Intake Assumptions for Dermal Contact with Chemicals in Sediment	6-39
6-19	Intake Assumptions for Ingestion of Chemicals in Sediment	6-40
6-20	Intake Assumptions for Inhalation of Airborne Chemicals in Vapor Phase	6-41
6-21	Intake Assumptions for Inhalation of Airborne Chemicals in Dust	6-42
6-22	Intake Assumptions for Ingestion of Chemicals in Homegrown Produce	6-43
6-23	Noncarcinogenic Toxicity Values	6-47
6-24	Carcinogenic Toxicity Values	6-50
6-25	Dermal Absorption Efficiency Factors	6-51
6-26	Chemicals of Concern for Quantitative Assessment	6-53
6-27	Derivation of Drinking Water Screening Levels for Nutrients from Estimated Safe Intakes	6-56
6-28	Chemicals of Concern by Medium for Quantitative Assessment	6-58
6-29	Chemicals of Concern Standards and Health Guideline Values	6-59
6-30	Cumulative Hazard Indices and Cancer Risk Industrial Scenario	6-65
6-31	Cumulative Hazard Indices and Cancer Risk Trespassing Scenario	6-66
6-32	Cumulative Hazard Indices and Cancer Risk Hypothetical Farm/Residential Scenario	6-67
6-33	Cumulative Hazard Indices and Cancer Risk Future Farm/Residential Scenario	6-68
6-34	Cumulative Hazard Indices and Cancer Risk Future Farm/Residential (Worst Case) Scenario	6-69

VOLUME 2 (Continued)

Table	Title	Page
6-35	Vegetative Species Observed September 1991 and November 1993 Field Surveys	6-85
6-36	Wildlife Species Observed September 1991 and November 1993 Field Surveys	6-93
6-37	Possible Wildlife and Covertype Associations	6-95
6-38	Summary of Detected Chemicals Paddys Run Surface Water and Sediment	6-99
6-39	Potential Exposure Concentrations Paddys Run Surface Water and Sediment	6-104
7-1	Chemicals of Concern for Further Evaluation in the Risk Assessment	7-6
7-2	Exposure Scenario Summary Comparison of Conservative and Unrealistic Land Use Assumptions	7-14

VOLUME 3

TABLE OF CONTENTS

Appendix A: Chronological Summary of Remedial Investigation/Risk Assessment Activities

Appendix B-1: Technical Memorandum on Raw Materials Investigation

Appendix B-2: Decontamination and Field Sampling Methodologies

Appendix B-3: Determination of Medium-Specific Chemical Background Comparison Values at the Paddys Run Road Site

VOLUME 4

TABLE OF CONTENTS

Appendix C: Groundwater Flow and Contaminant Transport Modeling Report

VOLUME 5

TABLE OF CONTENTS

Appendix D: Particle-Size Analyses Curves

Appendix E: Soil Boring, Well Construction and Piezometer Construction Logs

Appendix F: Laboratory Results for Bulk Density and Permeability

Appendix G: Groundwater Flow Meter Study

Appendix H: Analytical Results of Free-Floating Hydrocarbon Product

Appendix I: Estimating Risk for Future Groundwater Exposure - Concentration of Chemicals of Concern in Groundwater

Appendix J: Potential for the Plant Uptake of the PRRS Chemicals of Concern

Appendix K: Air Dispersion Models
Inhalation of Fugitive Dust,
Volatile Emissions from Soil
Volatile Organic Emissions during Showering

Appendix L: Toxicity Profile Assessment for PRRS Chemicals of Concern
Potassium Health Effects Summary
Additional Toxicological Information on Arsenic, Benzene and Manganese

Appendix M: Estimated Risk Calculations

Appendix N: Validity of Potassium-40 Slope Factors for Naturally Occurring Potassium

INTRODUCTION

TABLE OF CONTENTS

Section	Title	Page
1.0	INTRODUCTION	1-1
1.1	Purpose of the Report	1-4
1.2	Study Area Background	1-4
1.2.1	Study Area Description	1-4
1.2.2	Study Area History of the Companies' Facilities	1-6
1.2.3	Summary of Previous Investigations in the General Area by Governmental Agencies	1-12
1.2.4	Summary of Investigations by the Companies Prior to the AOC	1-13
1.2.5	Summary of Phase I RI Investigations Previously Reported by the Companies	1-15
1.3	Overview of Existing Reports Related to Field Investigations	1-19
1.3.1	Phase I Investigations	1-19
1.3.2	Phase II Investigations	1-22
1.4	Organization of the RI/RA Report	1-23

LIST OF FIGURES

Figure	Title	Page
1-1	Summary Schedule of PRRS Project Investigations - RI Phase I	1-2
1-2	Summary Schedule of PRRS Project Investigations - RI Phase II	1-3
1-3	Study Area Location Map	1-5
1-4	A&W Facility	1-8
1-5	RNC Facility	1-11
1-6	Well/Cistern Map-1989	1-16
1-7	Locations of Organic Vapors Detected Along the Perimeter of A&W and RNC Properties-1989	1-18
1-8	Total Concentration of Benzene, Toluene, Xylene and Cumene Measured During the Soil Gas Survey of the RNC Property-1989	1-20

REPORT ON THE REMEDIAL INVESTIGATION AND BASELINE RISK ASSESSMENT

PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO

REVISION 1
MAY 27, 1994

1.0 INTRODUCTION

In accordance with an Administrative Order on Consent (AOC) with the Ohio Environmental Protection Agency (Ohio EPA), a remedial investigation/feasibility study (RI/FS) began in May 1989 at the Paddys Run Road Site (PRRS or Study Area), located approximately 15 miles northwest of Cincinnati. The PRRS encompasses the Albright & Wilson Americas, Inc. (A&W) facility and the Ruetgers-Nease Corporation (RNC) facility, and areas adjacent to and south of the Department of Energy's (DOE) Fernald Environmental Management Project (FEMP), formerly the Feed Materials Production Center (FMPC).

A&W, Mobil Mining and Minerals Company (prior owner of the A&W property) and RNC, which are referred to throughout this document as the Companies, jointly began Phase I investigations of the RI in May 1989. Phase I investigations were intended to define the nature and extent of chemicals of concern in groundwater, surface water, sediment and soil within the PRRS. Analytical results indicated that one or more plumes of groundwater contain inorganic and organic chemicals, and extend southward from the area of the PRRS in the direction of the groundwater flow. A Phase II investigation was undertaken in September 1991 to define the nature and extent of chemicals of concern and to identify and characterize source areas.

Figures 1-1 and 1-2 illustrate the schedule of major activities for both phases from May 1989 through the original submittal of this report in September 1992. Appendix A summarizes the activities presented in these figures, as well as activities from October 1992 to present.

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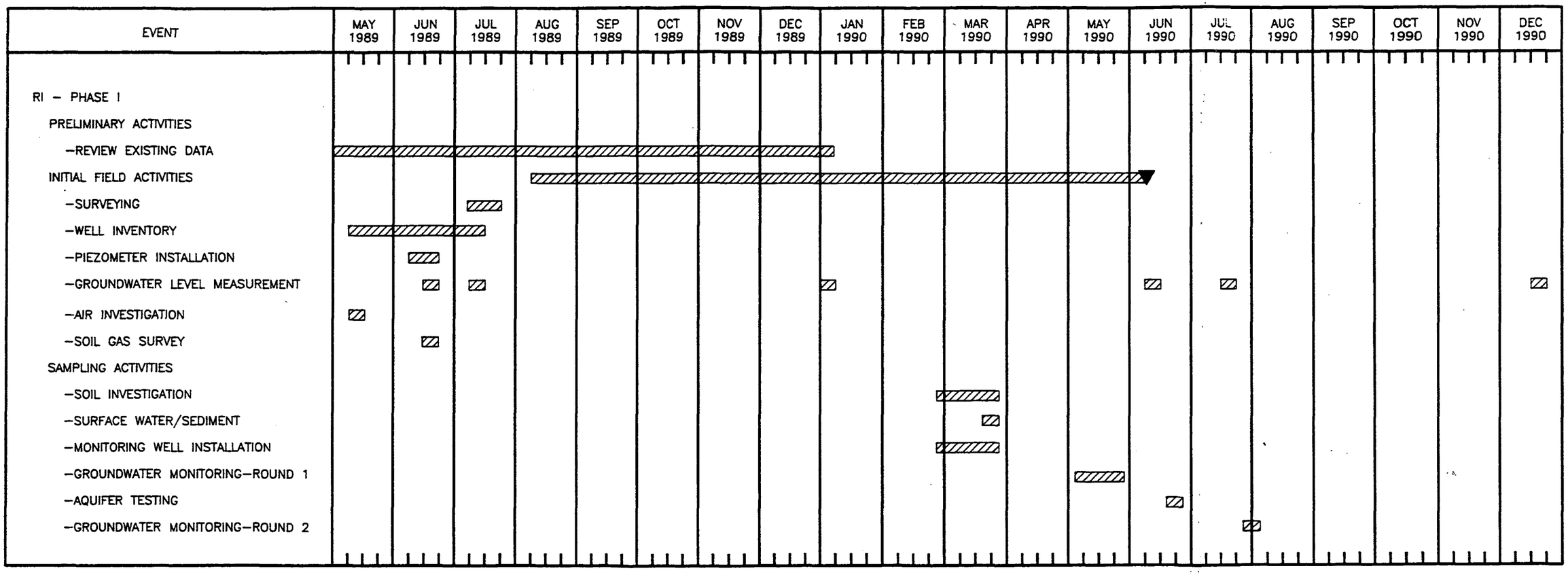

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SUMMARY SCHEDULE OF PRRS PROJECT INVESTIGATIONS RI PHASE I PADDYS RUN ROAD SITE HAMILTON, COUNTY, OHIO	FIGURE 1–1

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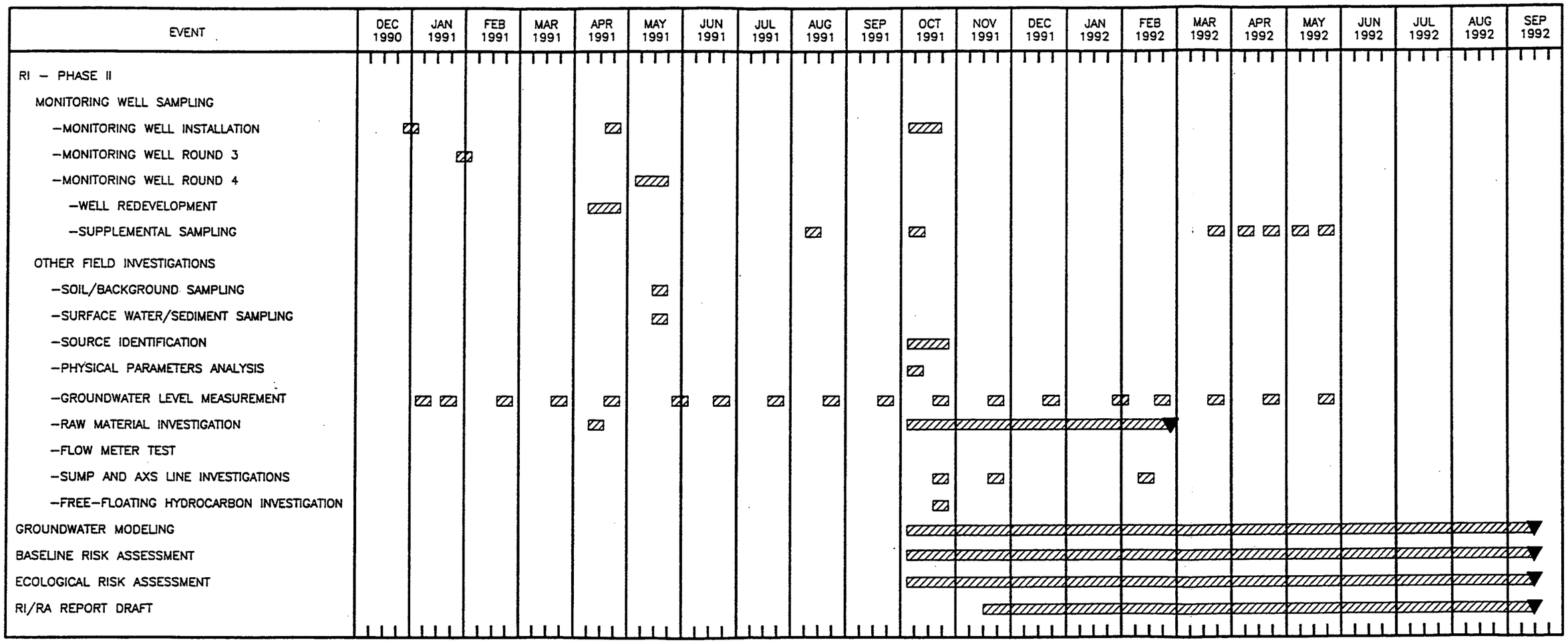

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SUMMARY SCHEDULE OF PRRS PROJECT INVESTIGATIONS RI PHASE II PADDYS RUN ROAD SITE HAMILTON, COUNTY, OHIO	FIGURE 1–2

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1.1 Purpose of the Report

The purpose of this report is to summarize RI investigations, findings and conclusions concerning the nature, extent, and sources of various PRRS-related chemicals within the Study Area boundaries. The report also includes the findings of the Baseline Risk Assessment (RA) conducted concurrently with the RI. Information from this report will be used in conducting the FS evaluation of remedial alternatives.

1.2 Study Area Background

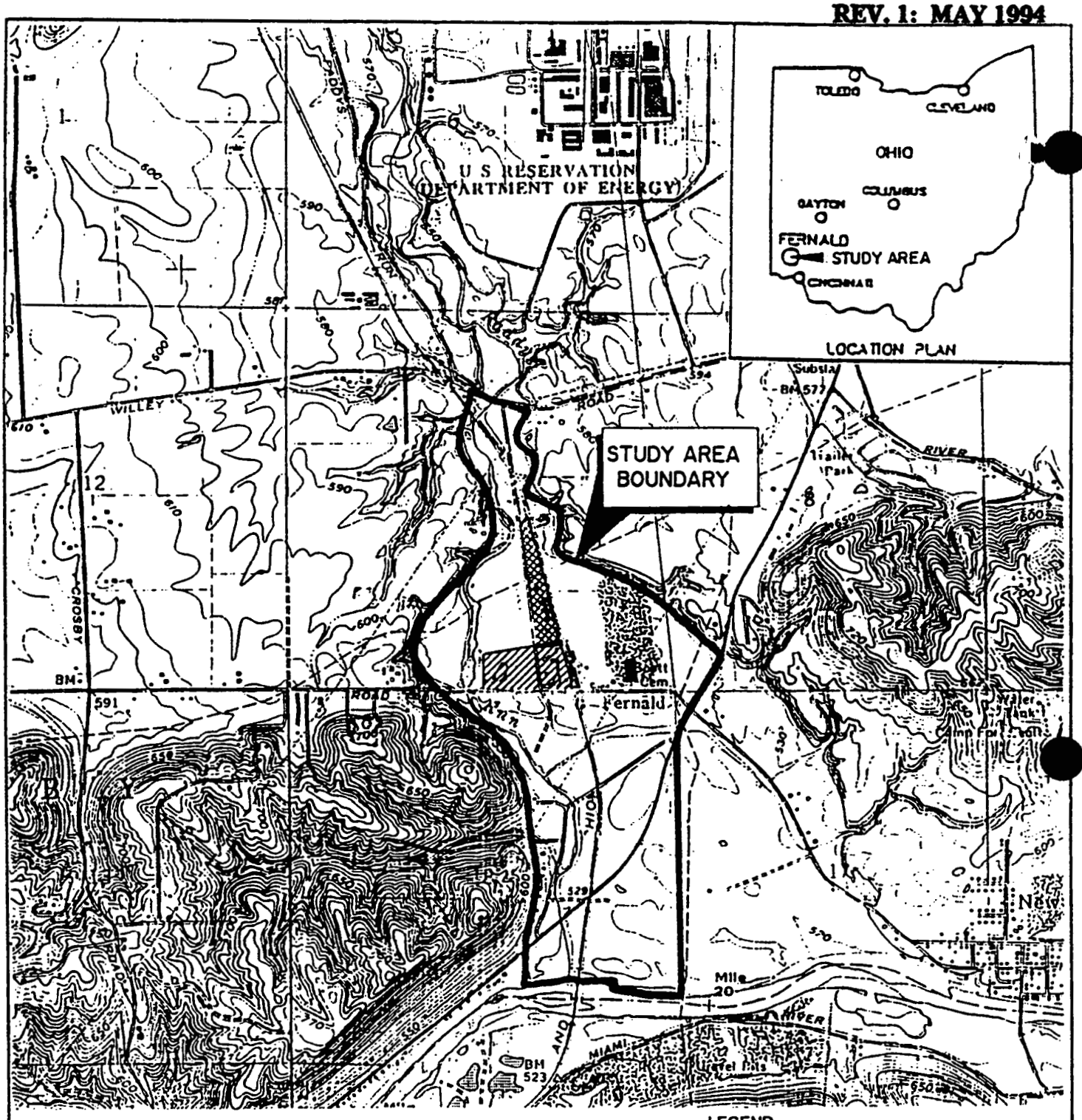
This section provides pertinent information concerning the physical characteristics and history of the PRRS, as well as a summary of Study Area-related investigations conducted prior to the RI.

1.2.1 Study Area Description

The PRRS Study Area is located in the lower Great Miami River Valley, approximately 15 miles northwest of Cincinnati near Fernald, in Crosby Township, Hamilton County, Ohio. Again, it encompasses the A&W facility, the RNC facility and areas adjacent to and south of the DOE FEMP.

The PRRS, shown in Figure 1-3, is about 1 1/2 miles in length from north to south. The valley wall west of Paddys Run defines the western Study Area boundary while glacial till hills define the northeastern extent. The northern boundary of the Study Area extends to Willey Road and coincides with the southern extent of the FEMP. An imaginary line drawn south from the intersection of Route 128 and New Haven Road to the Great Miami River defines the southeast boundary. The Great Miami River is the southern boundary.

The Companies' facilities consist of the A&W and RNC facilities, which lie mostly between Paddys Run Road and the CSX Railroad. A parcel of RNC property extends west of Paddys Run Road towards Paddys Run. This particular parcel is



SOURCE: USGS SHANDON, OHIO QUADRANGLE

STUDY AREA LOCATION MAP
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 1-3

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Environmental Resources Management

mostly undeveloped and does not include manufacturing or chemical processing facilities.

The soils within the Study Area are referred to as "valley-fill deposits." The sources of these deposits were repeated glacial advances combined with fluvial sediment transport processes during interglacial periods.

Land use in the Study Area consists primarily of grain and soybean farming, commercial operations, and light industry. A&W, RNC and Delta Steel are active facilities along Paddys Run Road between Willey Road and New Haven Road. Evers Welding, Heitman-Auto and Harrison Poured Foundations are along New Haven Road in Fernald. The Study Area is traversed by two buried petroleum pipelines and is bisected by a line of the CSX Railroad. There are residences located in Fernald along New Haven Road. The property east and west of Paddys Run Road, except for the above-mentioned industries, is largely undeveloped.

1.2.2 Study Area History of the Companies' Facilities

The Companies have been involved in manufacturing operations within the Study Area since the late 1950s. The northern portion of the Companies' properties is currently owned and operated by A&W. Since it was previously operated by Mobil Oil Corporation, it is designated the A&W/Mobil facility. The southern portion is the RNC facility.

1.2.2.1 A&W/Mobil Facility

The present-day A&W/Mobil facility was built in 1954 by Virginia-Carolina Chemical Corporation (VCCC) to produce thermal-grade phosphoric acid and sodium tripolyphosphate. VCCC merged into Socony Mobil Oil Company on November 29, 1963. Socony later changed its name to Mobil Oil Corporation. The former VCCC assets were operated under the name of Mobil Chemical Company until 1985. Mobil Chemical Company was not, and is not now, a separate legal entity. It is simply an unincorporated operating division of Mobil Oil Corporation.

Mobil Mining and Minerals Company was formed in 1985. Like Mobil Chemical Company, it is not a separate legal entity. It is simply an unincorporated operating division of Mobil Oil Corporation. In 1985, A&W purchased this plant from Mobil Oil Corporation.

As shown on Figure 1-4, the A&W/Mobil facility consists of approximately 10 acres, in the shape of a long thin triangle running south to north. Of these 10 acres, the manufacturing and chemical handling operations take place on less than 3 acres. The remainder of the 10-acre property is occupied by roadways, parking area, offices, maintenance and storage buildings, a laboratory, the plant water supply wells, the effluent storage tank, and open and unused land.

A&W/Mobil has manufactured and continues to handle phosphoric acid and phosphates for detergents, soaps, soft drinks and industrial uses.

Phosphoric Acid Production. Phosphoric acid was produced at the A&W/Mobil facility until 1990 when production ceased. The manufacturing process involved the oxidation of elemental phosphorus to phosphorus pentoxide with air, and the immediate hydrolysis of the phosphorus pentoxide with deionized water. The orthophosphoric acid solution thus produced was purified for food grade uses by treating with hydrogen sulfide and filtering out insoluble arsenic sulfide.

The phosphoric acid was shipped to customers or converted on-site to phosphate salts. Arsenic sulfide was shipped off-site to licensed landfills.

Orthophosphate Salt Solutions. Orthophosphate salt solutions are produced by neutralizing the phosphoric acid with a base form of the desired metal (aluminum, magnesium, sodium or potassium) in a mix tank, and adjusting the concentration. Major products of this type were monomagnesium phosphate, monoaluminum phosphate, and dipotassium phosphate. Dipotassium phosphate was also produced as feed stock for making tetrapotassium pyrophosphate, and sodium phosphate was made as feed stock for sodium tripolyphosphate.

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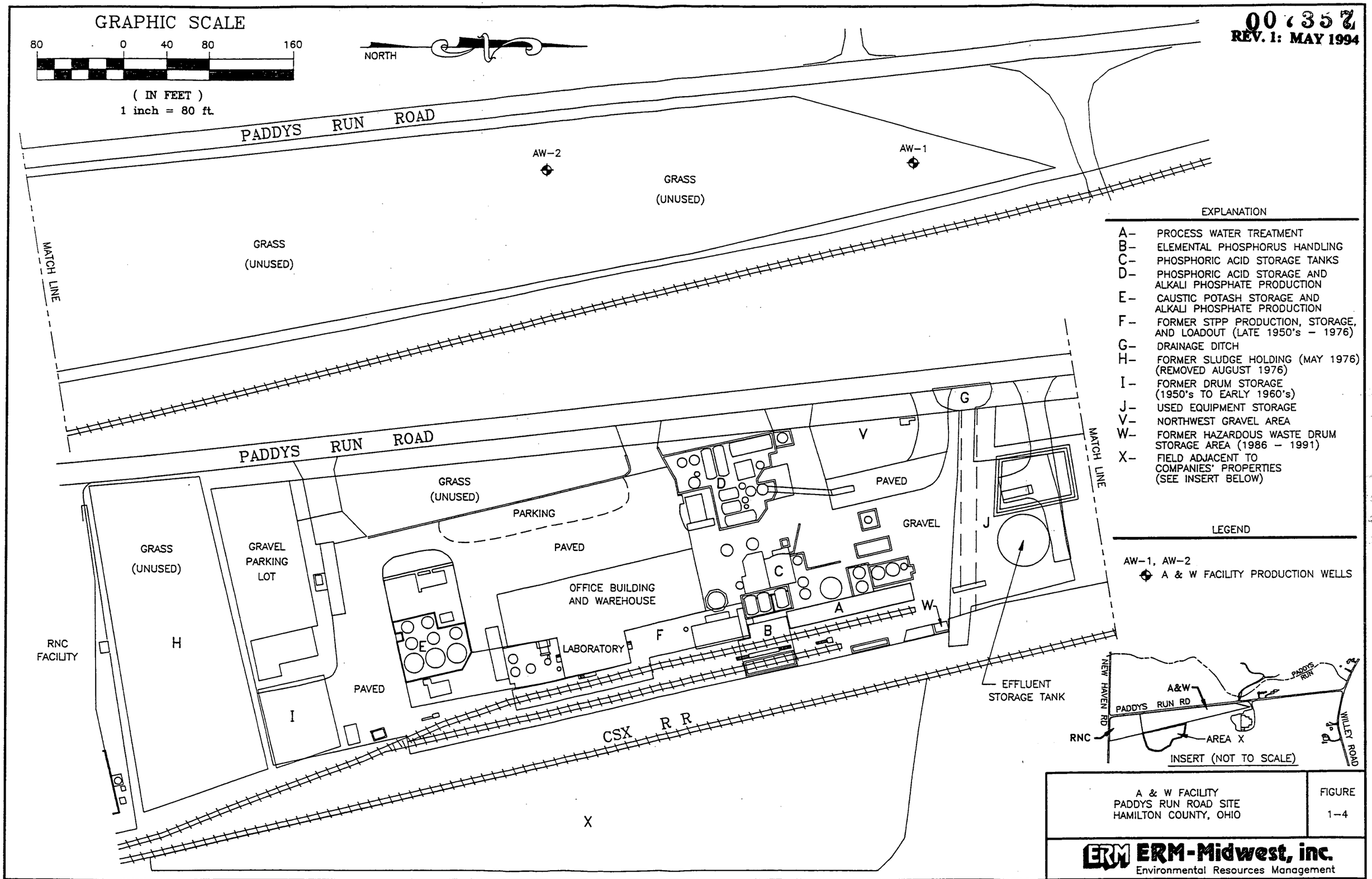

A & W FACILITY
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 1-4

ERM-Midwest, inc.
Environmental Resources Management

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Sodium Tripolyphosphate and Tetrapotassium Pyrophosphate. Sodium tripolyphosphate (STPP) was an initial product of the facility. It is produced by drying and then dehydrating a sodium phosphate solution in a calciner (kiln). The product was sold in solid form as a detergent builder. A second calciner was added in 1963. All STPP production was discontinued in 1976. The calciners and associated equipment were subsequently removed.

In 1959, a calciner and associated equipment to produce tetrapotassium pyrophosphate (TKPP) were added. TKPP is produced by drying and chemically dehydrating dipotassium phosphate solution in a calciner similar to STPP. In this case, however, the products are usually dissolved and sold as a liquid. The TKPP equipment is currently operating and is being used to produce a closely related material, potassium tripolyphosphate.

Monomagnesium Phosphate Production. A production train dedicated solely to monomagnesium phosphate production was put into operation in 1984. A&W's plant currently consists of two thermal phosphoric acid production trains, two alkaline phosphate trains and an alkaline pyrophosphate train.

Waste being generated at A&W consists of non-hazardous phosphates filter cake. Prior to 1990, arsenic sulfide was generated as a filter cake. It was stored in drums for less than 90 days in the hazardous waste container area and then manifested to a licensed landfill.

1.2.2.2 RNC Facility History

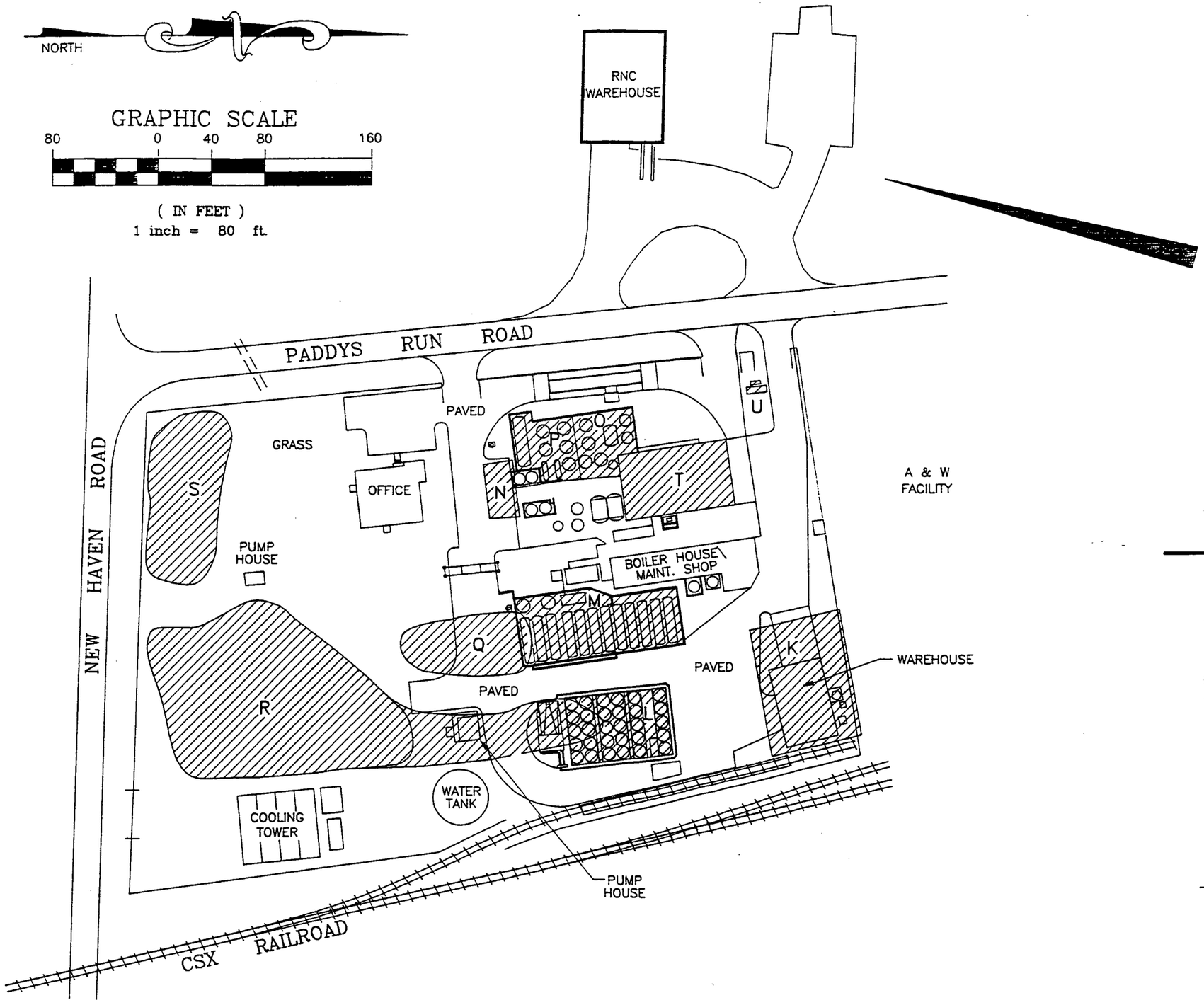
In 1959, 4 acres of farm land were purchased by Nease Chemical Company, Inc. from the C&O Railroad (now CSX Railroad). Nease constructed a plant to manufacture a variety of aromatic sulfonated compounds for detergents. In December 1977, Ruetgers Chemicals, Inc. and the former owner and operator, Nease Chemical Company, Inc., merged to become the Ruetgers-Nease Chemical Company, Inc. In August 1993, the company became known legally as the Ruetgers-Nease Corporation.

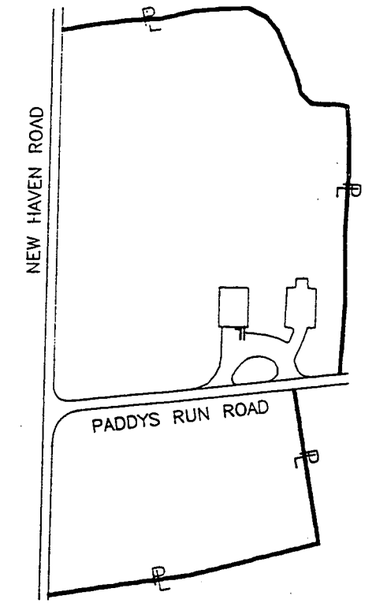
Since January 1978, RNC has operated this chemical manufacturing plant located at the northeast corner of Paddys Run Road and New Haven Road. The general layout of this 4-acre facility is shown on Figure 1-5. Depicted are the locations of processing and chemical storage areas, as well as past and present cooling ponds. In addition, RNC has obtained 10 acres of land west of Paddys Run Road, which contains a one-acre warehouse.

RNC has used cumene, toluene, xylene, benzene, sulfuric acid, ammonia, potassium hydroxide and sodium hydroxide to manufacture sulfonated compounds, referred to as hydrotropes, for detergents. Sulfonic acid products for use as catalysts in curing resins in both the foundry industry and foam insulation industry are also manufactured by RNC. Aromatic sulfonated compounds are manufactured by the reaction of toluene, xylene, cumene or benzene with sulfuric acid. During the production of aromatic sulfuric acids, a small amount of by-product sulfones (e.g., ditolyl sulfone, dixylyl sulfone) are formed. Waste from the RNC production process consists of filter residue, also known as filter cake, which is a diatomaceous earth and clay substance. This non-hazardous waste is collected and stored in boxes south of the Process Building. The material is disposed of in a licensed landfill off-site.

Toluene -- From 1959 to 1965, approximately 70% to 90% of the hydrocarbon used in manufacturing of sulfonates was toluene. By 1968, toluene accounted for less than 3% of the total hydrocarbon used. Currently, about 10% of the hydrocarbon used in manufacturing is toluene.

Xylene -- Xylene was first used in approximately 1963. At that time, approximately 30% of the hydrocarbons used was xylene. Ammonium xylene sulfonate was a typically sulfonated compound. Currently, xylene still accounts for 30% of the hydrocarbon used at the facility. Xylene contains approximately 15% ethylbenzene as an impurity.





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EXPLANATION

- K – FORMER RUNOFF DRAINAGE\TRUCK WASHDOWN AREA (1959 – 1978)
- L – HYDROTOPE STORAGE AREA
- M – TANK FARM AREA
- N – FORMER SMALL LAGOON (1959 – 1966)
- O – SULFURIC ACID STORAGE
- P – WASTE STORAGE
- Q – FORMER POND NO. 1 (1959 – 1974)
- R – POND NO. 2 (1965 – PRESENT)
- S – FORMER POND NO. 3 (1962 – 1974)
- T – PROCESS BUILDING
- U – FORMER UNDERGROUND FUEL STORAGE TANKS (1959 – 1988)
- — — EXTENT OF AREAS Q, R AND S INFERRED FROM HISTORICAL AERIAL PHOTOS

RNC FACILITY
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 1-5

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Environmental Resources Management

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Benzene -- Benzene was used from 1966-1967 to manufacture sodium benzene sulfonate. Difficulties with the process limited its use to approximately 15,000 gallons over that period. The use of benzene as a raw material was discontinued.

Cumene -- Cumene, also known as isopropylbenzene, was first used in 1966. Ammonium cumene sulfonate and sodium cumene sulfonate are the end products. In the first year, cumene accounted for approximately 20% of the hydrocarbons used. Today, cumene accounts for 60% of the total hydrocarbons used at the facility.

1.2.3 Summary of Previous Investigations in the General Area by Governmental Agencies

The first indication of potential groundwater contamination in the Fernald area was reported to the Ohio Department of Health in March 1962 by local residents complaining about chemical odors in their well water. Subsequent follow-up by the Ohio Department of Health resulted in water samples being collected from the RNC ponds, one from the RNC production well, and one from a driven well at a gasoline service station 150 to 200 yards east of the RNC property. The Ohio Department of Health recommended a more thorough investigation (Papier 1962).

On July 23, 1962, 12 wells within a half-mile radius of what was then Nease Chemical Company were investigated. Two of the 12 wells sampled had detectable sulfonated products (Richards 1962). Groundwater contamination was also noted in 1972 by a driller during the installation of a new well. The driller noted that the water in the well foamed when agitated by the drilling equipment. The water also had a chemical odor.

In 1973, the Miami Conservancy District (MCD) measured groundwater elevations from area wells and collected samples for chemical analyses. That study concluded that wells downgradient from RNC property contained levels of sodium, potassium, nitrogen ammonia, sulfates, phenols, methylene blue active substance (MBAS), total

organic carbon (TOC) and chemical oxygen demand (COD) that were higher than other area wells (Noyes 1973).

Sampling of the residential and commercial wells in Fernald from 1973 to 1984 by Ohio EPA revealed that several wells were apparently contaminated (Ohio EPA 1989). The specific organic chemicals were not identified at the time because of limitations in analytical techniques.

Groundwater sample analyses performed in 1981 indicated uranium in some wells located in the now-designated Study Area and in some wells to the north of the Study Area (U.S. Department of Energy 1984).

During its review of environmental contamination issues in the Fernald area, the State of Ohio concluded that not only was the environment within the 1050-acre FEMP itself contaminated with hazardous substances, but also that the environmental resources downgradient of the FEMP had been contaminated as well (ENSR 1989). To date the only chemical found in the Study Area that is known to be related to former DOE operations is uranium. Pursuant to the Comprehensive Environmental Response, Compensation and Liability Act of 1980, 42 U.S.C. SS 9601, et. seq. (CERCLA), DOE is conducting an RI/FS for the FEMP facility which is adjacent to and upgradient of the Companies' Study Area. The area being studied by the DOE in part overlaps the PRRS.

The following section highlights the findings of investigations conducted by the Companies, individually and collectively, prior to initiating the formal RI in 1989 in cooperation with the Ohio EPA.

1.2.4 Summary of Investigations by the Companies Prior to the AOC

In January of 1982, Mobil Chemical Company retained Leggette, Brashears & Graham, Inc. (LBG) to investigate an area on the southern boundary of the plant where residue from the recycle-water tank was staged temporarily and neutralized with sodium hypochlorite in 1976 (LBG 1982). In the summer of 1976, the Ohio

EPA evaluated the staged materials and approved the removal of about 100 cubic yards of residue and "contaminated earth" for disposal at an approved landfill, which was done in August. The LBG study was prompted by reports from RNC that phosphates were in its well water.

As part of its 1982 investigation, LBG augered eight boreholes to identify the extent of contamination remaining beneath the temporary residue treatment area of 1976. In five borings LBG found that the natural soils appeared to be discolored by the downward movement of the liquid portion of the residue. High values of phosphate and potassium were noted in one borehole, and were believed to be a result of this movement. The LBG study led to the subsequent removal of 700 cubic yards of contaminated soil. Test data on this soil indicated it met then-current limits on toxic materials for disposal in sanitary landfills. The Ohio EPA approved such disposal in July 1982 (Ohio EPA 1982).

In May 1983, Mobil undertook a study of the potential effect of discharges from its facility on Paddys Run, the intermittent stream west of the plant, in cooperation with the Ohio EPA (Stevens 1984). No nuisance algae growth was observed in the stream, and the statistical analysis of data indicated that the discharge being studied had no significant impact on the growth of blue-green algae in the stream, or on total algae.

Mobil again retained the services of LBG, in April 1985, to investigate the potential for the development of an alternate groundwater supply for its facility. Mobil requested the study because of reported high levels of dissolved uranium in water samples collected from two production wells supplying the plant (Dames & Moore 1985a, GeoTrans 1985). LBG reported that there was an alternate source of groundwater along Paddys Run for the facility. LBG recommended, however, that development of an alternate source should not proceed because the extent of uranium contamination from the FMPC facility was unknown (LBG 1985).

LBG reviewed groundwater studies of the then-FMPC area issued by other contractors later in 1985. In a report to Mobil/Albright & Wilson, LBG said that

uncertainty as to the actual areal extent of high uranium levels around Fernald made it impractical and expensive to locate an alternate fresh groundwater supply. (LBG 1986).

1.2.5 Summary of Phase I RI Investigations Previously Reported by the Companies

Incorporated as part of the AOC for the PRRS, the Work Plan specified investigations that were to be conducted under Phase I and Phase II of the RI. Findings from work conducted in 1989 have been reported by ENSR, the Companies' consultant at the time, in the *Preliminary Activities Report* (ENSR 1990a). That report addressed the Preliminary Activities and Initial Field Activities of Phase I. Highlights of the findings of those activities are presented here under the headings:

- Residential and Industrial Well Inventory
- Groundwater Level Measurements
- Perimeter Air Investigation
- Soil Gas Survey

Residential and Industrial Well Inventory. Based on door-to-door well survey inventories conducted on May 2, 1989 and July 24, 1989, it was determined that a total of 21 residential/industrial wells existed as shown in Figure 1-6.

The wells identified are used for domestic and industrial purposes. Six of the wells supply water to homes for domestic use. These include Estes, Fisher, Burton, Pottenger, Knollman Farms, Inc., and J. Rolfes. All of the wells with the exception of Rolfes appeared to be located hydraulically upgradient of the PRRS.

Eight of the remaining 15 wells identified are used by several industries including Harrison Poured Foundations (three wells), Evers Welding Equipment (one well), Delta Steel (one well), A & W Americas (two wells), and Ruetgers-Nease (one well). The wells owned by Evers Welding Equipment and Delta Steel are used for

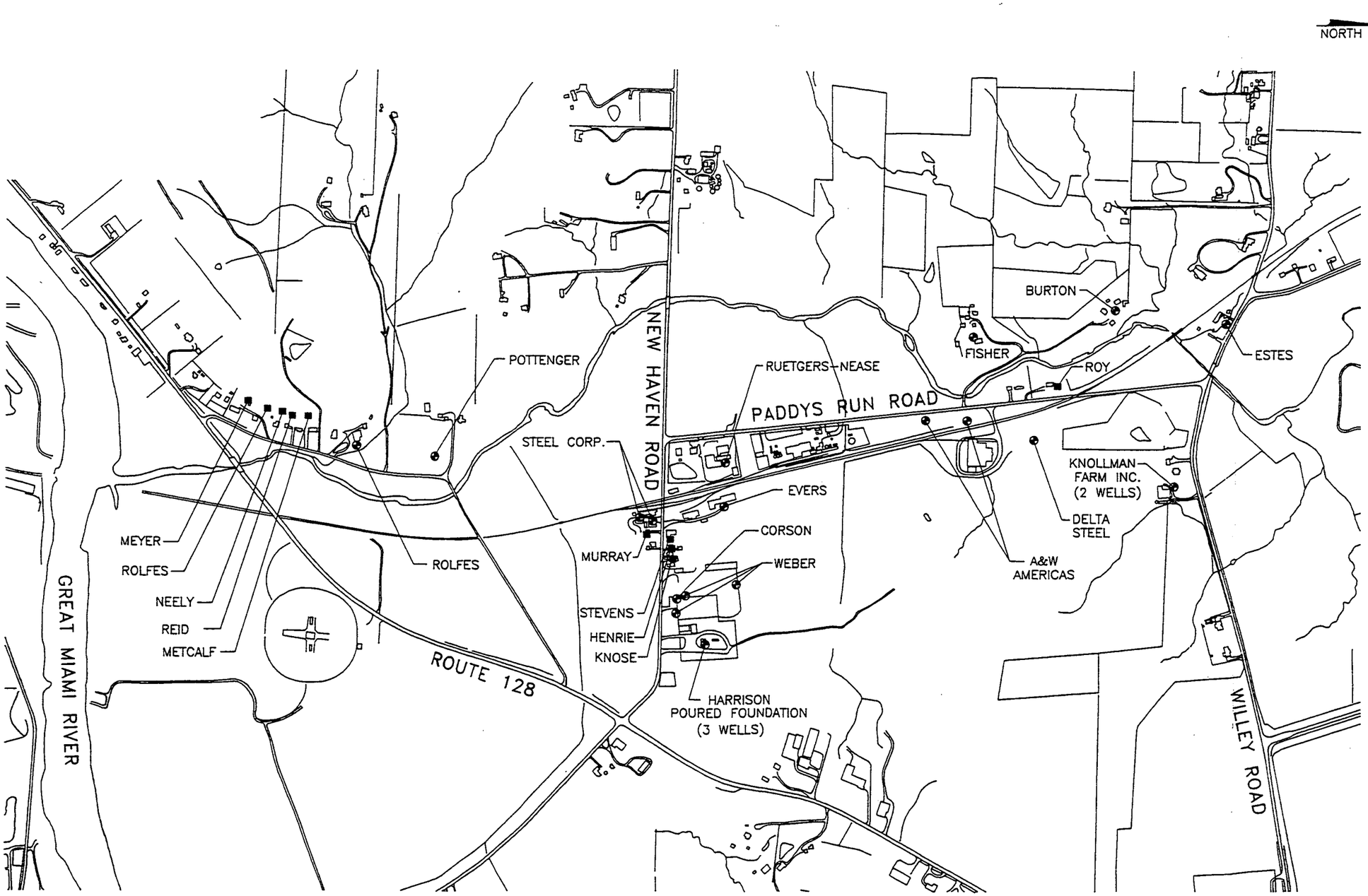
sanitary purposes (ENSR 1990). The other wells are used by the industries for their plant processes. None of the wells are used for drinking water purposes. Two wells were used by Steel Corp. prior to its relocation in 1991. One well has been abandoned and the other currently is not being used.

Drilling records were not filed with the State of Ohio for the remaining five wells, i.e., Corson, Weber (three wells), and a second well at Knollman Farms, Inc.

During the well inventory, Stevens, Knose, and Henrie indicated that their wells were plugged (ENSR 1990c). Stevens, Knose, Henrie, Roy, and Murray indicated that they used cisterns and purchased water for drinking (ENSR 1990c). Other cistern users in the area included Meyer, Rolfes, Neely, Reid and Metcalf.

Groundwater Level/Measurements. Eleven piezometers were installed throughout the Study Area for the sole purpose of establishing groundwater level and subsequently groundwater flow direction. Groundwater level measurements were made on two separate occasions following installation of piezometers. The first round of measurements was made on June 27, 1989 and the second round was made on July 24, 1989. The first-round measurements included the 11 newly installed piezometers. Second-round measurements were made on the 11 piezometers and A&W and RNC production wells. Water level measurements were not made in any of the residential/industrial wells found within the PRRS because of well construction limitations. The general groundwater flow direction within the PRRS is from the north towards the south-southeast.

Perimeter Air Investigation. The perimeter air investigation of the A&W and RNC plant boundaries was conducted in May 1989 using a portable flame ionization detector (OVA-128). This instrument measures air concentrations of volatile organic chemicals (VOCs) in parts per million (ppm). Organic vapors were only detected along the perimeters of the A&W and RNC plant boundaries at a few locations as shown in Figure 1-7. At the RNC plant, detected concentrations ranged from 0.2 to 3.0 parts per million (ppm) and from 0.1 to 0.8 ppm at the A&W plant. It was observed during the survey that the wind direction was from the northeast. It



LEGEND

- ⊕ APPROXIMATE LOCATION OF DOMESTIC AND INDUSTRIAL WELLS
- ■ APPROXIMATE LOCATION OF CISTERNS

GRAPHIC SCALE

800 0 400 800 1600

(IN FEET)
1 INCH = 800 FT.

WELL/CISTERN MAP–1989
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 1–6

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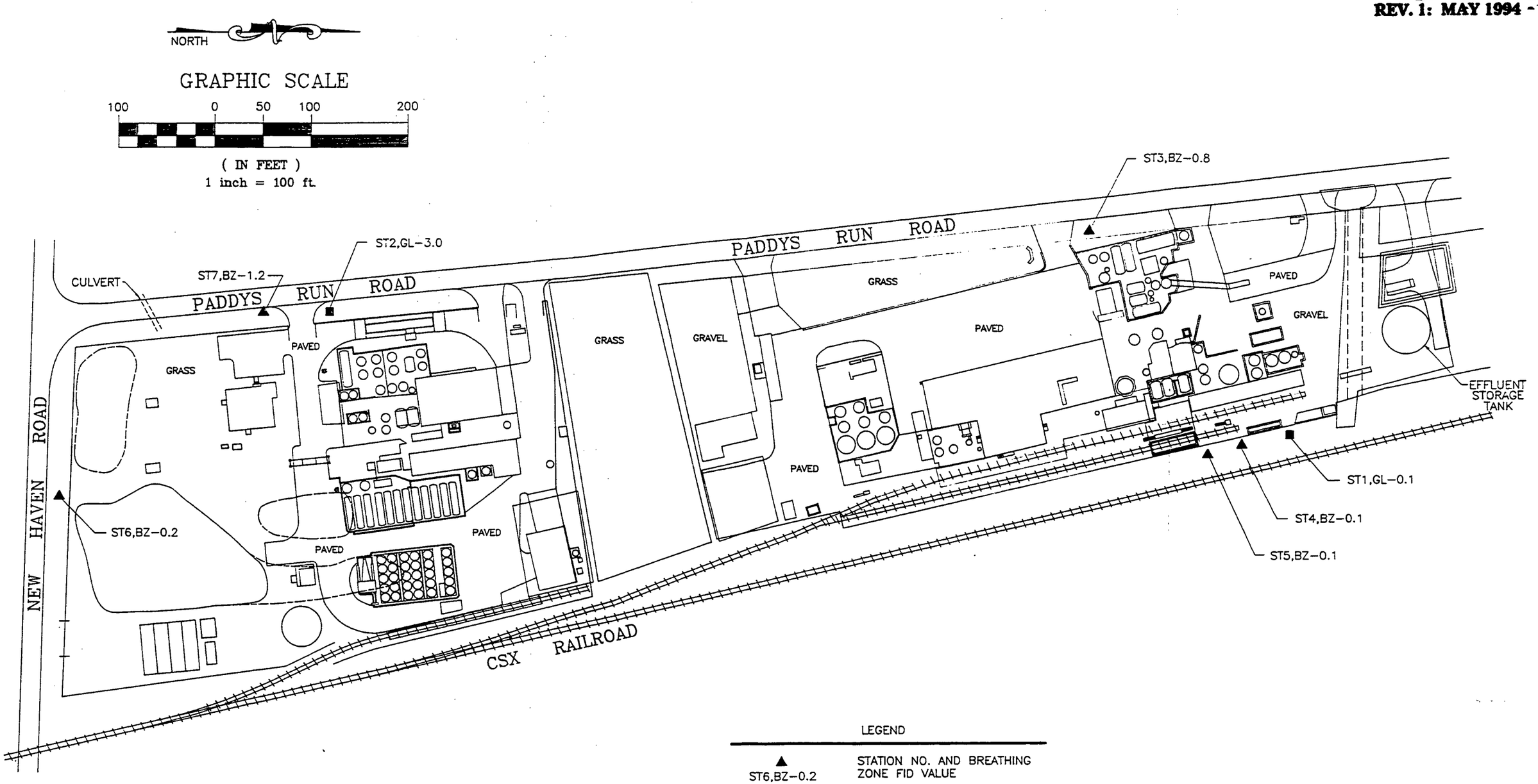


LEGEND

▲ ST6,BZ-0.2	STATION NO. AND BREATHING ZONE FID VALUE
■ ST2,GL-3.0	STATION NO. AND GROUND LEVEL FID VALUE

FID VALUES IN ppm

000040

LOCATIONS OF ORGANIC VAPORS DETECTED ALONG THE PERIMETER OF A&W AND RNC PROPERTIES – 1989
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 1-7

ERM-Midwest, inc.
Environmental Resources Management

PROJECT\539-10-02\1002F17.DWG

should be noted that the organic vapor concentrations reflected equivalent concentrations of methane, the standard gas used to calibrate the instrument, and that the instrument reads total VOCs because it is not capable of identifying specific organic compounds. The investigation showed that an action level of 10 ppm level was not exceeded as defined in the *Site Health and Safety Plan* (ENSR 1989).

Soil Gas Survey. A soil gas survey was performed in June 1989 to identify any VOC chemicals associated with the soils and/or underlying groundwater. Figure 1-8 shows the extent of the survey and isoconcentration lines, based on total VOCs.

As additional background for this report, Appendix A summarizes both Phase I and Phase II RI activities from May 1989 to May 1994, based on monthly progress reports to Ohio EPA.

1.3 Overview of Existing Reports Related to Field Investigations

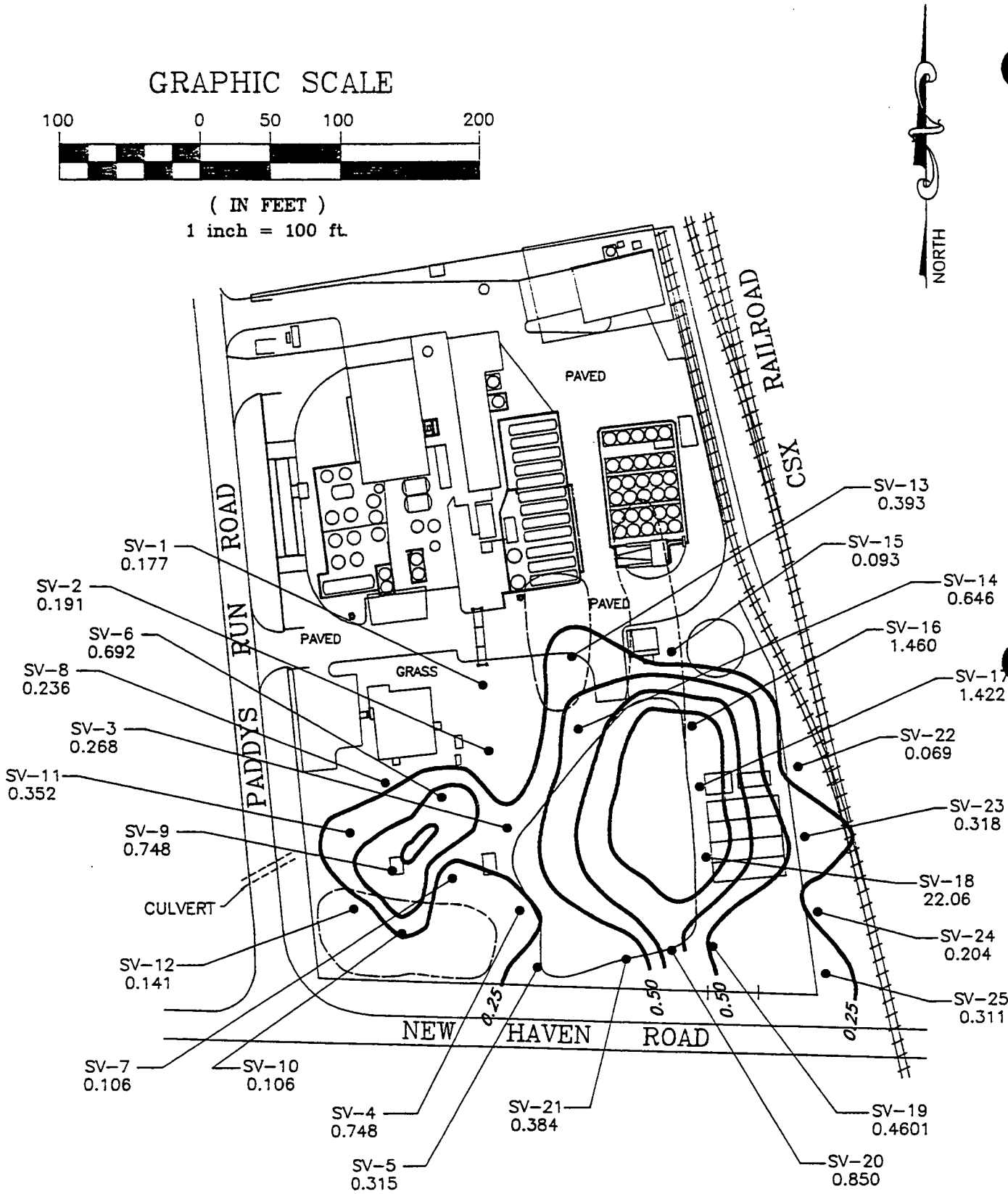
The March 1989 Work Plan outlined the elements of the proposed RI/FS and provided for Phase I and Phase II investigations. Some of these elements have been fully reported previously to the Ohio EPA while other elements may have been only partially reported. Below is a narrative describing where elements of the Phase I and Phase II investigations can be found.

1.3.1 Phase I Investigations

Phase I activities consisted of four components:

- **Preliminary Activities**
- **Initial Field Activities**
- **Sampling Activities**
- **Data Analysis and Evaluation**

The first two components, **Preliminary Activities** and **Initial Field Activities**, have been reported in the *Preliminary Activities Report* (ENSR 1990a) submitted to the



ISOCONCENTRATION CONTOUR
INTERVAL = .25 ppm

000042

TOTAL CONCENTRATION OF BENZENE, TOLUENE, XYLENE, AND CUMENE MEASURED DURING THE SOIL GAS SURVEY OF THE RNC PROPERTY–1989
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 1–8

ERM ERM-Midwest, inc.
Environmental Resources Management

PROJECT\539-10-02\1002F18.DWG

Ohio EPA June 4, 1990. Highlights of those findings are addressed in Section 1.2.5 of this report.

Sampling Activities, the third component, were undertaken in Phase I to begin characterizing the Study Area. Those activities included the investigation of Study Area soils, surface waters, sediments, and Rounds I and II groundwater sampling. Analytical laboratory results, soil boring descriptions and monitor well construction from those investigations have been reported in the following documents:

> *Summary Data Package Phase I Remedial Investigation, Volume I and Volume II Paddys Run Road Site Crosby Township, Ohio.* (ENSR 1990b)
>
> *Actual Detection Limit and Data Validation Report for Soil, Surface Water and Sediment Paddys Run Road Site Crosby Township, Ohio* (ENSR 1991a)
>
> *Actual Groundwater Detection Limits Paddys Run Road Site Crosby Township, Ohio* (ENSR 1991b)
>
> *Monitoring Well Construction Details and Well Development Records Paddys Run Road Site Crosby Township, Ohio* (ENSR 1991c)

Included in *Summary Data Package Phase I Remedial Investigation Volume I and Volume II Paddys Run Road Site Crosby Township* (ENSR 1990b) are the analytical laboratory results for groundwater Rounds I and II, and graphic presentations (logs) including the construction of monitoring wells and the associated description of the subsurface geology. The subsurface geology was determined from soil samples obtained while installing monitor wells throughout the Study Area.

The fourth component of Phase I activities, **Data Analysis and Evaluation**, was conducted until the Companies and the Agency agreed that the extent of groundwater and soil contamination had not been sufficiently defined. None of the Data Analysis and Evaluation component has been formally reported to the Agency previously, because at this point Phase II was initiated.

Previously unreported data from Phase I are incorporated into appropriate areas within this section and Section 4.0, Nature and Extent of Chemicals of Concern. A

brief description of elements of the Phase II investigations, and where they are reported is presented below.

1.3.2 Phase II Investigations

Phase II Monitoring Well Installation Program

To expand the network of wells necessary to address the extent of chemicals of concern in groundwater, a *Proposed Phase II Monitoring Well Program* (ENSR 1990c) was initiated. A total of 27 monitoring wells and one shallow piezometer were installed during the Phase II Monitoring Well Installation Program. Results from 18 of those wells were reported to the Ohio EPA in a document entitled *Phase II Investigation Summary Data Package* (ENSR 1991c). Results from the remaining nine monitor wells and one piezometer are reported in this document.

Phase II Work Plan Investigations

A *Work Plan For Phase II Remedial Investigation and Baseline Risk Assessment Paddys Run Road Site Hamilton County, Ohio* (ERM 1991a) was developed for the purpose of:

- Filling existing Phase I data gaps by installing more wells and collecting additional analytical information to more fully define the nature and extent of chemicals of concern in groundwater, soil, surface water and sediment
- Identifying and characterizing source areas

Phase II investigations began with Round III and Round IV groundwater sampling. Analytical results for Round III and Round IV have been reported to the Ohio EPA in *Validated Summary Data Packages, Rounds III and IV Groundwater Monitoring Paddys Run Road Site Crosby Township, Ohio* (ERM 1991b).

As previously mentioned, a final draft of the *Work Plan for Phase II Remedial Investigation and Baseline Risk Assessment* was submitted to the Ohio EPA

September 3, 1991 (ERM 1991a). During the implementation of the Work Plan, ancillary tasks included:

- Installing monitoring wells and a piezometer
- Installing continuous water level recorders in two monitoring wells and a piezometer
- Collecting additional groundwater samples from select monitoring wells

Results of all Phase II field investigations, including ancillary tasks, and other Phase I field investigations not previously reported are addressed here as outlined in Section 1.4.

1.4 Organization of the RI/RA Report

The organization of this report follows, as appropriate, the recommended outline contained in the U.S. EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (U.S. EPA 1988a).

Section 2.0, PRRS Area Investigations, describes the investigations conducted under the RI. (The overall schedule of investigations appears in Figures 1-1 and 1-2 in Section 1.0.) In some instances, frequently-referred-to details concerning particular aspects of a methodology have been placed in an appendix.

Section 3.0, Physical Characteristics of the PRRS, focuses on the results of the investigations identified in Section 2.0. These results are descriptive and analytical in nature. Analytical data are summarized, with field and laboratory details, in the appendices. No interpretations of results are made in this section.

Section 4.0, Nature and Extent of Chemicals of Concern, presents the results of the Study Area characterization investigations (Section 2.0 and 3.0) in terms of natural chemical elements present at the Study Area versus the presence of chemicals of concern in various media.

Section 5.0, Contaminant Fate and Transport, summarizes the available environmental fate and transport information for the chemicals of concern at the PRRS.

Section 6.0, Baseline Risk Assessment, provides an evaluation of the potential risk to human health and the environment posed by identified chemicals of concern. This assessment forms the basis for determining whether or not remedial action is necessary, and the justification for performing remedial actions.

Section 7.0, Summary and Conclusions, presents findings in terms of the nature and extent of chemicals of concern and associated risks, and presents conclusions.

The appendices of this report include supporting data and other information, such as supporting reports and technical memoranda.

References cited throughout the first seven sections of this report are listed separately after Section 7.0 and before Appendix A in the Bibliography.

TABLE OF CONTENTS

Section	Title	Page
2.0	PRRS INVESTIGATIONS	2-1
2.1	Surface Features	2-1
2.1.1	PRRS Setting	2-1
2.1.2	Facilities Setting	2-3
2.2	Meteorological Investigations	2-16
2.3	Land Use and Population	2-17
2.4	Ecological Investigations	2-17
2.5	Chemical Source Investigations	2-18
2.6	Surface Water Investigations	2-19
2.6.1	March 1990 Surface Water Sampling Event	2-20
2.6.2	May 1991 Surface Water Sampling Event	2-23
2.7	Sediment Sampling	2-25
2.7.1	March 1990 Sediment Sampling Event	2-27
2.7.2	May 1991 Sediment Sampling Event	2-27
2.8	Geological Investigations	2-30
2.9	Unsaturated and Saturated Soil Investigations	2-30
2.10	Groundwater Investigations	2-38
2.11	Groundwater Modeling	2-69
2.11.1	Regional Flow Model Development	2-71
2.11.2	Local Flow Model Development	2-73
2.11.3	Solute Transport Model Development	2-73
2.12	Determination of Chemical Backgrounds at PRRS	2-78

LIST OF FIGURES

Figure	Title	Page
2-1	Paddys Run Road Site	2-2
2-2	A&W Facility	2-5
2-3	Topographical Features of the A&W Facility	2-7
2-4	RNC Facility	2-12
2-5	Topographic Features of the RNC Facility	2-14
2-6	March 1990 Surface Water Sample Locations	2-22
2-7	May 1991 Surface Water Sample Locations	2-24
2-8	March 1990 Sediment Sample Locations	2-28
2-9	May 1991 Sediment Sample Locations	2-29
2-10	Locations of Surface Soil and Particle Size Distribution Sample Collection	2-31
2-11	Overlay Showing Various Plant Areas	2-33a
	Unsaturated and Saturated Soil Investigations - Monitoring Wells, Piezometers and Soil Borings; Companies' Facilities	2-33b
2-12	Unsaturated and Saturated Soils Investigations - Monitoring Well, Piezometer, and Soil Boring Locations Surrounding Companies' Facilities	2-34
2-13	Groundwater Investigations - Monitoring Wells and Soil Borings Companies' Facilities	2-57
2-14	Groundwater Investigations - PRRS, DOE, Residential and Industrial Well Locations Surrounding Companies' Facilities	2-58
2-15	Wells Sampled for Treatability Parameters	2-59

LIST OF TABLES

Table	Title	Page
2-1	Location and Parameters Analyzed for March 1990 and May 1991 Surface Water Investigations	2-21
2-2	Location and Parameters Analyzed for March 1990 and May 1991 Sediment Investigations	2-26
2-3	Boring Location, Depth, Parameters Analyzed for Phase I Investigations, A&W Property	2-35

LIST OF TABLES (Continued)

Table	Title	Page
2-4	Boring Location, Depth, Parameters Analyzed for Phase II Investigations, A&W Property	2-39
2-5	Boring Location, Depth, Parameters Analyzed for Phase I Investigations, RNC Property	2-47
2-6	Boring Location, Depth, Parameters Analyzed for Phase II Investigations, RNC Property	2-51
2-7	Summary of Round 1 Groundwater Sampling Parameters	2-60
2-8	Summary of Round 2 Groundwater Sampling Parameters	2-62
2-9	Summary of Round 3 Groundwater Sampling Parameters	2-64
2-10	Summary of Round 4 Groundwater Sampling Parameters	2-66
2-11	Summary of Supplemental 1 and Supplemental 2 Groundwater Sampling Parameters	2-68
2-12	Summary of Groundwater Sampling Parameters from Phase II Boring Program	2-70
2-13	Primary Calibration Evaluation Criteria for Transport Modeling	2-77

2.0 PRRS INVESTIGATIONS

Investigating the physical characteristics of the Paddys Run Road Site (Study Area) required collection of data to the extent necessary to define potential transport pathways for chemicals of concern and receptor populations. Such data also provide a basis for the development and evaluation of remedial action alternatives.

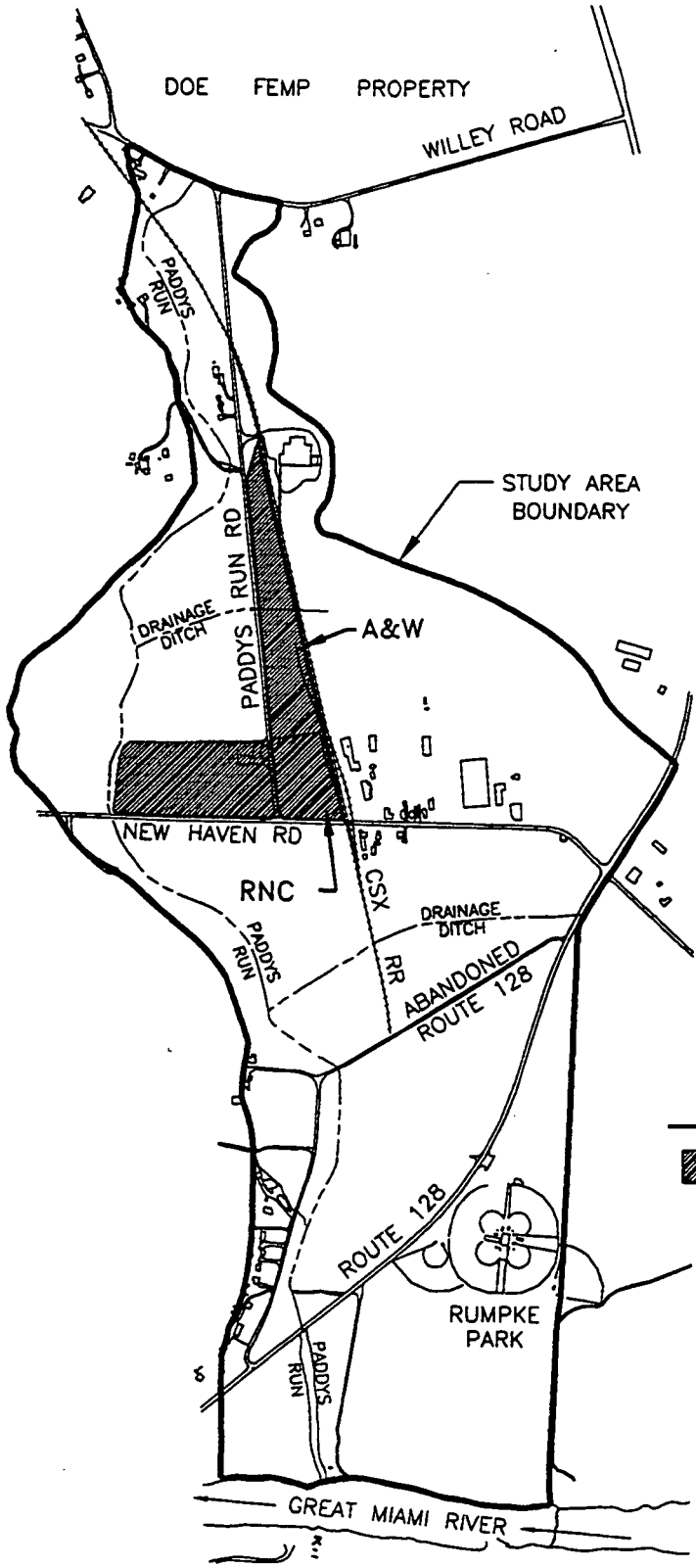
Section 2.0 describes Phase I investigations that have not been formally reported previously to the Ohio EPA and all Phase II investigations associated with the characterization of the PRRS. The descriptions of investigations are limited in this section to identifying what activities were performed at which locations, and how investigations were implemented. Section 3.0 presents the results of these investigations, addressing the physical characteristics of the Study Area.

2.1 Surface Features

Surface features were identified by walk-throughs, review of facility diagrams and previous documents, discussion with facility personnel, and a thorough regional literature review. Most of the surface feature information below derived from work conducted prior to Phase I and Phase II (ENSR 1989). Additional surface feature information obtained while conducting the Phase I and Phase II investigations, which includes location of underground piping and interpretation of historical aerial photographs, is reported in Section 3.1.

2.1.1 PRRS Setting

The Study Area encompasses the A&W facility, the RNC facility, and surrounding areas. The Study Area, as shown in Figure 2-1, is situated in a relatively flat valley about 1½ miles in length from north to south and ranges in width from approximately 500 to 4,000 feet to encompass approximately 400 acres.



LEGEND

THE COMPANIES' PROPERTIES

GRAPHIC SCALE

1200 0 600 1200 2400

(IN FEET)
1 inch = 1200 ft.

PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 2-

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The Study Area is partially surrounded by hills composed of bedrock or glacial till. Maximum elevation changes from the valley floor to the hill tops are approximately 200 feet. The change in relief within the valley is approximately 23 feet. The average valley floor elevation is between 525 and 530 Feet Above Mean Sea Level (FAMSL). The valley slopes from north to south toward the Great Miami River.

Physical boundaries of the Study Area include: the valley wall west of Paddys Run; glacial till hills to the east; highway State Route 128 and the intersection of Route 128 and New Haven Road directly south to the Great Miami River; Willey Road, which coincides with the southern boundary of the FEMP, to the north; and the Great Miami River to the south.

The valley is predominantly agricultural but has light industries in and just north of the town of Fernald. The hills located around the study area are currently wooded, and have limited commercial value for farming or industry. Rumpke Park, a softball complex, is located on Route 128 in the southeast limit of the study area.

The Chesapeake and Ohio Railroad (now CSX) passed north and south through the Study Area daily, carrying both passengers and freight. A depot for the railroad, formerly located at the southeast corner of the current RNC facility, was removed in 1987. At that time, the railroad discontinued traffic through the area and removed tracks south of Fernald. Railroad traffic now comes from the north and consists of freight trains that transport materials to and from both A&W and RNC on dedicated spurs of the railroad.

2.1.2 Facilities Setting

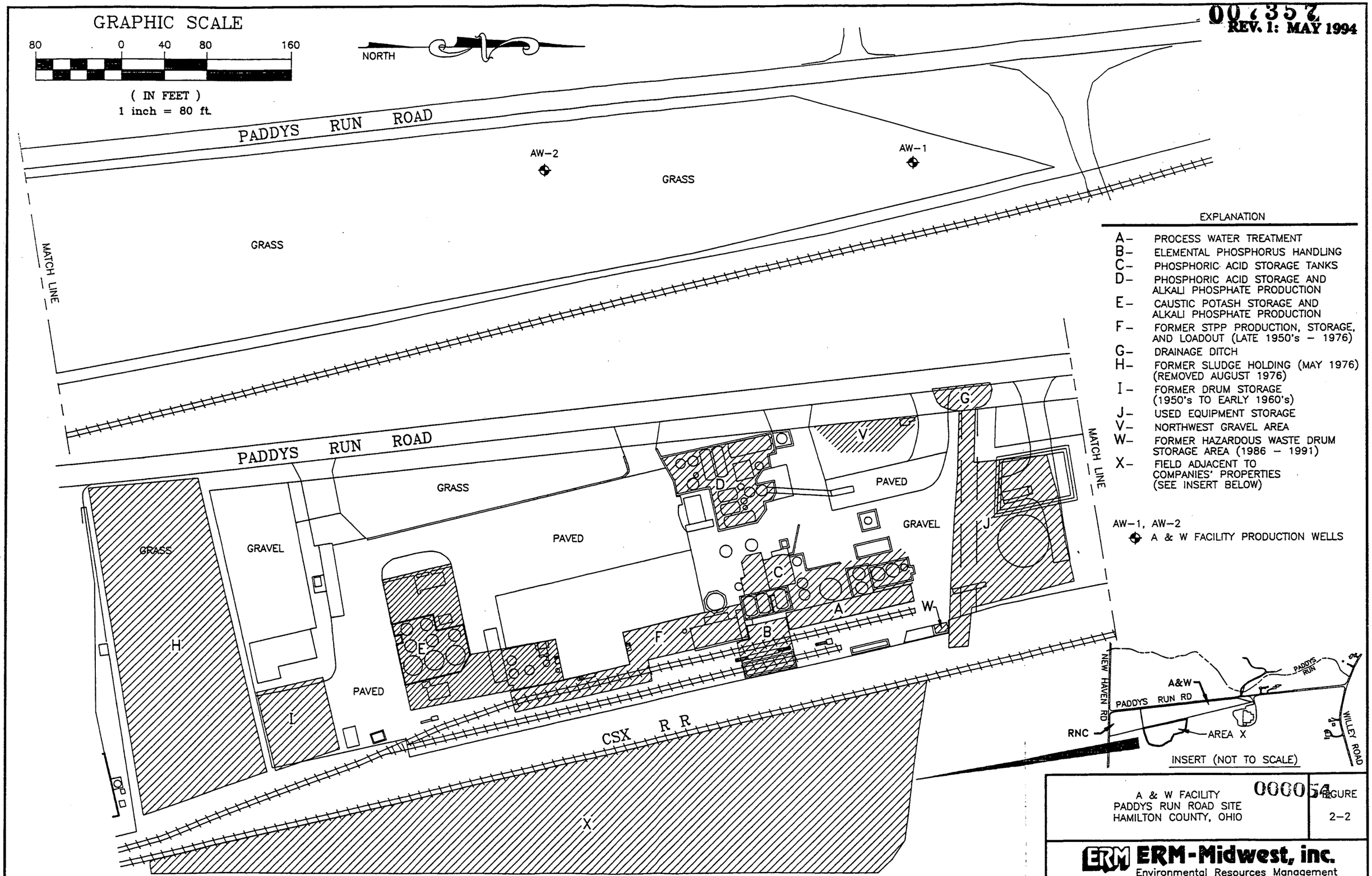
Locally, the Companies occupy approximately 24 adjoining acres (10 acres owned by A&W and 14 by RNC) situated in the upper half of the Study Area, as shown in Figure 2-1. Chemical manufacturing operations have been conducted on about 7 of the approximately 24 acres for a number of years. The facility on the northern portion of the active manufacturing area is currently owned and operated by A&W. Previous operators included Virginia-Carolina Chemical Company from 1954 to

1964, and Mobil Oil Corporation from 1964 to 1985. The southern portion of the active manufacturing area was operated by Nease Chemical Company from 1959 to 1978. On December 30, 1977, Nease merged with Ruetgers Chemical to become RNCC. On August 24, 1993, RNCC changed its operating name to Ruetgers-Nease Corporation.

These facilities are bounded to the east by a branch line of the CSX railroad system, which has spurs into both facilities. Paddys Run Road provides the only motor vehicle entrance for A&W, and defines its western property line. The 14 acres of RNC property extend across Paddys Run Road to the west. Approximately 10 acres, 9 of which are farmlands, are west of the road; 1 acre is occupied by a RNC warehouse. Access to RNC by motor vehicle is primarily from Paddys Run Road; however, a limited-access gate is present at RNC's southern property line along New Haven Road. Active areas of manufacturing at both facilities are secured by an 8-foot high, chain-link fence and gates.

A&W Facility Description

As shown on Figure 2-2, the A&W facility consists of about 10 triangular-shaped acres running roughly north to south (approximately 2700 feet). The southern boundary, contiguous with RNC, is approximately 300 feet east-west. North to south, it is approximately 2700 feet. Of these 10 acres, active operations occupy less than 3 acres, combined. Within this 3-acre area, chemical handling and process areas occupy 1 acre. The remaining 2 acres are occupied by a concrete block building that houses the office, laboratory, warehouse, shipping/receiving terminal, a parking area, and both paved and unpaved roadways. Sections of roadways were paved from 1980 to 1989. Other areas within the facility boundaries consist of: diked containment areas for storage of liquid, raw, and manufactured products; a liquid loading terminal; a hazardous waste storage pad (closed under the Resource Conservation Recovery Act [RCRA] provisions with the Ohio EPA in 1993); and a railroad spur.



A & W FACILITY
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

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FIGURE 2-2

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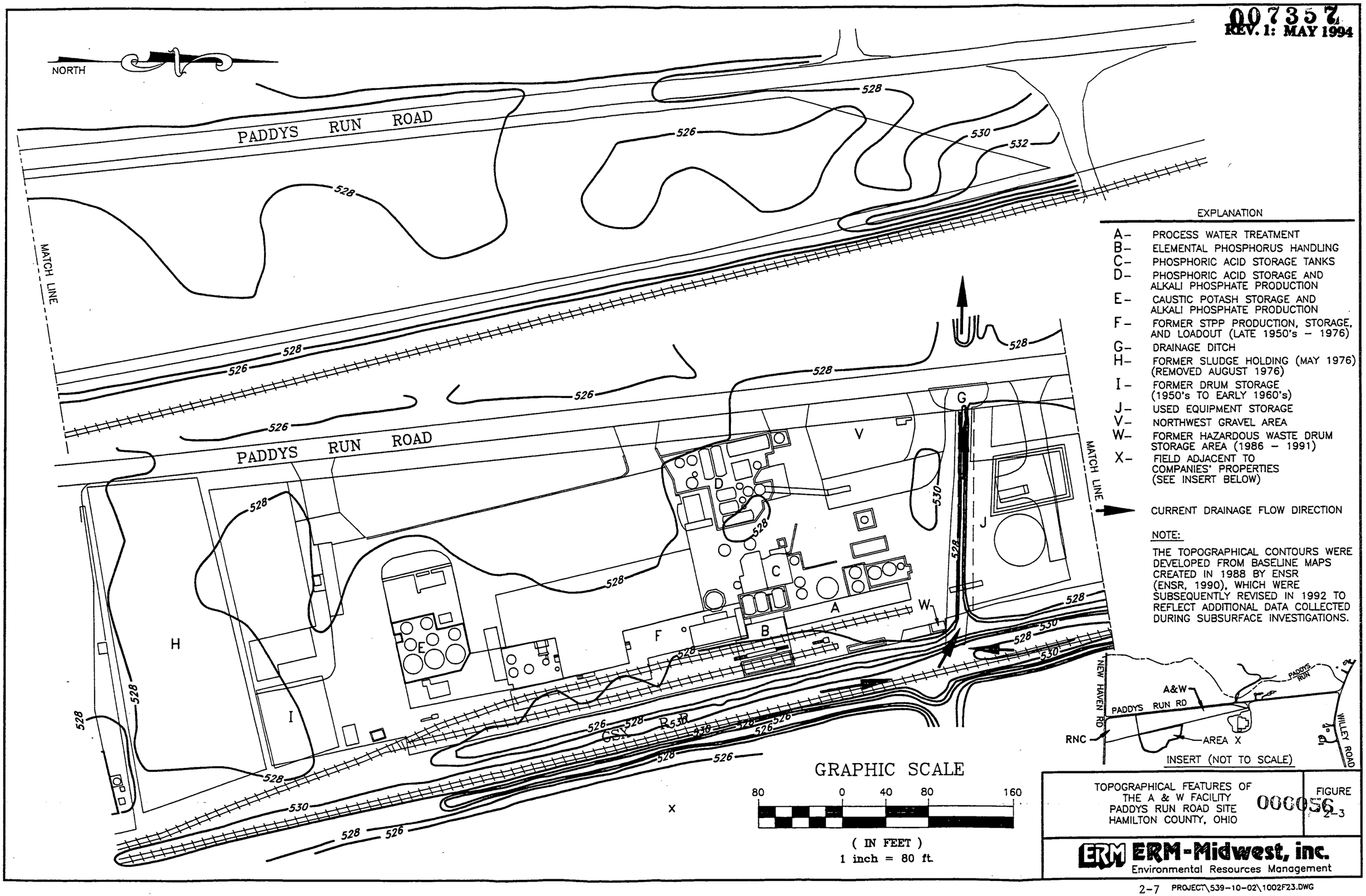
At the northern end of the active operations is an east-west oriented ditch traversing the width of A&W's property. The ditch originates approximately 1,100 feet east of the facility, passes through the property and ultimately connects to Paddys Run to the west. Originally the ditch served to drain precipitation from the adjacent fields. After construction of A&W's facility, stormwater from the facility likewise drained to the ditch. In March 1975, a pipeline was placed in the ditch for the purpose of carrying treated aqueous wastewater from A&W's manufacturing process to Paddys Run.

A metal footbridge across the drainage ditch connects the manufacturing and chemical handling operations on the south side of the ditch with the 5-acre portion of land to the north. Located on the northern portion of A&W's property are the plant's two process water-supply wells, the support foundation for a former aboveground standby oil storage tank, and an active 500,000-gallon effluent equalization tank that holds the facility wastewater.

The remaining 2 acres of the total 10-acre property include the open and unused land south between A&W's manufacturing area and the common property line with RNC.

The topography of the A&W facility, as shown in Figure 2-3, is relatively flat. The maximum topographic relief within the three-acre process area is about 2 feet, occurring along the eastern edge of the property. Another area of topographic relief is a tree lined grassy low area between the parking lot and Paddys Run Road. This low spot collects some surface water run-off, primarily from the paved areas. A culvert drains the north end of the low spot northward to the drainage ditch. Maximum relief of the grassy low area is approximately 2 feet. At the southern end of this area is located the sanitary wastewater unit.

The CSX railroad line, which bounds the eastern edge of the property, is approximately 2 feet higher than the surface of the facility. Between the road bed and the facility is a ditch lined with large diameter clay tiles that have been cut in



TOPOGRAPHICAL FEATURES OF THE A & W FACILITY PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO

000056

FIGURE 2-3

ERM ERM-Midwest, inc.
Environmental Resources Management

half. The lowest point in any part of the ditch is roughly 2 feet below that of the facility. It is sloped so that drainage flows north into the east-west drainage ditch.

A&W/Mobil Process Operations

A&W/Mobil's manufacturing process has used elemental phosphorus, phosphoric acid, soda ash and potassium hydroxide to manufacture phosphates for detergents, soaps, soft drinks, and industrial uses. Various operations have occurred in different areas during the life of the plant.

For the purpose of identification of A&W/Mobil's operations, the plant has been separated into Areas A through J, and V, W and X, based on specific chemical handling and process activities. Area X is east of A&W/Mobil's operations. Figure 2-2 identifies these specific areas, which are further described below.

Area A, located in the northeast area of the plant, contains the plant's water treatment equipment, which is used to treat process wastewater. Deionizers, also located in **Area A**, treat the groundwater from the two facility wells prior to use in the manufacturing process. Location of the facility wells designated A&W-1 and A&W-2 are shown in Figure 2-2. These two wells were taken out of service in 1993.

The phosphorus handling area, **Area B**, utilized elemental phosphorus in its manufacturing process from the 1950s to 1990. When in operation, the handling area was immediately south of the water treatment area. Elemental phosphorus in solid form was received in railway tank cars. The phosphorus-filled tank cars were positioned over a water-filled safety sump because elemental phosphorus is highly reactive in air and can be safely handled only in water. The car was heated to melt the phosphorus. When molten, the phosphorus was moved by water displacement to the phosphorus storage tanks immediately west of the unloading site. From the storage tanks, the phosphorus went to the two phosphoric acid production trains, **Area C**, sited west of the storage tanks. Phosphoric acid production units were used to convert elemental phosphorous to phosphorous pentoxide by oxidation and then

were hydrolyzed with deionized water to orthophosphoric acid. Food-grade phosphoric acid was produced by treating the orthophosphoric acid from the hydrator with hydrogen sulfide and then filtering out the insoluble sulfides.

The waste insoluble sulfides contained arsenic. Arsenic is an element that naturally occurs with elemental phosphorus. In accordance with applicable State and Federal laws, the insoluble arsenic sulfide waste was drummed and disposed of at a licensed facility. A&W eliminated the production of phosphoric acid at the facility in 1990; consequently, arsenic sulfide waste is no longer generated at this facility. Purified phosphoric acid is no longer manufactured at the facility either. Currently, phosphoric acid is brought to the facility for use in the manufacturing process.

On the western boundary of the plant are the phosphoric acid storage tanks, an alkali phosphate production unit, and truck-loading facilities designated as **Area D.** Alkali phosphates are produced here by reacting either an oxide or a hydroxide of the desired metal (aluminum, magnesium) with the requisite quantity of phosphoric acid.

Area E is located at the southern end of the processing area. It contains a potash caustic storage tank and an alkaline phosphate production unit. The pyrophosphate kiln is located approximately 100 feet northeast of this area.

The former sodium tripolyphosphate (STPP) production area, **Area F**, is located immediately southeast of the acid production units. The STPP storage bins and loadout facility (both truck and rail) were located along the rail siding south of the STPP production area. Production of STPP ceased in 1976, and associated manufacturing equipment was dismantled and removed in 1982.

An open drainage ditch about 800 feet north of the southern boundary is identified as **Area G.** Until February 1987, pursuant to National Pollutant Discharge Elimination System (NPDES) permits issued by the Ohio EPA (September 6, 1974 and November 14, 1979), wastewater was discharged to Paddys Run to the west via

a pipeline in this ditch. Subsequently, Ohio EPA authorized the discharge of the wastewater directly to the Miami River via an underground 4-inch PVC line, which parallels the CSX railroad right-of-way.

During 1976, wastewater sediment containing potassium and phosphates, with minor amounts of arsenic sulfide from the bottom of the effluent holding tank, was temporarily stored in a shallow depression in **Area H** near the southern boundary of the plant adjacent to the RNC plant, to permit repairs to the tank. Upon approval of Ohio EPA, about 100 cubic yards of this sludge was removed and disposed of in an approved landfill in 1976. In 1982, a study by Mobil showed that the 1976 sludge had leached downward into the underlying soil. Ohio EPA approved disposal of approximately 700 cubic yards of excavated soil in Rumpke Sanitary landfill in 1982.

Besides this temporary waste storage at the facility, during the 1950s and possibly the early 1960s, some solid wastes were temporarily stored in drums in **Area I**. Used equipment and piping have at various times been stored on the ground north of the east-west drainage ditch **Area J**. A former aboveground fuel oil storage tank was located adjacent to and west of the wastewater storage tank.

Temporary drum staging areas also have included **Area V**, a gravel area just north of the phosphoric acid holding tanks, and a drummed hazardous waste storage pad, **Area W**, which underwent RCRA closure in 1993.

Area X is located in the field east of A&W's manufacturing operation. This area has been designated as a potential source area based upon personal interviews, aerial photographs, and groundwater monitoring. The area exhibited evidence of stressed vegetation during the early period of operation of the plant, thought to be a result of air emissions of sodium caused during the manufacturing of STPP. Problems with scrubbers and cyclones are cited as the source of the emissions. Manufacturing of STPP began in the second half of the 1950s and ceased in 1976.

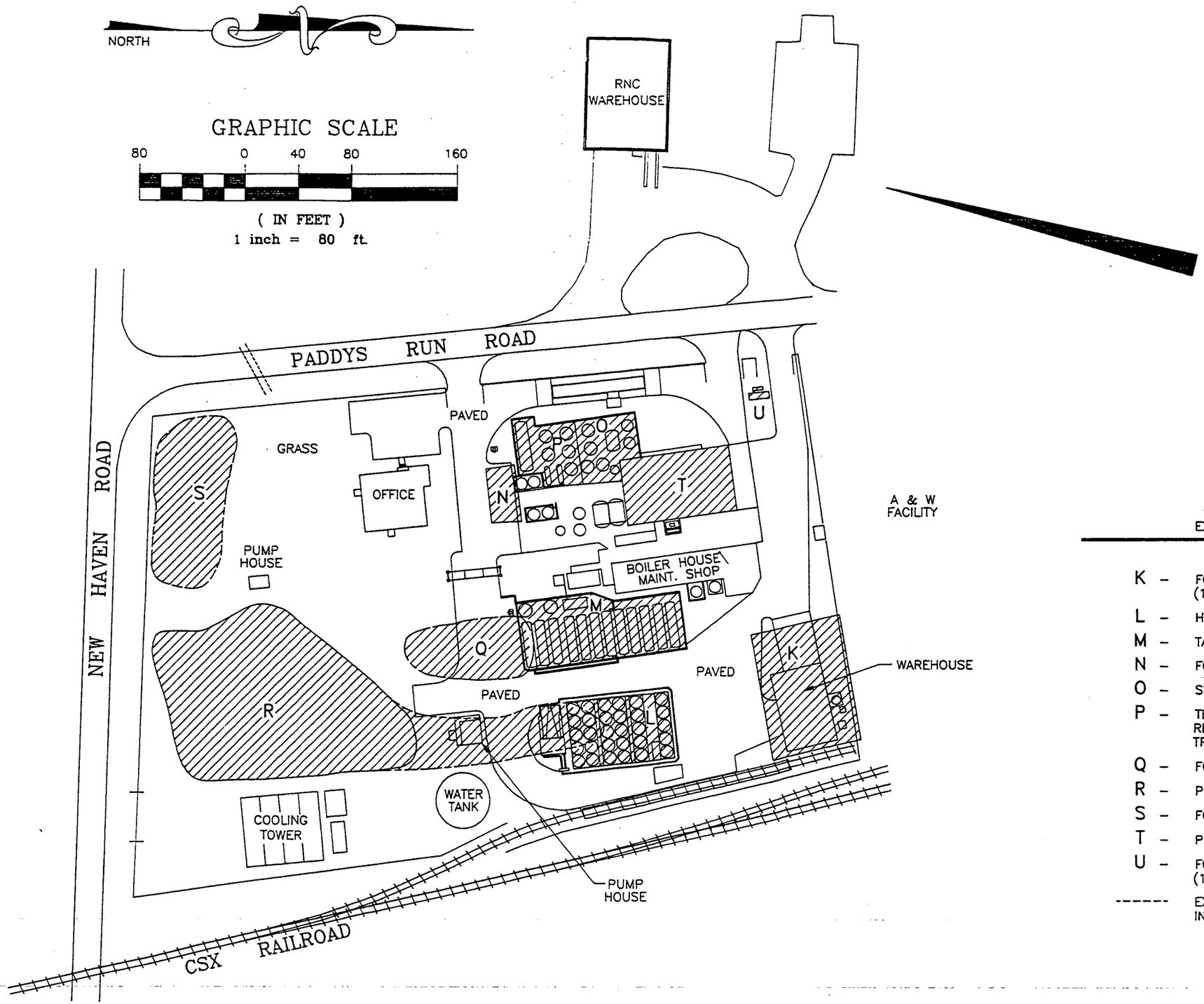
RNC Facility Description

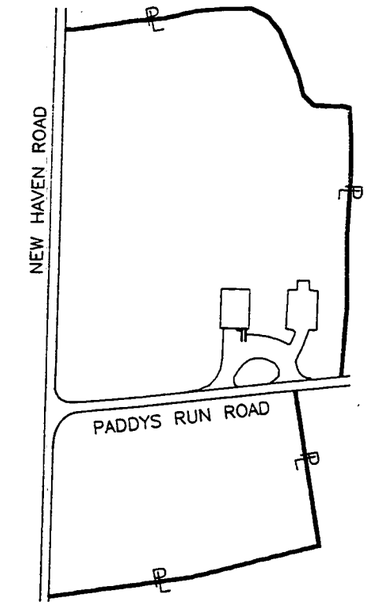
The general layout of the RNC facility is shown on Figure 2-4. This figure also depicts the locations of processing and chemical storage areas, the location of the present cooling water pond, and the approximate locations and configurations of the former lagoon and infiltration/cooling ponds. The facility is enclosed by a chainlink fence with two open gateways located along Paddys Run Road. Another controlled-access gate, located on New Haven Road, is the entrance to the southeastern portion of the facility.

The overall property dimensions are roughly 500 feet north to south, varying east to west from approximately 320 feet at the north to 360 feet along New Haven Road to the south. Total acreage within the manufacturing area is about 4 acres. A RNC warehouse is located adjacent to and west of the facility across Paddys Run Road in a 10-acre field. The warehouse occupies about 1 acre.

Facility grounds surrounding the buildings and tanks are currently paved with asphalt. Paving occurred during 1979 and 1980. Storage tank unit areas are currently diked and underlain by concrete. Storage tank areas were diked and underlain with concrete in the mid-1970s. The main manufacturing process area is at the north end of the manufacturing area in a two-story Process Building, which houses vessels where chemicals are mixed. The facility boiler house and maintenance shop is located east of and adjacent to the Process Building. Concrete-diked structures for raw material and product storage are located further east.

Non-hazardous process waste consisting of filter cake (diatomaceous earth and clay) is stored in roll-off boxes south of the Process Building. This material is disposed of four to six times per year at a licensed off-site landfill. Acid used in the production process also is stored southwest of the Process Building. A warehouse is located at the northeast corner of the facility. Office and laboratory space is toward the southwest corner of the property, as is the sanitary wastewater unit. A cooling tower is positioned in the southeast corner, and a 250,000-gallon water tank is located just north of the cooling tower. Several small water circulation pump houses are located





INSERT
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EXPLANATION

- K – FORMER RUNOFF DRAINAGE\TRUCK WASHDOWN AREA (1959 – 1978)
- L – HYDROTOPE STORAGE AREA
- M – TANK FARM AREA
- N – FORMER SMALL LAGOON (1959 – 1966)
- O – SULFURIC ACID STORAGE
- P – TEMPORARY WASTE STORAGE (1983 – 1986 HELD <90 DAYS AND REPROCESSED THROUGH PLANT) (1986 – PRESENT HELD <90 DAYS TRANSPORTED BY LICENSED HAULER TO PERMITTED DISPOSAL FACILITY)
- Q – FORMER POND NO. 1 (1959 – 1974)
- R – POND NO. 2 (1965 – PRESENT)
- S – FORMER POND NO. 3 (1962 – 1974)
- T – PROCESS BUILDING
- U – FORMER UNDERGROUND FUEL STORAGE TANKS (1959 – 1988)
- ------ EXTENT OF AREAS Q, R AND S INFERRED FROM HISTORICAL AERIAL PHOTOS

RNC FACILITY
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

000061

FIGURE 2-4

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on the southern half of the property. A large diked pond is prominent in the southeast quarter of the property. Wastewater from the sanitary unit discharges into this pond.

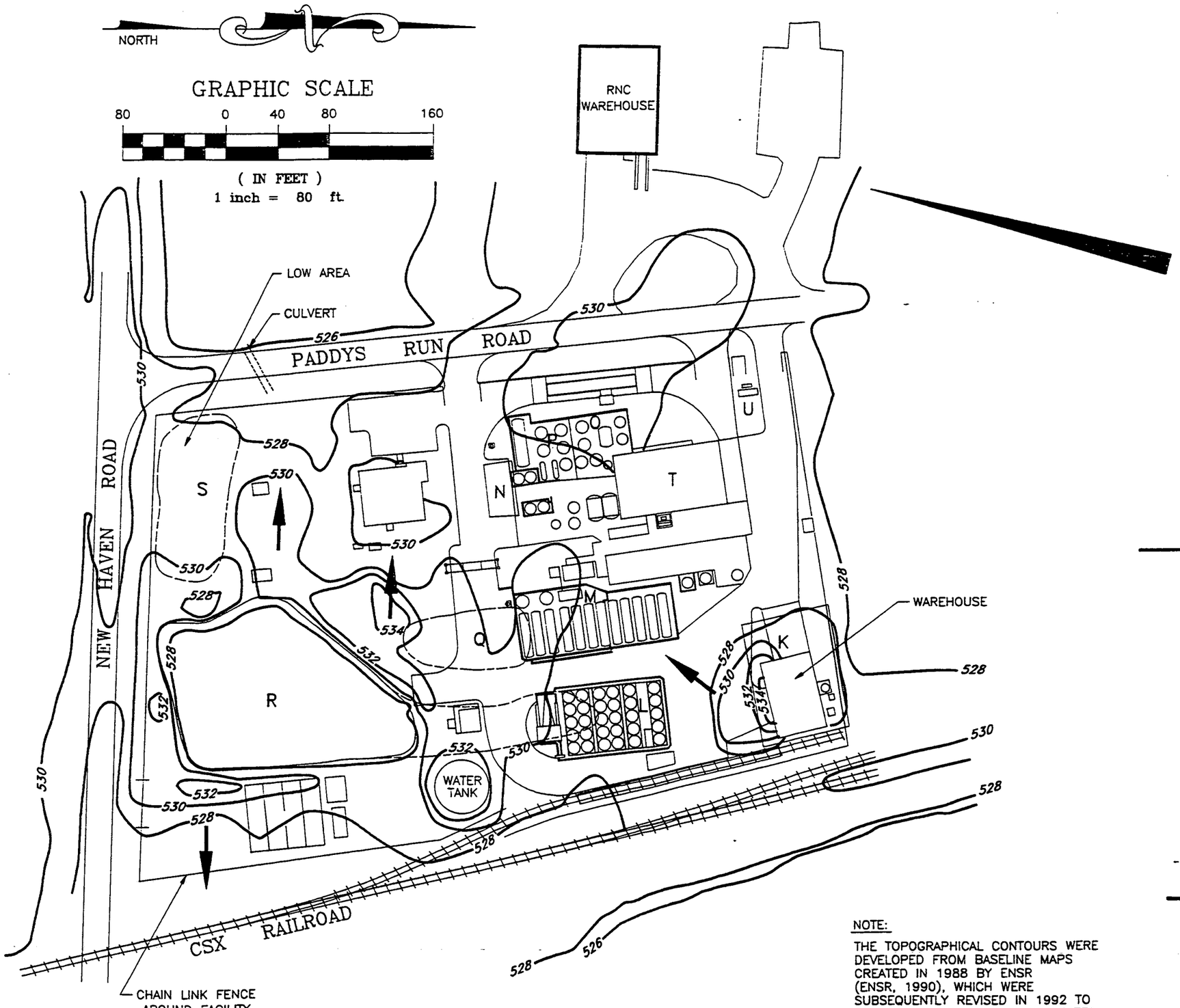
The topography of the RNC facility, illustrated in Figure 2-5, is relatively flat with a maximum topographic difference of about 6 feet in the area around the warehouse. Other areas with distinct elevation differences are the banks of the pond and the bermed area immediately surrounding the water tank where the maximum reliefs are 2 feet. There are no significant elevation changes between Paddys Run Road and New Haven Road, and the RNC property. There is an approximate 2-foot difference where the CSX line is higher than the RNC facility.

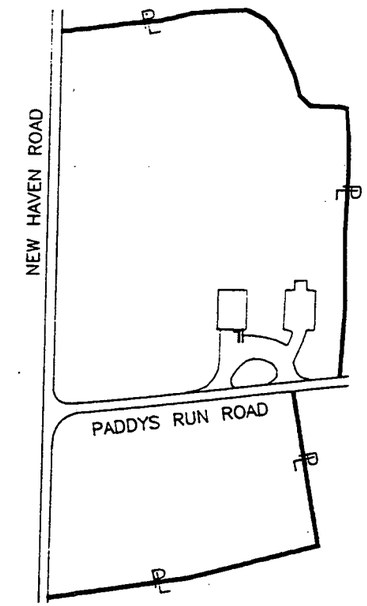
Stormwater drains toward low areas located at the southeast and southwest corners of the property. Because of the permeable characteristic of the surface soil, water usually infiltrates quickly. During times of temporary saturation, water can drain from the low area in the southwest corner via a culvert beneath Paddys Run Road to an adjacent field.

RNC's Process Operations

For the purpose of identification, RNC's operations have been separated into Areas K through U, based on specific chemical handling and process activities. (Figures 2-4 and 2-5 identify these specific areas).

Area T, the Process Building, was constructed prior to the starting of plant operations on February 17, 1959. Originally, it housed two chemical mixing systems that manufactured the sulfonated products. Initially, the raw materials used in the manufacturing process were toluene, xylene, sulfuric acid and potassium hydroxide and sodium hydroxide. In 1966, benzene was used in limited amounts, estimated to be a total of only 15,000 gallons, until 1967 when its use was discontinued. Cumene was added as a raw product in 1968. With the exception of benzene, all of the raw materials above are still being used at RNC.





INSERT
NOT TO SCALE

EXPLANATION

- K – FORMER RUNOFF DRAINAGE\TRUCK WASHDOWN AREA (1959 – 1978)
- L – HYDROTOPE STORAGE AREA
- M – TANK FARM AREA
- N – FORMER SMALL LAGOON (1959 – 1966)
- O – SULFURIC ACID STORAGE
- P – WASTE STORAGE
- Q – FORMER POND NO. 1 (1959 – 1974)
- R – POND NO. 2 (1965 – PRESENT)
- S – FORMER POND NO. 3 (1962 – 1974)
- T – PROCESS BUILDING
- U – FORMER UNDERGROUND FUEL STORAGE TANKS (1959 – 1988)
- ------ EXTENT OF AREAS Q, R AND S INFERRED FROM HISTORICAL AERIAL PHOTOS
- → CURRENT DRAINAGE FLOW DIRECTION

NOTE:

THE TOPOGRAPHICAL CONTOURS WERE DEVELOPED FROM BASELINE MAPS CREATED IN 1988 BY ENSR (ENSR, 1990), WHICH WERE SUBSEQUENTLY REVISED IN 1992 TO REFLECT ADDITIONAL DATA COLLECTED DURING SUBSURFACE INVESTIGATIONS.

000063

TOPOGRAPHIC FEATURES OF THE RNC FACILITY
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 2-5

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Environmental Resources Management

When the plant began operating, **Area Q** was used as a single-pass cooling water receiving pond. In the single-pass, cooling-water operation, groundwater was pumped from the plant well through the appropriate process equipment for non-contact cooling and subsequently to the pond.

At this time, sulfones, a by-product of the manufacturing process, were placed in a shallow lagoon, **Area N**, located south of the processing building.

During 1962, production at the plant increased. **Area S** was constructed as an infiltration pond to handle the additional cooling water. With the increased production, the volume of sulfone by-products increased and exceeded the holding capacity of the lagoon located in **Area N**. Subsequently, some sulfones also were placed in **Area Q**. By 1965, production had again increased so that an additional pond, **Area R**, was constructed to receive single-pass cooling water.

At this time, **Area Q** was used only for sulfones while **Areas R** and **S** were used for single-pass cooling water. In 1968, a recirculating pump was installed at **Areas R** and **S** so that the water stored in these ponds could be recirculated to the plant for cooling water. In 1974, following approval from the Ohio EPA, **Areas Q** and **S** were cleaned and backfilled with topsoil. **Area R** was cleaned and lined with 4 to 6 inches of bentonite clay, and continued to be used as a closed-loop cooling-water/fire-water pond, with Ohio EPA approval in 1974.

In 1979, several feet of soil in the northeast corner of the property, **Area K**, were removed in preparation for the installation of the present warehouse/spray dryer building. Prior to construction of the warehouse, rainwater run-off, truck wash-down water, and any plant spillage accumulated in what was then a natural low spot.

In July 1987, **Area R** was replaced by a closed-loop cooling system. A brief discussion of the cooling system and location of lines can be found in Section 3.1.1 and Figure 3-2.

From about 1974 to 1983, process wastes containing wastewater, sulfones and trace amounts of solvent were temporarily stored in tanks. These wastes were subsequently pumped into licensed tank trucks and transported to permitted off-site disposal facilities.

Beginning in late 1983 and continuing through 1986, process materials were temporarily stored in tanks located in **Area P** for less than 90 days and were then reprocessed through the plant where the water and hydrocarbon were reused in the manufacturing process. The resulting sulfone-still bottoms (solids accumulated from temporary storage tanks) were subsequently transported by a licensed carrier to permitted off-site disposal facilities.

Since 1986, process wastes have been temporarily stored in tanks for less than 90 days in **Area P**. These wastes are then transported by licensed transporters for incineration and disposal at permitted off-site disposal facilities.

Hydrocarbons used in the manufacturing process are stored in tanks, shown as **Area M**, while aromatic sulfonic acids are stored in tanks, shown as **Area O**. The majority of the sulfonic acids are converted to aqueous solutions called hydrotropes by neutralizing the aromatic sulfonic acid with an aqueous alkali such as sodium hydroxide. A hydrotrope is an anionic sulfonate of an aromatic hydrocarbon which performs well as a solubilizer for a variety of organic compounds in water or aqueous salt solutions. These hydrotropes are biodegradable and are used in such consumer products as dishwashing detergents, all-purpose cleaners and laundry detergent. Hydrotropes are stored in tanks, as shown in **Area L**.

2.2 Meteorological Investigations

Meteorological data were collected to help determine potential airborne dispersion patterns for modeling and the Risk Assessment, and to help select remedial actions. Sufficient information exists from weather-recording stations at the Greater Cincinnati Northern Kentucky International Airport and at FEMP to characterize regional and local atmospheric conditions. Information from these sources, which

includes climate, precipitation, wind and unusual weather conditions, is reported in Section 3.2.

2.3 Land Use and Population

Information drawn from readily available sources provided the necessary data to identify, enumerate, and characterize human populations potentially exposed to contaminants released from the Study Area. Land use and population information is reported in Section 3.3.

2.4 Ecological Investigations

An ecological investigation conducted by the Companies as part of Phase II activities characterized risks through an identification of potential exposures to ecological receptors and an estimation of the possible effects associated with such receptors.

The objectives for the PRRS Ecological Risk Assessment as defined in the Phase II Work Plan (ERM 1991a) were to:

- Consolidate extant biological and ecological data based on previous studies (Stevens 1984, and Facemire, et al. 1990).
- Integrate information regarding Study Area-specific physical characteristics with data collected in Phases I and Phase II concerning the distribution and extent of Study Area-related chemicals.
- Evaluate potential risk to aquatic life in Paddy's Run relative to potential migration of Study Area-related chemicals to surface water and sediment.
- Assess potential risk to terrestrial receptors from the migration and deposition of Study Area-related chemicals.
- Identify data gaps that may call for resolution in a supplemental assessment.
- Evaluate the need for corrective measures to mitigate any potential risk to ecological receptors that may be identified.

The ecological assessment consisted of four interrelated tasks:

- Characterization of the baseline ecology and identification of potential receptor populations
- Evaluation of potential exposures
- Ecological toxicity assessment
- Risk characterization

The results of this investigation are reported in Section 6.2 of the Risk Assessment.

2.5 Chemical Source Investigations

The Ohio EPA required that the Companies investigate facility operations and facility waste characteristics as potential sources of chemicals identified in soil and groundwater. Facility characteristics include manufacturing and storage areas, drainage and engineering structures, and facility security. Waste characteristics include the type and quantities of chemicals released, physical/chemical properties and measured concentrations. Information from these investigations not only is necessary to characterize the Study Area, but also serves as the basis for development of the groundwater transport models and for evaluation of risk to human health and the environment.

Analytical data generated from this investigation must meet certain data quality objectives (DQOs) as required by the Ohio EPA. Depending on specific DQOs, either Contract Laboratory Program (CLP) or non-CLP laboratories were used. A CLP laboratory is under contract to the U.S. EPA to provide analytical needs through standardized laboratory services. Throughout the project when analyzing for organics, inorganics, pesticides and polychlorinated biphenyls (PCBs), a CLP laboratory was used. For all other analyses, a non-CLP laboratory was used. Laboratory and field quality assurance and quality control procedures are specified in the quality assurance project plan portion of the RI/RA work plan (ENSR 1989 and ERM 1991a).

As part of source investigations, the Companies reviewed Material Safety Data Sheets and other information about raw materials used historically and currently at their respective facilities. One of the purposes of this review was to document the presence or absence of arsenic, potassium-40, and uranium in raw materials. The study found that:

- Arsenic is typically found as a naturally-occurring impurity in the raw material phosphorus at concentrations of 100 to 400 parts per million (ppm)

- Uranium is commonly found in phosphate rock throughout the United States, from which phosphorus is derived. Normal concentrations range from 100-150 parts per million (ppm) or 68-102 picocuries per gram (pCi/gm) (U.S. EPA 1975). In converting phosphate rock to elemental phosphorus, uranium is left in the waste materials. Phosphorus as a raw material used by the Companies at the Study Area contains as an impurity, by analysis, up to 0.0074 ppm or 0.005 pCi/gm of uranium

- Potassium-40 is found as a naturally-occurring radioisotope of potassium. It is present in all potassium-containing materials at approximately 0.012% of total potassium

As requested by Ohio EPA, the Companies reported the results of this review in a technical memorandum sent to the Agency dated February 28, 1992. That technical memorandum in its updated form is attached as Appendix B-1*. The media of occurrence and extent of these chemicals are discussed in the following sections.

To assess the impact source areas might have on specific media, the Companies investigated surface water, stream and drainage ditch sediments, unsaturated and saturated soils, and groundwater. The extent of these investigations is discussed below.

2.6 Surface Water Investigations

Surface water locations were selected to characterize both the surface water quality and anticipated extent of any potential chemicals of concern. Data generated

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*Appendix B also includes B-2, *Decontamination and Field Sampling Methodologies* and B-3, *PRRS Background Values*.

support the ecological and human risk assessment investigations and will be used in areas where remediation may be necessary, as determined by the FS.

Two rounds of surface water samples were collected from Paddys Run and one from the existing RNC pond (the pond - Area R, Figure 2-4). Dates of collection were March 21 and 22, 1990 and May 13 and 14, 1991. Eight surface water samples were collected during the first round of sampling, five from Paddys Run and three from the pond. Seven surface water samples were collected during the second round of sampling, all from Paddys Run. The purpose of collecting two rounds was to provide a basis for comparison between the two sampling events, allowing for temporal variations in the condition of Paddys Run. The single sampling event in the cooling pond was to evaluate whether contaminants are present.

The March 1990 sampling round followed the *Site Specific Sampling Plan* (ENSR 1989), which was approved by the Ohio EPA in March 1989. The May 1991 sampling round followed the *Phase II Work Plan* (ERM 1991a), which was approved by the Ohio EPA in September 1991.

All surface water samples for both events were analyzed for Contract Laboratory Program (CLP) parameters, and general and radiological parameters, as shown in Table 2-1.

Sections 2.6.1 and 2.6.2 describe the locations of the March 1990 and May 1991 sampling events. Results of these investigations are reported in Section 3.6. Sampling and decontamination procedures are described in Appendix B-2.

2.6.1 March 1990 Surface Water Sampling Event

During the March 1990 sampling event, five surface water samples were collected in Paddys Run, and three samples were collected from the RNC pond (the pond), as shown in Figure 2-6.

TABLE 2-1
LOCATION AND PARAMETERS ANALYZED FOR MARCH 1990 AND MAY 1991 SURFACE WATER INVESTIGATIONS PADDYS RUN ROAD SITE

	PARAMETER						
SAMPLE NUMBER	CLP (1) VOLATILES ORGANICS & CUMENE	CLP (1) SEMI-VOLATILE ORGANICS	CLP (1) INORGANICS	CLP (1) PESTICIDES/ PCB'S	CLP (1) CYANIDE	GENERAL PARAMETERS (2)(3)	RADIOLOGIC PARAMETERS (4)
ESW/SW-01							
March 1990	X	X	X	X	X	X	X
May 1991	X	X	X	X	–	X	X
ESW/SW-02							
March 1990	X	X	X	X	X	X	X
May 1991	X	X	X	X	–	X	X
ESW/SW-03							
March 1990	X	X	X	X	X	X	X
May 1991	X	X	X	X	–	X	X
ESW/SW-04							
March 1990	X	X	X	X	X	X	X
May 1991	X	X	X	X	–	X	X
ESW/SW-05							
March 1990	X	X	X	X	X	X	X
May 1991	X	X	X	X	–	X	X
SW-06							
May 1991	X	X	X	X	–	X	X
SW-08							
May 1991	X	X	X	X	–	X	X
ESWPD-01							
March 1990	X	X	X	X	X	X	X
ESWPD-02							
March 1990	X	X	X	X	X	X	X
ESWPD-03							
March 1990	X	X	X	X	X	X	X

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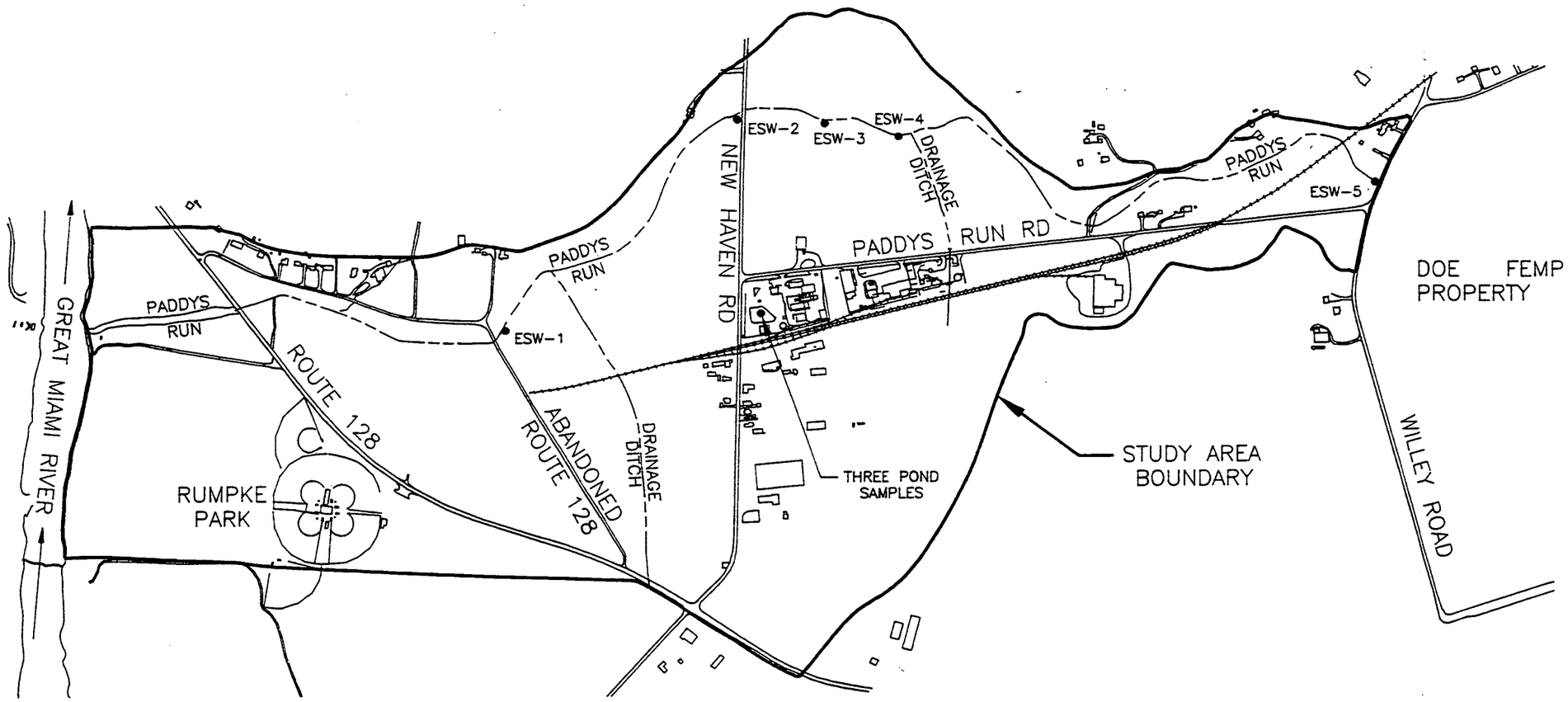
LEGEND:
– Sample not collected

ESW/SW-01 - ENSR Surface Water Sample
ESW/PD-01 - ENSR Surface Water Sampple (Pond)
SW-06 - ERM Surface Water Sample

NOTES:
(1) Contract Laboratory Program
(2) March 1990 - Ammonia, chloride, chemical oxygen demand (COD), methylene blue active substance (MBAS), total phosphorus, sulfate, total dissolved solids (TDS)
(3) March 1991 - Ammonia, chloride, COD, MBAS, total and dissolved phosphorus, sulfate, TDS, total organic carbon (TOC), hardness, specific gravity
(4) Gross alpha, gross beta, total uranium, potassium-40



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GRAPHIC SCALE

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(IN FEET)
1 inch = 800 ft.

MARCH 1990 SURFACE WATER SAMPLE LOCATIONS
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 2-6

ERM-Midwest, inc.
Environmental Resources Management

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Sample ESW-05 was collected at the Willey Road bridge between the Study Area and the DOE FEMP to provide a baseline representing conditions upstream that are unaffected by the Companies' facilities. Sample ESW-04 was collected south of the confluence of Paddys Run and the drainage ditch passing through the A&W/Mobil property. Sample ESW-03 was collected further downstream, and ESW-02 at the New Haven Road bridge. Sample ESW-01 was collected near the bridge at abandoned Route 128. Three samples were collected from different areas in the pond. Originally, a sixth surface water sample was to be collected from the A&W/Mobil drainageway, but during the time of sampling, standing water was not present in the drainageway and thus no sample was collected.

2.6.2 May 1991 Surface Water Sampling Event

During the second sampling event, May 13 and 14, 1991, seven surface water samples were collected in Paddys Run at locations indicated on Figure 2-7.

Sample SW-01 was collected furthest downstream at Paddys Run and the bridge at new Route 128; SW-02 at Paddys Run and the bridge at abandoned Route 128; SW-03 midway along Paddys Run between New Haven Road and abandoned Route 128; SW-04 at Paddys Run and the New Haven Road bridge; SW-05 at Paddys Run midway between New Haven Road and the drainage ditch that passes through the A&W/Mobil property; SW-06 near the confluence of Paddys Run and the drainage ditch; and SW-08 along Paddys Run at a foot bridge further upstream. SW-08 was selected to provide baseline comparison to represent conditions which may originate from upstream and are not contributed by the PRRS.

A location designated SW-07 was scheduled to be sampled for surface water. This location was to be placed in the drainage ditch at the north end of A&W's manufacturing area (see Figure 2-7 for intended location). At the time of sampling the ditch was dry. A sediment sample, discussed in the following section, was collected from this location.

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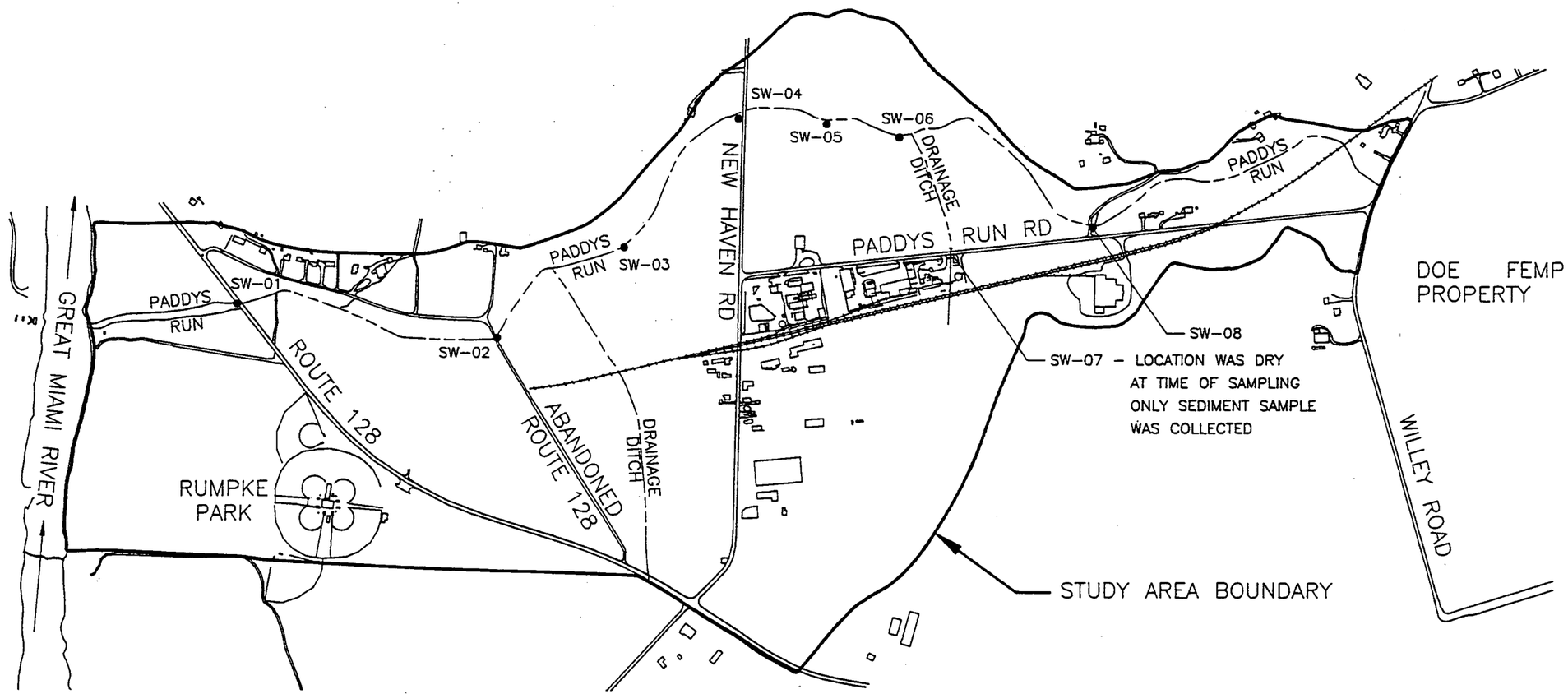

GRAPHIC SCALE

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(IN FEET)
1 inch = 800 ft.

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MAY 1991 SURFACE WATER SAMPLE LOCATIONS
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 2-7

ERM-Midwest, inc.
Environmental Resources Management

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2.7 Sediment Sampling

Sediment sampling locations were selected to characterize both the nature and extent of any potential sediment contamination. Data generated support the ecological and human risk assessment investigations and evaluation of potential remedial alternatives.

Consistent with the surface water sampling, two rounds of sediment samples were collected on March 21 and 22, 1990 and on May 13 and 14, 1991. Ten sediment samples were collected during the first round of sampling, and 13 sediment samples were collected during the second round.

The purpose of collecting these two rounds of sediment samples was to: provide a basis of comparison between the two sampling events allowing for temporal variation in the condition of Paddys Run; increase the number of samples within the data set for statistical purposes; and determine whether or not contaminants are present in the sediments surrounding the PRRS companies' facilities.

The samples collected during the March 1990 sampling round were collected at locations specified in the *Site Specific Sampling Plan* (ENSR 1989). The samples that were collected during the May 1991 sampling round were collected at locations specified in the *Phase II Work Plan* (ERM 1991a).

All of the sediment samples were analyzed for the CLP parameters, and general and radiological parameters shown in Table 2-2. Cyanide was analyzed for during the March 1990 event, but with Agency approval was subsequently deleted from the May 1991 event because it had not been detected in the first round. Total organic carbon (TOC) and pH were added to the parameter list for May 1991 to support the groundwater model and provide data necessary to evaluate the treatability of groundwater in the FS.

TABLE 2-2
LOCATION AND PARAMETERS ANALYZED FOR MARCH 1990 AND MAY 1991 SEDIMENT INVESTIGATIONS PADDYS RUN ROAD SITE

	PARAMETER						
SAMPLE NUMBER	CLP (1) VOLATILES ORGANICS & CUMENE	CLP (1) SEMI-VOLATILE ORGANICS	CLP (1) INORGANICS	CLP (1) PESTICIDES/ PCB'S	CLP (1) CYANIDE	GENERAL PARAMETERS (2)(3)	RADIOLOGIC PARAMETERS (4)
ESD/SD-01							
March 1990	X	X	X	X	X	X	X
May 1991	X	X	X	X	–	X	X
ESD/SD-02							
March 1990	X	X	X	X	X	X	X
May 1991	X	X	X	X	–	X	X
ESD/SD-03							
March 1990	X	X	X	X	X	X	X
May 1991	X	X	X	X	–	X	X
ESD/SD-04							
March 1990	X	X	X	X	X	X	X
May 1991	X	X	X	X	–	X	X
ESD/SD-05							
March 1990	X	X	X	X	X	X	X
May 1991	X	X	X	X	–	X	X
ESD/SD-06							
March 1990	X	X	X	X	X	X	X
May 1991	X	X	X	X	–	X	X
SD-07							
May 1991	X	X	X	X	–	X	X
SD-08							
May 1991	X	X	X	X	–	X	X
SD-09							
May 1991	X	X	X	X	–	X	X
SD-10							
May 1991	X	X	X	X	–	X	X
SD-11							
May 1991	X	X	X	X	–	X	X
SD-12							
May 1991	X	X	X	X	–	X	X
SD-13							
May 1991	X	X	X	X	–	X	X
ESDPD-01							
March 1990	X	X	X	X	X	X	X
ESDPD-02							
March 1990	X	X	X	X	X	X	X
ESDPD-03							
March 1990	X	X	X	X	X	X	X
ESDPD-04							
March 1990	X	X	=	=	=	=	=

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LEGEND:
– Sample not collected

ESD/SD-01 - ENSR Sediment Sample
ESDPD-01 - ENSR Sediment Sample (Pond)
SD-07 - ERM Sediment Sample

NOTES:
(1) Contract Laboratory Program
(2) March 1990 - Ammonia, chloride, phosphorus, sulfate
(3) March 1991 - Ammonia, chloride, phosphorus, sulfate, TOC, pH
(4) Gross alpha, gross beta, total uranium, potassium-40

000075

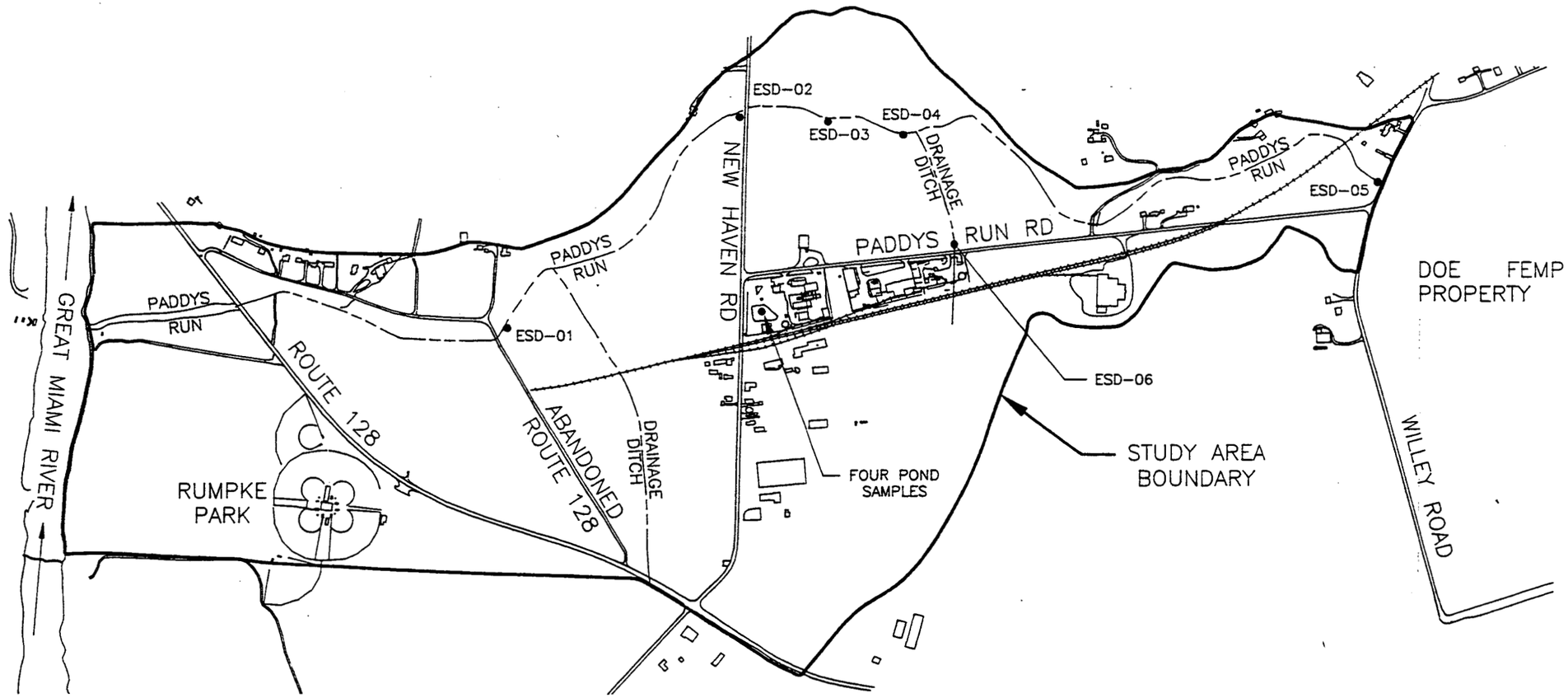
Sections 2.7.1 and 2.7.2 describe the locations of the March 1990 and May 1991 sampling events. Results of these investigations are reported in Section 3.7. Detailed sampling and decontamination procedures are in Appendix B-2.

2.7.1 March 1990 Sediment Sampling Event

During the March 1990 sampling event, a total of 10 sediment samples were collected for analyses. Sampling locations are shown in Figure 2-8 and are as follows: five sediment samples were collected in Paddys Run, one sediment sample from the drainage ditch located between A&W and Paddys Run, and four sediment samples from the pond. Specifically, ESD-05 was collected in Paddys Run at the Willey Road bridge between the Study Area and the DOE FEMP. This sample provides a baseline comparison for other downgradient samples. ESD-04 was collected near the confluence of Paddys Run and the drainage ditch that passes through the A&W/Mobil property. ESD-06 is located in the A&W/Mobil drainageway; ESD-03 downgradient of the A&W/Mobil facility drainageway; ESD-02 at New Haven Road bridge and ESD-01 near the bridge at abandoned Route 128. Four sediment samples were collected from various locations of the pond.

2.7.2 May 1991 Sediment Sampling Event

During the second sampling event, May 13 and 14, 1991, 13 sediment samples were collected in Paddys Run and from within ditches on and adjacent to the A&W and RNC properties. These locations are indicated on Figure 2-9. Specifically, SD-01 was collected in Paddys Run at the bridge on new Route 128; SD-02 in Paddys Run at the bridge on abandoned Route 128; SD-03 midway in Paddys Run between New Haven Road and abandoned Route 128; SD-04 in Paddys Run at the New Haven Road bridge; SD-05 in Paddys Run midway between the drainage ditch that runs through A&W/Mobil property and New Haven Road; SD-06 near the confluence of Paddys Run and the drainage ditch; SD-07 within the drainage ditch before exiting off of the A&W/Mobil property; and SD-08 in Paddys Run at a foot bridge south of Willey Road. SD-08 provides baseline comparison for all other downgradient samples. SD-09 was collected from the east-west drainage ditch east of the railroad



GRAPHIC SCALE

800 0 400 800 1600

(IN FEET)
1 inch = 800 ft.

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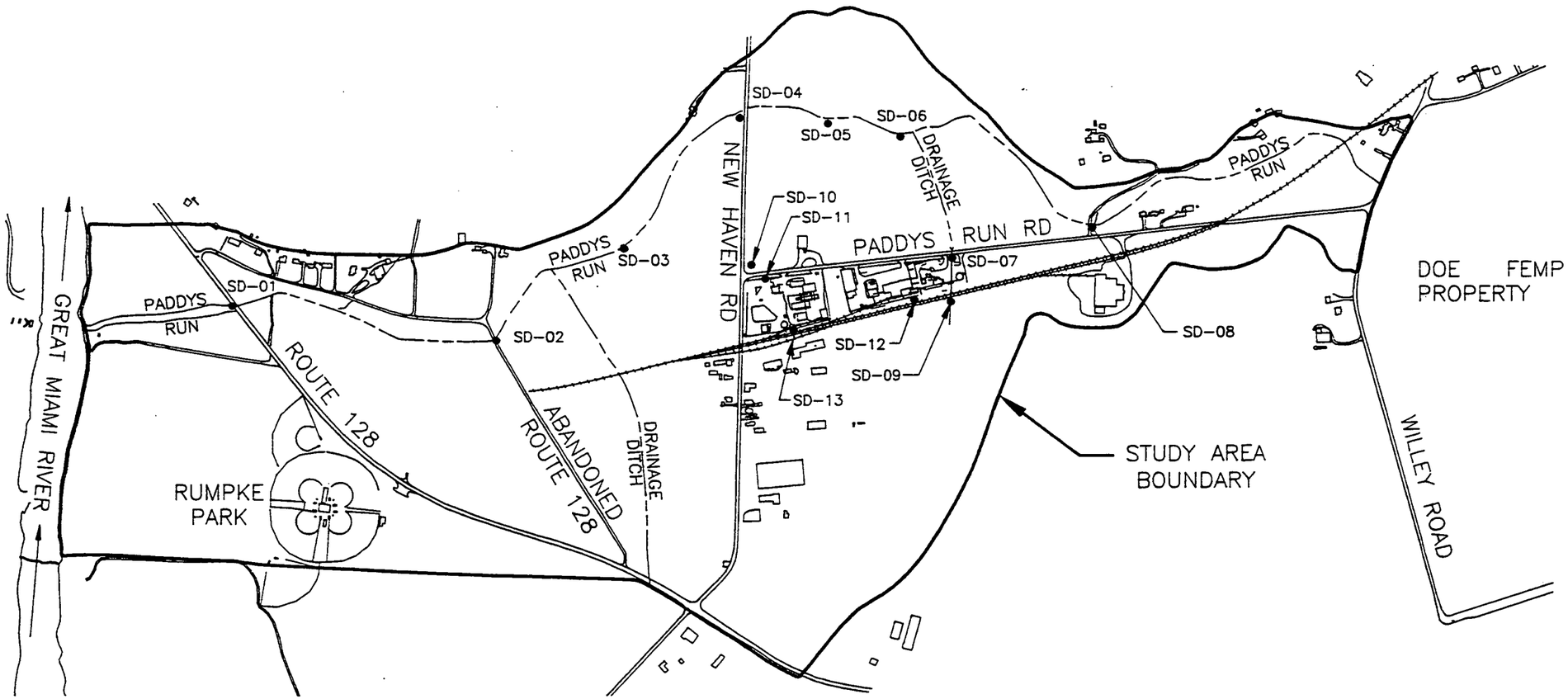
MARCH 1990 SEDIMENT SAMPLE LOCATIONS
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 2-8

ERM-Midwest, inc.
Environmental Resources Management



000078

GRAPHIC SCALE

800 0 400 800 1600

(IN FEET)
1 inch = 800 ft.

MAY 1991 SEDIMENT SAMPLE LOCATIONS
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 2-9

ERM-Midwest, inc.
Environmental Resources Management

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tracks. SD-10 was collected from the lowest spot in the field southeast of the RNC warehouse; SD-11 in the ditch along Paddys Run Road beneath the stormwater drainage line coming off the RNC facility; and Samples SD-12 and 13 along the railroad tracks in the ditch adjacent to the A&W and RNC facilities.

2.8 Geological Investigations

Geological investigations at the PRRS included both the bedrock and unconsolidated overburden (soils). While the geology of the bedrock was derived from numerous historical regional and local studies, information about the soils was obtained from both previous studies and studies approved in the Work Plan. A network of 54 PRRS monitoring wells and 80 soil borings, in addition to the DOE/FEMP well logs, provided the necessary Study Area-specific soil information.

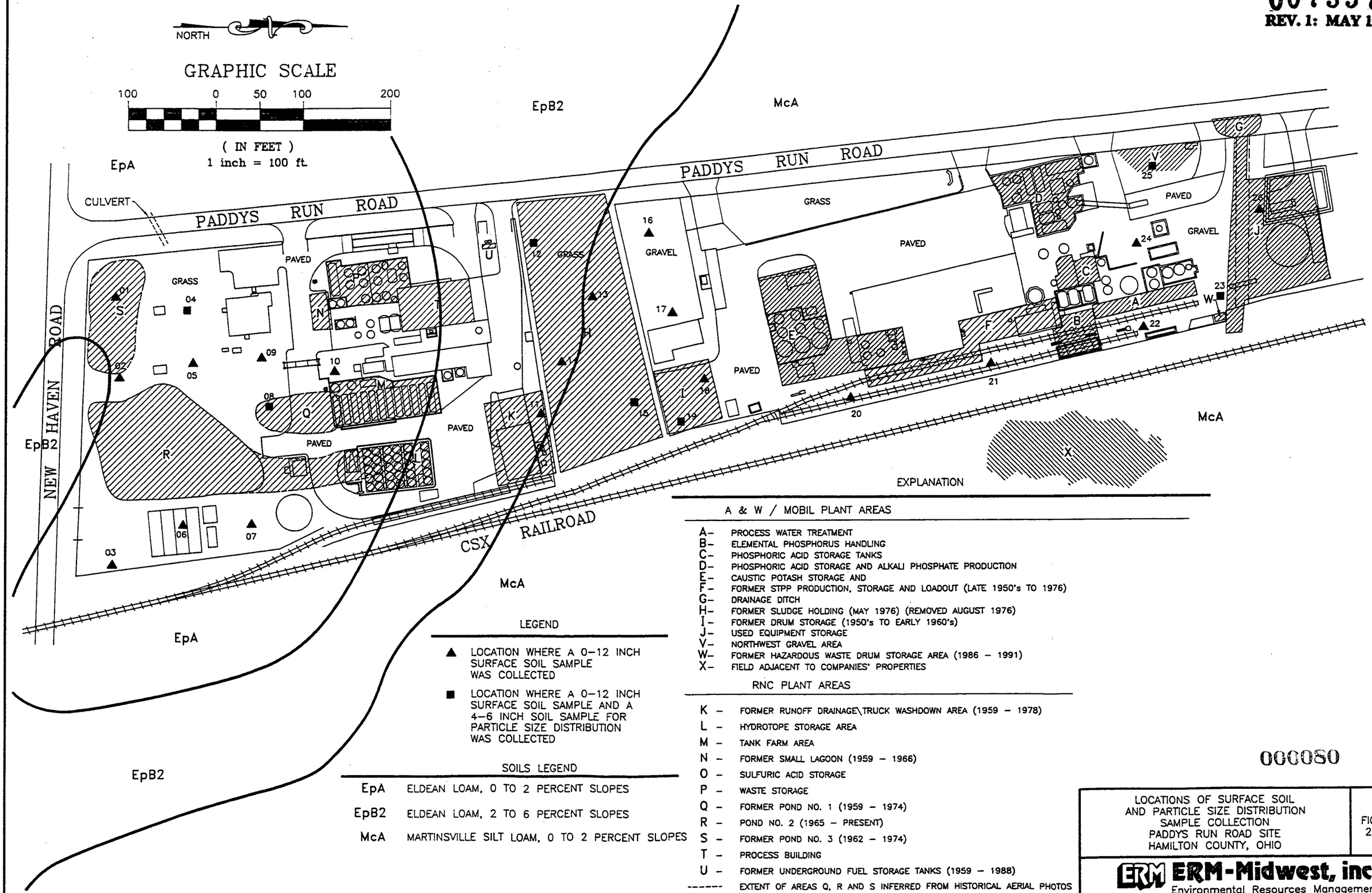
The objectives of these investigations were to collect information to evaluate the influence of the geology on the local aquifer, to assess how local geology controls migration of contaminants, and to collect essential information to evaluate potential remedial alternatives.

The findings of these investigations are presented in Section 3.8.

2.9 Unsaturated and Saturated Soil Investigations

The Companies characterized unsaturated and saturated soils with respect to their engineering, physical and chemical properties. The purpose of the soil investigations was to determine migration pathways, extent of chemicals of concern and their sources.

Twenty-six surface soil samples were collected from 26 locations within the boundaries of the A&W and RNC facilities, as shown in Figure 2-10. Also shown in Figure 2-10 are seven locations selected for particle-size distribution. Particle-size distribution analyses determine percentages of clay, silt, and sand particles. Analysis



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LOCATIONS OF SURFACE SOIL AND PARTICLE SIZE DISTRIBUTION SAMPLE COLLECTION PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO

FIGURE 2–10

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of the soil samples was used to support the exposure pathway analysis and quantization of exposure for the RA.

Soil investigations on the Companies' properties include, from both Phase I and Phase II, 79 borings, 18 monitoring wells, and 2 piezometers. (Six of the 79 borings were completed as monitoring wells and account for six of the 18 monitoring wells).

Location of the borings and monitoring wells involved with the soil investigations on the Companies' properties are shown in Figure 2-11. Surrounding property soil investigations include information collected while auguring one borehole, 10 piezometers and 36 monitoring wells under the Phase I and Phase II programs. Location of the surrounding property borings, piezometers, and monitoring wells involved with the investigation of soils are shown in Figure 2-12.

Engineering and physical properties for the surface and subsurface soils were obtained from the United States Department of Agriculture's (USDA) *Soil Survey of Hamilton County, Ohio* (USDA 1982), from field descriptions and from laboratory analysis of the physical characteristics of select samples.

Chemical analytical parameters were analyzed by the CLP laboratory and included for surface soils: CLP volatile organics plus cumene, CLP semivolatiles, CLP inorganics, CLP pesticides/PCBs and general parameters. General parameters included ammonia, chloride, phosphorus, sulfate, and radionuclides, including potassium-40, gross alpha, gross beta, and total uranium.

The analytical parameters for the Phase I subsurface soil investigations included the same parameters as in the surface soil studies. Over the course of the investigation, the number of analytical parameters for Phase II was reduced to a critical list, as defined by the Ohio EPA. The tables listed below show the boring location number, sample depth of collection, and parameters analyzed.

Table 2-3 Boring Location, Depth, Parameters Analyzed for Phase I Investigations, A&W Property

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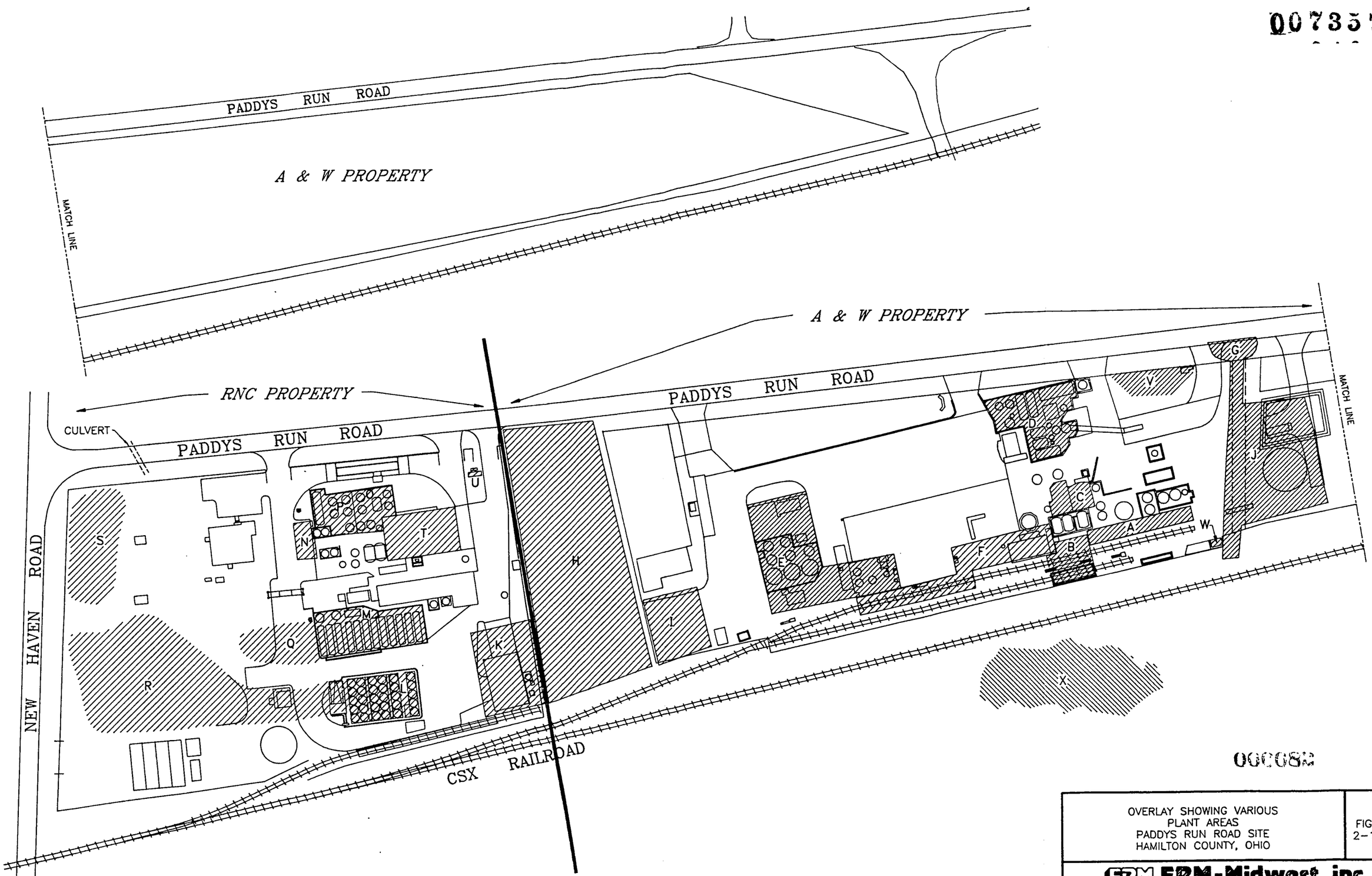

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OVERLAY SHOWING VARIOUS PLANT AREAS
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 2-110V

ERM-Midwest, inc.
Environmental Resources Management

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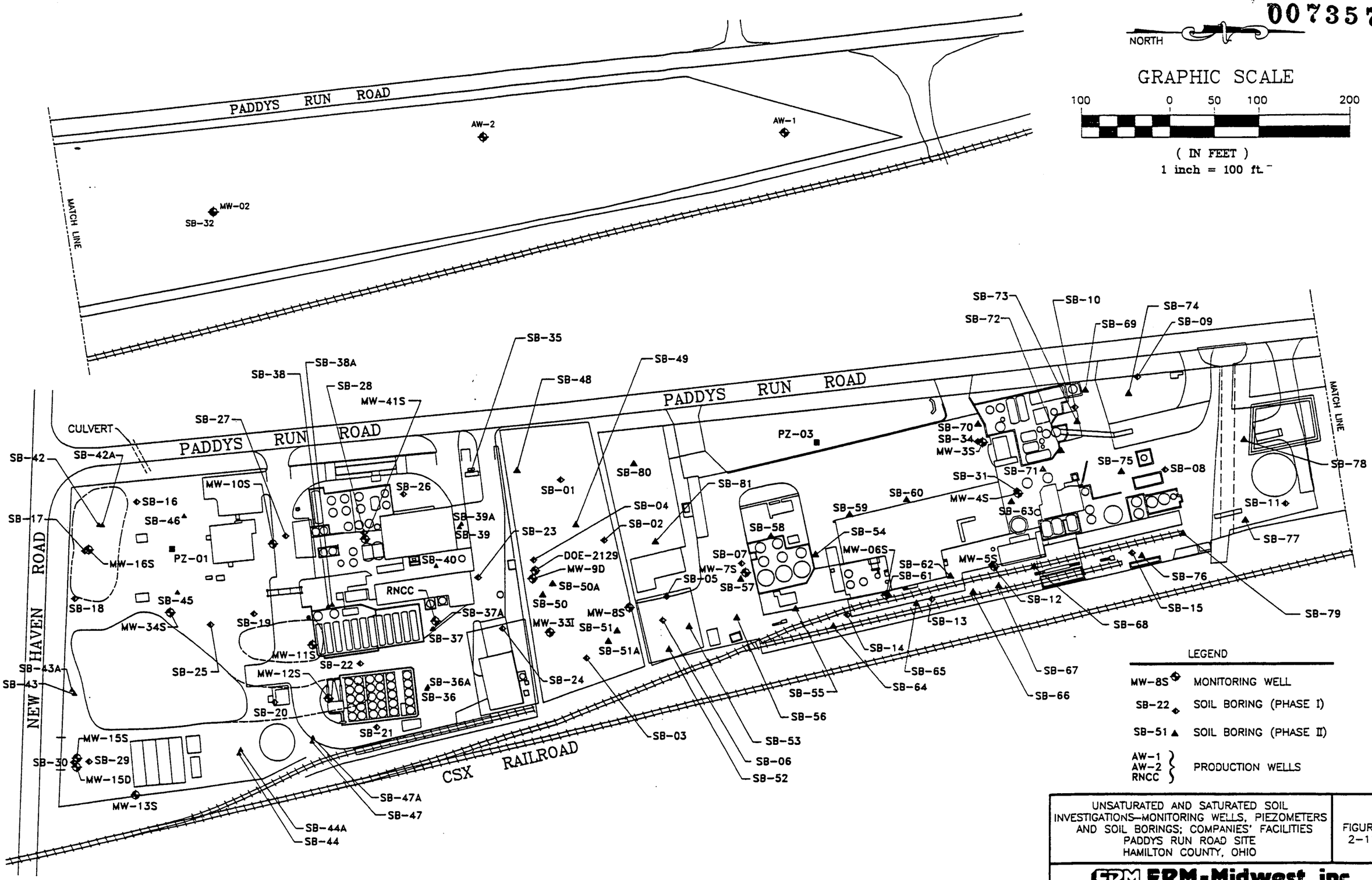
007357



UNSATURATED AND SATURATED SOIL INVESTIGATIONS—MONITORING WELLS, PIEZOMETERS AND SOIL BORINGS; COMPANIES' FACILITIES
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 2-11

ERM-Midwest, inc.
Environmental Resources Management

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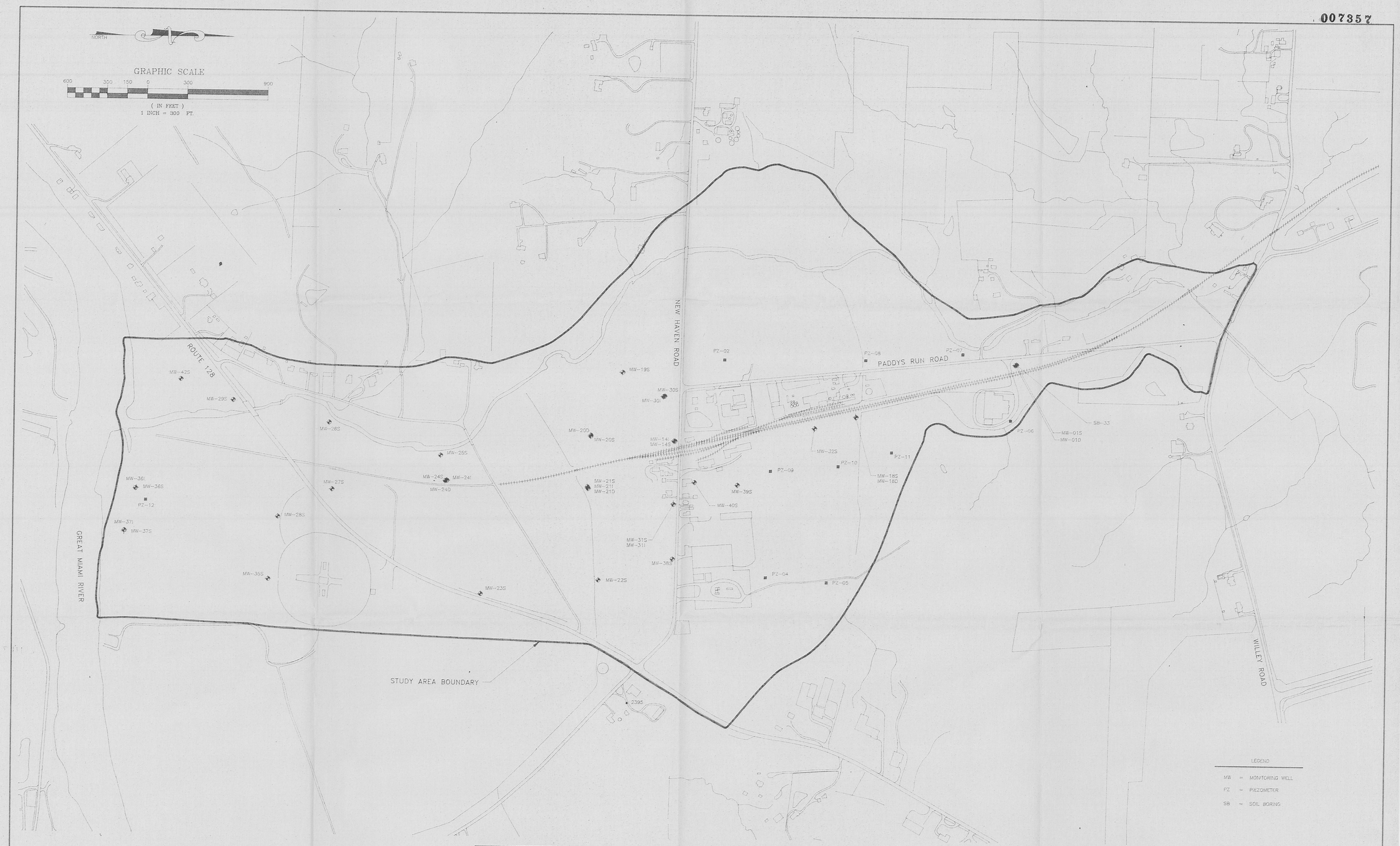
TABLE 2-3
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE I INVESTIGATIONS A & W PROPERTY PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volitiles	CLP Inorganics (1)	CLP Pest. & PCBs	Cyanide	General Parameters: Ammonia	Total Phos.	Sulfate	Chloride	Radiologic Parameters (2)
Area A Water Treatment	08	0-7 ft.		X	X	X	X	X	X	X	X	X
		7-10 ft.		X	X	X	X	X	X	X	X	X
		2-4 ft.		X								
Area B Near Elemental Phosphorus Handling	15	0-7 ft.		X	X	X	X	X	X	X	X	X
		0-2 ft.	X									
		6-8 ft.	X									
Area C Near Phosphoric Acid Storage Tanks	31	0-6 ft.		X	X	X	X	X	X	X	X	X
		2-4 ft.	X									
Area D Phosphoric Acid Storage and Alkali Phosphate Production	10	0-7 ft.		X	X	X	X	X	X	X	X	X
		7-11 ft.		X	X	X	X	X	X	X	X	X
		2-4 ft.			X							
		4-6 ft.	X		X							
Area D Phosphoric Acid Storage and Alkaline Phosphate Production	34	0-7 ft.		X	X	X	X	X	X	X	X	X
		2-4 ft.	X									
		7-9.5 ft.		X	X	X	X	X	X	X	X	X
Area E Caustic Potash and Alkali Phosphate Production	07	0-7 ft.		X	X	X	X	X	X	X	X	X
		7-12 ft.		X	X	X	X	X	X	X	X	X
		2-4 ft.	X									
		12-14 ft	X									
Area F Former STPP Production, Storage and Loadout	12	0-7 ft.		X	X	X	X	X	X	X	X	X
		2-4 ft.			X							
		6-8 ft.	X									
		8-10 ft.	X									
Area F Former STPP Production, Storage and Loadout	13	0-7 ft.		X	X	X	X	X	X	X	X	X
		0-2 ft.	X									
		7-10 ft.		X	X	X	X	X	X	X	X	X
		8-10 ft.	X									
Area F Former STPP Production, Storage and Loadout	14	0-7 ft.		X	X	X	X	X	X	X	X	X
		7-12 ft.		X	X	X	X	X	X	X	X	X
		4-6 ft.	X									
		8-10 ft.	X									
		10-12 ft	X									

LEGEND:
CLP-Contract Laboratory Program
FOOTNOTES:
(1) - Full CLP Inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese, vanadium, aluminum, cobalt, magnesium, calcium, sodium, potassium)
(2) - Gross alpha, gross beta, total uranium, K-40



Subconsultant	ERM – Midwest, Inc.	No.	Date	Revision

Principal :	
Project Manager :	TJS
Project No. :	539-10-02
Drawn :	DMW
CAD File :	1002F2120WG

PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

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Columbus, Ohio
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Indianapolis, IN
Louisville, KY

UNSATURATED AND SATURATED SOILS INVESTIGATION MONITORING WELL, PIEZOMETER, AND SOIL BORING LOCATIONS SURROUNDING COMPANIES' FACILITIES

Scale : AS SHOWN	Date : REV. 1: MAY 1994
Dwg. No. : FIGURE 2-12	Sheet : 007357

TABLE 2-3 (Continued)
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE I INVESTIGATIONS
A & W PROPERTY
PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volitiles	CLP Inorganics (1)	CLP Pest. & PCBs	Cyanide	General Parameters				Radiologic Parameters (2)
								Ammonia	Total Phos.	Sulfate	Chloride	
Area H Former Sludge Holding	01	0-7 ft.		X	X	X	X	X	X	X	X	X
		7-12 ft		X	X	X	X	X	X	X	X	X
		10-12 ft	X									
Area H Former Sludge Holding	02	0-7 ft.		X	X	X	X	X	X	X	X	X
		7-12 ft		X	X	X	X	X	X	X	X	X
		2-4 ft.	X									
Area H Former Sludge Holding	03	0-7 ft.		X	X	X	X	X	X	X	X	X
		7-12 ft		X	X	X	X	X	X	X	X	X
		2-4 ft.	X									
		8-10 ft.	X									
		10-12 ft	X									
Area H Former Sludge Holding	04	0-7 ft.		X	X	X	X	X	X	X	X	X
		7-12 ft		X	X	X	X	X	X	X	X	X
		2-4 ft.	X									
Area I Former Drum Storage	05	0-7 ft.		X	X	X	X	X	X	X	X	X
		0-2 ft.	X									
		7-12 ft.		X	X	X	X	X	X	X	X	X
		2-4 ft.	X									
Area I Former Drum Storage	06	0-7 ft.		X	X	X	X	X	X	X	X	X
		0-2 ft.	X									
		7-12 ft.		X	X	X	X	X	X	X	X	X
		8-10 ft.	X									
Area J Effluent Storage Tank	11	0-7 ft.		X	X	X	X	X	X	X	X	X
		7-11 ft.		X	X	X	X	X	X	X	X	X
		6-8 ft.	X									
		10-12 ft	X									
Area V Current Drum Storage	09	0-7 ft.		X	X	X	X	X	X	X	X	X
		7-11 ft.		X	X	X	X	X	X	X	X	X
		6-8 ft.	X									
		11-12 ft	X									
In Grass North of A & W Manufacturing	32	0-7 ft.		X	X	X	X	X	X	X	X	X
		7-8.5 ft.		X	X	X	X	X	X	X	X	X
		2-4 ft.	X									

LEGEND:
CLP-Contract Laboratory Program
FOOTNOTES:
(1) - Full CLP Inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese, vanadium, aluminum, cobalt, magnesium, calcium, sodium, potassium)
2) Gross alpha, gross beta, total uranium, K-40

TABLE 2-3 (Continued)
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE I INVESTIGATIONS
A & W PROPERTY
PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volitiles	CLP Inorganics (1)	CLP Pest. & PCBs	Cyanide	General Parameters				Radiologic Parameters (2)
								Ammonia	Total Phos.	Sulfate	Chloride	
In Grass North of A & W Manufacturing	33	0-7 ft.		X	X	X	X	X	X	X	X	X
		7-10 ft.		X	X	X	X	X	X	X	X	X
		8-10 ft.	X									

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LEGEND:
CLP-Contract Laboratory Program
FOOTNOTES:
(1) - Full CLP Inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese, vanadium, aluminum, cobalt, magnesium, calcium, sodium, potassium)
2) - Gross alpha, gross beta, total uranium, K-40

Table 2-4 Boring Location, Depth, Parameters Analyzed for Phase II Investigations, A&W Property

Table 2-5 Boring Location, Depth, Parameters Analyzed for Phase I Investigations, RNC Property

Table 2-6 Boring Location, Depth, Parameters Analyzed for Phase II Investigations, RNC Property

Specific field methodology for the surface and subsurface soil investigations are included in Appendix B-2. The detailed results of this investigation are discussed in Section 3.8.

2.10 Groundwater Investigations

Extensive groundwater assessment work has been conducted by various investigators in the vicinity of PRRS. In the 1950s and 1960s, studies were conducted by the United States Geological Survey (USGS) to assess water resources in the area. Ultimately, the Southwestern Ohio Water Company (SOWC) installed wells northeast of PRRS to provide a water source for the area. These large collector wells can pump in excess of 6,000 gallons per minute each and have given rise to a number of water resource-related studies which have helped refine the aquifer hydraulic parameters for the area. Monitoring of water resource related parameters (e.g., groundwater levels, rainfall recharge, etc.) has been ongoing since the 1950s, which has resulted in a large database that extends to the present.

With the FEMP becoming a public environmental concern during the 1980s, the bulk of hydrogeologic investigations conducted in the area in the 1980s were focused on groundwater contamination associated with the FEMP. The USGS and several private consulting firms have conducted numerous studies in the vicinity of the FEMP site. Investigative work is presently ongoing.

Much of the basis for understanding the Study Area's hydrogeology came from these reports. Information concerning the Study Area-specific hydrogeology also was obtained from the installation and groundwater sampling of a maximum of 54 PRRS wells, 18 DOE/FEMP wells, 13 residential/industrial wells and from groundwater

TABLE 2-4
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE II INVESTIGATIONS
A & W PROPERTY
PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volitiles	CLP Inorganics (1)	CLP Pest. & PCBs	General Parameters: Ammonia	Total Phos.	Sulfate	Potassium-40
Area A Water Treatment	75(3)	0-2 ft.	-	-	-	-	-	-	-	-
		2-4 ft.	-		X		X	X	X	X
		4-6 ft.	-	X	X	-	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		8-10 ft.	-	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X	-	X	X	X	X
Area A Water Treatment	76(3)	0-2 ft.	-	-	-	-	-	-	-	-
		2-4 ft.	-		X		X	X	X	X
		2-4 ft.(DUP)	-		X		X	X	X	X
		4-6 ft.	-	+ +	X	-	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		8-10 ft.	-	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X	-	X	X	X	X
+ +: A duplicate soil sample was also analyzed for the (2'-6') interval.										
Area B Elemental Phosphorus Handling	68	0-2 ft.	-	X	X	**	X	X	X	X
		0-2 ft.(DUP)	-	X	X	-	X	X	X	X
		2-4 ft.	-		X		X	X	X	X
		4-6 ft.	-	X	X	-	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		8-10 ft.	-	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X	-	X	X	X	X
Area C Phosphoric Acid Storage Tanks	63	0-2 ft.	-	X	X	X	X	X	X	X
		0-2 ft.(DUP)	-	X	X	X	X	X	X	X
		2-4 ft.	-		X		X	X	X	X
		4-6 ft.	-	X	X	-	X	X	X	X
		6-8 ft.	-		O		O	O	O	O
		8-10 ft.	-	O	O	-	O	O	O	O
		10 ft.. - Wat. Tab.	-	X	X	-	X	X	X	X
		Water Sample	-	-	X	-	X	X	X	X
Area D Phosphoric Acid Storage and Alkaline Phosphate Production	69	0-2 ft.	-	X	X	-	X	X	X	X
		2-4 ft.	-		X		X	X	X	X
		4-6 ft.	-	X	X	-	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		8-10 ft.	-	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.(DU	-	X	X	-	X	X	X	X

FOOTNOTES:

(1) Arsenic, sodium, potassium

(2) Full CLP inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese vanadium, aluminum, colbalt, magnesium, calcium, sodium, potassium)

(3) 0 to 2-foot sample was not collected because location coincides with the 0 to 1-ft sample collected for surface soils. Surface soil analyses include CLP volatiles & cumene, CLP semivolatiles, CLP metals, CLP Pesticides & PCBs, ammonia, chloride, total phosphorus, sulfate, gross alpha, gross beta, total uranium, and potassium-40

(4) SB-41 converted to MW-41S

(5) CLP volatiles minus cumene

LEGEND:

CLP - Contract Laboratory Program

X: Interval proposed and tested

O: Interval proposed and not tested

**: Interval not proposed but tested

+ +: Additional comments given

-: Interval not proposed or tested

TABLE 2-4 (Continued)
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE II INVESTIGATIONS
A & W PROPERTY
PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volitiles	CLP Inorganics (1)	CLP Pest. & PCBs	General Parameters			
							Ammonia	Total Phos.	Sulfate	Potassium-40
Area D Phosphoric Acid Storage and Alkaline Phosphate Production	70	0-2 ft.	-	X	X	-	X	X	X	X
		2-4 ft.	-		X		X	X	X	X
		4-6 ft.	-	X	X	-	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		6-8 ft.(DUP)	-		X		X	X	X	X
		8-10 ft.	-	+ +	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X	-	X	X	X	X
+ +: A duplicate soil sample was also analyzed for the (6'-10') interval.										
Area D Phosphoric Acid Storage and Alkaline Phosphate Production	71	0-2 ft.	-	X	X	-	X	X	X	X
		0-2 ft.(DUP)	-	X	X	-	X	X	X	X
		2-4 ft.	-		X		X	X	X	X
		4-6 ft.	-	X	X	-	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		8-10 ft.	-	X	O	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	O	O	-	O	O	O	O
Area D Phosphoric Acid Storage and Alkaline Phosphate Production	72	0-2 ft.	-	X	X	-	X	X	X	X
		2-4 ft.	-		X		X	X	X	X
		4-6 ft.	-	X	X	-	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		8-10 ft.	-	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X	-	X	X	X	X
Area D Phosphoric Acid Storage and Alkaline Phosphate Production	73	0-2 ft.	-	X	X	-	X	X	X	X
		2-4 ft.	-		O		O	O	O	O
		4-6 ft.	-	X	X	-	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		8-10 ft.	-	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X	-	X	X	X	X
Area E Caustic Potash and Alkali Phosphate Production	54	0-2 ft.	-	X	X	X	X	X	X	X
		2-4 ft.	-		X		X	X	X	X
		4-6 ft.	-	-	X	-	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		8-10 ft.	-	-	X	-	X	X	X	X
		8-10 ft.(DUP)	-		X		-	-	-	-
		10 ft.. - Wat. Tab.	-	-	X	-	X	X	X	X

FOOTNOTES:

(1) Arsenic, sodium, potassium

(2) Full CLP inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese vanadium, aluminum, colbalt, magnesium, calcium, sodium, potassium)

(3) 0 to 2-foot sample was not collected because location coincides with the 0 to 1-ft sample collected for surface soils. Surface soil analyses include CLP volatiles & cumene, CLP semivolatiles, CLP metals, CLP Pesticides & PCBs, ammonia, chloride, total phosphorus, sulfate, gross alpha, gross beta, total uranium, and potassium-40

(4) SB-41 converted to MW-41S

(5) CLP volatiles minus cumene

LEGEND:

CLP - Contract Laboratory Program

X: Interval proposed and tested

O: Interval proposed and not tested

**: Interval not proposed but tested

+ +: Additional comments given

-: Interval not proposed or tested

TABLE 2-4 (Continued)
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE II INVESTIGATIONS
A & W PROPERTY
PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volitiles	CLP Inorganics (1)	CLP Pest. & PCBs	General Parameters			
							Ammonia	Total Phos.	Sulfate	Potassium-40
Area E Caustic Potash and Alkali Phosphate Production	55	0-2 ft.	-	X	X	X	X	X	X	X
		2-4 ft.	-		X		X	X	X	X
		2-4 ft.(DUP)	-		X		X	X	X	X
		4-6 ft.	-	X	X	-	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		8-10 ft.	-	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.(DU	-	X	X	-	-	-	-	-
Area E Near Caustic Potash and Alkali Phosphate Production	56	0-2 ft.	-	X	X	X	X	X	X	X
		2-4 ft.	-		X		X	X	X	X
		4-6 ft.	-	+ +	X	-	X	X	X	X
		4-6 ft.(DUP)	-		X	-	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		8-10 ft.	-	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.(DU	-	X	X	-	-	-	-	-
+ +: A duplicate soil sample was also analyzed for the (2'-6') interval.										
Area E Caustic Potash and Alkali Phosphate Production	57	0-2 ft.	-	X	X	X	X	X	X	X
		0-2 ft.(DUP)	-	X	X	X	X	X	X	X
		2-4 ft.	-		X		X	X	X	X
		4-6 ft.	-	-	X	-	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		8-10 ft.	-	-	X	-	X	X	X	X
		8-10 ft.(DUP)	-		X		-	-	-	-
		10 ft.. - Wat. Tab.	-	-	X	-	X	X	X	X
		Water Sample	-	-	X	-	X	X	X	X
		Water Sample(DUP)	-	-	X	-	X	X	X	X
Area E Caustic Potash and Alkali Phosphate Production	58	0-2 ft.	-	X	X	X	X	X	X	X
		0-2 ft.(DUP)	-	X	X	X	X	X	X	X
		2-4 ft.	-		X		X	X	X	X
		4-6 ft.	-	X	X	-	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		8-10 ft.	-	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X	-	X	X	X	X
		12-14 ft.	**	-	-	-	-	-	-	-

FOOTNOTES:

(1) Arsenic, sodium, potassium

(2) Full CLP inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese vanadium, aluminum, colbalt, magnesium, calcium, sodium, potassium)

(3) 0 to 2-foot sample was not collected because location coincides with the 0 to 1-ft sample collected for surface soils. Surface soil analyses include CLP volatiles & cumene, CLP semivolatiles, CLP metals, CLP Pesticides & PCBs, ammonia, chloride, total phosphorus, sulfate, gross alpha, gross beta, total uranium, and potassium-40

(4) S8-41 converted to MW-41S

(5) CLP volatiles minus cumene

LEGEND:

CLP - Contract Laboratory Program

X: Interval proposed and tested

O: Interval proposed and not tested

**: Interval not proposed but tested

+ +: Additional comments given

-: Interval not proposed or tested

TABLE 2-4 (Continued)
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE II INVESTIGATIONS
A & W PROPERTY
PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volitiles	CLP Inorganics (1)	CLP Pest. & PCBs	General Parameters: Ammonia	Total Phos.	Sulfate	Potassium-40
Area F Former STPP Storage and Loadout	61(5)	0-2 ft.	X	X	X	X	X	X	X	X
		0-2 ft.(DUP)	X	X	X	X	X	X	X	X
		2-4 ft.	X	**	X	**	X	X	X	X
		4-6 ft.	X	X	X	-	X	X	X	X
		6-8 ft.	X		X		X	X	X	X
		8-10 ft.	X	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	X	X	X	-	X	X	X	X
		10-12 ft.	**	-	-	-	-	-	-	-
		12-14 ft.	**	-	-	-	-	-	-	-
		14-16 ft.	**	-	-	-	-	-	-	-
Area F Former STPP Storage and Loadout	62	0-2 ft.	-	X	X	X	X	X	X	X
		2-4 ft.	-		X		X	X	X	X
		4-6 ft.	-	X	O	-	O	O	O	O
		6-8 ft.	**		X		X	X	X	X
		8-10 ft.	**	++	X	-	X	X	X	X
		8-10 ft.(DUP)	**	-	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X	-	X	X	X	X
		10-12 ft.	**	-	-	-	-	-	-	-
		12-15 ft.	**	-	-	-	-	-	-	-
++: A duplicate soil sample was also analyzed for the (6'-10') interval.										
Area F Former STPP Storage and Loadout	64(3)	0-2 ft.	-	-	-	-	-	-	-	-
		2-4 ft.	-		X		X	X	X	X
		4-6 ft.	-	X	X	-	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		8-10 ft.	-	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.(DU	-	X	X	-	X	X	X	X
Area F Former STPP Storage and Loadout	65	0-2 ft.	-	X	X	-	X	X	X	X
		2-4 ft.	-		X		X	X	X	X
		4-6 ft.	-	X	X	-	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		8-10 ft.	-	++	X	-	X	X	X	X
		8-10 ft.(DUP)	-	-	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X	-	X	X	X	X
++: A duplicate soil sample was also analyzed for the (6'-10') interval.										

FOOTNOTES:

(1) Arsenic, sodium, potassium

(2) Full CLP inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese vanadium, aluminum, colbalt, magnesium, calcium, sodium, potassium)

(3) 0 to 2-foot sample was not collected because location coincides with the 0 to 1-ft sample collected for surface soils. Surface soil analyses include CLP volatiles & cumene, CLP semivolatiles, CLP metals, CLP Pesticides & PCBs, ammonia, chloride, total phosphorus, sulfate, gross alpha, gross beta, total uranium, and potassium-40

(4) SB-41 converted to MW-41S

(5) CLP volatiles minus cumene

LEGEND:

CLP - Contract Laboratory Program

X: Interval proposed and tested

O: Interval proposed and not tested

**: Interval not proposed but tested

++: Additional comments given

-: Interval not proposed or tested

TABLE 2-4 (Continued)
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE II INVESTIGATIONS
A & W PROPERTY
PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volitiles	CLP Inorganics (1)	CLP Pest. & PCBs	General Parameters			
							Ammonia	Total Phos.	Sulfate	Potassium-40
Area F Former STPP Storage and Loadout	66(3)	0-2 ft.	-	-	-	-	-	-	-	-
		2-4 ft.	-		X		X	X	X	X
		2-4 ft.(DUP)	-		X		-	-	-	-
		4-6 ft.	-	X	X	-	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		8-10 ft.	-	X	X	-	X	X	X	X
		8-10 ft.(DUP)	-				X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X	-	X	X	X	X
+ +: A duplicate soil sample was also analyzed for the (6'-10') interval.										
Area F Former STPP Production, Storage and Loadout	67	0-2 ft.	-	X	X	O	X	X	X	X
		2-4 ft.	-		X		X	X	X	X
		2-4 ft.(DUP)	-		X		-	-	-	-
		4-6 ft.	-	+ +	X	-	X	X	X	X
		4-6 ft.(DUP)	-		-		X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		8-10 ft.	-	O	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X	-	X	X	X	X
+ +: A duplicate soil sample was also analyzed for the (2'-6') interval.										
Area H Former Sludge Holding	48(3)	0-2 ft.	-	-	-	-	-	-	-	-
		2-4 ft.	-		X		X	X	X	X
		2-4 ft.(DUP)	-		X		X	X	X	X
		4-6 ft.	-	X	X	-	X	X	X	X
		6-8 ft.	-		+ +		X	X	X	X
		8-10 ft.	-	X	+ +	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	+ +	-	X	X	X	X
+ +: A full Metals list was reported for the (6'-8'), (8'-10') and (10'-Water Table) soil samples										
Area H Former Sludge Holding	49(3)	0-2 ft.	-	-	-	-	-	-	-	-
		2-4 ft.	-		X		X	X	X	X
		4-6 ft.	-	X	X	-	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		8-10 ft.	-	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	O	O	-	O	O	O	O
		10-16 ft.	-	••	••	-	••	••	••	••
		10-16 ft.(DUP)	-	••	••	-	••	••	••	••

FOOTNOTES:

(1) Arsenic, sodium, potassium

(2) Full CLP inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese vanadium, aluminum, colbalt, magnesium, calcium, sodium, potassium)

(3) 0 to 2-foot sample was not collected because location coincides with the 0 to 1-ft sample collected for surface soils. Surface soil analyses include CLP volatiles & cumene, CLP semivolatiles, CLP metals, CLP Pesticides & PCBs, ammonia, chloride, total phosphorus, sulfate, gross alpha, gross beta, total uranium, and potassium-40

(4) SB-41 converted to MW-41S

(5) CLP volatiles minus cumene

LEGEND:

CLP - Contract Laboratory Program

X: Interval proposed and tested

O: Interval proposed and not tested

••: Interval not proposed but tested

+ +: Additional comments given

-: Interval not proposed or tested

000038

TABLE 2-4 (Continued)
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE II INVESTIGATIONS
A & W PROPERTY
PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volatiles	CLP Inorganics (1)	CLP Pest. & PCBs	General Parameters: Ammonia	Total Phos.	Sulfate	Potassium-40
Area H Former Sludge Holding	50(3)	0-2 ft.	-	-	-	-	-	-	-	-
		2-4 ft.	-		X		X	X	X	X
		2-4 ft.(DUP)	-		X		X	X	X	X
		4-6 ft.	-	+ +	X	-	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		8-10 ft.	-	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X	-	X	X	X	X
+ +: SB-50(2'-6') - Analyzed for Metals and Semi-Volatiles. SB-50(2'-6')-DUP - Analyzed for Metals.										
Area H Former Sludge Holding	51(3)	0-2 ft.	-	-	-	-	-	-	-	-
		2-4 ft.	-		X(2), + +		X	X	X	X
		2-4 ft.(DUP)	-		X(2), + +		X	X	X	X
		4-6 ft.	-	X	X(2), + +	X	X	X	X	X
		6-8 ft.	-		X(2), + +		X	X	X	X
		8-10 ft.	-	X	X(2), + +	X	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X(2), + +	X	X	X	X	X
		Water Sample	-	X	X(2)	-	X	X	X	X
		Water Sample(DUP)	-	-	X(2)	-	X	X	X	X
Area I Former Drum Storage	52(3)	0-2 ft.	-	-	-	-	-	-	-	-
		2-4 ft.	-		X(2)		X	X	X	X
		4-6 ft.	-	X	X(2)	X	X	X	X	X
		6-8 ft.	-		X(2)		X	X	X	X
		6-8 ft.(DUP)	-		X(2)		X	X	X	X
		8-10 ft.	-	+ +	X(2)	+ +	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X(2)	X	X	X	X	X
+ +: A duplicate soil sample was also analyzed for the (6'-10') interval.										
Area I Former Drum Storage	53(3)	0-2 ft.	-	-	-	-	-	-	-	-
		2-4 ft.	-		X(2)		X	X	X	X
		2-4 ft.(DUP)	-		X(2)		X	X	X	X
		4-6 ft.	-	+ +	X(2)	+ +	X	X	X	X
		6-8 ft.	-		X(2)		X	X	X	X
		8-10 ft.	-	X	X(2)	X	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X(2)	X	X	X	X	X
+ +: A duplicate soil sample was also analyzed for the (2'-6') interval.										

FOOTNOTES:

(1) Arsenic, sodium, potassium

(2) Full CLP inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese vanadium, aluminum, colbalt, magnesium, calcium, sodium, potassium)

(3) 0 to 2-foot sample was not collected because location coincides with the 0 to 1-ft sample collected for surface soils. Surface soil analyses include CLP volatiles & cumene, CLP semivolatiles, CLP metals, CLP Pesticides & PCBs, ammonia, chloride, total phosphorus, sulfate, gross alpha, gross beta, total uranium, and potassium-40

(4) SB-41 converted to MW-41S

(5) CLP volatiles minus cumene

LEGEND:

CLP - Contract Laboratory Program

X: Interval proposed and tested

O: Interval proposed and not tested

**: Interval not proposed but tested

+ +: Additional comments given

-: Interval not proposed or tested

TABLE 2-4 (Continued)
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE II INVESTIGATIONS
A & W PROPERTY
PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volitiles	CLP Inorganics (1)	CLP Pest. & PCBs	General Parameters: Ammonia	Total Phos.	Sulfate	Potassium-40
Area J Effluent Storage Tank	77	0-2 ft.	-	X	X	X	X	X	X	X
		2-4 ft.	-		X		X	X	X	X
		4-6 ft.	-	X	X	X	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		8-10 ft.	-	X	X	X	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X	X	X	X	X	X
		10 ft.. - Wat. Tab.(DU	-	X	X	X	X	X	X	X
Area J Former Above Ground Oil Tank	78(3)	0-2 ft.	-	-	-	-	-	-	-	-
		2-4 ft.			X(2)		X	X	X	X
		4-6 ft.	O	O	X(2), + +	-	X	X	X	X
		4-6 ft.(DUP)	-		X(2)		-	-	-	-
		6-8 ft.			X(2)		X	X	X	X
		6-8 ft.(DUP)					X	X	X	X
		8-10 ft.	O	X	X(2), + +	-	X	X	X	X
		10 ft.. - Wat. Tab.	X	O	X(2)	-	X	X	X	X
		12-14 ft.	-	-	**	-	-	-	-	-
+ +: Both (4'-6') and (2'-6') soil samples were analyzed for Metals. Both (8'-10') and (6'-10') soil samples were analyzed for Metals.										
Area V Current Drum Storage	74(3)	0-2 ft.	-	-	-	-	-	-	-	-
		2-4 ft.	-		X		X	X	X	X
		4-6 ft.	-	X	X	-	X	X	X	X
		6-8 ft.	-		X		X	X	X	X
		6-8 ft.(DUP)	-		X		-	-	-	-
		8-10 ft.	-	+ +	X	-	X	X	X	X
		8-10 ft.(DUP)	-		-		X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X	-	X	X	X	X
+ +: A duplicate soil sample was also analyzed for the (6'-10') interval.										
Area W Former Hazardous Waste Storage	79(3)	0-2 ft.	-	-	-	-	-	-	-	-
		2-4 ft.			X(2)		X	X	X	X
		2-4 ft.(DUP)			X(2)		X	X	X	X
		4-6 ft.	+ +	+ +	X(2)	-	X	X	X	X
		6-8 ft.			X(2)		X	X	X	X
		8-10 ft.	X	X	X(2), + +	-	X	X	X	X
		10 ft.. - Wat. Tab.	X	X	X(2)	-	X	X	X	X
+ +: Both (8'-10') and (6'-10') soil samples were analyzed for Metals, but the (6'-10') sample was analyzed for Arsenic, Sodium and Potassium. A duplicate soil sample was also analyzed for the (2'-6') interval.										

FOOTNOTES:

(1) Arsenic, sodium, potassium

(2) Full CLP inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese vanadium, aluminum, colbalt, magnesium, calcium, sodium, potassium)

(3) 0 to 2-foot sample was not collected because location coincides with the 0 to 1-ft sample collected for surface soils. Surface soil analyses include CLP volatiles & cumene, CLP semivolatiles, CLP metals, CLP Pesticides & PCBs, ammonia, chloride, total phosphorus, sulfate, gross alpha, gross beta, total uranium, and potassium-40

(4) SB-41 converted to MW-41S

(5) CLP volatiles minus cumene

LEGEND:

CLP - Contract Laboratory Program

X: Interval proposed and tested

O: Interval proposed and not tested

**: Interval not proposed but tested

+ +: Additional comments given

-: Interval not proposed or tested

000094

TABLE 2-4 (Continued)
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE II INVESTIGATIONS
A & W PROPERTY
PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volitiles	CLP Inorganics (1)	CLP Pest. & PCBs	General Parameters: Ammonia	Total Phos.	Sulfate	Potassium-40
Concrete Building	59	0-2 ft.	-	X	X(2)	X	X	X	X	X
		2-4 ft.	-		X(2)		X	X	X	X
		4-6 ft.	-	X	X(2)	-	X	X	X	X
		6-8 ft.	-		X(2)		X	X	X	X
		8-10 ft.	-	X	X(2)	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	X	X(2)	-	X	X	X	X
		10 ft.. - Wat. Tab.(DU	-	X	+ +	-	X	X	X	X
		Water Sample	-	-	X(2)	-	X	X	X	X
+ +: SB-59(10'-Water Table)-DUP - Metals were only reported for Arsenic, Sodium and Potassium.										
Concrete Building	60(5)	0-2 ft.	X	X	X(2)	X	X	X	X	X
		2-4 ft.	X		X(2)		X	X	X	X
		4-6 ft.	X	X	X(2)	-	X	X	X	X
		6-8 ft.	X		X(2)		X	X	X	X
		8-10 ft.	X	X	X(2)	-	X	X	X	X
		10 ft.. - Wat. Tab.	X	X	X(2)	-	X	X	X	X
		10 ft.. - Wat. Tab.(DU	X	X	X(2)	-	X	X	X	X
Gravel Parking Lot	80	0-2 ft.	O	O	O	O	O	O	O	O
		2-4 ft.	O	O	X(2)	O	X	X	X	X
		4-6 ft.	X	X	X(2)	X	X	X	X	X
		6-8 ft.	O	O	X(2)	O	X	X	X	X
		8-10 ft.	X	X	X(2)	X	X	X	X	X
		10 ft.. - Wat. Tab.	O	O	O	O	O	O	O	O
		10-16 ft.	**	**	**(2)	**	**	**	**	X
		10-16 ft.(DUP)	**	**	**(2)	**	**	**	**	X
Gravel Parking Lot	81(3) (5)	0-2 ft.	-	-	-	-	-	-	-	-
		2-4 ft.	-		X(2)		X	X	X	X
		2-4 ft.(DUP)	-		X(2)		X	X	X	X
		4-6 ft.	-	-	X(2)	-	X	X	X	X
		6-8 ft.	-		X(2)		X	X	X	X
		8-10 ft.	-	-	X(2)	-	X	X	X	X
		10 ft.. - Wat. Tab.	-	-	O	-	O	O	O	O
		10-16 ft.	-	-	**(2)	-	**	**	**	**

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FOOTNOTES:

(1) Arsenic, sodium, potassium

(2) Full CLP inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese vanadium, aluminum, colbalt, magnesium, calcium, sodium, potassium)

(3) 0 to 2-foot sample was not collected because location coincides with the 0 to 1-ft sample collected for surface soils. Surface soil analyses include CLP volatiles & cumene, CLP semivolatiles, CLP metals, CLP Pesticides & PCBs, ammonia, chloride, total phosphorus, sulfate, gross alpha, gross beta, total uranium, and potassium-40

(4) SB-41 converted to MW-41S

(5) CLP volatiles minus cumene

LEGEND:

CLP - Contract Laboratory Program

X: Interval proposed and tested

O: Interval proposed and not tested

**: Interval not proposed but tested

+ +: Additional comments given

-: Interval not proposed or tested

TABLE 2-5
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE I INVESTIGATIONS RNC PROPERTY PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volatiles	CLP Inorganics (1)	CLP Pest. & PCBs	Cyanide	General Parameters: Ammonia	Total Phos.	Sulfate	Chloride	Radiologic Parameters (2)
Area K Runoff Drainage	24	0-7 ft.		X	X	X	X	X	X	X	X	X
		7-8.5; 9.5-12 ft.		X	X	X	X	X	X	X	X	X
		8.5-9.5 ft.		X	X	X	X					
		4-6 ft.	X									
		8-10 ft.	X									
		10-12 ft.	X									
Area L Hydrotrope	21	0-1; 2-7 ft.		X	X	X	X	X	X	X	X	X
		0-2 ft.	X									
		7-13 ft.		X	X	X	X	X	X	X	X	X
		2-4 ft.	X									
		4-6 ft.	X									
		1-2 ft.		X	X	X	X					
		6-8 ft.	X									
		13-14 ft.		X	X	X	X					
		8-10 ft.	X									
		10-12 ft.	X									
		12-14 ft.	X									
		14-16 ft.	X									
Area L Hydrotrope	22	1.5; 1.75-7 ft.		X	X	X	X	X	X	X	X	X
		0-2 ft.	X									
		7-12 ft.		X	X	X	X	X	X	X	X	X
		2-4 ft.	X									
		1.5-1.75 ft.		X	X	X	X					
		6-8 ft.	X									
		8-10 ft.	X									
		10-12 ft.	X									
		12-14 ft.	X									
Area Q Pond	19	5.5; 6-7 ft.		X	X	X	X	X	X	X	X	X
		7-9; 10-16 ft.		X	X	X	X	X	X	X	X	X
		5.5-6 ft.		X	X	X	X					
		4-6 ft.	X									
		9-10 ft.		X	X	X	X					
		6-8 ft.	X									
		8-10 ft.	X									
		10-12 ft.	X									
		12-14 ft.	X									
		14-16 ft.	X									
		16-18 ft.	X									

FOOTNOTES: (1) - Full CLP Inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese, vanadium, aluminum, cobalt, magnesium, calcium, sodium, potassium)

(2) - Gross alpha, gross beta, total uranium, K-40

LEGEND: CLP-Contract Laboratory Program

000096

TABLE 2-5 (Continued)
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE I INVESTIGATIONS
RNC PROPERTY
PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volitiles	CLP Inorganics (1)	CLP Pest. & PCBs	Cyanide	General Parameters				Radiologic Parameters (2)
								Ammonia	Total Phos.	Sulfate	Chloride	
Area Q Near Pond	25	0-7 ft.		X	X	X	X	X	X	X	X	X
		8-15.5; 16-17 ft.		X	X	X	X	X	X	X	X	X
		7-8 ft.		X	X	X	X					
		15.5-16 ft.		X	X	X	X					
		17-18 ft.		X	X	X	X					
		10-12 ft.	NA									
		12-14 ft.	X									
		14-16 ft.	X									
		16-18 ft.	X									
Area R Near Pond	20	0-7 ft.		X	X	X	X	X	X	X	X	X
		7-10 ft.		X	X	X	X	X	X	X	X	X
		4-6 ft.	X									
		6-8 ft.	X									
		8-10 ft.	X									
		10-12 ft.	X									
Area R Near Pond	29	1.75; 2-7 ft.		X	X	X	X	X	X	X	X	X
		0-2 ft.	X									
		7-14 ft.		X	X	X	X	X	X	X	X	X
		1.75-2 ft.		X	X	X	X					
		15-16 ft.		X	X	X	X					
		12-14 ft.	X									
		14-16 ft.	X									
Area R Near Pond	30	0-7 ft.		X	X	X	X	X	X	X	X	X
		14-16 ft.	X									
		7-14 ft.		X	X	X	X	X	X	X	X	X
		16-18 ft.	X									
Area S Pond	16	0-7 ft.		X	X	X	X	X	X	X	X	X
		7-14 ft.		X	X	X	X	X	X	X	X	X
		2-4 ft.	X									
		4-6 ft.	X									
		6-8 ft.	X									
		8-10 ft.	X									
		10-12 ft.	X									
		12-14 ft.	X									
		14-16 ft.	X									

FOOTNOTES: (1) - Full CLP Inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese, vanadium, aluminum, cobalt, magnesium, calcium, sodium, potassium)

(2) - Gross alpha, gross beta, total uranium, K-40

LEGEND: CLP-Contract Laboratory Program

TABLE 2-5 (Continued)
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE I INVESTIGATIONS
RNC PROPERTY
PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volitiles	CLP Inorganics (1)	CLP Pest. & PCBs	Cyanide	General Parameters: Ammonia	Total Phos.	Sulfate	Chloride	Radiologic Parameters (2)
Area S Pond	17	0-7 ft.		X	X	X	X	X	X	X	X	X
		7-9; 10-11 ft.		X	X	X	X	X	X	X	X	X
		12-16 ft.										
		4-6 ft.	X									
		9-10 ft.		X	X	X	X	X	X	X	X	X
		6-8 ft.	X									
		11-12 ft.		X	X	X	X					
		8-10 ft.	X									
		10-12 ft.	X									
		14-16 ft.	X									
		16-18 ft.	X									
		18-20 ft.	X									
		20-22 ft.	X									
Area S Pond	18	4.5; 5-7 ft.		X	X	X	X	X	X	X	X	X
		7-15.5 ft.		X	X	X	X	X	X	X	X	X
		4-6 ft.	X									
		4.5-5 ft.		X	X	X	X					
		14-16 ft.	X									
Area T Near Process Building	23	0-3; 5-7 ft.		X	X	X	X	X	X	X	X	X
		0-2 ft.	X									
		7-11.5 ft.		X	X	X	X	X	X	X	X	X
		2-4 ft.	X									
		3-4 ft.		X	X	X	X					
		4-5 ft.		X	X	X	X					
		8-10 ft.	X									
		11.5-12 ft.		X	X	X	X					
		10-12	X									
		12-14	X									
		14-16	X									
Area T Process Building	26	1; 1.5-7 ft.		X	X	X	X	X	X	X	X	X
		0-2 ft.	X									
		7-9.5; 10-15 ft.		X	X	X	X	X	X	X	X	X
		2-4 ft.	X									
		4-6 ft.	X	X		X	X					
		1-1.5 ft.			X							
		9.5-10 ft.		X	X	X	X					
		6-8 ft.	X									
		15-16 ft.		X	X	X	X					
		8-10 ft.	X									
		10-12 ft.	X									
		12-14 ft.	X									
		14-16 ft.	X									

FOOTNOTES: (1) - Full CLP Inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese, vanadium, aluminum, cobalt, magnesium, calcium, sodium, potassium)

(2) - Gross alpha, gross beta, total uranium, K-40

LEGEND: CLP-Contract Laboratory Program

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TABLE 2-5 (Continued)
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE I INVESTIGATIONS
RNC PROPERTY
PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volatiles	CLP Inorganics (1)	CLP Pest. & PCBs	Cyanide	General Parameters: Ammonia	General Parameters: Total Phos.	General Parameters: Sulfate	General Parameters: Chloride	Radiologic Parameters (2)
Area T Near Process Building	27	5.5; 6-7 ft.		X	X	X	X	X	X	X	X	X
		0-2 ft.	X									
		7-10.5; 11-13.5 ft.		X	X	X	X	X	X	X	X	X
		2-4 ft.	X									
		4-6 ft.	X									
		5.5-6 ft.		X	X	X	X					
		6-8 ft.	X									
		10.5-11 ft.		X	X	X	X					
		8-10 ft.	X									
		13.5-14 ft.		X	X	X	X					
		10-12 ft.	X									
		12-14 ft.	X									
Area T Process Building	28	0-1; 2-4.5 ft.		X	X	X	X	X	X	X	X	X
		6-7 ft.										
		0-2 ft.	X									
		7-15 ft.		X	X	X	X	X	X	X	X	X
		2-4 ft.	X									
		4.5-6 ft.		X	X	X	X					
		4-6 ft.	X									
		1.5-2 ft.		X	X	X	X					
		6-8 ft.	X									
		9-9.5 ft.	X									
		10-11.5 ft.	X									
		11.5-13 ft.	X									
		14-14.5 ft.	X									

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FOOTNOTES:
(1) - Full CLP Inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese, vanadium, aluminum, cobalt, magnesium, calcium, sodium, potassium)
(2) - Gross alpha, gross beta, total uranium, K-40

LEGEND: CLP-Contract Laboratory Program

TABLE 2-6
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE II INVESTIGATIONS
RNC PROPERTY
PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volitiles	CLP Inorganics (1)	CLP Pest. & PCBs	General Parameters: Ammonia	Total Phos.	Sulfate	Potassium-40
Area L Hydrotrope	36	0-2 ft.	X	X	X	X	X	X	X	X
		0-2 ft.(DUP)	X	X	X	X	X	X	X	X
		2-4 ft.	X							
		4-6 ft.	X	X	X	X	X	X	X	X
		6-8 ft.	X							
		8-10 ft.	X	X	X	X	X	X	X	X
		10 ft.. - Wat. Tab.	O	X	X	X	X	X	X	X
		10 ft.. - Wat. Tab.(DUP	-	X	X	X	-	-	-	-
		10-12 ft.	**	-	-	-	-	-	-	-
		12-14 ft.	**	-	-	-	-	-	-	-
		14-16 ft.	**	-	-	-	-	-	-	-
Area L Near Hydrotrope	47	0-2 ft.	X	X	X	X	X	X	X	X
		2-4 ft.	X							
		4-6 ft.	X	X	X	-	X	X	X	X
		6-8 ft.	X							
		6-8 ft.(DUP)	X							
		8-10 ft.	X	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	O	+ +	O	-	O	O	O	O
		10-18 ft.	-	**	**	-	**	**	**	**
		10-12 ft.	**	-	-	-	-	-	-	-
		12-14 ft.	**	-	-	-	-	-	-	-
		14-16 ft.	**	-	-	-	-	-	-	-
		16-18 ft.	**	-	-	-	-	-	-	-
Area M Tank Farm Storage	37	0-2 ft.	X	X	X	X	X	X	X	X
		0-2 ft.(DUP)	-	X	X	X	X	X	X	X
		2-4 ft.	X							
		4-6 ft.	X	X	X	X	X	X	X	X
		6-8 ft.	X							
		8-10 ft.	X	X	X	X	X	X	X	X
		10 ft.. - Wat. Tab.	O	X	O	X	O	O	O	O
		10-18 ft.	-	-	**	-	**	**	**	**
		10-12 ft.	**	-	-	-	-	-	-	-
		12-14 ft.	**	-	-	-	-	-	-	-
		14-16 ft.	**	-	-	-	-	-	-	-

+ +: SB-47(2'-6') - Analyzed for Metals, Semi-Volatiles and General Parameters.
SB-47(2'-6')-DUP - Analyzed for Metals and General Parameters.
No (10' - Water Table) sample was analyzed, only a duplicate sample for (10' - Water Table).

FOOTNOTES:
(1) Arsenic, sodium, potassium
(2) Full CLP inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese vanadium, aluminum, colbalt, magnesium, calcium, sodium, potassium)
(3) 0 to 2-foot sample was not collected because location coincides with the 0 to 1-ft sample collected for surface soils. Surface soil analyses include CLP volatiles & cumene, CLP semivolatiles, CLP metals, CLP Pesticides & PCBs, ammonia, chloride, total phosphorus, sulfate, gross alpha, gross beta, total uranium, and potassium-40
(4) SB-41 converted to MW-41S
(5) CLP volatiles minus cumene

LEGEND:
CLP - Contract Laboratory Program
X: Interval proposed and tested
O: Interval proposed and not tested
**: Interval not proposed but tested
+ +: Additional comments given
-: Interval not proposed or tested

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TABLE 2-6 (Continued)
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE II INVESTIGATIONS
RNC PROPERTY
PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volitiles	CLP Inorganics (1)	CLP Pest. & PCBs	General Parameters: Ammonia	Total Phos.	Sulfate	Potassium-40
Area M Tank Farm Storage	38(3)	0-2 ft.	-	-	-	-	-	-	-	-
		2-4 ft.	X							
		2-4 ft.(DUP)	X							
		4-6 ft.	X	X	+ +	X	X	X	X	X
		6-8 ft.	X							
		8-10 ft.	X	X	X	X	X	X	X	X
		10 ft.. - Wat. Tab.	O	X	O	X	O	O	O	O
		10-12 ft.	**	-	-	-	-	-	-	-
		12-14 ft.	**	-	-	-	-	-	-	-
		14-16 ft.	**	-	-	-	-	-	-	-
		16-18 ft.	**	-	-	-	-	-	-	-
+ +: SB-38(2'-6') - Analyzed for Metals, Semi-Volatiles, Pesticides and General Parameters. SB-38(2'-6')-DUP - Analyzed for Metals and General Parameters only.										
Area R Near Pond	43	0-2 ft.	X	X	X	X	X	X	X	X
		0-2 ft.(DUP)	X	X	X	X	X	X	X	X
		2-4 ft.	X							
		4-6 ft.	X	X	X	-	X	X	X	X
		6-8 ft.	X							
		8-10 ft.	X	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	O	X	O	-	O	O	O	O
		10-21 ft.	-	-	**	-	**	**	**	**
		10-12 ft.	**	-	-	-	-	-	-	-
		12-14 ft.	**	-	-	-	-	-	-	-
		14-16 ft.	**	-	-	-	-	-	-	-
		16-18 ft.	**	-	-	-	-	-	-	-
		18-20 ft.	**	-	-	-	-	-	-	-
		20-22 ft.	**	-	-	-	-	-	-	-

FOOTNOTES:
(1) Arsenic, sodium, potassium
(2) Full CLP inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese vanadium, aluminum, colbalt, magnesium, calcium, sodium, potassium)
(3) 0 to 2-foot sample was not collected because location coincides with the 0 to 1-ft sample collected for surface soils. Surface soil analyses include CLP volatiles & cumene, CLP semivolatiles, CLP metals, CLP Pesticides & PCBs, ammonia, chloride, total phosphorus, sulfate, gross alpha, gross beta, total uranium, and potassium-40
(4) SB-41 converted to MW-41S
(5) CLP volatiles minus cumene

LEGEND:
CLP - Contract Laboratory Program
X: Interval proposed and tested
O: Interval proposed and not tested
**: Interval not proposed but tested
+ +: Additional comments given
-: Interval not proposed or tested

TABLE 2-6 (Continued)
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE II INVESTIGATIONS
RNC PROPERTY
PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volitiles	CLP Inorganics (1)	CLP Pest. & PCBs	General Parameters: Ammonia	Total Phos.	Sulfate	Potassium-40
Area R Near Pond	44(3)	0-2 ft.	-	-	-	-	-	-	-	-
		2-4 ft.	X							
		2-4 ft.(DUP)	X							
		4-6 ft.	X	+ +	+ +	+ +	+ +	+ +	+ +	+ +
		6-8 ft.	X							
		8-10 ft.	X	X	X	X	X	X	X	X
		10 ft.. - Wat. Tab.	O	X	X	X	X	X	X	X
		10-12 ft.	**	-	-	-	-	-	-	-
		12-14 ft.	**	-	-	-	-	-	-	-
		14-16 ft.	**	-	-	-	-	-	-	-
		16-18 ft.	**	-	-	-	-	-	-	-
		18-20 ft.	**	-	-	-	-	-	-	-
		18-20 ft.(DUP)	**	-	-	-	-	-	-	-
+ +: SB-44(2'-6') - Analyzed for Metals, Semi-Volatiles, Pesticides and General Parameters. SB-44(2'-6')-DUP - Analyzed for Metals, Semi-Volatiles, Pesticides and General Parameters.										
Area R Near Pond	45(3)	0-2 ft.	-	-	-	-	-	-	-	-
		2-4 ft.	X							
		2-4 ft.(DUP)	X							
		4-6 ft.	X	+ +	+ +	-	+ +	+ +	+ +	+ +
		6-8 ft.	X							
		8-10 ft.	X	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	O	O	O	-	O	O	O	O
		10-18 ft.	-	**	**	-	**	**	**	**
		10-12 ft.	**	-	-	-	-	-	-	-
		12-14 ft.	**	-	-	-	-	-	-	-
		14-16 ft.	**	-	-	-	-	-	-	-
		16-18 ft.	**	-	-	-	-	-	-	-
		18-20 ft.	**	-	-	-	-	-	-	-
		Water Sample	O	X	X	-	X	X	X	X

FOOTNOTES:

(1) Arsenic, sodium, potassium
(2) Full CLP inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese vanadium, aluminum, colbalt, magnesium, calcium, sodium, potassium)
(3) 0 to 2-foot sample was not collected because location coincides with the 0 to 1-ft sample collected for surface soils. Surface soil analyses include CLP volatiles & cumene, CLP semivolatiles, CLP metals, CLP Pesticides & PCBs, ammonia, chloride, total phosphorus, sulfate, gross alpha, gross beta, total uranium, and potassium-40
(4) SB-41 converted to MW-41S
(5) CLP volatiles minus cumene

LEGEND:

CLP - Contract Laboratory Program
X: Interval proposed and tested
O: Interval proposed and not tested
**: Interval not proposed but tested
+ +: Additional comments given
-: Interval not proposed or tested

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TABLE 2-6 (Continued)
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE II INVESTIGATIONS
RNC PROPERTY
PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volitiles	CLP Inorganics (1)	CLP Pest. & PCBs	General Parameters: Ammonia	Total Phos.	Sulfate	Potassium-40
Area S Pond	42(3)	0-2 ft.	-	-	-	-	-	-	-	-
		2-4 ft.	X							
		4-6 ft.	X	X	X	X	X	X	X	X
		6-8 ft.	X							
		8-10 ft.	X	X	+ +	X	X	X	X	X
		8-10 ft.(DUP)	X							
		10 ft.. - Wat. Tab.	O	X	O	X	O	O	O	O
		10-18 ft.	-	-	**	-	**	**	**	**
		10-18 ft.(DUP)	-	-	**	-	**	**	**	**
		10-12 ft.	**	-	-	-	-	-	-	-
		12-14 ft.	**	-	-	-	-	-	-	-
		14-16 ft.	**	-	-	-	-	-	-	-
		16-18 ft.	**	-	-	-	-	-	-	-
+ +: SB-42(6'-10') - Analyzed for Metals, Semi-Volatiles, Pesticides and General Parameters. SB-42(6'-10')-DUP - Analyzed for Semi-Volatiles and Pesticides.										
Area S Near Pond	46	0-2 ft.	X	X	X	X	X	X	X	X
		2-4 ft.	X							
		2-4 ft.(DUP)	X							
		4-6 ft.	X	+ +	+ +	-	+ +	+ +	+ +	+ +
		6-8 ft.	X							
		8-10 ft.	X	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	O	O	O	-	O	O	O	O
		10-20 ft.	-	**	**	-	**	**	**	**
		10-12 ft.	**	-	-	-	-	-	-	-
		12-14 ft.	**	-	-	-	-	-	-	-
		14-16 ft.	**	-	-	-	-	-	-	-
		16-18 ft.	**	-	-	-	-	-	-	-
		18-20 ft.	**	-	-	-	-	-	-	-
+ +: SB-46(2'-6') - Analyzed for Metals, Semi-Volatiles and General Parameters. SB-46(2'-6')-DUP - Analyzed for Metals, Semi-Volatiles and General Parameters.										

FOOTNOTES:

(1) Arsenic, sodium, potassium
(2) Full CLP inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese vanadium, aluminum, colbalt, magnesium, calcium, sodium, potassium)
(3) 0 to 2-foot sample was not collected because location coincides with the 0 to 1-ft sample collected for surface soils. Surface soil analyses include CLP volatiles & cumene, CLP semivolatiles, CLP metals, CLP Pesticides & PCBs, ammonia, chloride, total phosphorus, sulfate, gross alpha, gross beta, total uranium, and potassium-40
(4) SB-41 converted to MW-41S
(5) CLP volatiles minus cumene

LEGEND:

CLP - Contract Laboratory Program
X: Interval proposed and tested
O: Interval proposed and not tested
**: Interval not proposed but tested
+ +: Additional comments given
-: Interval not proposed or tested

TABLE 2-6 (Continued)
BORING LOCATION, DEPTH, PARAMETERS ANALYZED FOR PHASE II INVESTIGATIONS
RNC PROPERTY
PADDYS RUN ROAD SITE

Location	Soil Bore	Sample Depth	CLP Vols. & Cumene	CLP Semi-Volitiles	CLP Inorganics (1)	CLP Pest. & PCBs	General Parameters: Ammonia	Total Phos.	Sulfate	Potassium-40
Area T Process Building	39	0-2 ft.	X	X	X	X	X	X	X	X
		0-2 ft.(DUP)	X	-	-	-	-	-	-	-
		2-4 ft.	X							
		4-6 ft.	X	X	X	-	X	X	X	X
		6-8 ft.	X							
		8-10 ft.	X	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	O	O	O	-	O	O	O	O
		10-18 ft.	-	**	**	-	**	**	**	**
		10-12 ft.	**	-	-	-	-	-	-	-
		12-14 ft.	**	-	-	-	-	-	-	-
		14-16 ft.	**	-	-	-	-	-	-	-
		16-18 ft.	**	-	-	-	-	-	-	-
Area T Process Building	40	0-2 ft.	X	X	X	X	X	X	X	X
		0-2 ft.(DUP)	X	X	X	X	X	X	X	X
		2-4 ft.	X							
		4-6 ft.	X	X	X	-	X	X	X	X
		6-8 ft.	X							
		8-10 ft.	X	X	X	-	X	X	X	X
		10 ft.. - Wat. Tab.	O	O	O	-	O	O	O	O
		10-18 ft.	-	**	**	-	**	**	**	**
		10-12 ft.	**	-	-	-	-	-	-	-
		12-14 ft.	**	-	-	-	-	-	-	-
		14-16 ft.	**	-	-	-	-	-	-	-
		16-18 ft.	**	-	-	-	-	-	-	-
Area U UST	35	0-2 ft.	X	X	X(2)	X	X	X	X	X
		0-2 ft(DUP)	X	X	X(2)	X	X	X	X	X
		2-4 ft.	X							
		4-6 ft.	X	X	X(2)	-	X	X	X	X
		6-8 ft.	X	**	**					
		8-10 ft.	O	X	X(2)	-	O	O	O	O
		10 ft.. - Wat. Tab.	O	O	O	-	O	O	O	O
		10-12 ft.	**	**	**(2)	-	-	-	-	-
		12-14 ft.	**	**	**(2)	-	-	-	-	-
		14-16 ft.	**	**	**(2)	-	-	-	-	-
	41(4) lease refer to footnote 4									

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FOOTNOTES:

(1) Arsenic, sodium, potassium
(2) Full CLP inorganics (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, zinc, barium, iron, manganese vanadium, aluminum, colbalt, magnesium, calcium, sodium, potassium)
(3) 0 to 2-foot sample was not collected because location coincides with the 0 to 1-ft sample collected for surface soils. Surface soil analyses include CLP volatiles & cumene, CLP semivolatiles, CLP metals, CLP Pesticides & PCBs, ammonia, chloride, total phosphorus, sulfate, gross alpha, gross beta, total uranium, and potassium-40
(4) SB-41 converted to MW-41S
(5) CLP volatiles minus cumene

LEGEND:

CLP - Contract Laboratory Program
X: Interval proposed and tested
O: Interval proposed and not tested
**: Interval not proposed but tested
+ +: Additional comments given
-: Interval not proposed or tested

000104

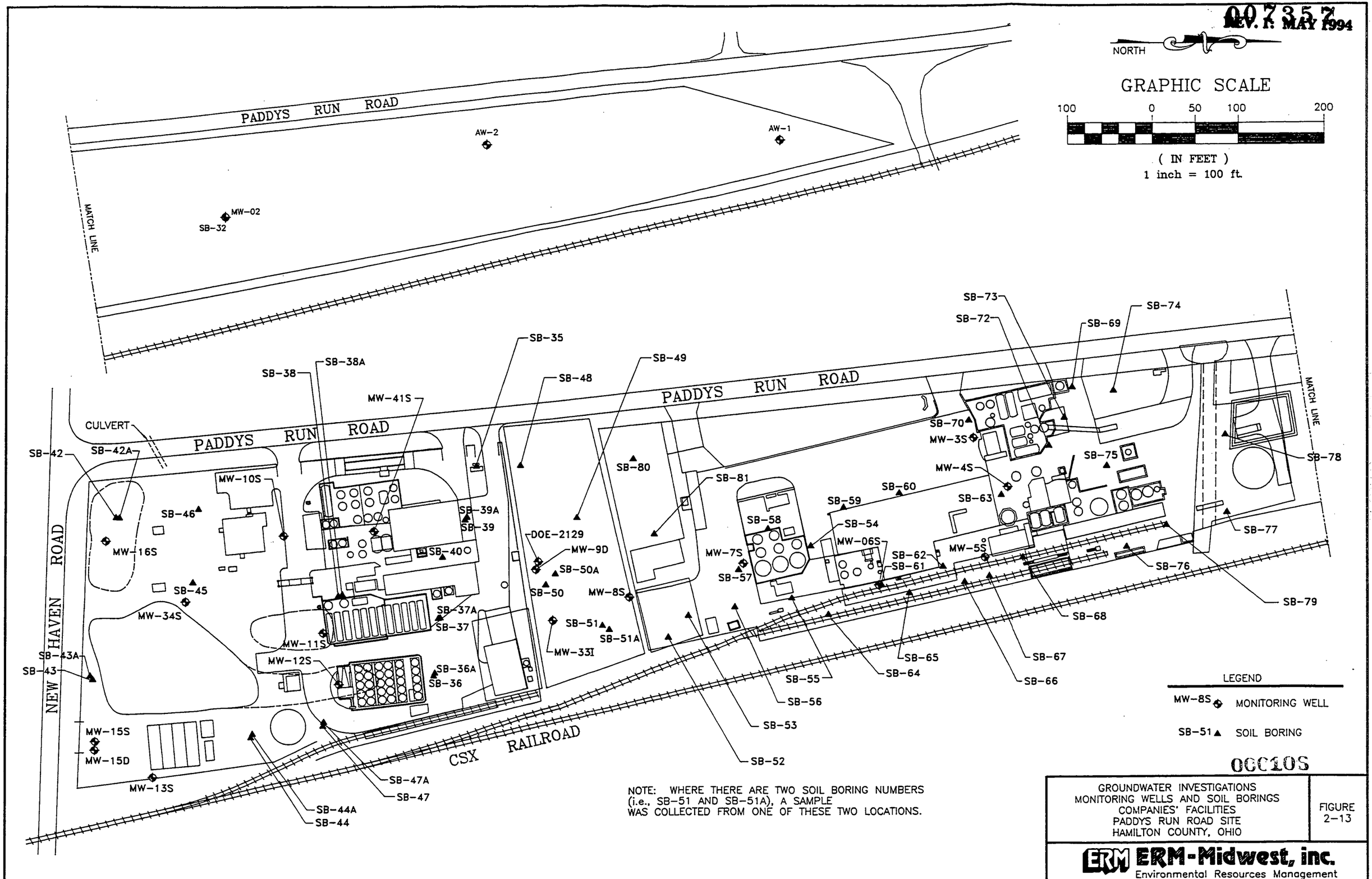
within 45 on-site boreholes. In particular, the transmissivity, direction and rate of flow, and groundwater quality were assessed for identifying pathways, extent of migration, and exposure scenarios for the RA and for supporting the groundwater model, and for the purpose of evaluating remedial alternatives for the FS.

To establish a vertical characterization of the groundwater quality, depths of intervals sampled ranged from the top of the groundwater at approximately 12 to 16 feet beneath the ground surface to a maximum depth of 90 feet below the top of the water surface (assumed in the groundwater model to average 13 feet beneath ground surface). On-site borings from which groundwater samples were collected are shown in Figure 2-13. Locations of the PRRS, DOE, and residential/industrial wells are shown in Figure 2-14.

Groundwater was analyzed for CLP volatile organics plus cumene, semivolatile organics, CLP inorganics, pesticides/PCBs and general parameters, including ammonia, chloride, chemical oxygen demand, MBAS, total and dissolved phosphorus, sulfate, total dissolved solids, and radionuclide parameters, including potassium-40, gross alpha, gross beta, and total uranium.

For the purpose of supporting the groundwater model and addressing the potential treatability of groundwater during the FS, a limited number of non-CLP parameters were analyzed on the fourth complete round of sampling and included: density, total Kjeldahl nitrogen (TKN), biochemical oxygen demand (BOD), hardness, TOC, standard plate count and total coliform. Wells involved in this study are shown in Figure 2-15.

For the monitoring wells and industrial/residential wells, up to four rounds of sampling occurred followed by seven supplemental groundwater sampling events for selected wells. Tables 2-7, 2-8, 2-9, 2-10 and 2-11 list wells sampled, selected parameters, sampling frequency and notes any sampling modifications. The number of wells sampled per round fluctuated due to the progressive installation of monitoring wells and the dynamic requirements for the sampling program. The



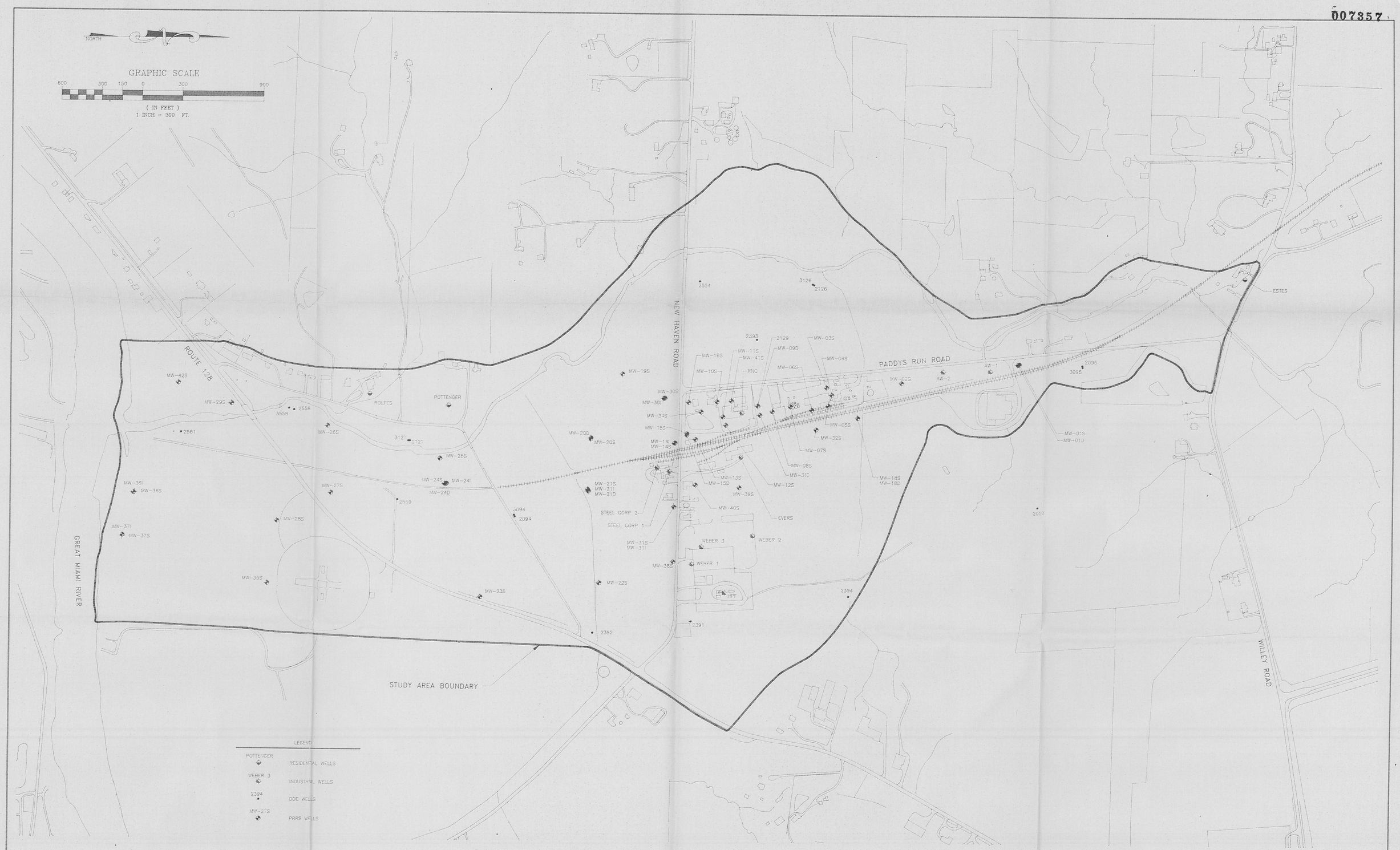
NOTE: WHERE THERE ARE TWO SOIL BORING NUMBERS (i.e., SB-51 AND SB-51A), A SAMPLE WAS COLLECTED FROM ONE OF THESE TWO LOCATIONS.

OCC10S

GROUNDWATER INVESTIGATIONS
MONITORING WELLS AND SOIL BORINGS
COMPANIES' FACILITIES
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 2-13

ERM ERM-Midwest, inc.
Environmental Resources Management



Subconsultant	ERM -- Midwest, Inc.	No.	Date	Revision

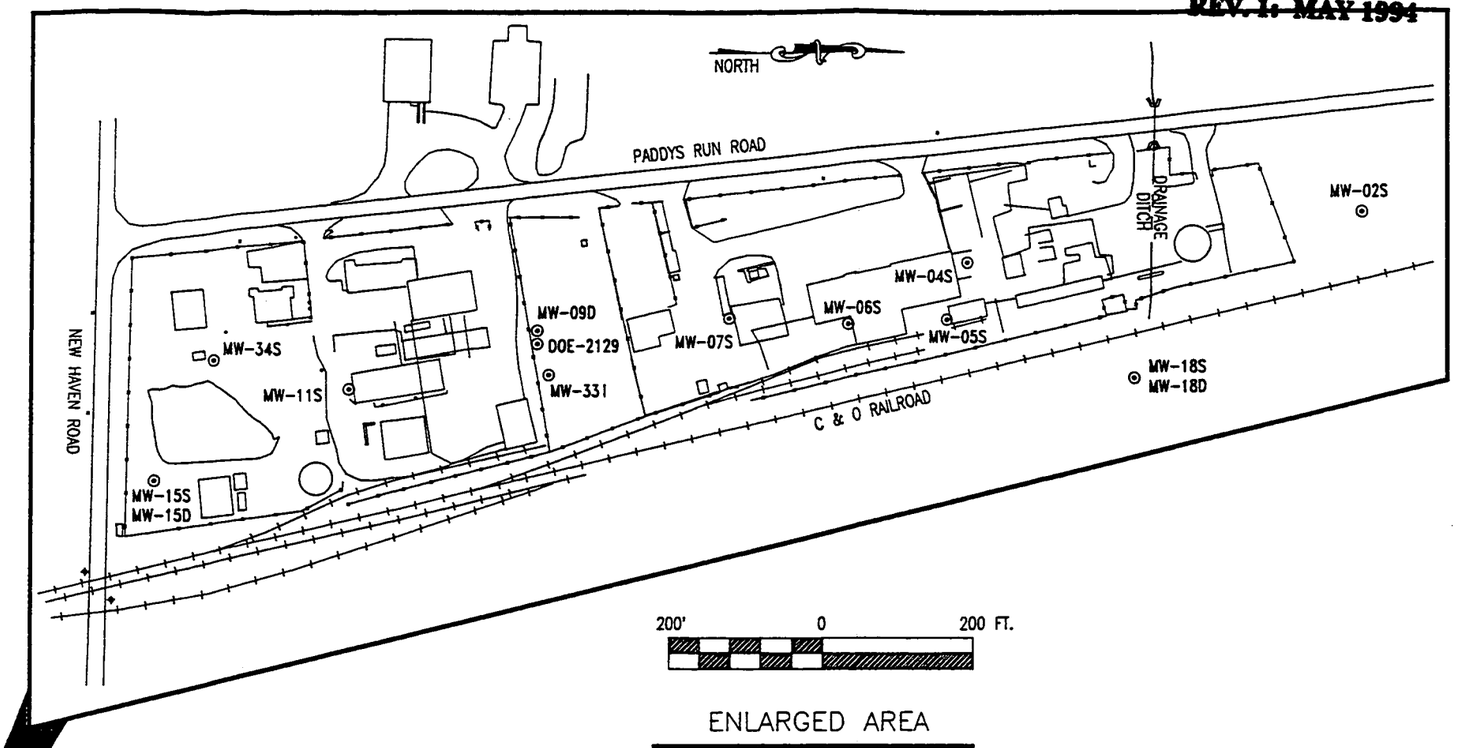
Principal :
Project Manager : TJS
Project No. : 539-10-02
Drawn : DMW
CAD File : 1002F214DWG

PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

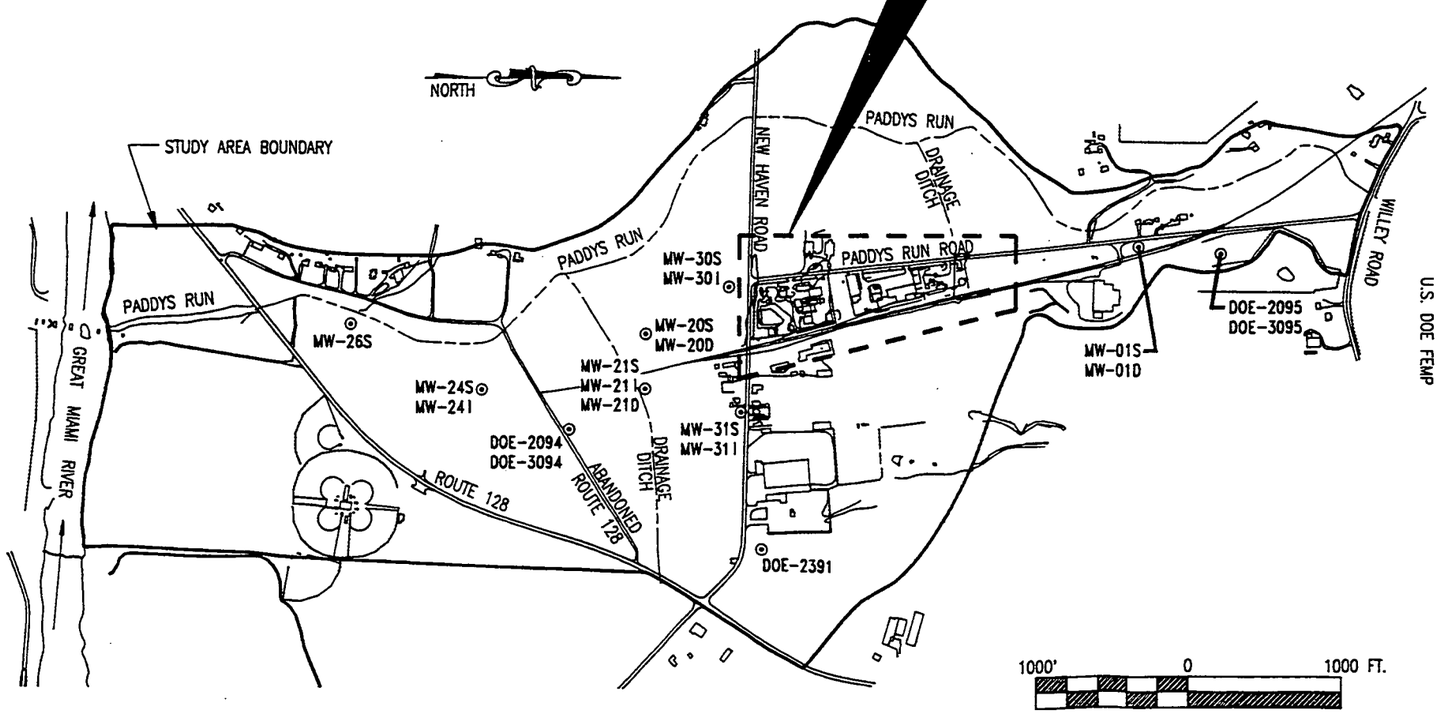
ERM ERM-Midwest, inc.
Environmental Resources Management
Columbus, Ohio
Charleston, WV
Indianapolis, IN
Louisville, KY

GROUNDWATER INVESTIGATIONS PRRS, DOE, RESIDENTIAL, AND INDUSTRIAL WELL LOCATIONS SURROUNDING COMPANIES' FACILITIES 000107

Scale : AS SHOWN
Date : REV. 1: MAY 1994
Dwg. No.: FIGURE 2-14
Sheet :



ENLARGED AREA



LEGEND

⊙ MW-20S MW-20D — WELLS SAMPLED

000108

WELLS SAMPLED FOR TREATABILITY PARAMETERS PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO	FIGURE 2-15

ERM-Midwest, inc.
Environmental Resources Management

TABLE 2-7
SUMMARY OF ROUND 1 GROUNDWATER SAMPLING PARAMETERS
PADDYS RUN ROAD SITE

	PARAMETER							
MONITORING WELLS	CLP (1) VOLATILE AND SEMI-VOLATILE ORGANICS CUMENE	CLP INORGANIC (2)	CLP PESTICIDES/PCBs	CLP CYANIDE	GENERAL PARAMETERS (3)	IN-STU PARAMETERS (4)	SPECIFIC GROUNDWATER MODELING PARAMETERS (5)	TREATABILITY PARAMETERS (5)
MW-01S	X	X	X	X	X	X	--	--
MW-01D	X	X	X	X	X	X	--	--
MW-02S	X	X	X	X	X	X	--	--
MW-03S	X	X	X	X	X	X	--	--
MW-05S	X	X	X	X	X	X	--	--
MW-06S	X	X	X	X	X	X	--	--
MW-07S	X	X	X	X	X	X	--	--
MW-08S	X	X	X	X	X	X	--	--
MW-09D	X	X	X	X	X	X	--	--
MW-10S	X	X	X	X	X	X	--	--
MW-11S	X	X	X	X	X	X	--	--
MW-12S	X	X	X	X	X	X	--	--
MW-13S	X	X	X	X	X	X	--	--
MW-14S	X	X	X	X	X	X	--	--
MW-15S	X	X	X	X	X	X	--	--
MW-15D	X	X	X	X	X	X	--	--
MW-16S	X	X	X	X	X	X	--	--
MW-18S	X	X	X	X	X	X	--	--
MW-18D	X	X	X	X	X	X	--	--
MW-19S	X	X	X	X	X	X	--	--
MW-20S	X	X	X	X	X	X	--	--
MW-20D	X	X	X	X	X	X	--	--
MW-21S	X	X	X	X	X	X	--	--
MW-21D	X	X	X	X	X	X	--	--
MW-22S	X	X	X	X	X	X	--	--
A&W-01	X	X	X	X	X	X	--	--
A&W-02	X	X	X	X	X	X	--	--
RNCC	X	X	X	X	X	X	--	--
U.S. DOE MONITORING WELLS								
2095	X	X	X	X	X	X	--	--
3095	X	X	X	X	X	X	--	--
2126	X	X	X	X	X	X	--	--
3126	X	X	X	X	X	X	--	--
2129	X	X	X	X	X	X	--	--
2094	X	X	X	X	X	X	--	--
3094	X	X	X	X	X	X	--	--

LEGEND:
X Well to be sampled for identified parameters
-- Well not to be sampled for identified parameters

NOTES:
(1) Contract Laboratory Program
(2) Dissolved only
(3) Ammonia, chloride, chemical oxygen demand, MBAS, phosporus, potassium-40, sulfate, total dissolved solids, gross alpha, gross beta, total uranium
(4) pH, specific conductance, temperature
(5) Density, nitrogen total Kjeldahl, biochemical oxygen demand, hardness, total organic carbon, standard plate count, total coliform

TABLE 2-7 (Continued)
SUMMARY OF ROUND 1 GROUNDWATER SAMPLING PARAMETERS
PADDYS RUN ROAD SITE

	PARAMETER							
MONITORING WELLS	CLP (1) VOLATILE AND SEMI-VOLATILE ORGANICS CUMENE	CLP INORGANIC (2)	CLP PESTICIDES/PCBs	CLP CYANIDE	GENERAL PARAMETERS (3)	IN-SITU PARAMETERS (4)	SPECIFIC GROUNDWATER MODELING PARAMETERS (5)	TREATABILITY PARAMETERS (6)
PRIVATE/ INDUSTRIAL								
HPF	X	X	X	X	X	X	–	–
Weber 1	X	X	X	X	X	X	–	–
Weber 2	X	X	X	X	X	X	–	–
Weber 3	X	X	X	X	X	X	–	–
Steel Corp 1	X	X	X	X	X	X	–	–
Steel Corp 2	X	X	X	X	X	X	–	–
Estes	X	X	X	X	X	X	–	–
Rolfes	X	X	X	X	X	X	–	–
Evers	X	X	X	X	X	X	–	–

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LEGEND:

X Well to be sampled for identified parameters

– Well not to be sampled for identified parameters

NOTES:

(1) Contract Laboratory Program

(2) Dissolved only

(3) Ammonia, chloride, chemical oxygen demand, MBAS, phosporus, potassium-40, sulfate, total dissolved solids, gross alpha, gross beta, total uranium

(4) pH, specific conductance, temperature

(5) Density, nitrogen total Kjeldahl, biochemical oxygen demand, hardness, total organic carbon, standard plate count, total coliform

(6) Nitrogen total Kjeldahl, biochemical oxygen demand, hardness, total organic carbon

000110

TABLE 2-8
SUMMARY OF ROUND 2 GROUNDWATER SAMPLING PARAMETERS
PADDYS RUN ROAD SITE

	PARAMETER							
MONITORING WELLS	CLP (1) VOLATILE AND SEMI-VOLATILE ORGANICS CUMENE	CLP INORGANIC (2)	CLP PESTICIDES/PCBs	CLP CYANIDE	GENERAL PARAMETERS (3)	IN-SITU PARAMETERS (4)	SPECIFIC GROUNDWATER MODELING PARAMETERS (5)	TREATABILITY PARAMETERS (6)
MW-01S	X	X	X	X	X	X	–	–
MW-01D	X	X	X	X	X	X	–	–
MW-02S	X	X	X	X	X	X	–	–
MW-03S	X	X	X	X	X	X	–	–
MW-05S	X	X	X	X	X	X	–	–
MW-06S	X	X	X	X	X	X	–	–
MW-07S	X	X	X	X	X	X	–	–
MW-08S	X	X	X	X	X	X	–	–
MW-09D	X	X	X	X	X	X	–	–
MW-10S	X	X	X	X	X	X	–	–
MW-11S	X	X	X	X	X	X	–	–
MW-12S	X	X	X	X	X	X	–	–
MW-13S	X	X	X	X	X	X	–	–
MW-14S	X	X	X	X	X	X	–	–
MW-15S	X	X	X	X	X	X	–	–
MW-15D	X	X	X	X	X	X	–	–
MW-16S	X	X	X	X	X	X	–	–
MW-18S	X	X	X	X	X	X	–	–
MW-18D	X	X	X	X	X	X	–	–
MW-19S	X	X	X	X	X	X	–	–
MW-20S	X	X	X	X	X	X	–	–
MW-20D	X	X	X	X	X	X	–	–
MW-21S	X	X	X	X	X	X	–	–
MW-21D	X	X	X	X	X	X	–	–
MW-22S	X	X	X	X	X	X	–	–
MW-23S	X	X	X	X	X	X	–	–
MW-24S	X	X	X	X	X	X	–	–
A&W-01	X	X	X	X	X	X	–	–
A&W-02	X	X	X	X	X	X	–	–
RNCC	X	X	X	X	X	X	–	–
U.S. DOE MONITORING WELLS								
2095	X	X	X	X	X	X	–	–
3095	X	X	X	X	X	X	–	–
2126	X	X	X	X	X	X	–	–
3126	X	X	X	X	X	X	–	–
2129	X	X	X	X	X	X	–	–
2094	X	X	X	X	X	X	–	–
3094	X	X	X	X	X	X	–	–
2394	X	X	X	X	X	X	–	–
2002	X	X	X	X	X	X	–	–

LEGEND:
X Well to be sampled for identified parameters
– Well not to be sampled for identified parameters

NOTES:
(1) Contract Laboratory Program
(2) Dissolved only
(3) Ammonia, chloride, chemical oxygen demand, MBAS, phosporus, potassium-40, sulfate, total dissolved solids, gross alpha, gross beta, total uranium
(4) pH, specific conductance, temperature
(5) Density, nitrogen total Kjeldahl, biochemical oxygen demand, hardness, total organic carbon, standard plate count, total coliform

TABLE 2-8 (Continued)
SUMMARY OF ROUND 2 GROUNDWATER SAMPLING PARAMETERS
PADDYS RUN ROAD SITE

	PARAMETER							
MONITORING WELLS	CLP (1) VOLATILE AND SEMI-VOLATILE ORGANICS CUMENE	CLP INORGANIC (2)	CLP PESTICIDES/PCBs	CLP CYANIDE	GENERAL PARAMETERS (3)	IN-SITU PARAMETERS (4)	SPECIFIC GROUNDWATER MODELING PARAMETERS (5)	TREATABILITY PARAMETERS (6)
PRIVATE/ INDUSTRIAL								
HPF	X	X	X	X	X	X	--	--
Weber 1	X	X	X	X	X	X	--	--
Weber 2	X	X	X	X	X	X	--	--
Weber 3	X	X	X	X	X	X	--	--
Steel Corp 1	X	X	X	X	X	X	--	--
Steel Corp 2	X	X	X	X	X	X	--	--
Estes	X	X	X	X	X	X	--	--
Rolfes	X	X	X	X	X	X	--	--
Evers	X	X	X	X	X	X	--	--

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LEGEND:
X Well to be sampled for identified parameters
-- Well not to be sampled for identified parameters

NOTES:
(1) Contract Laboratory Program
(2) Dissolved only
(3) Ammonia, chloride, chemical oxygen demand, MBAS, phosporus, potassium-40, sulfate, total dissolved solids, gross alpha, gross beta, total uranium
(4) pH, specific conductance, temperature
(5) Density, nitrogen total Kjeldahl, biochemical oxygen demand, hardness, total organic carbon, standard plate count, total coliform
(6) Nitrogen total Kjeldahl, biochemical oxygen demand, hardness, total organic carbon

000112

TABLE 2-9
SUMMARY OF ROUND 3 GROUNDWATER SAMPLING PARAMETERS
PADDYS RUN ROAD SITE

	PARAMETER							
MONITORING WELLS	CLP (1) VOLATILE AND SEMI-VOLATILE ORGANICS: CUMENE	CLP INORGANIC (2)	CLP PESTICIDES/PCBs	CLP CYANIDE	GENERAL PARAMETERS (3)	IN-SITU PARAMETERS (4)	SPECIFIC GROUNDWATER MODELING PARAMETERS (5)	TREATABILITY PARAMETERS (6)
MW-01S	X	X	--	--	X	X	--	--
MW-01D	X	X	--	--	X	X	--	--
MW-02S	X	X	--	--	X	X	--	--
MW-03S	X	X	--	--	X	X	--	--
MW-04S	X	X	X	--	X	X	--	--
MW-05S	X	X	X	--	X	X	--	--
MW-06S	X	X	--	--	X	X	--	--
MW-07S	X	X	--	--	X	X	--	--
MW-08S	X	X	--	--	X	X	--	--
MW-09D	X	X	--	--	X	X	--	--
MW-10S	X	X	--	--	X	X	--	--
MW-11S	X	X	X	--	X	X	--	--
MW-12S	X	X	X	--	X	X	--	--
MW-13S	X	X	X	--	X	X	--	--
MW-14S	X	X	X	--	X	X	--	--
MW-14i	X	X	X	--	X	X	--	--
MW-15S	X	X	X	--	X	X	--	--
MW-15D	X	X	--	--	X	X	--	--
MW-16S	X	X	--	--	X	X	--	--
MW-18S	X	X	--	--	X	X	--	--
MW-18D	X	X	--	--	X	X	--	--
MW-19S	X	X	--	--	X	X	--	--
MW-20S	X	X	--	--	X	X	--	--
MW-20D	X	X	--	--	X	X	--	--
MW-21S	X	X	--	--	X	X	--	--
MW-21I	X	X	--	--	X	X	--	--
MW-21D	X	X	--	--	X	X	--	--
MW-22S	X	X	--	--	X	X	--	--
MW-23S	X	X	--	--	X	X	--	--
MW-24S	X	X	--	--	X	X	--	--
MW-24I	X	X	--	--	X	X	--	--
MW-25S	X	X	--	--	X	X	--	--
MW-26S	X	X	--	--	X	X	--	--
MW-27S	X	X	--	--	X	X	--	--
MW-28S	X	X	--	--	X	X	--	--
MW-29S	X	X	--	--	X	X	--	--
MW-30S	X	X	X	--	X	X	--	--
MW-30I	X	X	X	--	X	X	--	--
MW-31S	X	X	X	--	X	X	--	--
MW-32S	X	X	--	--	X	X	--	--
MW-33I	X	X	X	--	X	X	--	--
MW-34S	X	X	X	--	X	X	--	--
MW-35S	X	X	--	--	X	X	--	--
MW-36S	X	X	--	--	X	X	--	--
MW-37S	X	X	--	--	X	X	--	--

LEGEND:
X Well to be sampled for identified parameters
-- Well not to be sampled for identified parameters

NOTES:
(1) Contract Laboratory Program
(2) Dissolved only
(3) Ammonia, chloride, chemical oxygen demand, MBAS, phosporus, potassium-40, sulfate, total dissolved solids, gross alpha, gross beta, total uranium
(4) pH, specific conductance, temperature
(5) Density, nitrogen total Kjeldahl, biochemical oxygen demand, hardness, total organic carbon, standard plate count, total coliform
(6) Nitrogen total Kjeldahl, biochemical oxygen demand, hardness, total organic carbon

TABLE 2-9 (Continued)
SUMMARY OF ROUND 3 GROUNDWATER SAMPLING PARAMETERS
PADDYS RUN ROAD SITE

	PARAMETER							
MONITORING WELLS	CLP (1) VOLATILE AND SEMI-VOLATILE ORGANICS CUMENE	CLP INORGANIC (2)	CLP PESTICIDES/PCBs	CLP CYANIDE	GENERAL PARAMETERS (3)	IN-SITU PARAMETERS (4)	SPECIFIC GROUNDWATER MODELING PARAMETERS (5)	TREATABILITY PARAMETERS (6)
A&W-01	X	X	–	–	X	X	–	–
A&W-02	X	X	–	–	X	X	–	–
RNCC	X	X	–	–	X	X	–	–
U.S. DOE MONITORING WELLS								
2095	X	X	–	–	X	X	–	–
3095	X	X	–	–	X	X	–	–
2126	X	X	–	–	X	X	–	–
3126	X	X	–	–	X	X	–	–
2129	X	X	–	–	X	X	–	–
2094	X	X	–	–	X	X	–	–
3094	X	X	–	–	X	X	–	–
2394	X	X	–	–	X	X	–	–
2002	X	X	–	–	X	X	–	–
PRIVATE/ INDUSTRIAL								
HPF	X	X	–	–	X	X	–	–
Weber 1	X	X	–	–	X	X	–	–
Weber 2	–	–	–	–	–	–	–	–
Weber 3	X	X	–	–	X	X	–	–
Steel Corp 1	X	X	–	–	X	X	–	–
Steel Corp 2	X	X	–	–	X	X	–	–
Estes	X	X	–	–	X	X	–	–
Rolfes	X	X	–	–	X	X	–	–
Evers	X	X	–	–	X	X	–	–

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LEGEND:
X Well to be sampled for identified parameters
– Well not to be sampled for identified parameters

NOTES:
(1) Contract Laboratory Program
(2) Dissolved only
(3) Ammonia, chloride, chemical oxygen demand, MBAS, phosporus, potassium-40, sulfate, total dissolved solids, gross alpha, gross beta, total uranium
(4) pH, specific conductance, temperature
(5) Density, nitrogen total Kjeldahl, biochemical oxygen demand, hardness, total organic carbon, standard plate count, total coliform
(6) Nitrogen total Kjeldahl, biochemical oxygen demand, hardness, total organic carbon

000114

TABLE 2-10
SUMMARY OF ROUND 4 GROUNDWATER SAMPLING PARAMETERS
PADDYS RUN ROAD SITE

	PARAMETER							
MONITORING WELLS	CLP (1) VOLATILE AND SEMI-VOLATILE ORGANICS CUMENE	CLP INORGANIC (2)	CLP PESTICIDES/PCBs	CLP CYANIDE	GENERAL PARAMETERS (3)	IN-SITU PARAMETERS (4)	SPECIFIC GROUNDWATER MODELING PARAMETERS (5)	TREATABILITY PARAMETERS (6)
MW-01S	X	X	--	--	X	X	--	X
MW-01D	X	X	--	--	X	X	--	X
MW-02S	X	X	--	--	X	X	--	X
MW-03S	X	X	--	--	X	X	--	--
MW-04S	X	X	X	--	X	X	--	X
MW-05S	X	X	X	--	X	X	--	X
MW-06S	X	X	--	--	X	X	--	X
MW-07S	X	X	--	--	X	X	--	X
MW-08S	X	X	--	--	X	X	--	--
MW-09D	X	X	--	--	X	X	X	X
MW-10S	X	X	--	--	X	X	--	--
MW-11S	X	X	X	--	X	X	--	X
MW-12S	X	X	X	--	X	X	--	--
MW-13S	X	X	X	--	X	X	--	--
MW-14S	X	X	X	--	X	X	--	--
MW-14I	X	X	X	--	X	X	--	--
MW-15S	X	X	X	--	X	X	X	X
MW-15D	X	X	--	--	X	X	X	X
MW-16S	X	X	--	--	X	X	--	--
MW-18S	X	X	--	--	X	X	--	X
MW-18D	X	X	--	--	X	X	--	X
MW-19S	X	X	--	--	X	X	--	--
MW-20S	X	X	--	--	X	X	X	X
MW-20D	X	X	--	--	X	X	X	X
MW-21S	X	X	--	--	X	X	--	X
MW-21I	X	X	--	--	X	X	--	X
MW-21D	X	X	--	--	X	X	--	X
MW-22S	X	X	--	--	X	X	--	--
MW-23S	X	X	--	--	X	X	--	--
MW-24S	X	X	--	--	X	X	--	X
MW-24I	X	X	--	--	X	X	--	X
MW-25S	X	X	--	--	X	X	--	--
MW-26S	X	X	--	--	X	X	--	X
MW-27S	X	X	--	--	X	X	X	--
MW-28S	X	X	--	--	X	X	--	--
MW-29S	X	X	--	--	X	X	--	--
MW-30S	X	X	X	--	X	X	X	X
MW-30I	X	X	X	--	X	X	X	X
MW-31S	X	X	X	--	X	X	--	X
MW-31I	X	X	--	--	X	X	--	X
MW-32S	X	X	X	--	X	X	--	--
MW-33I	X	X	X	--	X	X	X	X
MW-34S	X	X	X	--	X	X	X	X
MW-35S	X	X	--	--	X	X	--	--
MW-36S	X	X	--	--	X	X	X	--
MW-35S	X	X	--	--	X	X	--	--
MW-37S	X	X	--	--	X	X	--	--
MW-38S	X	X	--	--	X	X	--	--

LEGEND:

X Well to be sampled for identified parameters

-- Well not to be sampled for identified parameters

NOTES:

(1) Contract Laboratory Program

(2) Dissolved only

(3) Ammonia, chloride, chemical oxygen demand, MBAS, phosporus, potassium-40, sulfate, total dissolved solids, gross alpha, gross beta, total uranium

(4) pH, specific conductance, temperature

(5) Density, nitrogen total Kjeldahl, biochemical oxygen demand, hardness, total organic carbon, standard plate count, total coliform

(6) Nitrogen total Kjeldahl, biochemical oxygen demand, hardness, total organic carbon

(7) Weber #3 could not be sampled because its pump was inoperable

(8) Steel Corp 1 well was deleted because it was recently covered; it is not being used and is now unaccessible.

TABLE 2-10 (Continued)
SUMMARY OF ROUND 4 GROUNDWATER SAMPLING PARAMETERS
PADDYS RUN ROAD SITE

	PARAMETER							
MONITORING WELLS	CLP (1) VOLATILE AND SEMI-VOLATILE ORGANICS CUMENE	CLP INORGANIC (2)	CLP PESTICIDES/PCBs	CLP CYANIDE	GENERAL PARAMETERS (3)	IN-STU PARAMETERS (4)	SPECIFIC GROUNDWATER MODELING PARAMETERS (5)	TREATABILITY PARAMETERS (6)
MW-40S	X	X	X	–	X	X	–	X
MW-41S	X	X	–	–	X	X	–	X
A&W-01	X	X	–	–	X	X	–	–
A&W-02	X	X	–	–	X	X	–	–
RNCC	X	X	–	–	X	X	–	–
U.S. DOE MONITORING WELLS								
2095	X	X	–	–	X	X	–	–
3095	X	X	–	–	X	X	–	–
2126	X	X	–	–	X	X	–	–
3126	X	X	–	–	X	X	–	–
2129	X	X	–	–	X	X	–	–
2094	X	X	X	–	X	X	–	–
3094	X	X	X	–	X	X	–	–
2394	X	X	X	–	X	X	–	–
2002	X	X	X	–	X	X	–	–
2391	X	X	–	–	X	X	–	–
2393	X	X	–	–	X	X	–	–
2554	X	X	–	–	X	X	–	–
2559	X	X	–	–	X	X	–	–
PRIVATE/ INDUSTRIAL								
HPF	X	X	–	–	X	X	–	–
Weber 1	X	X	–	–	X	X	–	–
Weber 2	X	X	–	–	X	X	–	–
Weber 3 (7)	–	–	–	–	–	–	–	–
Steel Corp 1 (8)	–	–	–	–	–	–	–	–
Steel Corp 2	X	X	–	–	X	X	–	–
Estes	X	X	–	–	X	X	–	–
Rolfes	X	X	–	–	X	X	–	–
Evers	X	X	–	–	X	X	–	–

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LEGEND:

X Well to be sampled for identified parameters

– Well not to be sampled for identified parameters

NOTES:

(1) Contract Laboratory Program

(2) Dissolved only

(3) Ammonia, chloride, chemical oxygen demand, MBAS, phosporus, potassium-40, sulfate, total dissolved solids, gross alpha, gross beta, total uranium

(4) pH, specific conductance, temperature

(5) Density, nitrogen total Kjeldahl, biochemical oxygen demand, hardness, total organic carbon, standard plate count, total coliform

(6) Nitrogen total Kjeldahl, biochemical oxygen demand, hardness, total organic carbon

(7) Weber #3 could not be sampled because its pump was inoperable

(8) Steel Corp 1 well was deleted because it was recently covered; it is not being used and is now unaccessible.

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TABLE 2-11
SUMMARY OF SUPPLEMENTAL 1 GROUNDWATER SAMPLING PARAMETERS
PADDYS RUN ROAD SITE

	PARAMETER							
Monitoring Wells	CLP (1) VOLATILE ORGANICS CUMENE	CLP (1) SEMI-VOLATILE ORGANICS	CLP INORGANIC (2)	CLP PESTICIDES/ PCB'S	GENERAL PARAMETERS (3)	IN-SITU PARAMETERS (4)	SPECIFIC GROUNDWATER MODELING PARAMETERS (5)	TREATABILITY PARAMETERS (6)
DOE-2559	X	-	-	-	-	X	-	-
MW-20D	X	-	-	-	-	X	-	-
MW-21D	X	-	-	-	-	X	-	-
MW-22S	X	-	-	-	-	X	-	-
MW-28S	X	-	-	-	-	X	-	-
MW-35S	X	-	-	-	-	X	-	-

SUMMARY OF SUPPLEMENTAL 2 GROUNDWATER SAMPLING PARAMETERS
PADDYS RUN ROAD SITE

	PARAMETER								
Monitoring Wells	CLP (1) VOLATILE ORGANICS CUMENE	CLP (1) SEMI-VOLATILE ORGANICS	CLP INORGANIC (2)	CLP PESTICIDES/ PCB'S	CLP CYANIDE	GENERAL PARAMETERS (3)	IN-SITU PARAMETERS (4)	SPECIFIC GROUNDWATER MODELING PARAMETERS (5)	TREATABILITY PARAMETERS (6)
DOE-2127	X	X	X (9)	-	-	X	X	-	-
DOE-2392	X	X	X (9)	-	-	X	X	-	-
DOE-2558	X	X	X (9)	-	-	X	X	-	-
DOE-2561	X	X	X (9)	-	-	X	X	-	-
DOE-3127	X	X	X (9)	-	-	X	X	-	-
MW-24D	X	X	X	-	-	X	X	-	-
MW-26S	X	X	X (9)	-	-	X	X	-	-
MW-28S	-	X	X (9)	-	-	-	X	-	-
MW-29S	X	X	X (9)	-	-	X	X	-	-
MW-35S	X	X	X (9)	-	-	X	X	-	-
MW-36I	X	X	X (9)	-	-	X	X	-	-
MW-37I	X	X	X (9)	-	-	X	X	-	-
MW-38S	X	X	X (9)	-	-	X	X	-	-
MW-42S	X	X	X (9)	-	-	X	X	-	-
POTT	X	-	X	-	-	X	X	-	-

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LEGEND:

X Well sampled for identified parameters

– Well not sampled for identified parameters

NOTES:

(1) Contract Laboratory Program

(2) Total and dissolved

(3) Ammonia, chloride, chemical oxygen demand, MBAS, phosporus -- total and dissolved, potassium-40, sulfate, total dissolved solids, gross alpha, gross beta, total uranium

(4) pH, specific conductance, temperature

(5) Density, nitrogen total Kjeldahl, biochemical oxygen demand, hardness, total organic carbon, standard plate count, total coliform

(6) Nitrogen total Kjeldahl, biochemical oxygen demand, hardness, total organic carbon

(7) Weber #3 could not be sampled because its pump was inoperable

(8) Steel Corp 1 well was deleted because it was recently covered; it is not being used and is now unaccessible.

(9) Arsenic, manganese, calcium, sodium, potassium

methodology for the collection of groundwater samples from monitoring wells and residential/industrial wells is included in Appendix B-2.

Borings were placed on the Companies' properties primarily to identify the location and extent of chemical sources in the soil. To properly define the vertical extent of potential contamination, the entire vadose zone to the water table was investigated to evaluate whether or not identified contamination in the soil had impacted the underlying groundwater. In addition, a water sample at the water table was also collected. The sampled parameters for this investigation were modified somewhat from those parameters sampled from monitoring wells and residential/industrial wells to conform to critical parameters as designated by the Ohio EPA. However, where applicable, analyses included CLP volatiles plus cumene, CLP semivolatiles, CLP inorganics, CLP pesticides/PCBs and general parameters (ammonia, total and dissolved phosphorus, sulfate and the radionuclide potassium-40). Table 2-12 summarizes the boring location and parameters sampled. The methodology for collecting groundwater from boreholes is described in Appendix B-2.

The detailed results from these investigations are presented in Section 3.11.

2.11 Groundwater Modeling

Comprehensive groundwater flow and solute transport models were developed for the PRRS. The modeling effort incorporated regional information available from previous studies in the area of the PRRS and local information derived during the site characterization to form a comprehensive analytical representation of the physical groundwater flow system. Flow modeling evaluated only the movement of the groundwater and did not incorporate the associated movement of dissolved solute. In addition, solute transport models simulating the movement of the dissolved-phase chemicals in the groundwater aquifer system were developed. The modeling was conducted during the RI for two primary purposes :

1. To assist with the interpretation and characterization of groundwater flow and chemical transport at the Study Area

TABLE 2-12
SUMMARY OF GROUNDWATER SAMPLING PARAMETERS FROM PHASE II BORING PROGRAM PADDYS RUN ROAD SITE

	PARAMETER								
Soil Boring	CLP (1) VOLATILE ORGANICS CUMENE	CLP (1) SEMI-VOLATILE ORGANICS	CLP INORGANIC (2)	CLP PESTICIDES PCB'S	CLP CYANIDE	GENERAL PARAMETERS (3)	IN-SITU PARAMETERS (4)	SPECIFIC GROUNDWATER MODELING PARAMETERS (5)	TREATABILITY PARAMETERS (6)
SB-35	X	X	X	-	-	X	-	-	-
SB-36	X	X	X (11)	X	-	X	-	-	-
SB-37	X	X	X (11)	X	-	X	-	-	-
SB-38	X	X	X (11)	X	-	X	-	-	-
SB-39	X	X	X (11)	-	-	X	-	-	-
SB-40	X	X	X (11)	-	-	X	-	-	-
SB-42	X	X	X (11)	X	-	X	-	-	-
SB-43	X	X	X (11)	X	-	X	-	-	-
SB-44	X	-	X (11)	-	-	X	-	-	-
SB-45	-	X	X (11)	-	-	X	-	-	-
SB-46	X	X	X (11)	-	-	X	-	-	-
SB-47	X	X	X (11)	-	-	X	-	-	-
SB-48	-	X	X (11)	-	-	X	-	-	-
SB-49	-	X	X (11)	-	-	X	-	-	-
SB-50	-	X	X (11)	-	-	X	-	-	-
SB-51	-	X	X	-	-	X	-	-	-
SB-52	-	X	X	-	-	X	-	-	-
SB-53	-	X	X	-	-	X	-	-	-
SB-54	-	-	X (11)	-	-	X	-	-	-
SB-55	-	-	X (11)	-	-	X	-	-	-
SB-56	-	-	X (11)	-	-	X	-	-	-
SB-57	-	-	X (11)	-	-	X	-	-	-
SB-58	-	X	X (11)	-	-	X	-	-	-
SB-59	-	-	X	-	-	X	-	-	-
SB-60	X (10)	-	X	-	-	X	-	-	-
SB-61	X (10)	-	X (11)	-	-	X	-	-	-
SB-62	-	-	X (11)	-	-	X	-	-	-
SB-63	-	-	X (11)	-	-	X	-	-	-
SB-64	-	-	X (11)	-	-	X	-	-	-
SB-65	-	-	X (11)	-	-	X	-	-	-
SB-66	-	-	X (11)	-	-	X	-	-	-
SB-67	-	-	X (11)	-	-	X	-	-	-
SB-68	-	-	X (11)	-	-	X	-	-	-
SB-69	-	-	X (11)	-	-	X	-	-	-
SB-70	-	-	X (11)	-	-	X	-	-	-
SB-72	-	-	X (11)	-	-	X	-	-	-
SB-73	-	-	X (11)	-	-	X	-	-	-
SB-74	-	-	X (11)	-	-	X	-	-	-
SB-75	-	-	X (11)	-	-	X	-	-	-
SB-76	-	-	X (11)	-	-	X	-	-	-
SB-77	-	-	X (11)	-	-	X	-	-	-
SB-78	X (10)	X	X	-	-	X	-	-	-
SB-79	X (10)	X	X	-	-	X	-	-	-
SB-80	X (10)	X	X	X	-	X	-	-	-
SB-81	-	-	X	-	-	X	-	-	-

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LEGEND:
X Well sampled for identified parameters
-- Well not sampled for identified parameters

NOTES:
(1) Contract Laboratory Program
(2) Total and dissolved
(3) Ammonia, chloride, chemical oxygen demand, MBAS, phosporus – total and dissolved, potassium-40, sulfate, total dissolved solids, gross alpha, gross beta, total uranium
(4) pH, specific conductance, temperature
(5) Density, nitrogen total Kjeldahl, biochemical oxygen demand, hardness, total organic carbon, standard plate count, total coliform
(6) Nitrogen total Kjeldahl, biochemical oxygen demand, hardness, total organic carbon
(7) Weber #3 could not be sampled because its pump was inoperable
(8) Steel Corp 1 well was deleted because it was recently covered; it is not being used and is now unaccessible.
(9) Arsenic, manganese, calcium, sodium, potassium
(10) Volatile organics minus cumene
(11) Arsenic, sodium, potassium

2. To support the RA through the prediction of future dissolved groundwater chemical concentrations under a No Action remedial alternative scenario

In addition to these RI-specific objectives, a fully developed and calibrated solute transport model will serve as the basis for the simulation of potential groundwater extraction scenarios during the Feasibility Study. This section summarizes the process for the groundwater flow and solute transport modeling at the PRRS.

The model code utilized for developing the PRRS model was the *Heat and Solute Transport in Three Dimensional (HST3D)* groundwater flow and transport model code written and distributed by the U.S. Geological Survey. This model is fully documented and described in the U.S.G.S. Water-Resources Investigations Report 86-4095 (1987). This model was identified in the work plan approved by Ohio EPA.

The groundwater modeling was conducted in two primary phases:

- Phase I, Groundwater Flow Model Development and Calibration (regional and local)
- Phase II, Solute Transport Model Calibration and Simulation (local).

A complete modeling report detailing the specifics of the modeling effort is enclosed as Appendix C. This section of the RI report summarizes the approach to the modeling as is presented in that report. Groundwater flow modeling results are summarized in Section 3.11, and solute transport modeling is referred to in Section 4.3 of this report.

2.11.1 Regional Flow Model Development

A regional flow model was developed for PRRS to allow for characterization and evaluation of the hydrogeology of the regional buried valley aquifer system in the vicinity of the Study Area, and to form the basis for development of localized solute transport modeling. The model development consisted of the following tasks:

- Data Collection and Review
- Model Conceptualization and Formulation
- Model Calibration
- Sensitivity Testing

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- Data Collection and Review
- Model Conceptualization and Formulation
- Model Calibration
- Sensitivity Testing

Each of these tasks is summarized below.

Data Collection and Review

In accordance with the *Work Plan for Phase II Remedial Investigation and Baseline Risk Assessment* (ERM 1991a), an evaluation of reference sources was initiated for the regional area. Estimates of parameters in the regional aquifer flow system varied, depending upon the reference source. To select parameter values for model development, references were compared with measured Study Area data and evaluated based upon professional judgment.

Model Conceptualization and Formulation

The second task of the Regional Groundwater Flow Model development consisted of the conceptualization of the hydrodynamic flow system and the actual construction of the computer model to incorporate that conceptualization and the identified input parameters into a mathematical representation of the physical system. HST3D model input files were constructed using the information obtained during data collection, review and evaluation.

Model Calibration

Once the HST3D regional flow model was developed, model calibration was initiated. Calibration is the process of adjusting the developed model (e.g., the input data values) to simulate the measured conditions. It also provides a means of verification for the representativeness of both the input data parameters and the conceptual assumptions.

The primary objective of the model calibration was to refine the developed groundwater flow model so that it approximately simulated the observed regional hydraulic head and hydraulic gradient distributions and, thus, provided a reasonable representation of the dynamic and physical characteristics of the aquifer flow system.

Model Sensitivity Analysis

Finally, as part of the regional flow model calibration efforts, a sensitivity analysis was conducted on the calibrated flow model. Sensitivity testing is a process whereby the input parameters that cause the greatest variation in the modeling results can be identified. The sensitivity analysis for the regional model focused on the following parameters:

- Horizontal Hydraulic Conductivity
- Vertical Hydraulic Conductivity
- River Stage
- Recharge
- River Leakance

2.11.2 Local Flow Model Development

Once the regional groundwater flow model was developed and calibrated, modeling efforts turned to the construction of a local flow model to provide a more Study Area-specific representation of the groundwater flow system. The calibrated regional flow model served as a basis for boundary conditions and flow parameters (e.g., hydraulic conductivities, river leakance, specified pressure boundaries), but model grid spacing for the local flow model was much finer, thus providing greater resolution for the study area.

The development of the local flow model followed the same procedures as utilized for the regional flow model. However, because sensitivity testing was conducted on flow parameters of the regional model, it was not repeated for the flow parameters of the local model.

2.11.3 Solute Transport Model Development

Because solute transport processes are, in part, different from the processes which strictly govern groundwater flow, the solute transport models were constructed following local flow model calibration. The calibrated May 1991 local flow model

was utilized for the solute transport model development because it corresponded to the time period for which groundwater monitor well data were available.

As identified in the RI Phase II Work Plan (ERM 1991a) five organic chemicals and four inorganic chemicals were considered for solute transport modeling. To simplify the modeling process, one chemical from each of the chemical groups was modeled. The nine chemicals were separated into the organic chemical group (benzene, ethylbenzene, toluene, xylenes and cumene) and the inorganic chemical group (sodium, potassium/potassium-40, and arsenic) based on chemical nature, typical transport processes within an aquifer environment, and chemical source areas at PRRS. Consequently, the approved PRRS Work Plan (ERM, 1991a) specified that one calibrated transport model would be developed for one chemical of each group (organic and inorganic) and that the concentrations of the other group chemical would be estimated based on the results of the two calibrated transport models. Thus, two separate and calibrated solute transport models (organic and inorganic) were developed. The modeling procedure generally followed that previously outlined for the regional and local flow models and is further discussed below.

Data Collection and Review

Three previous modeling efforts including the PRRS have been conducted (Spieker 1968b, GeoTrans 1985, IT 1990). These studies were reviewed to assess applicability to the PRRS solute transport models. The results of the previous modeling studies are summarized in Appendix C. In addition to the previous modeling information, the information collected during the PRRS field activities was reviewed and evaluated. PRRS RI data which were collected through field activities and literature review and are integral to solute transport modeling include:

- Unsaturated and saturated soil chemical concentrations and liquid-phase hydrocarbon concentrations in PRRS chemical source areas
- Dissolved chemical groundwater concentrations in monitoring wells to delineate chemical plumes
- Aquifer characteristic data such as organic carbon content (to estimate sorption of chemicals), density, porosity, thickness, horizontal and vertical

hydraulic conductivity distribution, and longitudinal and transverse dispersivity. The parameters used in the PRRS models are described in the discussion and tables in Section 3.10.1 and Section 4.3 of this report.

Evaluation of Source Areas

A primary focus of the Phase II RI activities was to identify and evaluate potential chemical source areas which may be contributing to the degradation of groundwater quality. Potential source areas are delineated in Section 3.4. Based on available information (detected unsaturated and saturated soil chemical concentrations, information on the presence of liquid-phase hydrocarbon, and historical data collected from interviewing site personnel), general chemical source areas were delineated. Observed chemical concentrations collected during the RI were heavily relied upon. Multiple chemical concentrations collected from each PRRS RI soil boring were averaged (vertically) to obtain a depth-averaged concentration for each boring. The average chemical concentrations representative of each model source cell were estimated by averaging soil boring chemical concentrations within each cell and through interpolation between soil boring locations. The average floating hydrocarbon thickness across each cell was estimated by interpolation of observed hydrocarbon floating thicknesses between well locations. For the zone of the source area representing the floating hydrocarbon layer, it was assumed that the soil pore space was filled to capacity (saturated) with free phase hydrocarbon based on CONCAWE (1979), API (1986), and AAPG (1989). Once delineated, the source areas were evaluated by incorporating Study Area-specific soil sampling and liquid level (depth to free hydrocarbon and depth to water) data to estimate the chemical mass that was present in both the unsaturated and saturated zones and the associated solute loading to the aquifer system. (See Appendix C.)

Model Conceptualization and Formulation

Based upon the review of regional and Study Area-specific data and the evaluation of potential contaminant sources, the solute transport models were conceptualized and formulated. The transport model conceptualization entailed the following processes:

- Hydrogeochemical characterization
- Chemical sorption and decay estimation
- Existing solute mass estimation
- Chemical mass loading rate calculation

Upon completion of model conceptualization and formulation, two separate solute transport models (inorganic and organic) were constructed.

Model Calibration

The inorganic and organic solute transport models were calibrated individually to the observed dissolved chemical concentration data collected during the PRRS field operations. Because of the variability inherent in the chemical concentration data (i.e., due to seasonal factors, biodegradation/decay, aquifer variability, among others), the calibration criteria of the solute transport model were modified in comparison with the criteria used for the flow model calibration (the approved PRRS Work Plan (ERM 1991a) provided for this approach). Primary methods used to evaluate transport model calibration are presented in Table 2-13. In addition, the six statistical tests of hypothesis on the equality of means and variances of the observed and computed values were conducted according to the methodology described in Subappendix B of Appendix C. Transport model calibration heavily relied upon a graphical comparison of observed versus estimated values (i.e., comparison of simulated and observed chemical concentration contour maps).

Model Sensitivity Analysis

Both of the calibrated solute transport models were used in sensitivity testing analysis to evaluate the effect of varying transport parameters on computed dissolved chemical concentrations. Sensitivity analysis is conducted by making incremental changes to one modeling input parameter (such as retardation or dispersion) while keeping all other parameters the same as the calibration run. By evaluating the change in model results due to the change in the selected parameter a determination can be made as to the extent the developed model is sensitive to

TABLE 2-13
PRIMARY CALIBRATION EVALUATION CRITERIA FOR TRANSPORT MODELING
PADDYS RUN ROAD SITE

DESIGNATION	DESCRIPTION	ACCEPTABLE RANGE	OPTIMUM VALUE
1. Graphical comparison	Comparison of observed and simulated values via computer mapping and x-y arithmetic graphs.	Not quantifiable.	Not quantifiable.
2. R1	R1 is the ratio of the mean of the residuals (the difference between observed and computed values) to the mean of the observed values.	-30% < R1 < + 30%	0%
3. Percent of residuals (the difference between observed and computed values) within ± one standard deviation of observed values	Example: For 40 observations then 5% of observations (i.e., two residuals (40x0.05-2)) can fall outside of the one standard deviation of observed values.	90% - 100%	100%
4. R4	R4 is the regression coefficient between the observed and computed dissolved chemical concentrations.	0.5 - 1.0	1.0
5. R5	R5 is the ratio of the coefficient of variation (the standard deviation divided by the mean) of the observed values to the computed values.	0.80 - 1.2	1.0
6. Model mass balance error	This error is calculated by HST3D and termed the "fractional imbalance" by the code.	-15% < model mass balance error < + 15%	0.0

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changes in that parameter. Sensitivity analysis is very useful when interpreting prediction results, especially if additional data become available after modeling is completed.

Model Prediction

One of the goals of the solute transport modeling was to support the development of the Risk Assessment through the prediction of future dissolved chemical concentrations in the aquifer at various times and locations. (See Section 6.1.4.3.) To accomplish this goal, the calibrated solute transport models were used to simulate future conditions in the aquifer for the designated modeling parameters at one year increments up to a total of 30 years. Note that after 30 years, a trend could be established from which additional predictions could be extrapolated. Validation of the solute transport model may be accomplished by comparing observed chemical concentration data collected at future dates to simulated chemical concentration data obtained from the transport model, as discussed with the Ohio EPA in response to Comment 15 of the Agency's letter of February 12, 1993.

2.12 Determination of Chemical Backgrounds at PRRS

In general, the determination of representative chemical concentrations associated with unaffected areas at a site is critical for the successful characterization of potential contamination related to on-site activities. Inorganic, radiological, and organic (volatile, semivolatile, pesticides, etc.) chemicals may be present at a site due to either natural occurrence or to non-site related activities (e.g., farming, industrial sources, transportation activity, septic systems, etc.) Thus, it is essential to identify and determine which levels of a site's chemical concentrations are related to site activities compared to "non-site", or background activities for all media of concern.

For the PRRS RI, a background investigation was conducted in accordance with the Ohio EPA's July 1990, *How Clean is Clean*, final policy and the related *Background Determination* policy. The complete background determination study, entitled,

Determination of Medium-Specific Chemical Background Comparison Values at the Paddys Run Road Site, was submitted for review to the Ohio EPA on July 20, 1992. The background study was revised in March 1994 with the inclusion of additional PRRS groundwater background samples from 1993 and validated sampling data from FEMP. The updated report is included as Appendix B-3. This section serves to summarize that document.

The determination of representative background concentrations of analytical parameters for the RI/RA/FS is required to support the following activities:

- Identify the extent of Study Area-related contamination
- Identify the primary chemicals of concern during the RA by comparing background levels to concentrations on the Companies' facilities and downgradient of them
- Evaluate potential chemical specific applicable or relevant and appropriate requirements (ARARs) to be evaluated during the development of remedial alternatives (relevant to Feasibility Study)
- Evaluate potential clean-up standards.

The process followed to develop the background values for all chemicals analyzed for each medium -- the unsaturated zone soils, groundwater, surface water and sediment -- was as follows:

- Review local and regional data in the literature to determine "normal" ranges of the chemical constituents in the area.
- Identify appropriate background sampling locations and data for each medium of concern.
- Perform a simple univariate statistical evaluation (e.g., mean and standard deviation) of the identified data.
- Based on the results of the initial statistical elevation, determine whether a statistically adequate number of background sampling data exists.
- If sufficient data are available, continue the statistical evaluation by determining whether the data is "distributed" in a statistically normal manner.

- If the data are not normally distributed, transform the data to normality with a base 10 logarithmic transform.
- Calculate the upper 95% tolerance interval of the normal distribution for each chemical.

It should be noted that the chemicals provided herein as background concentrations are calculated levels. While some of the figures were derived from available empirical data, others were developed using statistical analysis and assumptions with respect to analytic laboratory capabilities. There is no assertion that the values presented as background represent actual measurements of ambient concentrations.

Background comparison values of chemicals are addressed in Section 3.5 of this report.

TABLE OF CONTENTS

Section	Title	Page
3.0	PHYSICAL CHARACTERISTICS OF THE STUDY AREA	3-1
3.1	Results of Surface Features Investigation	3-1
3.1.1	Companies' Sumps, Underground Pipelines and USTs	3-2
3.1.2	Non-Company USTs and Specialty Paint Mixing Facility	3-6
3.2	Meteorology	3-7
3.3	Population and Land Use	3-10
3.3.1	Population	3-10
3.3.2	Industry, Farmland and Recreational Areas	3-13
3.3.3	Surface Waters as Potential Exposure Routes	3-14
3.3.4	Groundwater as a Drinking Water Source	3-15
3.3.5	Direction of Groundwater Flow and Location of Wells Associated with the Study Area	3-19
3.3.6	Availability of Alternate Water Sources	3-20
3.3.7	Human Use of or Access to the Companies' Properties and Adjacent Areas	3-20
3.3.8	Future Population Growth and Land Use	3-21
3.4	Source Area Characterization	3-23
3.5	Background Comparison Values of Chemicals	3-51
3.6	Surface Water Characterization	3-61
3.6.1	Physical Characteristics of Paddys Run	3-61
3.6.2	Physical Characteristics of the Cooling Pond	3-68
3.6.3	Paddys Run and Pond Chemical Characteristics	3-68
3.7	Sediment Characterization	3-71
3.7.1	Physical and Chemical Properties of Sediments in Paddys Run	3-73
3.7.2	Physical and Chemical Properties of Sediments in the Drainage Ditches	3-74
3.7.3	Physical and Chemical Properties of Sediments in the Cooling Pond	3-76

TABLE OF CONTENTS (Continued)

Section	Title	Page
3.8	Geology	3-76
3.8.1	Geologic Setting	3-81
3.8.2	Bedrock Formations	3-81
3.8.3	Chemistry and Mineralogy	3-83
3.8.4	Composition above Bedrock	3-86
3.9	Characterization of the Unsaturated and Saturated Soils	3-89
3.9.1	Surface Soils	3-90
3.9.2	Unsaturated Subsurface Soils	3-100
3.9.3	Saturated Subsurface Soils	3-110
3.10	Hydrogeologic Investigations	3-128
3.10.1	Regional Hydrogeology	3-128
3.10.2	Study Area Hydrogeology	3-166
3.11	Groundwater Flow Modeling	3-196
3.11.1	Regional Flow Model	3-196
3.11.2	Local Flow Modeling	3-231

LIST OF FIGURES

Figure	Title	Page
3-1	A&W/Mobil Property - Locations of Active and Inactive Pipelines and Sumps	3-3
3-2	Ruetgers-Nease Corporation Property Locations of Active and Inactive Pipelines and Sumps	3-4
3-3	Approximate Locations of USTs Close to Companies' Properties	3-8
3-4	Location of Former Specialty Paint Mixing Facility	3-9

LIST OF FIGURES (Continued)

Figure	Title	Page
3-5	Wind Rose Diagram and Yearly Precipitation Totals at FEMP	3-11
3-6	Population and Land Use Study Area within a 1.5 Mile Radius of Companies' Properties	3-12
3-7	Well/Cistern Map and Direction of Groundwater Flow April 1992	3-16
3-8	Area within a 1.5 Mile Radius of the Companies' Properties Divided into Traffic Zones	3-22
3-9	Locations of Stream Sampling Points (Locations 1 and 2) in Mobil's 1983 Study of Paddys Run and Water Level Gauges SG-1 through SG-5	3-65
3-10	Flood Boundaries within the Study Area for a 100 Year Flood and a 500 Year Flood	3-67
3-11	Surface Water and Sediment Collection Locations for Phase I and Phase II	3-72
3-12	Geologic Map and Cross Section of Ohio and Location of the Cincinnati Arch	3-82
3-13	Rock Formations in and around Study Area	3-84
3-14	Top of Bedrock and Distribution of Alluvium	3-85
3-15	Relationship of the New Haven Trough with the Paddys Run Road Site	3-88
3-16	Locations of Surface Soil and Particle Size Distribution Sample Collection and Soil Types	3-91
3-17	Soil Type Based on Particle Size	3-93
3-18	Geologic Cross-Section Location Map	3-103
3-19	Cross Section A-A'	3-104

LIST OF FIGURES (Continued)

Figure	Title	Page
3-20	Cross Section B-B'	3-105
3-21	Cross Section C-C'	3-106
3-22	Cross Section D-D' and Cross Section E-E'	3-107
3-23	Locations of Soil Borings that had Samples Submitted for Particle Size Analysis and Cation Exchange Capacity	3-126
3-24	Five Hydrogeologic Environments within a 1.5 Mile Radius of the Site	3-130
3-25	Regional Flow Model Net Precipitation Recharge Distribution	3-156
3-26	Water Level Elevation vs. Rainfall	3-157
3-27	Observed 1986 Groundwater Level Elevations	3-161
3-28	Great Miami/Little Miami River Basins Buried Valley Aquifer System	3-163
3-29	Locations of Major Groundwater Withdrawals in the Area	3-165
3-30	Subsurface Geology Shown in Relation to Soil Boring Elevations on the Companies' Properties	3-168
3-31	Piezometric Contour Map Groundwater Elevations, June 1990	3-172
3-32	Piezometric Contour Map Groundwater Elevations, August 1990	3-173
3-33	Piezometric Contour Map Groundwater Elevations, January 1991	3-174
3-34	Piezometric Contour Map Groundwater Elevations, April 1991	3-175
3-35	Piezometric Contour Map Groundwater Elevations, July 1991	3-176
3-36	Piezometric Contour Map Groundwater Elevations, October 1991	3-177
3-37	Piezometric Contour Map Groundwater Elevations. January 1992	3-178

LIST OF FIGURES (Continued)

Figure	Title	Page
3-38	Piezometric Contour Map Groundwater Elevations April 1992	3-179
3-39	Piezometric Contour Map Groundwater Elevations August 1992	3-180
3-40	PRRS Water Level Measurements, February 13-24, 1992	3-183
3-41	PRRS Water Level Measurements, February 24-March 7, 1992	3-184
3-42	PRRS Water Level Measurements, March 31-April 15, 1992	3-185
3-43	PRRS Water Level Measurements, April 15-22, 1992	3-186
3-44	PRRS Water Level Measurements, May 15-17, 1992	3-187
3-45	PRRS Water Level Measurements, July 7-9, 1992	3-188
3-46	PRRS Water Level Measurements, August 7-18, 1992	3-189
3-47	PRRS Water Level Measurements, August 18-September 21, 1992	3-190
3-48	PRRS Water Level Measurements, November 23-December 15, 1992	3-191
3-49	PRRS Water Level Measurements, December 15, 1992-January 20, 1993	3-192
3-50	PRRS Water Level Measurements, January 20-February 25, 1993	3-193
3-51	Regional Flow Model - Planar Node Specifications	3-218
3-52	Comparison of Observed and Simulated 1986 Groundwater Level Elevations	3-220
3-53	Local Flow Model - Planar Node Specification	3-232
3-54	Comparison of Observed and Simulated 1991 Groundwater Table Elevations	3-235

TABLE OF CONTENTS (Continued)

PLATE 1 October 1956 Paddys Run Road Site 3-24
PLATE 2 1963 Paddys Run Road Site 3-25
PLATE 3 March 1966 Paddys Run Road Site 3-26
PLATE 4 May 1, 1968 Paddys Run Road Site 3-27
PLATE 5 1973 Paddys Run Road Site 3-28
PLATE 6 1981 Paddys Run Road Site 3-29
PLATE 7 November 1988 Paddys Run Road Site 3-30

LIST OF TABLES

Table	Title	Page
3-1	Summary of the Residential and Industrial Well Inventory Survey Conducted within the Study Area PRRS RI/RA - August 1989	3-17
3-2	1980 Census vs. 2010 Population Projections	3-21
3-3	Chronological Listing of Spills and Releases at the Site	3-31
3-4	Storage Tank Characteristics at A&W	3-39
3-5	Storage Tank Area Characteristics at RNC	3-45
3-6	Summary of Analytical Testing Parameters	3-53
3-7	Dissolved CLP Metals Background Concentration Summary	3-54
3-8	Total CLP Metals Background Concentration Summary	3-55
3-9	CLP Volatile Organic Background Concentration Summary	3-56
3-10	CLP Semi-Volatile Organic Background Concentration Summary	3-57
3-11	CLP Pesticides/PCB Background Concentration Summary	3-59
3-12	General and Radiological Background Concentration Summary	3-60

LIST OF TABLES (Continued)

Table	Title	Page
3-13	Paddys Run Stream Characteristics	3-64
3-14	Paddys Run Surface Water - Chemicals Detected above Background	3-69
3-15	Pond Surface Water - Chemicals Detected above Background	3-70
3-16	Paddys Run Sediment - pH and TOC Results	3-73
3-17	Paddys Run Road Sediments - Chemicals Detected above Background	3-75
3-18	Drainage Ditch Sediments - pH and TOC Results	3-76
3-19	Drainway Sediments - Chemicals Detected above Background	3-77
3-20	Pond Sediments - Chemicals Detected above Background	3-79
3-21	Chemical Components in Limestone and Shale	3-87
3-22	Mineral Components in Limestone and Shale	3-87
3-23	Surface Soil Summary of Chemicals Detected above Background	3-97
3-24	Total Metals Detected above Background in Soil Borings	3-111
3-25	Volatile Organic Compounds Detected above Background in Soil Borings	3-117
3-26	Semivolatiles Detected above Background in Soil Borings	3-122
3-27	Pesticides/PCB, General Parameters and Radiological Parameters Detected above Background in Soil Borings	3-124
3-28	Soil Physical Parameter Analyses	3-127
3-29	Reported Groundwater Flow Parameter Values (Including RI Field Data)	3-132

LIST OF TABLES (Continued)

Table	Title	Page
3-30	Groundwater Flow Parameter Values Used in Calibrated Regional Model	3-149
3-31	Yearly Precipitation Collected by MCD and FEMP	3-154
3-32	Major Water Users - Hamilton-New Baltimore Area	3-164
3-33	Dissolved Metals Detected above Background in the Groundwater	3-197
3-34	Total Metals Detected above Background in Groundwater Samples	3-202
3-35	Volatile Organic Compounds Detected above Background in the Groundwater	3-206
3-36	Semivolatile Organic Compounds Detected above Background in the Groundwater	3-209
3-37	Pesticides/PCBs Detected above Background in the Groundwater	3-212
3-38	General Parameters Detected above Background in the Groundwater	3-213
3-39	Radiological Parameters Detected above Background in the Groundwater	3-216
3-40	Primary Calibration Evaluation Criteria for Flow Modeling	3-219
3-41	1986 Regional Flow Model Calibration Performance	3-221
3-42	1991 Regional Flow Model Calibration Performance	3-224
3-43	Calibrated Regional Groundwater Flow Model Input Parameters	3-227
3-44	Regional Flow Model Sensitivity Analysis Summary	3-230
3-45	Local Flow Model Calibration Performance - April 1986	3-236
3-46	1991 Local Flow Model Calibration Performance	3-237

3.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

A final draft of the *Work Plan for Phase II Remedial Investigation and Baseline Risk Assessment* was submitted to the Ohio EPA September 3, 1991 and was approved September 30. Remedial investigation results reported within Section 3.0 are:

- Results of surface features investigation - Section 3.1
- Meteorology - Section 3.2
- Population and land use - Section 3.3
- Source area characterization - Section 3.4
- Background comparison values of chemicals - Section 3.5
- Surface water characterization - Section 3.6
- Sediment characterization - Section 3.7
- Geology - Section 3.8
- Characterization of unsaturated and saturated soils - Section 3.9
- Hydrogeologic investigations - Section 3.10
- Groundwater flow modeling - Section 3.11

Although not specifically called for in the Work Plan, several ancillary tasks were added by the Ohio EPA during the course of investigation, including:

- Installation of monitoring wells and a piezometer
- Installation of continuous water level recorders in two monitoring wells and a piezometer
- Collection of additional groundwater samples from select monitoring wells

Results of all Phase II field investigations, including ancillary tasks, and other Phase I field investigations not previously reported are addressed.

3.1 Results of Surface Features Investigation

Section 3.1 focuses on surface features as they are related to potential sources on and in the vicinity of A&W's and RNC's property. Most of the information

presented below is a result of the Phase II investigations; however, selected relevant information from the *Preliminary Activities Report* (ENSR 1990a) is added to augment the discussion.

In general, surface or near-surface features that may be sources of subsurface chemicals of concern include sumps and underground pipelines on A&W and RNC properties, two former underground storage tanks (USTs) on the RNC property, and several USTs along with a specialty paint mixing operation adjacent to the Companies' properties. Findings pertaining to these surface features are presented below.

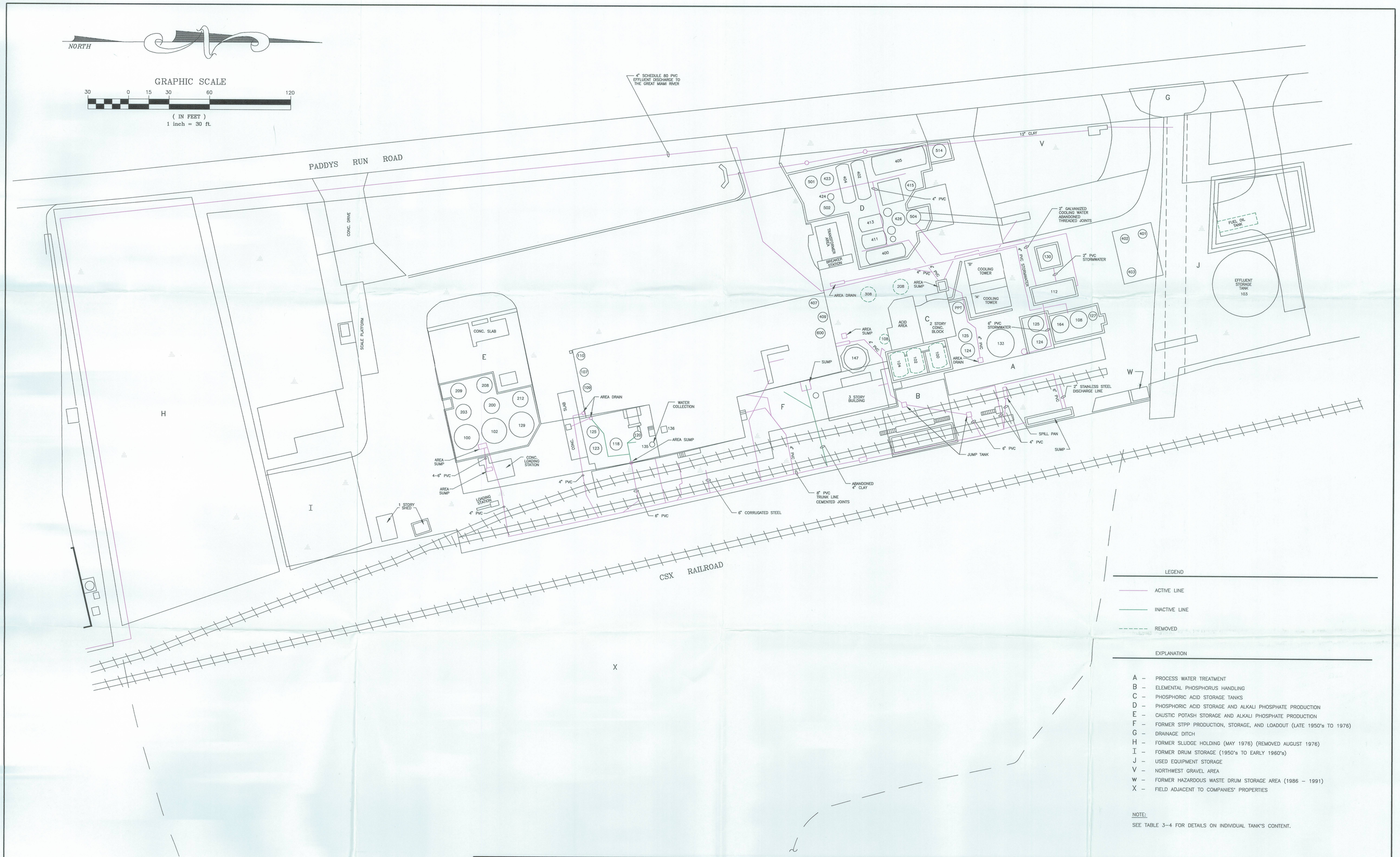
3.1.1 Companies' Sumps, Underground Pipelines and USTs

A&W Facility

Sumps and underground pipelines have been identified from personnel interviews and historical facility engineering diagrams. Locations of the A&W sumps and underground lines are shown in Figure 3-1. Currently, fluids conveyed by underground lines include stormwater, washdown water and treated wastewater.

To maintain the integrity of the underground lines, A&W performs leak tests. The last leak test was performed in November 1991. That test revealed five leaks, all of which were subsequently repaired. There are no active or known abandoned USTs on the A&W property.

It is possible that accidently spilled liquids could infiltrate underground lines. Such spills during transportation and handling would be collected in area drains within the loading station areas. Accidental spills within process areas would be conveyed to area sumps (Jones 1992).



LEGEND

ACTIVE LINE

INACTIVE LINE

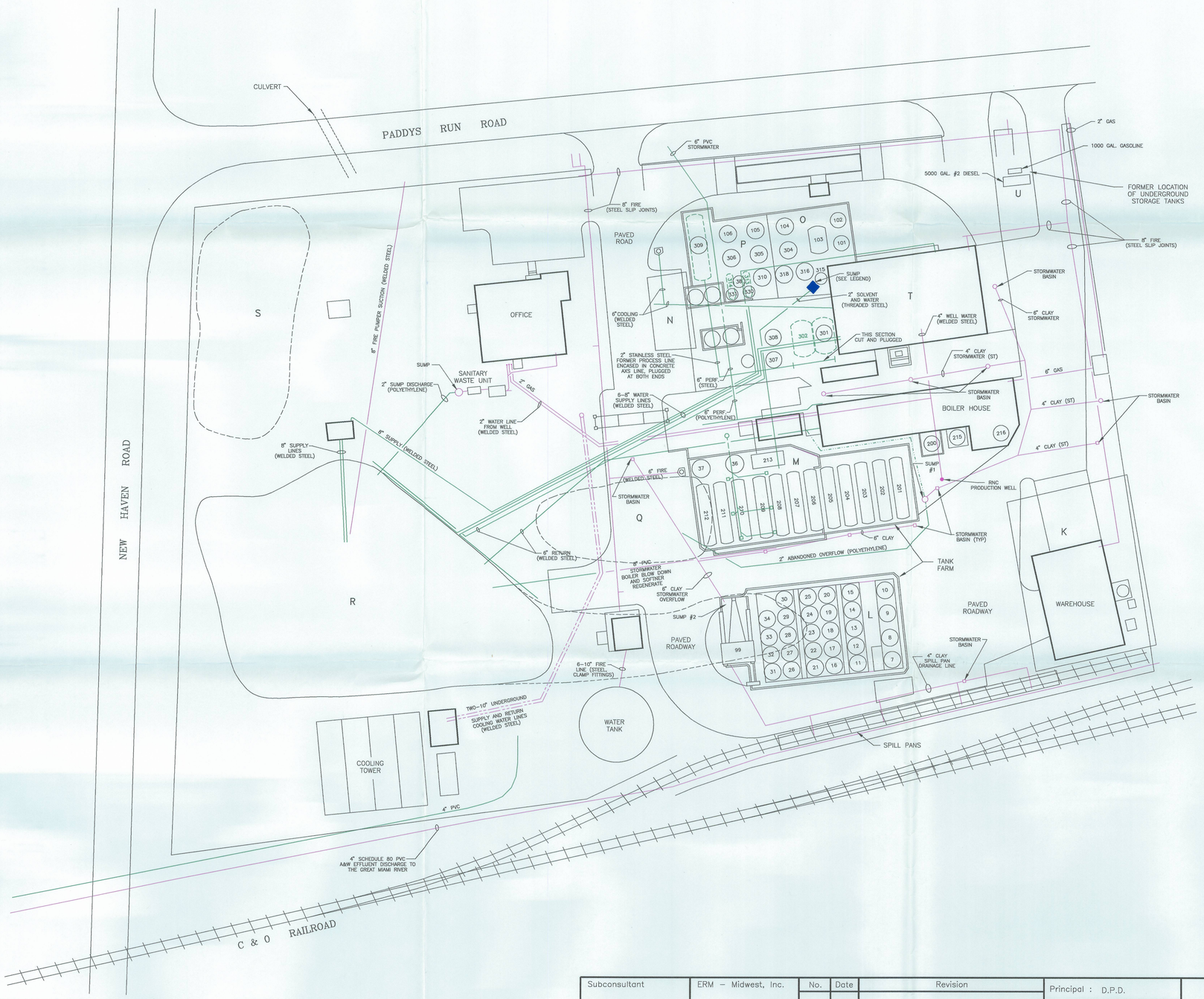
REMOVED

EXPLANATION

A – PROCESS WATER TREATMENT
B – ELEMENTAL PHOSPHORUS HANDLING
C – PHOSPHORIC ACID STORAGE TANKS
D – PHOSPHORIC ACID STORAGE AND ALKALI PHOSPHATE PRODUCTION
E – CAUSTIC POTASH STORAGE AND ALKALI PHOSPHATE PRODUCTION
F – FORMER STPP PRODUCTION, STORAGE, AND LOADOUT (LATE 1950's TO 1976)
G – DRAINAGE DITCH
H – FORMER SLUDGE HOLDING (MAY 1976) (REMOVED AUGUST 1976)
I – FORMER DRUM STORAGE (1950's TO EARLY 1960's)
J – USED EQUIPMENT STORAGE
V – NORTHWEST GRAVEL AREA
W – FORMER HAZARDOUS WASTE DRUM STORAGE AREA (1986 – 1991)
X – FIELD ADJACENT TO COMPANIES' PROPERTIES

NOTE:
SEE TABLE 3–4 FOR DETAILS ON INDIVIDUAL TANK'S CONTENT.

Subconsultant	ERM – Midwest, Inc.	No.	Date	Revision	Principal : D.P.D.	PRRS HAMILTON COUNTY, OHIO	A&W/MOBIL PROPERTY LOCATIONS OF ACTIVE AND INACTIVE PIPELINES AND SUMPS
					Project Manager : T.J.S.		
					Project No. : 539–10–02	ERM-Midwest, inc. Environmental Resources Management Columbus, Ohio Charleston, WV Indianapolis, IN Louisville, KY	Scale : AS SHOWN ABOVE / Date : REV. 1: MAY 1994
					Drawn : D.M.W.		Dwg. No.: 3 – 1 / Sheet :
					CAD File : 1002F31.DWG		



NORTH

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 30 ft.

LEGEND

◆ PROCESS AREA T SUMP

NOTE:
ALL SUMPS AND STORMWATER BASINS ARE ACTIVE AND WITH THE EXCEPTION OF THE ONE SUMP LOCATED SOUTHWEST OF THE PROCESS BUILDING, ALL ARE TIED INTO STORMWATER LINES.

ACTIVE LINE

SECTION OF ACTIVE UNDERGROUND NON-CONTACT COOLING WATER PIPELINE THAT WAS REPLACED IN 1990

INACTIVE LINE

INACTIVE REMOVED LINES AND TANKS

UNCERTAIN IF LINE EXISTS

EXPLANATION

K – RUNOFF DRAINAGE AREA\TRUCK WASHDOWN AREA (1959 – 1978)
L – HYDROTOPE STORAGE AREA
M – TANK FARM AREA
N – FORMER SMALL LAGOON (1959 – 1966)
O – SULFURIC ACID STORAGE
P – WASTE STORAGE
Q – FORMER POND NO. 1 (1959 – 1974)
R – POND NO. 2 (1965 TO PRESENT)
S – FORMER POND NO. 3 (1962 – 1974)
T – PROCESS BUILDING
U – FORMER UNDERGROUND FUEL STORAGE TANKS (1959 – 1988)

EXTENT OF AREAS Q, R AND S INFERRED FROM HISTORICAL AERIAL PHOTO

NOTE:
SEE TABLE 3-5 FOR DETAILS ON INDIVIDUAL TANK'S CONTENT.

Subconsultant	ERM – Midwest, Inc.	No.	Date	Revision

Principal : D.P.D.
Project Manager : T.J.S.
Project No. : 539-10-02
Drawn : D.M.W.
CAD File : 1002F32.DWG

PRRS
HAMILTON COUNTY, OHIO

ERM-Midwest, inc.
Environmental Resources Management
Columbus, Ohio
Charleston, WV
Indianapolis. IN
Louisville, KY

RUETGERS-NEASE CORPORATION PROPERTY
LOCATIONS OF ACTIVE AND INACTIVE PIPELINES AND SUMPS

Scale : AS SHOWN ABOVE
Date : REV. 1: MAY 1994
Dwg. No.: 3 – 2
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RNC Facility

The locations of the RNC sumps, underground lines and former location of two USTs are shown in Figure 3-2. The line construction and whether it is active or not is shown.

In 1974, a sump was installed just south of the Process Building (Area T) to collect floor washings and any drips or leaks that occurred inside the Process Building (ENSR 1990a). The bottom of the sump was poured concrete; its walls were built of concrete blocks lined with acid-resistant tile. It measured approximately four feet in diameter. In August 1986, this sump was removed and replaced with a new sump consisting of concrete walls and bottom with a stainless steel box inserted into the concrete structure. This sump's opening is 4 ft^2 with a depth of 52 inches.

As part of the Phase II Work Plan activities, the sump installed in 1986 was tested for leaks (ERM 1991a). Prior to testing, any fluid which had accumulated within the sump was pumped into drums and disposed of in a regulated facility. A visual inspection revealed that no cracks were present. The sump then was filled with water to a depth equal to its operating level of 46 inches. The sump was covered with plastic to isolate it from rainfall and to control evaporation. After 24 hours, the depth of water remaining in the sump was 46 inches. The sump was considered to be free of leaks.

Concrete floors, sumps, drains, and drainlines were installed in the Raw Product Tank Farm (Area M) in 1978 to collect rainwater and spills. Any collected material drains to a 4-foot diameter sump located 20 to 30 feet south of Area M. In 1986, this concrete sump and about 12 feet of drain pipe were removed. In addition, the sumps in the Raw Product Tank Farm were filled with concrete. Currently, any collected material such as stormwater or spills is pumped via aboveground lines to the processing area or to a holding tank for disposal.

All but one underground line at the RNC facility was used to convey stormwater, boiler blowdown, softener regenerate, wastewater from the sanitary unit, water for the facility fire protection system, and production water from the RNC water well.

According to plant personnel, an ammonium xylene sulfonate (AXS) line originally was constructed on the ground surface, but in paving the area in 1978 the line became encapsulated in concrete. This line was leak tested in accordance with procedures outlined in the Phase II Work Plan on October 21, 1991. To test the line, a valve was placed at the AXS tank and inside the Process Building where the line came above ground. The line was then filled with water, forcing pressure to 73-74 pounds per square inch (psi). A gauge monitored the line pressure for one hour. After that time it was noted that the pressure was maintained at 73-74 psi. The line was considered to be free of leaks.

Because the excavation of the abandoned AXS line was determined to be economically infeasible, the line was cut at both ends and plugged with concrete on February 12, 1992. The AXS tank was decommissioned in mid-August 1992.

Two USTs were once located on the RNC property north of the Process Building (Area T). These tanks (one 1,000-gallon gasoline, and one 5,000-gallon diesel fuel) were excavated on May 1, 1986 and backfilled with crushed gravel. According to a RNC interoffice memorandum (May 2, 1986), prior to backfilling, four soil samples were collected from the bottom of the tank pit and sampled for "contamination." Results of those samples are not available. However, based on the Phase II boring investigation, it is apparent that spills and/or releases associated with these tanks have occurred. Results of analyses for soil boring SB-35, which was placed to characterize the former UST area, are presented in Section 4.0, Table 4-26.

3.1.2 Non-Company USTs and Specialty Paint Mixing Facility

Based on a reconnaissance of the Study Area on March 28, 1991, four USTs have tentatively been identified within the Study Area at locations east of the Companies' properties. Existing pumps, pump islands and vent pipes were noted. It is not

known whether any of these tanks or pumps are currently in use. Figure 3-3 shows their approximate locations.

An abandoned service station at location 1 ceased business operations in the 1960s. Evidence of vent pipes, tank filling cap and pump island remain. Location 2 is on the Harrison Poured Foundations (HPF) property where a pump and vent pipe were observed. A pump and vent pipe also were noted at a fiberglass fabricating shop at location 3. At Location 4, which is a recycling facility, both a pump and a vent pipe were observed. Fuels containing the chemicals benzene, ethylbenzene, toluene and xylene are commonly stored in USTs, such as the ones suspected to exist or have existed at all four locations.

According to RNC plant personnel, a small specialty paint mixing facility operated just east of the RNC facility for an undetermined number of years. The operation was thought to have ceased business operations in the early 1980s (Caneppa 1992). The operator reportedly purchased toluene and xylene from the same manufacturer as RNC (Cope 1992). Figure 3-4 shows the location of the paint mixing facility.

3.2 Meteorology

The regional climate for southwestern Ohio is defined as continental, with a wide range of temperatures and precipitation throughout the year. Typically summers are warm and humid while winters are classified as moderately cold and dry (U.S. DOE 1987). Temperatures range from a monthly average of 29° F in January to 75° F in July. The average number of days with a maximum temperature of 90° F or above is about 20 days per year. The highest temperature recorded from 1961 through 1990 was 103° F in July 1988 (NOAA 1990a). The average number of days per year with a minimum temperature of 32° F or less is 108 days. The lowest temperature recorded was -25° F in January 1977.

Based upon records from the Greater Cincinnati Northern Kentucky International Airport (GCNKIA), the average annual precipitation for the period 1961 through 1990 was 40.96 inches, ranging from 27.99 inches in 1963 to 57.58 inches in 1990

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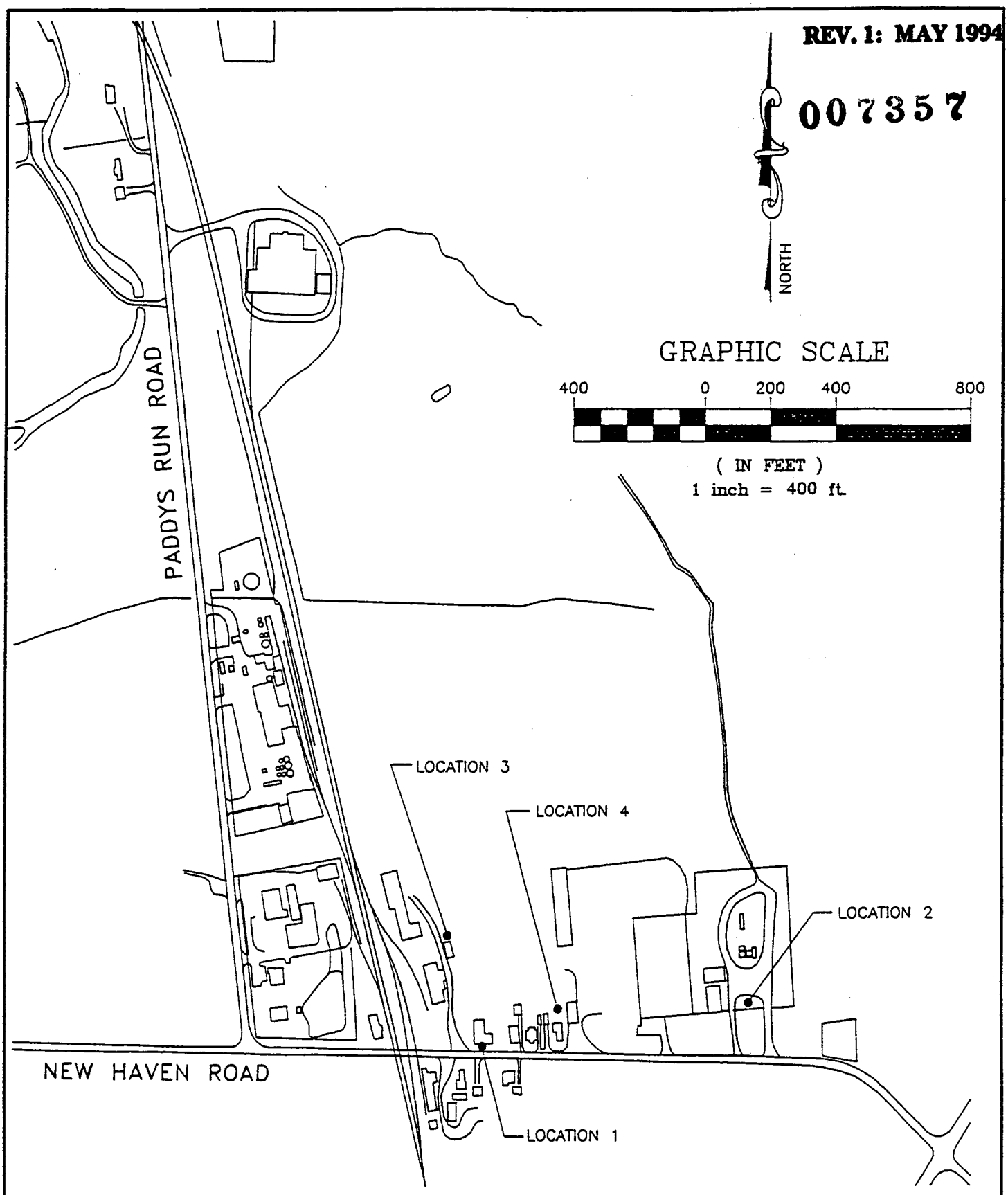

APPROXIMATE LOCATIONS OF USTs CLOSE TO COMPANIES' PROPERTIES
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

000146

FIGURE 3-3

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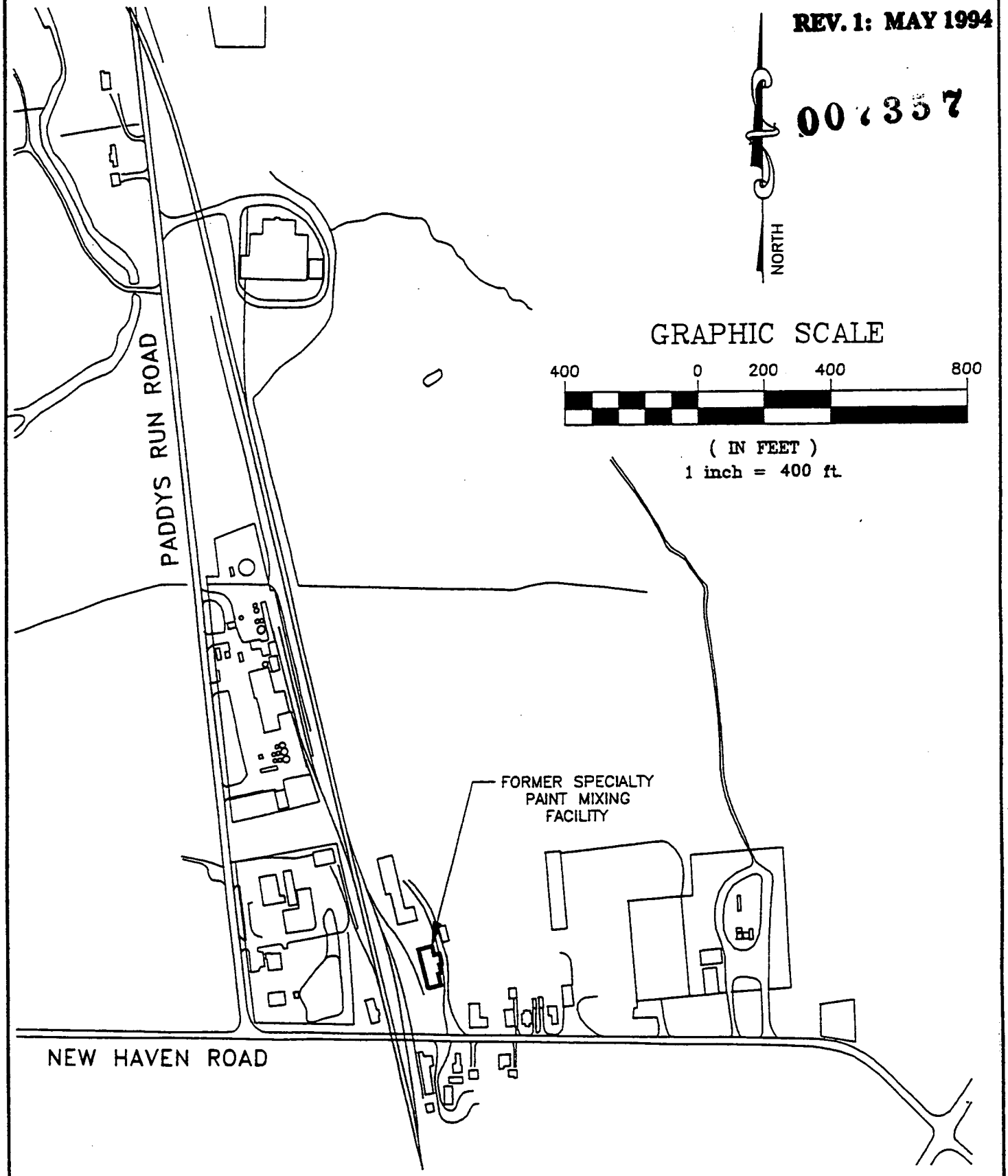

LOCATION OF FORMER SPECIALTY PAINT MIXING FACILITY PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO 000147	FIGURE 3-4

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(NOAA 1990a). The maximum monthly amount of precipitation measured in this time period was 12.18 inches in March 1964, and the monthly minimum recorded was 0.18 inches in September 1963. The maximum rainfall recorded in a 24-hour period was 5.21 inches in March 1964. The highest precipitation occurs during the winter and late spring. The average annual snowfall from 1961 through 1990 was 23.4 inches. The maximum snowfall occurs during January.

Information obtained from FEMP for the years 1987 through 1991 indicates precipitation ranged from 30.10 inches in 1987 to 57.60 inches in 1988, averaging 40.98 inches annually.

At the GCNKIA average wind speed for the period 1961 through 1990 was 9.1 miles per hour (mph), with a peak gust of 64 mph recorded in March 1986 (NOAA 1990a). As shown on the wind rose diagrams in Figure 3-5, the prevailing wind direction at FEMP is from the west and southwest, and wind speeds have averaged around 5 mph.

Severe weather, in the form of thunderstorms and tornadoes, usually occurs from April 1 through July 31. Intense winter storms can occur but are infrequent. Typically, weather moves through the area from the southwest and west-southwest.

3.3 Population and Land Use

This section identifies and enumerates human populations in or adjacent to the Study Area. Exposure to water through recreation or drinking is addressed as are current population growth and land use. For this section of the RI, the word "Area" refers to a 1.5 mile radius around the Companies' property. See Figure 3-6.

3.3.1 Population

The PRRS is located in northwest Hamilton County about 15 miles northwest of Cincinnati, Ohio. Most of the population in the Area are in unincorporated small towns. Two unincorporated towns within the Area are Fernald and New Baltimore.

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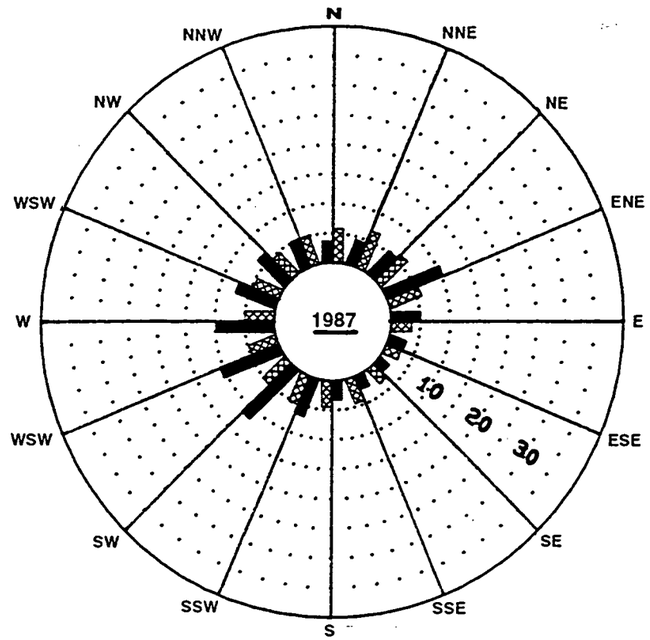

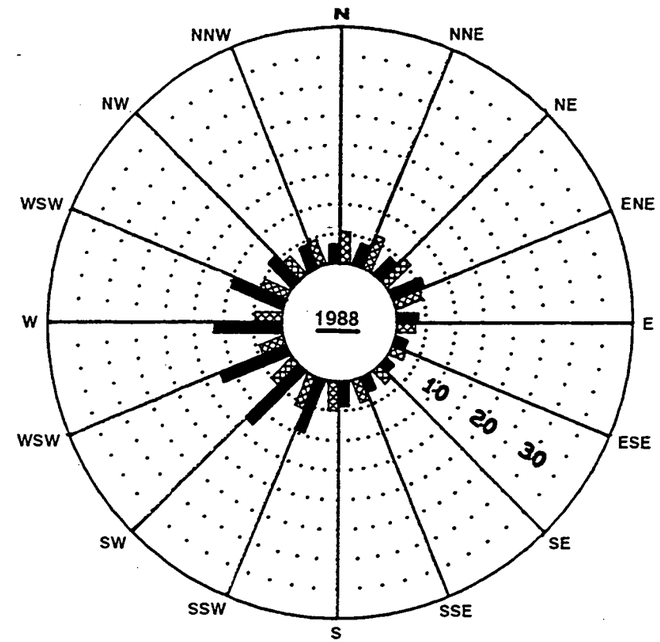

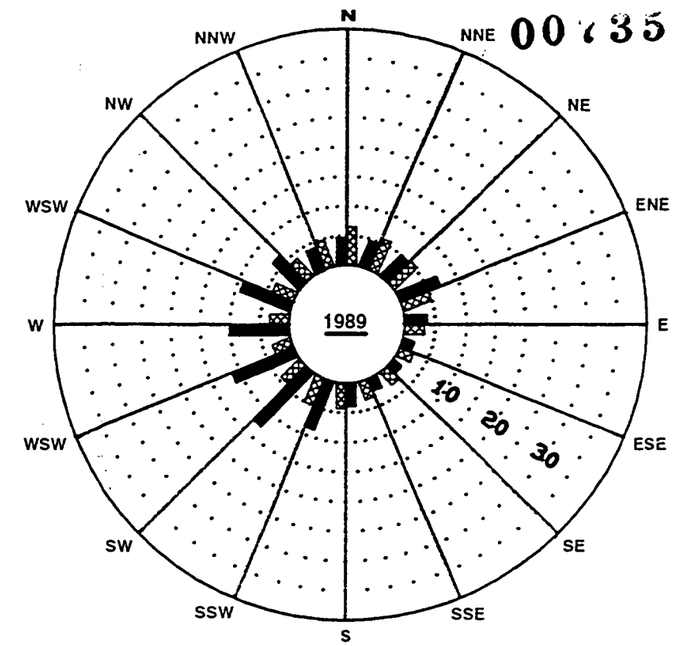

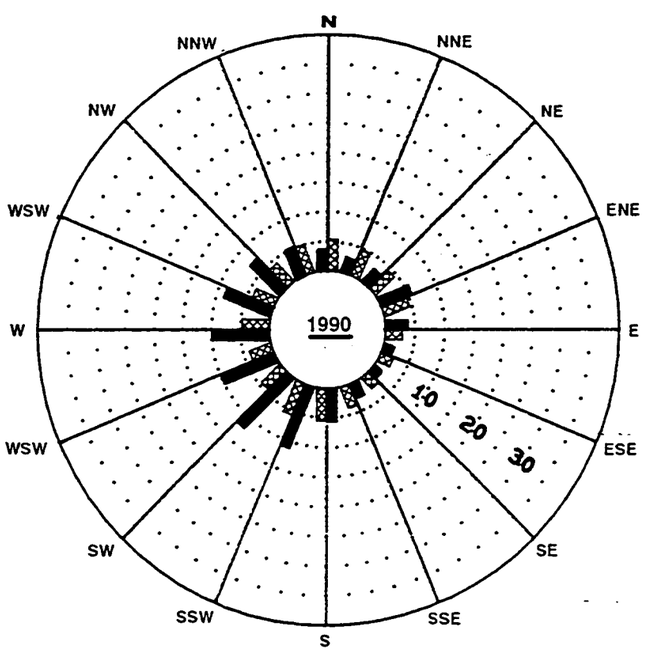

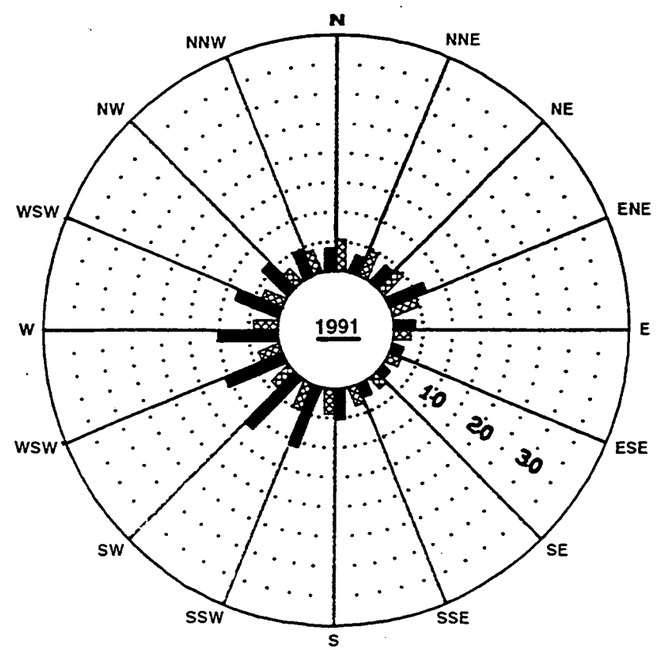

PRECIPITATION DATA AT FEMP
YEARLY TOTALS

YEAR	TOTAL (IN.)
1987	30.10
1988	57.60
1989	37.04
1990	42.08
1991	38.07

LEGEND

WIND SPEED (MPH)

DIRECTION FREQUENCY (%)

000149

WIND ROSE DIAGRAM AND YEARLY PRECIPITATION TOTALS AT FEMP PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO	FIGURE 3-5

ERM ERM-Midwest, inc.
Environmental Resources Management

SOURCE: WEMCO 1992

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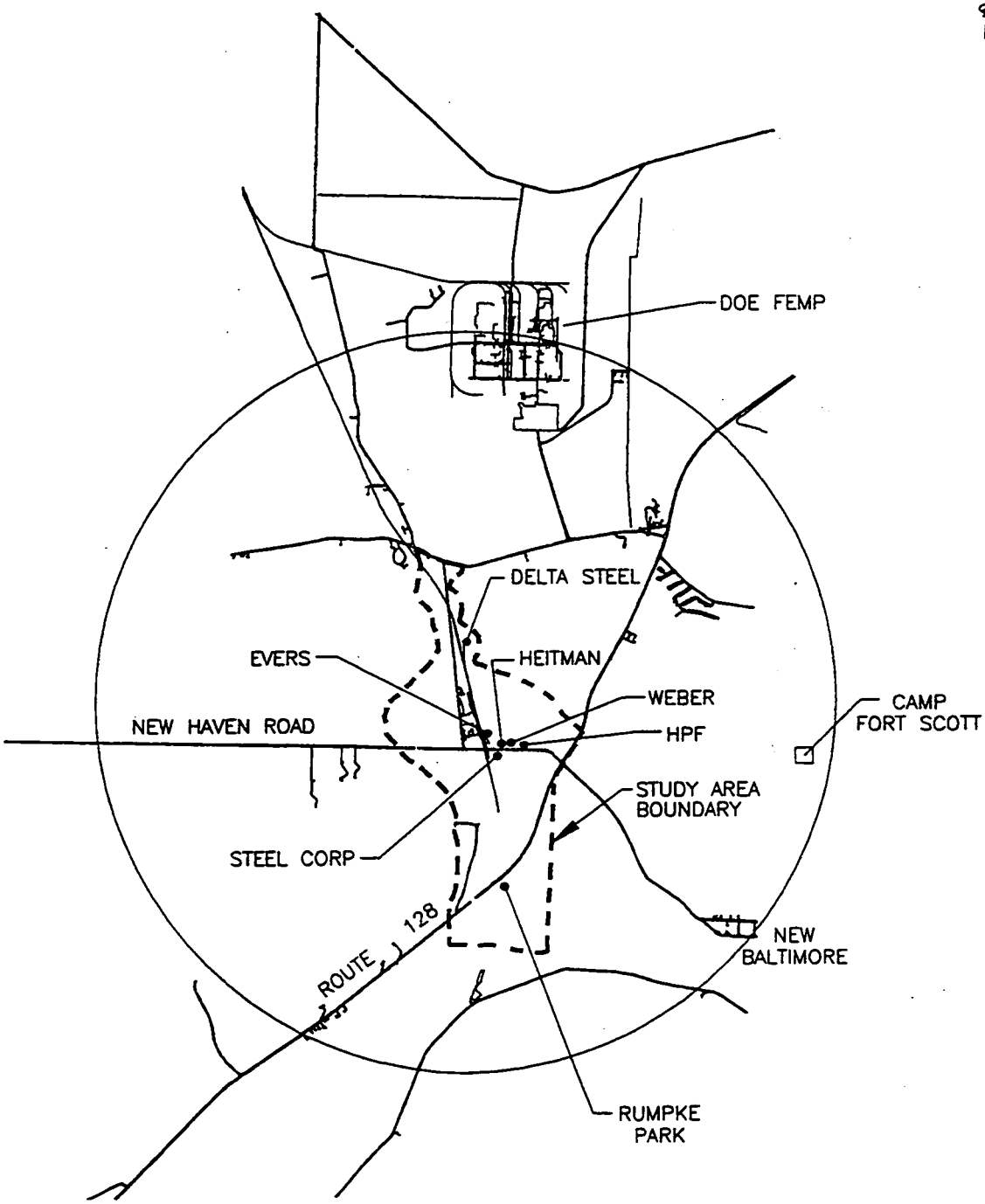

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GRAPHIC SCALE

3600 0 1800 3600 7200

(IN FEET)
1 inch = 3600ft.

POPULATION AND LAND USE STUDY AREA WITHIN A 1.5 MILE RADIUS OF COMPANIES' PROPERTIES
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 3-6

ERM-Midwest, inc.
Environmental Resources Management

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Both towns are located within Crosby Township. According to the 1990 census, the population for Crosby Township is 2,665 (USCB 1992).

Populations estimated by the DOE for Fernald and New Baltimore were 30 and 200 respectively (U.S. DOE 1990a). The residents and commercial operations within the town of Fernald are within a 0.2 of a mile of the Companies' property. The town of New Baltimore is at the limits of the Study Area.

3.3.2 Industry, Farmland and Recreational Areas

The Area is characterized as a mixture of residential, commercial, light industrial and farm properties. Industries in the Area, in addition to A&W and RNC, include: Delta Steel, a specialty steel fabricator; Evers Welding Shop; Harrison Poured Foundations (HPF), a cement plant; and Heitman Auto Repair. Delta Steel employs 65 people (Dun & Bradstreet 1991). The number of employees at Evers Welding Shop, HPF and Heitman Auto Repair are unknown. Steel Corp., a specialty steel fabricator, relocated its operations outside the Area to Miamitown in 1991. Prior to relocating, Steel Corp. employed 10 people (Ohio Industrial Directory 1991).

Portions of the Area support agricultural production for dairy, beef, corn, and soybean. Other fields are fallow or managed as pasture.

Several recreational facilities are located nearby including: Weber motorbike course about 1/4 mile east of the Companies' properties; Rumpke Softball Park about 1 mile to the southeast; and Camp Fort Scott, an abandoned youth camp formerly operated by the Roman Catholic Archdiocese of Cincinnati.

The Weber Motorbike course is an unpaved dirt motorcycle racing course that operates seasonally. There are no water wells for drinking purposes at the facility.

151

Rumpke Softball Park is a sports complex operating from early spring to late fall. There are six fenced softball fields equipped with bleachers. There are no water wells for drinking purposes at the complex.

The youth camp at Camp Fort Scott is approximately 1.25 miles to the east of the Companies' manufacturing operations. Camp Fort Scott operated for over 62 years from 1928 to May or June 1990. The camp operated seasonally and usually accommodated up to 150 campers per year. With the exception of counselors and other camp workers, the campers ranged in age from 4 to 15 years old.

There is a drinking water well on the camp property about 0.5 miles from the northwest entrance. The well presently is not used, but was the main source of water when the camp was open. When operating, the well was tested monthly, and test results never indicated the presence of contaminants (Ruffel 1992).

3.3.3 Surface Waters as Potential Exposure Routes

Surface waters in the Area include Paddys Run, the Great Miami River, and several small ponds. Paddys Run is located on the western portion of the Study Area. It flows approximately from north to south and empties into the Great Miami River. It has a surface elevation of about 525 feet above mean sea level (FAMSL) at its intersection with Willey Road and a surface elevation of about 508 FAMSL at its intersection with Route 128.

Limited recreational activities in Paddys Run include wading and perhaps some fishing. Paddys Run generally does not contain enough water to swim or to support sport fish (see Section 6.2).

The Great Miami River represents the main surface water feature in the vicinity of the PRRS and defines the southern boundary of the Study Area. It flows to the southwest and is designated by the Ohio Department of Natural Resources (ODNR) as a scenic waterway. Recreational activities in the Great Miami River include swimming, wading, fishing and boating. Fish commonly caught include

trout, panfish, northern pike, largemouth bass, smallmouth bass, spotted bass, and catfish. Boating is generally limited to rowboats and canoes.

Also in the Area are a number of small ponds as determined from the USGS topographic map (Shandon Ohio Quadrangle 1981). Typically, agricultural ponds are used for conservation purposes and drainage control. In addition, ponds are usually stocked with fish to control unwanted pond growth and for recreation. Ponds in the Area do not appear to be connected to Paddys Run or the Great Miami River.

None of the surface water bodies described above are used for drinking water purposes.

3.3.4 Groundwater as a Drinking Water Source

Based upon a well/cistern inventory conducted in May and July 1989 (ENSR 1990) a total of 21 residential/industrial wells and 10 cisterns exist as shown in Figure 3-7. Well information is summarized in Table 3-1.

The wells identified are used for domestic and industrial purposes. Six of the wells supply water to homes for domestic use. These include Estes, Fisher, Burton, Pottenger, Knollman Farms, Inc., and J. Rolfes. All of the wells with the exception of Rolfes appeared to be located hydraulically upgradient of the PRRS.

Eight of the remaining 15 wells identified are used by several industries including Harrison Poured Foundations (three wells), Evers Welding Equipment (one well), Delta Steel (one well), A & W Americas (two wells), and Ruetgers-Nease (one well). The wells owned by Evers Welding Equipment and Delta Steel are used for sanitary purposes (ENSR 1990). The other wells are used by the industries for their

REV. 1: MAY 1994

007357

NORTH

POTTENGER

NEW HAVEN ROAD

RUETGERS-NEASE

PADDYS RUN ROAD

BURTON

FISHER

ROY

ESTES

STEEL CORP.

EVERS

KNOLLMAN FARM INC.

DELTA STEEL

A&W AMERICAS

CORSON

WEBER

MEYER

ROLFES

ROLFES

MURRAY

NEELY

RED

METCALF

STEVENS

HENRIE

KNOSE

HARRISON POURED FOUNDATIONS

ROUTE 128

GREAT MIAMI RIVER

WILLEY ROAD

LEGEND

- APPROXIMATE LOCATION OF DOMETIC AND INDUSTRIAL WELLS
- APPROXIMATE LOCATION OF CISTERNS

000154

GRAPHIC SCALE

800 0 400 800 1600

(IN FEET)

1 INCH = 800 FT.

WELL/CISTERN MAP AND DIRECTION OF GROUNDWATER FLOW APRIL 1992
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 3-7

ERM-Midwest, inc.
Environmental Resources Management

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TABLE 3-1
SUMMARY OF THE RESIDENTIAL AND INDUSTRIAL WELL INVENTORY SURVEY CONDUCTED WITHIN THE STUDY AREA
PADDYS RUN ROAD SITE RI/RA - AUGUST 1989

Owner	Type of Water Source	Number of Wells	Depth (Feet)	Diameter (Inches)	Screened Interval (Feet)	Pump Type	Rate (GPM)	Construction Material	Installation Method	Use(a)	Sampled(b)	Remarks
Harrison Poured Fdntn.	Well	1	80	6	Unknown	Submersible	100	Iron-Steel	Drilled	Industrial	No	Used primarily during business hours.
Harrison Poured Fdntn.	Well	1	80	6	Unknown	Submersible	100	Iron-Steel	Drilled	Industrial	No	Used primarily during business hours.
Harrison Poured Fdntn.	Well	1	60	6	Unknown	Submersible	50	Iron-Steel	Drilled	Industrial	No	Used primarily during business hours.
Steel Corp.	Well	1	70-80	Unknown	Unknown	Submersible	Unknown	Unknown	Drilled	Sanitary	Yes	
Steel Corp.(c)	Well	1	103	6	97-103	Unknown	Unknown	Brass-Screen	Drilled	Sanitary	Yes	
Estes	Well	1	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Domestic	Yes	Well supplys this home and daughter's house (located adjacent to this home).
Evers Welding Equip.	Well	1	Unknown	0.75	Unknown	Surface (Jet Valve)	Unknown	Unknown	Driven Well Point	Sanitary/ Industrial	Yes	
Delta Steel	Well	1	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Drilled	Sanitary/ Industrial	Yes	
J. Rolfes	Well	1	40	5 5/8	Unknown	Unknown	Unknown	Unknown	Drilled	Domestic	Yes	Well supplys several homes in the area.
A&W Americas	Well	1	82	12	62-82	Turbine	100	Unknown	Drilled	Industrial	Yes	
A&W Americas	Well	1	81	12	60-81	Turbine	100	Unknown	Drilled	Industrial	Yes	Typically pump approximately 100 gpm.

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TABLE 3-1 (Continued)
SUMMARY OF THE RESIDENTIAL AND INDUSTRIAL WELL INVENTORY SURVEY CONDUCTED WITHIN THE STUDY AREA
PADDYS RUN ROAD SITE RI/RA - AUGUST 1989

Owner	Type of Water Source	Number of Wells	Depth (Feet)	Diameter (Inches)	Screened Interval (Feet)	Pump Type	Rate (GPM)	Construction Material	Installation Method	Use(a)	Sampled(b)	Remarks
Knollman	Well	1	80-85	6	Unknown	Submersible	Unknown	Unknown	Unknown	None	Yes	Two DOE monitoring wells are on the property.
Knollman	Well	1	191	6	Unknown	Submersible	Unknown	Unknown	Unknown	Domestic	Yes	Two DOE monitoring wells are on the property.
Burton	Well	1	70	6	Unknown	Submersible	Unknown	Unknown	Drilled	Domestic	Yes	
Fisher	Well	1	70	6	Unknown	Submersible	Unknown	Steel	Drilled	Domestic	Yes	
Ruetgers-Nease C. (d)	Well	1	95	10	78-95	Submersible	2-3	Steel	Drilled	Industrial	Yes	Typically pumps 2 to 3 gpm. Occasionally pumps approximately 100 gpm.
Weber (d)	Well	1	60	6	58-60	Unknown	Unknown	Brass-Screen	Drilled	Unknown	--	
Weber (d)	Well	1	80	8	65-80	Unknown	Unknown	Brass-Screen	Drilled	Unknown	--	
Weber (d)	Well	1	80	8	65-80	Unknown	Unknown	Brass-Screen	Drilled	Unknown	--	
Pottenger(d)	Well	1	40	5	37-40	Unknown	Unknown	Brass-Screen	Drilled	Domestic	--	
Corson(d,a,e)	Well	1	48	5	46-48	Unknown	Unknown	Brass-Screen	Drilled	Unknown	--	

(a) Industrial use refers to those wells which are used as part of a process.
Sanitary use refers to wells used by businesses in the area for sanitary purposes.
Domestic use refers to wells used by homeowners for domestic needs (e.g., bathing, sanitary, drinking).

(b) Information provided by well owner.

(c) Former well owner Spray Dyne Corp.

(d) Incomplete information from ODNR, Ground Water Resources.

(e) It is unknown whether this well currently exists.

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plant processes. None of the wells are used for drinking water purposes. Two wells were used by Steel Corp. prior to its relocation in 1991. One well has been abandoned and the other currently is not being used.

Drilling records were not filed with the State of Ohio for the remaining five wells, i.e., Corson, Weber (three wells), and a second well at Knollman Farms, Inc.

During the well inventory, Stevens, Knose, and Henrie indicated that their wells were plugged (ENSR 1990c). Stevens, Knose, Henrie, Roy, and Murray indicated that they used cisterns and purchased water for drinking (ENSR 1990c). Other cistern users in the area included Meyer, Rolfes, Neely, Reid and Metcalf.

3.3.5 Direction of Groundwater Flow and Location of Wells Associated with the Study Area

Since June 27, 1989, groundwater level measurements have been taken regularly to determine the direction of groundwater flow at the Study Area. As shown in Figure 3-7, the general groundwater flow direction within the Study Area is from the north towards the south-southeast.

Piezometric contour maps indicate that the groundwater flow direction is not significantly affected by any industrial supply wells. A more thorough description of groundwater measurements and flow direction is discussed in Section 3-9.

The locations of residential/industrial wells associated with the Study Area are identified in Figure 3-7. Eight of the wells (i.e., Estes, Burton, Knollman Farms, Inc., Delta Steel, Fisher, and A&W) are located hydraulically upgradient of the current manufacturing processes. The remaining 12 wells (i.e., Ruetgers-Nease, Evers, Steel Corp., Corson, Weber, Harrison Poured Foundations, Pottenger, and Rolfes) are downgradient or crossgradient of the Companies' property.

3.3.6 Availability of Alternate Water Sources

According to the May and July 1989 survey (ENSR, 1990c) the following residents use cisterns for domestic water needs: Roy, Stevens, Henrie, Knose, Murray, Metcalf, Reid, Neely, Rolfes and Meyer. (Approximate locations of those cisterns are shown in Figure 3-7.)

As a result of area groundwater contamination with uranium from the U.S. DOE/FEMP facility, the U.S. DOE/FEMP currently supplies bottled water to six residences in the Area for drinking water purposes. The U.S. DOE/FEMP has been supplying this water to the residences since early 1990 (Cherry 1992).

The U.S. DOE/FEMP has installed an alternative water supply well for Delta Steel and A&W near the intersection of Willey and Crosby Roads, northwest of the PRRS. This alternative supply was developed for Delta Steel and A&W so that uranium contaminated water was not being withdrawn from the aquifer and uranium contaminated water would no longer be pulled downward into the aquifer by the deep pumping wells. The U.S. DOE/FEMP began supplying water to A&W on March 23, 1993. Delta Steel is currently not connected to the alternate supply.

A public water supply for the Fernald area is being initiated by the U.S. DOE/FEMP. This project entails installing an underground waterline from the Bolton well field in Hamilton County to the Fernald area. This waterline will provide water to the Area for residential and industrial use. Engineering on this project has been completed and the system is expected to be operational in the fall of 1995.

3.3.7 Human Use of or Access to the Companies' Properties and Adjacent Areas

Human use of and access to the Companies' properties and adjacent area are addressed in Section 6.1.2.1 of the RA portion of this report.

3.3.8 Future Population Growth and Land Use

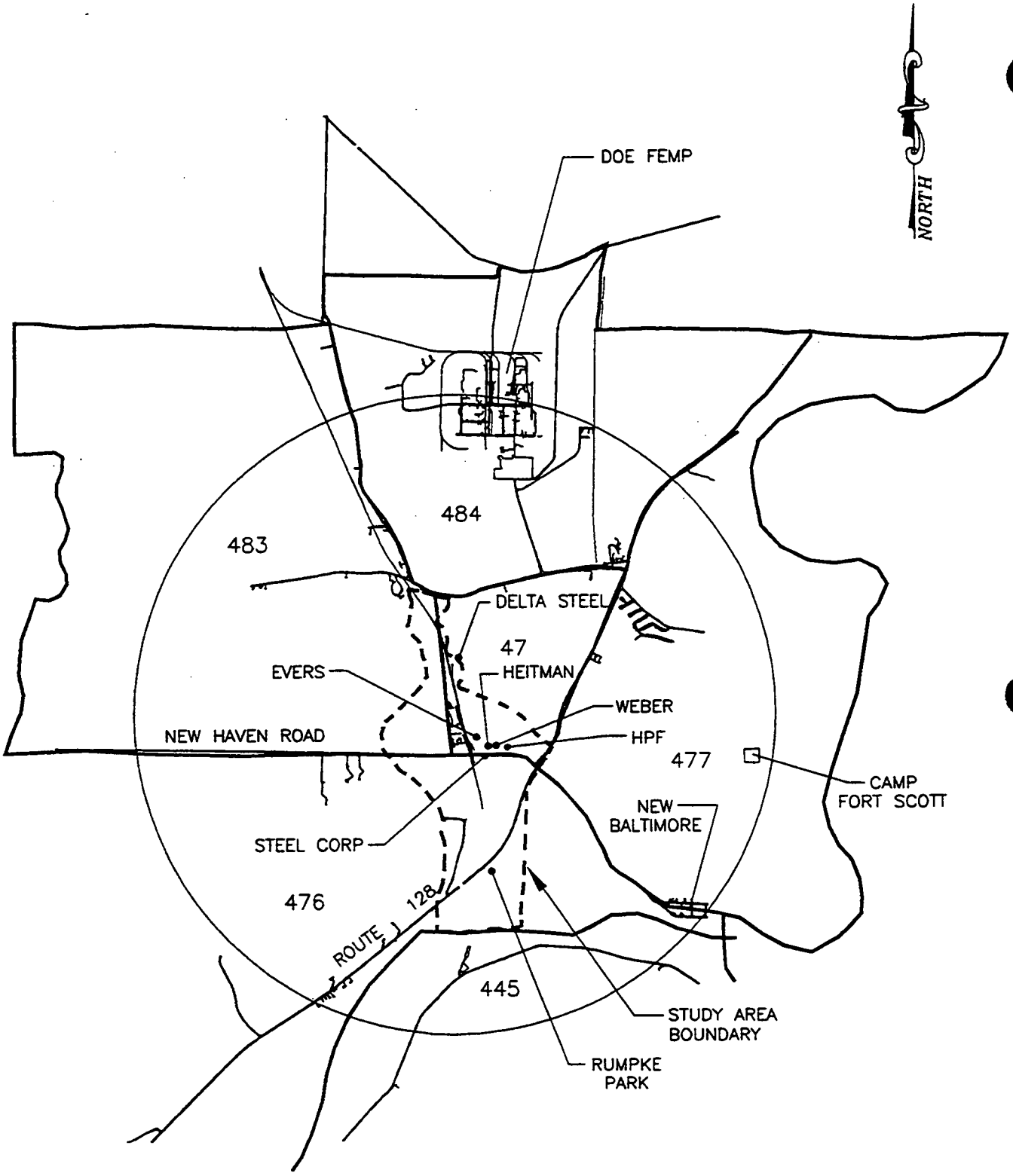
Population projections were obtained from the Ohio-Kentucky-Indiana (OKI) Regional Council of Governments. For the purpose of estimating population, OKI has divided counties into traffic zones as shown in Figure 3-8. Table 3-2 presents the 1980 census versus 2010 projections of population and households. The Fernald District, which includes the Companies' properties and surrounding property southeast and north, is projected to show a decrease in population and households. The New Haven District, which is southwest and west of the Companies' property, is projected to more than double in both population and households.

TABLE 3-2
1980 CENSUS VS 2010 POPULATION PROJECTIONS

Zone		1980 Population	2010 Population	1980 Households	2010 Households
476	New-Haven	471	1183	150	445
483	New-Haven	135	279	50	122
47	Fernald	27	25	9	10
477	Fernald	692	586	254	254
484	Fernald	105	75	36	30

Land-use projections are periodically updated. The latest available data was from 1986. Currently the Cincinnati Regional Planning Commission is revising the survey, but at the time of this report was incomplete. From personal interview, land use in the Area will remain essentially the same (Rienza 1994).

REV. 1: MAY 1994



GRAPHIC SCALE

3600 0 1800 3600 7200

(IN FEET)
1 inch = 3600ft.

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AREA WITHIN A 1.5 MILE RADIUS OF THE COMPANIES' PROPERTIES DIVIDED INTO TRAFFIC ZONES
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 3-8

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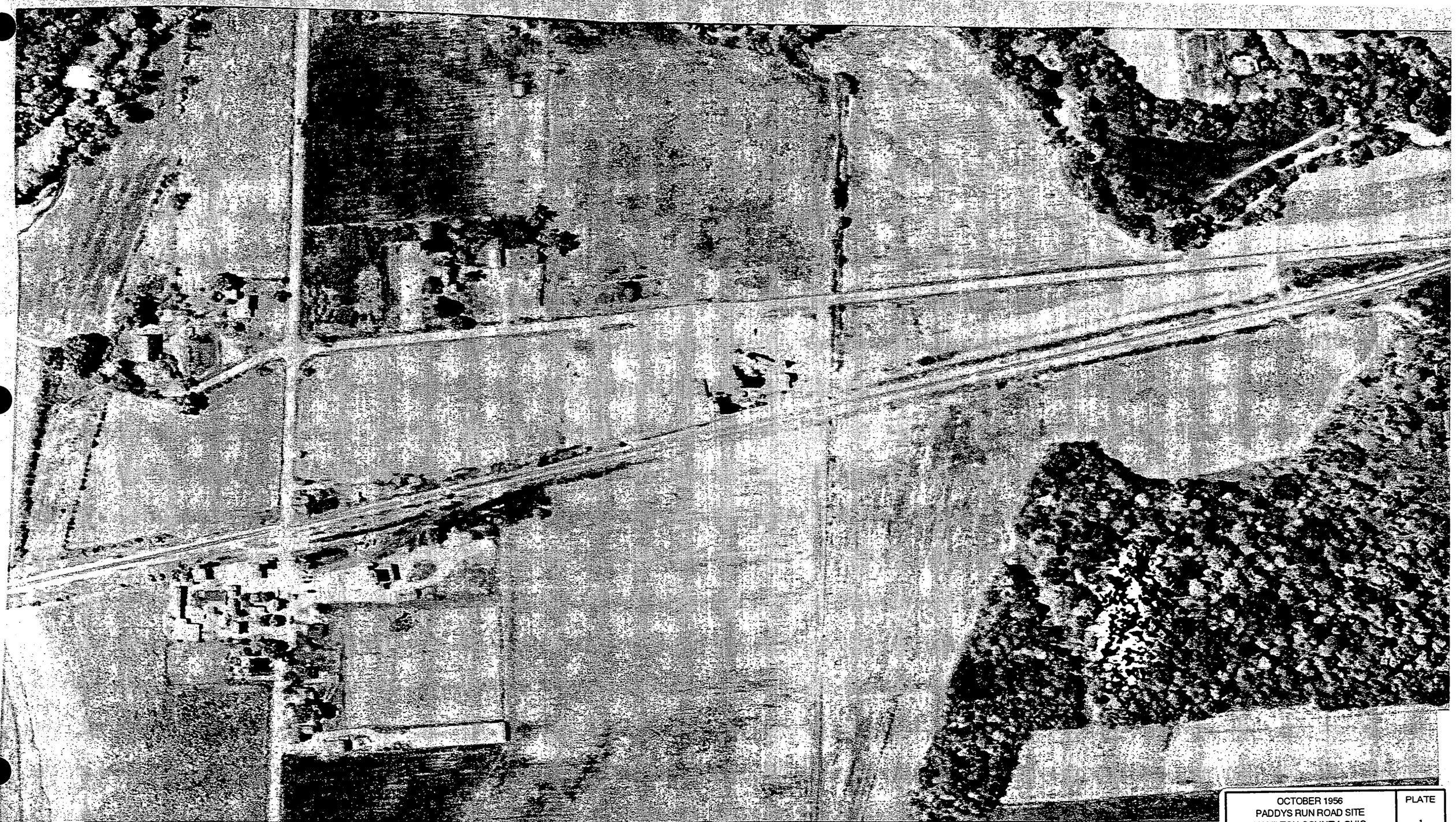
3.4 Source Area Characterization

The following sections describe source areas which include A&W, RNC properties and areas off the Companies' property adjacent to A&W. These areas have been identified through personal interviews, reviews of historical aerial photographs, company records and diagrams, and surface and subsurface investigations as follows:

- Personal interviews include discussions with both plant and corporate personnel. Information obtained included descriptions of facilities operations, procedures, accidental spills and releases.
- Aerial photographs from the years 1956, 1963, 1966, 1968, 1973, 1981 and 1988 (Plates 1-7) were used to identify surficial sources and the expansion and movement of facility activities through the years.
- Company records document spills and releases (Table 3-3). Company diagrams showed manufacturing operations, underground pipelines (sizes, construction materials, materials transported), sumps, above and below ground storage tanks (volume and contained material) and containment areas.
- Information from 26 surface soil sampling locations, 80 soil boring locations and 54 Study Area monitor wells were used to further define source areas.

Section 2.1.2, Facilities Setting, describes Areas A through X and their relationship to facilities activities. In this section, only the areas determined to be potential sources are discussed, starting with A&W followed by RNC.



OCTOBER 1956 PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO	PLATE 1
ERM ERM-Midwest, inc. Environmental Resources Management	

PHOTO TAKEN BY: COLLINS-SADDLER AND ASSOCIATES,
BEAVER CREEK, OHIO
REPRODUCED BY: HAI IMAGES, DAYTON, OHIO

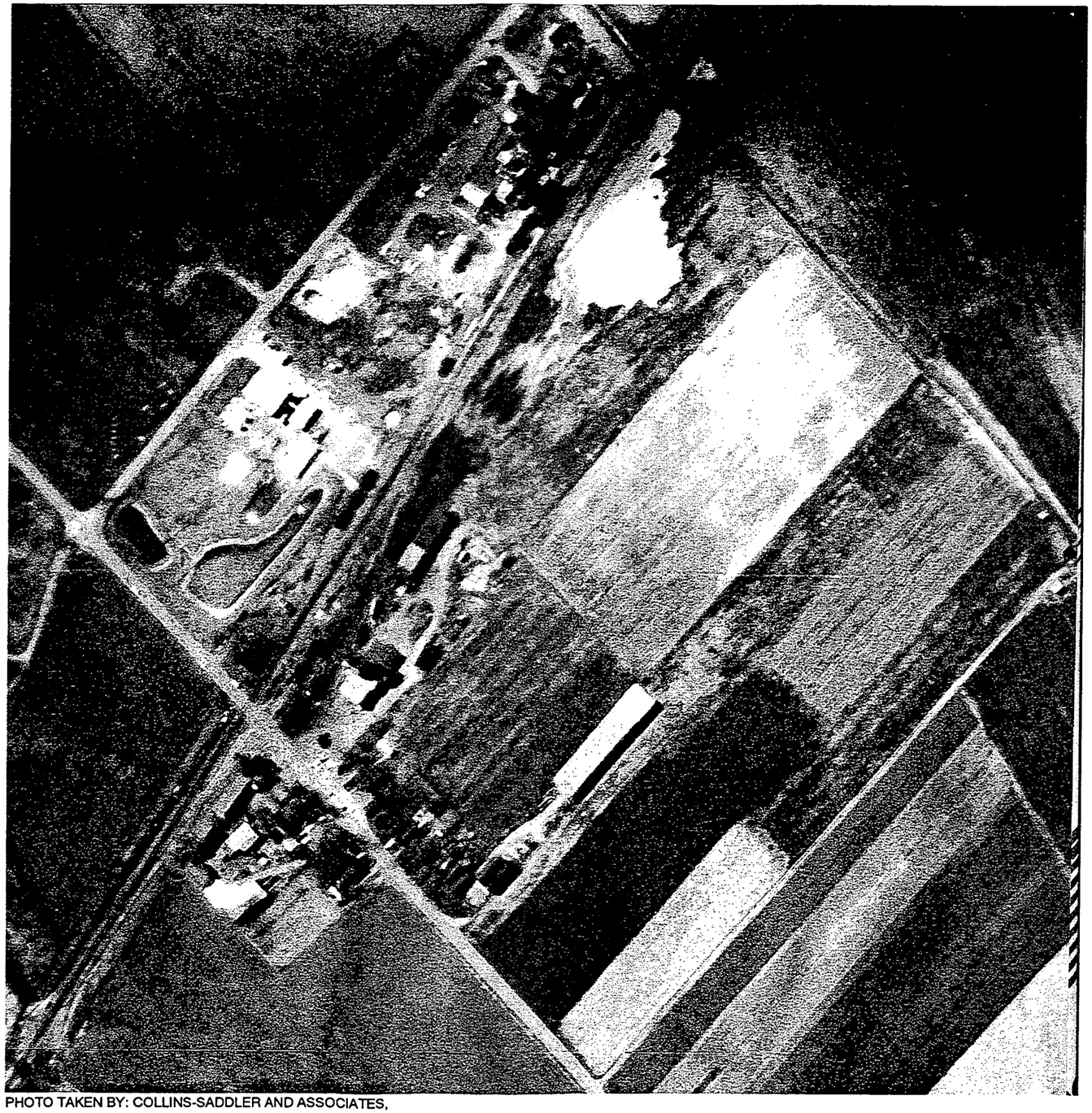


PHOTO TAKEN BY: COLLINS-SADDLER AND ASSOCIATES,
BEAVER CREEK, OHIO
REPRODUCED BY: HAI IMAGES, DAYTON, OHIO

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1963 PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO	PLATE 2
ERM-Midwest, inc. Environmental Resources Management	

PHOTO TAKEN BY: COLLINS-SADDLER AND ASSOCIATES,
BEAVER CREEK, OHIO
REPRODUCED BY: HAI IMAGES, DAYTON, OHIO

MARCH 1966 PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO	PLATE 3
ERM-Midwest, inc. Environmental Resources Management	

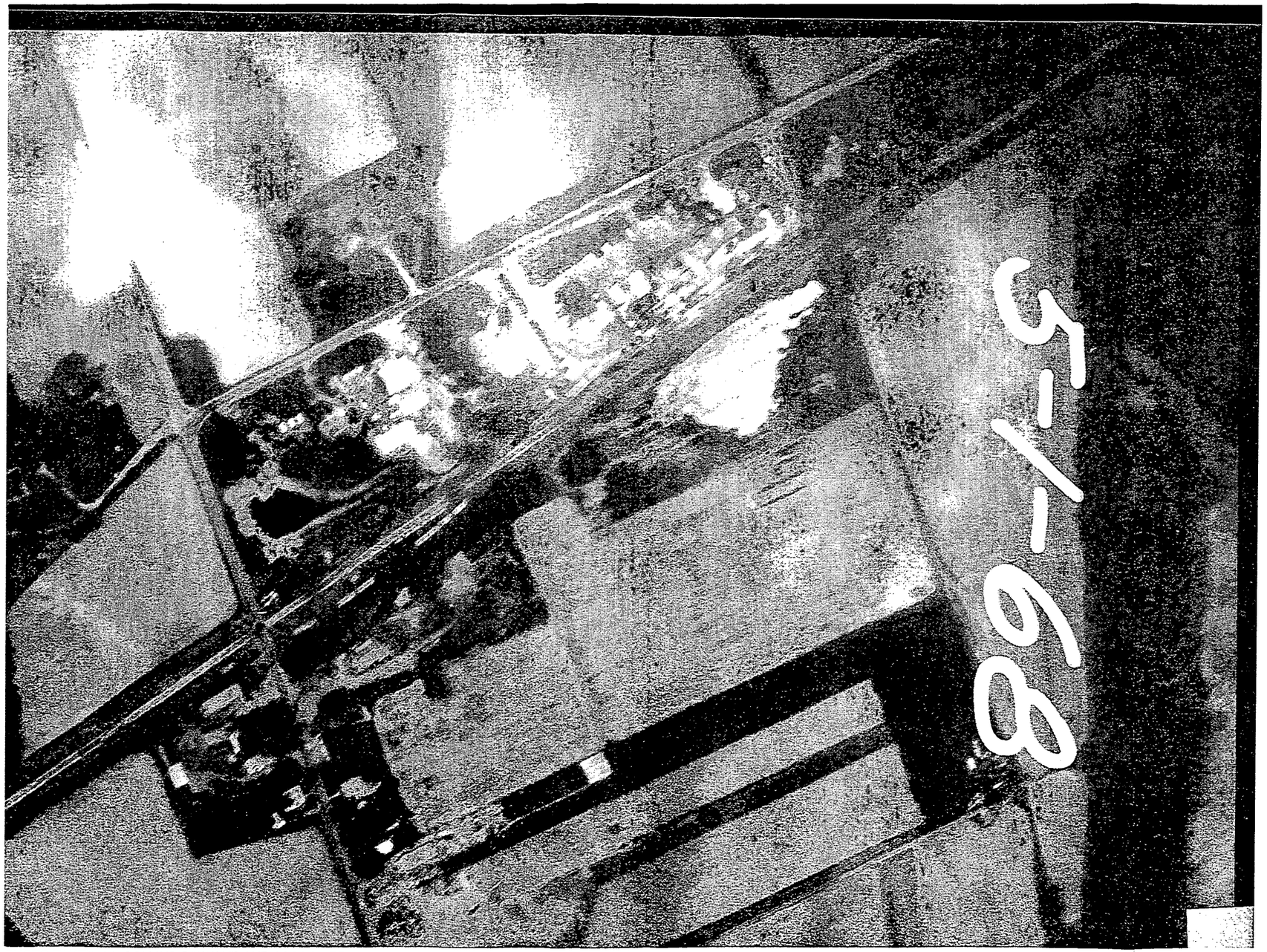

PHOTO TAKEN BY: COLLINS-SADDLER AND ASSOCIATES,
BEAVER CREEK, OHIO
REPRODUCED BY: HAI IMAGES, DAYTON, OHIO

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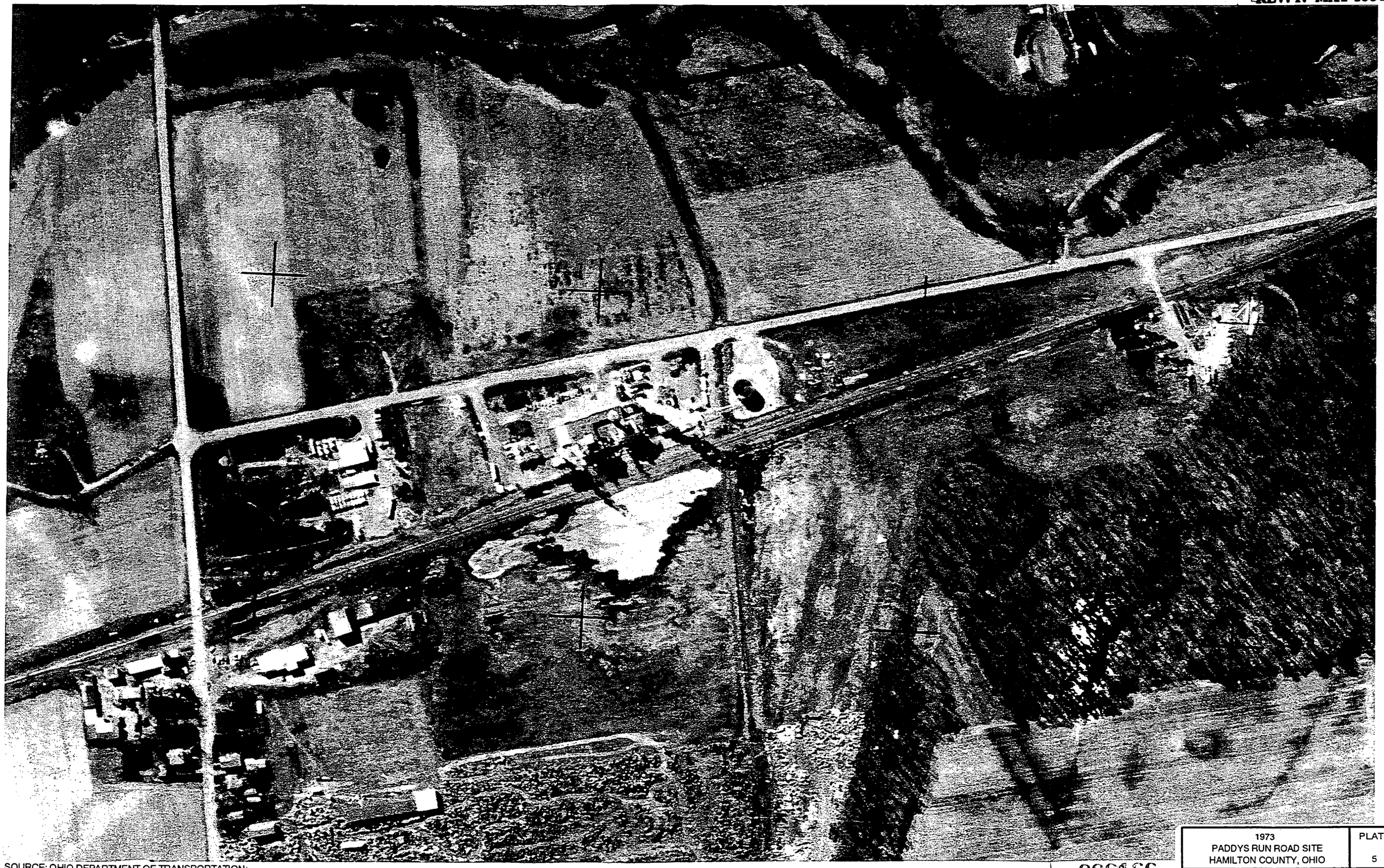
MAY 1, 1968 PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO	PLATE 4
ERM-Midwest, inc. Environmental Resources Management	



SOURCE: OHIO DEPARTMENT OF TRANSPORTATION

1973 PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO	PLATE 5
ERM-Midwest, inc. Environmental Resources Management	

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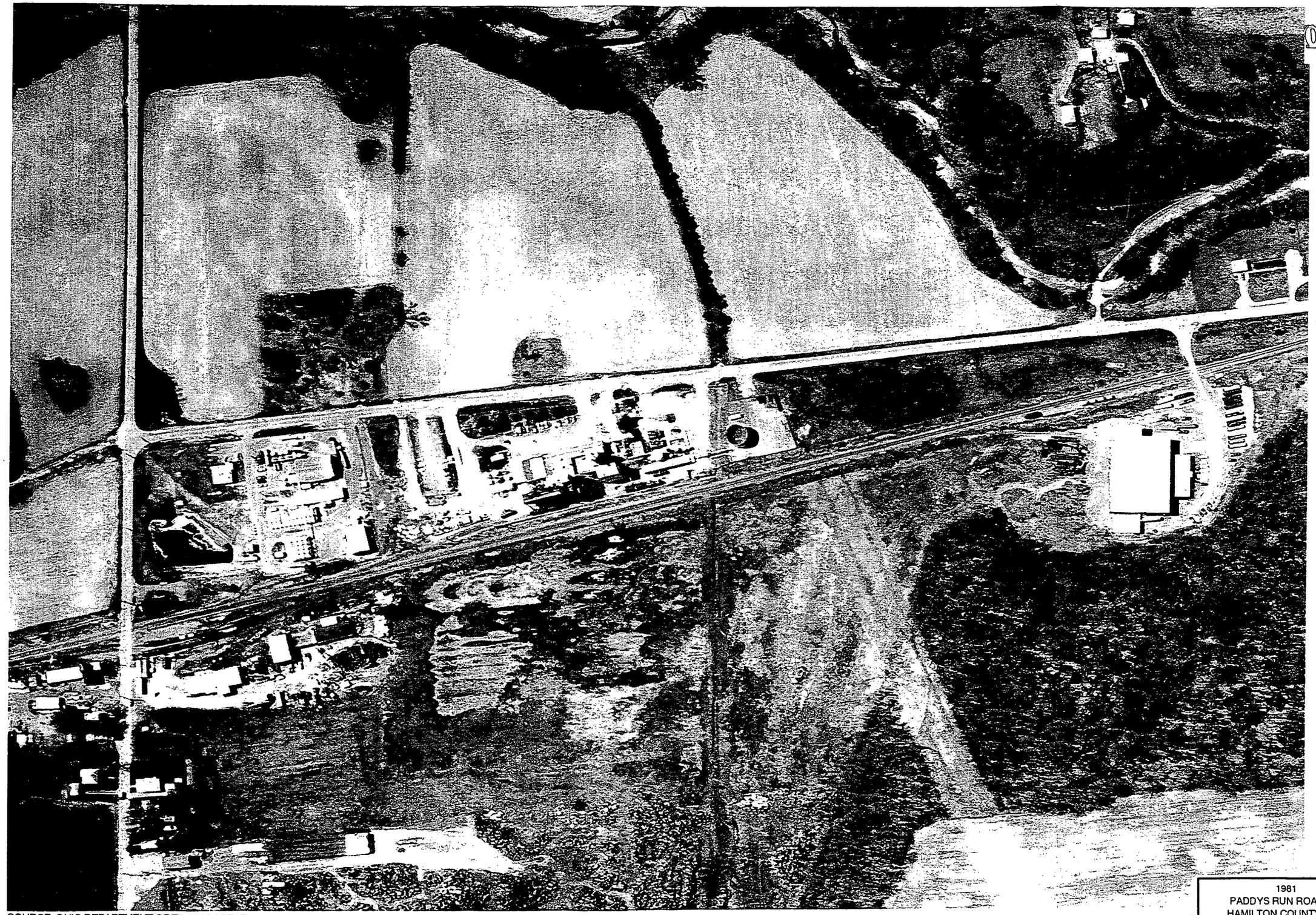

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SOURCE: OHIO DEPARTMENT OF TRANSPORTATION

1981 PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO	PLATE 6
ERM-Midwest, inc. Environmental Resources Management	

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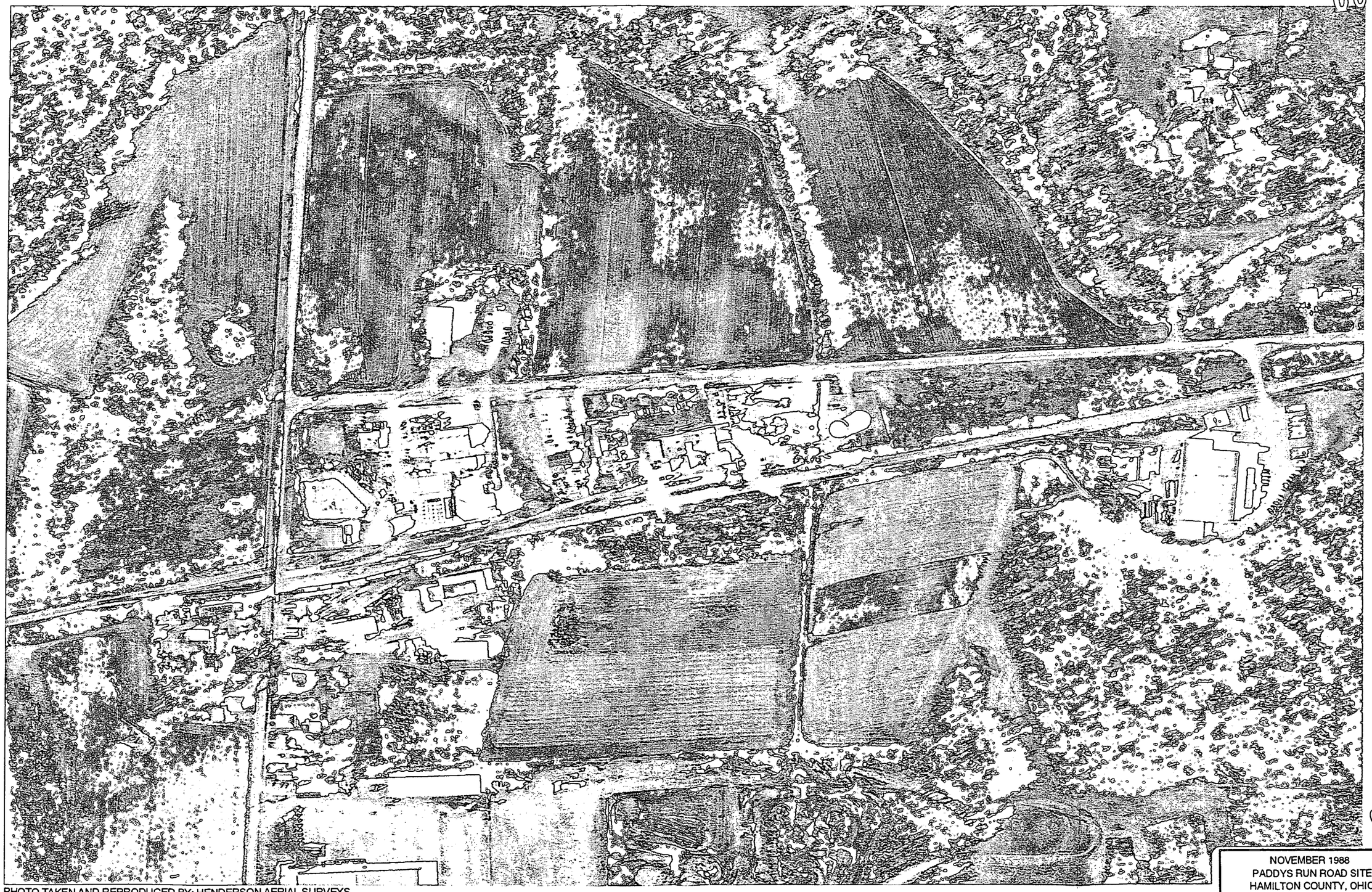

PHOTO TAKEN AND REPRODUCED BY: HENDERSON AERIAL SURVEYS, COLUMBUS, OHIO

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NOVEMBER 1988 PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO	PLATE 7
ERM ERM-Midwest, inc. Environmental Resources Management	

TABLE 3-3
CHRONOLOGICAL LISTING OF SPILLS AND RELEASES AT THE SITE
PADDYS RUN ROAD SITE

Date of Incident	Quantity	Material	Location	Incident Description	Source of Information
04/71	Unknown	Phosphoric Acid	Sodium Tripoly-Phosphate (STPP) Mixing Area (A&W Area B)	Two acid spills were noted in the area of the STPP mixing area.	Mobil Files
04/71	Unknown	Weak Acid	Weak Acid Tank (A&W - South of Area C)	The weak acid tank was observed to be overflowing at a rate of approximately 5 to 10 GPM.	Mobil Files
04/71	Unknown	Phosphoric Acid	Acid Degasser Hold-up Tank Transfer Pump (A&W - West of Area A)	A seal on an acid degasser hold-up tank transfer pump was noted to be leaking at a rate of approximately 0.25 GPM.	Mobil Files
03/75	150,000 Gallons	Recycle Wastewater	Effluent Storage Tank (F-103) (A&W - Area J)	A release of waste containing phosphate, suspended solids, and soils was reported at 3:00 P.M.	Mobil Files
07/80	Unknown	Phosphoric Acid	Tank Car Loading Station (A&W - Area B)	Housekeeping records indicated than an acid hose was leaking at the tank car loading station.	Mobil Files
06/81	Unknown	Hydrochloric Acid	HCL Tank (F-130) (A&W - Area C)	Housekeeping records indicated that an HCL tank leaked. The tank was within a diked area.	Mobil Files
06/81	Unknown	Hydrochloric Acid	Unknown	Records indicate that an HCL spill had occurred at the site which was absorbed with soda ash.	Mobil Files
08/82	Unknown	Oil	Oil Drum Storage Area (A&W - Area I)	Records indicate that oil was cleaned from underneath the oil drum storage area.	Mobil Files
08/83	Unknown	Oil	Gas House (A&W - Area D)	Records indicate that an oil spill occurred near the gas house.	Mobil Files
06/84	20-30 Gallons	Copper Carbonate	Acid Tank Farm Tank (F-420) (A&W - Area D)	Records indicate that a spill of copper carbonate solution occurred.	Mobil Files
11/84	Unknown	Acid	Acid Loading Station (A&W - South of Area A)	A spill of acid at the acid loading station was noted.	Mobil Files
12/84	500,000 Gallons	Recycle Cooling Water Blowdown	Adjacent Farm Field West of RNC	RNC informed OEPA that approximately 500,000 gallons of recycled cooling water blowdown was pumped to an adjacent farm field. The cooling water was rendered unusable due to an accumulation of dissolved solids.	RNC Files
03/85	Unknown	Waste Chemicals	Unknown (RNC)	A citizen reported the release of waste chemicals at RNC.	OEPA Emergency Reponse Online System

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REV. 1: MAY 1994

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TABLE 3-3 (Continued)
CHRONOLOGICAL LISTING OF SPILLS AND RELEASES AT THE SITE
PADDYS RUN ROAD SITE

Date of Incident	Quantity	Material	Location	Incident Description	Source of Information
08/85	Unknown	Phossy Water	Phosphorus Containment Dike (A&W - West of Area B)	A&W reported to OEPA a spill of 5.4% phosphorus waste at the A&W site.	OEPA Emergency Response Online System
08/86	Unknown	Waste Material (Soil)	TKPP (1) Tank Farm (A&W - Area E)	A citizen reported a spill of waste material at the A&W site. (Excavated soil was being removed from site.)	OEPA Emergency Response Online System
09/86	20,000 Gallons	Demineralized Water	Outfall 001 to Paddys Run (A&W)	A&W reported to OEPA a 20,000 gallon release of demineralized water at the A&W site.	OEPA Emergency Response Online System
12/86	90,000 Gallons 6,912 Pounds	Wastewater Phosphate (Ortho)	Northeast Sump (A&W - South of Area A)	A&W reported to OEPA a 90,000 gallon spill of wastewater and 6,912 pounds of phosphate (Ortho) at the A&W site.	OEPA Emergency Response Online System
04/87	4,000 Gallons	Hydrochloric Acid	HCL Storage Tank (A&W - Area C)	A&W reported to OEPA a 4,000 gallon spill of hydrochloric acid at the A&W site. The spill occurred within a containment area.	OEPA Emergency Response Online System
05/87	1,100 Gallons	Wastewater	New Haven Road Effluent Pipeline (A&W - Area G)	A&W reported to OEPA a 1,100 gallon spill of wastewater at the A&W site.	OEPA Emergency Response Online System
06/87	Unknown	Wastewater	New Haven Road Effluent Pipeline (A&W - Area G)	A&W reported to OEPA a spill of wastewater at the A&W site.	OEPA Emergency Response Online System
08/87	50-100 Pounds	Phosphorus	Phosphorus Tank (A&W - Area C)	The phosphorus tank overflowed. Spilled material was was contained within a secondary containment. A phosphorus pentoxide cloud was released.	A&W Files
12/87	Unknown	Wastewater	Drainage Ditch near New Haven Road (A&W - Area G)	The wastewater effluent discharge pipe leading to the Miami River leaked causing the effluent to accumulate in the drainage ditch next to the railroad near New Haven Road.	A&W Files
4/88	25 Gallons	75% Phosphoric Acid	(A&W - Area D)	A contained spill of approximately 25 gallons of phosphoric acid.	A&W Files
11/88	40 Pounds	Phosphorus Pentoxide	Phosphorus Metering Tank (F-104) (A&W - West of Area B)	A&W reported to OEPA a 40 pound air release of phosphorus pentoxide at the A&W site.	OEPA Emergency Response Online System A&W Files

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TABLE 3-3 (Continued)
CHRONOLOGICAL LISTING OF SPILLS AND RELEASES AT THE SITE
PADDYS RUN ROAD SITE

Date of Incident	Quantity	Material	Location	Incident Description	Source of Information
01/89	60 Pounds	Phosphorus Pentoxide	Phosphorus Unloading Station (A&W - Area B)	A&W reported to OEPA a 60 pound air release of phosphorus pentoxide at the A&W site.	OEPA Emergency Response Online System
01/89	1,500-2,000 Gallons	75% Phosphoric Acid	(A&W - Area D)	A contained spill of approximately 1500-2000 gallons of phosphoric acid.	A&W Files
03/89	100 Pounds	Phosphorus Pentoxide	Phosphorus Unloading Station (A&W - Area B)	A&W reported to OEPA a 100 pound spill of chemicals at the A&W site.	OEPA Emergency Response Online System
05/89	10-15 Gallons	60% TKPP (1)	Between Area E and Main Building - A&W	Contained spill of approximately 10-15 gallons of TKPP.	A&W Files
05/89	75 Gallons	75% Phosphoric Acid	Degreaser Tank 124 (A&W - Area A)	Contained spill of approximately 75 gallons of phosphoric acid at A&W site.	A&W Files
05/89	20-50 Gallons	Hydrochloric Acid	Tank 130 (A&W - Area C)	Contained spill of 20-50 gallons of hydrochloric acid at A&W site.	A&W Files
05/89	10,880 Pounds	DAB 80 (2)	Inside Acid Storage Tank Farm (A&W - Area D)	Pumping overflow of 10,880 pounds of DAB 80 at A&W site.	A&W Files
07/89	432 Gallons	75% Phosphoric Acid	A&W - Area E	Uncontained spill of 432 gallons of phosphoric acid.	A&W Files
08/89	10-20 Gallons	Phos-Brite (3)	Heat Exchanger (A&W - Area D)	Contained leak of 10-20 gallons of Phos-Brite from heat exchanger.	A&W Files
08/89	129 Gallons	Phos-Brite (3)	Heat Exchanger (A&W - Area D)	Contained leak of approximately 129 gallons of Phos-Brite from heat exchanger.	A&W Files
08/89	1,400 Gallons	80% Phosphoric Acid	A&W - Area C	80% Phosphoric acid spill of 1400 gallons at A&W site.	A&W Files
08/89	20-25 Gallons	TKPP Scrubber Water	Tank 118 (A&W - Area C)	Contained over fill of 20 to 25 gallons of TKPP scrubber water at A&W site.	A&W Files
09/89	100 Gallons	75% Phosphoric Acid	A&W - Area E	Overfill spill of approximately 100 gallons of Phosphoric acid at A&W site.	A&W Files

000174

TABLE 3-3 (Continued)
CHRONOLOGICAL LISTING OF SPILLS AND RELEASES AT THE SITE
PADDYS RUN ROAD SITE

Date of Incident	Quantity	Material	Location	Incident Description	Source of Information
09/89	563 Gallons	DKP Tech (4)	A&W - Area E	Contained spill of 563 gallons of DKP Tech at A&W site.	A&W Files
09/89	50 Gallons	88% Phosphoric Acid	Phos-Brite mix (A&W Area D)	Contained spill of approximately 50 gallons of 88% Phosphoric acid at A&W site.	A&W Files
10/89	20 Gallons	Phosphoric Acid	Degreaser (Tank 124) (A&W - Area C)	Overfill spill of approximately 20 gallons of Phosphoric acid at A&W site.	A&W Files
11/89	3 Gallons	88% Phosphoric Acid	Loading/Unloading (A&W - Area C)	Line leaked, spilling 3 gallons of 88% Phosphoric acid at A&W site.	A&W Files
11/89	2-3 Gallons	85% Phosphoric Acid	Storage Tank (A&W - Area D)	Leak in storage tank pump seal spilling 2-3 gallons of H3PO4 at A&W site.	A&W Files
12/89	544 Gallons	63% TKPP	North of Area E by Tank 123 - A&W	Contained spill of 544 gallons of 63% TKPP at A&W site.	A&W Files
12/89	400-500 Gallons	Phos-Brite	Tank 600 (A&W - South of Area C)	Overfill spill of approximately 400-500 gallons of Phos-Brite at A&W site.	A&W Files
12/89	1200 Pounds	Salt	A&W - East of Area A	Tank overfill spilling 1200 pounds of salt at A&W site.	A&W Files
12/89	800 Gallons	Big "E" Water	A&W - Area J	Spill of 800 gallons of water from effluent storage tank at A&W site.	A&W Files
02/90	3-4 Gallons	75% Phosphoric Acid	A&W - East of Area A	Contained spill of 2-3 gallons of phosphoric acid at A&W site	A&W Files
07/90	470 Gallons	MALP (5)	A&W - Area D	Contained spill of 470 gallons of MALP at A&W site.	A&W Files
07/90	2,400 Gallons	Phosphoric Acid	A&W - East of Area B	Contained spill of approximately 2400 gallons at A&W site.	A&W Files

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TABLE 3-3 (Continued)
CHRONOLOGICAL LISTING OF SPILLS AND RELEASES AT THE SITE
PADDYS RUN ROAD SITE

Date of Incident	Quantity	Material	Location	Incident Description	Source of Information
08/90	1,325 Gallons	75% Phosphoric Acid	A&W - Area E	Contained spill of 1325 gallons of phosphoric acid at A&W site.	A&W Files
08/90	700 Gallons	Phosphoric & Sulfuric Acid	Tank 600 (A&W - South of Area C)	Contained spill of phosphoric and sulfuric acid at A&W site.	A&W Files
11/90	1,200-1,700 Gallons	Phosphoric Acid	A&W - Area B	Spill resulting from corroded pipe fitting releasing phosphoric acid at A&W site.	A&W Files
01/91	1,255 Gallons	MALP	Filter Press (A&W - Area D)	Contained spill of MALP due to filter press failure at A&W site.	A&W Files
01/91	3-5 Gallons	Phosphoric Acid	A&W - East of Area A	Contained spill of phosphoric acid resulting from broken steam hose at A&W site.	A&W Files
01/91	1,700-1,800 Gallons	75% Phosphoric Acid	A&W - West of Area A (Tank 125)	Contained spill of phsophoric acid at A&W site.	A&W Files
02/91	1,500 Gallons	50% KOH	A&W - Area E (Tank 129)	Contained spill of Potassium Hydroxide due to filter press failure.	A&W Files
02/91	3-4 Gallons	Aqua Ammonia	A&W - Area D	Contained spill of aqua ammonia resulting from tank overfill at A&W site.	A&W Files
03/91	50-100 Gallons	75% Phosphoric Acid	A&W - Area D	Contained spill of phosphoric acid resulting from tank overfill at A&W site.	A&W Files
05/91	3 Gallons	DKP	A&W - Area E	Contained spill of DKP resulting from leaking hose at A&W site.	A&W Files
06/91	2 Gallons	MALP	A&W - Area D	Contained spill of 2 gallons of MALP in area of cooler at A&W site.	A&W Files
06/91	10-15 Gallons	MALP	A&W - North of Area D	MALP spill resulting from drain line open; contained.	A&W Files

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TABLE 3-3 (Continued)
CHRONOLOGICAL LISTING OF SPILLS AND RELEASES AT THE SITE
PADDYS RUN ROAD SITE

Date of Incident	Quantity	Material	Location	Incident Description	Source of Information
07/91	100 Gallons	KTPP (6)	A&W - North and East of Area E	Spill of KTPP resulting from broken hose at A&W site; contained.	A&W Files
08/91	15 Gallons	ADO (7)	A&W - East of scale platform	Aproximately 15 gallon spill of ADO at A&W site; contained.	A&W Files
11/91	10 Gallons	Phosphoric Acid	A&W - Area A or F (rail car)	Contained spill of phosphoric acid resulting from leak on bottom of rail car.	A&W Files
11/91	5-50 Gallons	88% Phosphoric Acid	A&W - East of Area A	Contained spill due to ruptured hose at the new acid unloading area.	A&W Files
11/91	5-10 Gallons	Phos-Brite	Tank 600 inside building (A&W - South of Area C)	Contained Phos-Brite spill along south side mix tank at A&W site.	A&W Files
11/91	5-10 Gallons	85% Phosphoric Acid	A&W - South of Area D	Spill of phosphoric acid at pump discharge resulting in mist over transformer yard.	A&W Files
11/91	40-45 Gallons	Phosphoric Acid	A&W - Area E (Tank 44)	Contained spill around diked area of storage tank 44 at A&W site.	A&W Files
12/91	7 Gallons	Liquid	A&W - Unknown tank	Contained overflow spill of liquid at A&W site.	A&W Files
12/91	1000 Gallons	86% Phosphoric Acid	A&W - East of Area A	Spill resulted when unloading rail car.	A&W Files
12/91	1/8 Gallons	98% Sulfuric Acid	A&W - Near Tank 407 west of building	Contained spill resulting from broken o-ring hose at A&W site.	A&W Files
01/92	10 Gallons	"Additive B" (8)	A&W - Area D	Contained tank overfill spill of "Additive B" at A&W site.	A&W Files
02/92	25 Gallons	75% Phosphoric Acid	A&W - North of Area D	Contained spill of approximately 25 gallons of phosphoric acid at A&W site.	A&W Files

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TABLE 3-3 (Continued)
CHRONOLOGICAL LISTING OF SPILLS AND RELEASES AT THE SITE
PADDYS RUN ROAD SITE

Date of Incident	Quantity	Material	Location	Incident Description	Source of Information
03/92	100-300 Gallons	75% Phosphoric Acid	Tank 44 of Tank Farm A&W	Contained spill in line to storage tank at A&W site.	A&W Files
03/92	1000 Gallons	86% Phosphoric Acid	A&W - Area F	Spilled occured on bottom of railcar due to corroded line coupling.	A&W Files
04/92	< 1 Pound	Elemental Phophorus	A&W - Area B	Contained spill resulted in fire.	A&W Files
05/92	100 Gallons	75% Phosphoric Acid	Sump Area (Tank 208) (A&W - Area C)	Contained spill in area of acid sump and effluent tank at A&W site.	A&W Files

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(1) TKPP - Tetrapotassium pyrophosphate
(2) DAB-80 - Phosphoric acid 80%, nitric acid 3%
(3) Phos-Brite - Phosphoric acid 70%, sulfuric acid 15%
(4) DKP Tech - Dipotassium phosphate, technical grade
(5) MALP - Phosphoric acid 2%, monoaluminum phosphate trihydrate 57%
(6) KTPP - Potassium tripolyphosphate
(7) ADO - Phosphoric acid 80%
(8) Additive "B" - Phosphoric acid 80%, copper dihydrogen phosphate 12%

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A&W/Mobil Property

Areas have been identified, as shown in Table 3-3, where accidental spills and releases of chemicals have occurred. Field investigations verified areas where operations could have been a source of chemicals of concern. Those areas (shown in Figure 3-1) include:

Area B - Phosphorus Handling
Area C - Phosphoric Acid Storage Tanks
Area D - Phosphoric Acid and Alkali Phosphate Production
Area E - Potash Caustic Storage and Alkali Phosphate Production
Area F - Former STPP Production, Storage and Loadout
Area H - Former Sludge Holding Area Removed in 1982
Area I - Former Drum Storage
Area J - Used Equipment Storage
Area V - Northwest Gravel Area
Area X - Field Adjacent East of A&W Property

As part of the source investigation, past and present materials use and storage were determined. Raw materials used at the facility in the manufacturing process in the past included elemental phosphorus, soda ash and presently phosphoric acid and potassium hydroxide. Liquid and solid raw materials and product have always been stored at the facility in tanks and drums within contained areas. Details on the tanks are presented in Table 3-4. Included are the tank location, designated tank number, tank capacity, contents, construction date, and date taken out of service, if applicable. Tanks are located in Figure 3-1 by their designated number.

Each of the areas determined as a source, as outlined above, will be discussed below. Media in which chemicals and their related concentrations have been identified for each of the source areas are discussed in Section 4.0 Nature and Extent of Chemicals of Concern.

Area B - Phosphorus Handling

Prior to 1990, this area handled elemental phosphorus which arrived by railroad tank cars. The tank cars were positioned over water-filled safety sumps and heated

TABLE 3-4
STORAGE TANK CHARACTERISTICS AT A&W
PADDYS RUN ROAD SITE

LOCATION	TANK NUMBER	VOLUME (gal)	CONTENTS	CONSTRUCTED	COMMENTS
AREA C	100	15,000	Phosphorus	1962	Decommissioned in October 1990; Removed in 1993
Phosphoric Acid Storage Tanks	102	10,000	Phosphorus	1962	Decommissioned in October 1990; Removed in 1993
	104	10,000	Phosphorus	1962	Decommissioned in October 1990; Removed in 1993
	108	1,000	Phossy H2O	NA	Decommissioned in October 1990; Removed in 1993
	208	8,000	Phosphoric Acid		Decommissioned and Removed in 1993
	308	8,000	Phosphoric Acid		Decommissioned and Removed in 1993
AREA D	400	15,000	Phosphoric Acid	1962	
Phosphoric Acid Storage & Alk	402	10,000	Phosphoric Acid	1962	
Phosphate Production	404	10,000	Phosphoric Acid	1962+/-	
	405	30,000	Phosphoric Acid	1962	
	411	10,000	Phosphoric Acid	1962	
	413	10,000	Phosphoric Acid	1962	
	415	4,500	Aqua Ammonia	NA	
	420	600	Additive B	1977	This is 75% Phosphoric Acid With 8% Copper
	423	5,000	Nitric Acid	1967	
	424	700	Nitric Acid	1967	
	426	4,200	See Comment	1963	Contained Phosphoric Acid, Alumina Phosphate Solution, and Magnesium Phosphate Solution
	501	10,000	Alumina Phosphate Solution	1965	
	502	7,000	Alumina Phosphate Solution	1965	
	504	3,800	Alumina Phosphate Solution	1965	
	514	12,000	See Comment	1984	Alumina Phosphate Until 1987, Phosphoric and Sulfuric Acid After
AREA E	100	30,000	Potassium Phosphate Solution	1962	
Caustic Potash Storage & Alkali	102	30,000	Potassium Phosphate Solution	1962	
Phosphate Production	118	6,400	See Comment	1981	Contained Phosphoric Acid Prior to May 1991
	129	30,000	50% KOH Solution	1963	
	200	12,000	Potassium Phosphate Solution	1963	
	203	8,400	Phosphoric Acid	1963	
	208	15,000	Potassium Phosphate Solution	1963	
	209	15,000	Potassium Phosphate Solution	1963	
	212	7,500	Potassium Phosphate Solution	1971	
	118	5,500	Potassium Phosphate Solution	1974	
	120	1,500	Potassium Phosphate Solution	1963	
	123	3,300	Potassium Phosphate Solution	1963	
	125	3,300	Potassium Phosphate Solution	1963	

TABLE 3-4 (Continued)
STORAGE TANK CHARACTERISTICS AT A&W
PADDYS RUN ROAD SITE

LOCATION	TANK NUMBER	VOLUME (gal)	CONTENTS	CONSTRUCTED	COMMENTS
AREA J					
Used Equipment Storage	103	450,000	Wastewater surge tank	1971	
		10,000	Aboveground fuel oil tank	1977	Decommissioned and Removed in 1991
	124	10,000	See Comment	1972	Contained Spent Regenerate H2O from softeners and demineralizers
	125	10,000	See Comment	1972	Contained Spent Regenerate H2O from softeners and demineralizers
	133	108,000	Demineralized H2O	1970+/-	
	130	7,000	HCL	1981	Tank Failed in 1987, Was Replaced That Same Year
	108	8,000	Softened Well H2O	1972	
	127	5,000	See Comment	1972	25% Caustic Soda Solution
	164	15,000	Phossy H2O	1972	Tank Removed in 1984; Replaced with Brine Tank in 1986
	112	33,000	Waste H2O	1972	
	401	250	Flocculating Agent	1992	
	402	1,000	Softened Well H2O	1992	
	403	8,000	Waste H2O	1992	
	114	6,400	See Comment	1976	Phosphoric Acid Until May 1991; Potassium Phosphate Solution After
	124	6,400	Phosphoric Acid	1973	
	125	6,400	Phosphoric Acid	1973	
	407	3,800	Phosphoric Acid	1962	
	409	4,500	Phosphoric Acid	1962	
	600	4,500	See Comment	1954	Sodium Phosphate Until 1974; Abandoned in 1974 Until 1987; Sulfuric Acid After
	601	7,400	See Comment	1954	Sodium Phosphate Until 1974; Abandoned in 1974 Until 1987; Sulfuric Acid After
	107	5,500	Potassium Phosphate Solution	1962	
	110	5,500	Potassium Phosphate Solution	1962	
	147	30,000	Cooling Water Feed Tank	--	

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until the phosphorus was molten. It was then conveyed by water displacement to the phosphorus holding tanks designated 100, 102 and 104. Tank 108 contained the water used to convey the elemental phosphorus to the storage tanks. This process was utilized until 1990 when elemental phosphorus was no longer used to make phosphoric acid. The tanks associated with this process were taken out of service in October 1990.

Currently phosphoric acid is brought to the plant by railcar and stored in tanks prior to use.

Area C - Phosphoric Acid Storage Tanks

There were five phosphoric acid storage tanks and one phosphoric acid/water (phossy water) tank in this area, ranging from 1,000 to 15,000-gallons capacity. These tanks were decommissioned and removed in 1993.

Area D - Phosphoric Acid Storage and Alkali Phosphate Production

Within Area D there are 15 storage tanks ranging in capacity from 600 gallons to 30,000 gallons. Most of the tanks within this area were constructed in the early 1960s.

Area E - Potash Caustic Storage and Alkali Phosphate Production

Within Area E there are 14 active liquid storage tanks ranging in capacity from 1,500 gallons to 30,000 gallons, and one 34,000 lbs. solid potassium phosphate bin. Twelve of the tanks contain potassium phosphate solutions, one contains phosphoric acid and one contains potassium hydroxide solution.

Area F - Former STPP Production, Storage, and Loadout

Sodium tripolyphosphate (STPP) was produced at the plant during the second half of the 1950's through 1976. This area contained aboveground storage bins that

contained STPP. All of the equipment such as cyclones (used to blow the powdered material into railcars) and calcinators (used to condense alkali phosphate salts to pyrophosphate) were removed by 1982.

Area H - Former Sludge Holding

In 1976, Area H was used as a temporary holding area for sludge from Mobil's (A&W's) recycle-water tank (LBG 1982). The sludge contained potassium and phosphates with minor amounts of arsenic sulfide (ENSR 1989a).

As part of the facilities water-recirculation system maintenance program, approximately 40,000 gallons of sludge from the 500,000 storage tank was temporarily placed in a shallow depression in Area H. The unlined depression (approximately 40 feet in diameter and less than one-foot deep) was diked with surrounding soils to prevent lateral surface migration of fluids (LBG 1982). As discussed in Section 2.1.2, about 100 cubic yards of sludge and soil were removed in 1976 with approval of the Ohio EPA. Disposal was to an approved landfill. A 1982 study by Mobil indicated that the 1976 sludge had migrated downward into the underlying soil. Soil samples showed a black discoloration believed to be the result of the downward movement of the liquid portion of the sludge (LBG 1982). The Ohio EPA approved the removal of an additional 700 cubic yards in 1982 to an approved landfill (Ohio EPA 1982).

Currently this area is covered with grass and is not being used by A&W as part of their operation. However, the area is being used by the Companies as a base for carrying out the field operations for the Study Area investigation. Located within this area are a field trailer, two storage trailers, a decontamination pad and diked storage tank area for purge and decontamination washwater.

Area I - Former Drum Storage

As stated in Section 2.1.2, drums of solid waste were temporarily stored in this area. The area currently is gravel covered, and primarily contains metal construction materials, used equipment, and several dumpsters containing miscellaneous debris.

Area J - Used Equipment Storage

At various times used equipment and piping have been stored in this area. Within Area J are the 450,000 gallon wastewater surge tank and a former aboveground fuel oil storage tank.

Area V - Northwest Gravel Area

At various times, drums were temporarily staged in this area. The area currently is gravel covered.

Area X - Field Adjacent to A&W

Area X is located in the field east of A&W's manufacturing operation. This area has been designated as a potential source area based upon personal interviews, aerial photographs, and groundwater monitoring. The area exhibited evidence of stressed vegetation during the early period of operation of the plant, is thought to be a result of air emissions released during the manufacturing of STPP. Problems with scrubbers and cyclones are cited as the source of the emissions. Manufacturing of STPP began in the second half of the 1950s and ceased in 1976.

RNC Property

Through various interviews, areas have been identified on the RNC property (as shown in Table 3-3) where accidental spills and releases of chemicals have occurred. Physical investigations have revealed additional areas impacted by RNC's activities. These areas (shown in Figure 3-2) include:

- Area L - Hydrotrope Tank Farm
- Area M - Raw Product Tank Farm
- Area N - Former Lagoon
- Area R - Pond No. 2
- Areas Q&S - Former Ponds Nos. 1 and 2
- Area T - Process Building
- Area U - Former UST

As part of the source investigation, past and present materials use and storage were determined. Liquid raw materials and product are currently stored at the facility in tanks and drums within contained areas. (No solid materials are used by RNC in the manufacturing process.) Storage areas have been contained since 1978. Details on the tanks within storage areas are presented in Table 3-5. Included are the tank location, designated tank number, tank capacity, contents, construction date and date taken out of service, if applicable. Tanks are located in Figure 3-2 by their designated number.

Each of the areas determined as a source, as outlined above, will be discussed below. Concentrations of chemicals and media in which they occur have been identified for each of the source areas and are discussed in Section 4.0 Nature and Extent of Chemicals of Concern.

Area L - Hydrotrope Tank Farm

Hydrotropes are the main product manufactured at the RNC facility. They are produced when sulfonic acids (the direct result of chemical reaction between sulfuric acid and either toluene, xylene, cumene or benzene) are neutralized with either sodium or potassium hydroxide.

In 1978 the initial Hydrotrope Tank Farm was constructed consisting of a single row of four tanks. The area has been expanded to 29 tanks as shown in Figure 3-2. Four of the tanks have a capacity of 12,500 gallons while the remaining 25 hold 6,500 gallons each. Concrete containment and dikes have been added.

TABLE 3-5
STORAGE TANK AREA CHARACTERISTICS AT RNC
PADDYS RUN ROAD SITE

LOCATION	NUMBER	(gal)	CONTENTS	CONSTRUCTED	COMMENTS
Area L Hydrotrope Storage Area	7	12,500	Sodium Cumene Sulfonate	1989 - 1990	
	8	12,500	Sodium Cumene Sulfonate	1989 - 1990	
	9	12,500	Sodium Cumene Sulfonate	1989 - 1990	
	10	12,500	Sodium Cumene Sulfonate	1989 - 1990	
	11	6,500	Sodium Cumene Sulfonate	Unknown	
	12	6,500	Sodium Cumene Sulfonate	Unknown	
	13	6,500	Sodium Cumene Sulfonate	Unknown	
	14	6,500	Sodium Cumene Sulfonate	Unknown	
	15	6,500	Sodium Cumene Sulfonate	Unknown	
	16	6,500	Ammonium Xylene Sulfonate	Unknown	
	17	6,500	Ammonium Xylene Sulfonate	Unknown	
	18	6,500	Ammonium Xylene Sulfonate	Unknown	
	19	6,500	Ammonium Xylene Sulfonate	Unknown	
	20	6,500	Ammonium Xylene Sulfonate	Unknown	
	21	6,500	Sodium Xylene Sulfonate	Unknown	
	22	6,500	Sodium Xylene Sulfonate	Unknown	
	23	6,500	Sodium Xylene Sulfonate	Unknown	
	24	6,500	Sodium Xylene Sulfonate	Unknown	
	25	6,500	Sodium Xylene Sulfonate	Unknown	
	26	6,500	Sodium Xylene Sulfonate	Unknown	
	27	6,500	Sodium Xylene Sulfonate	Unknown	
	28	6,500	Sodium Xylene Sulfonate	Unknown	
	29	6,500	Sodium Xylene Sulfonate	Unknown	
	30	6,500	Sodium Xylene Sulfonate	Unknown	
	31	6,500	Potassium Toluene Sulfonate	Unknown	
	32	6,500	Sodium Toluene Sulfonate	Unknown	
	33	12,500	Sodium Xylene Sulfonate	Unknown	
	34	12,500	Sodium Xylene Sulfonate	Unknown	
	--	250,000	City Water	Unknown	City H2O

TABLE 3-5 (Continued)
STORAGE TANK AREA CHARACTERISTICS AT RNC
PADDYS RUN ROAD SITE

LOCATION	NUMBER	(gal)	CONTENTS	CONSTRUCTED	COMMENTS
Area M Tank Farm	36	6,500	Sodium Xylene Sulfonate	Unknown	
	37	6,500	Sodium Xylene Sulfonate	Unknown	
	201	12,500	Sulfuric Acid	1985	
	202	10,000	Ammonium Hydroxide	1983	
	203	10,000	Sodium Hydroxide	Unknown	
	204	10,000	Sodium Hydroxide	Unknown	
	205	10,000	Potassium Hydroxide	Unknown	
	206	10,000	Cumene	1959	
	207	10,000	Xylene	1959	
	208	10,000	Cumene	1959	
	209	10,000	Toluene	1959	
	210	10,000	Xylene	1980	
	211	10,000	Toluene	1980	
	212	10,000	Xylene	1980	
	213	8,000	Xylene	1980	
Area O Sulfuric Acid Storage	101	6,500	XSA	Unknown	
	102	7,500	Mod Acid	Unknown	
	103	7,500	Mod Acid	Unknown	
	104	7,500	TSA	Unknown	
	304	6,500	Xylene	Unknown	
	312	6,500	Waste	Unknown	Decommissioned, replaced with Tank 316, a 6,500 gallon cumene still feed tank.
	315	1,000	Seal Water Tank	Unknown	
	316	6,500	STS Filter Tank	Unknown	

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TABLE 3-5 (Continued)
STORAGE TANK AREA CHARACTERISTICS AT RNC
PADDYS RUN ROAD SITE

LOCATION	TANK NUMBER	VOLUME (gal)	CONTENTS	CONSTRUCTED	COMMENTS
Area P Waste Storage	105	7,500	TSA	1985	
	106	10,000	DDBSA	1989 - 1990	
	305	6,500	Still Bottoms	Unknown	
	306	6,500	Process Waste	Unknown	
	309	14,000	Xylene Sulfonate	Unknown	Decommissioned 1992. Replaced with 6,500 gallon AXS tank.
	310	6,500	SXS Filter Tank	Unknown	
	313	2,000	Cumene	Unknown	Decommissioned June 1991
	314	2,000	Xylene		Decommissioned June 1991
	330	6,500	Xylene Still Feed tank		
	331	6,500	Xylene Still Feed tank		
	38	6,500	Empty		
Area South of Process Building	301	6,500	SXS Filter Tank	Unknown	
	302	14,000	Ammonium Hydroxide Recovery Tank	Unknown	Removed 1992
	307	6,500	AXS Setting Tank	Unknown	
	308	6,500	SCS Filter Tank	Unknown	
Area on East Side of Boiler House	200		City Water	Unknown	
	215			Unknown	
	216		Fuel Oil	Unknown	

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XSA = Xylene Sulfonic Acid
TSA = Toluene Sulfonic Acid
AXS = Ammonium Xylene Sulfonate
SXS Filter Tank = Sodium Xylene Sulfonate
SCS Filter Tank = Sodium Cumene Sulfonate

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Area M - Raw Product Tank Farm

Initially, the raw materials sulfuric acid, potassium hydroxide and sodium hydroxide were received by railcar, while toluene and xylene were delivered by truck. Materials were moved to the Process Building by hand, with the exception of sulfuric acid which was piped above ground from railcars. In mid-1959, aboveground tanks were installed for storage of the raw materials. Presently 15 tanks exist in this area. Tank capacity ranges from 6,500 gallons to 12,000 gallons. Within the raw product tank farm, and included in the 15 tanks are two 6,500 gallon hydrotrope load-out tanks. Materials stored in these tanks are shown in Figure 3-2.

Originally, the tank farm did not have dikes or concrete floors, but in the mid 1970s concrete floors, dikes and sumps were added.

Sumps placed within the tank farm collected water which was pumped via underground lines to the Process Building where it was used in the manufacturing process. Figure 3-2 presents the facilities drawing that shows the location of underground lines.

Area N - Former Lagoon

A lagoon was constructed just south of the Process Building in 1959 to handle the sludge by-product. This lagoon was excavated into the clay soil to a depth of 1 to 2 feet, measured approximately 10 x 10 feet, and was bermed. Because of increased production another small lagoon was dug adjacent to the first lagoon (Cope 1990). The use of these lagoons was discontinued after 1965. In the years 1965-1966 the lagoons were backfilled without excavation. The location of these lagoons (Area N) is currently under pavement.

Area Q - Former Pond No. 1

Pond Q was constructed in 1959 to handle non-contact cooling water from the facility. It was designed as an infiltration pond being 10 to 12 feet deep and

covering a surface area of 40 x 50 feet. The bottom of the pond was in sand and gravel. Water was conveyed from the plant to Pond Q via a trench that contained a 4 inch pipe that discharged into the pond.

As production increased, sludges that were previously placed in the lagoon were sent to Pond Q which also received floor drainage from the Process Building. Use of Pond Q for sludges occurred between 1965-1966 and was discontinued in 1974 when the conveyance line from the facility was replaced with a sump. (Details of the sump are discussed in Area T - Process Building.) The pond was excavated in 1974 and was refilled with topsoil obtained from gravel pits located east of the U.S.DOE/FEMP facility (Cope 1992).

Area R - Pond No. 2

Pond R was constructed in 1965-1966 as an infiltration pond. It had an odd shape extending from near New Haven Road north to the tank farms. It ranged in depth from approximately 10 feet in the south to 6 feet in the north. It is uncertain what soil type is at the 10 foot depth at the south end of the pond because the pond still exists. In the north end where the pond has been excavated and backfilled, the soil type at a depth of 6 feet is clay. The current shape of the pond is trapezoidal with the eastern edge being approximately 160 feet north to south, the southern boundary 110 feet northeast to southwest, the western limit approximately 90 feet north to south, and the northern limit approximately 160 feet northeast to southwest.

This pond received only the non-contact cooling water from the Process Building (Cope 1990). In 1974, the pond was excavated, the bottom sludge removed, and subsequently lined with 4 inches of bentonite. After lining the bottom, steel lines were laid to the Process Building so that the pond water could be used as non-contact cooling water. With Pond R in use, a production well that had been for cooling water was discontinued. Water from the Process Building was conveyed through two 6-inch steel lines which discharge via spray nozzles to the pond. During the cleaning and backfilling process the pond was reduced to its current size.

Area S - Former Pond No. 3

As a result of additional expansion, Pond S was built in 1962-1963 to handle the non-contact cooling water. It was designed for infiltration by being excavated to a depth of at least 12 feet, where the soil types are sand and gravel. Surface dimensions of Pond S were 75 x 150 feet. A 1-2 foot wide 2-3 foot deep open trench connected Pond S to Pond R. As determined by borings, this pond did receive sulfones. In 1974, the pond and connector trench were excavated and backfilled with topsoil obtained from gravel pits located east of the U.S.DOE/FEMP facility (Cope 1992).

Area T - Process Building

The Process Building was constructed prior to the start of plant operations on February 17, 1959. Originally, it housed only two chemical mixing systems that manufactured the sulfonated products. The manufacturing process has since been expanded. In 1959 the only raw materials used in the manufacturing process were toluene, xylene, sulfuric acid and potassium hydroxide and sodium hydroxide. In 1965, benzene was used in limited amounts, estimated to be a total of only 15,000 gallons, until 1968 when its use was discontinued. Cumene was added as a raw product in 1968. With the exception of benzene, all raw materials mentioned above are still being used at RNC. Ethylbenzene is not a raw material used at RNC but is present as an impurity associated with xylene.

As part of the manufacturing process, sludges accumulate in the chemical mixing systems and must be removed for efficient operation. Sludges are approximately 90% liquid consisting of primarily sulfones, hydrotropes, and minor hydrocarbons. These liquids were run through a still to recover everything but the sulfones before being sent to the lagoon. Washwater went via floor drains to a surface trench from the Process Building to a lagoon (Area Q). Approximately three to four years after the plant was constructed the surface trench was lined with acid-resistant tile to prevent leakage. Between 1970 and 1974 additional concrete was placed within the

Process Building to provide containment. The sump south of the building was installed in 1974 and constructed with a concrete floor and concrete block lined with acid-resistant tile. This sump was removed in 1986 and replaced with a new sump that had concrete walls and base and a stainless steel liner. Figure 3-2 shows the location of the sump.

Area U - Underground Fuel Storage Tanks

Two underground fuel storage tanks existed at the site until 1988. One tank stored #1 diesel fuel and had a 5,000-gallon capacity while the other tank stored gasoline and had a 1,000-gallon capacity.

3.5 Background Comparison Values of Chemicals

The determination of representative background concentrations of analytical parameters for the PRRS RI/FS is required to support the following activities:

- Identify the extent of Study Area-related contamination
- Identify the primary chemicals of concern during the RI by comparing background levels to concentrations on and downgradient of the Companies' facilities
- Evaluate potential chemical specific applicable or relevant and appropriate requirements (ARARs) to be evaluated during the development of remedial alternatives (relevant to Feasibility Study)
- Evaluate potential clean-up standards.

The process followed to develop the background values for all chemicals analyzed for each medium -- the unsaturated zone soils, groundwater, surface water and sediment -- was as follows:

- Review, for comparison purposes only, local and regional data in the literature to determine "normal" ranges of the chemical constituents in the area.
- Identify appropriate background sampling locations and data for each medium of concern.

- Perform a simple univariate statistical evaluation (e.g., mean and standard deviation) of the identified data.
- Based on the results of the initial statistical evaluation following Ohio EPA, Division of Emergency and Remedial Response, Final *How Clean is Clean* Policy, July 26, 1991, determine whether a statistically adequate number of background sampling data exists.
- If sufficient data are available, continue the statistical evaluation by determining whether the data are "distributed" in a statistically normal manner.
- If the data are not normally distributed, transform the data to normality with a base 10 logarithmic transform. If the data do not fit normal or log-normal distribution, then the normal distribution is utilized.
- Calculate the upper 95% tolerance interval of the normal distribution for each chemical for use in calculation of chronic daily intake for RA purposes.

(Table 3-6 summarizes analytical testing parameters.)

Through the process outlined above, background concentrations were established for each parameter in each medium of concern. Tables 3-7 through 3-12 summarize those values to which analytical results were compared in the course of investigating the Study Area. The chemical concentrations provided herein as background concentrations are calculated levels. While some of the figures were derived from available empirical data, others were developed using statistical analysis and assumptions with respect to analytical laboratory capabilities. There is no assertion that the values presented as background represent actual measurements of ambient concentrations.

In developing the background, the Companies used data generated and from the DOE/FEMP study area during the RI. Details of the statistical methods used in establishing background are found in Determination of Medium-Specific Chemical Background Comparison Values in Appendix B-3.

Table 3-6
Summary of Analytical Testing Parameters

Dissolved Metals

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

Total Metals

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

Volatile Organic Compounds

- Acrolein
- Acrylonitrile
- Benzene
- Bromoform
- Carbon tetrachloride
- Chlorobenzene
- Dibromochloromethane
- Chloroethane
- Chloroform
- Bromodichloromethane
- 1,1-Dichloroethane
- 1,2-Dichloroethane
- 1,1-Dichloroethene
- 1,2-Dichloropropane
- Cis-1,3-Dichloropropene
- 1,2-Dichlorobenzene*
- 1,3-Dichlorobenzene*
- 1,4-Dichlorobenzene*
- Ethylbenzene
- Bromomethane
- Chloromethane
- Methylene chloride
- 1,1,2,2-Tetrachloroethane
- Tetrachloroethene
- Toluene
- 1,1,1-Trichloroethane
- 1,1,2-Trichloroethane
- Trichloroethene
- Vinyl chloride
- Trans-1,3-Dichloropropene
- Styrene
- Acetone
- 2-Butanone
- Carbon disulfide
- 2-Hexanone
- 4-Methyl-2-pentanone
- Vinyl acetate
- Xylenes (Total)
- 1,2-Dichloroethene(Total)
- Cumene

Semi-Volatile Organic Compounds

- Acenaphthene
- Acenaphthylene
- Anthracene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- bis(2-Chloroethoxy)methane
- bis(2-Chloroethyl)ether
- bis(2-Chloroisopropyl)ether
- bis(2-Ethylhexyl)phthalate
- 4-Bromophenyl phenyl ether
- Butyl benzyl phthalate
- 2-Chloronaphthalene
- 4-Chlorophenyl phenyl ether
- Chrysene
- Dibenzo(a,h)anthracene
- Diethyl phthalate
- Dimethyl phthalate
- Di-n-butyl phthalate
- 2,4-Dinitrotoluene
- 2,6-Dinitrotoluene
- Di-n-octyl phthalate
- Fluoranthene
- Fluorene
- Hexachlorobenzene
- Hexachlorobutadiene
- Hexachlorocyclopentadiene
- Hexachloroethane
- Indeno(1,2,3-cd)pyrene
- 3-3-Dichlorobenzidine
- Isophorone
- Naphthalene
- Nitrobenzene
- N-Nitroso-di-n-propylamine
- N-Nitrosodiphenylamine(1)
- Phenanthrene
- Pyrene
- 1,2,4-Trichlorobenzene
- Benzyl alcohol
- 4-Chloroaniline
- Dibenzofuran
- 2-Methylnaphthalene
- 2-Nitroaniline
- 3-Nitroaniline
- 4-Nitroaniline
- 2-Chlorophenol
- 2,4-Dichlorophenol
- 2,4-Dimethylphenol
- 4,6-Dinitro-2-methylphenol
- 2,4-Dinitrophenol
- 2-Nitrophenol
- 4-Nitrophenol
- 4-Chloro-3-methylphenol
- Pentachlorophenol
- Phenol
- 2,4,6-Trichlorophenol
- 2-Methylphenol
- 4-Methylphenol
- Benzoic acid
- 2,4,5-Trichlorophenol

Pesticides and PCBs

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

General Parameters

- Ammonia (N), Distillation
- BOD(O2) - 5 day
- Carbon, Organic - Nonpurgeable
- COD(O2)
- Chloride (Cl)
- Hardness, Total (as CaCO3)
- Nitrogen, Kjeldahl (N)
- Phosphorus, Total (as P)
- Solids, Dissolved at 180C
- Sulfate, Turbidimetric (as SO4)
- Surfactants (MBAS)
- Standard Plate Count
- Total Coliform
- Phosphorus, Dissolved (Filtered)
- Specific Gravity by Hydrometer

Radiologic Parameters

- Gross Alpha
- Gross Beta
- Uranium, Total (Radio-chemical)
- Potassium-40

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* Prior to the June 1991, EPA CLP Volatile Organic Statement of Work, these compounds were reported as semi-volatile organic compounds.

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TABLE 3-7
DISSOLVED CLP METALS BACKGROUND CONCENTRATION SUMMARY
PADDYS RUN ROAD SITE

CHEMICAL	Soils (mg/kg)		Groundwater (ug/l)		Sediments (mg/kg)		Surface Water (ug/l)	
	Concentration	Basis	Concentration	Basis	Concentration	Basis	Concentration	Basis
Aluminum	N/A	D	367.0	A	N/A	D	13980.0	A
Antimony	N/A	D	39.0	C	N/A	D	22.0	C
Arsenic	N/A	D	3.0	A	N/A	D	DL (3.0)	B
Barium	N/A	D	122.0	A	N/A	D	79.4	A
Beryllium	N/A	D	5.0	C	N/A	D	9.64	A
Cadmium	N/A	D	5.0	C	N/A	D	DL (5.0)	B
Calcium	N/A	D	138549.0	A	N/A	D	131270.0	A
Chromium	N/A	D	4.0	A	N/A	D	30.9	A
Cobalt	N/A	D	7.0	A	N/A	D	10.9	A
Copper	N/A	D	60.0	A	N/A	D	17.7	A
Iron	N/A	D	21216.0	A	N/A	D	16270.0	A
Lead	N/A	D	53.0	A	N/A	D	14.4	A
Magnesium	N/A	D	33589.0	A	N/A	D	34597.0	A
Manganese	N/A	D	537.0	A	N/A	D	63.6	A
Mercury	N/A	D	0.3	A	N/A	D	DL (0.2)	B
Nickel	N/A	D	27.0	A	N/A	D	DL (29.0)	B
Potassium	N/A	D	5021.0	A	N/A	D	5644.0	A
Selenium	N/A	D	4.0	A	N/A	D	DL (3.0)	B
Silver	N/A	D	13.0	A	N/A	D	DL (5.0)	B
Sodium	N/A	D	60457.0	A	N/A	D	19793.0	A
Thallium	N/A	D	8.0	A	N/A	D	DL (3.0)	B
Vanadium	N/A	D	27.0	A	N/A	D	25.9	A
Zinc	N/A	D	258.0	A	N/A	D	14.8	G

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Basis Notes:

A - Background determined statistically in accordance with Ohio EPA "How Clean is Clean" policy (July 1991).

B - Background identified as the detection limit (DL), which is the highest reported Contract Required Quantification Limit (CRQL) (listed in parenthesis). The constituent was not found in Site or background samples in the medium.

C - Background identified as the DL, which is the CRQL. The constituent did not exhibit a positive hit above the DL in the background samples AND the statistical evaluation (using a value of one-half the DL) resulted in a value less than the DL (which is the CRQL).

D - Not Applicable (N/A) as the constituent was not analyzed in Site medium.

E - Background determined based upon results of the dissolved metals analysis.

F - Background listed as the DL, which is the CRQL. No variability was present in the background results to determine statistical background.

G - Background identified as the highest (maximum) reported value. An insufficient number of samples (<3) was available for statistical evaluation of background.

TABLE 3-8
TOTAL CLP METALS BACKGROUND CONCENTRATION SUMMARY
PADDYS RUN ROAD SITE

	Soils (mg/kg)		Groundwater (ug/l)		Sediments (mg/kg)		Surface Water (ug/l)	
CHEMICAL	Concentration	Basis	Concentration	Basis	Concentration	Basis	Concentration	Basis
Aluminum	18753.97	A	17982.0	A	7208.31	A	13980.0	E
Antimony	4.96	C	15.0	A	28.22	A	22.0	E
Arsenic	7.74	A	33.0	A	14.18	A	DL (3.0)	E
Barium	169.45	A	184.0	A	44.01	A	79.4	E
Beryllium	1.02	A	7.0	A	1.11	A	DL (1.0)	B
Cadmium	0.83	A	3.0	A	9.55	A	DL (4.0)	B
Calcium	118266.30	A	238165.0	A	193827.31	A	131270.0	E
Chromium	23.46	A	188.0	A	38.42	A	DL (5.0)	B
Cobalt	13.11	A	21.0	A	10.89	A	DL (5.0)	B
Copper	28.37	A	196.0	A	20.68	A	DL (4.0)	B
Iron	28841.20	A	186690.0	A	13694.94	A	16270.0	E
Lead	112.63	A	67.0	A	48.50	A	14.4	E
Magnesium	28113.63	A	76441.0	A	49714.69	A	34597.0	E
Manganese	1601.18	A	11390.0	A	558.09	A	63.6	E
Mercury	0.20	A	0.2	F	DL (0 .1)	B	DL (0.2)	B
Nickel	29.71	A	143.0	A	31.14	A	DL(7.0)	B
Potassium	3528.42	A	6045.0	A	1557.88	A	5644.0	E
Selenium	2.39	A	DL (3.0)	B	2.79	A	DL (3.0)	B
Silver	DL (1.2)	B	DL (5.0)	B	DL (1.1)	B	DL (5.0)	B
Sodium	212.27	A	189339.0	A	1407.57	A	19793.0	E
Thallium	DL (0.73)	B	DL (3.0)	B	DL (0.63)	B	DL (3.0)	B
Vanadium	34.52	A	42.0	A	29.31	A	DL (4.0)	B
Zinc	234.33	A	420.0	A	49.81	A	3.7	G

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Basis Notes:

A - Background determined statistically in accordance with Ohio EPA "How Clean is Clean" policy (July 1991).

B - Background identified as the detection limit (DL), which is the highest reported Contract Required Quantification Limit (CRQL) (listed in parenthesis). The constituent was not found in Site or background samples in the medium.

C - Background identified as the DL, which is the CRQL. The constituent did not exhibit a positive hit above the DL in the background samples AND the statistical evaluation (using a value of one-half the DL) resulted in a value less than the DL (which is the CRQL).

D - Not Applicable (N/A) as the constituent was not analyzed in Site medium.

E - Background determined based upon results of the dissolved metals analysis.

F - Background listed as the DL, which is the CRQL. No variability was present in the background results to determine statistical background.

G - Background identified as the highest (maximum) reported value. An insufficient number of samples (<3) was available for statistical evaluation of background.

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TABLE 3-9
CLP VOLATILE ORGANIC BACKGROUND CONCENTRATION SUMMARY
PADDYS RUN ROAD SITE

CHEMICAL	Soils (ug/kg)		Groundwater (ug/l)		Sediments (ug/kg)		Surface Water (ug/l)	
	Concentration	Basis	Concentration	Basis	Concentration	Basis	Concentration	Basis
Acrolein	N/A	D	25.0	C	N/A	D	DL(25.0)	B
Acrylonitrile	N/A	D	25.0	C	N/A	D	25.0	G
Benzene	5.9	C	5.0	C	DL(6.0)	B	DL(5.0)	B
Bromoform	DL(7.0)	B	5.0	C	DL(6.0)	B	DL(5.0)	B
Carbon tetrachloride	DL(7.0)	B	DL(5.0)	B	DL(6.0)	B	DL(5.0)	B
Chlorobenzene	DL(7.0)	B	DL(5.0)	B	DL(6.0)	B	DL(5.0)	B
Dibromochloromethane	DL(7.0)	B	DL(5.0)	B	DL(6.0)	B	DL(5.0)	B
Chloroethane	DL(13.0)	B	DL(10.0)	B	DL(13.0)	B	DL(10.0)	B
Chloroform	5.9	C	5.0	C	DL(6.0)	B	DL(5.0)	B
Bromodichloromethane	DL(7.0)	B	DL(50.0)	B	DL(6.0)	B	DL(5.0)	B
1,1-Dichloroethane	DL(7.0)	B	5.0	C	DL(6.0)	B	DL(5.0)	B
1,2-Dichloroethane	DL(7.0)	B	5.0	C	DL(6.0)	B	5.0	A
1,1-Dichloroethene	DL(7.0)	B	DL(5.0)	B	DL(6.0)	B	DL(5.0)	B
1,2-Dichloropropane	DL(7.0)	B	DL(5.0)	B	DL(6.0)	B	DL(5.0)	B
Cis-1,3-Dichloropropene	DL(7.0)	B	DL(5.0)	B	DL(6.0)	B	DL(5.0)	B
Ethylbenzene	5.9	C	5.0	C	6.0	C	DL(5.0)	B
Bromomethane	11.4	C	5.0	C	DL(13.0)	B	DL(10.0)	B
Chloromethane	11.4	C	5.0	C	DL(13.0)	B	11.8	A
Methylene chloride	672.0	A	13.0	A	44.3	A	9.5	A
1,1,2,2-Tetrachloroethane	DL(7.0)	B	DL(5.0)	B	DL(6.0)	B	DL(5.0)	B
Tetrachloroethene	5.9	C	5.0	C	DL(6.0)	B	DL(5.0)	B
Toluene	5.9	C	5.0	C	6.0	C	DL(5.0)	B
1,1,1-Trichloroethane	DL(7.0)	B	5.0	C	DL(6.0)	B	DL(5.0)	B
1,1,2-Trichloroethane	DL(7.0)	B	DL(5.0)	B	DL(6.0)	B	DL(5.0)	B
Trichloroethene	DL(7.0)	B	5.0	C	DL(6.0)	B	DL(5.0)	B
Vinyl chloride	DL(13.0)	B	5.0	C	DL(13.0)	B	DL(10.0)	B
Trans-1,3-dichloropropene	5.9	C	DL(5.0)	B	DL(6.0)	B	DL(5.0)	B
Styrene	5.9	C	DL(5.0)	B	DL(6.0)	B	DL(5.0)	B
Acetone	248.0	A	3.3	A	343.5	A	8.36	A
2-Butanone	11.4	C	DL(10.0)	B	DL(13.0)	B	DL(10.0)	B
Carbon disulfide	DL(7.0)	B	DL(5.0)	B	DL(6.0)	B	DL(5.0)	B
2-Hexanone	DL(13.0)	B	3.3	A	DL(13.0)	B	DL(10.0)	B
4-Methyl-2-pentanone	DL(13.0)	B	10.0	C	DL(13.0)	B	DL(10.0)	B
Vinyl acetate	DL(13.0)	B	DL(10.0)	B	DL(13.0)	B	DL(10.0)	B
Xylenes (total)	5.9	C	5.0	C	6.0	C	DL(5.0)	B
1,2-Dichloroethene (total)	5.9	C	5.0	C	DL(6.0)	B	DL(5.0)	B
Cumene	5.9	C	5.0	C	6.0	C	DL(5.0)	B

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Basis Notes:

A - Background determined statistically in accordance with Ohio EPA "How Clean is Clean" policy (July 1991).

B - Background identified as the detection limit (DL), which is the highest reported Contract Required Quantification Limit (CRQL) (listed in parenthesis). The constituent was not found in Site or background samples in the medium.

C - Background identified as the DL, which is the CRQL. The constituent did not exhibit a positive hit above the DL in the background samples AND the statistical evaluation (using a value of one-half the DL) resulted in a value less than the DL (which is the CRQL).

D - Not Applicable (N/A) as the constituent was not analyzed in Site medium.

E - Background determined based upon results of the dissolved metals analysis.

F - Background listed as the DL, which is the CRQL. No variability was present in the background results to determine statistical background.

G - Background identified as the highest (maximum) reported value. An insufficient number of samples (<3) was available for statistical evaluation of background.

TABLE 3-10
CLP SEMI-VOLATILE ORGANIC BACKGROUND CONCENTRATION SUMMARY
PADDYS RUN ROAD SITE

CHEMICAL	Soils (ug/kg)		Groundwater (ug/l)		Sediments (ug/kg)		Surface Water (ug/l)	
	Concentration	Basis	Concentration	Basis	Concentration	Basis	Concentration	Basis
Acenaphthene	372.6	C	DL (10.0)	F	425.0	C	DL (10.0)	B
Acenaphthylene	372.6	C	DL (10.0)	F	425.0	C	DL (10.0)	B
Anthracene	237.0	A	DL (10.0)	C	384.0	A	DL (10.0)	B
Benzo(a)anthracene	597.0	A	DL (10.0)	B	380.0	A	DL (10.0)	B
Benzo(a)pyrene	866.0	A	DL (10.0)	F	400.0	A	DL (10.0)	B
Benzo(b)fluoranthene	1925.0	A	DL (10.0)	F	343.0	A	DL (10.0)	B
Benzo(g,h,i)perylene	602.0	A	DL (10.0)	B	306.0	A	DL (10.0)	B
Benzo(k)fluoranthene	2090.0	A	DL (10.0)	F	495.0	A	DL (10.0)	B
bis(2-Chloroethoxy)methane	DL (430.0)	B	DL (10.0)	B	DL (420.0)	B	DL (10.0)	B
bis(2-Chloroethyl)ether	DL (430.0)	B	DL (10.0)	B	DL (420.0)	B	DL (10.0)	B
bis(2-Chloroisopropyl)ether	DL (430.0)	B	DL (10.0)	C	DL (420.0)	B	DL (10.0)	B
bis(2-Ethylhexyl)phthalate	605.0	A	10.0	A	914.0	A	12.4	A
4-Bromophenyl phenyl ether	DL (430.0)	B	DL (10.0)	B	DL (420.0)	B	DL (10.0)	B
Butyl benzyl phthalate	372.6	C	DL (10.0)	B	DL (420.0)	B	DL (10.0)	B
2-Chloronaphthalene	DL (430.0)	B	DL (10.0)	B	DL (420.0)	B	DL (10.0)	B
4-Chlorophenyl phenyl ether	DL (430.0)	B	DL (10.0)	B	DL (420.0)	B	DL (10.0)	B
Chrysene	836.0	A	DL (10.0)	B	399.0	A	DL (10.0)	B
Dibenzo(a,h)anthracene	257.0	A	DL (10.0)	C	425.0	C	DL (10.0)	B
1,2-Dichlorobenzene	DL (430.0)	B	DL (10.0)	C	DL (420.0)	B	DL (10.0)	B
1,3-Dichlorobenzene	DL (430.0)	B	DL (10.0)	F	DL (420.0)	B	DL (10.0)	B
1,4-Dichlorobenzene	DL (430.0)	B	3.8	A	DL (420.0)	B	DL (10.0)	B
3-3-Dichlorobenzidine	DL (860.0)	B	DL (10.0)	B	DL (850.0)	B	DL (10.0)	B
Diethyl phthalate	DL (430.0)	B	DL (10.0)	F	DL (420.0)	B	DL (10.0)	B
Dimethyl phthalate	372.6	C	DL (10.0)	F	DL (420.0)	B	DL (10.0)	B
Di-n-butyl phthalate	372.6	C	DL (10.0)	F	397.0	A	DL (10.0)	B
2-4-Dinitrotoluene	372.6	C	2.1	A	DL (420.0)	B	DL (10.0)	B
2,6-Dinitrotoluene	DL (430.0)	B	DL (10.0)	B	DL (420.0)	B	DL (10.0)	B
Di-n-octyl phthalate	372.6	C	1.5	A	DL (420.0)	B	DL (10.0)	B
Fluoranthene	506.0	A	DL (10.0)	F	624.0	A	DL (10.0)	B
Fluorene	372.6	C	DL (10.0)	F	425.0	C	DL (10.0)	B
Hexachlorobenzene	DL (430.0)	B	3.8	A	DL (420.0)	B	DL (10.0)	B
Hexachlorobutadiene	DL (430.0)	B	DL (10.0)	B	DL (420.0)	B	DL (10.0)	B
Hexachlorocyclopentadiene	DL (430.0)	B	DL (10.0)	B	DL (420.0)	B	DL (10.0)	B
Hexachloroethane	DL (430.0)	B	DL (10.0)	B	DL (420.0)	B	DL (10.0)	B

Basis Notes:

A - Background determined statistically in accordance with Ohio EPA "How Clean is Clean" policy (July 1991).

B - Background identified as the detection limit (DL), which is the highest reported Contract Required Quantification Limit (CRQL) (listed in parenthesis). The constituent was not found in Site or background samples in the medium.

C - Background identified as the DL, which is the CRQL. The constituent did not exhibit a positive hit above the DL in the background samples AND the statistical evaluation (using a value of one-half the DL) resulted in a value less than the DL (which is the CRQL).

D - Not Applicable (N/A) as the constituent was not analyzed in Site medium.

E - Background determined based upon results of the dissolved metals analysis.

F - Background listed as the DL, which is the CRQL. No variability was present in the background results to determine statistical background.

G - Background identified as the highest (maximum) reported value. An insufficient number of samples (<3) was available for statistical evaluation of background.

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TABLE 3-10 (Continued)
CLP SEMI-VOLATILE ORGANIC BACKGROUND CONCENTRATION SUMMARY
PADDYS RUN ROAD SITE

CHEMICAL	Soils (ug/kg)		Groundwater (ug/l)		Sediments (ug/kg)		Surface Water (ug/l)	
	Concentration	Basis	Concentration	Basis	Concentration	Basis	Concentration	Basis
Indeno (1,2,3-cd)pyrene	662.0	A	DL (10.0)	B	425.0	C	DL (10.0)	B
Isophorone	DL (430.0)	B	DL (10.0)	C	DL (420.0)	B	DL (10.0)	B
Naphthalene	372.6	C	DL (10.0)	F	425.0	C	DL (10.0)	B
Nitrobenzene	DL (430.0)	B	DL (10.0)	B	DL (420.0)	B	DL (10.0)	B
Nitroso-di-n-propylamine	DL (430.0)	B	DL (10.0)	B	DL (420.0)	B	DL (10.0)	B
N-Nitrosodiphenylamine(1)	DL (430.0)	B	DL (10.0)	B	DL (420.0)	B	DL (10.0)	B
Phenanthrene	292.0	A	DL (10.0)	F	420.0	A	DL (10.0)	B
Pyrene	505.0	A	DL (10.0)	F	643.0	A	DL(10.0)	B
1,2,4-Trichlorobenzene	DL (430.0)	B	DL (10.0)	B	DL (420.0)	B	DL (10.0)	B
Benzyl alcohol	372.6	C	DL (10.0)	F	DL (420.0)	B	DL (10.0)	B
4-Chloroaniline	DL (430.0)	B	DL (10.0)	B	DL (420.0)	B	DL (10.0)	B
Dibenzofuran	372.6	C	DL (10.0)	F	425.0	C	DL (10.0)	B
2-Methylnaphthalene	372.6	C	DL (10.0)	F	425.0	C	DL (10.0)	B
2-Nitroaniline	DL (2100.0	B	DL (50.0)	B	DL (2100.0)	B	DL (50.0)	B
3-Nitroaniline	DL (2100.0)	B	DL (50.0)	C	DL (2100.0)	B	DL (50.0)	B
4-Nitroaniline	DL (2100.0)	B	DL (50.0)	F	DL (2100.0)	B	DL (50.0)	B
2-Chlorophenol	DL (430.0)	B	DL (10.0)	B	DL (420.0)	B	DL (10.0)	B
2,4-Dichlorophenol	DL (430.0)	B	DL (10.0)	B	DL (420.0)	B	DL (10.0)	B
2,4-Dimethylphenol	372.6	C	DL (10.0)	F	425.0	C	DL (10.0)	B
4,6-Dinitro-2-Methylphenol	1806.2	C	DL (50.0)	B	DL (2100.0)	B	DL (50.0)	B
2,4-Dinitrophenol	1806.2	C	DL (50.0)	B	DL (2100.0)	B	DL (50.0)	B
2-Nitrophenol	DL (430.0)	B	DL (10.0)	B	DL (420.0)	B	DL (10.0)	B
4-Nitrophenol	1806.2	C	DL (50.0)	F	DL (2100.0)	B	DL (50.0)	B
4-Chloro-3-methylphenol	372.6	C	DL (10.0)	F	DL (420.0)	B	DL (10.0)	B
Pentachlorophenol	1403.0	A	DL (50.0)	F	DL (2100.0)	B	DL (50.0)	B
Phenol	372.6	C	DL (10.0)	F	425.0	C	DL (10.0)	B
2,4,6-Trichlorophenol	DL (430.0)	B	DL (10.0)	B	DL (420.0)	B	DL (10.0)	B
2-Methylphenol	372.6	C	DL (10.0)	F	DL (420.0)	B	DL (10.0)	B
4-Methylphenol	372.6	C	DL (10.0)	F	425.0	C	DL (10.0)	B
Benzoic acid	3612.4	C	DL (50.0)	F	1379.0	A	DL (50.0)	B
2,4,5-Trichlorophenol	1806.2	C	DL (50.0)	B	DL (2100.0)	B	DL (50.0)	B

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Basis Notes:

A - Background determined statistically in accordance with Ohio EPA "How Clean is Clean" policy (July 1991).

B - Background identified as the detection limit (DL), which is the highest reported Contract Required Quantification Limit (CRQL) (listed in parenthesis). The constituent was not found in Site or background samples in the medium.

C - Background identified as the DL, which is the CRQL. The constituent did not exhibit a positive hit above the DL in the background samples AND the statistical evaluation (using a value of one-half the DL) resulted in a value less than the DL (which is the CRQL).

D - Not Applicable (N/A) as the constituent was not analyzed in Site medium.

E - Background determined based upon results of the dissolved metals analysis.

F - Background listed as the DL, which is the CRQL. No variability was present in the background results to determine statistical background.

G - Background identified as the highest (maximum) reported value. An insufficient number of samples (<3) was available for statistical evaluation of background.

TABLE 3-11
CLP PESTICIDES/PCB BACKGROUND CONCENTRATION SUMMARY
PADDYS RUN ROAD SITE

CHEMICAL	Soils (ug/kg)		Groundwater (ng/l)		Sediments (ug/kg)		Surface Water (ng/l)	
	Concentration	Basis	Concentration	Basis	Concentration	Basis	Concentration	Basis
Pesticides								
Aldrin	DL (10.0)	B	DL (5.0)	F	DL (10.0)	B	DL (5.0)	B
Alpha-BHC	DL (10.0)	B	DL (5.0)	F	DL (10.0)	B	DL (5.0)	B
Beta-BHC	18.0	C	DL (5.0)	B	DL (10.0)	B	DL (5.0)	B
Gamma-BHC	DL (10.0)	B	DL (5.0)	B	DL (10.0)	B	DL (5.0)	B
Delta-BHC	DL (10.0)	B	DL (5.0)	F	DL (10.0)	B	DL (5.0)	B
4,4'-DDT	146.0	A	DL (10.0)	F	DL (20.0)	B	DL (10.0)	B
4,4'-DDE	426.0	A	DL (10.0)	F	DL (20.0)	B	DL (10.0)	B
4,4-DDD	35.9	C	DL (10.0)	F	DL (20.0)	B	DL (10.0)	B
Dieldrin	35.9	C	DL (10.0)	F	DL (20.0)	B	DL (10.0)	B
Endosulfan I	9.0	C	DL (5.0)	B	DL (10.0)	B	DL (5.0)	B
Endosulfan II	DL (20.0)	B	DL (10.0)	F	DL (20.0)	B	DL (10.0)	B
Endosulfan Sulfate	35.9	C	DL (10.0)	F	DL (20.0)	B	DL (10.0)	B
Endrin	17.9	C	DL (10.0)	F	DL (20.0)	B	DL (10.0)	B
Heptachlor	DL (10.0)	B	DL (5.0)	F	DL (10.0)	B	DL (5.0)	B
Heptachlor epoxide	9.0	C	DL (10.0)	F	DL (10.0)	B	DL (10.0)	B
Toxaphene	DL (200.0)	B	DL (100.0)	B	DL (200.0)	B	1350.0	A
p,p'-Methoxychlor	89.8	C	DL (50.0)	F	DL (100.0)	B	DL (50.0)	B
Endrin Ketone	35.9	C	DL (10.0)	F	DL (20.0)	B	DL (10.0)	B
Alpha Chlordane	DL (100.0)	B	DL (50.0)	B	DL (100.0)	B	DL (50.0)	B
Gamma Chlordane	DL (100.0)	B	DL (50.0)	B	DL (100.0)	B	DL (50.0)	B
Polychlorinated Biphenyls								
PCB-1242	DL (100.0)	B	DL (50.0)	B	DL (100.0)	B	DL (50.0)	B
PCB-1254	DL (200.0)	B	DL (100.0)	B	DL (200.0)	B	DL (100.0)	B
PCB-1221	DL (100.0)	B	DL (50.0)	B	DL (100.0)	B	DL (50.0)	B
PCB-1232	DL (100.0)	B	DL (50.0)	F	DL (100.0)	B	DL (50.0)	B
PCB-1248	DL (100.0)	B	DL (50.0)	B	DL (100.0)	B	DL (50.0)	B
PCB-1260	358.8	C	DL (100.0)	B	DL (200.0)	B	DL (100.0)	B
PCB-1016	179.8	C	DL (50.0)	B	DL (100.0)	B	DL (50.0)	B

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Basis Notes:

A - Background determined statistically in accordance with Ohio EPA "How Clean is Clean" policy (July 1991).

B - Background identified as the detection limit (DL), which is the highest reported Contract Required Quantification Limit (CRQL) (listed in parenthesis). The constituent was not found in Site or background samples in the medium.

C - Background identified as the DL, which is the CRQL. The constituent did not exhibit a positive hit above the DL in the background samples AND the statistical evaluation (using a value of one-half the DL) resulted in a value less than the DL (which is the CRQL).

D - Not Applicable (N/A) as the constituent was not analyzed in Site medium.

E - Background determined based upon results of the dissolved metals analysis.

F - Background listed as the DL, which is the CRQL. No variability was present in the background results to determine statistical background.

G - Background identified as the highest (maximum) reported value. An insufficient number of samples (<3) was available for statistical evaluation of background.

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TABLE 3-12
GENERAL AND RADIOLOGICAL BACKGROUND CONCENTRATION SUMMARY
PADDYS RUN ROAD SITE

CHEMICAL	Soils (mg/kg)		Groundwater (mg/l)		Sediments (mg/kg)		Surface Water (mg/l)	
	Concentration	Basis	Concentration	Basis	Concentration	Basis	Concentration	Basis
General Parameters								
Cyanide	DL (0.52)	D	DL (0.01)	D	2.338	A	DL (0.01)	D
Ammonia	216.835	A	0.398	A	232.561	A	8.139	A
Chloride	10	C	100	A	603.6	A	42.07	A
Total Organic Carbon	N/A	D	33.113	A	N/A	D	N/A	D
Nitrate	N/A	D	0.032	A	N/A	D	N/A	D
pH (S.U.*)	6.798-8.214	A	6.62-7.78	A	7.2 - 7.5	G	7.2 - 7.5	G
Total Phosphorus	2943.249	A	12.367	A	2072.34	A	0.836	A
Diss. Phosphorus	N/A	D	0.437	A	N/A	D	0.1	G
Diss. Solids	N/A	D	634.395	A	N/A	D	N/A	D
Sulfate	4747.008	A	123.068	A	1567.204	A	83.421	A
Radiological (pCi/l and pCi/g)								
Gross Alpha	14.946	A	579.27	A	7.4	G	17	G
Gross Beta	30.319	A	365.393	A	16	G	18	G
Total Uranium	1.16	A	647.279	A	149.932	A	26.727	A
Potassium-40	22.305	A	189.817	A	5.7	G	DL (80)	G

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Basis Notes:

A - Background determined statistically in accordance with Ohio EPA "How Clean is Clean" policy (July 1991).

B - Background identified as the detection limit (DL), which is the highest reported Contract Required Quantification Limit (CRQL) (listed in parenthesis). The constituent was not found in Site or background samples in the medium.

C - Background identified as the DL, which is the CRQL. The constituent did not exhibit a positive hit above the DL in the background samples AND the statistical evaluation (using a value of one-half the DL) resulted in a value less than the DL (which is the CRQL).

D - Not Applicable (N/A) as the constituent was not analyzed in Site medium.

E - Background determined based upon results of the dissolved metals analysis.

F - Background listed as the DL, which is the CRQL. No variability was present in the background results to determine statistical background.

G - Background identified as the highest (maximum) reported value. An insufficient number of samples (<3) was available for statistical evaluation of background.

* Standard Units

3.6 Surface Water Characterization

The physical and chemical characteristics of Paddys Run and the cooling pond on RNC property were assessed as part of the Phase II RI. Understanding the physical characteristics of surface water helps determine the potential for constituent transportation. Analyzing for chemical quality indicates whether or not the surface water has been impacted. In addition, determination of these characteristics support both the groundwater model and the human exposure assessment.

The physical characteristics of Paddys Run and the cooling pond are discussed in the following sections. Chemical characteristics for both Paddys Run and the cooling pond are presented in Section 3.6.3.

3.6.1 Physical Characteristics of Paddys Run

Originating north of FEMP in Butler County, Ohio, Paddys Run flows along the western edge of the Study Area south to where it empties into the Great Miami River. Its total length is less than four miles.

Paddys Run is a seasonally flowing stream which means that at certain times of the year the stream channel will either contain water or be dry. In late winter and during the spring months the stream channel usually flows with water. Other times of the year, sections of the stream channel contain no water or contain small areas of pooled, stagnant water. Rainstorms can cause the stream to flow temporarily. The potential for flooding is discussed in Section 3-10.

North of the Study Area and mostly on FEMP property, Paddys Run is confined to a narrow channel that has been created through erosion. The stream has eroded steep sided banks of 20 feet or more through glacial till and lacustrine deposits (U.S. DOE 1990b).

Sediments collected at two locations from the Paddys Run channel were analyzed for particle size distribution. Results indicate that 82% to 90% of the material was

composed of medium coarse sands and gravels. Medium coarse sand and gravel stream beds and deeply cut banks are indicative of erosion that occurs during high flow rates caused by precipitation events.

The narrow channel opens into a wide valley south of Delta Steel. The stream channel generally follows the till and bedrock outcrops on the west side of the Study Area as it flows towards the Great Miami River. The stream has not eroded a deep channel in this reach as it has on the FEMP property. Generally, the bottom of the channel ranges 2 to 15 feet lower than the adjacent banks.

The course of Paddys Run has been modified three times by engineering techniques. In 1961 and 1962, it was redirected away from the waste pit area on the FEMP property. In 1970, a stretch of Paddys Run south of the K-65 silos (on the FEMP property) was straightened to prevent undercutting Paddys Run Road.

Paddys Run Flow Characteristics

Paddys Run loses and gains water to the aquifer system. North of the Study Area, Paddys Run is above the regional water table, and any water within the channel continually loses water to the underlying zones. Between Willey and New Haven Roads, Paddys Run gains water because the stream channel lies below the water table, and groundwater discharges to Paddys Run (U.S. DOE 1988a). Locations where Paddys Run lies below the water table vary with the seasons, but they tend to be further south during months when groundwater levels are lowest (U.S. DOE 1988a). During very dry periods the water table can be sufficiently low such that Paddys Run's channel does not intercept the water table, and no water is present in the channel except for small pools of water.

Between January and May, flow is generally continuous to the Great Miami River. During these months, the flow typically ranges from 0.2 cubic feet per second (cfs) to 4 cfs (Dames & Moore, Inc. 1985b). Under conditions of heavy runoff from rain or snow, the stream can carry up to 223 cfs of water at an instantaneous rate (Mobil Chemical Company 1984).

Between the months of June and December any water in Paddys Run south of Willey Road usually disappears into the underlying aquifer.

A biological investigation was performed in Paddys Run by Mobil Chemical in 1983 (Mobil Chemical Company 1984). As part of that investigation, the average depth, velocity, channel width, and flow rate were measured. Also, as part of the monthly recording of water levels, the Companies measured the depth of the channel bottom at five staff gauge locations. Data from the Mobil and the Companies' investigations are shown in Table 3-13. Mobil data collection points along with staff gauge locations are shown in Figure 3-9. Table 3-13 indicates clearly the high spring flow rates and low fall flow rates.

Discharges to Paddys Run

Outside of the Study Area, most surface water from the western portion of the FEMP site drains into Paddys Run. A portion of the runoff from the FEMP production area is collected and is allowed to discharge to the storm sewer outfall ditch (SSOD) (U.S. DOE 1987). The SSOD has been the point of discharge for the storm sewer system since the FEMP was constructed.

The ditch is a natural gully that cuts through the south-central to southwest portion of the FEMP Site. The SSOD empties into Paddys Run near Willey Road at the southwestern corner of the FEMP (U.S. DOE 1987).

Within the Study Area, two field drainage ditches empty into Paddys Run. One originates in a field east of the A&W property, passing under the railroad tracks and through the northern end of the A&W property, and continues west to Paddys Run. The total length of the ditch is approximately 1,500 feet. In the past, A&W used this ditch to discharge its treated wastewater. Prior to 1974, discharge to the ditch could infiltrate through the ditch bottom to the subsurface soils. In 1974, a National Pollutant Discharge Elimination System (NPDES) permit was issued to discharge to the ditch. In 1975, a pipeline was placed in the ditch to carry the permitted, treated,

TABLE 3-13
PADDYS RUN STREAM CHARACTERISTICS
PADDYS RUN ROAD SITE

		UPSTREAM STATION	DOWNSTREAM STATION	STAFF GAUGE				
		1	2	1	2	3	4	5
May 11, 1983	Average Depth (feet)	1.83	1.60					
	Velocity (feet/sec)	0.6	1.28					
	Channel Width (feet)	27.42	29.08					
	GPM	13,500	26,800					
November 30, 1983	Average Depth (feet)	0.45	0.59					
	Velocity (feet/sec)	1.16	0.88					
	Channel Width (feet)	25.42	27.0					
	GPM	100	105					
March 25, 1992	Depth (feet)			Dry	0.11	0.22	Dry	2.08
April 27, 1992	Depth (feet)			0.38	0.17	0.23	0.13	2.21
May 20, 1992	Depth (feet)			Dry	0.30	Dry	Dry	Dry
	Channel Width (feet)			50.0	41.0	47.0	47.4	18.7

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Notes:

1 - Taken from June 1984 . . .

Final Report Biological Investigation in Paddys Run Creek

2 - Measured at Staff Gauges on Paddys Run

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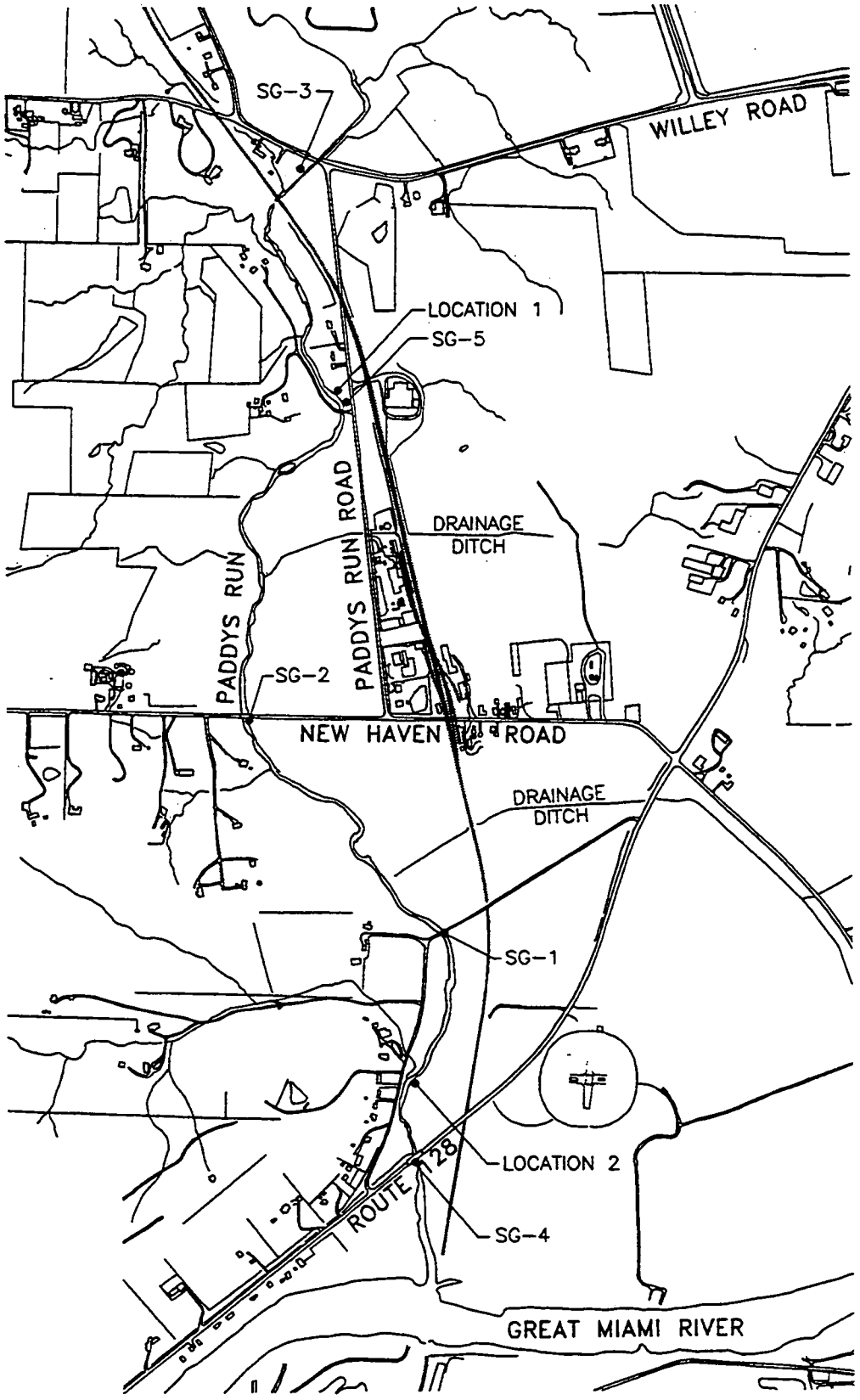

GRAPHIC SCALE

1200 0 600 1200 2400

(IN FEET)
1 INCH = 1200 FT.

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LOCATIONS OF STREAM SAMPLING POINTS (LOCATIONS 1 AND 2) IN MOBIL'S 1983 STUDY OF PADDYS RUN AND WATER LEVEL GAUGES SG-1 THROUGH SG-5 PPRS HAMILTON COUNTY, OHIO

FIGURE 3-9

ERM-Midwest, inc.
Environmental Resources Management

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wastewater. In April 1991, A&W received an NPDES permit to discharge via a pipeline to the Great Miami River. Currently, the ditch receives only stormwater from the A&W property.

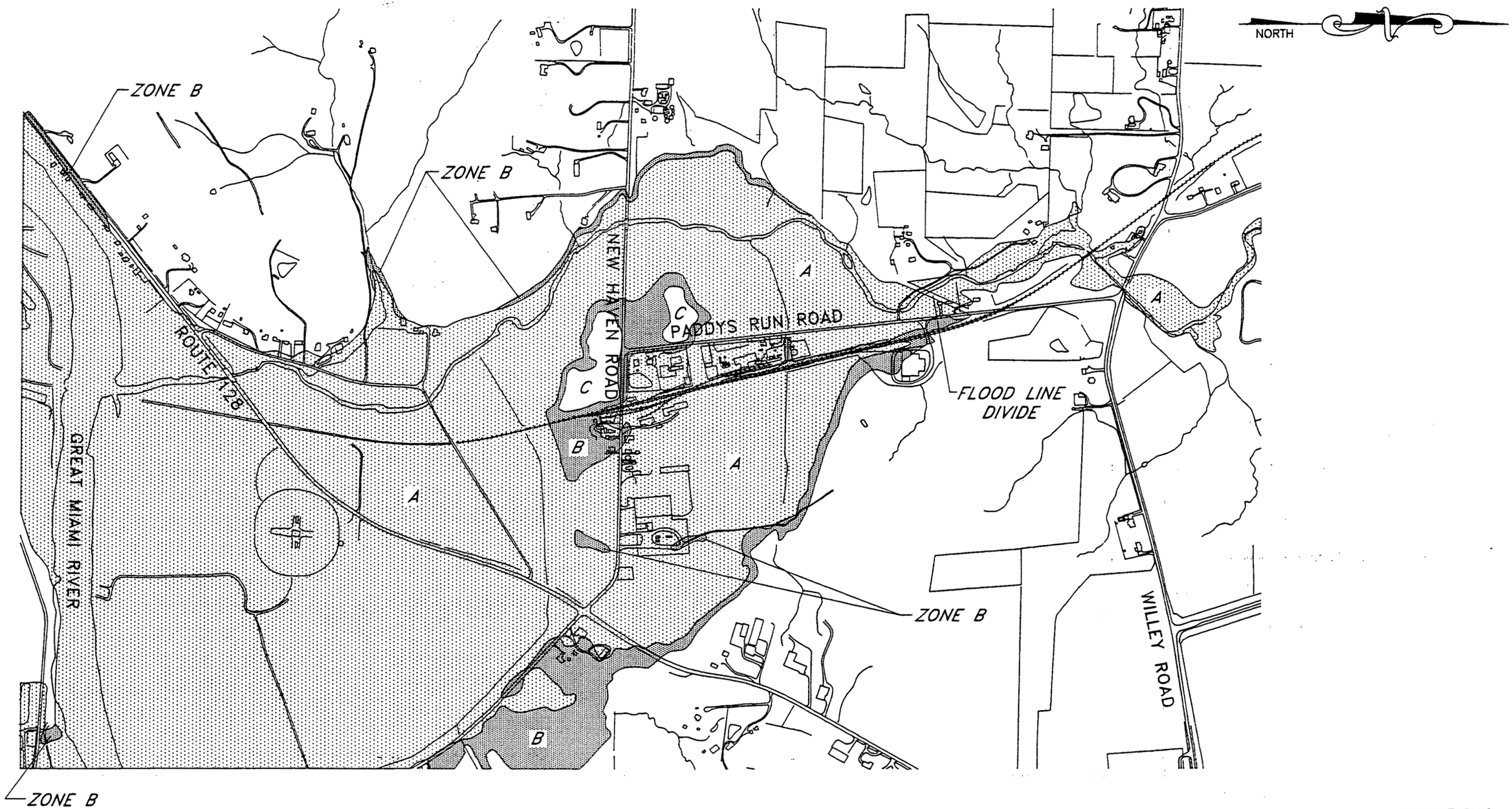
Another ditch is south of New Haven Road and drains an agricultural field. This ditch originates east of Paddys Run, outside the Study Area. Both ditches are shown in Figure 3-9.

Flooding

Figure 3-10 shows the flooding potential related to the Study Area. Areas potentially affected by 100 and 500 year floods are determined based on statistical probability that within a time period of 100 years and 500 years a flood will occur that will equal or exceed the areas outlined within the respective zone. The areas indicated as zone "A" are the approximate areas that would be affected by a 100 year flood. Zone "B" are those areas that would be susceptible to flooding in a 500 year flood, and zone "C" areas are described as areas that would not be affected by flooding even through a 500 year flood.

The short line located just north of the Companies' property that runs from northeast to southwest is a floodwater divide line. That is, flooded areas north of this line would be influenced by Paddys Run while areas south of the line would be affected by the flood waters from the Great Miami River. Thus, most flooding that would occur within the Study Area would be from the Great Miami River.

As indicated on the figure, most of the Study Area would be affected during a 100 year flood. Areas not directly affected by the 100 year flood include the areas south and west of the Companies' properties (indicated as zones B and C), two small zone B areas east of the Companies' properties, and those areas which surround the Study Area (zones B and C).



LEGEND

ZONE A		100 YEAR FLOOD BOUNDARY
ZONE B		500 YEAR FLOOD BOUNDARY
ZONE C		AREAS NOT AFFECTED BY FLOODING

GRAPHIC SCALE

800 0 400 800 1600

(IN FEET)
1 INCH = 800 FT.

FLOOD BOUNDARIES RELATED TO THE STUDY AREA FOR A 100 YEAR FLOOD AND A 500 YEAR FLOOD PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO

FIGURE 3-10

ERM-Midwest, inc.
Environmental Resources Management

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3.6.2 Physical Characteristics of the Cooling Pond

As discussed in Section 3.4, the cooling pond (Pond R) is located on the southeast corner of the RNC property. It is approximately 150 feet by 100 feet, by 3 feet deep (ENSR 1990), and is bordered by an area of maintained grass. It has a surface elevation of approximately 524 FAMSL.

The pond was originally constructed in 1965-1966 and was designed as an infiltration pond. The maximum depths were 10 feet at the south end and 6 feet at the north end. This pond received only the non-contact cooling water from the Process Building.

3.6.3 Paddys Run and Pond Chemical Characteristics

This section presents the results of analyses for Paddys Run and the pond. There have been two rounds of samples collected from Paddys Run and one round of samples collected from the cooling pond as part of the PRRS RI.

The two rounds for Paddys Run were collected on March 21 and 22, 1990 and on May 13, and 14, 1991. Eight surface water samples were collected during the first round of sampling, five from Paddys Run and three from the cooling pond. Seven surface water samples were collected during the second round of sampling, all from Paddys Run. The purpose of collecting two rounds was to provide a basis for comparison between the two sampling events for seasonal variations in Paddys Run. The single sampling event in the pond was to determine whether chemicals are present.

As stated in Section 2.6, all surface water samples for both events were analyzed for the CLP, general and radiological parameters shown in Table 2-1.

Table 3-14 shows the results of analyses for parameters that were detected at levels above background in the surface water samples for the two sampling rounds. Table 3-15 shows results of analyses for parameters that were detected at levels above

TABLE 3-14
PADDYS RUN SURFACE WATER
CHEMICALS DETECTED ABOVE BACKGROUND(+)
PADDYS RUN ROAD SITE

Sample ID	Phase(++)	Value	Sample ID	Phase(++)	Value	Sample ID	Phase(++)	Value
DISSOLVED METALS								
Zinc (14.8 ug/l)								
ESW -01	1	18.8	ESW-05	1	14.8			
Manganese (63.6 ug/l)								
ESW-04	1	69.9	SW-03	2	136	SW-04	2	122
SW-05	2	88.8	SW-06	2	93.4			
TOTAL METALS								
Zinc (3.7 ug/l)								
SW-01	2	7.1	SW-02	2	11.2			
Antimony (22.0 ug/l)								
SW-02	2	25.8						
Manganese (63.6 ug/l)								
SW-03	2	128	SW-04	2	106	SW-05	2	81.3
SW-06	2	80.5						
VOLATILE ORGANIC COMPOUNDS								
Acetone (8.36 ug/l)								
ESW-04	1	18						
SEMIVOLATILE ORGANIC COMPOUNDS - NONE								
PESTICIDES/PCBS								
Toxaphene (1350 ng/l)								
SW-06	2	8600						
GENERAL PARAMETERS								
Phosphorus, Dissolved (0.1 mg/l)								
SW-01	2	0.5	SW-02	2	0.6	SW-03	2	0.5
SW-04	2	0.6	SW-05	2	0.3	SW-06	2	0.3
RADIOLOGICAL PARAMETERS - NONE								

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(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)Phase 1 surface water samples were collected by ENSR in March 1990; Phase 2 was collected by ERM in May 1991.

ESW-01 - ENSR surface water sample
SW-04 - ERM surface water sample

TABLE 3-15
POND SURFACE WATER
CHEMICALS DETECTED ABOVE BACKGROUND (+)
PADDYS RUN ROAD SITE

Sample ID	Phase(++)	Value	Sample ID	Phase(++)	Value	Sample ID	Phase(++)	Value
DISSOLVED METALS								
Zinc (14.8 ug/l)								
ESWPD-01	1	80.6	ESWPD-02	1	51	ESWPD-03	1	48
Manganese (63.6 ug/l)								
ESWPD-01	1	120	ESWPD-02	1	118	ESWPD-03	1	117
Sodium (19793 ug/l)								
ESWPD-01	1	292000	ESWPD-02	1	287000	ESWPD-03	1	284000
Potassium (5644 ug/l)								
ESWPD-01	1	7720	ESWPD-02	1	6480	ESWPD-03	1	7100
VOLATILE ORGANIC COMPOUNDS								
Methylene Chloride (9.5 ug/l)								
ESWPD-03	1	410						
Acetone (8.36 ug/l)								
ESWPD-01	1	9600	ESWPD-03	1	7800			
4-Methyl-2-pentanone [DL (10 ug/l)]								
ESWPD-02	1	48						
Xylenes, Total [DL (5 ug/l)]								
ESWPD-02	1	360	ESWPD-03	1	140			
SEMIVOLATILE ORGANIC COMPOUNDS								
Fluoranthene [DL (10 ug/l)]								
ESWPD-01	1	13	ESWPD-03	1	11			
2,4-Dimethylphenol [DL (10 ug/l)]								
ESWPD-01	1	190	ESWPD-02	1	120	ESWPD-03	1	150
PESTICIDES/PCBS - NONE								
GENERAL PARAMETERS								
Phosphorus, Total (0.836 mg/l)								
ESWPD-01	1	4.5	ESWPD-02	1	5.0	ESWPD-03	1	4.7
Chloride (42.07 mg/l)								
ESWPD-01	1	140	ESWPD-02	1	160	ESWPD-03	1	160
Sulfate (83.421 mg/l)								
ESWPD-01	1	230	ESWPD-02	1	250	ESWPD-03	1	240
Ammonia (8.139 mg/l)								
ESWPD-01	1	24	ESWPD-02	1	25	ESWPD-03	1	26
RADIOLOGICAL PARAMETERS - NONE								

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(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)Pond surface water samples were collected in March 1990 by ENSR.

ESWPD-01 - ENSR surface water sample (pond)

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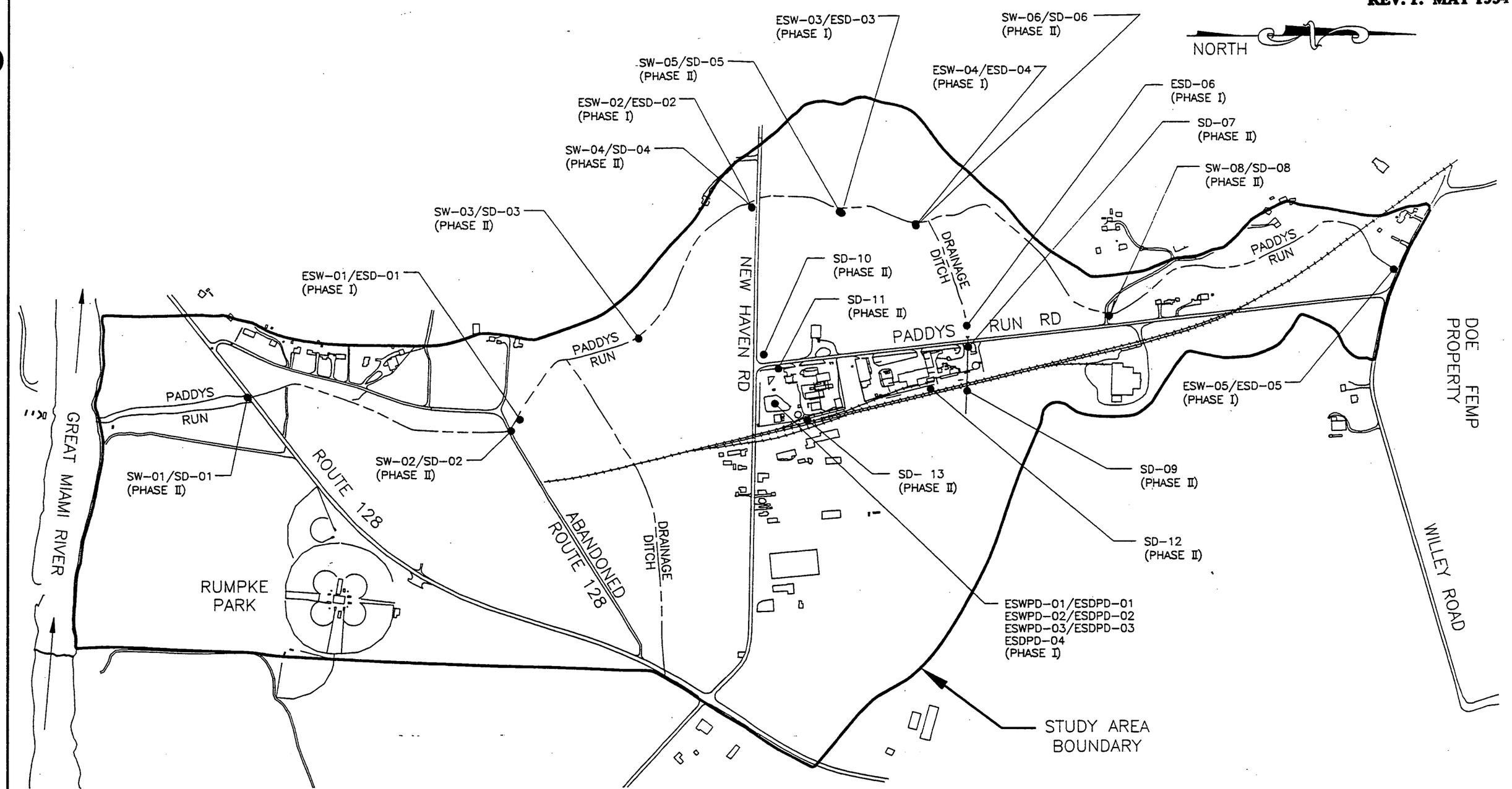
background for the pond surface water samples. Figure 3-11 shows the locations of sample collection.

3.7 Sediment Characterization

The physical and chemical characteristics of sediments within Paddys Run, drainage ditches and the cooling pond were assessed as part of the RI/RA. Sediments are accumulations of soil, sand, and minerals washed from land into water usually after rain (U.S. EPA 1992). Sediments are important because of their ability to retain chemicals. With the appropriate properties, sediment can sorb organic chemicals and complex metals (Baudo, et al. 1990). Physical and chemical properties that influence sorption include, particle size, clay type and content, organic carbon content, cation exchange capacity, and pH (Baudo, et al. 1990). Clay content and organic content are important because sorption takes place primarily on clay particles and organic material. The more clay and/or organic carbon present, the more likely sorption will take place.

Sample locations are shown in Figure 3-11. The physical properties were established from one sampling event during Phase II. Chemical properties, determined from Phase I, came from five locations in Paddys Run, one sediment sample from the drainage ditch that passes through the north end of A&W, and four sediment samples from the cooling pond. Phase II expanded the number of sampling locations within Paddys Run from five to seven and added five more sediment samples from drainage ditches around the Companies' property. No additional samples were collected from the cooling pond.

The pH of the sediment also affects the extent of absorption of metal ions as well as its ionic form. In addition, pH controls the process of methylation which is a biogeochemical process between a metal ion and a methyl ion. This process is important because metals and metalloids that are typically toxic (i.e., mercury, lead and arsenic) can, through methylation, become less toxic. The following sections will present the available data on the physical and chemical properties for the sediments in Paddys Run, drainage ditches and the pond.



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GRAPHIC SCALE

600 0 300 600 1200

(IN FEET)
1 inch = 600 ft.

KEY

ESW-02	–	ENSR SURFACE WATER SAMPLE
ESWPD-01	–	ENSR SURFACE WATER SAMPLE (POND)
ESDPD-01	–	ENSR SEDIMENT SAMPLE (POND)
ESD--04	–	ENSR SEDIMENT SAMPLE
SW-01	–	ERM SURFACE WATER SAMPLE
SD-06	–	ERM SEDIMENT SAMPLE

SURFACE WATER AND SEDIMENT COLLECTION LOCATIONS FOR PHASE I AND PHASE II PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO

FIGURE 3-11

ERM ERM-Midwest, inc.
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3.7.1 Physical and Chemical Properties of Sediments in Paddys Run

Sediment samples for particle size analysis were collected from the stream channel of Paddys Run at three locations shown in Figure 3-11. At the time of collection water was either barely flowing or was in pools. Samples were collected from areas that did contain water. Methodology for sediment collection is presented in Appendix B-2.

Particle size analysis curves, included in Appendix D, indicate that at location SB-02 the sample was composed of 20 percent gravel, 65 percent sand, and 15 percent silt. Sample from SD-06 contained 12 percent gravel, 79 percent sand and 9 percent silt. Sediment from SD-08 contained 14 percent gravel, 76 percent sand and 10 percent silt. No clay was detected in any of the three samples analyzed.

Sediment pH was analyzed from five locations within Paddys Run during the Phase I investigations. Organic carbon content reported as total organic carbon (TOC) and measured in milligrams per kilogram (mg/kg), and pH samples were collected for analysis at seven locations during Phase II within Paddys Run. Results of those analyses are shown in Table 3-16.

TABLE 3-16
PADDYS RUN SEDIMENT - pH AND TOC RESULTS

Collection Point	Phase	Analysis Result pH	% TOC
ESD - 01	1	7.3	-
ESD - 02	1	7.3	-
ESD - 03	1	7.4	-
ESD - 04	1	7.1	-
ESD - 05	1	7.2	-
SD - 01	2	7.3	0.015
SD - 02	2	7.4	0.015
SD - 03	2	7.7	0.015
SD - 04	2	7.6	0.015
SD - 05	2	7.7	0.015
SD - 06	2	7.5	0.015
SD - 08	2	7.5	0.34

A pH of 7.0 is considered neutral; values below 7.0 are acidic and above 7.0 are alkaline. The range of pH can be from 1 through 14. Background is 7.2 to 7.5 for the Study Area. TOC affects chemical mobility primarily by its capacity to sorb organic chemicals and complex metals (Baudo, et al. 1990). The higher the TOC, the higher the sorptive capacity. Total organic carbon in Paddys Run is low.

Table 3-17 shows results of analyses for those parameters that were detected at levels above background in the sediment samples from Paddys Run for the two sampling rounds.

3.7.2 Physical and Chemical Properties of Sediments in the Drainage Ditches

Sediment samples for particle size analysis were collected from surface drainage ditches from two locations shown in Figure 3-11. Water was not present during the sampling event. Methodology for sediment collection is presented in Appendix B-2.

Particle size curves in Appendix D indicate that at location number 11 the sample was composed of 1 percent gravel, 44 percent sand, 41 percent silt and 14 percent clay. Sediment from location 12 contained 4 percent gravel, 28 percent sand, 43 percent silt, and 25 percent clay. Bottom sediment of the ditches is made up of fine-grained material.

During Phase I, one sediment sample was collected west of Paddys Run Road from the drainage ditch that passes through the north end of the A&W property. That sample had a pH of 6.9. Sediment samples were collected from six different locations during Phase II. Those samples were analyzed for total organic carbon and pH. The results of those analyses are shown in Table 3-18.

TABLE 3-17
PADDYS RUN ROAD SEDIMENTS
CHEMICALS DETECTED ABOVE BACKGROUND(+)
PADDYS RUN ROAD SITE

Sample ID	Phase(++)	Value	Sample ID	Phase(++)	Value	Sample ID	Phase(++)	Value
TOTAL METALS								
Manganese (558.09 mg/kg)								
SD-02	2	630.0	ESD-02	1	570			
Calcium (193827.31 mg/kg)								
SD-04	2	495000						
Potassium (1557.88 mg/kg)								
ESD-01	1	1950.0	ESD-03	1	1710.0			
VOLATILE ORGANIC COMPOUNDS								
Methylene Chloride (44.3 ug/kg)								
ESD-01	1	49	ESD-02	1	46			
SEMIVOLATILE ORGANIC COMPOUNDS								
Fluoranthene (624 ug/kg)								
ESD-01	1	680						
PESTICIDES AND PCBs - NONE								
GENERAL PARAMETERS								
Ammonia (232.561 mg/kg)								
ESD-02	1	310.0						
RADIOLOGICAL PARAMETERS								
Gross Alpha (7.4 pCi/g)								
SD-02	2	13.0						
Gross Beta (16 pCi/g)								
SD-02	2	22.0						
Potassium-40 (5.7 pCi/g)								
ESD-01	1	7.8	ESD-03	1	8.6	SD-05	2	5.9
ESD-02	1	7.6	SD-01	2	6.6			

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(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)Phase 1 sediment samples were collected by ENSR in March 1990; Phase 2 was collected by ERM-Midwest in May 1991.

SD-02 - ERM sediment sample

ESD-01 - ENSR sediment sample

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TABLE 3-18
DRAINAGE DITCH SEDIMENTS
pH AND TOC RESULTS

Collection Point	Phase	Analysis Result pH	% TOC
SD - 07	2	7.1	0.6
SD - 09	2	7.1	1.8
SD - 10	2	6.4	1.3
SD - 11	2	7.7	0.41
SD - 12	2	7.3	0.015
SD - 13	2	7.4	2.8

Table 3-19 shows results of analyses for parameters that were detected at levels above background in the sediment samples from the drainage ditches for the two sampling rounds.

3.7.3 Physical and Chemical Properties of Sediments in the Cooling Pond

Four sediment samples were collected from the bottom of the cooling pond during the Phase I investigations. Only chemical parameters were evaluated. Table 3-20 shows the results of analyses for parameters that were detected at levels above background for pond sediment samples.

3.8 Geology

The geologic features of the PRRS were studied in order to understand and evaluate their influence on groundwater, the release and movement of chemicals through a given medium, and to evaluate the potential remedial alternatives during the FS.

TABLE 3-19
DRAINWAY SEDIMENTS
CHEMICALS DETECTED ABOVE BACKGROUND (+)*
PADDYS RUN ROAD SITE

Sample ID	Phase(++)	Value	Sample ID	Phase(++)	Value	Sample ID	Phase(++)	Value
METALS								
Arsenic (7.74 mg/kg)								
SD-7	2	10.3	SD-13	2	14.6			
Beryllium (1.02 mg/kg)								
SD-13	2	2.2						
Copper (28.37 mg/kg)								
SD-7	2	43.4	SD-13	2	46.8			
Mercury (0.20 mg/kg)								
SD-7	2	2.2	SD-9	2	0.3			
Selenium (2.39 mg/kg)								
SD-13	2	2.4						
Barium (189.45 mg/kg)								
SD-13	2	205.0						
Manganese (1601.18 mg/kg)								
SD-13	2	2040.0						
Sodium (212.27 mg/kg)								
ESD-6	1	543.0	SD-9	2	236.0	SD-12	2	234.0
SD-7	2	229.0	SD-10	2	220.0	SD-13	2	388.0
VOLATILE ORGANIC COMPOUNDS - NONE								
SEMIVOLATILE ORGANIC COMPOUNDS								
Acenaphthylene (372.6 ug/kg)								
SD-13	2	450.0						
Benzo(a)anthracene (597 ug/kg)								
SD-7	2	910.0	SD-13	2	2900.0			
Benzo(a)pyrene (866/ug/kg)								
SD-7	2	1100.0	SD-13	2	2600.0			
Benzo(b)fluoranthene (1925 ug/kg)								
SD-7	2	2500.0	SD-13	2	9500.0			
Benzo(g,h,i)perylene (802 ug/kg)								
SD-7	2	620.0	SD-13	2	1700.0			
Benzo(k)fluoranthene (2090 ug/kg)								
SD-7	2	2500.0	SD-13	2	9500.0			
Chrysene (836 ug/kg)								
SD-7	2	1200.0	SD-13	2	3900.0			
Dibenzo(a,h)anthracene (257 ug/kg)								
SD-13	2	680.0						
Fluoranthene (506 ug/kg)								
SD-7	2	1600.0	SD-10	2	1100.0	SD-13	2	5600.0
SD-9	2	800.0						
Indeno(1,2,3-cd)pyrene (662 ug/kg)								
SD-13	2	1700.0						
Naphthalene (372.6 ug/kg)								
SD-13	2	1400.0						

(+)The number in parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)Phase 1 drainageway sediment samples were collected by ENSR in March 1990; Phase 2 was collected by ERM in May 1991.

*For the risk assessment, the drainageway sediment sampling results were calculated with the soil borings; therefore, the background levels are those of soils, not sediments.

SD-7 - ERM sediment sample
ESD-6 - ENSR sediment sample

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TABLE 3-19 (Continued)
DRAINWAY SEDIMENTS
CHEMICALS DETECTED ABOVE BACKGROUND(+)*
PADDYS RUN ROAD SITE

Sample ID	Phase	Value	Sample ID	Phase	Value	Sample ID	Phase	Value
SEMIVOLATILE ORGANIC COMPOUNDS (Continued)								
Phenanthrene (292 ug/kg)								
SD-7	2	620.0	SD-10	2	580.0	SD-13	2	4200.0
Pyrene (505 ug/kg)								
SD-7	2	1100.0	SD-10	2	730.0	SD-13	2	4000.0
Dibenzofuran (372.6 ug/kg)								
SD-13	2	1100.0						
2-Methylnaphthalene (372.6 ug/kg)								
SD-13	2	1900.0						
PESTICIDES AND PCBs - NONE								
GENERAL PARAMETERS								
Chloride (10 mg/kg)								
SD-9	2	12.0						
Total Phosphorus (2943.249 mg/kg)								
SD-7	2	7000.0	SD-12	2	3400.0			
RADIOLOGICAL PARAMETERS								
Uranium 1.16 (pCi/g)								
SD-7	2	1.2						

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(+)The number in parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)Phase 1 drainageway sediment samples were collected by ENSR in March 1990; Phase 2 was collected by ERM in May 1991.

*For the risk assessment, the drainageway sediment sampling results were calculated with the soil borings; therefore, the background levels are those of soils, not sediments.

TABLE 3-20
POND SEDIMENTS
CHEMICALS DETECTED ABOVE BACKGROUND(+)*
PADDYS RUN ROAD SITE

REV. 1: MAY 1994

Sample ID	Phase(++)	Value	Sample ID	Phase(++)	Value	Sample ID	Phase(++)	Value
TOTAL METALS								
Chromium (23.46 mg/kg)								
ESDPD-01	1	58.9	ESDPD-02	1	40.4	ESDPD-03	1	61.3
Copper (28.37 mg/kg)								
ESDPD-01	1	585.0	ESDPD-02	1	119.0	ESDPD-03	1	852.0
Cadmium (0.83 mg/kg)								
ESDPD-02	1	7.0						
Nickel (29.71 mg/kg)								
ESDPD-01	1	72.8	ESDPD-03	1	63.6			
Zinc (234.33mg/kg)								
ESDPD-01	1	287.0	ESDPD-02	1	314.0	ESDPD-03	1	476.0
Barium (169.45mg/kg)								
			ESDPD-02	1	229	ESDPD-03	1	227
Mercury (0.2 mg/kg)								
ESDPD-3	1	1.5						
Sodium (212.27 mg/kg)								
ESDPD-01	1	7720.0	ESDPD-02	1	6230.0	ESDPD-03	1	10100.0
Magnesium (28113.63 mg/kg)								
ESDPD-01	1	28800.0	ESDP-03	1	29500.0			
Calcium (118266.30 mg/kg)								
ESDPD-02	1	128000.0						
VOLATILE ORGANIC COMPOUNDS								
Ethylbenzene (5.9 ug/kg)								
ESDPD-01	1	54000.0	ESDPD-02	1	15000.0	ESDPD-03	1	140000.0
Methylene Chloride (672 ug/kg)								
ESDPD-01	1	5800.0	ESDPD-03	1	8500.0	ESDPD-04	1	70.0
ESDPD-02	1	4400.0						
Toluene (5.9 ug/kg)								
ESDPD-01	1	27000.0	ESDPD-02	1	18000.0	ESDPD-03	1	25000.0
Acetone (246 ug/kg)								
ESDPD-03	1	20000.0						
Xylene (5.9 ug/kg)								
ESDPD-01	1	140000.0	ESDPD-03	1	380000.0	ESDPD-04	1	12.0
ESDPD-02	1	45000.0						
Cumene (5.9 ug/kg)								
ESDPD-01	1	110000.0	ESDPD-02	1	60000.0	ESDPD-03	1	200000.0
SEMIVOLATILE ORGANIC COMPOUNDS								
Benzo(a)anthracene (597 ug/kg)								
ESDPD-02	1	710.0	ESDPD-03	1	1000.0			
Benzo(a)pyrene (866/ug/kg)								
ESDPD-03	1	1300.0						
Benzo(b)fluoranthene (1925 ug/kg)								
ESDPD-02	1	2300.0	ESDPD-03	1	3000.0			
Benzo(g,h,i)perylene (602 ug/kg)								
ESDPD-02	1	640.0	ESDPD-03	1	830.0			
Benzo(k)fluoranthene (2090 ug/kg)								
ESDPD-02	1	2300.0	ESDPD-03	1	3000.0			
Bis(2-ethylhexyl)phthalate (605 ug/kg)								
ESDPD-02	1	2700.0	ESDPD-03	1	8600.0			
Chrysene (836 ug/kg)								
ESDPD-02	1	1200.0	ESDPD-03	1	2700.0			
Di-n-octyl phthalate (372.6 ug/kg)								
ESDPD-03	1	600.0						
Fluoranthene (506 ug/kg)								
ESDPD-01	1	850.0	ESDPD-02	1	2300.0	ESDPD-03	1	4300.0
Fluorene (372 ug/kg)								
ESDPD-01	1	1500.0	ESDPD-03	1	600.0			

(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)Pond sediment samples were collected by ENSR in March 1990.

*For the risk assessment, the pond sediment sampling results were calculated with the soil borings; therefore, the background levels are those of soils, not sediments.

TABLE 3-20 (Continued)
POND SEDIMENTS
CHEMICALS DETECTED ABOVE BACKGROUND(+)*
PADDYS RUN ROAD SITE

REV. 1: MAY 1994

Sample ID	Phase(++)	Value	Sample ID	Phase(++)	Value	Sample ID	Phase(++)	Value
SEMIVOLATILE ORGANIC COMPOUNDS (Continued)								
Indeno(1,2,3-cd)pyrene (662 ug/kg)								
ESDPD-03	1	740.0						
N-nitrosodiphenylamine (1) [DL (430 ug/kg)]								
ESDPD-01	1	1600.0	ESDPD-03	1	1900.0			
Phenanthrene (292 ug/kg)								
ESDPD-02	1	1400.0	ESDPD-03	1	2700.0			
Pyrene (505 ug/kg)								
ESDPD-01	1	720.0	ESDPD-02	1	1900.0	ESDPD-03	1	2800.0
2,4-Dimethylphenol (372.6 ug/kg)								
ESDPD-02	1	560.0	ESDPD-03	1	750.0			
Phenol (372.6 ug/kg)								
ESDPD-03	1	9900.0						
4-Methylphenol (372.6 ug/kg)								
ESDPD-02	1	1900.0	ESDPD-03	1	650.0			
PESTICIDES AND PCBs - NONE								
GENERAL PARAMETERS								
Ammonia (216.835 mg/kg)								
ESDPD-02	1	270.0	ESDPD-03	1	320.0			
Chloride (10 mg/kg)								
ESDPD-01	1	430.0	ESDPD-02	1	410	ESDPD-03	1	700
Phosphorus Total (2943.249 mg/kg)								
ESDPD-03	1	3800.0						
RADIOLOGICAL PARAMETERS - NONE								

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(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)Pond sediment samples were collected by ENSR in March 1990.

*For the risk assessment, the pond sediment sampling results were calculated with the soil borings; therefore, the background levels are those of soils, not sediments.

This section describes the bedrock and composition of the unconsolidated materials above bedrock. Bedrock is described in terms of its type, lithology/mineralogy, if there are any structural features such as faults or folds, or any other discontinuities or unusual features. Unconsolidated sediments, soils, and clays are defined in terms of thickness and areal extents of unit, lithology and mineralogy of the material, particle size, sorting, and porosity.

3.8.1 Geologic Setting

Most of the PRRS is located within the New Haven Trough, a 2-to-3 mile wide valley that formed as a result of a large stream that flowed through the area during pre-glacial or early glacial times. The channel of this stream cut into the shale bedrock to a level more than 200 feet below the present-day Great Miami River (U.S. DOE 1987). During subsequent glacial activity, approximately 100,000 to 400,000 years ago, the trough, or valley, was filled with outwash sand and gravel deposits from the melting glaciers. A layer of clay-rich till beyond the Study Area, deposited from the most recent glacier, covers these sand and gravel deposits as do recent alluvial silt deposits. The outwash deposits of the New Haven Trough constitute what is known as the Great Miami Aquifer (GMA).

3.8.2 Bedrock Formations

The consolidated formations (i.e., bedrock) in the PRRS were deposited in the Ordovician Period, which began some 500 million years ago and ended approximately 440 to 430 million years ago. They consist of shales with interbedded limestones that were originally deposited as sediment on the seafloor in horizontal layers. During the millions of years since these sediments were deposited and compressed into rocks, tectonic changes occurred in the crust of the earth so that the present day Cincinnati area sits near the center of a fold in the bedrock known as the Cincinnati Arch. The approximate location of the Cincinnati Arch is shown in Figure 3-12. This broad anticlinal structure was formed during Post Ordovician

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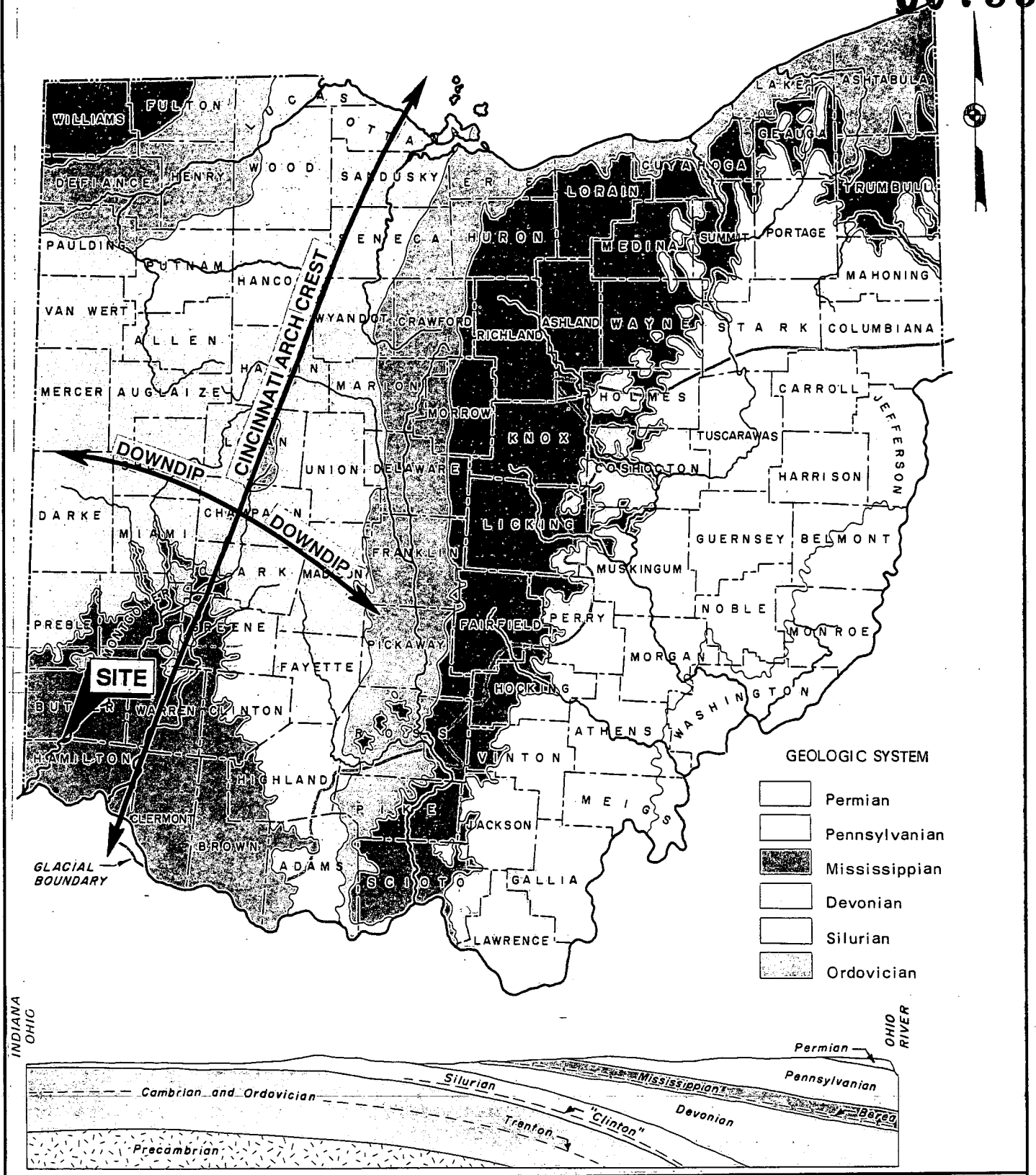

GEOLOGIC MAP AND CROSS SECTION OF OHIO AND LOCATION OF THE CINCINNATI ARCH PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO

FIGURE 3-12

ERM-Midwest, inc.
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OHIO DIVISION OF GEOLOGICAL SURVEY

I-539-10-02

deposition in Paleozoic times (approximately 225 to 570 million years ago). Bedrock beneath the Study Area should dip slightly to the west.

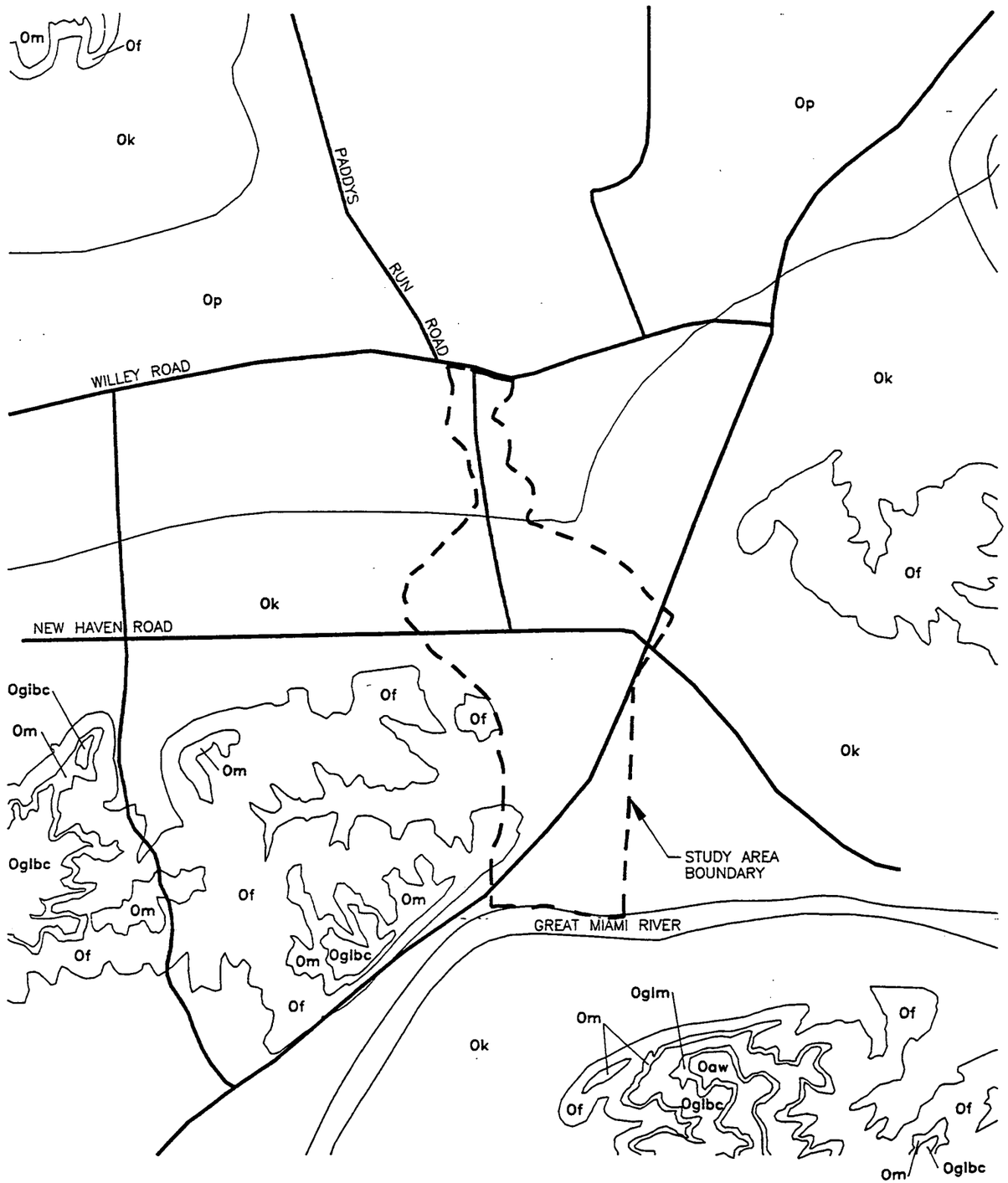
Shale is a fine grained rock that is rich in clay and silt-sized particles and forms much of the floor and valley of the New Haven Trough and acts as a semi-impervious barrier to fluids. The limestone is composed primarily of the mineral calcite, and contains shells and skeletal fragments from ancient sea organisms.

The shale and limestone rocks found throughout the bedrock sequence beneath the Study Area and surrounding areas are interbedded and grouped into formations. From the oldest to youngest, the rock formations are the Point Pleasant Tongue of the Clays Ferry Formation, the Kope Formation, the Fairview Formation, the Miamitown shale, and the Bellevue Member of the Grant Lake Formation. In general, the Point Pleasant Tongue of the Clays Ferry Formation and the Kope formation form much of the floor and some of the side walls of the New Haven Trough, while the Fairview Formation, the Miamitown Shale, and the Grant Lake Formations are found in the bedrock highs of the area. The distribution of these rock formations, along with their stratigraphic sequence, are shown in Figure 3-13. Figure 3-14 illustrates the top of the bedrock surface for the PRRS and surrounding area.

3.8.3 Chemistry and Mineralogy

The purpose of this section is to outline the chemical and mineralogical compositions of typical rock formations found within the PRRS. The samples discussed in this section were described in the Geological Survey of Ohio (1941).

A total of four samples (two limestone and two shale) were collected from what was described as the Maysville Formation (currently called the Fairview Formation). One set of samples (consisting of one limestone and one shale sample) was collected from an old quarry in the southwest portion of Hamilton, which is north of the PRRS in Butler County. The second set of samples (consisting of one limestone and



SYSTEM	GROUP		FORMATION AND MEMBERS		LITHOLOGY	THICKNESS IN FEET
ORDOVICIAN	CINCINNATI GROUP		WAYNESVILLE/ ARNHEIM FORMATION (Oaw)	UNDIFFERENTIATED		60 +
		GREAT LAKE FORMATION	MOUNT AUBURN MEMBER (Ogim)			15–20
			BELLEVUE MEMBER (Ogibc)			15–20
		MIAMITOWN SHALE (Om)				15–35
		FAIRVIEW FORMATION (Of)				40–90
		KOPE FORMATION (Ok)				260–280
		POINT PLEASANT TONGUE OF THE CLAYS FERRY FORMATION (Op)				30+

NORTH

LEGEND

- INTER BEDDED LIMESTONE AND SHALE
- SILTY SHALE
- NODULAR OR IRREGULAR BEDDED LIMESTONE

GRAPHIC SCALE

2000 0 1000 2000 4000

(IN FEET)
1 inch = 2000ft.

000222

ROCK FORMATIONS IN AND AROUND STUDY AREA
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 3-13

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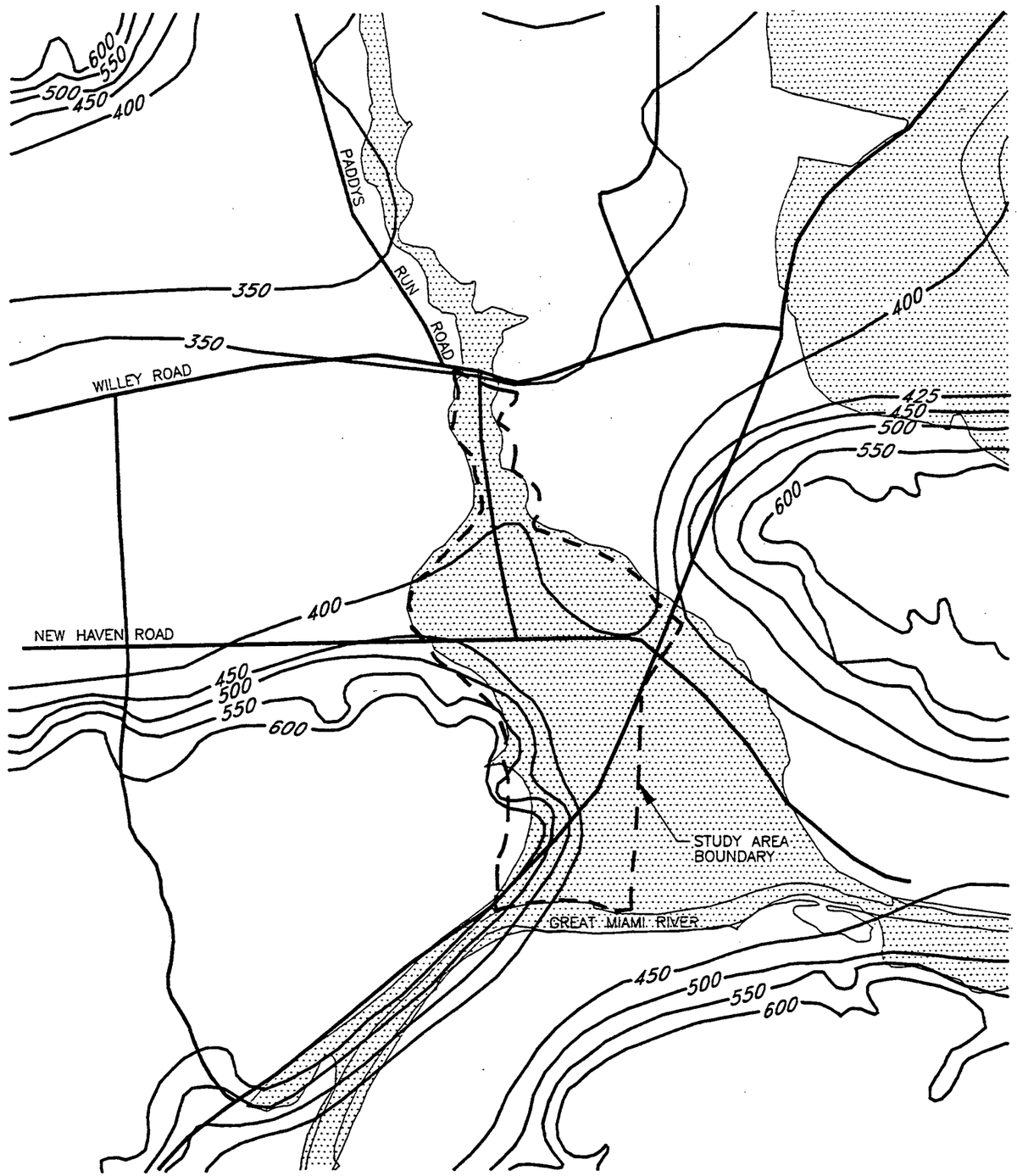

GRAPHIC SCALE

(IN FEET)
1 inch = 2000ft.

LEGEND

—350— TOP OF BEDROCK CONTOUR

ALLUVIUM

000223

TOP OF BEDROCK AND DISTRIBUTION OF ALLUVIUM PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO	FIGURE 3-14

ERM ERM-Midwest, inc.
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one shale sample) was collected from the east bank of First Creek about one mile south of Morrow, Ohio, which is northeast of the PRRS in Warren County.

The chemical and mineralogical results of these four rock samples are presented in Tables 3-21 and 3-22.

3.8.4 Composition Above Bedrock

Overlying the bedrock within the New Haven Trough is a sequence of sand and gravel glacial outwash material that is up to 300 feet thick and 2 to 3 miles wide. These sediments are Pleistocene in age (i.e., deposited within the last 2.5 million years) and comprise the Great Miami Aquifer. The Great Miami Aquifer is the regional aquifer that underlies the PRRS and surrounding area. Its areal extent (as well as the New Haven Trough) is illustrated in Figure 3-15.

The sediments comprising the Great Miami Aquifer within the PRRS consist of sands and gravels of varying thickness and have been described from the 80 soil borings and 54 monitor wells that have been drilled. Also described from these soil borings is the more recent, Holocene-aged deposits that blanket the PRRS.

In general, the upper 10 to 15 feet (i.e., unsaturated zone) consists of clay, silt, and sand with small amounts of gravel while the deeper zone (i.e., saturated zone) consists predominantly of sand and gravel with very small amounts of silt.

The material in the unsaturated zone is alluvium. Alluvium is a fluvial deposit of recent (Holocene) origin, and it includes a wide variety of textural classes from silts to boulders. It is generally not compact, and in the case of the PRRS, is found within the 100 year floodplain. Figure 3-14 shows the approximate distribution of alluvium deposited within the PRRS.

The material in the saturated zone generally is glacial outwash that was deposited by streams during glacial retreat. These deposits are typically highly stratified, poorly sorted, and have a porosity of about 22.5%.

TABLE 3-21
CHEMICAL COMPONENTS IN LIMESTONE AND SHALE
PADDYS RUN ROAD SITE

COMPONENTS	Limestone Sample 27	Shale Sample 28	Limestone Sample 30	Shale Sample 31
Silica, SiO2	6.50	48.12	8.42	48.89
Alumina, Al2O3	1.50	12.80	1.20	14.06
Ferric Oxide, Fe2O2	0.24	1.60	0.68	1.33
Ferrous Oxide, FeO	0.97	3.25	1.01	3.40
Pyrite, FeS2	0.15	0.88	0.15	1.13
Magnesium Oxide, MgO	1.20	2.55	1.20	2.90
Calcium Oxide, CaO	48.65	10.77	47.25	8.90
Strontium Oxide, SrO	None	None	None	None
Barium Oxide, BaO	<0.01	<0.01	<0.01	<0.01
Sodium Oxide, Na2O	0.10	0.60	0.36	0.69
Potassium Oxide, K2O	0.15	3.60	0.40	3.83
Water, Hydroscopic, H2O	0.25	1.70	0.23	1.32
Water, Combined, H2O+	0.41	3.25	0.32	3.56
Carbon Dioxide, CO2	39.27	9.19	38.03	8.42
Titanic Oxide, TiO2	0.10	0.78	0.14	0.86
Phosphorus Pentoxide, P2O5	0.55	0.65	0.38	0.60
Sulphur Trioxide, SO3	0.04	0.24	0.22	0.07
Manganous Oxide, MnO	0.12	0.09	0.16	0.10
Vanadium Oxide, V2O5	<0.01	<0.01	<0.01	<0.01
Carbon, Organic, C	0.08	0.25	0.18	0.25
Hydrogen, Organic, H	0.01	0.04	0.03	0.04
TOTAL	100.29	100.36	100.36	100.35

TABLE 3-22
MINERAL COMPONENTS IN LIMESTONE AND SHALE
PADDYS RUN ROAD SITE

COMPONENTS	Limestone Sample 27	Shale Sample 28	Limestone Sample 30	Shale Sample 31
Sericite (K,Na)2 0.3Al2O3.6SiO2.2H2O	2.50	33.17	3.05	35.80
Kaolinite, Al2O3.2SiO2.2H2O	1.31	0.00	0.00	0.48
Celadonite (Fe,Mg,K2,Na2)0.2SiO2.H2 Fe2O3,6SiO2,3H2O	1.96	19.54	4.75	19.31
Quartz or Free Silica, SiO2	3.53	20.87	4.06	20.35
Limonite, 2Fe2O3.3H2O	0.16	0.70	0.51	0.39
Pyrite, FeS2	0.15	0.88	0.15	1.13
Rutile, TiO2	0.10	0.78	0.14	0.86
Apatite, 3CaO.P2O5	1.20	1.42	0.83	1.31
Anhydrite, CaO.SO3	0.07	0.41	0.37	0.12
Limestone	87.82	19.26	84.87	16.93
Water, Hydroscopic, H2O-	0.25	1.70	0.23	1.32
Hydrocarbons, CnH2n+2	0.09	0.29	0.21	0.29
Unbalanced Parts (excess CO2,H2O)	-0.09	-0.18	-0.33	+0.01
TOTAL	100.29	100.36	100.36	100.35

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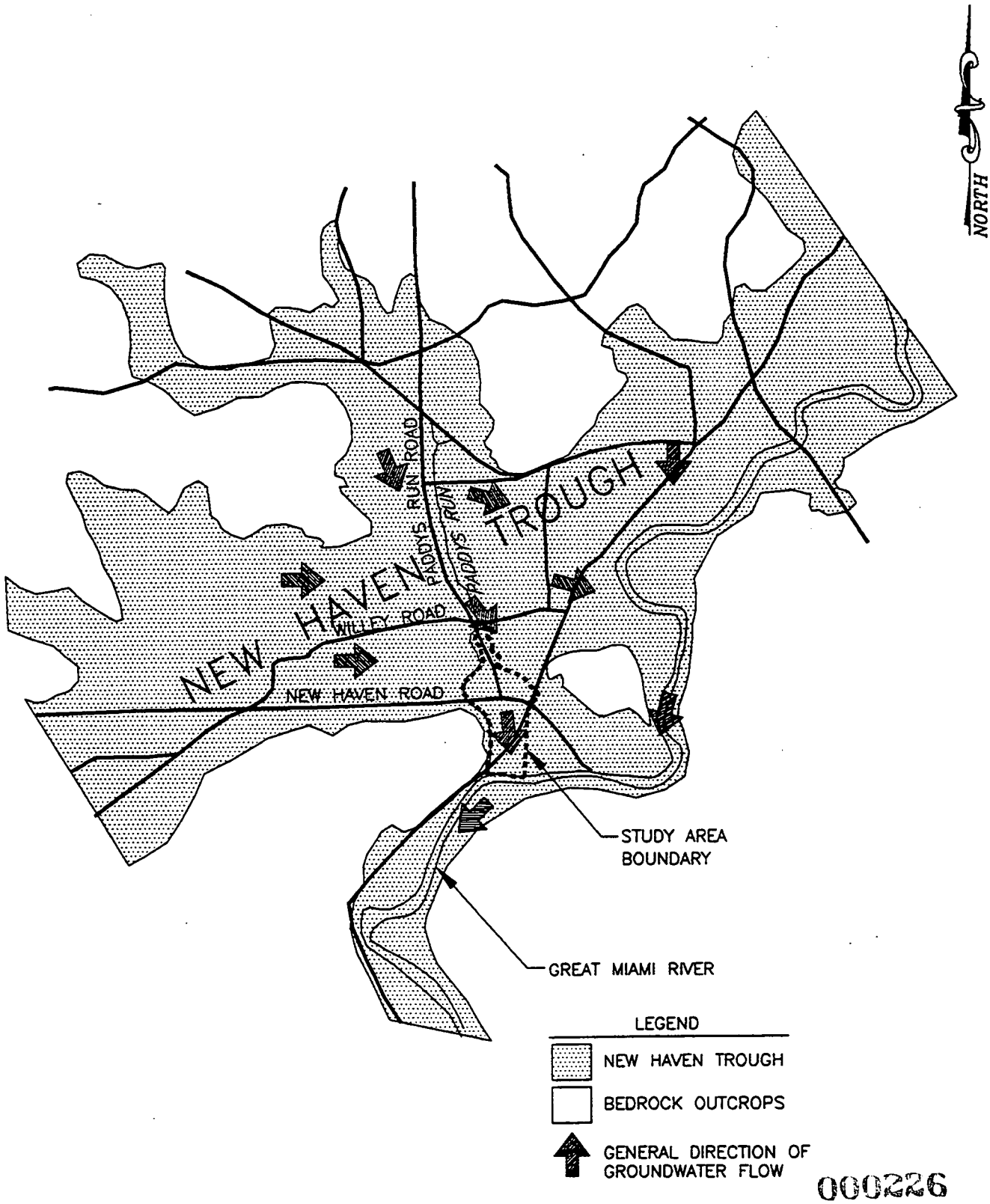
000225



000226

GRAPHIC SCALE

8000 0 4000 8000 16000

(IN FEET)
1 inch = 8000ft.

RELATIONSHIP OF THE NEW HAVEN TROUGH WITH THE PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO

FIGURE 3-15

ERM ERM-Midwest, inc.
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Another deposit that is found outside the PRRS Study Area is till material deposited as the glaciers advanced over previously deposited outwash. Till is generally clay-rich and contains silt and sand.

3.9 Characterization of the Unsaturated and Saturated Soils

As outlined in Section 2.9, the Companies' investigated soils are contained in unconsolidated materials overlying the bedrock. The purpose of investigating the engineering, physical and chemical properties of the Study Area soils is to reasonably estimate the extent of chemical transport and the processes affecting transport. Properties of the soils can influence the type and rate of chemical movement. Many chemicals adsorb onto the soil which retards the migration process. However, the adhered chemical can then become a continual source of contamination to the underlying soils and groundwater.

Characterization of the surface soils zone supports the exposure pathway analysis and quantitation of exposure for the RA. Collected data were used to evaluate the potential for human exposure via fugitive dust emissions and direct contact exposures by workers or trespassers.

Subsurface unsaturated and saturated soils were investigated to determine migration pathways, extent of chemicals and source for support of the groundwater model and for evaluating remedial alternatives for the FS.

The surface and subsurface soil investigations developed data from 26 surface soil samples, 80 soil borings and 54 monitor wells. The engineering, physical and chemical properties are discussed for each soil starting first with the unsaturated surface soils, followed by unsaturated subsurface soils, and then the saturated subsurface soils.

3.9.1 Surface Soils

Twenty-six surface soil samples were collected within the active facility boundaries of the Companies' properties. Soil types found on the Companies' properties include two horizons of the Eldean Loam (EpA and EpB2) and a single Martinsville Silt Loam (McA) horizon. These soil types are shown along with the 26 boring locations on Figure 3-16. The properties of each soil type are discussed below. Collection procedures as described in the Phase II Work Plan (ERM 1991a) are presented in detail in Appendix B-2.

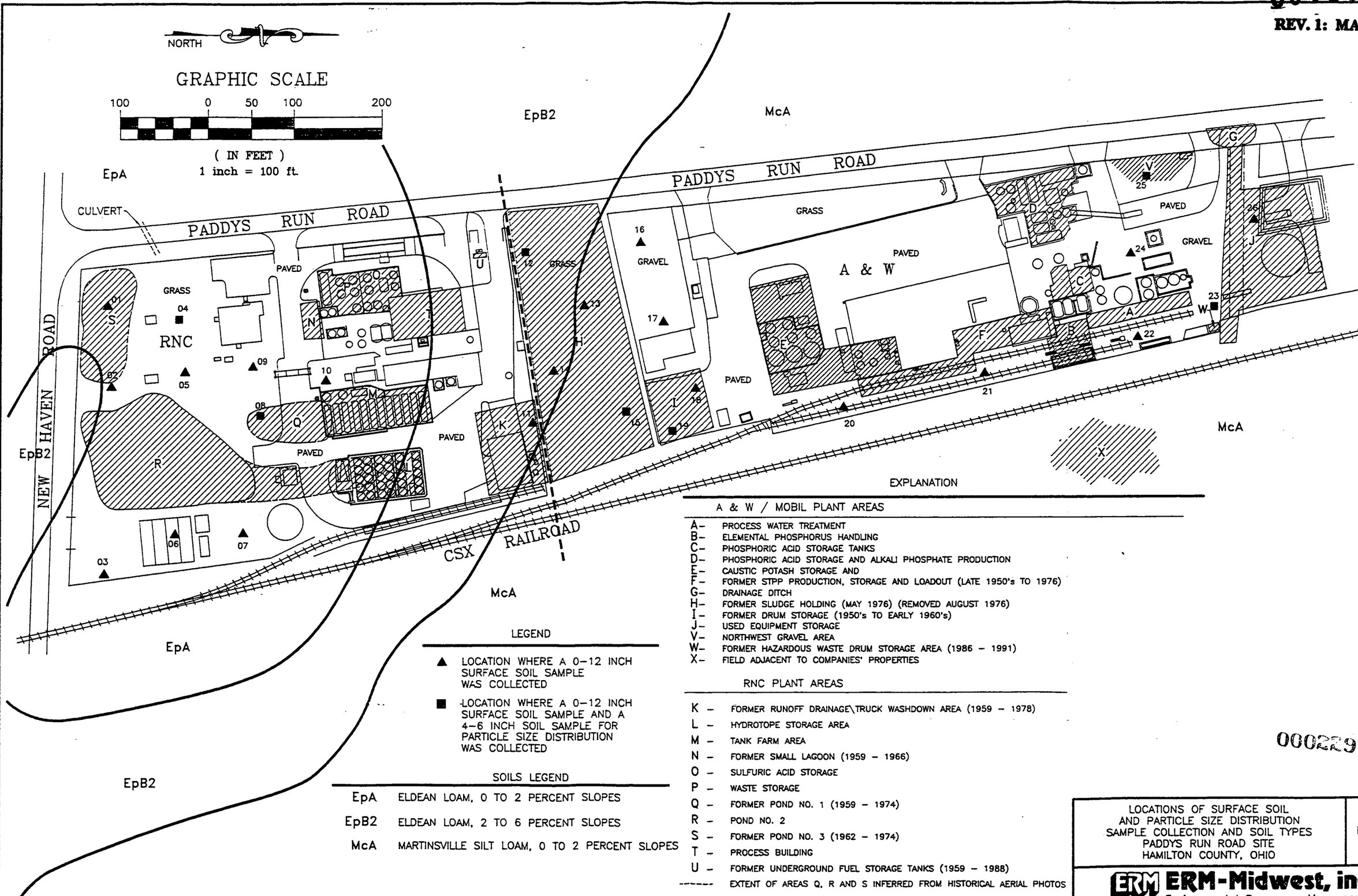
3.9.1.1 Eldean Loam

The Eldean Loam, on the Companies' property, is made up of two soil horizons, the EpA and EpB2. A horizon is a layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes (USDA 1982). A collection of horizons, as seen in road cuts or pits, is referred to as a soil profile. Typically, horizons are designated using letters O, A, B, C, and R with numbers 1, 2, 3, 4, and 5 and small letters such as b, p, x, etc. These letters and numbers are used to identify horizons and subhorizons within the soil profile. The *Soil Survey Manual* 1951 provides a detailed description of soil nomenclature.

The nomenclature for the EpA and EpB2 horizons is as follows:

- Ep designates the Eldean Loam.
- A and B are classified as mineral layers having differing fractional amounts of clay and organic matter.
- 2 signifies that this part of the B horizon is transitional and has characteristics of both the overlying A and underlying C horizon

As seen from Figure 3-16, the EpA soils cover all but a very small portion of the RNC property. Typically EpA soils form on nearly level (0 to 2 percent slopes), well drained soil on stream terraces and outwash plains and range from 5 to 500 acres in size (USDA SCS 1982). The EpB2 soils cover a small area along New Haven Road



000229

LOCATIONS OF SURFACE SOIL AND PARTICLE SIZE DISTRIBUTION SAMPLE COLLECTION AND SOIL TYPES
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 3-16

ERM-Midwest, inc.
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and a narrow area at the north end of the RNC property contiguous with the grassy area on A&W's southern boundary. The EpB2 soil type also is present at the extreme north end of the A&W property beyond the active manufacturing operations. These soils form on gentle 2 to 6 percent slopes. Much of the original surface layer, in this case EpA, has been removed by erosion. Areas where the EpB2 has formed are long and narrow and range from 3 to 25 acres in size (USDA SCS 1982).

EpA and EpB2 Engineering Properties

The EpA and EpB2 soils are found on glacial outwash sands and gravels, ranging in thickness from 0 to 7 inches and 7 to 36 inches respectively. EpA soil is classified by the soil survey of Hamilton County (USDA SCS 1982) as having the texture of a loam. A loam is identified as a soil with 7 to 27 percent clay size particles, 28 to 50 percent silt particles, and less than 52 percent sand particles. EpB2 soils are classified as clays, clay loams and gravelly clay loams. Clay loams contain 27 to 40 percent clay and 20 to 45 percent sand. Figure 3-17 is a chart showing the variety of soil types and how the percentages of clay, silt and sand determine the soil type.

Three surface soil samples were collected from 4 to 6 inches below the ground surface for particle size analysis. Particle size analysis determine the percentages of clay, silt and sand which make up the soil type. This information was useful in preparation of the mathematical model to determine the potential for exposure via fugitive dust emissions. Those locations designated 04, 08 and 12 and are shown on Figure 3-16. Soil from SS-04 and SS-08 tested the EpA horizon and penetrated part of the EpB2 horizon. A sample from location 12 tested only the EpB2 horizon because the EpA horizon is not present at this location.

Soils were analyzed and classified according to their particle sizes. Particle size gradation curves, in Appendix D, show that soil from location 04 is composed of 97 percent sand, 2 percent silt and 1 percent clay which classifies it as a sand. Location 08 is made up of 76 percent sand, 15 percent silt and 9 percent clay which classifies

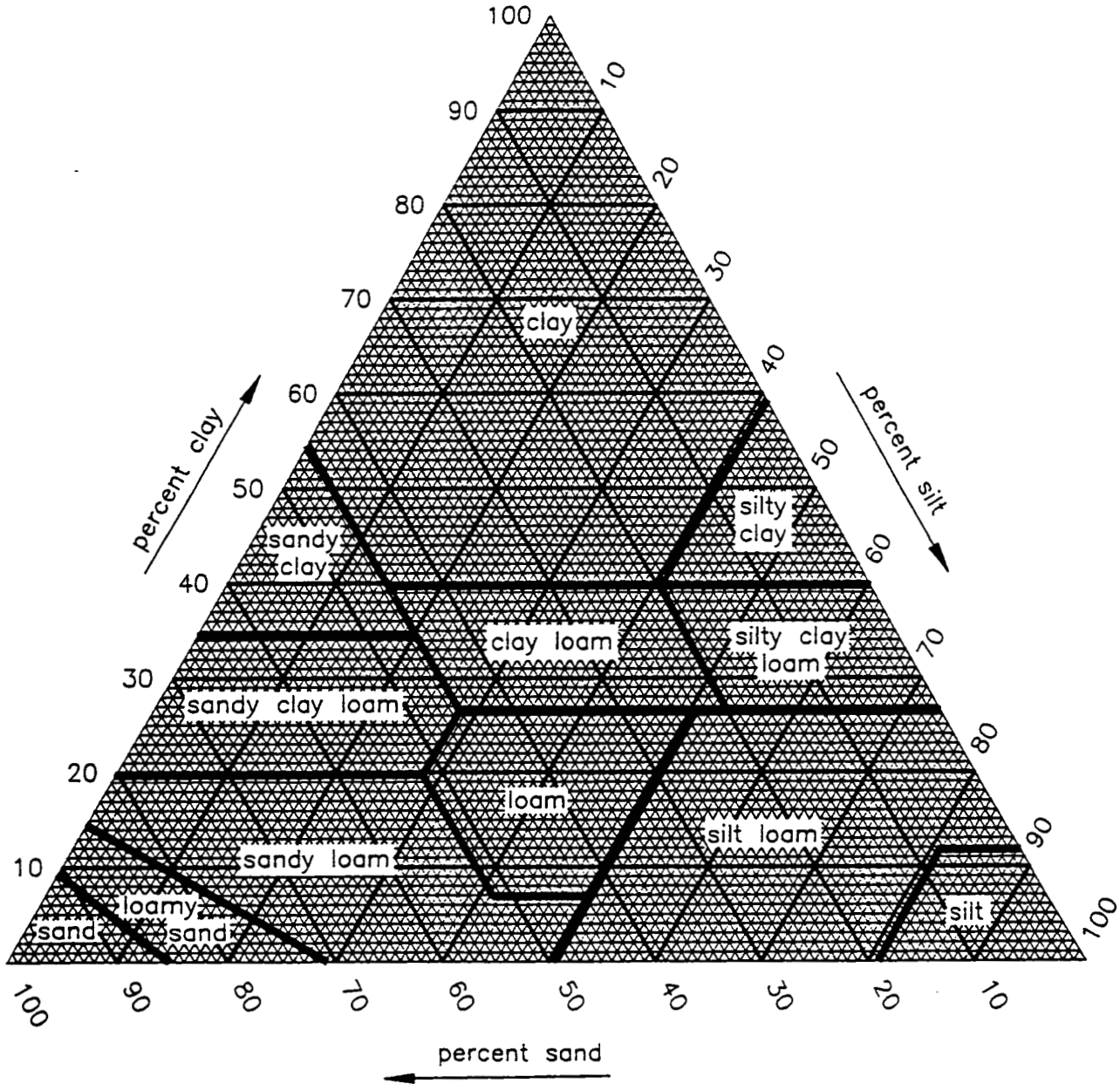

CHART SHOWING THE PERCENTAGES OF CLAY (BELOW 0.002 mm.), SILT (0.002 TO 0.005 mm.), AND SAND (0.05 TO 2.0 mm.) IN THE TEXTURAL CLASSES.

SOURCE: USDA SOIL SURVEY, STAFF, 1951

000231

SOIL TYPE BASED ON PARTICLE SIZE PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO	FIGURE 3-17

ERM-Midwest, inc.
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it as a coarse sandy loam. Location 12 is composed of 62 percent sand, 27 percent silt and 11 percent clay which classifies it as a sandy loam.

None of these soil samples are identical to those identified by the USDA. Soil types can change dramatically over short distances under natural conditions. That coupled with artificial soil disturbances caused by excavation and construction activities on both A&W and RNC property account for such discrepancies. The purpose of collecting these surface soils was to use the data for the exposure assessment scenarios of the RA, not to verify the USDA soil survey. The significance of the results, as pertaining to exposure, will be addressed in the RA.

EpA and EpB2 Physical Properties

Physical properties include color, permeability and bulk density. Each of these properties are explained and discussed below.

Color is important because it reveals various properties of the soil such as organic matter content, drainage and aeration (Millar 1966). Soil colors are based on standard Munsell notation and are determined by hue, value and chroma. Hue of a color indicates its relation to Red, Yellow, Green, Blue, and Purple; the value notation indicates its lightness; and the chroma notation indicates its strength and increases with decreasing grayness (Munsell Color 1990). Color is usually a good indicator of the reduction/oxidation status of a soil horizon (uniform high chroma colors indicate oxidizing conditions; uniform low chroma colors usually indicate reducing conditions; mixed chromas indicate variable saturation). In addition, low chroma, low value colors are often indicative of high organic matter content (*Guide to Site and Soil Description for Hazardous Waste Characterization - Volume 1: Metals,* EPA 1992). The USDA SCS describes the colors for EpA and EpB2 as varying between brown 7.5YR 4/2 (7.5 yellow-red hue, 4 value, 2 chroma) to yellowish brown (10YR 6/4).

Field description for surface soil locations representing EpA and EpB2 soil types, surface soil locations SS-1 through SS-14, (presented below), indicated that soil

colors fall within these color ranges varying from very dark grayish brown (10YR 3/2) to yellowish brown (10YR 5/4). These colors imply mixed, reducing and oxidizing conditions, variable saturations, and high organic content. Soils were dry when described.

Location	Color Code
SS - 1	10YR 5/3
SS - 2	10YR 5/4
SS - 3	10YR 4/3
SS - 4	10YR 5/4
SS - 5	10YR 3/3
SS - 6	10YR 4/4
SS - 7	10YR 4/2
SS - 8	10YR 4/3
SS - 9	10YR 5/3
SS - 10	10YR 4/3
SS - 11	10YR 5/4
SS - 12	10YR 3/2
SS - 13	10YR 3/3
SS - 14	10YR 4/2

Permeability is the quality of soil that enables water to move downward and is measured in inches per hour (in/hr). The permeability in the EpA horizon has been calculated by the USDA SCS as 0.6 - 2.0 in/hr, which is classified as a moderate rate of penetration. Permeability of the EpB2 horizon is 0.2 - 2.0 in/hr. which is also classified as a moderate rate of penetration.

Bulk density is a measure of the total weight of an amount of soil divided by the volume of that soil. Both the solid particles and the pore space between particles are considered in determining bulk density. Units of measurement are grams per cubic centimeter (G/cm^3). As calculated by the USDA SCS, the bulk density for the EpA horizon ranges from 1.30 - 1.50 G/cm^3 and 1.40 - 1.60 G/cm^3 for the EpB2 horizon.

The concept of bulk density is important because it relates to porosity and permeability both of which control fluid movement. The greater the bulk density, the lower the porosity. Sands and gravels are more dense than clays, which means

that there is lower porosity in sands and gravels than in clays. However, even though there is more porosity in clays, the pore spaces are small and do not interconnect whereas pore spaces are fewer but larger and more connecting in sands and gravels. Therefore, clays even though they are more porous are not as permeable as sands and gravels. As shown from the particle size curves in Appendix D, the EpB2 horizon has more silt and clay particles than the EpA horizon, meaning the permeability of EpB2, as discussed above, is slightly less than the EpA horizon.

EpA and EpB2 Chemical Properties

As discussed in Section 2.9, chemical analyses of the subject soils included CLP organics plus cumene, CLP semivolatiles, CLP inorganics, CLP pesticides/PCBs and general parameters. General parameters included ammonia, chloride, phosphorus, sulfate, pH and radionuclides, including potassium-40, gross alpha, gross beta, and total uranium. Table 3-23 shows results of analyses for parameters that were detected at levels above background. The nature and extent of these parameters are discussed in Section 4.0.

3.9.1.2. Martinsville Silt Loam

As shown in Figure 3-16, the Martinsville Silt Loam covers most of the A&W property, and may be present on the extreme northeast corner of the RNC property.

Only the McA horizon of the Martinsville Silt Loam is present, as mapped by the USDA (SCS).

McA Engineering Properties

The McA soils form in stratified silty and loamy outwash materials and range in thickness from 0 to 9 inches. McA soil is classified by the soil survey of Hamilton County as having the texture of a silt loam. Silt loam is identified as a soil containing 50 percent or more silt and 12 to 27 percent clay (or) 50 to 80 percent silt and less than 12 percent clay.

TABLE 3-23
SURFACE SOIL SUMMARY OF CHEMICALS DETECTED ABOVE BACKGROUND(+)
PADDYS RUN ROAD SITE

Sample ID(++)	Value	Sample ID(++)	Value	Sample ID(++)	Value
TOTAL METALS					
Arsenic (7.74 mg/kg)					
SS-03	24.2	SS-12	8.4	SS-17	32.5
SS-07	8.1	SS-13	53.4	SS-18	8.9
SS-08	62.9	SS-15	18.6	SS-23	8.1
Chromium (23.46 mg/kg)					
SS-08	24				
Copper (28.37 mg/kg)					
SS-13	38.4	SS-22	31.3	SS-25	32.2
SS-18	54.6	SS-23	41.0		
Lead (112.63 mg/kg)					
SS-03	341.0	SS-22	120.0		
Mercury (0.20 mg/kg)					
SS-08	0.34	SS-14	0.25	SS-20	0.26
SS-10	0.26	SS-15	0.96	SS-21	0.31
SS-11	0.27	SS-17	0.49	SS-22	0.36
SS-12	0.41	SS-18	2.90	SS-23	1.3
SS-13	0.90	SS-19	0.27	SS-24	1.3
Zinc (234.33 mg/kg)					
SS-03	432.0				
Barium (169.45 mg/kg)					
SS-03	204.0				
Magnesium (28113.63 mg/kg)					
SS-02	34900.0	SS-17	71900.0	SS-21	32700.0
SS-05	28400.0	SS-18	50400.0	SS-24	42000.0
SS-11	48200.0	SS-19	50200.0	SS-25	31000.0
SS-15	30000.0	SS-20	39000.0	SS-26	41300.0
SS-16	60900.0				
Calcium (118266.30 mg/kg)					
SS-11	120000.0	SS-18	168000.0	SS-22	157000.0
SS-16	176000.0	SS-19	136000.0	SS-24	137000.0
SS-17	188000.0	SS-21	130000.0	SS-25	230000.0
Sodium (212.27 mg/kg)					
SS-01	231.0	SS-15	366.0	SS-21	3150.0
SS-04	215.0	SS-16	325.0	SS-22	1230.0
SS-06	1250.0	SS-17	281.0	SS-23	604.0
SS-07	231.0	SS-18	1400.0	SS-24	339.0
SS-11	234.0	SS-19	1060.0	SS-25	310.0
SS-13	241.0	SS-20	1320.0		

(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.
(++)Surface soil samples were collected by ERM in May 1991.

TABLE 3-23 (Continued)
SURFACE SOIL SUMMARY OF CHEMICALS DETECTED ABOVE BACKGROUND(+)
PADDYS RUN ROAD SITE

Sample ID(++)	Value	Sample ID(++)	Value	Sample ID(++)	Value
TOTAL METALS - Continued					
Potassium (3528.42 mg/kg)					
SS-18	4510.0				
SS-20	3530.0				
VOLATILE ORGANICS					
Xylene (5.9 ug/kg)					
SS-10	20.0				
Cumene (5.9 ug/kg)					
SS-10	56.0				
SEMIVOLATILE ORGANICS					
Benzo(a)anthracene (597.0 ug/kg)					
SS-03	1000.0	SS-20	610.0		
Benzo(a)pyrene (866.0 ug/kg)					
SS-03	1100.0				
Benzo(b)fluoranthene (1925.0 ug/kg)					
SS-03	2800.0				
Benzo(k)fluoranthene (2090.0 ug/kg)					
SS-03	2800.0				
bis(2-Ethylhexyl)phthalate (605.0 ug/kg)					
SS-22	2700.0	SS-23	1000.0	SS-24	1500.0
Chrysene (836.0 ug/kg)					
SS-03	1100.0	SS-20	880.0		
Di-n-butylphthalate (372.6 ug/kg)					
SS-19	380.0				
Fluoranthene (506.0 ug/kg)					
SS-03	1500.0	SS-20	1100.0	SS-24	660.0
SS-18	910.0	SS-22	510.0		
Phenanthrene (292.0 ug/kg)					
SS-03	550.0	SS-18	400.0	SS-20	320.0
Pyrene (505.0 ug/kg)					
SS-03	1300.0	SS-20	770.0	SS-24	540.0
SS-18	630.0				
PESTICIDES					
Dieldrin (35.9 ug/kg)					
SS-15	65.0	SS-16	65.0		
GENERAL PARAMETERS - (NONE)					
RADIOLOGICAL PARAMETERS - (NONE)					

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(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)Surface soil samples were collected by ERM in May 1991.

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Four surface soil samples were collected from the 4-6 inch depth for particle size analysis. Sample locations, designated 15, 19, 23 and 25 are shown on Figure 3-16. Soils from these locations were classified according to their particle size.

Particle size gradation curves, attached in Appendix D, indicate that soil from location 15 is composed of 72 percent sand, 23 percent silt and 5 percent clay which classifies it as a sandy loam. Location 19 is composed of 91 percent sand, 8 percent silt and 1 percent clay which classifies it as a sand. Location 23 is composed of 75 percent sand, 23 percent silt and 2 percent clay which classifies it as a loamy sand. Location 25 is composed of 92 percent sand, 7 percent silt and 1 percent clay, which makes it sand.

None of these soils are identical to those identified by the USDA's survey. As previously stated, soil types can change dramatically over short distances under natural conditions. That coupled with artificial soil disturbances caused by excavation and construction activities on both A&W and RNC property account for such discrepancies.

McA Physical Properties

Physical properties include: color, bulk density, and permeability. The USDA describes the color of the McA soil as ranging between dark grayish brown (10YR 4/2) to light yellowish brown (10YR 6/4) (USDA, 1982). Field description for surface soil locations representing McA soil types 15 through 26, presented below, showed that soil colors range from pale olive (5Y 6/3) to very pale brown (10YR 7/3). Except for locations 18, 19 (pale olive 5Y 6/3) and 17 (very pale brown 10YR 7/3) the remaining soil colors fall within the USDA ranges. The values of 5 and above and low chromas 2, 3 and 4 suggest reducing conditions with little organic matter. Soils were dry when described.

Location	Color Code
SS - 15	10YR 5/3
SS - 16	10YR 7/3
SS - 17	10YR 6/3
SS - 18	5Y 6/3
SS - 19	5Y 6/3
SS - 20	10YR 5/3
SS - 21	10YR 6/4
SS - 22	10YR 6/3
SS - 23	10YR 5/3
SS - 24	10YR 4/3
SS - 25	10YR 6/2
SS - 26	10YR 4/3

Permeability in the McA horizon has been calculated by the USDA SCS as 0.6 to 2.0 in/hr., which is classified as a moderate rate of penetration. Bulk density as calculated by the USDA ranges from 1.30 G/cm^3 - 1.45 G/cm^3. Surface soil was not collected by the Companies for either permeability or bulk density tests. However, based on particle size analysis and field observations of the soil at A&W, permeability may be higher than described by the USDA SCS.

McA Chemical Properties

As discussed in Section 2.9, chemical parameters were provided by the laboratory and included CLP organics plus cumene, CLP semivolatiles, CLP inorganics, CLP pesticides/PCBs and general parameters. General parameters included ammonia, chloride, phosphorus, sulfate, pH and radionuclides, including potassium-40, gross alpha, gross beta, and total uranium. Table 3-23 shows results of analyses for parameters that were detected at levels above background. The nature and extent of these parameters are discussed in Section 4.0.

3.9.2 Unsaturated Subsurface Soils

The unsaturated subsurface is the section between the earth's surface and the groundwater table. This zone is significant because it can serve as a buffer to protect the underlying groundwater aquifer (Hillel 1989). Migration, retention, and

transportation of chemicals in the unsaturated soils are affected by complex interactions among the physical and chemical properties of soils.

The characterization of the Study Area's unsaturated subsurface was derived from data collected from 80 soil borings and 54 monitor wells. Descriptions of soils encountered while augering the boreholes and installing the monitor wells are presented on boring and well logs contained in Appendix E. The soil boring logs typically contain general information on the location, elevation, depth, water level if encountered and field determination of moisture content, soil consistency, radioactivity, organic vapor readings, penetration resistance and lithology. Information included on the well logs typically contains general information about well construction and field determination of moisture content, grain sorting, soil consistency, organic vapor readings and soil lithology. Data generated from the boring and well logs are used throughout this report to support the RI/RA findings.

Engineering and Physical Properties

Engineering and physical properties determined from field and laboratory data include: thickness of the unsaturated zone based on the depth to the water table, moisture content derived from field description and laboratory sample, soil type, permeability, bulk density and cation exchange capacity.

Thickness of Unsaturated Subsurface Soil Zone

The thickness of this soil is the difference between the ground surface and the level of the water table. Within this zone, chemicals are both degraded and retained on soil particles. The thicker the section, the more likely chemicals will be degraded or retained prior to entering into the water table. Two variables control the zone's thickness: water table configuration and surface topography.

The thickness constantly varies because the water table rises and falls in response to precipitation. As the water table rises in response to precipitation the unsaturated

interval is thinner. In times of drought when the water table is low, the unsaturated section is thicker.

The water table is primarily a flat plane that rises and falls, but topography usually is not flat. Hills typically add to the total thickness between the ground surface and water table while low spots are thinner.

For purposes of determining an average thickness of the unsaturated interval at PRRS, a representative number of wells having similar surface elevations and water level information were used for the estimation. Based on data collected from June 1989 to May 1992, the average thickness of the unsaturated zone is approximately 13 feet.

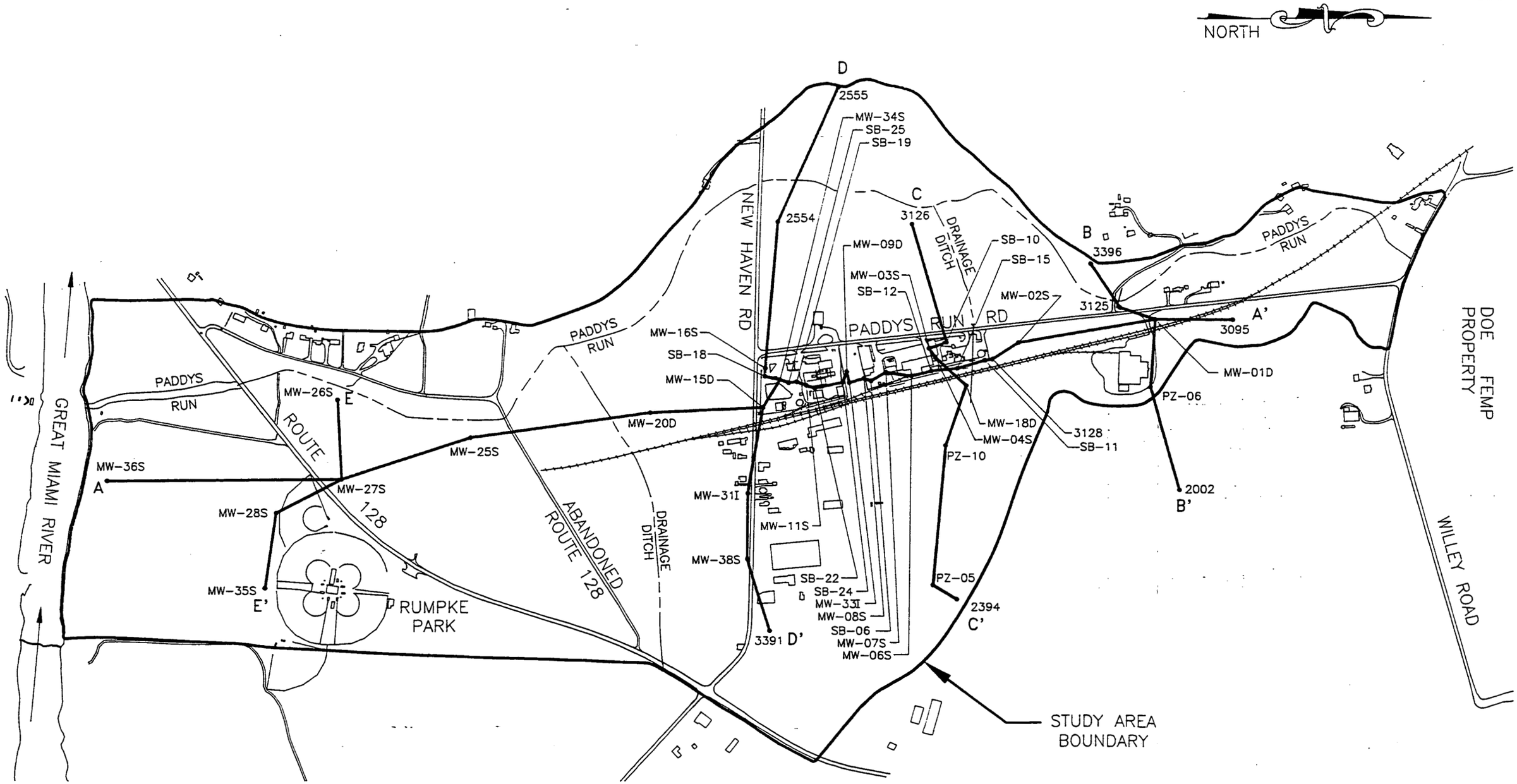
Moisture Content

Soil moisture occupies the porosity within the soil. Generally at PRRS soils contain less moisture at the surface and increase in moisture with depth. Soils that are clayey contain more moisture in comparison with sandy type soils. For example, the average percentage of moisture for borehole SB-77 was 10.2 percent (located on A&W property) and the average percentage of moisture for borehole SB-43 (located on the RNC property) was 10.9 percent.

Soil Type

Soil type was described from each of the 80 soil borings and 54 monitor wells. Those descriptions are presented on the boring and well logs found in Appendix E. Soil types within the unsaturated subsurface comprise mixtures of clay, silt and sand. To illustrate the relationship, stratigraphic cross sections have been prepared. Figure 3-18 is a base map for the cross sections. Representative cross sections of the Study Area are shown in Figures 3-19, 3-20, 3-21, and 3-22.

Particle size analyses were performed on soils from 15 to 17 feet at location MW-9D, 2 to 4 feet at location SB-37 and 6 to 8 feet at location SB-64. This information



000241

GRAPHIC SCALE

600 0 300 600 1200

(IN FEET)
1 inch = 600 ft.

CROSS SECTION LOCATION MAP
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 3-18

ERM ERM-Midwest, inc.
Environmental Resources Management

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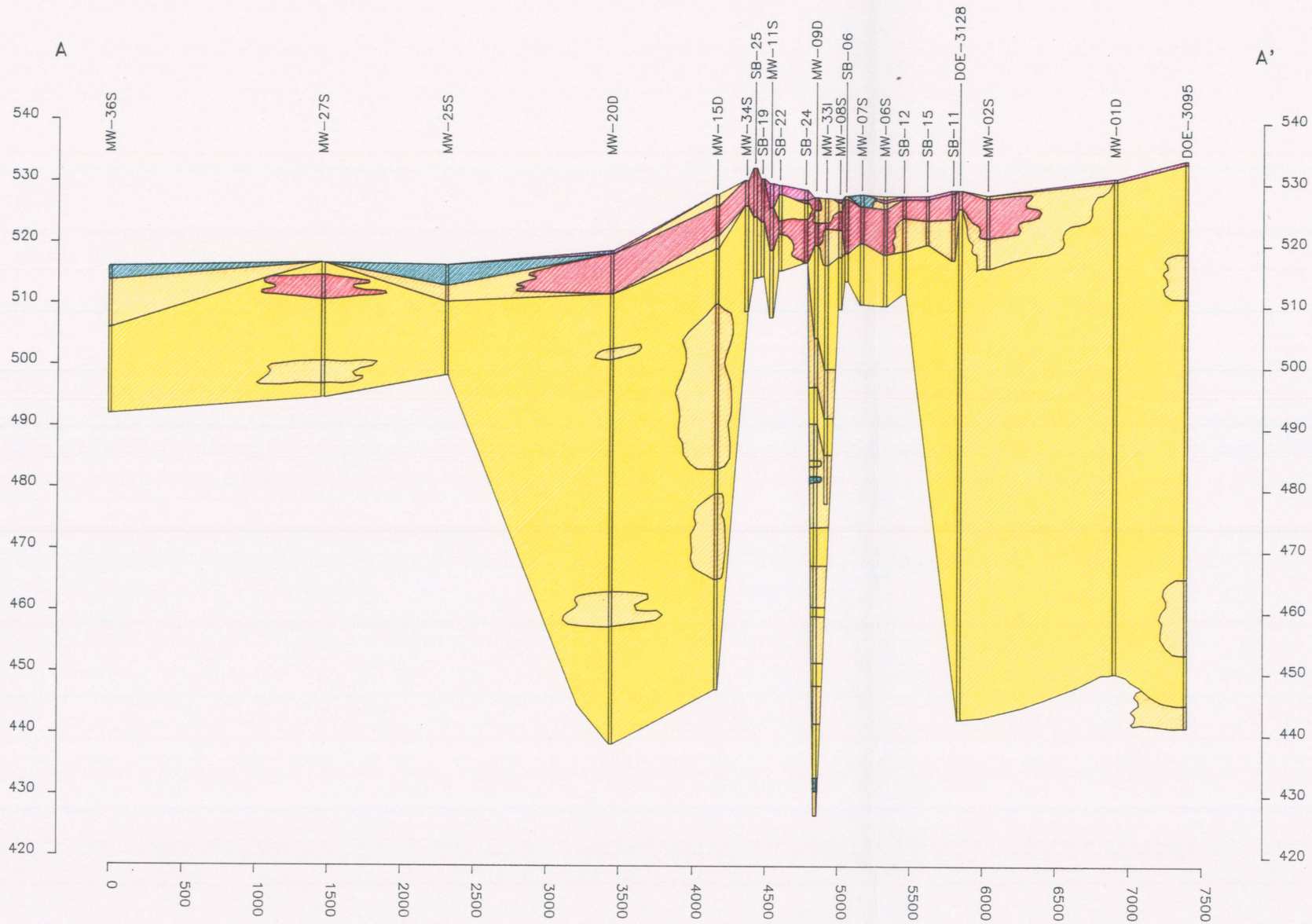


LEGEND

- SILT
- FILL/SOIL
- CLAY
- SAND AND GRAVEL
- SAND

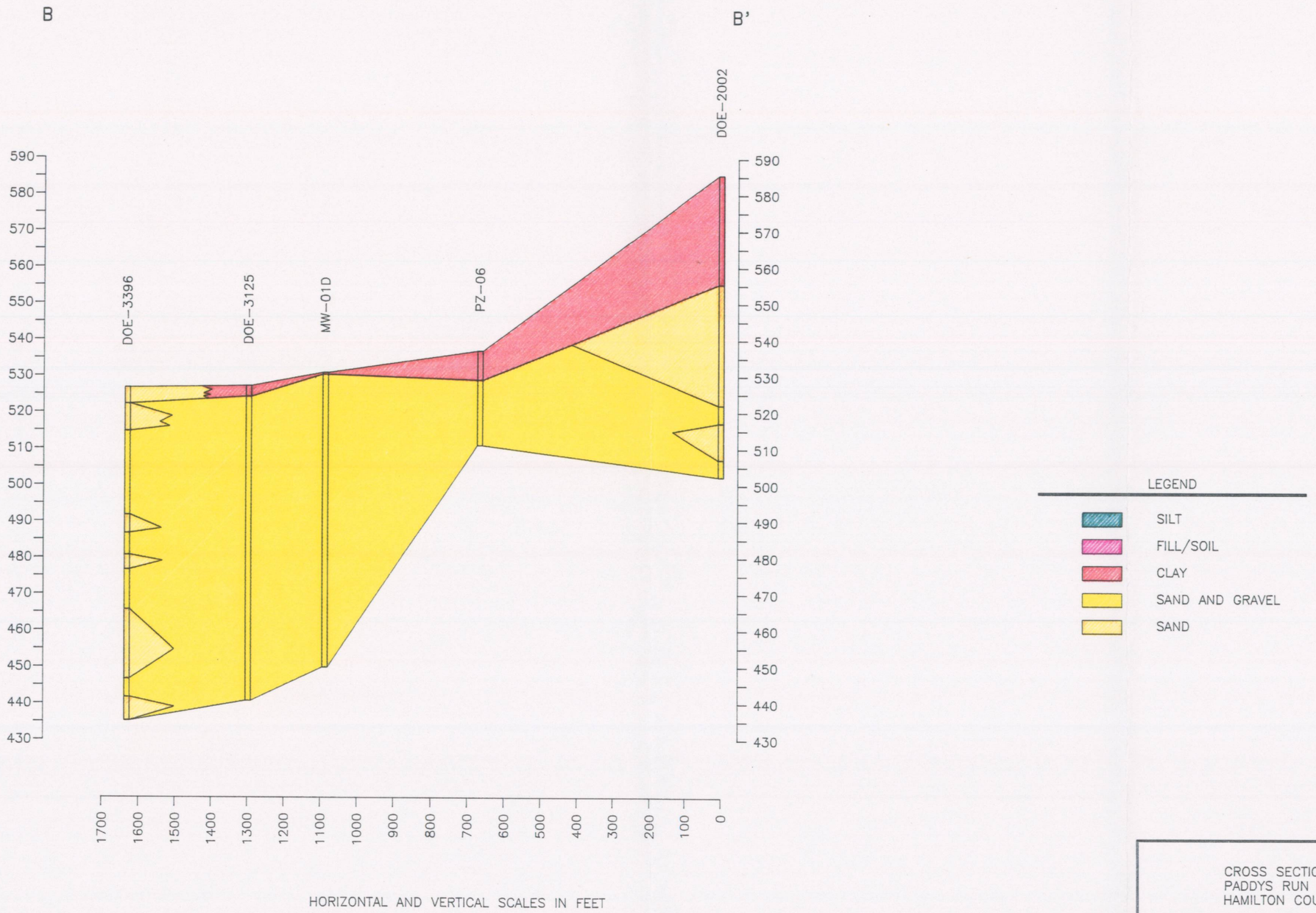
000242

CROSS SECTION A – A'
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 3-19

ERM-Midwest, inc.
Environmental Resources Management

PROJECT\539-10-02\1002F317.DWG



000243

CROSS SECTION B – B'
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE
3-20

ERM-Midwest, inc.
Environmental Resources Management

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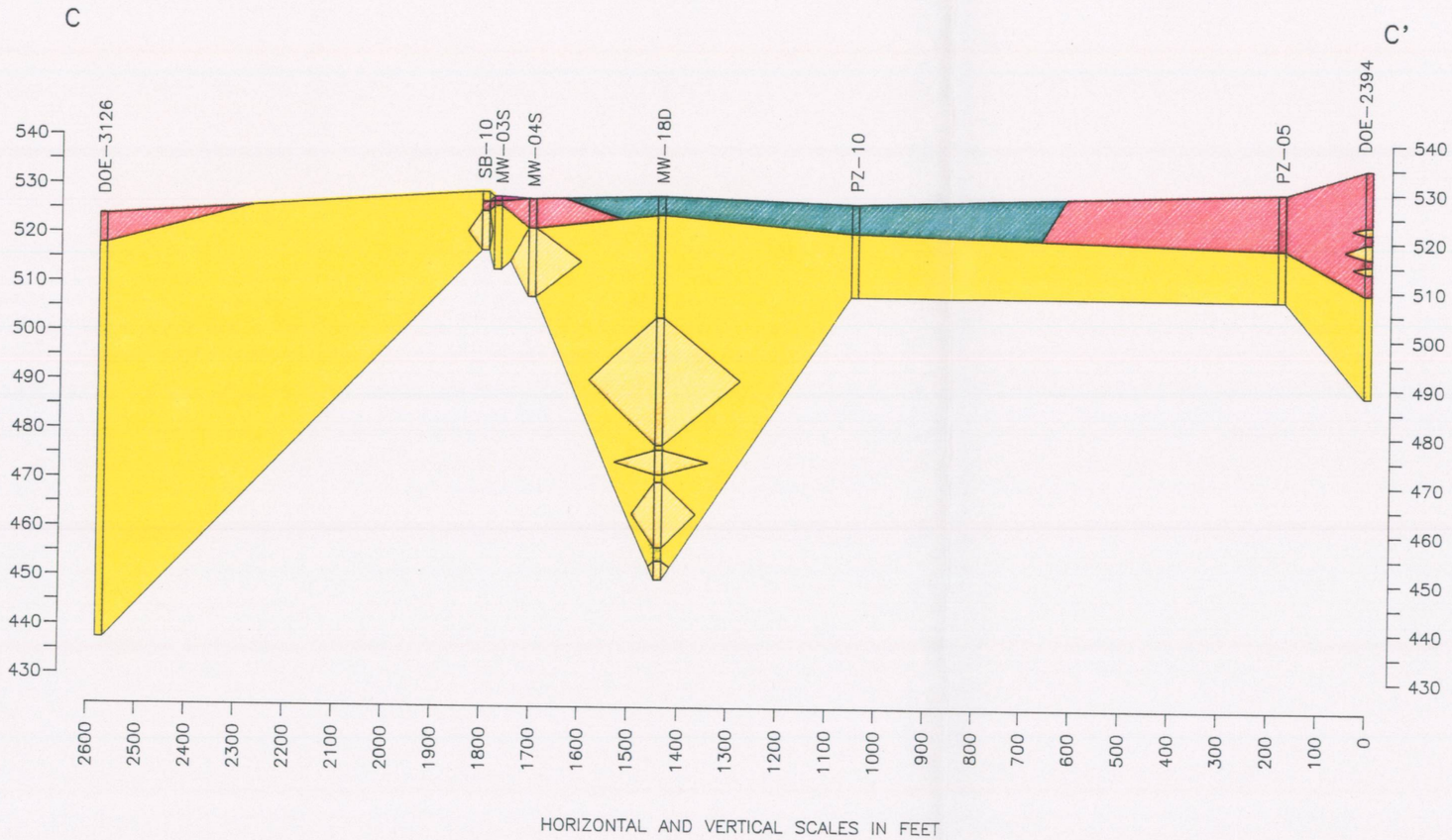


LEGEND

- SILT
- FILL/SOIL
- CLAY
- SAND AND GRAVEL
- SAND

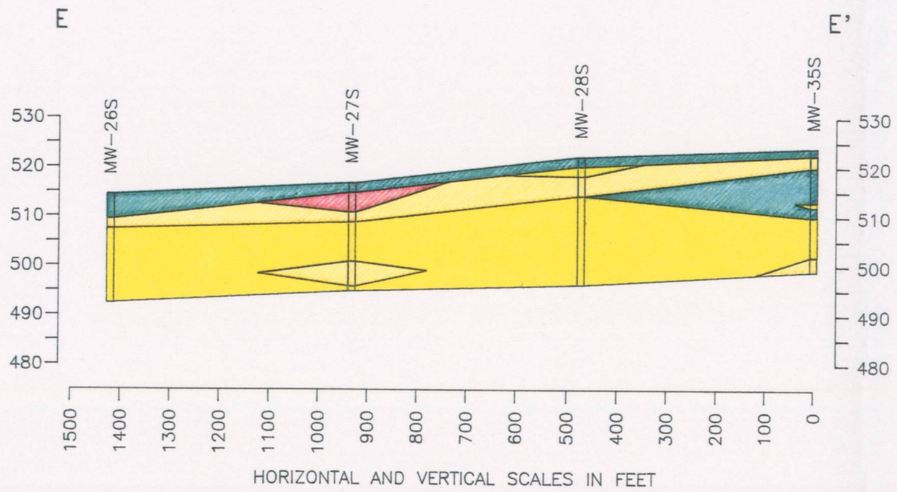
000244

CROSS SECTION C – C'
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 3-21

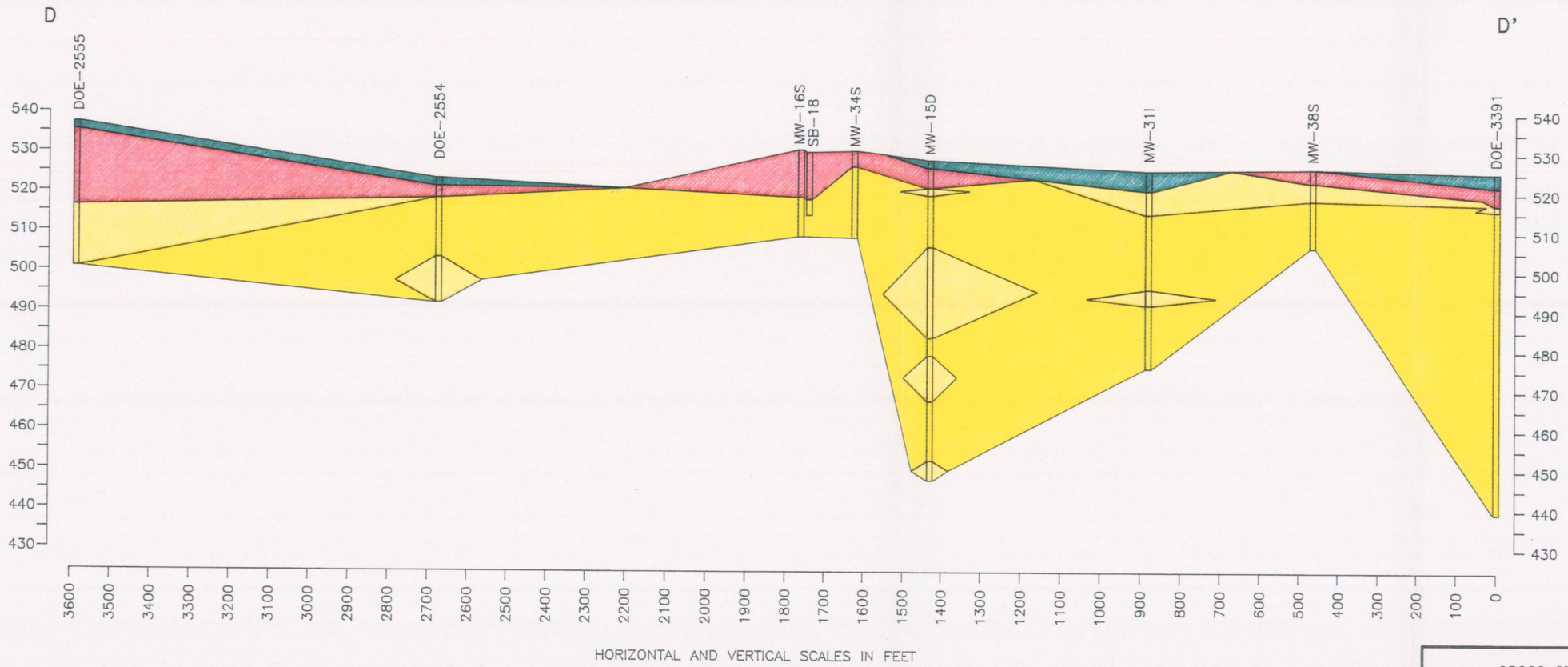
ERM-Midwest, inc.
Environmental Resources Management

PROJECT\539-10-02\1002F319.DWG



LEGEND

- SILT
- FILL/SOIL
- CLAY
- SAND AND GRAVEL
- SAND



CROSS SECTION D – D' AND
CROSS SECTION E – E'
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 3-22

ERM-Midwest, inc.
Environmental Resources Management

PROJECT\539-10-02\1002F320.DWG

was used primarily to support the groundwater model, but is presented here to verify the field visual description. The particle size curves indicate that soil at this depth from MW-9D consists of 50 percent gravel, 41 percent sand, 8 percent silt and 1 percent clay which classifies it as a gravelly medium coarse sand. Field description classifies it as a medium coarse sand with some fine to medium gravel and silt. Three analyses from soil within the 2 to 4 feet interval range from 53 to 84 percent sand, 13 to 39 percent silt and 3 to 14 percent clay. These three soils can be classified as silty clayey sand. Field classification described this interval as clayey sand. Particle size analysis from the 6 to 8 feet zone within SB-64 shows the percentages of soil sizes to be 10 percent sand, 62 percent silt and 28 percent clay which classifies it as a silty sandy clay. Field description classified the soil as a silty clay. Field description is comparable with the laboratory results.

Permeability

Two Shelby tube samples were collected from the unsaturated zone for permeability measurements. Two shelby tube samples obtained from location SB-37 at a depth of 2 to 4 feet had permeabilities ranging between 9.0E-08 cm/sec, which classifies the rate of water penetration as very slow to 1.6E-04 cm/sec, which is moderately slow. It is apparent that the range of permeabilities is a result of different soil types. Sample description verifies this. The laboratory described the very slow penetration rate sample as a gray clayey silt with fine to medium sand. The sample rated moderately slow was described as a gray to brown fine to coarse sand with a little fine gravel, little silt and a trace of clay. These results are included in Appendix F. A sample collected from SB-64 at a depth of 6 to 8 feet had a permeability of 3.7E-08 cm/sec, which is very slow. This sample was described as a gray brown silty clay with a trace of fine to coarse sand.

Bulk Density

Bulk density has been calculated from soil borings SB-37 and SB-64. The averaged bulk density from those samples is 1.58 G/cm^3. A value of 1.60 G/cm^3, determined

from separate studies, is reported from the FEMP site (IT Corp. 1990/ASI, 1990). Laboratory results are included in Appendix F.

Cation Exchange Capacity

Cation exchange capacity (CEC) measures the capacity of soil to sorb cations (Manahan, 1991). Cations are positive charged ions such as: hydrogen (H), calcium (Ca), magnesium (Mg), potassium (K), sodium (Na), iron (Fe), manganese (Mn), and aluminum (Al). While sands and silts have minimal capacity for sorption, clays, because of their chemical and physical structure and organic material, are significant in sorbing cations. The medium in which sorption takes place is in water.

The CEC is expressed in millequivalents per 100 grams of oven dry soil with classes of results being <12 is low; 12-20 is medium; and >20 is high. Soils with low CEC values contain less clay and/or organic material than soils with high CECs. This value considers both the percent clay content and the percent organic material. The CECs for two samples within the unsaturated zone were measured. Those samples, from MW-9D (15 to 17 feet) and PRS-18S (monitor well 18S, 8 to 10 feet), had CECs of 16.9 and 16.8, respectively. The organic content was laboratory determined only for MW-9D and was 8 percent. The percent clay by particle size analysis in MW-9D was 1 percent. For these conditions, 100 grams of soil is 2 millequivalents for each percent of organic matter and 1/2 millequivalent for each percent clay (Millar 1966). Therefore, the soil sample from MW-9D having an organic content and clay content of 1 percent would have a CEC of approximately 16.5 millequivalents per 100 grams [2(8) + ½ (1) = 16.5] which is approximate to the estimated literature value.

Clays and organic material play a significant role in the transport of and reactions with chemicals that are being carried in the water. Clay and organic material can retard the movement of dissolved chemicals because of their ability to attract cations. This retardation factor is important component in developing the model estimates of the rate and direction of chemical movement. The solute transport

model is discussed in Section 4.0 of the Groundwater Flow Model Study, which is attached as Appendix C.

Chemical Properties

As discussed in Section 2.9, chemical parameters were provided by the laboratory and included CLP organics plus cumene, CLP semivolatiles, CLP inorganics, CLP pesticides/PCBs and general parameters. General parameters included ammonia, chloride, phosphorus, sulfate, pH and radionuclides, including potassium-40, gross alpha, gross beta, and total uranium. Tables 3-24 through 3-27 indicate parameters that detected at levels above background. The nature and extent of these parameters are discussed in Section 4.0.

3.9.3 Saturated Subsurface Soils

Saturated subsurface soils are those which occur within the zone of water saturation. Migration, retention, and transformation of chemicals in this zone are affected by complex interactions among the engineering, physical and chemical properties of soils. This zone beneath the Study Area has been characterized from information collected from 80 soil borings and 54 monitor wells. Descriptions of soils encountered while augering the boreholes and installing monitor wells are presented on boring and well logs contained in Appendix E.

Engineering and Physical Properties

The total thickness of the saturated subsurface soils varies across the Study Area depending on the fluctuating depth of the water table and the uneven surface of the bedrock. Bedrock ranges in elevation across the Study Area from 380 to 432 FAMSL. The average elevation of bedrock is approximately 406 FAMSL. Due to fluctuation and gradient changes, the water table ranges from 528 to 488 FAMSL for an average of 508 FAMSL. Subtracting the average elevation of the bedrock from the average elevation of the groundwater gives an average saturated soil thickness of 102 feet.

TABLE 3-24
TOTAL METALS DETECTED ABOVE BACKGROUND IN SOIL BORINGS(+)
PADDYS RUN ROAD SITE

SB No.(++)	Depth*	Value	SB No.(++)	Depth*	Value	SB No.(++)	Depth*	Value
Antimony (4.96 mg/kg)								
SB-02	7-12	7.5	SB-21	0-2	10.5	SB-28	7-15	9.7
SB-03	7-12	6.4	SB-21	0-7	5.5	SB-29	7-14	7.3
SB-05	7-12	5.6	SB-21	7-13	11.0	SB-29	15-16	9.7
SB-07	0-7	6.0	SB-21	13-14	9.8	SB-30	7-14	10.4
SB-08	0-7	5.5	SB-22	0-7	11.5	SB-31	0-7	6.4
SB-09	0-7	5.2	SB-23	0-7	5.2	SB-32	7-8	10.7
SB-09	7-11	12.0	SB-23	3-4	5.5	SB-33	0-7	7.1
SB-10	0-7	11.3	SB-23	7-11	13.5	SB-33	7-10	9.9
SB-11	0-7	7.6	SB-23	11-12	13.5	SB-34	7-9	8.6
SB-11	7-11	11.5	SB-25	0-7	7.2	MW-11S	17-19	10.0
SB-12	0-7	8.2	SB-25	7-8	6.0	MW-12S	6-8	12.1
SB-13	0-7	8.7	SB-25	15-16	13.4	MW-12S	16-18	10.2
SB-13	7-10	9.1	SB-25	8-17	6.8	MW-13S	14-16	7.3
SB-14	0-7	13.8	SB-25	17-18	10.8	MW-13S	19-20	9.6
SB-14	7-12	6.6	SB-26	0-1	5.5	MW-14S	16-18	9.6
SB-15	0-7	6.3	SB-26	0-7	6.0	MW-40S	12-14	7.6
SB-16	0-7	5.4	SB-26	9-10	6.6	MW-40S	18-20	6.9
SB-17	9-10	7.5	SB-26	7-15	6.8	MW-41S	0-2	7.1
SB-18	7-15	5.9	SB-26	15-16	6.5	MW-41S	6-8	5.8
SB-19	5-6	6.3	SB-27	5-6	5.1	MW-41S	8-10	6.0
SB-19	9-10	9.0	SB-27	7-13	7.9	MW-41S	12-14	5.1
SB-19	7-16	6.3	SB-27	10-11	12.4	MW-41S	14-15	6.6
SB-20	0-7	6.3	SB-27	13-14	7.1	MW-41S	15-16	6.2
SB-20	7-10	5.5	SB-28	0-7	12.1			
Arsenic (7.74 mg/kg)								
SB-01	0-7	13.3	SB-38	10-18	23.0	SB-51	8-10	13.9
SB-02	0-7	44.1	SB-39	6-10	7.8	SB-52	8-10	9.0
SB-04	0-7	7.9	SB-39	10-18	9.5	SB-53	2-4	12.3
SB-04	7-12	12.7	SB-40	10-18	10.5	SB-53	6-8	8.4
SB-05	0-7	41.9	SB-43	0-2	8.7	SB-54	6-8	9.69
SB-05	7-12	14.9	SB-44	10-WT	41.9	SB-55	2-4	40.0
SB-06	0-7	19.2	SB-45	10-18	13.4	SB-55	8-10	7.8
SB-08	0-7	8.1	SB-47	6-10	8.0	SB-56	4-6	9.5
SB-19	7-16	17.1	SB-47	10-18	20.7	SB-59	6-8	47.9
SB-21	13-14	8.6	SB-48	2-4	11.1	SB-60	8-10	15.1
SB-22	7-12	8.5	SB-48	4-6	12.7	SB-61	2-4	9.8
SB-25	15-16	8.7	SB-48	6-8	8.9	SB-61	6-8	30.8
SB-25	17-18	9.0	SB-48	8-10	12.3	SB-61	8-10	9.7
SB-26	0-7	44.8	SB-48	10-16	11.5	SB-64	6-8	28.4
SB-26	7-15	13.0	SB-49	2-4	52.7	SB-65	2-4	10.9
SB-27	7-13	23.2	SB-49	4-6	45.1	SB-65	6-8	15.9
SB-27	10-11	198.0	SB-49	6-8	29.1	SB-65	8-10	10.6
SB-27	13-14	7.9	SB-49	8-10	14.2	SB-68	2-4	8.3
SB-28	7-15	37.3	SB-49	10-16	10.9	SB-70	4-6	10.4
SB-29	0-7	9.1	SB-50	2-4	11.1	SB-71	6-8	114.0
SB-29	1-2	17.0	SB-50	2-6	9.1	SB-72	4-6	7.8
SB-29	15-16	11.8	SB-50	4-6	13.5	SB-72	10-WT	30.4
SB-33	7-10	8.8	SB-50	6-8	12.1	SB-73	6-8	8.0
SB-35	0-2	18.7	SB-50	6-10	11.2	SB-73	4-6	15.9
SB-35	2-6	10.5	SB-51	2-4	17.3	SB-74	4-6	10.5
SB-35	10-12	8.4	SB-51	4-6	41	SB-77	2-4	8.7
SB-35	12-14	10.4	SB-51	6-8	23.6	SB-77	6-8	9.5

(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)SB-1 through SB-35 samples were collected by ENSR in March 1990; SB-36 through SB-81 samples were collected by ERM-Midwest in May 1991.

*Numbers are foot intervals.

WT = Water Table

For locations of borings and wells, see Figure 2-11 in Section 2.9 - Unsaturated and Saturated Soil Investigations.

TABLE 3-24 (Continued)
TOTAL METALS DETECTED ABOVE BACKGROUND IN SOIL BORINGS(+)
PADDYS RUN ROAD SITE

SB No.(++)	Depth*	Value	SB No.(++)	Depth*	Value	SB No.(++)	Depth*	Value
Arsenic (7.74 mg/kg) Continued								
SB-77	8-10	9.1	SB-80	10-16	7.9	MW-13S	19-20	12.0
SB-77	10-WT	19.2	SB-81	2-4	402.0	MW-40S	10-12	8.1
SB-78	2-4	8.9	SB-81	4-6	178.0	MW-41S	8-10	9.6
SB-79	6-8	11.1	SB-81	6-8	17.3	MW-41S	12-14	58.7
SB-79	6-10	10.7	SB-81	8-10	9.3	MW-41S	14-15	46.7
SB-80	2-4	108.0	SB-81	10-16	23.5	MW-41S	15-16	15.4
SB-80	4-6	76.9	MW-06	12-14	10.8	MW-41S	16-18	8.6
SB-80	6-8	31.4	MW-10S	14-16	8.2	MW-41S	18-20	8.8
SB-80	8-10	11.5	MW-13S	14-16	58.5			
Beryllium (1.02 mg/kg)								
SB-13	0-7	1.9	SB-59	0-2	3.7	SB-59	8-10	1.7
SB-21	0-2	6.1						
Cadmium (0.83 mg/kg)								
SB-12	0-7	4.3	SB-14	0-7	1.2	SB-33	7-10	1.80
SB-13	7-10	1.2						
Chromium (23.46 mg/kg)								
SB-13	0-7	29.9	SB-31	0-7	27.7	SB-81	4-6	27.3
SB-17	9-10	31.3	SB-48	8-10	29.2	MW-41S	0-2	41.7
SB-27	5-6	24.0	SB-52	4-6	27.5	MW-41S	8-10	128.0
SB-31	0-6	26.8	SB-78	6-8	25.9	MW-41S	14-15	34.7
Copper (28.37 mg/kg)								
SB-23	0-7	33.1	SB-31	0-6	32.0	SB-53	2-4	35.4
SB-29	1-2	68.8	SB-31	0-7	33.8			
Mercury (0.2 mg/kg)								
SB-01	0-7	0.42	SB-17	9-10	0.26	SB-31	0-6	0.59
SB-02	0-7	0.85	SB-17	7-16	0.4	SB-31	0-7	0.64
SB-04	0-7	0.48	SB-19	0-7	0.25	SB-33	0-7	0.4
SB-05	0-7	0.22	SB-19	5-6	0.39	SB-78	8-10	0.27
SB-08	0-7	0.52	SB-19	9-10	0.27	SB-79	4-6	0.36
SB-10	0-7	0.45	SB-19	7-16	0.73	SB-41S	0-2	0.42
SB-12	0-7	1.9	SB-20	7-10	0.23	SB-41S	8-10	2.5
SB-14	0-7	0.22	SB-25	0-7	0.24	MW-41S	14-15	0.65
SB-17	0-7	0.7	SB-26	1-1	0.22			
Nickel (29.71 mg/kg)								
SB-27	5-6	29.9	MW-41S	8-10	42.1			
Selenium (2.39 mg/kg)								
SB-34	7-9	4.00	SB-59	0-2	2.70			
Barium (169.45 mg/kg)								
SB-21	0-2	223.0	SB-27	10-11	449.0	MW-41S	12-14	193.0
SB-26	9-10	636.0	SB-59	0-2	221.0	MW-41S	14-15	416.0
Iron (28841.20 mg/kg)								
SB-27	10-11	68400.0	SB-32	0-7	29000.0	MW-41S	12-14	50200.0
Manganese (1601.18 mg/kg)								
SB-21	0-2	2830.0	SB-27	10-11	4600.0	SB-60	2-4	1690.0
SB-25	8-17	1810.0	SB-51	8-10	1710.0	MW-41S	12-14	3220.0
SB-26	9-10	5370.0	SB-59	0-2	3190.0	MW-41S	14-15	2740.0
Vanadium (34.52 mg/kg)								
SB-48	8-10	44.0	SB-78	6-8	43.3	MW-06	6-8	36.7
SB-52	4-6	37.9	SB-81	4-6	50.1			

(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)SB-1 through SB-35 samples were collected by ENSR in March 1990; SB-36 through SB-81 samples were collected by ERM-Midwest in May 1991.

*Numbers are foot intervals.

WT = Water Table

For locations of borings and wells, see Figure 2-11 in Section 2.9 - Unsaturated and Saturated Soil Investigations.

TABLE 3-24 (Continued)
TOTAL METALS DETECTED ABOVE BACKGROUND IN SOIL BORINGS(+)
PADDYS RUN ROAD SITE

SB No.(++)	Depth*	Value	SB No.(++)	Depth*	Value	SB No.(++)	Depth*	Value
Aluminum (18753.97 mg/kg)								
SB-13	0-7	19500.0	SB-52	4-6	21800.0	SB-78	6-8	20800.0
SB-21	0-2	26200.0	SB-59	0-2	22400.0	SB-81	4-6	23000.0
SB-48	8-10	24700.0						
Cobalt (13.11 mg/kg)								
SB-02	0-7	13.4	SB-18	0-7	13.5	SB-32	0-7	13.9
SB-06	7-12	13.3	SB-27	5-6	17.3			
Calcium (118266.30 mg/kg)								
SB-07	7-12	129000.0	SB-27	13-14	121000.0	SB-80	6-8	143000.0
SB-09	7-11	139000.0	SB-28	0-7	190000.0	SB-80	10-16	138000.0
SB-10	0-7	136000.0	SB-28	7-15	140000.0	MW-10S	14-16	187000.0
SB-11	7-11	122000.0	SB-29	7-14	163000.0	MW-12S	6-8	140000.0
SB-14	7-12	144000.0	SB-29	15-16	133000.0	MW-12S	16-18	140000.0
SB-18	7-15	139000.0	SB-33	0-7	125000.0	MW-13S	14-16	214000.0
SB-19	9-10	151000.0	SB-33	7-10	126000.0	MW-13S	19-20	174000.0
SB-19	7-16	155000.0	SB-35	0-2	172000.0	MW-14S	16-18	120000.0
SB-21	0-2	209000.0	SB-35	8-10	139000.0	MW-40S	12-14	160000.0
SB-21	0-7	129000.0	SB-35	10-12	143000.0	MW-40S	14-16	151000.0
SB-21	7-13	146000.0	SB-52	10-WT	188000.0	MW-40S	16-18	148000.0
SB-21	13-14	123000.0	SB-52	8-10	119000.0	MW-40S	18-20	163000.0
SB-22	0-7	163000.0	SB-59	0-2	215000.0	MW-41S	4-6	149000.0
SB-23	7-11	142000.0	SB-59	8-10	130000.0	MW-41S	6-8	171000.0
SB-23	11-12	123000.0	SB-59	10-WT	157000.0	MW-41S	10-12	119000.0
SB-25	17-18	123000.0	SB-60	10-WT	125000.0	MW-41S	14-15	141000.0
SB-25	15-16	147000.0	SB-78	12-14	177000.0	MW-41S	15-16	133000.0
SB-26	9-10	146000.0	SB-78	10-WT	130000.0	MW-41S	16-18	132000.0
SB-26	7-15	134000.0	SB-79	4-6	123000.0	MW-41S	18-20	195000.0
SB-26	15-16	146000.0	SB-79	6-8	141000.0	MW-41S	20-22	119000.0
SB-27	7-13	129000.0	SB-79	8-10	146000.0	MW-41S	22-24	189000.0
SB-27	10-11	130000.0	SB-79	10-WT	140000.0			
Magnesium (28113.63 mg/kg)								
SB-01	7-12	43000.0	SB-21	13-14	64000.0	SB-35	8-10	30700.0
SB-02	7-12	38200.0	SB-22	1-2	30800.0	SB-35	10-12	60700.0
SB-03	7-12	35900.0	SB-22	0-7	61200.0	SB-35	14-16	42000.0
SB-05	7-12	40300.0	SB-23	3-4	30100.0	SB-48	10-16	36500.0
SB-07	0-7	30200.0	SB-23	7-11	35600.0	SB-52	6-8	39400.0
SB-07	7-12	44400.0	SB-23	11-12	40500.0	SB-52	8-10	63000.0
SB-08	7-10	38700.0	SB-25	7-8	36300.0	SB-52	10-WT	79000.0
SB-09	7-11	55600.0	SB-25	15-16	62200.0	SB-53	8-10	83500.0
SB-10	0-7	39600.0	SB-25	17-18	50700.0	SB-53	10-WT	34000.0
SB-10	2-4	31100.0	SB-26	0-7	36700.0	SB-59	0-2	41200.0
SB-10	4-6	29200.0	SB-26	7-15	59200.0	SB-59	6-8	37800.0
SB-10	7-11	33100.0	SB-26	9-10	56400.0	SB-59	8-10	40300.0
SB-11	7-11	33600.0	SB-26	15-16	53200.0	SB-59	10-WT	71200.0
SB-13	7-10	35700.0	SB-27	5-6	29000.0	SB-60	10-WT	60100.0
SB-14	0-7	44800.0	SB-27	7-13	42200.0	SB-78	6-10	28200.0
SB-14	7-12	68300.0	SB-27	10-11	46300.0	SB-78	12-14	79000.0
SB-16	7-14	50700.0	SB-27	13-14	30400.0	SB-78	10-WT	46900.0
SB-17	7-16	36800.0	SB-28	0-7	53100.0	SB-79	4-6	36700.0
SB-17	10-12	42600.0	SB-28	7-15	52100.0	SB-79	6-8	44300.0
SB-18	0-7	37600.0	SB-29	7-14	46400.0	SB-79	8-10	42100.0
SB-18	7-15	63000.0	SB-29	15-16	53000.0	SB-79	10-WT	56100.0
SB-19	0-7	35900.0	SB-30	7-14	38600.0	SB-80	4-6	46100.0
SB-19	7-16	68100.0	SB-32	7-8	33800.0	SB-80	6-8	36800.0
SB-19	9-10	62100.0	SB-33	0-7	35700.0	SB-80	8-10	37800.0
SB-20	7-10	29400.0	SB-33	7-10	45700.0	SB-80	10-16	47100.0
SB-21	0-2	81600.0	SB-35	0-2	30400.0	SB-81	6-8	33200.0
SB-21	7-13	50300.0	SB-35	6-8	28300.0	SB-81	8-10	34600.0

(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.
(++)SB-1 through SB-35 samples were collected by ENSR in March 1990; SB-36 through SB-81 samples were collected by ERM-Midwest in May 1991.
*Numbers are foot intervals.
WT = Water Table
For locations of borings and wells, see Figure 2-11 in Section 2.9 - Unsaturated and Saturated Soil Investigations.

TABLE 3-24 (Continued)
TOTAL METALS DETECTED ABOVE BACKGROUND IN SOIL BORINGS(+)
PADDYS RUN ROAD SITE

SB No.(++)	Depth*	Value	SB No.(++)	Depth*	Value	SB No.(++)	Depth*	Value
Magnesium (28113.63 mg/kg) - Continued								
SB-81	10-16	45700.0	MW-40S	10-12	41300.0	MW-41S	10-12	55100.0
MW-06	0-2	38300.0	MW-40S	12-14	74200.0	MW-41S	12-14	50900.0
MW-06	12-14	29400.0	MW-40S	14-16	55300.0	MW-41S	14-15	40000.0
MW-10S	14-16	58800.0	MW-40S	16-18	45900.0	MW-41S	15-16	59800.0
MW-12S	6-8	46800.0	MW-40S	18-20	52000.0	MW-41S	16-18	44300.0
MW-13S	14-16	93400.0	MW-41S	4-6	55600.0	MW-41S	18-20	50800.0
MW-13S	20-21	79800.0	MW-41S	6-8	63300.0	MW-41S	22-24	32500.0
MW-14S	16-18	46500.0	MW-41S	8-10	36900.0			
Sodium (212.27 mg/kg)								
SB-01	0-7	370.0	SB-21	13-14	1120.0	SB-44	6-10	229.0
SB-01	7-12	845.0	SB-22	1	310.0	SB-44	10-WT	288.0
SB-02	0-7	929.0	SB-22	0-7	1150.0	SB-45	6-10	252.0
SB-02	7-12	734.0	SB-22	7-12	790.0	SB-45	10-18	261.0
SB-03	0-7	725.0	SB-23	0-7	687.0	SB-46	6-10	220.0
SB-03	7-12	1020.0	SB-23	3-4	360.0	SB-46	10-20	219.0
SB-04	0-7	949.0	SB-23	4-5	490.0	SB-47	0-2	539.0
SB-04	7-12	1070.0	SB-23	7-11	802.0	SB-47	2-6	319.0
SB-05	0-7	767.0	SB-23	11-12	1080.0	SB-47	6-10	245.0
SB-05	7-12	1180.0	SB-24	7-12	445.0	SB-47	10-18	223.0
SB-06	0-7	1010.0	SB-25	0-7	563.0	SB-48	4-6	245.0
SB-06	7-12	589.0	SB-25	7-8	799.0	SB-48	6-8	522.0
SB-07	0-7	547.0	SB-25	8-17	938.0	SB-48	8-10	760.0
SB-07	7-12	525.0	SB-25	15-16	1070.0	SB-48	10-16	579.0
SB-08	0-7	665.0	SB-25	17-18	802.0	SB-49	4-6	564.0
SB-08	7-10	604.0	SB-26	1	449.0	SB-49	6-8	462.0
SB-09	0-7	462.0	SB-26	9-10	325.0	SB-49	8-10	287.0
SB-09	7-11	989.0	SB-28	0-7	1220.0	SB-49	10-16	260.0
SB-10	0-7	1590.0	SB-28	1-2	977.0	SB-50	2-4	268.0
SB-10	2-4	3130.0	SB-28	4-6	479.0	SB-50	2-6	542.0
SB-10	4-6	1090.0	SB-28	7-15	747.0	SB-50	4-6	544.0
SB-10	7-11	1250.0	SB-29	15-16	519.0	SB-51	2-4	348.0
SB-11	0-7	3180.0	SB-30	7-14	377.0	SB-51	4-6	388.0
SB-11	7-11	1280.0	SB-31	0-6	712.0	SB-51	6-8	386.0
SB-12	0-7	3700.0	SB-31	0-7	641.0	SB-51	8-10	365.0
SB-12	2-4	464.0	SB-32	7-8	373.0	SB-52	2-4	1910.0
SB-13	0-7	6320.0	SB-33	0-7	569.0	SB-52	4-6	1880.0
SB-13	7-10	2990.0	SB-33	7-10	852.0	SB-52	6-8	747.0
SB-14	0-7	1400.0	SB-34	0-7	1320.0	SB-52	8-10	420.0
SB-14	7-12	1640.0	SB-34	7-9	1630.0	SB-52	10-WT	323.0
SB-15	0-7	700.0	SB-35	0-2	230.0	SB-53	2-4	1770.0
SB-16	0-7	442.0	SB-35	2-6	223.0	SB-53	4-6	1020.0
SB-16	7-14	467.0	SB-36	2-6	762.0	SB-53	6-8	1320.0
SB-17	0-7	469.0	SB-36	10-WT	327.0	SB-53	8-10	400.0
SB-17	7-16	442.0	SB-37	0-2	1440.0	SB-53	10-WT	250.0
SB-17	9-10	463.0	SB-37	2-6	718.0	SB-54	0-2	760.0
SB-17	10-12	625.0	SB-37	6-10	517.0	SB-54	2-4	418.0
SB-18	0-7	549.0	SB-37	10-18	571.0	SB-54	4-6	328.0
SB-18	7-15	588.0	SB-38	2-6	214.0	SB-54	6-8	316.0
SB-19	5-6	358.0	SB-38	10-18	225.0	SB-54	8-10	344.0
SB-19	9-10	698.0	SB-40	10-18	435.0	SB-54	10-WT	283.0
SB-20	0-7	360.0	SB-42	2-6	252.0	SB-55	0-2	462.0
SB-20	7-10	488.0	SB-42	6-10	243.0	SB-55	2-4	537.0
SB-21	0-7	2390.0	SB-42	10-18	226.0	SB-55	4-6	579.0
SB-21	1-2	934.0	SB-43	10-21	273.0	SB-55	6-8	254.00
SB-21	7-13	2490.0	SB-44	2-6	344.0	SB-56	0-2	1360.0

+The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

++SB-1 through SB-35 samples were collected by ENSR in March 1990; SB-36 through SB-81 samples were collected by ERM-Midwest in May 1991.

*Numbers are foot intervals.

WT = Water Table

For locations of borings and wells, see Figure 2-11 in Section 2.9 - Unsaturated and Saturated Soil Investigations.

TABLE 3-24 (Continued)
TOTAL METALS DETECTED ABOVE BACKGROUND IN SOIL BORINGS(+)
PADDYS RUN ROAD SITE

SB No.(++)	Depth*	Value	SB No.(++)	Depth*	Value	SB No.(++)	Depth*	Value
Sodium (212.27 mg/kg) - Continued								
SB-56	2-4	1800.0	SB-66	4-6	1060.0	SB-76	8-10	719.0
SB-56	4-6	649.0	SB-66	6-8	1080.0	SB-76	10-WT	510.0
SB-56	6-8	302.0	SB-66	8-10	1280.0	SB-77	0-2	1240.0
SB-56	8-10	293.0	SB-66	10-WT	3150.0	SB-77	8-10	303.0
SB-56	10-WT	272.0	SB-67	0-2	6110.0	SB-78	2-6	420.0
SB-57	0-2	431.0	SB-67	2-4	4090.0	SB-78	8-10	263.00
SB-57	2-4	352.0	SB-67	4-6	707.0	SB-78	12-14	354.0
SB-57	4-6	277.0	SB-67	6-8	390.0	SB-78	10-WT	265.0
SB-57	6-8	265.0	SB-67	8-10	1200.0	SB-79	2-4	783.0
SB-57	8-10	306.0	SB-67	10-WT	788.0	SB-79	4-6	300.0
SB-57	10-WT	272.0	SB-68	0-2	2810.0	SB-79	6-8	296.0
SB-58	0-2	242.0	SB-68	2-4	1770.0	SB-79	6-10	254.0
SB-58	2-4	442.0	SB-68	4-6	1070.0	SB-79	8-10	295.0
SB-58	4-6	742.0	SB-68	6-8	5560.0	SB-79	10-WT	528.0
SB-58	6-8	938.0	SB-68	8-10	887.0	SB-80	2-4	631.0
SB-58	8-10	506.0	SB-68	10-WT	498.0	SB-80	4-6	596.0
SB-58	10-WT	343.0	SB-69	0-2	554.0	SB-80	6-8	376.0
SB-59	0-2	949.0	SB-69	2-4	498.0	SB-80	8-10	435.0
SB-59	2-4	530.0	SB-69	4-6	469.0	SB-80	10-16	252.0
SB-59	4-6	552.0	SB-69	6-8	259.0	SB-81	2-4	289.0
SB-59	8-10	492.0	SB-69	10-WT	302.0	SB-81	4-6	818.0
SB-59	10-WT	281.0	SB-70	0-2	1650.0	SB-81	6-8	497.0
SB-60	0-2	622.0	SB-70	2-4	1500.0	SB-81	8-10	390.0
SB-60	2-4	462.0	SB-70	4-6	548.0	SB-81	10-16	256.0
SB-60	8-10	230.0	SB-71	0-2	2210.0	MW-06	0-2	2340.0
SB-60	10-WT	312.0	SB-71	2-4	3730.0	MW-06	6-8	1300.0
SB-61	0-2	667.0	SB-71	4-6	1890.0	MW-06	12-14	2820.0
SB-61	2-4	1690.0	SB-71	6-8	485.0	MW-10S	14-16	983.0
SB-61	4-6	1780.0	SB-72	0-2	549.0	MW-11S	8-10	939.0
SB-61	6-8	1780.0	SB-72	2-4	1660.0	MW-12S	6-8	797.0
SB-61	8-10	1070.0	SB-72	4-6	333.0	MW-13S	14-16	1050.0
SB-61	10-WT	785.0	SB-72	6-8	366.0	MW-13S	20-21	1410.0
SB-62	0-2	1020.0	SB-72	8-10	403.0	MW-14S	16-18	909.0
SB-62	2-4	11900.0	SB-72	10-WT	404.0	MW-40S	10-12	216.0
SB-62	6-8	8950.0	SB-73	0-2	804.0	MW-40S	12-14	262.0
SB-62	8-10	12,000	SB-73	4-6	456.0	MW-40S	14-16	228.0
SB-62	10-WT	3700.0	SB-73	6-8	418.0	MW-40S	16-18	246.0
SB-63	0-2	5490.0	SB-73	8-10	314.0	MW-40S	18-20	238.0
SB-63	2-4	3100.0	SB-73	10-WT	508.0	MW-41S	0-2	749.0
SB-63	10-WT	1380.0	SB-74	2-4	817.0	MW-41S	2-4	811.0
SB-64	2-4	1540.0	SB-74	4-6	381.0	MW-41S	4-6	441.0
SB-64	4-6	3890.0	SB-74	6-8	360.0	MW-41S	6-8	465.0
SB-64	6-8	3590.0	SB-74	8-10	371.0	MW-41S	8-10	936.0
SB-64	8-10	2670.0	SB-74	10-WT	328.0	MW-41S	10-12	393.0
SB-64	10-WT	411.0	SB-75	2-4	359.0	MW-41S	12-14	485.0
SB-65	0-2	4240.0	SB-75	4-6	449.0	MW-41S	14-15	582.0
SB-65	2-4	2970.0	SB-75	6-8	481.0	MW-41S	15-16	362.0
SB-65	4-6	3430.0	SB-75	8-10	390.0	MW-41S	16-18	333
SB-65	6-8	5570.0	SB-75	10-WT	440.0	MW-41S	18-20	254.0
SB-65	8-10	3540.0	SB-76	2-4	1180.0	MW-41S	20-22	221.0
SB-65	10-WT	3380.0	SB-76	4-6	789.0	MW-41S	22-24	222.0
SB-66	2-4	8280.0	SB-76	6-8	1180.0	MW-41S	22-24	222.0

+The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

++SB-1 through SB-35 samples were collected by ENSR in March 1990; SB-36 through SB-81 samples were collected by ERM-Midwest in May 1991.

*Numbers are foot intervals.

WT = Water Table

For locations of borings and wells, see Figure 2-11 in Section 2.9 - Unsaturated and Saturated Soil Investigations.

000253

TABLE 3-24 (Continued)
TOTAL METALS DETECTED ABOVE BACKGROUND IN SOIL BORINGS(+)
PADDYS RUN ROAD SITE

SB No.(++)	Depth*	Value	SB No.(++)	Depth*	Value	SB No.(++)	Depth*	Value
Potassium (3528.42 mg/kg)								
SB-13	0-7	4380	SB-58	0-2	3910.0	SB-65	6-8	8130.0
SB-14	0-7	5720.0	SB-58	2-4	3730.0	SB-65	8-10	5040.0
SB-48	4-6	3930.0	SB-61	0-2	14200.0	SB-67	6-8	4450.0
SB-48	8-10	6370.0	SB-61	2-4	7810.0	SB-67	8-10	7020.0
SB-48	10-16	3790.0	SB-61	4-6	6630.0	SB-72	10-WT	3570.0
SB-50	2-6	4300.0	SB-61	6-8	13900	SB-76	4-6	4420.0
SB-50	4-6	4240.0	SB-61	8-10	5150.0	SB-76	6-8	6000.0
			SB-64	2-4	6460.0	SB-78	6-8	4280.0
SB-53	2-4	3540.0	SB-64	4-6	5080.0	SB-81	4-6	4050.0
SB-54	0-2	4120.0	SB-65	0-2	30500.0	MW-06	0-2	24500.0
SB-57	2-4	3790.0	SB-65	2-4	8510.0	MW-06	6-8	8230.0
SB-57	4-6	3600.0	SB-65	4-6	9440.0			

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+The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

++SB-1 through SB-35 samples were collected by ENSR in March 1990; SB-36 through SB-81 samples were collected by ERM-Midwest in May 1991.

*Numbers are foot intervals.

WT = Water Table

For locations of borings and wells, see Figure 2-11 in Section 2.9 - Unsaturated and Saturated Soil Investigations.

TABLE 3-25
VOLATILE ORGANIC COMPOUNDS DETECTED ABOVE BACKGROUND IN SOIL BORINGS(+)
PADDYS RUN ROAD SITE

Sample ID(++)	Depth*	Value	Sample ID(++)	Depth*	Value	Sample ID(++)	Depth*	Value
Benzene (5.9 ug/kg)								
SB-35	10-12	2600.0	SB-40	8-10	180.0	SB-45	18-20	1700.0
SB-39	6-8	150.0	SB-40	10-12	150.0	MW-21S	12-14	400.0
Chloroform (5.9 ug/kg)								
SB-17	6-8	7.0	SB-39	2-4	100,000			
Ethylbenzene (5.9 ug/kg)								
SB-16	4-6	37000.0	SB-28	14-16	980.0	SB-44	14-16	230000.0
SB-16	6-8	170000.0	SB-29	14-16	980.0	SB-44	16-18	1300000.
SB-16	8-10	78000.0	SB-30	16-18	7.0	SB-44	18-20	280000.0
SB-16	10-12	66000.0	SB-35	4-6	22.0	SB-45	14-16	2900.0
SB-16	12-14	140000.0	SB-35	10-12	90.0	SB-45	16-18	9600.0
SB-17	8-10	38000.0	SB-35	14-16	290.0	SB-45	18-20	850000.0
SB-17	10-12	140000.0	SB-36	0-2	2700.0	SB-47	10-12	6.0
SB-17	18-20	170.0	SB-36	2-4	200.0	SB-47	12-14	96000.0
SB-18	4-6	1700.0	SB-36	4-6	26.0	SB-47	14-16	270000.0
SB-19	6-8	77000.0	SB-36	6-8	29.0	SB-47	16-18	560000.0
SB-19	8-10	240000.0	SB-36	8-10	74.0	MW-10S	8-10	6.0
SB-19	10-12	530000.0	SB-36	10-12	14.0	MW-10S	12-14	320000.0
SB-19	12-14	370000.0	SB-37	0-2	1900.0	MW-10S	14-16	870000.0
SB-19	14-16	720000.0	SB-37	2-4	19.0	MW-10S	16-17	2900000.
SB-19	16-18	810000.0	SB-37	4-6	180.0	MW-10S	17-19	1400.0
SB-21	2-4	4100.0	SB-37	6-8	530.0	MW-10S	19-20	360.0
SB-21	4-6	31.0	SB-37	8-10	17.0	MW-11S	4-6	3900.0
SB-21	8-10	800.0	SB-37	10-12	330.0	MW-11S	8-10	480000.0
SB-21	10-12	42.0	SB-37	12-14	870.0	MW-11S	10-12	930000.0
SB-21	12-14	24000.0	SB-38	6-8	8000.0	MW-11S	12-14	460000.0
SB-21	14-16	17000.0	SB-38	8-10	440000.0	MW-11S	14-16	670000.0
SB-22	0-2	88000.0	SB-38	10-12	220000.0	MW-11S	16-17	570000.0
SB-22	2-4	330000.0	SB-38	12-14	480000.0	MW-11S	17-19	220000.0
SB-22	6-8	2000.0	SB-38	14-16	200000.0	MW-11S	19-20	38000.0
SB-22	8-10	350.0	SB-38	16-18	440000.0	MW-12S	2-4	4100.0
SB-22	10-12	340.0	SB-39	0-2	370000.0	MW-12S	4-6	270000.0
SB-22	12-14	260000.0	SB-39	2-4	140000.0	MW-12S	8-10	110000.0
SB-23	8-10	8.0	SB-39	4-6	820.0	MW-12S	10-12	69000.0
SB-23	10-12	450.0	SB-39	6-8	230.0	MW-12S	12-14	33000.0
SB-26	10-WT	54000.0	SB-39	12-14	17.0	MW-12S	14-16	560000.0
SB-27	2-4	220.0	SB-39	14-16	8200.0	MW-12S	16-18	880000.0
SB-27	4-6	170.0	SB-39	16-18	810.0	MW-12S	18-20	22000.0
SB-27	6-8	6.0	SB-40	2-4	140.0	MW-12S	20-21	180000.0
SB-27	8-10	47.0	SB-40	6-8	24.0	MW-13S	12-14	230000.0
SB-27	10-12	660.0	SB-40	8-10	1700.0	MW-13S	14-16	1200000.
SB-27	12-14	260000.0	SB-40	10-12	3400.0	MW-13S	18-20	86000.0
SB-28	0-2	4200.0	SB-40	12-14	68000.0	MW-14S	14-16	150.0
SB-28	2-4	13000.0	SB-40	14-16	100000.0	MW-14S	16-18	220000.0
SB-28	4-6	19000.0	SB-40	16-18	26000.0	MW-14S	10-WT	220000.0
SB-28	9-9	470000.0	SB-42	8-10	72000.0	MW-21S	10-12	29000.0
SB-28	10-11	310000.0	SB-42	12-14	900.0	MW-21S	12-14	14000.0
SB-28	11-13	2400000.	SB-43	20-22	270.0	MW-21S	14-16	320.0
SB-28	14	950000.0	SB-44	12-14	520.0	MW-21D	16-18	21.0

(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)SB-1 through SB-35 samples were collected by ENSR in March 1990; SB-36 through SB-81 samples were collected by ERM-Midwest in May 1991.

*Numbers are foot intervals.

WT = Water Table

For locations of borings and wells, see Figure 2-11 in Section 2.9 - Unsaturated and Saturated Soil Investigations.

TABLE 3-25 (Continued)
VOLATILE ORGANIC COMPOUNDS DETECTED ABOVE BACKGROUND IN SOIL BORINGS(+)
PADDYS RUN ROAD SITE

Sample ID(++)	Depth*	Value	Sample ID(++)	Depth*	Value	Sample ID(++)	Depth*	Value
Ethylbenzene (5.9 ug/kg) - Continued								
MW-21D	20-21	210.0	MW-41S	4-6	310000.0	MW-41S	14-16	900000.0
MW-21D	21-23	13.0	MW-41S	8-10	900000.0	MW-41S	16-18	520000.0
MW-40S	9-10	62000.0	MW-41S	10-12	780000.0	MW-41S	18-20	15000.0
MW-40S	16-18	3000.0	MW-41S	12-14	210000.0	MW-41S	20-22	42.0
MW-40S	18-20	150.0						
Xylenes (5.9 ug/kg)								
SB-16	4-6	220000.0	SB-28	0-2	23000.0	SB-40	6-8	150.0
SB-16	6-8	880000.0	SB-28	2-4	35000.0	SB-40	8-10	6900.0
SB-16	8-10	370000.0	SB-28	4-6	73000.0	SB-40	10-12	13000.0
SB-16	10-12	310000.0	SB-28	6-8	1400000.	SB-40	12-14	300000.0
SB-16	12-14	64000.0	SB-28	9-9	1900000.	SB-40	14-16	410000.0
SB-17	8-10	200000.0	SB-28	10-11	1200000.	SB-40	16-18	93000.0
SB-17	10-12	790000.0	SB-28	11-13	8700000.	SB-42	2-4	14.0
SB-18	4-6	9500.0	SB-28	14.0	350000.0	SB-42	8-10	460000.0
SB-19	4-6	68.0	SB-29	14-16	11000.0	SB-42	12-14	3900.0
SB-19	6-8	460000.0	SB-30	16-18	16.0	SB-44	12-14	2000.0
SB-19	8-10	1400000.	SB-35	4-6	71.0	SB-44	14-16	750000.0
SB-19	10-12	2300000.	SB-35	6-8	41.0	SB-44	16-18	4100000.
SB-19	12-14	1700000.	SB-35	10-12	83.0	SB-44	18-20	1100000.
SB-19	14-16	1600000.	SB-35	12-14	230.0	SB-45	14-16	1800.0
SB-19	16-18	2500000.	SB-35	14-16	170.0	SB-45	16-18	32000.0
SB-21	0-2	12.0	SB-36	0-2	30000.0	SB-45	18-20	3100000.
SB-21	2-4	13000.0	SB-36	2-4	840.0	SB-47	0-2	8.0
SB-21	4-6	170.0	SB-36	4-6	120.0	SB-47	6-8	28.0
SB-21	6-8	22.0	SB-36	6-8	160.0	SB-47	8-10	14.0
SB-21	8-10	3600.0	SB-36	8-10	170.0	SB-47	10-12	22.0
SB-21	10-12	170.0	SB-36	10-12	86.0	SB-47	12-14	330000.0
SB-21	12-14	73000.0	SB-37	0-2	9000.0	SB-47	14-16	870000.0
SB-21	14-16	55000.0	SB-37	2-4	38.0	SB-47	16-18	2000000.
SB-22	0-2	320000.0	SB-37	8-10	43.0	MW-10S	4-6	280.0
SB-22	2-4	1000000.	SB-38	6-8	38000.0	MW-10S	10-12	31.0
SB-22	6-8	9900.0	SB-38	8-10	1500000.	MW-10S	12-14	1200000.
SB-22	8-10	1800.0	SB-38	10-12	820000.0	MW-10S	14-16	2800000.
SB-22	10-12	1600.0	SB-38	12-14	1600000.	MW-10S	16-17	9100000.
SB-22	12-14	790000.0	SB-38	14-16	680000.0	MW-10S	17-19	4800.0
SB-23	0-2	600.0	SB-38	16-18	1400000.	MW-10S	19-20	1700.0
SB-23	8-10	20.0	SB-39	0-2	3000000.	MW-11S	4-6	25000.0
SB-23	10-12	1100.0	SB-39	2-4	470000.0	MW-11S	8-10	1700000.
SB-23	12-14	120.0	SB-39	4-6	6900.0	MW-11S	10-12	3400000.
SB-26	0-2	54.0	SB-39	8-10	940.0	MW-11S	12-14	1600000.
SB-26	10-WT	240000.0	SB-39	10-12	21.0	MW-11S	14-16	2300000.
SB-27	2-4	510.0	SB-39	12-14	75.0	MW-11S	16-17	1900000.
SB-27	4-6	470.0	SB-39	14-16	27000.0	MW-11S	17-19	790000.0
SB-27	6-8	17.0	SB-39	16-18	3000.0	MW-11S	19-20	110000.0
SB-27	8-10	130.0	SB-40	0-2	54.0	MW-12S	2-4	24000.0
SB-27	10-12	1900.0	SB-40	2-4	1600.0	MW-12S	4-6	1400000.
SB-27	12-14	760000.0	SB-40	4-6	1000.0	MW-12S	6-8	220000.0

(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.
(++)SB-1 through SB-35 samples were collected by ENSR in March 1990; SB-36 through SB-81 samples were collected by ERM-Midwest in May 1991.
*Numbers are foot intervals.
WT = Water Table
For locations of borings and wells, see Figure 2-11 in Section 2.9 - Unsaturated and Saturated Soil Investigations.

TABLE 3-25 (Continued)
VOLATILE ORGANIC COMPOUNDS DETECTED ABOVE BACKGROUND IN SOIL BORINGS(+)
PADDYS RUN ROAD SITE

Sample ID(++)	Depth*	Value	Sample ID(++)	Depth*	Value	Sample ID(++)	Depth*	Value
Xylenes (5.9 ug/kg) - Continued								
MW-12S	8-10	330000.0	MW-14S	16-18	680000.0	MW-40S	18-20	470.0
MW-12S	10-12	220000.0	MW-14S	10-WT	680000.0	MW-41S	4-6	1700000.
MW-12S	12-14	120000.0	MW-21S	10-12	76000.0	MW-41S	8-10	3800000.
MW-12S	14-16	1400000.	MW-21S	12-14	44000.0	MW-41S	10-12	2800000.
MW-12S	16-18	3100000.	MW-21S	14-16	8300.0	MW-41S	12-14	790000.0
MW-12S	18-20	85000.0	MW-21D	16-18	360.0	MW-41S	14-16	3700000.
MW-12S	20-21	560000.0	MW-21D	20-21	110.0	MW-41S	16-18	2100000.
MW-13S	12-14	730000.0	MW-21D	21-23	67.0	MW-41S	18-20	66000.0
MW-13S	14-16	4100000.	MW-40S	9-10	330000.0	MW-41S	20-22	140.0
MW-13S	18-20	260000.0	MW-40S	16-18	13000.0	MW-41S	22-24	8.0
MW-14S	14-16	630.0						
Methylene Chloride (672 ug/kg)								
SB-16	4-6	4300.0	SB-28	10-11	18000.0	MW-12S	14-16	47000.0
SB-16	6-8	11000.0	SB-28	11-13	60000.0	MW-12S	16-18	19000.0
SB-18	4-6	970.0	SB-28	14.0	22000.0	MW-12S	20-21	24000.0
SB-19	8-10	25000.0	SB-44	14-16	22000.0	MW-13S	18-20	4200.0
SB-27	12-14	18000.0	MW-10S	14-16	26000.0	MW-14S	16-18	15000.0
SB-28	2-4	690.0	MW-12S	2-4	870.0	MW-14S	10-WT	15000.0
SB-28	5-6	1200.0	MW-12S	12-14	4700.0	MW-21S	10-12	1400.0
SB-28	9-9	13000.0						
Toluene (5.9 ug/kg)								
SB-14	8-10	8.0	SB-28	2-4	3500.0	SB-40	8-10	16000.0
SB-16	4-6	120000.0	SB-28	4-6	3000.0	SB-40	10-12	26000.0
SB-16	6-8	490000.0	SB-28	9-9	290000.0	SB-40	12-14	450000.0
SB-16	8-10	180000.0	SB-28	10-11	190000.0	SB-40	14-16	270000.0
SB-16	10-12	140000.0	SB-28	11-13	4600000.	SB-40	16-18	38000.0
SB-16	12-14	5900.0	SB-28	14.0	840000.0	SB-42	2-4	6.0
SB-17	8-10	130000.0	SB-35	8-10	320.0	SB-42	8-10	360000.0
SB-17	10-12	510000.0	SB-36	0-2	660.0	SB-43	20-22	400.0
SB-19	6-8	45000.0	SB-37	8-10	6.0	SB-44	12-14	220.0
SB-19	8-10	920000.0	SB-37	12-14	160.0	SB-44	14-16	160000.0
SB-19	10-12	210000.0	SB-38	6-8	4300.0	SB-44	16-18	160000.0
SB-19	12-14	160000.0	SB-38	8-10	310000.0	SB-44	18-20	240000.0
SB-19	14-16	720000.0	SB-38	12-14	360000.0	SB-45	18-20	380000.0
SB-19	16-18	130000.0	SB-38	14-16	170000.0	SB-47	0-2	19.0
SB-21	2-4	1900.0	SB-38	16-18	590000.0	SB-47	2-4	13.0
SB-21	8-10	390.0	SB-39	0-2	200000.0	SB-47	12-14	29000.0
SB-21	10-12	13.0	SB-39	2-4	180000.0	SB-47	14-16	240000.0
SB-21	12-14	11000.0	SB-39	4-6	280.0	SB-47	16-18	460000.0
SB-21	14-16	8300.0	SB-39	6-8	530.0	MW-10S	12-14	92000.0
SB-22	0-2	8300.0	SB-39	8-10	180.0	MW-10S	14-16	1100000.
SB-22	2-4	110000.0	SB-39	10-12	15.0	MW-10S	16-17	4700000.
SB-22	6-8	270.0	SB-39	12-14	13.0	MW-10S	17-19	1900.0
SB-22	12-14	53000.0	SB-39	14-16	9600.0	MW-10S	19-20	450.0
SB-27	10-12	170.0	SB-39	16-18	170.0	MW-11S	4-6	15000.0
SB-27	12-14	31000.0	SB-40	4-6	290.0	MW-11S	8-10	150000.0
SB-28	0-2	680.0	SB-40	6-8	29.0	MW-11S	10-12	390000.0

(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)SB-1 through SB-35 samples were collected by ENSR in March 1990; SB-36 through SB-81 samples were collected by ERM-Midwest in May 1991.

*Numbers are foot intervals.

WT = Water Table

For locations of borings and wells, see Figure 2-11 in Section 2.9 - Unsaturated and Saturated Soil Investigations.

000257

TABLE 3-25 (Continued)
VOLATILE ORGANIC COMPOUNDS DETECTED ABOVE BACKGROUND IN SOIL BORINGS(+)
PADDYS RUN ROAD SITE

Sample ID(++)	Depth*	Value	Sample ID(++)	Depth*	Value	Sample ID(++)	Depth*	Value
Toluene (5.9 ug/kg) - Continued								
MW-11S	12-14	190000.0	MW-12S	16-18	1500000.	MW-40S	9-10	8900.0
MW-11S	14-16	600000.0	MW-12S	18-20	11000.0	MW-40S	16-18	2600.0
MW-11S	16-17	580000.0	MW-12S	20-21	200000.0	MW-40S	18-20	120.0
MW-11S	17-19	350000.0	MW-13S	12-14	83000.0	MW-41S	4-6	120000.0
MW-11S	19-20	43000.0	MW-13S	14-16	1200000.	MW-41S	8-10	840000.0
MW-12S	4-6	840000.0	MW-13S	18-20	63000.0	MW-41S	10-12	960000.0
MW-12S	6-8	24000.0	MW-14S	16-18	100000.0	MW-41S	12-14	100000.0
MW-12S	8-10	16000.0	MW-14S	10-WT	100000.0	MW-41S	14-16	1300000.
MW-12S	10-12	16000.0	MW-21S	10-12	29000.0	MW-41S	16-18	670000.0
MW-12S	12-14	4800.0	MW-21S	12-14	12000.0	MW-41S	18-20	17000.0
MW-12S	14-16	550000.0	MW-21D	16-18	11.0	MW-41S	20-22	86.0
Acetone (248 ug/kg)								
SB-16	6-8	12000.0	SB-29	14-16	1500.0	MW-21S	10-12	4300.0
SB-21	12-14	4000.0	MW-11S	4-6	430.0	MW-21S	12-14	1800.0
SB-27	8-10	250.0	MW-12S	8-10	23000.0			
2-Butanone (11.4 ug/kg)								
SB-12	8-10	15.0	SB-14	8-10	60.0	SB-14	10-12	41.0
Cumene (5.9 ug/kg)								
SB-16	4-6	240000.0	SB-23	8-10	12.0	SB-37	0-2	37000.0
SB-16	6-8	900000.0	SB-23	10-12	530.0	SB-37	2-4	52.0
SB-16	8-10	510000.0	SB-23	12-14	32.0	SB-37	4-6	1300.0
SB-16	10-12	460000.0	SB-26	10-WT	440000.0	SB-37	6-8	630.0
SB-16	12-14	220000.0	SB-27	2-4	580.0	SB-37	8-10	59.0
SB-16	14-16	27.0	SB-27	4-6	770.0	SB-37	10-12	920.0
SB-17	8-10	240000.0	SB-27	6-8	22.0	SB-37	12-14	1700.0
SB-17	10-12	880000.0	SB-27	8-10	150.0	SB-37	14-16	3200.0
SB-17	18-20	1400.0	SB-27	10-12	1300.0	SB-38	6-8	15000.0
SB-17	20-22	46.0	SB-27	12-14	820000.0	SB-38	8-10	610000.0
SB-18	4-6	16000.0	SB-28	0-2	4600.0	SB-38	10-12	310000.0
SB-19	4-6	36.0	SB-28	2-4	7400.0	SB-38	12-14	540000.0
SB-19	6-8	440000.0	SB-28	4-6	1300.0	SB-38	14-16	280000.0
SB-19	8-10	900000.0	SB-28	6-8	540000.0	SB-38	16-18	410000.0
SB-19	10-12	1400000.	SB-28	9-9	780000.0	SB-39	0-2	1200000.
SB-19	12-14	1000000.	SB-28	10-11	480000.0	SB-39	2-4	220000.0
SB-19	14-16	950000.0	SB-28	11-13	3500000.	SB-39	4-6	4500.0
SB-19	16-18	1200000.	SB-28	14	1200000.	SB-39	6-8	1100.0
SB-20	6-8	83.0	SB-29	14-16	17000.0	SB-39	8-10	780.0
SB-20	10-12	45.0	SB-30	16-18	190.0	SB-39	10-12	46.0
SB-21	4-6	78.0	SB-35	0-2	7.0	SB-39	12-14	420.0
SB-21	6-8	15.0	SB-35	4-6	1600.0	SB-39	14-16	69000.0
SB-21	8-10	1500.0	SB-35	6-8	520.0	SB-39	16-18	15000.0
SB-21	10-12	68.0	SB-35	8-10	710.0	SB-40	0-2	100.0
SB-21	12-14	110000.0	SB-35	10-12	6100.0	SB-40	2-4	4900.0
SB-21	14-16	56000.0	SB-35	12-14	9800.0	SB-40	4-6	850.0
SB-22	0-2	280000.0	SB-35	14-16	6200.0	SB-40	6-8	100.0
SB-22	2-4	400000.0	SB-36	0-2	49000.0	SB-40	8-10	2400.0
SB-22	6-8	5500.0	SB-36	2-4	2200.0	SB-40	10-12	4500.0
SB-22	8-10	980.0	SB-36	4-6	250.0	SB-40	12-14	300000.0
SB-22	10-12	1200.0	SB-36	6-8	320.0	SB-40	14-16	320000.0
SB-22	12-14	270000.0	SB-36	8-10	690.0	SB-40	16-18	93000.0
SB-23	0-2	240.0	SB-36	10-12	250.0	SB-42	4-6	24.0

(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.
(++)SB-1 through SB-35 samples were collected by ENSR in March 1990; SB-36 through SB-81 samples were collected by ERM-Midwest in May 1991.
*Numbers are foot intervals.
WT = Water Table
For locations of borings and wells, see Figure 2-11 in Section 2.9 - Unsaturated and Saturated Soil Investigations.

TABLE 3-25 (Continued)
VOLATILE ORGANIC COMPOUNDS DETECTED ABOVE BACKGROUND IN SOIL BORINGS(+)
PADDYS RUN ROAD SITE

Sample ID(++)	Depth*	Value	Sample ID(++)	Depth*	Value	Sample ID(++)	Depth*	Value
Cumene (5.9 ug/kg) - Continued								
SB-42	6-8	120.0	MW-10S	8-10	13.0	MW-13S	12-14	320000.0
SB-42	8-10	400000.0	MW-10S	10-12	65.0	MW-13S	14-16	1500000.
SB-42	10-12	1300.0	MW-10S	12-14	1100000.	MW-13S	18-20	110000.0
SB-42	12-14	41000.0	MW-10S	14-16	2300000.	MW-14S	14-16	900.0
SB-42	14-16	11000.0	MW-10S	16-17	7600000.	MW-14S	16-18	380000.0
SB-42	16-18	3800.0	MW-10S	17-19	3500.0	MW-14S	10-WT	380000.0
SB-43	20-22	1000.0	MW-10S	19-20	760.0	MW-21S	10-12	66000.0
SB-44	12-14	750.0	MW-11S	4-6	13000.0	MW-21S	12-14	27000.0
SB-44	14-16	390000.0	MW-11S	10-12	1400000.	MW-21S	14-16	4700.0
SB-44	16-18	1600000.	MW-11S	12-14	990000.0	MW-21D	16-18	230.0
SB-44	18-20	450000.0	MW-11S	14-16	1100000.	MW-21D	20-21	270.0
SB-45	14-16	3800.0	MW-11S	16-17	1100000.	MW-21D	21-23	120.0
SB-45	16-18	85000.0	MW-11S	17-19	240000.0	MW-40S	9-10	270000.0
SB-45	18-20	2100000.	MW-11S	19-20	43000.0	MW-40S	16-18	9500.0
SB-46	18-20	6900.0	MW-12S	2-4	21000.0	MW-40S	18-20	330.0
SB-47	4-6	7.0	MW-12S	4-6	960000.0	MW-41S	4-6	530000.0
SB-47	6-8	14.0	MW-12S	8-10	530000.0	MW-41S	8-10	1600000.
SB-47	8-10	8.0	MW-12S	10-12	330000.0	MW-41S	10-12	1200000.
SB-47	10-12	11.0	MW-12S	12-14	95000.0	MW-41S	12-14	400000.0
SB-47	12-14	160000.0	MW-12S	14-16	530000.0	MW-41S	14-16	250000.0
SB-47	14-16	380000.0	MW-12S	16-18	1100000.	MW-41S	16-18	1300000.
SB-47	16-18	750000.0	MW-12S	18-20	61000.0	MW-41S	18-20	37000.0
MW-10S	4-6	360.0	MW-12S	20-21	220000.0	MW-41S	20-22	57.0

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(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)SB-1 through SB-35 samples were collected by ENSR in March 1990; SB-36 through SB-81 samples were collected by ERM-Midwest in May 1991.

*Numbers are foot intervals.

WT = Water Table

For locations of borings and wells, see Figure 2-11 in Section 2.9 - Unsaturated and Saturated Soil Investigations.

000259

TABLE 3-26 REV. 1: MAY 1994

SEMIVOLATILES DETECTED ABOVE BACKGROUND IN SOIL BORINGS(+)

PADDYS RUN ROAD SITE

SB No.(++)	Depth*	Value	SB No.(++)	Depth*	Value	SB No.(++)	Depth*	Value
Acenaphthene (372.6 ug/kg)								
SB-35	2-6	1000.0	SB-35	10-12	2600.0	SB-35	14-16	3800.0
SB-35	8-10	790.0	SB-35	12-14	3200.0			
Anthracene (237 ug/kg)								
SB-22	0-7	430.0	SB-68	0-2	410.0	SB-70	2-6	520.0
SB-67	0-2	760.0	SB-69	0-2	370.0			
Benzo(a)anthracene (597 ug/kg)								
SB-22	0-7	740.0	SB-69	0-2	2000.0	SB-70	6-10	600.0
SB-67	0-2	720.0	SB-70	2-6	1700.0			
Benzo(a)pyrene (866 ug/kg)								
SB-69	0-2	1800.0	SB-70	2-6	1400.0			
Benzo(b)fluoranthene (1925 ug/kg)								
SB-69	0-2	3900.0						
Benzo(g,h,i)perylene (602 ug/kg)								
SB-69	0-2	830.0	SB-70	6	670.0			
Benzo(k)fluoranthene (2090 ug/kg)								
SB-69	0-2	3900.0	SB-70	2-6	2300.0			
Bis(2-Ethylhexyl)phthalate (605 ug/kg)								
SB-03	0-7	630.0	SB-35	8-10	1500.0	SB-59	6-10	950.0
SB-03	7-12	810.0	SB-35	10-12	770.0	SB-59	10-WT	920.0
SB-04	7-12	2800.0	SB-35	12-14	900.0	SB-62	0-2	5900.0
SB-05	0-7	2300.0	SB-35	14-16	1100.0	SB-62	2-6	650.0
SB-05	7-12	5300.0	SB-36	0-2	750.0	SB-62	6-10	740.0
SB-06	0-7	2600.0	SB-36	10-WT	750.0	SB-62	10-WT	660.0
SB-06	7-12	1700.0	SB-38	6-10	11000.0	SB-64	6-10	2400.0
SB-08	0-7	610.0	SB-40	0-2	910.0			
SB-16	0-7	5200.0	SB-40	2-6	670.0	SB-68	6-10	610.0
SB-16	7-14	3300.0	SB-43	6-10	620.0	SB-70	6-10	1100.0
SB-17	0-7	1900.0	SB-45	10-18	810.0	SB-71	0-2	850.0
SB-17	9-10	4500.0	SB-49	10-16	920.0	SB-72	0-2	630.0
SB-17	7-16	6000.0	SB-50	2-6	780.0	SB-73	2-6	1000.0
SB-23	0-7	620.0	SB-50	10-WT	1400.0	SB-73	6-10	2600.0
SB-24	0-7	1500.0	SB-52	10-WT	760.0	SB-73	10-WT	3100.0
SB-25	0-7	760.0	SB-54	0-2	2600.0	SB-74	10-WT	1400.0
SB-26	0-7	660.0	SB-55	0-2	630.0	SB-75	2-6	900.0
SB-31	0-7	610.0	SB-55	6-10	4900.0	SB-75	6-10	850.0
SB-35	2-6	700.0	SB-55	10-WT	620.0	SB-79	2-6	720.0
SB-35	6-8	2400.0	SB-58	6-10	630.0	SB-79	6-10	810.0
Chrysene (836 ug/kg)								
SB-69	0-2	1600.0						
2,4-Dinitrotoluene (372.6 ug/kg)								
SB-35	8-10	1200.0	SB-42	10-WT	590.0			
SB-35	10-12	3500.0						
SB-35	14-16	4400.0						
Di-n-octylphthalate (372.6 ug/kg)								
SB-05	7-12	470.0	SB-17	0-7	570.0	SB-19	9-10	690.0
SB-06	0-7	480.0						
Fluoranthene (506 ug/kg)								
SB-22	0-7	2500.0	SB-59	2-6	510.0	SSB-70	2-6	6800.0
SB-31	0-6	870.0	SB-63	0-2	960.0	SB-70	6-10	2200.0
SB-31	0-7	1100.0	SB-67	0-2	1800.0	SB-70	10-WT	1700.0
SB-36	10-WT	610.0	SB-68	0-2	640.0	SB-71	0-2	630.0
SB-47	0-2	780.0	SB-69	0-2	3700.0			
Fluorene (372.6 ug/kg)								
MW-12S	6-8	500.0	SB-35	2-6	1300.0	SB-35	10-12	3600.0
SB-16	7-14	580.0	SB-35	6-8	1900.0	SB-35	12-14	3700.0
SB-19	7-16	860.0	SB-35	8-10	1200.0	SB-35	14-16	4700.0

(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)SB-1 through SB-35 samples were collected by ENSR in March 1990; SB-36 through SB-81 samples were collected by ERM-Midwest in May 1991.

*Numbers are foot intervals.

WT = Water Table

For locations of borings and wells, see Figure 2-11 in Section 2.9 - Unsaturated and Saturated Soil Investigations.

TABLE 3-26 (Continued)
SEMIVOLATILES DETECTED ABOVE BACKGROUND IN SOIL BORINGS(+)
PADDYS RUN ROAD SITE

SB No.(++)	Depth*	Value	SB No.(++)	Depth*	Value	SB No.(++)	Depth*	Value
Indeno(1,2,3-cd)pyrene (662 ug/kg)								
SB-69	0-2	800.0	SB-70	2-6	680.0			
Naphthalene (372.6 ug/kg)								
SB-19	7-16	110.0	SB-35	6-8	3800.0	SB-35	12-14	7300.0
SB-19	9-10	600.0	SB-35	8-10	2800.0	SB-35	14-16	14000.0
SB-35	2-6	3000.0	SB-35	10-12	9500.0	SB-68	0-2	400.0
Phenanthrene (292 ug/kg)								
SB-19	7-16	710.0	SB-35	12-14	8100.0	SB-67	0-2	1900.0
SB-22	0-7	2200.0	SB-35	14-16	9200.0	SB-68	0-2	700.0
SB-31	0-6	480.0	SB-36	10-WT	320.0	SB-69	0-2	1600.0
SB-31	0-7	380.0	SB-57	0-2	310.0	SB-70	2-6	3800.0
SB-35	2-6	2900.0	SB-59	2-6	450.0	SB-70	6-10	1300.0
SB-35	6-8	2800.0	SB-62	6-10	530.0	SB-70	10-WT	800.0
SB-35	8-10	2200.0	SB-63	0-2	880.0	SB-72	0-2	410.0
SB-35	10-12	6900.0						
Pyrene (505 ug/kg)								
SB-22	0-7	1500.0	SB-35	14-16	1300.0	SB-69	0-2	2600.0
SB-31	0-6	630.0	SB-36	10-WT	590.0	SB-70	2-6	3000.0
SB-31	0-7	740.0	SB-47	0-2	600.0	SB-70	6-10	1400.0
SB-35	10-12	940.0	SB-63	0-2	880.0	SB-70	10-WT	1200.0
SB-35	12-14	1100.0	SB-67	0-2	1300.0	SB-71	0-2	670.0
Dibenzofuran (372.6 ug/kg)								
SB-35	2-6	590.0	SB-35	6-8	740.0	SB-35	12-14	1600.0
2-Methylnaphthalene (372.6)								
SB-22	0-7	430.0	SB-35	8-10	11000.0	SB-35	14-16	54000.0
SB-35	2-6	18000.0	SB-35	10-12	36000.0	SB-39	10-18	480.0
SB-35	6-8	12000.0	SB-35	12-14	35000.0			
2,4-Dimethylphenol (372.6 ug/kg)								
MW-10S	14-16	1700.0	SB-17	7-16	480.0	SB-26	0-7	500.0
MW-11S	8-10	4700.0	SB-17	9-10	400.0	SB-27	5-6	430.0
MW-12S	6-8	2100.0	SB-18	4-5	560.0	SB-27	7-13	430.0
MW-13S	14-16	830.0	SB-19	0-7	2300.0	SB-27	13-14	1900.0
MW-13S	2-21	2600.0	SB-19	5-6	2700.0	SB-28	1-2	630.0
MW-14S	16-18	1100.0	SB-19	9-10	1700.0	SB-28	4-6	1200.0
MW-40S	16-18	480.0	SB-19	7-16	3700.0	SB-28	7-15	1500.0
SB-16	7-14	1300.0	SB-21	13-14	820.0	SB-29	15-16	490.0
SB-17	10-12	810.0	SB-25	17-18	470.0			
Phenol (372.6 ug/kg)								
SB-17	11-12	600.0	SB-21	7-13	430.0			
2-Methylphenol (372.6 ug/kg)								
MW-10S	14-16	1400.0	SB-16	7-14	510.0	SB-19	7-16	3200.0
MW-11S	8-10	1300.0	SB-17	7-16	430.0	SB-38	6-10	3300.0
MW-12S	6-8	1100.0	SB-19	9-10	1300.0	SB-42	6-10	920.0
MW-13S	20-21	920.0						
4-Methylphenol (372.6 ug/kg)								
MW-10S	14-16	1200.0	SB-17	9-10	770.0	SB-21	7-13	550.0
MW-11S	8-10	1300.0	SB-17	11-12	1400.0	SB-28	7-15	470.0
MW-12S	6-8	2500.0	SB-17	7-16	530.0	SB-38	6-10	1500.0
MW-13S	20-21	960.0	SB-19	9-10	1500.0	SB-40	10-18	400.0
SB-16	7-14	1000.0	SB-19	7-16	3500.0	SB-42	6-10	2200.0

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(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)SB-1 through SB-35 samples were collected by ENSR in March 1990; SB-36 through SB-81 samples were collected by ERM-Midwest in May 1991.

*Numbers are foot intervals.

WT = Water Table

For locations of borings and wells, see Figure 2-11 in Section 2.9 - Unsaturated and Saturated Soil Investigations.

000261

TABLE 3-27
PESTICIDES/PCB, GENERAL PARAMETERS AND RADIOLOGICAL PARAMETERS DETECTED ABOVE BACKGROUND IN SOIL BORINGS(+) PADDYS RUN ROAD SITE

Sample ID(++)	Depth*	Value	Sample ID(++)	Depth*	Value	Sample ID(++)	Depth*	Value
PESTICIDES								
Beta-BHC (18 ug/kg)								
SB-22	0-7	32.0	SB-28	1-2	21.0			
Dieldrin (35.9 ug/kg)								
SB-20	7-10	110.0						
Endosulfan I (9 ug/kg)								
SB-17	0-7	9.5						
Endrin (17.9 ug)								
MW-06	6-8	24						
4-4' DDT (146 ug/kg)								
SB-44	10-WT	300						
GENERAL PARAMETERS								
Cyanide (DL mg/kg)								
SB-09	7-11	1.2	SB-10	7-11	1.3	SB-22	1	1.2
Ammonia (216.835 mg/kg)								
SB-49	4-6	280.584						
Chloride (10 mg/kg)								
SB-01	0-7	230.0	SB-10	0-7	240.0	SB-18	0-7	230.0
SB-05	7-12	340.0	SB-17	0-7	16.0	SB-23	7-11	230.0
SB-08	0-7	280.0	SB-17	7-16	19.0			
Sulfate (as SO4)(4747.008 mg/kg)								
SB-04	7-12	6600.0	SB-32	0-7	4800.0			
Total Phosphorus (2943.249 mg/kg)								
SB-12	0-7	4100.0	SB-66	8-10	12514.22	SB-72	0-2	19540.23
SB-13	0-7	4100.0	SB-66	10-WT	10125.14	SB-72	4-6	5402.3
SB-31	0-6	13000.0	SB-67	0-2	14130.43	SB-72	8-10	9310.34
SB-34	7-9	6200.0	SB-67	6-8	6739.13	SB-72	10-WT	13793.1
SB-57	0-2	5093.56	SB-67	8-10	5869.59	SB-73	0-2	8461.54
SB-61	0-2	4505.49	SB-68	6-8	8536.59	SB-73	10-WT	14285.71
SB-61	2-4	9010.99	SB-68	8-10	13303.77	SB-74	6-8	18264.84
SB-61	6-8	6373.63	SB-68	10-WT	7871.4	SB-74	8-10	5593.61
SB-62	0-2	7446.81	SB-69	0-2	4039.3	SB-74	10-WT	7420.09
SB-62	2-4	5555.56	SB-69	2-4	40393.01	SB-75	4-6	6875.614
SB-62	6-8	13002.36	SB-69	4-6	41484.72	SB-75	6-8	8980.044
SB-62	8-10	14814.4	SB-69	6-8	4585.15	SB-75	8-10	9201.774
SB-62	10-WT	3073.29	SB-69	10-WT	13100.44	SB-75	10-WT	10199.55
SB-63	2-4	5830.58	SB-70	8-10	2997.86	SB-76	4-6	32846.72
SB-63	4-6	8250.83	SB-71	0-2	28230.18	SB-76	6-8	29197.08
SB-65	0-2	12471.66	SB-71	2-4	21715.53	SB-76	8-10	9854.01
SB-65	2-4	2947.85	SB-71	4-6	16286.64	SB-76	10-WT	10340.63
SB-66	2-4	12514.22	SB-71	6-8	6840.39	SB-79	10-WT	7292.82
SB-66	6-8	11376.56						
RADIOLOGICAL PARAMETERS								
Potassium-40 (22.305 pCi/g)								
SB-61	4-6	36.0	SB-77	4-6	24.0			

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(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)SB-1 through SB-35 samples were collected by ENSR in March 1990; SB-36 through SB-81 samples were collected by ERM-Midwest in May 1991.

*Numbers are foot intervals.

WT = Water Table

DL = Detection Limit

For locations of borings and wells, see Figure 2-11 in Section 2.9 - Unsaturated and Saturated Soil Investigations.

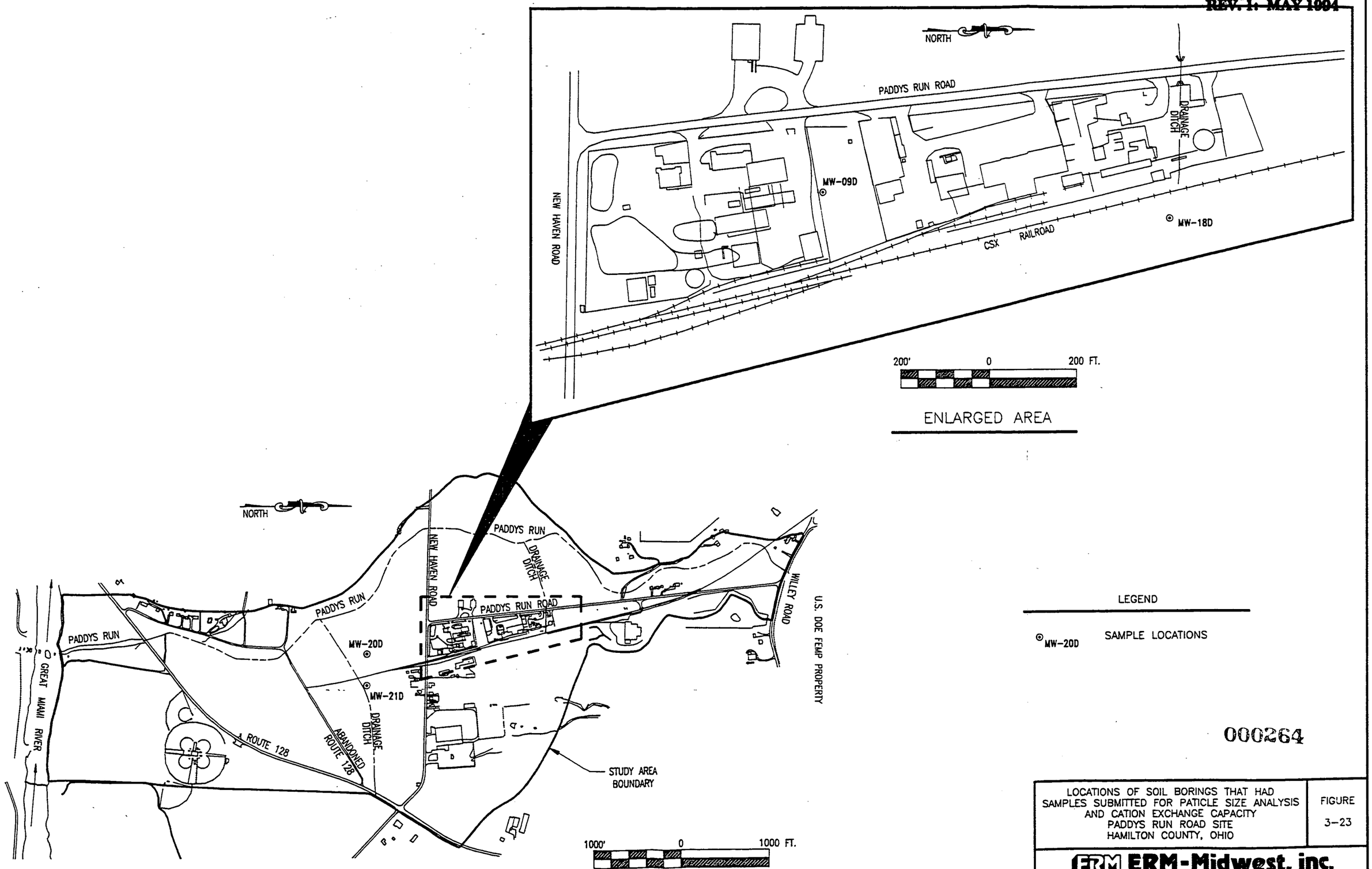
Soils within the saturated interval are predominantly gradations of sand and gravel with traces of silt and clay. Particle size analyses were performed on samples from six discrete depths at location MW-9D, two samples from discrete depths at location MW-18D, one sample from MW-20D and one sample from MW-21D. Figure 3-23 shows sampled locations. Location was based on availability of sample and overall representativeness of the saturated zone. Results indicate clay and silt are minimal, ranging from 0 to 1 percent clay and 5 to 10 percent silt. The dominant soil is sand and gravel. Sand percentages range from 41 to 90 percent and gravel from 0 to 52 percent. Typically, the coarser grained materials are deeper in the aquifer. Particle size curves for these samples are presented in Appendix D.

Cation Exchange Capacity

Cation exchange capacity and organic content from six intervals of MW-9D, two intervals from MW-18D, one sample from MW-20D and one sample from MW-21D are shown in Table 3-28. Locations are shown on Figure 3-23. The CEC values range from 12.5 meq/100gm to 17.0 meq/100gm. As presented above, there is minimal clay content (0 to 1 percent) which means the CEC value is controlled by the organic content which, as shown, ranges from 4 to 8 percent. Soils having low CEC values (<12) are normally poor adsorbers of organic chemicals, inorganic metals and ammonium.

Chemical Properties

As discussed in Section 2.9 chemical parameters analyzed included CLP organics plus cumene, CLP semivolatiles, CLP inorganics, CLP pesticides/PCBs and general parameters. General parameters included ammonia, chloride, phosphorus, sulfate, pH and radionuclides, including potassium-40, gross alpha, gross beta, and total uranium. Tables 3-24, 3-25, 3-26 and 3-27 indicate results of analyses for parameters in soil borings that were detected at levels above background. The nature and extent of these parameters are discussed in Section 4.0.



000264

LOCATIONS OF SOIL BORINGS THAT HAD SAMPLES SUBMITTED FOR PATICLE SIZE ANALYSIS AND CATION EXCHANGE CAPACITY
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 3-23

ERM-Midwest, inc.
Environmental Resources Management

TABLE 3-28
SOIL PHYSICAL PARAMETER ANALYSES
PADDYS RUN ROAD SITE

ANALYSES					
Boring	Depth (Feet)	Soil pH	Cation Exchange Capacity	% Moisture	Total Organic Carbon (Percent)
MW-9D	24-25	8.0	14.8	17	7
MW-9D	31.7-33	8.0	16.1	14	8
MW-9D	45-47	8.0	14.2	21	4
MW-9D	55-57	8.0	15.8	–	7
MW-9D	83-85	8.0	14.7	17	4
MW-9D	95-96.5	8.0	17.0	8	6
MW-18D	18-20	8.0	12.5	–	–
MW-18D	22.7-24.5	7.0	14.5	13	7
MW-18D	72.5-74.6	7.4	15.8	19	5
MW-20D	72-74	8.0	16.4	9	6
MW-21D	27-29	8.5	15.2	7	6
MW-21D	65-67	–	–	–	5

(–) Not analyzed for this parameter

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3.10 Hydrogeologic Investigations

Hydrogeology is the study of groundwater: its origin, occurrence, movement, and quality (U.S. EPA 1990). Subsurface groundwater movement is the primary means by which chemicals migrate.

Hydrogeologic data gathered from the Study Area have been used in:

- Constructing chemical isoconcentration groundwater plume maps
- Constructing regional and Study Area groundwater flow models
- Constructing Study Area chemical transport flow models

Plume maps and models were developed from a compilation of data generated by the RI and other studies conducted in the area. Plume maps are discussed in Section 4, Nature and Extent of Chemicals of Concern. Parameters used in developing the groundwater and transport flow models are presented in this section. A description of the groundwater models occurs in Section 3.10 while the modeling report itself is attached as Appendix C.

The groundwater plume maps and groundwater models also support exposure assessment and risk characterization for the RA, and assist with the remedial alternative development to be conducted during the FS.

In the following sections, information is presented that characterizes both the regional and Study Area hydrogeology. In characterizing the hydrogeology, the geology, hydraulic properties, groundwater use and quality will be discussed.

3.10.1 Regional Hydrogeology

3.10.1.1. Geology

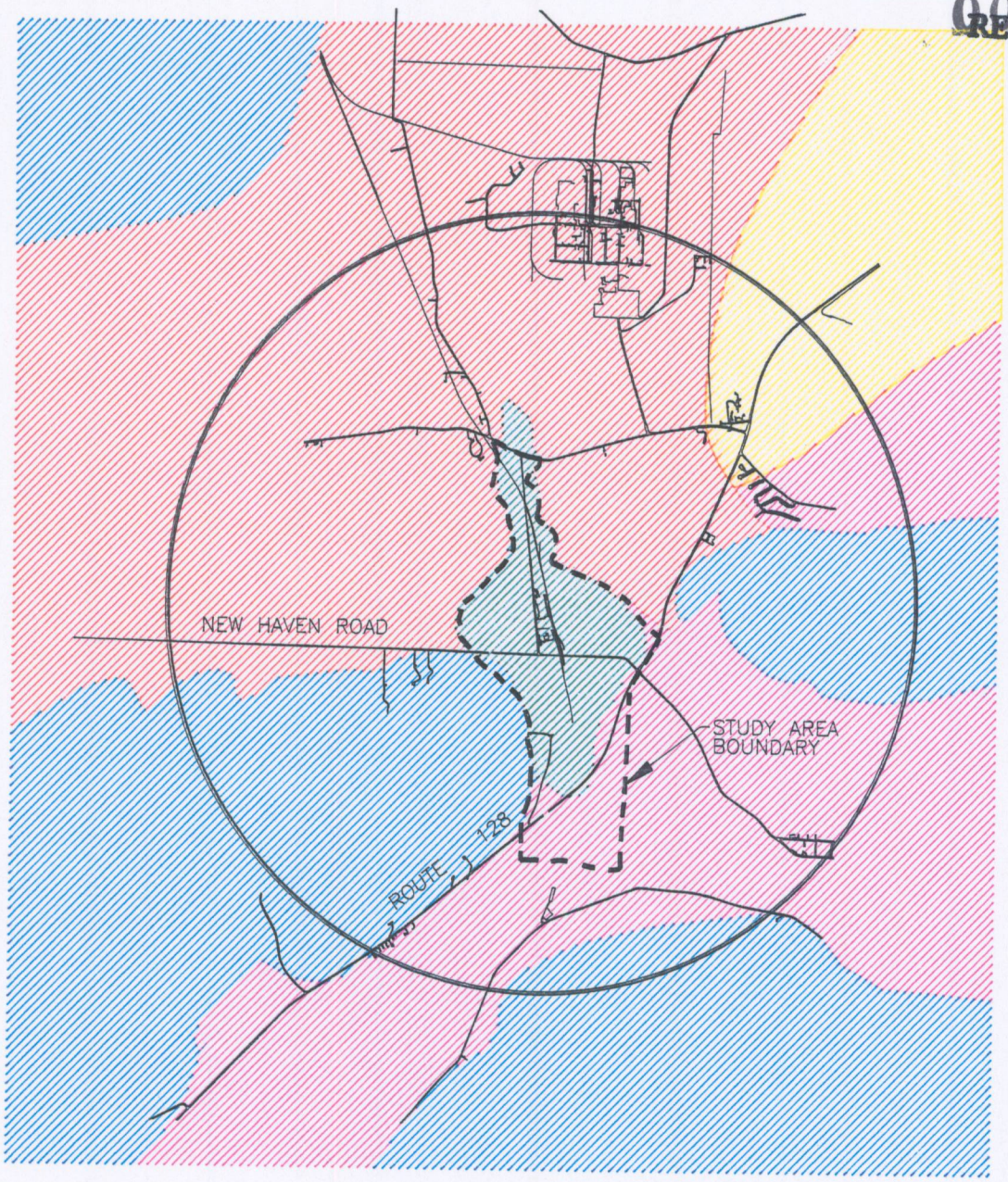
The area surrounding the PRRS is located within the New Haven Trough, a two- to three- mile wide valley formed as a result of Pleistocene glaciation. The channel of

this ancient river cut into the shale bedrock to a level of more that 200 feet below that of the present-day Great Miami River (GMR) (U.S. DOE 1987). During subsequent glacial activity approximately 100,000 to 400,000 years ago, the trough/valley was filled with outwash sand and gravel deposits from the melting glaciers. A layer of clay-rich till beyond the Study Area deposited from the most recent glacier less than 100,000 years ago now covers these sand and gravel deposits. A trough/valley which has been filled in with sediments, such as this one, is commonly referred to as a buried valley. These outwash deposits, which fill the New Haven Trough, comprise what is known as the GMR basin. On a larger scale, the GMR basin is part of a larger system known as the Greater Miami/Little Miami River Basin Buried Aquifer System.

The regional water supply comes from the GMR basin which has been designated as a sole source aquifer. It is estimated that this aquifer supplies at least 90 percent of the population within the GMR basin (OKI 1988b). Because of its importance, the regional hydrogeology has been studied in detail by numerous investigators. Most of the studies have been developed around a series of investigations performed by the United States Geological Survey (U.S. Geological Survey) in the 1950s and 1960s assessing the water resources in the area.

In the U.S. Geological Survey studies, 11 separate hydrogeologic environments were identified within the GMR basin. A hydrogeologic environment is a mappable geologic unit that has aquifer characteristics that are different from the aquifer characteristics in adjacent areas (U.S. Geological Survey 1968). Five hydrogeologic environments identified as I-A-1, I-A-2, I-B-2, III, and V, and shown in Figure 3-24, are present within approximately a 1.5 mile radius of the center of the Study Area. The classification of these hydrogeologic environments is based upon four criteria: the nature of the aquifer, availability of recharge by induced stream infiltration, presence or absence of interstratified clay layers, and thickness of the aquifer unit. Characteristics of the five identified units are as follows:

- I-A-1 - Sand and gravel aquifer; recharge by induced stream infiltration potentially available. No interstratified clay layers present. Aquifer is 150-200 feet or more thick.



LEGEND

- I–A–1
- I–A–2
- I–B–2
- III
- V

000268

GRAPHIC SCALE

3600 0 1800 3600 7200

(IN FEET)
1 inch = 3600 ft.

FIVE HYDROGEOLOGIC ENVIRONMENTS WITHIN A 1.5 MILE RADIUS OF THE SITE
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 3–24

ERM ERM-Midwest, inc.
Environmental Resources Management

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- I-A-2 - Sand and gravel aquifer; recharge by induced stream infiltration potentially available. No interstratified clay layers present. Aquifer is less than 150 feet thick.
- I-B-2 - Sand and gravel aquifer; recharge by induced stream infiltration potentially available. Interstratified clay layers possibly present. Aquifer less than 150 feet thick.
- III - Sand and gravel aquifer overlain by clay; stream recharge generally not available.
- V - Shale bedrock overlain by glacial till; large water supplies generally not available.

Numerous water resource studies have been generated around two, high-volume, collector wells installed in the early 1950s. Those wells operated by the Southern Ohio Water Company (SOWC) are located in the flood plain of the GMR northeast of PRRS. Those studies characterized the hydrology and geology of the aquifer for that area.

With the FEMP becoming an environmental concern, the bulk of the hydrogeologic investigations conducted in the area in the 1980s have been focused on groundwater contamination associated with the FEMP. Three regional groundwater models previous to that of the Companies' have been developed. Those models are discussed in Section 2.0 of the regional groundwater flow model found in Appendix C. The PRRS models were developed independent of the FEMP models. Where the PRRS and FEMP model input data are similar, the Companies assessed the appropriateness of that data.

Discussed below are the individual hydraulic characteristics of the aquifer. Table 3-29 provides a comprehensive review of groundwater flow parameters reported for the area, including the test methods and locations and constraints on the data. Table 3-30 provides a summary of the individual hydraulic characteristics used in the regional groundwater flow model and the technical rationale for selecting the modeled values. Additional information about the hydraulic characteristics used in the modeling is presented in Appendix C. Numerous sources were reviewed to

000270

TABLE 3-29
REPORTED GROUNDWATER FLOW PARAMETER VALUES (INCLUDING RI FIELD DATA)
PADDYS RUN ROAD SITE

Parameter	Test Method	Test Location	Reported Value/ Reported Units	Reported Value/ English Units	Value Based on These Constraints	Reference	Comments
Groundwater Temperature	Direct Measurement	SOWC, Venice Area	53.7 - 58.9°F	---	---	Dove (1961) p. 69	Average range measured during 6/56 to 6/59
Average Groundwater Temperature	Direct Measurement	Hamilton-New Baltimore	13.15 - 16.33°C	55.7 - 61.4°F	1974 Measurements	Plummer (1975)	---
Average Groundwater Temperature	Direct Measurement	Hamilton-New Baltimore	10.0 to 18.6°C	50 - 66°F	1971 - 1973 Measurements	Plummer (1974)	---
Groundwater Temperature	Direct Measurement	Hamilton-New Baltimore	12 - 16.5°C	54 - 62°F	1985 - 1986 Measurements	Weber (1987)	---
Groundwater Temperature	Direct Measurement	PRRS	6.25 - 27.0°C Avg. = 14.4°C	43°F - 81°F Avg. ≈ 60°F	---	ERM (Sept. 1992)	Range measured during 1991
Fluid (Ground water) Compressibility	Literature Value	Not applicable	4.4E-10 1/Pa	3.033694E-06 1/psi	---	Freeze and Cherry (1979) p. 52	Text book reference
Fluid (Ground water) Compressibility	Literature Value	Not applicable	---	3.215E-06 1/psi	Pure Water @ 60°F	Daugherty, Franzini & Finnemore, (1985) p. 4 & 571	Text book reference
Groundwater Specific Gravity	Direct Measurement	PRRS	1.000	---	Average Value	ERM (Sept. 1992)	---

(See notes and abbreviations at end of table.)

TABLE 3-29 (Continued)
REPORTED GROUNDWATER FLOW PARAMETER VALUES (INCLUDING RI FIELD DATA)
PADDYS RUN ROAD SITE

Parameter	Test Method	Test Location	Reported Value/ Reported Units	Reported Value/ English Units	Value Based on These Constraints	Reference	Comments
Fluid (Groundwater) Viscosity	Literature Value	Not applicable	1.14 cP	---	Pure H_2O @ 60°F	Dove (1961) p. 70	---
Fluid (Groundwater) Viscosity	Literature Value	Not applicable	1.125 cP	---	Pure H_2O @ 60°F	Fetter (1980) pg. 73	---
Fluid (Groundwater) Viscosity	Literature Value (interpolated)	Not applicable	1,138 μPa(s)	1.138 cP	Pure H_20 @ 60°F	Lide (1991) pg. 6-9	---
Fluid (Groundwater) Viscosity	Literature Value	Not applicable	2.359E-05 lbs/ft^2	1.129 cP	Pure H_2O @ 60°F	Daugherty, Franzini, & Finnemore (1985) p. 571	---
Viscosity (River Water)	Estimate based on surface water temperature	Near Venice	0.836 cP - 1.7513 cP	---	@ 82° - 34°F	Dove (1961) p. 75	Change in viscosity due to seasonal temperature variations may lead to 52% variance between summer and winter infiltration

(See notes and abbreviations at end of table.)

REV. 1: MAY 1994
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TABLE 3-29 (Continued)
REPORTED GROUNDWATER FLOW PARAMETER VALUES (INCLUDING RI FIELD DATA)
PADDYS RUN ROAD SITE

Parameter	Test Method	Test Location	Reported Value/ Reported Units	Reported Value/ English Units	Value Based on These Constraints	Reference	Comments
K_h (S&G aquifer)	---	Spieker's (1968a) Type III Area	250 ft/day	---	---	GeoTrans (1985)	Used in GeoTrans Model
K_h (S&G aquifer)	---	Spieker's (1968a) Type I-A-1 Area	350 ft/day	---	---	GeoTrans (1985)	Used in GeoTrans Model
K_h (S&G aquifer)	Pump Test	SOWC, Venice Area	2,380 - 2,760 gpd/ft^2	319 - 369 ft/day	Aquifer thickness = 120 - 125 feet	GeoTrans (1985)	See GeoTrans (1985) Table 4.1
K_h (S&G aquifer)	Flow Net Analysis	SOWC, Venice Area	2,440 - 2,780 gpd/ft^2	327 - 373 ft/day	Aquifer thickness = 120 feet	Schaefer & Walton (1956)	See GeoTrans (1985) Table 4.1
K_h (S&G aquifer)	Flow Net Analysis	SOWC, Venice Area	2,466 gpd/ft^2	330 ft/day	Aquifer thickness = 150	Dove (1961)	See GeoTrans (1985) Table 4.1
K_h (S&G aquifer)	Pump Test	SOWC, Venice Area	2,800 to 3,000 gpd/ft^2	375 to 402 ft/day	---	Dove (1961)	---
K_h (S&G aquifer)	Pump Test	Beneath clay unit at FEMP	2,000 gpd/ft^2	268 ft/day	Aquifer thickness = 70 feet	Spieker & Norris (1962)	See GeoTrans (1985) Table 4.1
K_h (S&G aquifer)	Pump Test	SOWC, Venice Area	2,500 - 3,020 gpd/ft^2	335 - 405 ft/day	---	Lewis (1968)	See GeoTrans (1985) Table 4.1

(See notes and abbreviations at end of table.)

TABLE 3-29 (Continued)
REPORTED GROUNDWATER FLOW PARAMETER VALUES (INCLUDING RI FIELD DATA)
PADDYS RUN ROAD SITE

Parameter	Test Method	Test Location	Reported Value/ Reported Units	Reported Value/ English Units	Value Based on These Constraints	Reference	Comments
K_h (S&G aquifer)	---	South Plume Study Area (South of FEMP)	250 to 500 ft/day	---	Sat. Aq. Thickness ≈ 130 ft.	IT Corp./ASI (Aug. 1988)	---
K_h (S&G aquifer)	Estimated	NW of Fernald	1,000 to 2,000 gpd/ft^2	134 - 268 ft/day	---	Univ. of Cinn. (1989)	Used in DRASTIC rating
K_h (S&G aquifer)	Estimated	N, NE, & S of Fernald	2,000 gpd/ft^2 and greater	268 ft/day and greater	---	Univ. of Cinn. (1989)	Used in DRASTIC rating
K_h (S&G aquifer)	Estimated	New Baltimore Area	60 ft/day	---	---	IT Corp./ASI (Dec, 1990)	Used in IT Model
K_h (S&G aquifer)	Estimated	North of FEMP Area	120 ft/day	---	---	IT Corp./ASI (Dec, 1990)	Used in IT Model
K_h (S&G aquifer)	Estimated	Upper 3 layers of model throughout most of study area	450 ft/day	---	---	IT Corp./ASI (Dec, 1990)	Used in IT Model
K_h (S&G aquifer)	Estimated	Lower 2 layers of model throughout most of study area near Ross & FEMP	600 ft/day	---	---	IT Corp./ASI (Dec, 1990)	Used in IT Model
K_v (S&G aquifer)	---	Spieker's (1968a) Type III Area	2.5 ft/day	---	---	GeoTrans (1985)	Used in GeoTrans Model
K_v (S&G aquifer)	---	Spieker's (1968a) Type I-A-1 Area	35 ft/day	---	---	GeoTrans (1985)	Used in GeoTrans Model

(See notes and abbreviations at end of table.)

REV. 1: MAY 1994
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TABLE 3-29 (Continued)
REPORTED GROUNDWATER FLOW PARAMETER VALUES (INCLUDING RI FIELD DATA)
PADDYS RUN ROAD SITE

Parameter	Test Method	Test Location	Reported Value/ Reported Units	Reported Value/ English Units	Value Based on These Constraints	Reference	Comments
K_v (S&G aquifer)	Estimated	New Baltimore Area	6 ft/day	---	---	IT Corp./ASI (Dec, 1990)	Used in IT Model Assumed $K_v = 0.1 K_h$
K_v (S&G aquifer)	Estimated	North of FEMP Area	12 ft/day	---	---	IT Corp./ASI (Dec, 1990)	Used in IT Model; Assumed $K_v = 0.1 K_h$
K_v (S&G aquifer)	Estimated	Upper 3 layers of model throughout most of study area	45 ft/day	---	---	IT Corp./ASI (Dec, 1990)	Used in IT Model; Assumed $K_v = 0.1 K_h$
K_v (S&G aquifer)	Estimated	Lower 2 layers of model throughout most of study area near Ross & FEMP	60 ft/day	---	---	IT (Dec, 1990)	Used in IT Model; Assumed $K_v = 0.1K_h$
K_v (Clay unit)	---	Aquitard below FEMP	0.025 ft/day	---	---	GeoTrans (1985)	Used in GeoTrans Model
K_v (Clay unit)	Pump Test	Aquitard below FEMP	0.43 to 0.33 ft/day	---	---	Spieker & Norris (1962)	---
K_v (Clay unit)	Estimated	Aquitard below FEMP	0.0003 ft/day	---	---	IT Corp./ASI (Dec, 1990)	Used in IT Model
K_h (Bedrock)	Estimated	FEMP Area	5 gpd/ft^2	0.67 ft/day	---	IT Corp./ASI Nov. (1990)	---

(See notes and abbreviations at end of table.)

TABLE 3-29 (Continued)
REPORTED GROUNDWATER FLOW PARAMETER VALUES (INCLUDING RI FIELD DATA)
PADDYS RUN ROAD SITE

Parameter	Test Method	Test Location	Reported Value/ Reported Units	Reported Value/ English Units	Value Based on These Constraints	Reference	Comments
K_h (Bedrock)	Estimated	SOWC, Venice	5 gpd/ft^2	0.67 ft/day	---	Dove (1961)	Based on well flow rates in upland areas
K (Bedrock)	Estimated	E of Fernald	1 to 100 gpd/ft^2	0.1 to 13 ft/day	---	Univ. of Cinn. (1989)	Used in DRASTIC rating
Groundwater Flow Velocity (S&G aquifer)	Flow Meter	PRRS	2.7 ft/day	---	Avg. from 7 Shallow, 3 Intermed. & 1 Deep Well	Groundwater Flow Meter Study Ruetgers-Nease Corporation Paddys Run Road Fernald, OH K-V Associates, Inc. Apr. (1991)	Direction = 154° from true north
Net Groundwater Recharge	Measurement/ Estimate	Venice area of Ohio	12 in./year	---	---	Dove (1961) p. 61	Equals 570,000 gpd/mi^2 Rainy season - Apr, May, June, Dry season - Sept, Oct

(See notes and abbreviations at end of table.)

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REV. 1: MAY 1994

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TABLE 3-29 (Continued)
REPORTED GROUNDWATER FLOW PARAMETER VALUES (INCLUDING RI FIELD DATA)
PADDYS RUN ROAD SITE

Parameter	Test Method	Test Location	Reported Value/ Reported Units	Reported Value/ English Units	Value Based on These Constraints	Reference	Comments
Net Groundwater Recharge	Measurement/ Estimate	Fairfield-New Baltimore, Ohio	6 - 21 in./year Avg 15 in./year	---	1931 - 1960	Spieker (1968a)	Other estimates for avg. conditions: ET - 25 in./year; runoff = 8 in./year; rainfall 39 in./year; U.S. Weather Bureau Records
Net Groundwater Recharge	Calculated	Hamilton Co.; SOWC collector well area	12 in./year	---	---	Lewis (1968)	---
Net Groundwater Recharge	Measurement/ Estimate	NW of Fernald	4 to 7 in./year	---	---	Univ. of Cinn (1989)	Used in DRASTIC rating
Net Groundwater Recharge	Measurement/ Estimate	N of Fernald	7 to 10 in./year	---	---	Univ. of Cinn (1989)	Used in DRASTIC rating
Net Groundwater Recharge	Measurement/ Estimate	S of Fernald	10 in./year or greater	---	---	Univ. of Cinn (1989)	Used in DRASTIC rating
Net Groundwater Recharge	Measurement/ Estimate	E of Fernald	10 in./year or greater	---	---	Univ. of Cinn (1989)	Used in DRASTIC rating
Net Groundwater Recharge	Measurement/ Estimate	SW, S, & SE of Fernald	2 to 4 in./year	---	---	Univ. of Cinn (1989)	Used in DRASTIC rating
Net Groundwater Recharge	Estimate	Venice area where there was no till @ land surface	15 in./year	---	---	GeoTrans (1985)	Used in GeoTrans Model

(See notes and abbreviations at end of table.)

TABLE 3-29 (Continued)
REPORTED GROUNDWATER FLOW PARAMETER VALUES (INCLUDING RI FIELD DATA)
PADDYS RUN ROAD SITE

Parameter	Test Method	Test Location	Reported Value/ Reported Units	Reported Value/ English Units	Value Based on These Constraints	Reference	Comments
Net Groundwater Recharge	Estimate	Venice area where there was no till @ land surface	6 in./year	---	---	GeoTrans (1985)	Used in GeoTrans Model
Net Groundwater Recharge	Estimate	FEMP site	2 in./year	---	---	IT Corp./ASI (Dec. 1990) Walton & Schaefer (1956)	Used in IT Model
Net Groundwater Recharge	Estimate	Areas without till @ land surface (stream flood plains)	14 in./year	---	---	IT Corp./ASI (Dec. 1990)	Used in IT Model
Net Groundwater Recharge	Estimate	Areas with till @ land surface (N,S,E, & W of FEMP); and New Baltimore Area	6 in./year	---	---	IT Corp./ASI (Dec. 1990)	Used in IT Model
Net Groundwater Recharge	Calculated	Fairfield - New Baltimore Area	6 - 21 in/yr	---	Average annual rise of water table	Spieker (1968C) p. C5	Considered recharge induced by pumping at boundaries and river
Net Groundwater Recharge	Water Budget	Hamilton	6 in/yr	---	38.81 in/yr precp; 25 in/yr ET; 8 in/yr run-off	Spieker (1968C) p. C9	Referenced US Weather Bureau

(See notes and abbreviations at end of table.)

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REV. 1: MAY 1994

007352

TABLE 3-29 (Continued)
REPORTED GROUNDWATER FLOW PARAMETER VALUES (INCLUDING RI FIELD DATA)
PADDYS RUN ROAD SITE

Parameter	Test Method	Test Location	Reported Value/ Reported Units	Reported Value/ English Units	Value Based on These Constraints	Reference	Comments
Net Groundwater Recharge	Calculated	Fairfield - New Baltimore	15.2 in/yr	---	76.2 in. rise in water level at well BU-7; s = 0.2	Spieker (1968C) p. C10)	Used in model
Net Groundwater Recharge	Literature	Fairfield Area	21 in/yr	---	---	GeoTrans (1985) p. 32	---
Net Groundwater Recharge	Literature	SOWC Wellfield Area	8.5 in/yr	---	---	GeoTrans (1985) p. 34	---
Leakage from Valley Walls	Estimate	Fairborn Area to SOWC Area	30 to 38 gpd/lf, respectively	1.74 ft^3/day-lf	K_h (Bedrock) = 1-5gpd/ft^2	Spieker (1968c)	13 gpd/lin. ft. was the rate used in the Spieker Model
Leakage from Valley Walls		FEMP	---	---	---	GeoTrans (1985)	Modeled as no-flow boundaries
Leakage from Valley Walls	Estimate	SOWC Area	200,000 gpd/mi.	5.1 ft^3/day-lf	K_h (Bedrock) = 5 gpd/ft^2	Dove (1961)	---
Volumetric Flux (bedrock to aquifer)	Inferred	Near Venice	200,000 gpd/mi.	5.1 ft^3/ft^2 day	---	Dove (1961) p. 62	Based on permeability of 5 gpd/ft^2 for limestone and shale bedrock

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(See notes and abbreviations at end of table.)

TABLE 3-29 (Continued)
REPORTED GROUNDWATER FLOW PARAMETER VALUES (INCLUDING RI FIELD DATA)
PADDYS RUN ROAD SITE

Parameter	Test Method	Test Location	Reported Value/ Reported Units	Reported Value/ English Units	Value Based on These Constraints	Reference	Comments
Great Miami River Leakage	Calculated	Near SOWC Collector Wells 1 and 2	113,000 - 140,000 gpd/ac-ft	0.34 - 0.43 day^{-1}	Headlosses from observation wells	Dove (1961) p. 64	---
Great Miami River Leakage	Flow net calculations	SOWC	240,000 gpd/ac-ft	0.74 day^{-1}	Water table contours 512-513	Dove (1961) p. 64	---
Great Miami River Leakage	Calculated from pump test	Near Fairfield	490,000 gpd/ac	---	---	Spieker (1968)	Calculated average infiltration
Great Miami River Leakage	Calculated from observations	SOWC	735,000 gpd/ac	---	115,000 gpd/ac-ft @ 6.37 ft headloss	Spieker (1968c) p. 10	---
Great Miami River Leakage	Estimated	Great Miami River	240,000 - 500,000 gpd/ac	---	Estimated range under low flow (summer) conditions or high flow (winter) with lower viscosities	Spieker (1968c) p. 11	Used in Spieker Model
Great Miami River Leakage	Model fitted value/ estimate	IT Model domain	0.5 day^{-1}	---	Initially set @ 0.35 day^{-1} (3 orders of magnitude below K-value)	IT Corp/ASI (1990) p. 20-11, 14	Calibrated model to 0.5 day^{-1}

(See notes and abbreviations at end of table.)

REV. 1: MAY 1994
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TABLE 3-29 (Continued)
REPORTED GROUNDWATER FLOW PARAMETER VALUES (INCLUDING RI FIELD DATA)
PADDYS RUN ROAD SITE

Parameter	Test Method	Test Location	Reported Value/ Reported Units	Reported Value/ English Units	Value Based on These Constraints	Reference	Comments
Recharge due to Paddys Run	Assumed	FEMP	14 in/yr	---	Equivalent to infiltration rate of areas not covered with glacial overburden	IT Corp/ASI (1990) p. 13-4	Used IT flow model
Recharge due to Paddys Run	Assumed	FEMP	32 in/yr	---	Increased to compensate for smaller cell dimensions	IT Corp/ASI (1990) p. 13-4	Used in IT solute transport model
Average Width of Great Miami River	Assumed	Fairfield - New Baltimore	250 ft	---	---	Spieker (1968C) p. C19	Used in Spieker model
Average Width of Great Miami River	Estimated	Near SOWC wells	200 ft	---	---	Dove (1961), p. 64	Used to estimate rate of infiltration
Average Width of Great Miami River	---	Near Baltimore - Ross	302 - 346 ft	---	---	IT Corp. (1987) p. 2-8	Based on USCOE HEC2. Modeled river as a constant head
Average Width of Great Miami River	---	---	Not reported	---	---	GeoTrans (1985)	Modeled as a constant head boundary

(See notes and abbreviations at end of table.)

TABLE 3-29 (Continued)
REPORTED GROUNDWATER FLOW PARAMETER VALUES (INCLUDING RI FIELD DATA)
PADDYS RUN ROAD SITE

Parameter	Test Method	Test Location	Reported Value/ Reported Units	Reported Value/ English Units	Value Based on These Constraints	Reference	Comments
Average Width of Paddys Run Creek	Measurement	@ SR 128	2.8 ft 4.0 ft 16.0 ft	---	Measured in 10/76, 9/70, & 4/72, respectively	USGS Discharge Measurement Notes	Provided by MCD November 22, 1991
Average Width of Paddys Run	Measurement	North of PRRS (near Delta Steel)	24 - 28 ft	---	---	MCC (1984) p. 2	---
Average Flow Depth of Great Miami River	Measurement	Near FEMP	5.4 - 5.7 feet	---	---	IT Corp./ASI (1990) p. 12-15 IT Corp. (1987) p. 2-8	Based on USCOE HEC2 model
Average Flow Depth of Paddys Run	Measurement	Upstream of PRRS	1.60 - 1.83 ft 0.45 - 0.59 ft	--- ---	Measured on 05/11/83 Measured on 11/30/83	MCC (1984) Tbl. 1 MCC (1984) Tbl. 1	--- ---
GMR Streambed Elevations	Survey	Hamilton County	527 - 479 ft. (NGVD)	---	---	FEMA FIS (1981)	---
Absolute Atmospheric Pressure	Book value	Book value	1.01325E+05 Pa	---	---	Lide (1991)	---
Acceleration of Gravity (g)	Book value	General	32.15 ft/s^2	2.4E+11 ft/day^2	@ 39° Latitude	Lide (1991)	---

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(See notes and abbreviations at end of table.)

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REV. 1: MAY 1994

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TABLE 3-29 (Continued)
REPORTED GROUNDWATER FLOW PARAMETER VALUES (INCLUDING RI FIELD DATA)
PADDYS RUN ROAD SITE

Parameter	Test Method	Test Location	Reported Value/ Reported Units	Reported Value/ English Units	Value Based on These Constraints	Reference	Comments
Well Pumping Rate	Direct Measurement	SOWC Collector Well 1, Venice Area	6.51 to 11.86 mgd Avg = 9.19 mgd	8.70E+05 ft^3/day-1.50E+06 ft^3/day Avg = 1.23E+06 ft^3/day	1952 to 1958	Dove (1961)	---
Well Pumping Rate	Direct Measurement	SOWC Collector Well 2, Venice Area	6.54 to 7.63 mgd Avg = 7.09 mgd	8.74E+05 ft^3/day-1.02E+06 ft^3/day Avg = 9.47E+05 ft^3/day	1955 to 1958	Dove (1961)	---
Well Pumping Rate	Estimate	FEMP Well P3 #4103	292 gpm	5.6E+04 ft^3/day	Avg. 3/86 & 4/86 rate	IT Corp./ASI Dec. 1990	Value used in IT Model
Well Screen Interval	---	SOWC collector well 1, Venice	117 - 140 ft. bls	---	---	Spieker (1968a) Tbl. 10 Dove (1961) Fig. 17 & 18	Layer 4 of IT Model (≈EL 420)
Well Screen Interval	---	SOWC collector well 2, Venice	133 - 137 ft., bls	---	---	Spieker (1968) Tbl. 10 Dove (1961) Fig. 17 & 18	Layer 4 of IT Model (≈EL 420)
Well Screen Interval	---	FEMP well P3, #4103	390 - 369 msl	---	Ground surface elevations = 579.34 msl	IT Corp. (1987) Tbl 2.1.1	Not used in IT (1987) to construct ground water contour map

(See notes and abbreviations at end of table.)

TABLE 3-29 (Continued)
REPORTED GROUNDWATER FLOW PARAMETER VALUES (INCLUDING RI FIELD DATA)
PADDYS RUN ROAD SITE

Parameter	Test Method	Test Location	Reported Value/ Reported Units	Reported Value/ English Units	Value Based on These Constraints	Reference	Comments
Well Screen Interval	---	A&W well 1	62 - 82 ft, bls	---	---	ENSR (1988)	Total depth = 82 feet, bls
Well Screen Interval	---	A&W well 2	60 - 81 ft, bls	---	---	ENSR (1988)	Total depth = 81 feet, bls
Well Screen Interval	---	Rutgers-Nease well	78 - 94 ft, bls	---	---	Koehne (1959)	---
Average Well Pumping Rate	Estimate	Rutgers-Nease pumping well	2.5 gpm	481 ft^3/day	---	IT Corp./ASI (Dec, 1990)	Used in IT Model
Average Well Pumping Rate	Estimate	A&W wells 1&2	225 gpm	43,316 ft^3/day	Combined pumping rate	IT Corp./ASI (Dec., 1990) p. 20-26	Used in IT Model
Average Well Pumping Rate	Estimate	SOWC Collector well 1, Venice	6,026 gpm	1.16E+06 ft^3/day	---	IT Corp./ASI (Dec., 1990) p. 20-26	Used in IT Model
Average Well Pumping Rate	Estimate	SOWC Collector well 2, Venice	6,026 gpm	1.16E+06 ft^3/day	---	IT Corp./ASI (Dec., 1990) p. 21-26	Used in IT Model
Average Well Pumping Rate	Estimate	Rutgers-Nease pumping well	2 - 3 gpm	385 -578 ft^3/day	---	ENSR (1988)	---
Average Well Pumping Rate	Estimate	A&W well 1	100 gpm	19,251 ft^3/day	---	ENSR (1988)	Typical pumping rate

(See notes and abbreviations at end of table.)

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TABLE 3-29 (Continued)
REPORTED GROUNDWATER FLOW PARAMETER VALUES (INCLUDING RI FIELD DATA)
PADDYS RUN ROAD SITE

Parameter	Test Method	Test Location	Reported Value/ Reported Units	Reported Value/ English Units	Value Based on These Constraints	Reference	Comments
Average Well Pumping Rate	Estimate	A&W well 2	100 gpm	19,251 ft^3/day	---	ENSR (1988)	Typical pumping rate
Bedrock Elevation (aquifer dimensions)	Combined Watkins & Spieker (1964 & 1971) data with geologic drilling logs for area	Vicinity of subject site	Varies - see Plate 4.1 in Geotrans (1985)	---	---	GeoTrans (1985)	GeoTrans Model used aquifer dimensions shown on Plate 4.1
Bedrock Elevation (aquifer dimensions)	Geologic drilling logs and geophysical data	Vicinity of subject site	Varies see Figure 4.1 in Watkins and Spieker (1964 and 1971)	---	---	Watkins & Spieker (1964 and 1971)	---
Bedrock Elevation (aquifer dimensions)	Not reported	Vicinity of subject site	Varies	---	---	Vormelker (Sept, 1985)	Only the map was available for review
Bedrock Elevation (aquifer dimensions)	Literature review and well logs	Vicinity of subject site	Varies (see Figure 11-2)	___	___	IT Corp./ASI (Dec, 1990)	IT Model used aquifer dimensions shown in Figure ___
Land Surface Elevation	Topographic Survey	Vicinity of subject site	Varies, see 7.5-minute Shandon Quadrangle topographic map)	---	---	USGS (1981)	---

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(See notes and abbreviations at end of table.)

TABLE 3-29 (Continued)
REPORTED GROUNDWATER FLOW PARAMETER VALUES (INCLUDING RI FIELD DATA)
PADDYS RUN ROAD SITE

Parameter	Test Method	Test Location	Reported Value/ Reported Units	Reported Value/ English Units	Value Based on These Constraints	Reference	Comments
Aquifer porosity	Estimated	---	0.25	0.25	Literature and GeoTrans pump test (1965)	IT Corp./ASI (Dec, 1990)	Used in IT model
Aquifer porosity	Estimated	---	0.20	0.20	---	GeoTrans (1985)	Not field tested but representative of similar aquifer used in GeoTrans model
Storativity (S&G aquifer)	Estimated	Venice, OH & Louisville, KY	0.2	---	---	Dove (1961) p. 25	---
Storativity (S&G aquifer)	Pump Test	FEMP	0.01	---	---	Spieker & Norris (1962)	Confined conditions
Storativity (S&G aquifer)	Estimated	FEMP & PRRS Area	0.1	---	---	Spieker (1968c)	Used in Spieker Model
Storativity (S&G aquifer)	Estimated	East & South of FEMP & PRRS Area	0.2	---	---	Spieker (1968c)	Used in Spieker Model
Storativity (S&G aquifer)	Estimated	Great Miami Aquifer	0.2	---	---	IT Corp./ASI (Dec. 1990)	Used in IT Model

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TABLE 3-29 (Continued)
REPORTED GROUNDWATER FLOW PARAMETER VALUES (INCLUDING RI FIELD DATA)
PADDYS RUN ROAD SITE

Parameter	Test Method	Test Location	Reported Value/ Reported Units	Reported Value/ English Units	Value Based on These Constraints	Reference	Comments
Storativity (S&G aquifer)	Pump Test	SOWC Collector Well, Venice Area	0.23	---	---	GeoTrans, (1985)	See GeoTrans Table 4.1
Storativity (S&G aquifer)	Estimated	FEMP	0.2	---	---	IT Corp./ASI (Oct, 1990)	Spieker's (1968a) Type I Environ
Storativity (S&G aquifer)	Estimated	Operable Unit 5 - FEMP	0.2	---	---	IT Corp./ASI (Nov, 1990)	Spieker's (1968a) Type I Environ
Storativity (S&G aquifer)	Estimated	Operable Unit 5 - FEMP	0.001	---	---	IT Corp./ASI (Nov, 1990)	Aquifer Below Clay; Clay 10 to 20 ft. thick
Storativity (S&G aquifer)	Estimated	IT's Modeled Area	0.25	---	---	IT Corp./ASI (Dec, 1990)	Value used in IT Model

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NOTES:

Refer to Section 6.0 in Appendix C for a listing of references.

ABBREVIATIONS:

USCOE = United States Corps of Engineers
S&G = Sand and gravel
K_h = Horizontal hydraulic conductivity
K_v = Vertical hydraulic conductivity
MCD = Miami Conservancy District
bls = Below land surface

TABLE 3-30
GROUNDWATER FLOW PARAMETER VALUES USED
IN CALIBRATED REGIONAL MODEL
PADDYS RUN ROAD SITE

Model Parameter	Reported Range	Modeled Value	Comments	Technical Rationale
Fluid Compressibility	3.03E-06 to 3.22E-06 psi^{-1}	3.03E-06 psi^{-1}	---	Freeze and Cherry (1979); [f], [g]
Reference Pressure	NA	0.0 psi	Assume 0.0 psi at land surface	Model Assumption
Reference Temperature - Groundwater, PPT and Surface Water	34.2 - 82.8°F	60°F	---	Approximate average ground water temperature measured during 1991 PRRS RI[f]
Fluid Density - Groundwater, PPT and Surface Water	62.37 - 62.42 lb/ft^3	62.4 lb/ft^3	---	[f], [g]
Fluid Viscosity - Groundwater, PPT, and Surface Water	0.836 to 1.7513 cP	1.138 cP	---	Lide (1991), page 6-9, book value[f]
Absolute Atmospheric Pressure	1.01325E+05 Pa	1.01325E+05 Pa	---	Lide (1991), book value[f]
K_h aquifer (Figures 2-7 and 3-6)	134 - 600 ft/day	350 - 450 ft/day	Converted to intrinsic permeability for model input[a]	Well supported by aquifer tests for the area; calibrated values to average observed water levels for 1986 and 1991
K_v aquifer	2.5 - 60 ft/day	35 - 45 ft/day	Converted to intrinsic permeability for model input[a]	Calibrated values to average observed water levels for 1986 and 1991; sensitivity testing showed simulated heads to be relatively insensitive to values between kh/kv=10 and kh/kv=100
K_h clay (Figures 2-7 and 3-6)	NA	0.35 ft/day	Converted to intrinsic permeability for model input[a][b]	Calibrated values to average observed water levels for 1986 and 1991; simulated heads were relatively insensitive to changes in values within the reported range; values for these parameters had negligible effect on simulated heads near the site

007357
REV. 1: MAY 1994

TABLE 3-30 (Continued)
GROUNDWATER FLOW PARAMETER VALUES USED
IN CALIBRATED REGIONAL MODEL
PADDYS RUN ROAD SITE

Model Parameter	Reported Range	Modeled Value	Comments	Technical Rationale
K_v clay	0.00030 - 0.43 ft/day	0.35 ft/day	Converted to intrinsic permeability for model input[a][b]	Calibrated values to average observed water levels for 1986 and 1991; simulated heads were relatively insensitive to changes in values within the reported range; values for these parameters had negligible effect on simulated heads near the site
K_h bedrock (Figures 2-7 and 3-6)	0.1 - 13 ft/day	0.67 ft/day	Converted to intrinsic permeability for model input[a]	Well supported by literature; varying values within the reported range had minimal effect on simulated heads
K_v bedrock	NA	0.67 ft/day	Converted to intrinsic permeability for model input[a]	Set equal to kh of the bedrock for lack of reported values; could be lower but this would likely have a minimal effect on simulated heads
Porosity	0.20 - 0.25	0.225	---	Average of values from several other calibrated ground water flow models; supported by aquifer test-derived S_y's for the aquifer in the area
Bulk Vertical Compressibility of Aquifer	NA	0.0	Assume Incompressibility	[g]
Elevation of top of clay confining unit @ FEMP	≈ 455 - 469 ft. (MSL)	455 ft. (MSL)	Range of Reported Clay Thickness ≈ 0 - 16 ft[b]	Typical observed value in boring logs presented in IT's assessment reports
Elevation of bottom of clay confining unit at FEMP	≈ 425 - 450 ft. (MSL)	445 ft. (MSL)	[b]	Typical observed value in boring logs presented in IT's assessment reports
Range of elevation of water table	≈ 504 - 542 ft. (MSL)	496 - 553 ft. (MSL)	[c]	Typical observed values in IT's and ERM's assessment reports
Range of elevation of top of bedrock	334 - 600+ ft. (MSL)	380 - 553 ft. (MSL)	---	Relied primarily on well and boring lithologic logs and geophysical data taken from a variety of USGS reports, IT (1990), and Geotrans (1985)

TABLE 3-30 (Continued)
GROUNDWATER FLOW PARAMETER VALUES USED
IN CALIBRATED REGIONAL MODEL
PADDYS RUN ROAD SITE

Model Parameter	Reported Range	Modeled Value	Comments	Technical Rationale
Leakance[d] (Figures 2-6 and 3-5)				
Leakance of GMR and PR	0.34 - 0.74 day^{-1}	0.5 day^{-1}	No Reported Value for PR	[h]
K_v of GMR and PR streambeds	NA	0.5 ft/day	---	[i]
b of GMR and PR streambeds	NA	1.0 ft.	---	Assumed value
Width of GMR	200 - 346 ft.	300 ft.	---	Approximate average of estimated annual stream width within the model domain
Depth of flow in GMR	5.4 - 5.7 ft.	6 ft/5 ft.	1986/1991 Model	Calibrated value; approximate average of estimated annual stream depth within the model domain
Elevation of GMR streambed	479 - 527 ft. (MSL)	495 - 524 ft. (MSL)	[c]	Linear interpolation of FEMA FIS (1981) survey elevations
Width of PR	2.8 ft to 28 ft	20 ft.	---	Approximate average of estimated annual stream width within the model domain
Depth of flow in PR	0 - 1.83 ft.	1.0 ft./0.5 ft.	1986/1991 Model	Calibrated value; approximate average of estimated annual stream depth within the model domain
Elevation of PR streambed	NA	522 - 503 ft. (MSL)	---	Estimated from USGS (1981) Shandon, Ohio 7.5 minute topographic contour map
Pump Rate SOWC Wells 1 & 2	8.74E+05 - 1.50E+06 ft^3/day	1.16E+06 ft^3/day each	[b]	Values used by IT (1990) and evaluted for accuracy by ERM
Pump Rate A & W Wells 1 & 2	19,251 - 21,656 ft^3/day	21,500 ft^3/day each	---	Values used by IT (1990) and evaluted for accuracy by ERM
Pump Rate FEMP Well	56,000 ft^3/day	56,000 ft^3/day	[b]	Values used by IT (1990) and evaluted for accuracy by ERM
Pump Rate RNC Well	481 ft^3/day	481 ft^3/day	[c]	Values used by IT (1990) and evaluted for accuracy by ERM

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REV. 1: MAY 1994

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TABLE 3-30 (Continued)
GROUNDWATER FLOW PARAMETER VALUES USED IN CALIBRATED REGIONAL MODEL PADDYS RUN ROAD SITE

Model Parameter	Reported Range	Modeled Value	Comments	Technical Rationale
Net PPT Recharge (Figures 2-8 and 3-7)	4 - 21 in/yr	0.0014 - 0.0032 ft/ft day (2 - 14 in./yr)	(c)	(j)
g	2.4E + 11 ft/day^2	2.4E + 11 ft/day^2	---	Variation of this parameter not typically done for this type of modeling effort

G:\PROJECT\539-15\SECT3\TAB2_2.NEW

ABBREVIATIONS:

PPT	=	Rainfall precipitation
NA	=	Not applicable or available
g	=	Acceleration of gravity
K	=	Hydraulic conductivity (K_v = vertical K; K_h = horizontal K)
GMR	=	Great Miami River
PR	=	Paddys Run
k_i	=	Intrinsic permeability
v	=	Viscosity
D	=	Fluid density
L	=	Leakance through streambed
b	=	Bed thickness
ft. (MSL)	=	Feet above mean sea level

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TABLE 3-30 (Continued)
GROUNDWATER FLOW PARAMETER VALUES USED IN CALIBRATED REGIONAL MODEL PADDYS RUN ROAD SITE

FOOTNOTES:

(a) $k_i = \frac{KV}{gD}$

(b) Applies to regional model only

(c) A subset of this range was used in the local model

(d) $L = \frac{K_v}{b}$

(e) Pumping from RNC's well was not included in the regional model because of the negligible effect that pumping at such a low rate would have on heads in the model.

(f) Minimum variability and effect on ground water flow at the site anticipated.

(g) A typical assumption for most ground water modeling projects is not to spatially vary this variable.

(h) Average of values observed in the literature for GMR; calculated based on estimated Kv and b of stream beds; it was resolved that the PR stream could best be simulated with leakage rather than recharge (as other modelers had done) since the stream is less intermittent in the vicinity of and south of the PRRS.

(i) Based on average reported leakance value for the GMR and assumed streambed thickness of 1 ft; since a literature review found no direct measurements for estimating hydraulic properties for the PR stream, it was assumed that its Kv would be similar to the GMR streambed.

(j) In general, followed Spieker's (1968c) estimate of recharge for different areas of the model domain; modified in some areas due to more recent information on near-surface lithologies and ground cover.

COMMENTS:
Storativity is calculated internally by HST3D based on the relationship between the compressibilities of the fluid and porous media, the density of the water, gravity, and aquifer thickness (see Fetter, 1980 and Kipp, 1987).

References for reported ranges of parameters listed in this table are found in Table 2-1 of Appendix C and/or ERM (Sept., 1992).

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REV. 1: MAY 1994

gather this information, resulting in a database that provides comprehensive information on the hydrology and hydrogeology of the aquifer system.

3.10.1.2 Hydraulic Characteristics

Groundwater Recharge

The principal sources of recharge to the GMR aquifer are the infiltration of precipitation (rain and snow) and infiltration from streams.

Recharge Through Precipitation Infiltration. Not all precipitation enters the aquifer. Some enters directly to streams, some evaporates, some is taken up by plants and the remainder seeps into the ground and eventually enters the aquifer.

Precipitation data has been collected and reviewed from other investigations for the purpose of comparing recharge rates. These data support the regional and local groundwater model. Yearly precipitation from three locations collected by the Miami Conservancy District (MCD) and one by FEMP are presented in Table 3-31.

Table 3-31
YEARLY PRECIPITATION COLLECTED BY MCD and FEMP (in inches)

Year	MCD Hamilton(1)	MCD New Baltimore(2)	MCD SOWC(3)	DOE FEMP
1987	-	-	-	30.10
1988	-	-	-	57.60
1989	-	-	-	37.04
1990	55.33	53.73	53.14	42.08
1991	32.18	30.37	33.75	38.07

(1) Caretaker garage on the southeast end of Wayne Ave. Hamilton
(2) Guard shack at the FEMP
(3) Southwestern Ohio Water Company by collector well #1

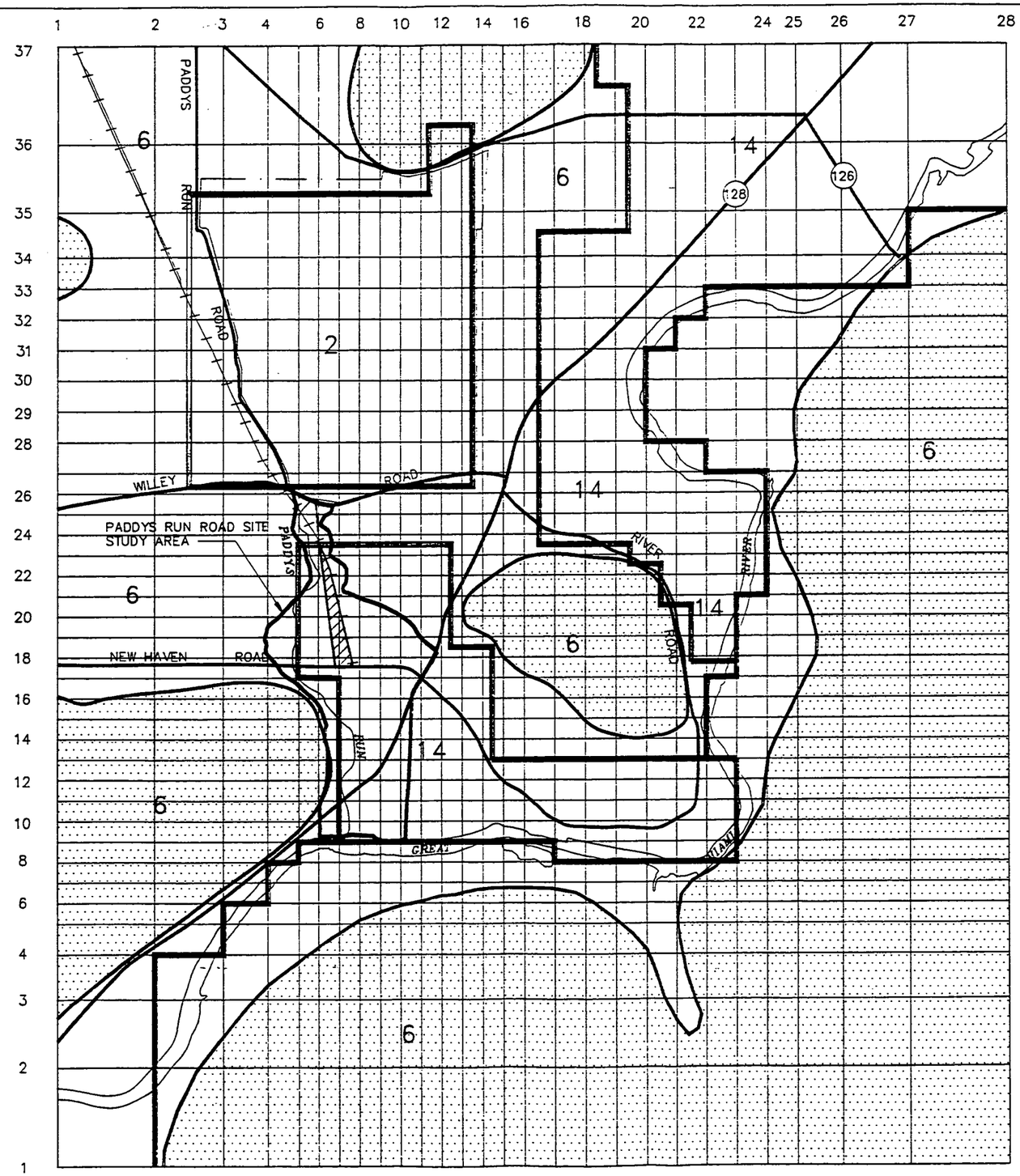
Aquifer recharge due to precipitation is variable throughout the region depending, in part, on the presence or absence of clay within the unsaturated zone. Previous

investigations report recharge ranges of 4 inches to 21 inches per year. In addition to reported values, estimates of recharge due to precipitation used in the Companies' groundwater flow model were based on a review of the soils comprising the unsaturated zone and amount of surface above these soils that was pervious to vertical infiltration. An abundance of fine-grained soils in the unsaturated zone, and surface areas covered by pavement, would reduce the infiltration of precipitation, thus reducing the recharge to the aquifer system. Grainsize analyses and soil boring data were used to gain a qualitative understanding of area expected to have potentially low, moderate, or high recharge potential. When the soils evaluation (relative to infiltration of precipitation) was completed, the areal extent and proximity of pavement or structures inhibitive to recharge from precipitation was ascertained. These two information types (soil type and presence of pavement on the surface) were used to resolve spatially what portion of precipitation was likely to infiltrate through the unsaturated zone and recharge the aquifer system. Final recharge values used in the PRRS flow model are a result of model calibration, whereby the recharge was adjusted within the range of the estimated values (based on site-specific information) and those values used by previous researchers (as summarized in Table 3-31). The regional groundwater model developed by the Companies was calibrated at recharge rates as illustrated in Figure 3-25. Additional details on the recharge aspects of the groundwater modeling are provided in Appendix C.

The relationship between precipitation and water table fluctuation is shown in Figure 3-26 for 1991. PZ-11 was selected as a representative monitoring location for example purposes, primarily because subsurface soils are representative of the Study Area and because it is located away from the influence of Study Area operations. As can be seen, there is a direct relationship between the amount of precipitation and the watertable level. Note that there is a delay between the precipitation and the time at which the effect is recorded in PZ-11. This is explained by the infiltration of the precipitation being retarded by the surface clay layer.

REV. 1: MAY 1994

Figure 3-25
Regional Flow Model Net Precipitation
Recharge Distribution
Paddy Run Road Site
Hamilton County, Ohio



LEGEND

BEDROCK OUTCROP

6 RECHARGE RATE (IN/YR)

PADDYS RUN ROAD SITE COMPANIES FACILITY PROPERTY BOUNDARY

N

0 3000
FEET

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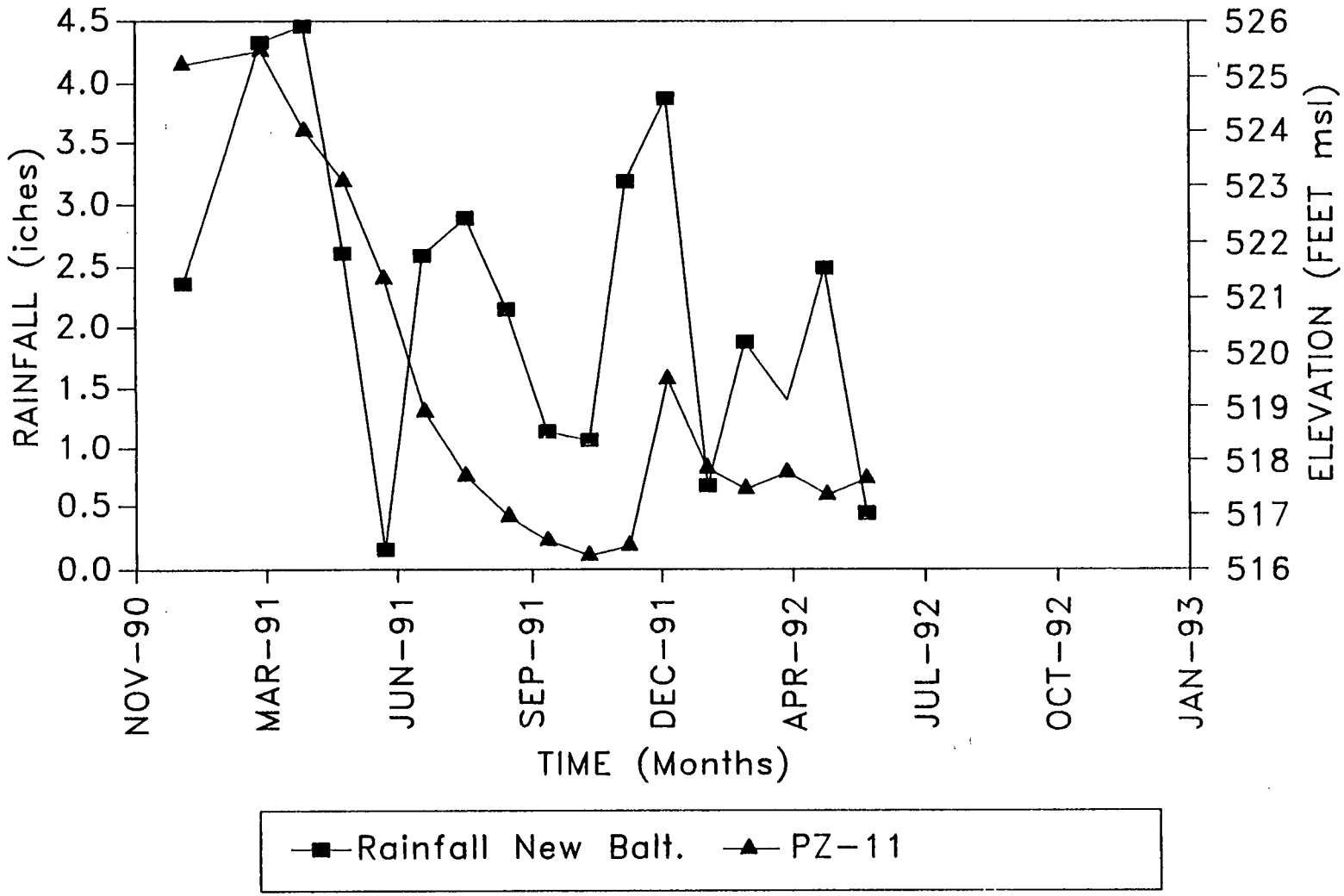

WATER LEVEL ELEVATION VS. RAINFALL PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO	FIGURE 3-26
ERM-Midwest, inc. Environmental Resources Management	

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Recharge Through Streambed Infiltration. Studies measuring the infiltration of river and stream water into the underlying aquifer and vice versa were not included in the scope of work for this RI. Instead, published leakance- and leakage-related information (references reviewed are given in Table 3-29) was used to support both the regional and local groundwater models. Reported leakance values (see Table 3-30) range from 0.34 to 0.74 day^{-1}. (Leakance is streambed vertical hydraulic conductivity in feet per day divided by streambed thickness in feet.) Leakage (the movement of water through a layer of material that has a vertical hydraulic conductivity lower than that of the aquifer) between the underlying aquifer system and streams (the GMR and Paddys Run) is a function of the length and width of the river, the thickness and vertical hydraulic conductivity of the river-bottom sediments (the leakance), and the difference in head between the river stage and the groundwater elevation in the underlying aquifer. Thus when heads are greater in the river than in the aquifer, water will leak downwards from the river into the aquifer, and when heads are greater in the aquifer than in the river, water will leak upwards from the aquifer into the river. An initial average leakance value of 0.5 day^{-1} was chosen based on published leakance and leakage values (summarized in Table 3-29). During the calibration of the PRRS flow model, the leakances for Paddys Run stream and the GMR were adjusted such that simulated head values proximal to Paddys Run stream and the GMR more closely matched observed head values. Adjustments were made such that the final leakance terms fell within ranges of reported and/or observed leakance terms.

Hydraulic Conductivity

Hydraulic conductivity is defined as the rate of flow of water in gallons per day through a cross section of one square foot under a unit hydraulic gradient, at the prevailing temperature (Johnson Division, 1986). More simply, it is a measure of the capacity of a porous medium to transmit water. Hydraulic conductivity is controlled by porosity and the physical properties of the fluid. It is typically expressed in feet per day. Reported ranges near the Study Area for the horizontal hydraulic conductivity (K_h) are 134 to 600 feet per day. For modeling the regional groundwater flow, the Companies divided the GMR aquifer into four nodal layers

to give three porous zones. This method was similar to the vertical discretization of previous models developed by GeoTrans (1985) and IT (1990). The K_h used for modeling both the upper and middle porous zones is 350 ft/day. A K_h of 450 ft/day was selected for the lower porous zone. The hydraulic conductivity of the lower permeable zone is approximately 30% greater than the upper two zones. This higher hydraulic conductivity value is supported by lithologic data (ERM 1992a), which shows a decrease in fine-grained material with depth, and by GeoTrans (1985) and IT (1990). Table 3-30 summarizes the selection of modeling parameters including hydraulic conductivity and the rationale for their use.

Porosity. Porosity is the percentage of the bulk volume of a medium occupied by void space (interstices). If the interconnected pore space (effective porosity) is small or plugged, the volume of water passing from pore to pore is limited, and the hydraulic conductivity is lower. Published porosity values for a sand and gravel range from 10 to 35 percent. From tests performed on soils at PRRS, a porosity of 22.5 percent was determined to represent the aquifer, and that value was used in the groundwater model.

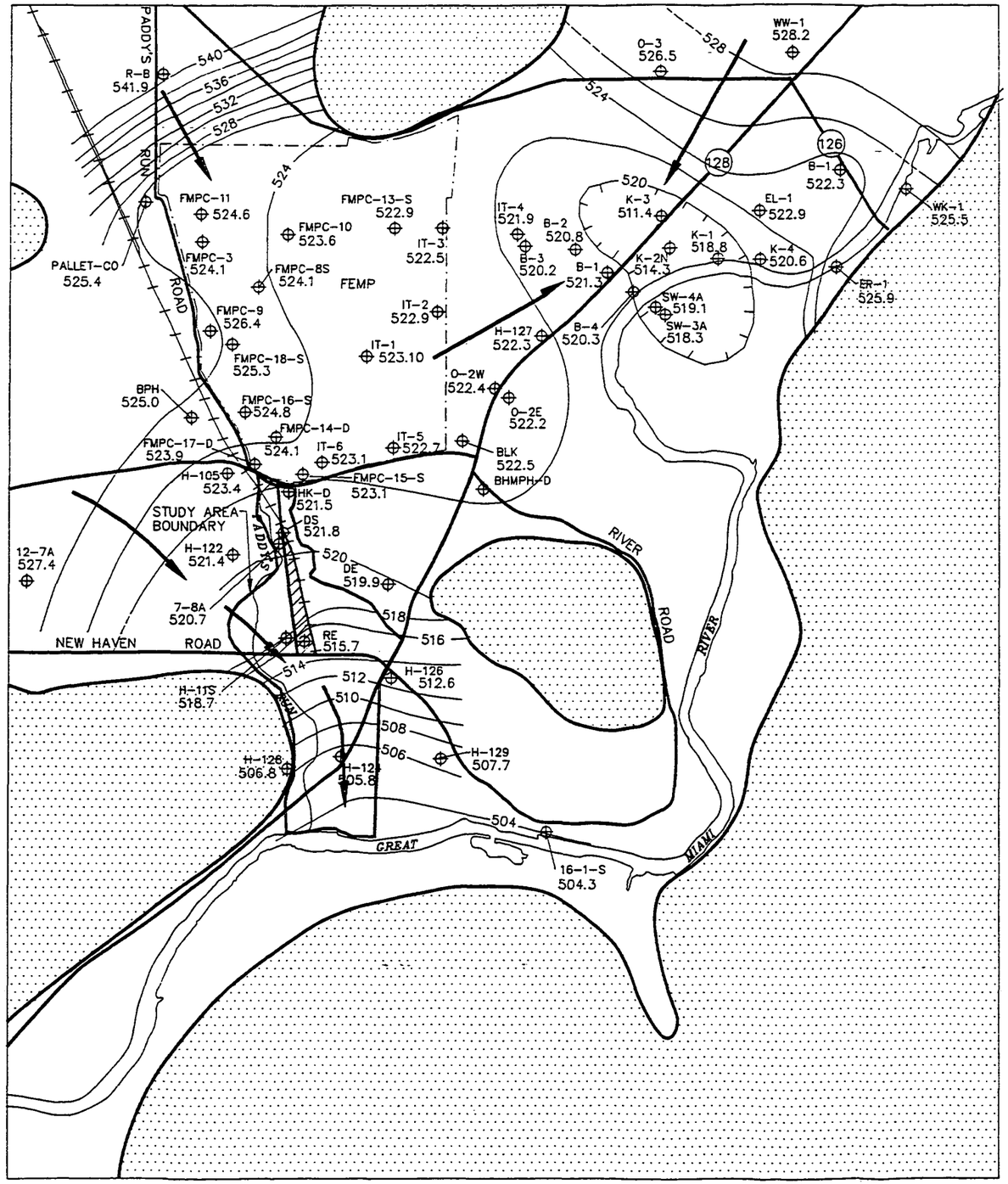
Fluid Properties. Fluid properties of water vary according to the water temperature, fluid density and fluid viscosity. Published water temperatures for the aquifer range from 50° Fahrenheit (F) to 66°F for an average of 58°F. Based on 119 readings from the PRRS, ranges were found to be from 43°F to 81°F for an average of 60°F which is the value selected for the groundwater model. Fluid density is the weight of the fluid per a volume usually expressed as pounds per cubic foot (lbs/ft^3). Reported ranges are from 62.37 to 62.42 lbs/ft^3. A value of 62.4 lbs/ft^3 was selected for use in the groundwater model.

Fluid viscosity is the resistance to flow and is expressed as centapoise (cP). Published values range from 0.836 to 1.7513 cP, with the range in values due primarily to temperature fluctuations. Table 3-30 summarizes ground and river water viscosities as obtained from a literature review. Pure water at a temperature of 60°F exhibits a viscosity ranging from 1.125 to 1.14 cP. ERM (1992) directly measured water temperatures in groundwater monitoring wells at the site

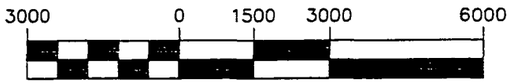
000297

throughout the year and found the average groundwater temperature to be approximately 60°F. Significant variations in viscosity (which could alter groundwater flow) were not anticipated in the vicinity of most of the chemical plume area associated with the PRRS. This was due to the fact that most of the plume area was well removed from portions of streams which discharged to the aquifer. Groundwater in the area generally maintains a steady temperature and dissolved solids content distribution (and therefore viscosity) except in areas where streams discharge to the aquifer (e.g., in close proximity to some portions of the GMR). These are the reasons for assignment of a uniform viscosity. Since a uniform viscosity was used, the value assigned is less important as long as it falls in the reported range for the average temperature of groundwater reported for the area. In other words, at the reported ranges of viscosity values for the area, it is the spatial variability and not the actual value that makes the difference to groundwater flow; since the spatial variability was estimated to be low, the actual value used (as long as it was in the range that was reported) does not have a great effect on model results. The modeled value was 1.138 cP.

Hydraulic Head. Hydraulic head is defined as the energy contained in a water mass, produced by pressure, velocity or elevation. A regional groundwater elevation map, also called a piezometric contour map, was developed from water elevations observed in April 1986 from 55 wells. Figure 3-27 shows the well locations and piezometric contours. The contours indicate that at the northwest corner of FEMP the groundwater flow is southeast. In the northeast corner of the figure groundwater flow is naturally flowing southwest following the flow of the GMR until it is disrupted by a cone of depression caused by the pumping wells of the SOWC. The effect of this pumping is so pronounced that it changes the direction of part of the groundwater movement at FEMP from a southeasterly flow to an east northeast flow towards the pumping wells. Some of the groundwater movement from FEMP continues south where it is joined by an eastern flow of groundwater from the west. Both flow systems converge at the PRRS. The resultant flow pattern is south-southeast to the GMR.



GRAPHIC SCALE



(IN FEET)
1 inch = 3000 ft.

LEGEND

- BEDROCK OUTCROP (AT SURFACE)
- PADDYS RUN ROAD SITE COMPANIES FACILITY PROPERTY BOUNDARY
- MONITORING WELL
- 520 — GROUND WATER CONTOUR (FEET ABOVE MSL)
- GENERAL DIRECTION OF GROUNDWATER FLOW

000299

OBSERVED 1986 GROUNDWATER LEVEL ELEVATIONS PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO	FIGURE 3-27

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SOURCE FOR WATER LEVEL DATA: IT (DEC. 1990)
MANUAL CONTOURING USED [SURFER (GOLDEN SOFTWARE, 1989) NOT APPLIED]

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Appendix C contains the Ground Water Flow and Chemical Transport Modeling Report for the PRRS, Crosby Township, Ohio, which further explains the methodology and selection of parameters used in the groundwater model.

3.10.1.3 Regional Groundwater Use and Quality

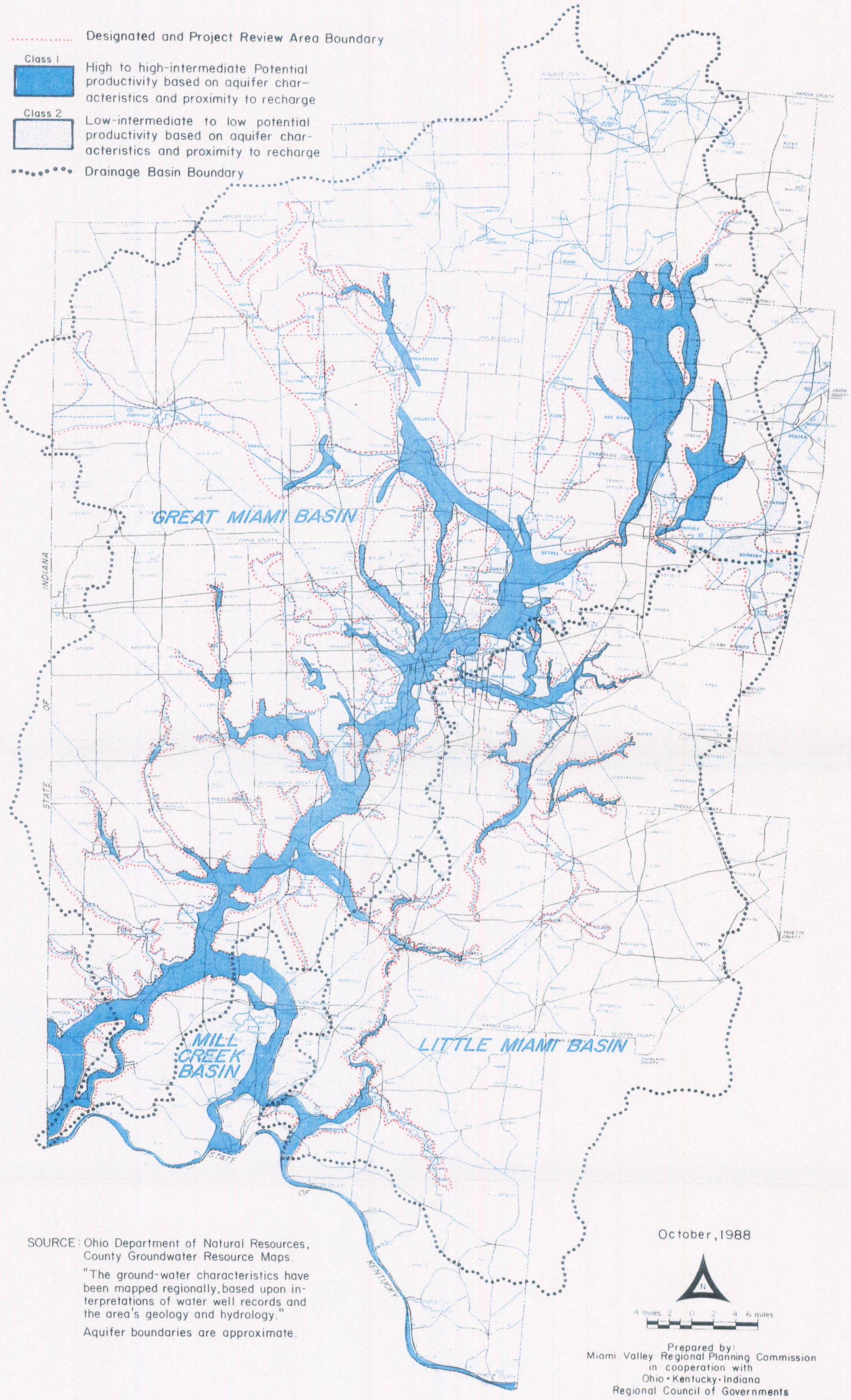
This section addresses the water use and quality in the general vicinity of the Study Area. All information presented below comes from data in various documents authored by the USGS, Miami Conservancy District (MCD), Ohio-Kentucky-Indiana Regional Council of Governments (OKI), United States Department of Energy (U.S. DOE), Ohio Department of Natural Resources Division of Water (ODNR), and the Ohio Environmental Protection Agency (Ohio EPA).

Regionally, the Great Miami/Little Miami River Basin Buried Valley Aquifer System underlies portions of 13 counties in Ohio. All but four public water systems rely on the Buried Valley Aquifer System (BVAS) for their supply of water (OKI Sole Source Aquifer Designation, March 1988). Figure 3-28 shows the extent of the BVAS with relation to the Study Area.

The MCD has conducted hydrologic studies in the lower third of the BVAS between Hamilton and New Baltimore since 1968. Those studies have included measurements of: precipitation, stream flow, groundwater level, and monitoring of water use and water quality. Water use data developed by the MCD is presented below.

Water Use

Table 3-32 lists the major groundwater users, type of water supply, population or industry served, and groundwater use in 1989 for the Hamilton-New Baltimore area. The MCD classifies withdrawal in excess of 100,000 gallons per day as a major user. Figure 3-29 shows location where major groundwater withdrawal is occurring.



SOURCE: Ohio Department of Natural Resources, County Groundwater Resource Maps.

"The ground-water characteristics have been mapped regionally, based upon interpretations of water well records and the area's geology and hydrology."

Aquifer boundaries are approximate.

Prepared by:
Miami Valley Regional Planning Commission
in cooperation with
Ohio • Kentucky • Indiana
Regional Council of Governments

GREAT MIAMI/LITTLE MIAMI RIVER BASINS BURIED VALLEY AQUIFER SYSTEM PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO	FIGURE 3-28
ERM ERM-Midwest, inc. Environmental Resources Management	

REV. 1: MAY 1994

TABLE 3-32
MAJOR WATER USERS
HAMILTON-NEW BALTIMORE AREA
PADDYS RUN ROAD SITE

NAME OF WATER USER	TYPE OF WATER SUPPLY	NUMBER OF PEOPLE SERVED	WATER USE MILLIONS GAL./DAY
Potable Water			
Cincinnati - Bolton Plant	Municipal	86,000	16.63
Hamilton South	Municipal	60,000*	14.81
Fairfield	Municipal	35,000	4.49
Westinghouse Materials Company of Ohio	Non-Community	800	.27
Water Association	Public	25,800	2.05
Non-Potable Water			
Southwestern Ohio Water Company	Industrial	13 Industries	17.12
Champion International Champion Papers Div., Hamilton Mill	Industrial	1 Factory	–

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* includes people served from Hamilton North Plant

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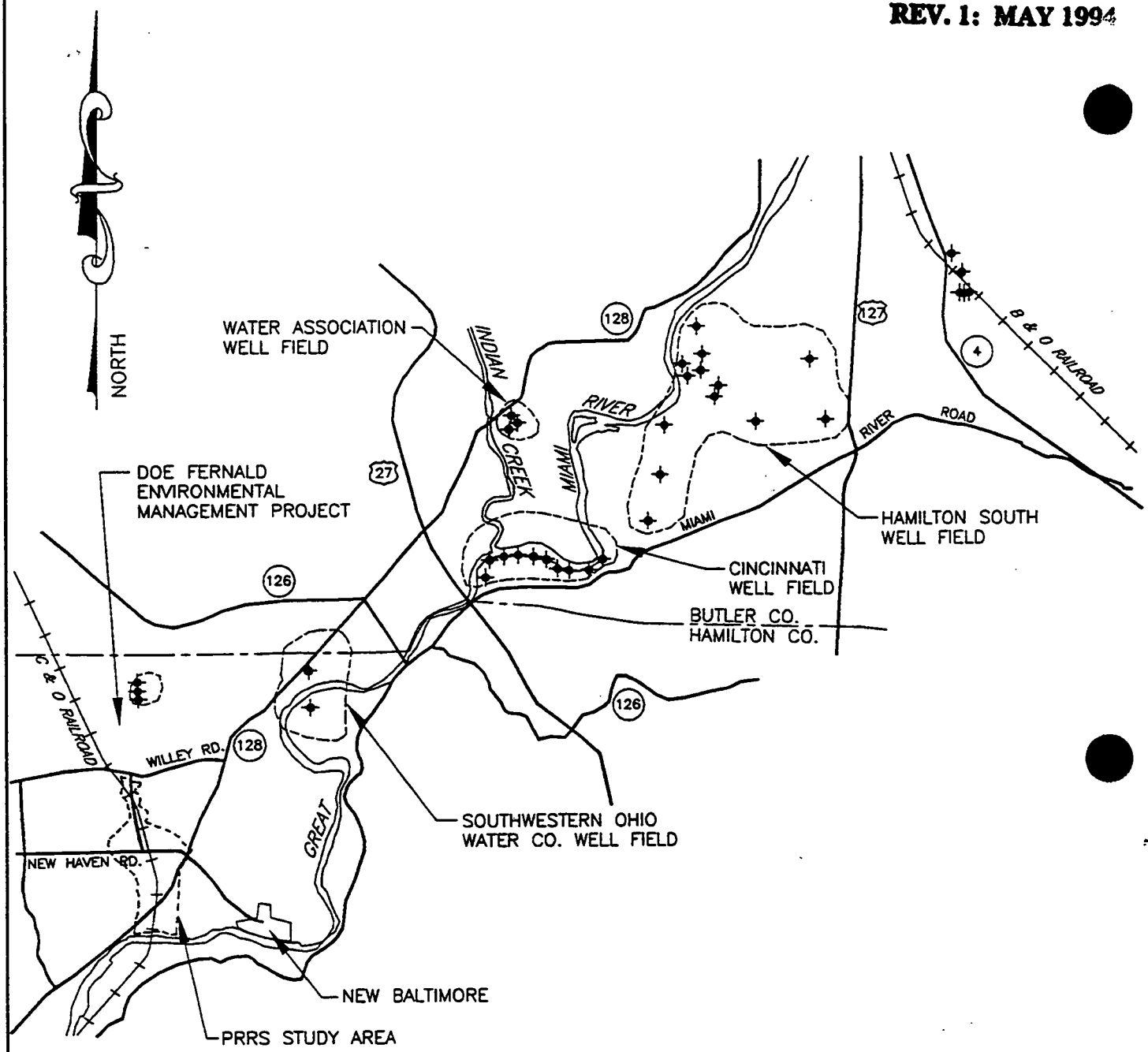

GRAPHIC SCALE

8000 0 4000 8000 16000

(IN FEET)
1 inch = 8000 ft.

LEGEND

PUMPING WELL LOCATION

000303

LOCATIONS OF MAJOR GROUNDWATER WITHDRAWALS IN THE AREA
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE

ERM-Midwest, inc.
Environmental Resources Management

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The two major water users closest to the Study Area are the Southwestern Ohio Water Company (SOWC) and the FEMP. Both of these users are upgradient to the PRRS and have no effect on groundwater flow beneath the Study Area as verified by the groundwater flow direction shown in Figure 3-27.

Private water supply accounts for the households within the BVAS that are not served by the public water systems. As estimated by OKI, population currently using private wells for drinking water from the BVAS amounts to 1898 in Ross Township, Butler County and 1611 in Crosby Township, Hamilton County. Ross and Crosby are the two townships closest to the Study Area.

Groundwater Quality Monitoring

Three public agencies monitor groundwater quality in the region: the MCD, USGS/ODNR and Ohio EPA. The MCD has water quality data from approximately 125 wells and monitors water level elevations for more than 200 wells. The U.S. Geological Survey/Ohio Department of Natural Resources sampled 13 wells once for water quality and have used an additional 12 wells for water level elevation measurements. The Ohio EPA began collecting water quality data in 1986 (OKI 1988b). The Agency currently monitors 18 wells twice a year in the four-county area. In addition, at least 20 suppliers of groundwater for drinking purposes conduct some water quality analysis. Documents including groundwater quality data reported by these agencies are included in the reference section of this report.

3.10.2 Study Area Hydrogeology

The Study Area hydrogeology has been characterized by information obtained from 80 soil borings, 54 PRRS monitoring wells, 13 U.S. DOE monitoring wells, and 12 piezometers. Characterization includes the geology, hydraulic properties, and groundwater quality.

3.10.2.1 Geology

As shown in Figure 3-24 two hydrogeologic environments, I-A-2 and I-B-2, exist within the Study Area boundaries. The previous USGS investigation identified only the I-A-2 environment. This was based on data from a single water production well on the RNC property. Extensive drilling at the Study Area has shown that the I-B-2 environment is present and is prevalent.

As described earlier, the I-A-2 environment consists of a sand and gravel aquifer less than 150 feet thick, contains no interstratifed clay layers, and is potentially recharged by induced stream infiltration. The I-B-2 is similar in that it also is a sand and gravel aquifer less than 150 feet thick, and is potentially recharged by induced stream infiltration. However, interstratified clay layers can be present. The I-B-2 is the environment typically seen from detailed boring logs across the Study Area. Cross sections (Figures 3-19 through 3-22) show the subsurface relationship of the clay to the sands and gravels. This relationship was discussed in detail in Section 3.9.

Geology Beneath the A&W and RNC Properties

The relationship of the fine grained materials (silts and clays) to the coarse grained materials (sands and gravels) is shown in the fence diagram shown in Figure 3-30. The fence diagram was constructed from representative boring logs (Appendix E) much like the stratigraphic cross sections. Unlike a single line of borings used in a cross section the fence diagram uses any number of borings from a wide range of locations. Like intervals are correlated and connected with lines giving the cross section a three-dimensional appearance.

As shown in Figure 3-30, topsoil and fill material are represented in magenta. Most of the manufacturing areas have been excavated with low spots elevated for construction purposes. Topsoil and fill are most readily seen around the perimeter of the Companies' properties and in areas not covered by manufacturing operations or pavement.

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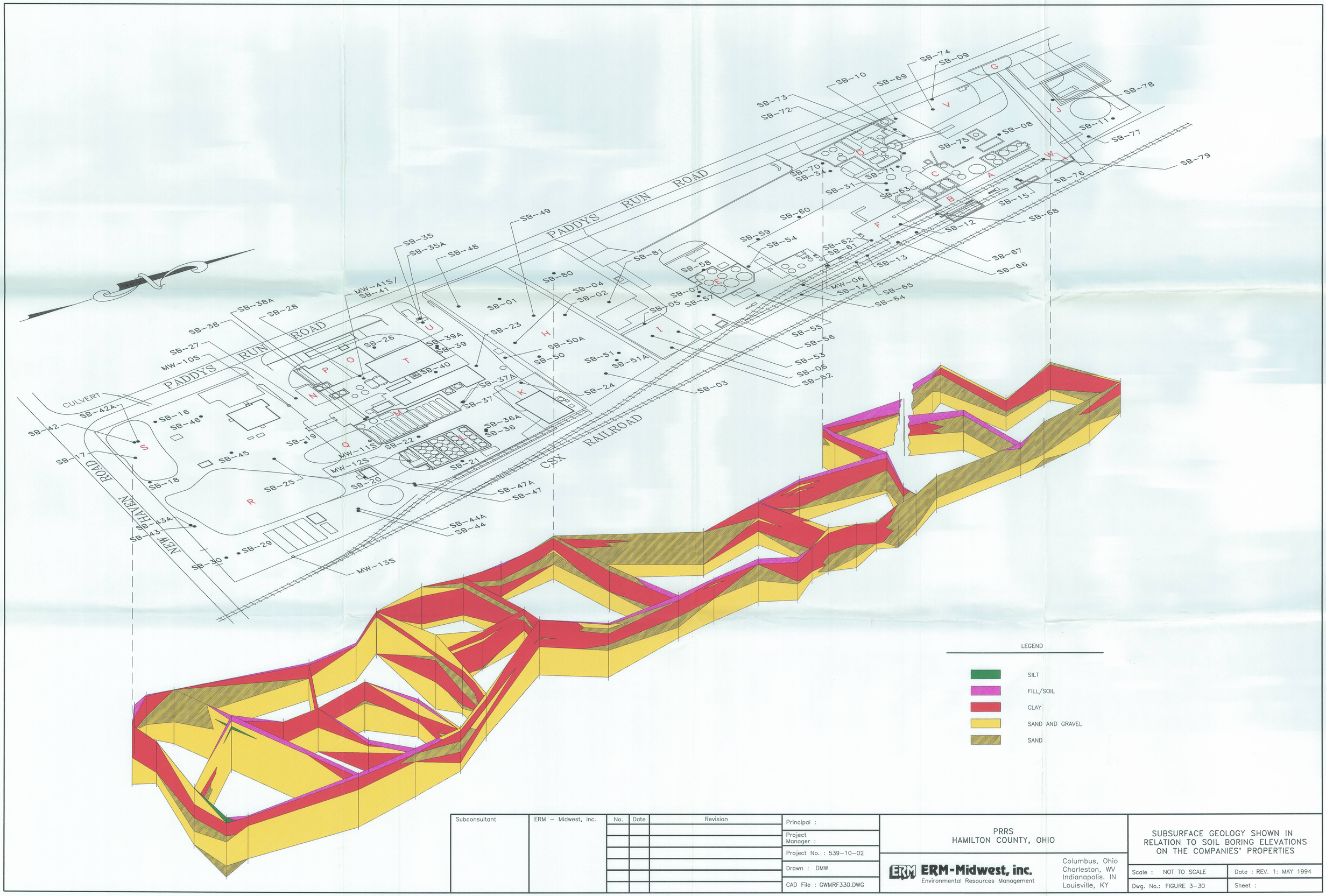

Subconsultant	ERM – Midwest, Inc.	No.	Date	Revision

Principal :

Project Manager :

Project No. : 539-10-02

Drawn : DMW

CAD File : GWMRF330.DWG

PRRS
HAMILTON COUNTY, OHIO

ERM-Midwest, inc.
Environmental Resources Management

Columbus, Ohio
Charleston, WV
Indianapolis, IN
Louisville, KY

SUBSURFACE GEOLOGY SHOWN IN RELATION TO SOIL BORING ELEVATIONS ON THE COMPANIES' PROPERTIES

Scale : NOT TO SCALE

Date : REV. 1: MAY 1994

Dwg. No.: FIGURE 3-30

Sheet :

Areas of clay, represented in red, are widespread and vary in thickness to a maximum of approximately 10 feet. Areas that have been identified as silts are shown in green and represent a very small vertical and horizontal extent. Dark yellow denotes sands while the lighter yellow represent sands and gravels.

The fence diagram illustrates the regional geology framework of a glacio-fluvial environment where the glacial outwash sands and gravels (yellow colors) are overlain by clay rich material (red), deposited by the most recent glaciers.

As noted in Section 3.9, the permeability of clay is very low. Sands and gravels have higher permeabilities than clays. Therefore, areas where the clay is thin or absent represent zones with higher average permeability. Based on this, areas on the A&W property having higher average permeabilities due to the absence of clay would be around soil borings SB-55, SB-58, SB-66, SB-67, SB-73 and SB-76. On the RNC property, clay is absent at SB-28, SB-39, SB-41, SB-45 and SB-46. Soil borings SB-28, SB-39 and SB-41 occur in the Process Building area (Area T). Soil borings SB-45 and SB-46 are removed from areas of manufacturing operations. All of these soil borings are located adjacent to past or current manufacturing operations.

The relationships of the various soils and the groundwater shown in Figure 3-30 will become more evident in Section 4, Nature and Extent of Chemicals of Concern.

Perched Water-Bearing Units

At the FEMP site there is an extensive clay layer overlying the regional sand and gravel aquifer. Perched on top of this clay is a shallow sand aquifer. Similar conditions are not extensive at PRRS. There are, however, two areas where perched water does occur. The first area is located on A&W property at soil boring SB- 68. Water was encountered in the 0 to 2 foot interval beneath the ground surface. Though the samples were described as wet to saturated from 2 foot to a total depth of 14 feet, free standing water was not encountered again until 13 feet below the ground surface. Soil descriptions of the 2 to 4 foot zone show clay layers intermixed with clayey sand. These clay layers likely have allowed surface water to

accumulate in the upper 0 to 2 foot section. This zone was not encountered elsewhere on the A&W property.

On the RNC property a perched zone was encountered in the vicinity of the Process Building (Area T) in boring SB-40. Water was detected at the 4- to 6-foot depth. Most likely the water is contained in a 1-foot thick coarse sand and gravel lens. A thin 6-inch clay layer overlays the saturated sand and gravel, which in turn is underlain by a 3-foot sandy clay. The underlying clay can be traced laterally to adjacent borings, but the saturated conditions overlying clay exist at only one other location on the RNC property. As determined from an ENSR soil boring log SB-20 has a wet coarse sand and gravel zone at approximately 2 to 5 feet below the ground surface. This wet zone is underlain by 7 feet of brown clay.

Neither perched water bearing zones on A&W or RNC property can be considered an aquifer for domestic use for the following reasons:

- The water bearing zones are discontinuous and not found elsewhere at the Study Area.
- Due to the limited vertical thickness and horizontal extent, suitable quantities of water for domestic use would not be available.
- It is unlikely that water in these zones would be potable under any circumstances due to the shallow depth, less than 6 feet below ground surface.

3.10.2.2 Hydraulic Properties

The text and tables in Section 3.10.1 describe the hydrogeological parameters used in the PRRS groundwater flow modeling. The local groundwater flow model which addresses conditions at the PRRS is presented in detail in Appendix C. Many of the parameters used in calibrating the regional flow model were incorporated into developing the local flow model. Parameters that are addressed below include groundwater recharge through precipitation and the groundwater flow direction and rate.

Groundwater Recharge through Precipitation

Rainfall recharge for the local model was refined and slightly revised from the regional model recharge. Recharge in some areas in the vicinity of and just south of the PRRS in the local model was reduced in comparison to the regional model. This reduction was based on the finding of an abundance of fine-grained materials in the unsaturated zone and the presence of pavement at A&W and RNC properties.

The Companies calibrated the regional groundwater model consistent with recharge rates of 14 inches per year for the I-A-II hydrogeologic environment and 10 inches per year for the I-B-II. Through extensive drilling and examination of cuttings it was determined that the I-B-II environment was prevalent throughout the Study Area. Only the very southern end of the Study Area remained within the I-A-II hydrogeologic environment. (Refer to Figure 3-4 of the groundwater model, Appendix C for the exact placement.)

Groundwater recharge through precipitation is estimated to be 2 inches per year in covered areas on the A&W and RNC properties, allowing for some infiltration through pavement. The details on recharge aspects of the groundwater modeling are presented in Appendix C.

Groundwater Flow Direction

To date, 25 rounds of groundwater elevation data have been collected at the Study Area since June 1989 for the purpose of determining groundwater flow direction. The data indicate that groundwater flow is consistently to the south-southeast toward the GMR. Figures 3-31 through 3-39 show the representative flow direction for each quarter from June 1990 to August 1992.

Minor changes of direction can be seen in the northeast part of the Site in the vicinity of Delta Steel and along sections of Paddys Run by New Haven Road and Route 128. In the general area of New Haven Road and Paddys Run, a very

WELLS	ELEVATION
MW-01S	521.37
MW-01D	521.39
MW-02S	520.57
MW-03S	517.55
MW-04S	----
MW-05S	517.75
MW-06S	517.18
MW-07S	516.84
MW-08S	516.74
MW-09D	516.51
MW-10S	515.85
MW-11S	----
MW-12S	515.61
MW-13S	514.87
MW-14S	514.77
MW-14I	----
MW-15S	515.08
MW-15D	515.21
MW-16S	515.41
MW-18S	518.10
MW-18D	518.02
MW-19S	514.18
MW-20S	512.33
MW-20D	512.50
MW-21S	511.92
MW-21I	----
MW-21D	512.02
MW-22S	512.04
MW-23S	507.90
MW-24S	507.15
MW-24I	----
MW-24D	----
MW-25S	----
MW-26S	----
MW-27S	----
MW-28S	----
MW-29S	----
MW-30S	----
MW-30I	----
MW-31S	----
MW-31I	----
MW-32S	----
MW-33I	----
MW-34S	----
MW-35S	----
MW-36S	----
MW-36I	----
MW-37S	----
MW-37I	----
MW-38S	----
MW-39S	----
MW-40S	----
MW-41S	----
MW-42S	----

DOE WELLS	ELEVATION
1015	----
1915	----
2002	----
2015	----
2017	----
2094	508.89
2095	522.35
2096	----
2106	----
2125	----
2126	517.49
2127	----
2128	----
2129	516.54
2391	----
2392	----
2393	----
2394	----
2395	----
2396	----
2398	----
2550	----
2551	----
2552	----
2553	----
2554	----
2555	----
2556	----
2557	----
2558	----
2559	----
2560	----
2561	----
3015	----
3017	----
3094	509.04
3095	522.40
3096	----
3106	----
3125	----
3126	517.79
3127	----
3128	----
3391	----
3396	----
3550	----
3551	----
4096	----
4125	----

PRRS WELLS	ELEVATION
PZ-01	----
PZ-02	516.20
PZ-03	517.14
PZ-04	516.07
PZ-05	517.15
PZ-06	521.41
PZ-07	520.36
PZ-08	518.17
PZ-09	516.27
PZ-10	517.56
PZ-11	521.22
PZ-12	----

STAFF GAUGES	ELEVATION
SG-1	508.41
SG-2	514.55
SG-3	524.60
SG-3(ERM)	----
SG-4	----
SG-5	----

R/I WELLS	ELEVATION
SG-2	----

DATA FROM JUNE 15, 1990

Subconsultant	ERM - Midwest, Inc.	No.	Date	Revision

Principal :
Project Manager : TJS
Project No. : 539-10-02
Drawn : DMW
CAD File : 1002F331.DWG

PRRS
HAMILTON COUNTY, OHIO

ERM-Midwest, inc.
Environmental Resources Management
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Louisville, KY

PIEZOMETRIC CONTOUR MAP
GROUNDWATER ELEVATIONS - JUNE 1990

Scale : AS SHOWN
Date : REV. 1: MAY 1994
Dwg. No.: FIGURE 3-31
Sheet :

WELLS	ELEVATION
MW-01S	520.83
MW-01D	520.86
MW-02S	519.77
MW-03S	---
MW-04S	---
MW-05S	517.11
MW-06S	516.43
MW-07S	516.16
MW-08S	515.80
MW-09D	515.81
MW-10S	514.85
MW-11S	514.77
MW-12S	514.73
MW-13S	513.60
MW-14S	513.88
MW-14I	---
MW-15S	513.98
MW-15D	514.42
MW-16S	514.67
MW-18S	517.48
MW-18D	517.39
MW-19S	511.87
MW-20S	511.63
MW-20D	511.79
MW-21S	510.92
MW-21I	---
MW-21D	511.00
MW-22S	510.46
MW-23S	507.06
MW-24S	506.48
MW-24I	---
MW-24D	---
MW-25S	---
MW-26S	---
MW-27S	---
MW-28S	---
MW-29S	---
MW-30S	---
MW-30I	---
MW-31S	---
MW-31I	---
MW-32S	---
MW-33I	---
MW-34S	---
MW-35S	---
MW-36S	---
MW-36I	---
MW-37S	---
MW-37I	---
MW-38S	---
MW-39S	---
MW-40S	---
MW-41S	---
MW-42S	---

DOE WELLS	ELEVATION
1015	---
1915	---
2002	---
2015	---
2017	---
2094	508.14
2095	521.61
2096	---
2106	---
2125	---
2126	517.03
2127	---
2128	---
2129	515.54
2391	---
2392	---
2393	---
2394	517.09
2395	---
2396	---
2398	---
2550	---
2551	---
2552	---
2553	---
2554	---
2555	---
2556	---
2557	---
2558	---
2559	---
2560	---
2561	---
3015	---
3017	---
3094	508.31
3095	521.64
3096	---
3106	---
3125	---
3126	517.29
3127	---
3128	---
3391	---
3396	---
3550	---
3551	---
4096	---
4125	---

PRRS WELLS	ELEVATION
PZ-01	---
PZ-02	---
PZ-03	---
PZ-04	---
PZ-05	---
PZ-06	---
PZ-07	---
PZ-08	---
PZ-09	---
PZ-10	---
PZ-11	---
PZ-12	---

STAFF GAUGES	ELEVATION
SG-1	---
SG-2	---
SG-3(ERM)	---
SG-4	---
SG-5	---

R/I WELLS	ELEVATION
SC-2	---

DATA FROM AUGUST 7, 1990

Subconsultant	ERM – Midwest, Inc.	No.	Date	Revision

Principal :
Project Manager : TJS
Project No. : 539-10-02
Drawn : DMW
CAD File : 1002F332.DWG

PRRS
HAMILTON COUNTY, OHIO

ERM-Midwest, inc.
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Louisville, KY

PIEZOMETRIC CONTOUR MAP
GROUNDWATER ELEVATIONS – AUGUST 1990

Scale : AS SHOWN
Date : REV. 1: MAY 1994
Dwg. No.: FIGURE 3-32
Sheet :

WELLS	ELEVATION
MW-01S	521.78
MW-01D	521.80
MW-02S	520.67
MW-03S	517.68
MW-04S	518.02
MW-05S	518.00
MW-06S	517.42
MW-07S	516.99
MW-08S	516.89
MW-09D	516.68
MW-10S	515.99
MW-11S	516.07
MW-12S	515.96
MW-13S	515.37
MW-14S	514.92
MW-14I	515.00
MW-15S	515.21
MW-15D	515.31
MW-16S	515.54
MW-18S	518.32
MW-18D	518.26
MW-19S	514.29
MW-20S	512.40
MW-20D	512.60
MW-21S	511.94
MW-21I	512.06
MW-21D	513.09
MW-22S	512.11
MW-23S	507.86
MW-24S	507.00
MW-24I	507.08
MW-24D	----
MW-25S	507.23
MW-26S	504.71
MW-27S	504.09
MW-28S	502.55
MW-29S	499.52
MW-30S	514.53
MW-30I	515.11
MW-31S	514.64
MW-31I	----
MW-32S	517.41
MW-33I	516.63
MW-34S	514.60
MW-35S	502.67
MW-36S	496.91
MW-36I	----
MW-37S	496.76
MW-37I	----
MW-38S	----
MW-39S	----
MW-40S	----
MW-41S	----
MW-42S	----

DOE WELLS	ELEVATION
1015	----
1915	----
2002	----
2015	----
2017	----
2094	508.82
2095	522.72
2096	----
2106	----
2125	----
2126	517.65
2127	----
2128	----
2129	516.69
2391	----
2392	----
2393	----
2394	518.31
2395	----
2396	----
2398	----
2550	----
2551	----
2552	----
2553	----
2554	----
2555	----
2556	----
2557	----
2558	----
2559	----
2560	----
2561	----
3015	----
3017	----
3094	509.00
3095	522.74
3096	----
3106	----
3125	----
3126	517.95
3127	----
3128	----
3391	----
3396	----
3550	----
3551	----
4096	----
4125	----

PRRS WELLS	ELEVATION
PZ-01	515.77
PZ-02	516.36
PZ-03	517.30
PZ-04	516.26
PZ-05	517.39
PZ-06	521.88
PZ-07	520.84
PZ-08	518.77
PZ-09	516.45
PZ-10	517.78
PZ-11	523.30
PZ-12	----

STAFF GAUGES	ELEVATION
SG-1	513.19
SG-2	519.36
SG-3(ERM)	----
SG-4	504.84
SG-5	----

R/I WELLS	ELEVATION
SG-2	----

DATA FROM JANUARY 28, 1991

Subconsultant	ERM – Midwest, Inc.	No.	Date	Revision

Principal :
Project Manager : TJS
Project No. : 539-10-02
Drawn : DMW
CAD File : 1002F333.DWG

PRRS
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ERM-Midwest, inc.
Environmental Resources Management
Columbus, Ohio
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Indianapolis, IN
Louisville, KY

PIEZOMETRIC CONTOUR MAP
GROUNDWATER ELEVATIONS – JANUARY 1991

Scale : AS SHOWN
Date : REV. 1: MAY 1994
Dwg. No.: FIGURE 3-33
Sheet :

000312

WELLS	ELEVATION
MW-01S	521.88
MW-01D	521.92
MW-02S	520.96
MW-03S	517.72
MW-04S	517.73
MW-05S	----
MW-06S	517.63
MW-07S	516.99
MW-08S	517.10
MW-09D	516.69
MW-10S	515.99
MW-11S	516.08
MW-12S	515.97
MW-13S	515.39
MW-14S	514.91
MW-14I	515.00
MW-15S	515.25
MW-15D	515.28
MW-16S	515.59
MW-18S	518.16
MW-18D	518.29
MW-19S	514.28
MW-20S	512.40
MW-20D	512.56
MW-21S	511.99
MW-21I	512.07
MW-21D	512.05
MW-22S	512.06
MW-23S	507.85
MW-24S	507.02
MW-24I	507.09
MW-24D	----
MW-25S	507.29
MW-26S	504.70
MW-27S	504.10
MW-28S	502.60
MW-29S	499.32
MW-30S	515.07
MW-30I	515.39
MW-31S	514.62
MW-31I	514.55
MW-32S	517.41
MW-33I	516.64
MW-34S	515.81
MW-35S	502.74
MW-36S	496.96
MW-36I	----
MW-37S	496.96
MW-37I	----
MW-38S	514.23
MW-39S	516.00
MW-40S	515.19
MW-41S	516.98
MW-42S	----

DOE WELLS	ELEVATION
1015	----
1915	----
2002	522.19
2015	----
2017	----
2094	508.92
2095	522.80
2096	----
2106	----
2125	----
2126	517.76
2127	----
2128	----
2129	516.72
2391	514.71
2392	----
2393	516.97
2394	518.31
2395	----
2396	----
2398	----
2550	----
2551	----
2552	----
2553	----
2554	516.49
2555	----
2556	----
2557	----
2558	----
2559	506.07
2560	----
2561	----
3015	----
3017	----
3094	509.01
3095	522.89
3096	----
3106	----
3125	----
3126	518.03
3127	----
3128	----
3391	----
3396	----
3550	----
3551	----
4096	----
4125	----

PRRS WELLS	ELEVATION
PZ-01	515.80
PZ-02	516.36
PZ-03	517.31
PZ-04	516.22
PZ-05	517.34
PZ-06	521.93
PZ-07	520.58
PZ-08	518.84
PZ-09	516.42
PZ-10	517.73
PZ-11	----
PZ-12	----

STAFF GAUGES	ELEVATION
SG-1	----
SG-2	----
SG-3(ERM)	----
SG-4	----
SG-5	----

R/I WELLS	ELEVATION
SC-2	----

DATA FROM APRIL 29,1991

Subconsultant	ERM - Midwest, Inc.	No.	Date	Revision

Principal :
Project Manager : TJS
Project No. : 539-10-02
Drawn : DMW
CAD File : 1002F334.DWG

PRRS
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PIEZOMETRIC CONTOUR MAP
GROUNDWATER ELEVATIONS - APRIL 1991

Scale : AS SHOWN
Date : REV. 1: MAY 1994
Dwg. No.: FIGURE 3-34
Sheet :

WELLS	ELEVATION
MW-01S	520.29
MW-01D	520.31
MW-02S	519.08
MW-03S	516.45
MW-04S	516.43
MW-05S	516.47
MW-06S	516.43
MW-07S	515.69
MW-08S	515.55
MW-09D	515.36
MW-10S	514.62
MW-11S	514.62
MW-12S	514.52
MW-13S	513.82
MW-14S	513.35
MW-14I	513.45
MW-15S	513.65
MW-15D	513.80
MW-16S	514.14
MW-18S	517.01
MW-18D	516.93
MW-19S	512.85
MW-20S	510.68
MW-20D	510.91
MW-21S	510.15
MW-21I	509.71
MW-21D	510.81
MW-22S	510.02
MW-23S	505.59
MW-24S	504.99
MW-24I	505.04
MW-24D	----
MW-25S	505.31
MW-26S	502.00
MW-27S	501.49
MW-28S	499.78
MW-29S	496.80
MW-30S	513.60
MW-30I	513.62
MW-31S	512.86
MW-31I	512.84
MW-32S	516.07
MW-33I	515.30
MW-34S	514.39
MW-35S	499.74
MW-36S	DRY
MW-36I	----
MW-37S	DRY
MW-37I	----
MW-38S	512.35
MW-39S	514.36
MW-40S	513.51
MW-41S	514.86
MW-42S	----

DOE WELLS	ELEVATION
1015	----
1915	----
2002	520.20
2015	----
2017	----
2094	505.86
2095	521.10
2096	----
2106	----
2125	----
2126	516.77
2127	----
2128	----
2129	515.45
2391	512.75
2392	----
2393	515.80
2394	516.43
2395	----
2396	----
2398	----
2550	----
2551	----
2552	----
2553	----
2554	515.47
2555	----
2556	----
2557	----
2558	----
2559	503.69
2560	----
2561	----
3015	----
3017	----
3094	507.03
3095	521.14
3096	----
3106	----
3125	----
3126	517.07
3127	----
3128	----
3391	----
3396	----
3550	----
3551	----
4096	----
4125	----

PRRS WELLS	ELEVATION
PZ-01	514.36
PZ-02	515.10
PZ-03	516.08
PZ-04	514.38
PZ-05	515.56
PZ-06	520.15
PZ-07	519.48
PZ-08	517.24
PZ-09	514.85
PZ-10	516.31
PZ-11	518.93
PZ-12	----

STAFF GAUGES	ELEVATION
SG-1	508.16
SG-2	514.87
SG-3(ERM)	----
SG-4	DRY
SG-5	----

R/I WELLS	ELEVATION
SC-2	----

DATA FROM JULY 24, 1991

Subconsultant	ERM - Midwest, Inc.

No.	Date	Revision

Principal :
Project Manager : TJS
Project No. : 539-10-02
Drawn : DMW
CAD File : 1002F335.DWG

PRRS
HAMILTON COUNTY, OHIO

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PIEZOMETRIC CONTOUR MAP
GROUNDWATER ELEVATIONS - JULY 1991

Scale : AS SHOWN
Date : REV. 1: MAY 1994
Dwg. No.: FIGURE 3-35
Sheet :

WELLS	ELEVATION
MW-01S	518.61
MW-01D	518.62
MW-02S	517.23
MW-03S	515.23
MW-04S	515.19
MW-05S	515.20
MW-06S	DRY
MW-07S	514.50
MW-08S	514.26
MW-09D	514.09
MW-10S	513.42
MW-11S	513.30
MW-12S	513.21
MW-13S	512.50
MW-14S	510.88
MW-14I	511.98
MW-15S	512.27
MW-15D	512.45
MW-16S	512.83
MW-18S	515.61
MW-18D	516.55
MW-19S	511.55
MW-20S	508.04
MW-20D	509.21
MW-21S	508.34
MW-21I	507.90
MW-21D	509.00
MW-22S	508.25
MW-23S	503.69
MW-24S	502.54
MW-24I	502.63
MW-24D	502.54
MW-25S	502.68
MW-26S	499.86
MW-27S	499.53
MW-28S	498.29
MW-29S	495.61
MW-30S	512.31
MW-30I	512.32
MW-31S	511.30
MW-31I	511.28
MW-32S	514.77
MW-33I	514.02
MW-34S	513.07
MW-35S	498.16
MW-36S	DRY
MW-36I	492.90
MW-37S	DRY
MW-37I	492.76
MW-38S	510.72
MW-39S	512.72
MW-40S	512.02
MW-41S	513.61
MW-42S	493.38

DOE WELLS	ELEVATION
1015	----
1915	----
2002	518.04
2015	----
2017	----
2094	504.80
2095	519.13
2096	----
2106	----
2125	----
2126	515.92
2127	----
2128	----
2129	514.10
2391	511.08
2392	----
2393	----
2394	514.75
2395	514.69
2396	----
2398	----
2550	----
2551	----
2552	----
2553	----
2554	514.64
2555	----
2556	----
2557	----
2558	----
2559	501.33
2560	----
2561	----
3015	----
3017	----
3094	506.00
3095	519.18
3098	----
3106	----
3125	----
3126	516.11
3127	----
3128	----
3391	----
3396	----
3550	----
3551	----
4096	----
4125	----

PRRS WELLS	ELEVATION
PZ-01	513.09
PZ-02	514.00
PZ-03	514.89
PZ-04	512.72
PZ-05	515.90
PZ-06	518.27
PZ-07	518.11
PZ-08	516.04
PZ-09	513.40
PZ-10	514.89
PZ-11	516.53
PZ-12	493.43

STAFF GAUGES	ELEVATION
SG-1	DRY
SG-2	515.21
SG-3(ERM)	----
SG-4	DRY
SG-5	----

R/I WELLS	ELEVATION
SG-2	----

DATA FROM OCTOBER 29, 1991

Subconsultant	ERM – Midwest, Inc.

No.	Date	Revision

Principal :
Project Manager : TJS
Project No. : 539-10-02
Drawn : DMW
CAD File : 1002F336.DWG

PRRS
HAMILTON COUNTY, OHIO

ERM-Midwest, inc.
Environmental Resources Management
Columbus, Ohio
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PIEZOMETRIC CONTOUR MAP
GROUNDWATER ELEVATIONS – OCTOBER 1991

Scale : AS SHOWN
Date : REV. 1: MAY 1994
Dwg. No.: FIGURE 3-36
Sheet :

WELLS	ELEVATION
MW-01S	518.54
MW-01D	518.55
MW-02S	518.31
MW-03S	515.33
MW-04S	515.26
MW-05S	515.26
MW-06S	DRY
MW-07S	514.61
MW-08S	514.38
MW-09D	514.32
MW-10S	513.62
MW-11S	513.55
MW-12S	513.46
MW-13S	512.76
MW-14S	511.89
MW-14I	512.39
MW-15S	512.63
MW-15D	512.70
MW-16S	513.15
MW-18S	519.44
MW-18D	519.59
MW-19S	512.00
MW-20S	509.70
MW-20D	509.95
MW-21S	509.13
MW-21I	508.70
MW-21D	509.80
MW-22S	508.91
MW-23S	504.72
MW-24S	503.91
MW-24I	503.95
MW-24D	503.91
MW-25S	504.12
MW-26S	501.37
MW-27S	500.90
MW-28S	499.43
MW-29S	497.03
MW-30S	512.68
MW-30I	512.70
MW-31S	511.74
MW-31I	511.72
MW-32S	514.86
MW-33I	514.24
MW-34S	513.35
MW-35S	501.43
MW-36S	----
MW-36I	493.95
MW-37S	493.80
MW-37I	493.77
MW-38S	511.19
MW-39S	513.00
MW-40S	513.31
MW-41S	----
MW-42S	494.45

DOE WELLS	ELEVATION
1015	----
1915	----
2002	----
2015	518.86
2017	520.12
2069	518.50
2093	517.64
2094	505.92
2095	518.99
2096	521.71
2106	519.42
2125	518.49
2126	515.97
2127	503.37
2128	516.17
2129	514.29
2391	511.39
2392	508.83
2393	514.90
2394	514.74
2395	509.67
2396	518.48
2398	522.78
2550	519.66
2551	520.16
2552	518.12
2553	516.71
2554	514.78
2555	518.07
2556	510.76
2557	508.20
2558	500.68
2559	502.76
2560	511.25
2561	495.07
3015	518.78
3017	520.08
3069	518.24
3093	517.54
3094	506.09
3095	519.03
3096	521.67
3106	519.34
3125	518.46
3126	516.16
3127	503.44
3128	516.20
3391	511.47
3396	518.46
3550	519.75
3551	520.06
4096	521.92
4125	518.53

PRRS WELLS	ELEVATION
PZ-01	513.37
PZ-02	514.19
PZ-03	514.95
PZ-04	512.99
PZ-05	514.02
PZ-06	518.09
PZ-07	518.28
PZ-08	516.12
PZ-09	----
PZ-10	----
PZ-11	519.52
PZ-12	494.52

STAFF GAUGES	ELEVATION
SG-1	----
SG-2	----
SG-3(ERM)	----
SG-4	----
SG-5	----

R/I WELLS	ELEVATION
SC-2	----

DATA FROM JANUARY 30, 1992

Subconsultant	ERM – Midwest, Inc.

No.	Date	Revision

Principal :
Project Manager : TJS
Project No. : 539-10-02
Drawn : DMW
CAD File : 1002F337.DWG

PRRS
HAMILTON COUNTY, OHIO

ERM-Midwest, inc.
Environmental Resources Management
Columbus, Ohio
Charleston, WV
Indianapolis, IN
Louisville, KY

PIEZOMETRIC CONTOUR MAP
GROUNDWATER ELEVATIONS – JANUARY 1992

Scale : AS SHOWN
Date : REV. 1: MAY 1994
Dwg. No.: FIGURE 3-37
Sheet :

WELLS	ELEVATION
MW-01S	519.06
MW-01D	519.07
MW-02S	518.48
MW-03S	515.56
MW-04S	515.46
MW-05S	515.46
MW-06S	DRY
MW-07S	514.69
MW-08S	514.69
MW-09D	514.54
MW-10S	513.94
MW-11S	513.9
MW-12S	513.78
MW-13S	513.15
MW-14S	512.73
MW-14I	512.8
MW-15S	513.06
MW-15D	513.15
MW-16S	513.52
MW-18S	515.87
MW-18D	515.84
MW-19S	512.41
MW-20S	510.46
MW-20D	510.68
MW-21S	509.91
MW-21I	509.47
MW-21D	510.53
MW-22S	509.57
MW-23S	506.24
MW-24S	505.99
MW-24I	506.03
MW-24D	506.04
MW-25S	506.32
MW-26S	504.09
MW-27S	503.41
MW-28S	502.03
MW-29S	499.1
MW-30S	513.06
MW-30I	513.08
MW-31S	512.15
MW-31I	512.13
MW-32S	515.1
MW-33I	514.5
MW-34S	513.66
MW-35S	502.06
MW-36S	496.73
MW-36I	496.8
MW-37S	496.74
MW-37I	496.65
MW-38S	511.6
MW-39S	513.34
MW-40S	512.78
MW-41S	514.2
MW-42S	496.88

DOE WELLS	ELEVATION
1015	DRY
1915	DRY
2002	----
2015	519.42
2017	520.96
2094	507.38
2095	519.52
2096	521.66
2106	520.15
2125	518.98
2126	----
2127	----
2128	516.33
2129	514.53
2391	511.73
2392	509.47
2393	----
2394	514.94
2395	510.08
2396	518.89
2398	518.05
2550	520.36
2551	520.85
2552	----
2553	----
2554	514.42
2555	----
2556	511.32
2557	----
2558	503.21
2559	505.23
2560	509.70
2561	----
3015	519.33
3017	----
3094	507.48
3095	519.79
3096	521.65
3106	520.08
3125	518.81
3126	----
3127	----
3128	516.48
3391	511.70
3396	518.89
3550	520.35
3551	520.07
4096	521.93
4125	519.01

PRRS WELLS	ELEVATION
PZ-01	513.75
PZ-02	514.50
PZ-03	515.21
PZ-04	513.23
PZ-05	514.21
PZ-06	518.49
PZ-07	518.72
PZ-08	516.27
PZ-09	513.83
PZ-10	515.16
PZ-11	517.82
PZ-12	497.39

STAFF GAUGES	ELEVATION
SG-1	508.43
SG-2	514.99
SG-3(ERM)	----
SG-4	498.81
SG-5	520.33

R/I WELLS	ELEVATION
SG-2	511.96

DATA FROM APRIL 27, 1992

Subconsultant	ERM - Midwest, Inc.

No.	Date	Revision

Principal :
Project Manager : TJS
Project No. : 539-10-02
Drawn : DMW
CAD File : 1002F338.DWG

PRRS
HAMILTON COUNTY, OHIO

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Environmental Resources Management
Columbus, Ohio
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Indianapolis, IN
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PIEZOMETRIC CONTOUR MAP
GROUNDWATER ELEVATIONS - APRIL 1992

Scale : AS SHOWN
Date : REV. 1: MAY 1994
Dwg. No.: FIGURE 3-38
Sheet :

WELLS	ELEVATION
MW-01S	518.63
MW-01D	518.69
MW-02S	518.13
MW-03S	515.64
MW-04S	515.63
MW-05S	515.54
MW-06S	DRY
MW-07S	514.54
MW-08S	514.83
MW-09D	514.60
MW-10S	514.05
MW-11S	514.00
MW-12S	513.91
MW-13S	513.38
MW-14S	512.98
MW-14I	513.03
MW-15S	513.27
MW-15D	513.37
MW-16S	513.70
MW-18S	—
MW-18D	516.07
MW-19S	512.50
MW-20S	510.41
MW-20D	510.63
MW-21S	509.96
MW-21I	509.51
MW-21D	510.60
MW-22S	509.64
MW-23S	505.05
MW-24S	504.85
MW-24I	504.90
MW-24D	504.86
MW-25S	505.10
MW-26S	502.17
MW-27S	501.76
MW-28S	498.25
MW-29S	497.51
MW-30S	513.21
MW-30I	513.23
MW-31S	512.48
MW-31I	512.45
MW-32S	515.27
MW-33I	514.58
MW-34S	513.75
MW-35S	500.35
MW-36S	494.38
MW-36I	494.22
MW-37S	494.17
MW-37I	493.90
MW-38S	512.01
MW-39S	513.73
MW-40S	513.08
MW-41S	514.34
MW-42S	494.91

DOE WELLS	ELEVATION
1015	DRY
1915	DRY
2002	—
2015	519.58
2017	—
2069	519.57
2093	—
2094	506.84
2095	519.18
2096	521.29
2106	519.68
2125	518.52
2126	516.14
2127	—
2128	516.56
2129	514.73
2391	512.33
2392	509.82
2393	516.06
2394	515.52
2395	510.68
2396	518.41
2398	519.20
2550	519.76
2551	519.87
2552	516.14
2553	516.73
2554	515.06
2555	518.01
2556	511.23
2557	—
2558	501.28
2559	—
2560	510.67
2561	495.51
3015	519.51
3017	—
3069	519.29
3093	—
3094	507.00
3095	519.24
3096	521.24
3106	519.62
3125	518.53
3126	516.33
3127	—
3128	516.60
3391	512.05
3396	518.44
3550	519.74
3551	519.84
4096	521.49
4125	518.60

PRRS WELLS	ELEVATION
PZ-01	513.93
PZ-02	514.58
PZ-03	515.39
PZ-04	513.75
PZ-05	514.74
PZ-06	518.43
PZ-07	518.18
PZ-08	516.29
PZ-09	514.15
PZ-10	515.45
PZ-11	—
PZ-12	494.99

STAFF GAUGES	ELEVATION
SG-1	DRY
SG-2	514.98
SG-3(ERM)	DRY
SG-4	498.46
SG-5	518.48

R/I WELLS	ELEVATION
SC-2	512.04

DATA FROM AUGUST 18, 1992

Subconsultant	ERM – Midwest, Inc.

No.	Date	Revision

Principal :
Project Manager : TJS
Project No. : 539-10-02
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PRRS
HAMILTON COUNTY, OHIO

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Indianapolis, IN
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PIEZOMETRIC CONTOUR MAP
GROUNDWATER ELEVATIONS – AUGUST 1992

Scale : AS SHOWN
Date : REV. 1: MAY 1994
Dwg. No.: FIGURE 3-39
Sheet :

pronounced southeast flow direction is apparent. This is a result of the easterly flow from the west converging with the flow coming from the north. South of New Haven Road west of Paddys Run, water flows around the bedrock high because it is essentially impermeable. The effect of the bedrock on groundwater flow can be seen regionally in Figure 3-14.

Another location where flow direction appears to be anomalous occurs near the intersection of Paddys Run and Route 128. A DOE monitor well (2560) located just west of that intersection has recorded water level elevations up to 11 feet higher than what is expected. Study of the boring log reveals that the subsurface soils consist of silts and clays with a silty clay gravel mixture directly overlying shale bedrock at a total depth of 16.5 feet below the ground surface. Water was encountered at approximately 9 feet below the ground surface. Depth to the groundwater in adjacent wells ranges from 14 to 18 feet. Shale at such a shallow depth probably represents the edge of the bedrock outcrop near the eroded valley. Groundwater in this well is perched on the shale. Most likely this water will follow the surface of the shale until it intercepts the sands and gravels of the regional aquifer.

Groundwater Flow Direction and Rate Verification Studies - GMR

The Ohio EPA was concerned with the Companies' interpretation of flow direction along the GMR because at certain times when river water levels are high, such as springtime, the direction of groundwater flow may be temporarily reversed causing flow near the river to be towards the north. This temporary influx of water could mask or dilute chemicals that may be present. To demonstrate the effect these temporary reversals might have, the Companies performed a year-long investigation adjacent to the GMR at the southernmost part of the Study Area.

With Ohio EPA concurrence (Ohio EPA 1991), the Companies installed two intermediate depth monitor wells MW-36I and MW-37I and one intermediate depth piezometer PZ-12. The two wells were completed at a depth of 36 feet below ground surface. The piezometer was completed at a depth of 43 feet below ground

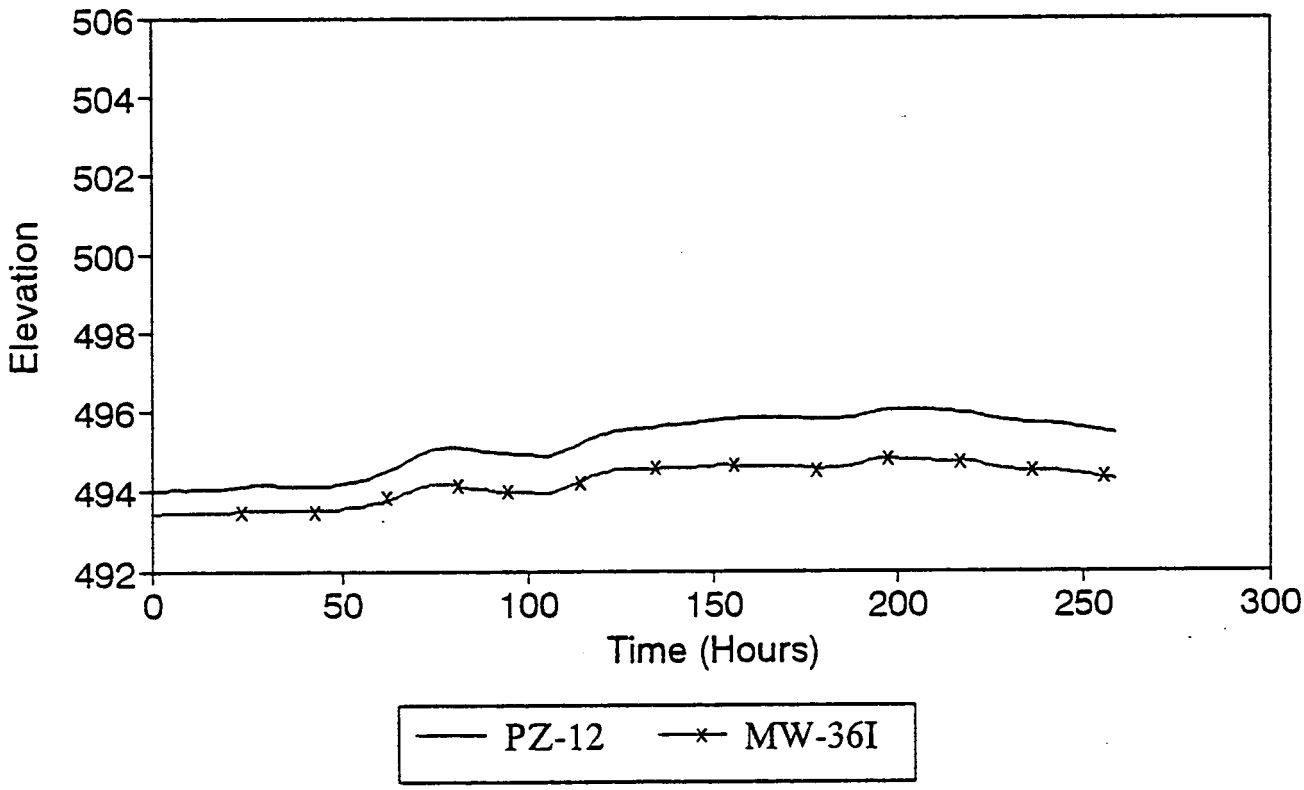
surface. These wells and piezometer were installed with 15-foot long screens placed across the water table in such a way as to account for any extreme groundwater fluctuations. Continuous water level recorders were placed in each well and the piezometer. These devices were used to continuously record the rise and fall of the water table and to verify if groundwater flow direction reversals occurred. The results of that monitoring are shown in Figures 3-40 through 3-50. These figures plot the groundwater level changes from February 1992 to February 1993 for MW-36I, MW-37I and PZ-12.

As shown in Figures 3-31 through 3-39, groundwater flow is normally south towards the GMR. Flow reversals would necessitate that levels of water in the GMR would be sufficiently high to cause a mounding effect and reverse the groundwater flow from south to north. The piezometric maps do not reflect this phenomenon. However, these maps were generated from water levels collected within a 4-6 hour time period for each posted date. To collect more detailed information, data from the continuous water level recorders, Figures 3-40 through 3-50, were reviewed.

As shown in Figure 3-38, MW-36I and MW-37I are downgradient of PZ-12. For a reversal to occur, the water elevations in MW-36I and MW-37I would have to be greater than PZ-12. Normally, this does not happen. However, in mid April, late August (probable occurrence), late November, 1992 and early and late January, 1993, reversals did occur. As shown, these reversals occurred when high water levels associated with heavy rain and/or melting snow caused the GMR to rise.

The normal difference in groundwater levels between MW-36I, MW-37I and PZ-12 is approximately one foot (PZ-12 being one foot higher). At reversal the elevation difference is approximately 3 to 6 inches (with PZ-12 being lower). As shown, the elapsed times for which reversals occur are hours. The maximum time recorded in the reversal stage was approximately 40 hours after which the normal southern gradient was quickly re-established. Generally, prolonged periods of reversal do not occur; therefore, significant dilution effects from the GMR should not be expected.

000030



PRRS WATER LEVEL MEASUREMENTS
FEBRUARY 13–24, 1992
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

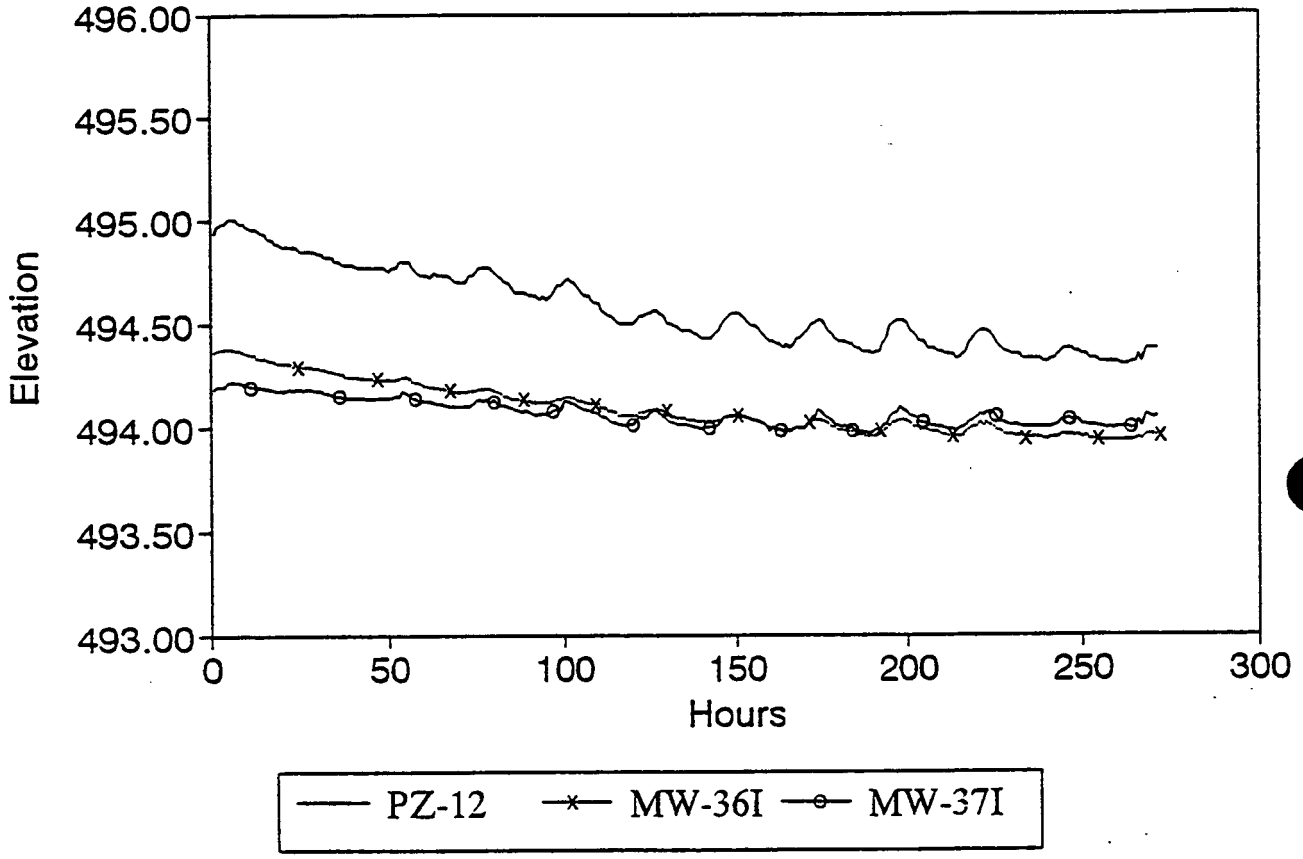
FIGURE 3–40

ERM

ERM-Midwest, inc.
Environmental Resources Management

000321

PROJECT\539-10-02\1002F340.DWG



000322

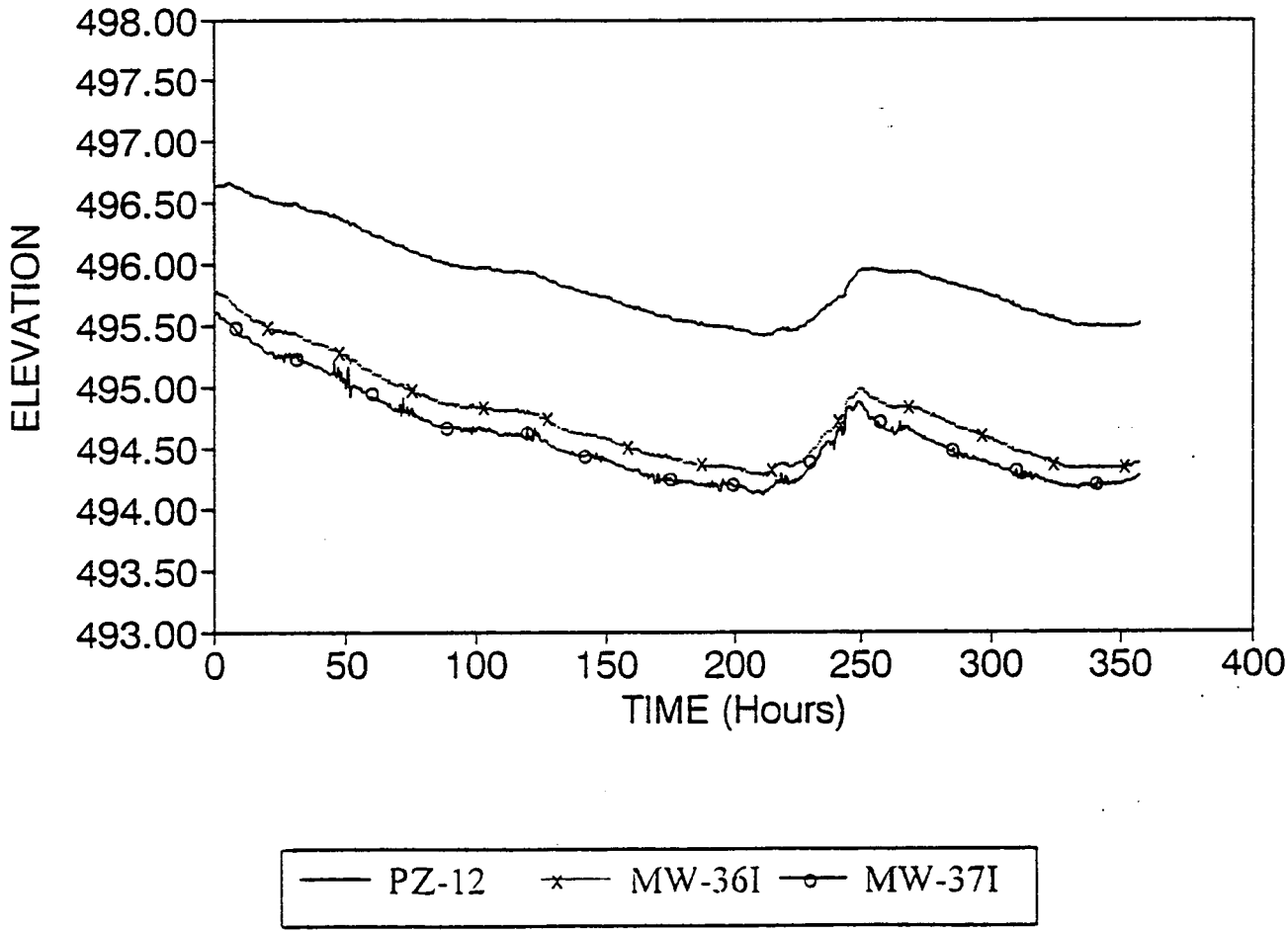
PRRS WATER LEVEL MEASUREMENTS
FEBRUARY 24 – MARCH 7, 1992
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 3-

ERM

ERM-Midwest, inc.
Environmental Resources Management

PROJECT\539-10-02\1002F341.DWG



PRRS WATER LEVEL MEASUREMENTS
MARCH 31 – APRIL 15, 1992
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

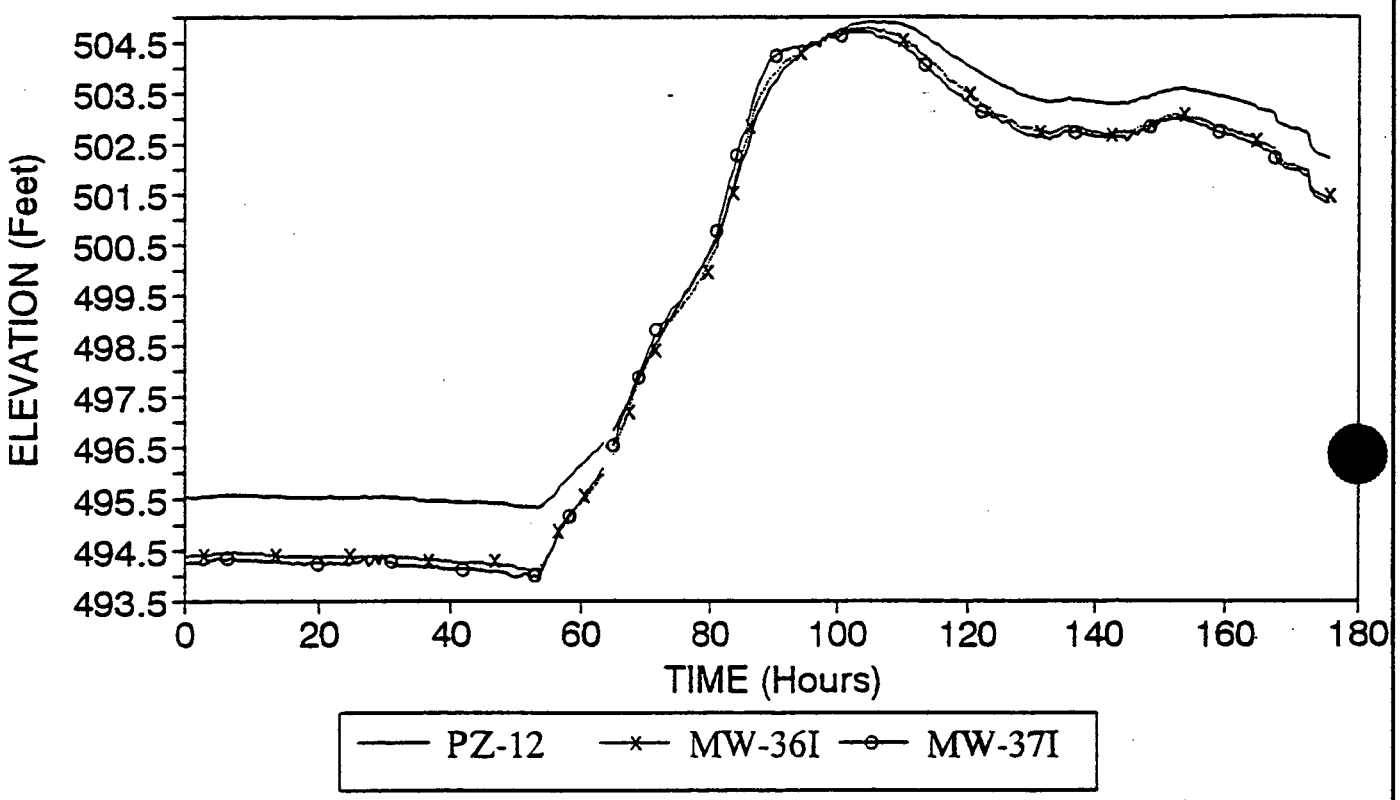
FIGURE
3-42

ERM

ERM-Midwest, inc.
Environmental Resources Management

000323

PROJECT\539-10-02\1002F342.DWG



000324

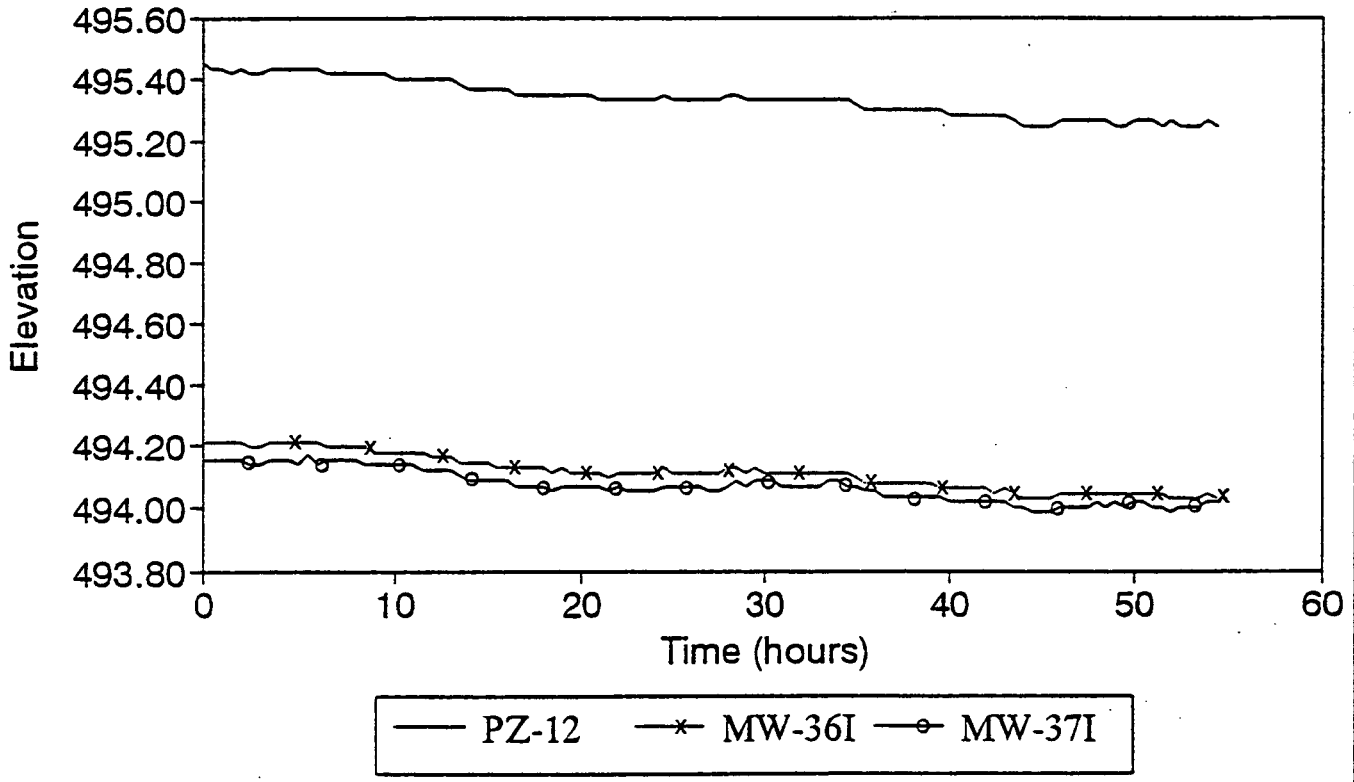
ERM

PRRS WATER LEVEL MEASUREMENTS
APRIL 15 - APRIL 22, 1992
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE
3-4

ERM-Midwest, inc.
Environmental Resources Management

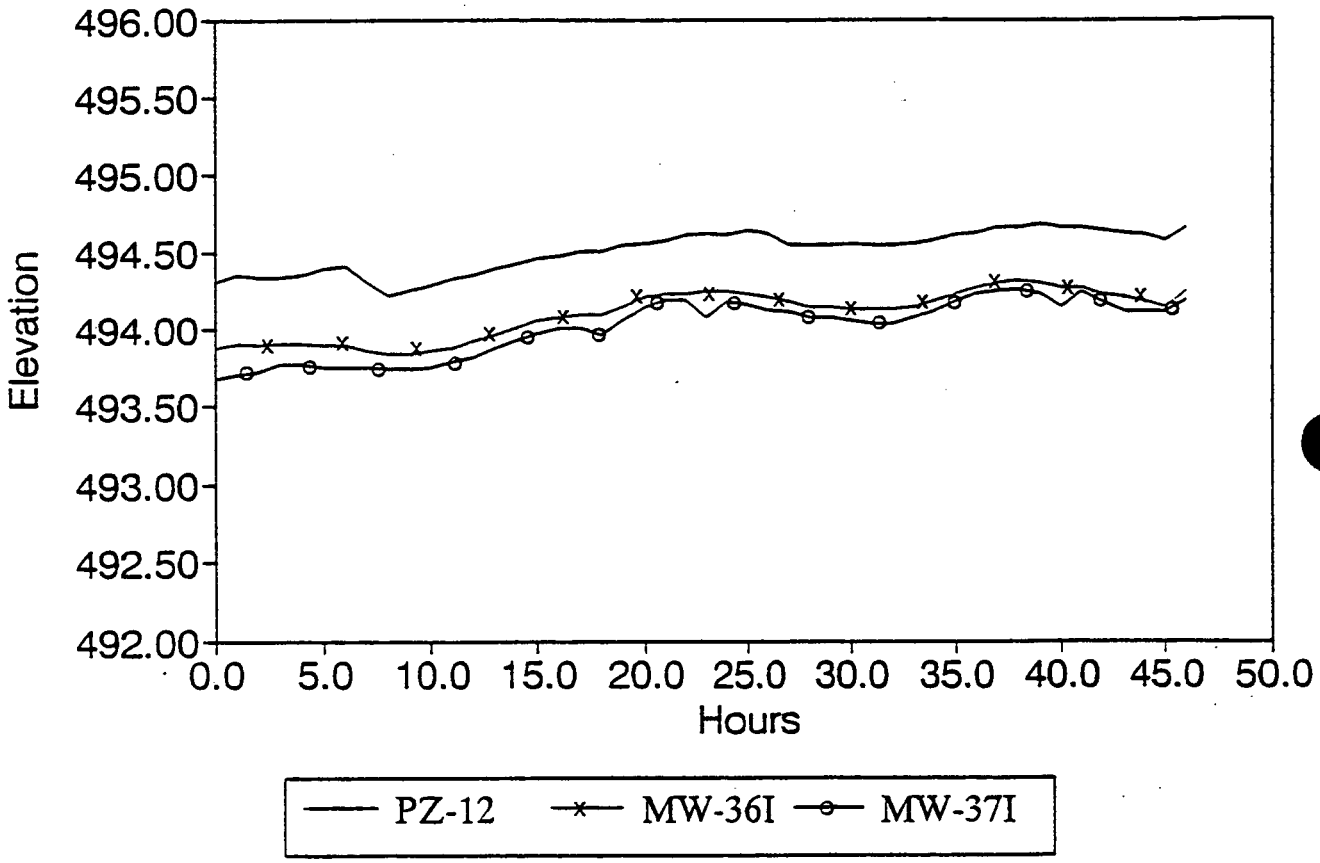
PROJECT\539-10-02\1002F343.DWG



000325

ERM	PRRS WATER LEVEL MEASUREMENTS MAY 15 – 17, 1992 PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO	FIGURE 3–44
	ERM-Midwest, inc. Environmental Resources Management	

PROJECT\539-10-02\1002F344.DWG



000326

PRRS WATER LEVEL MEASUREMENTS
JULY 7 – 9, 1992
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

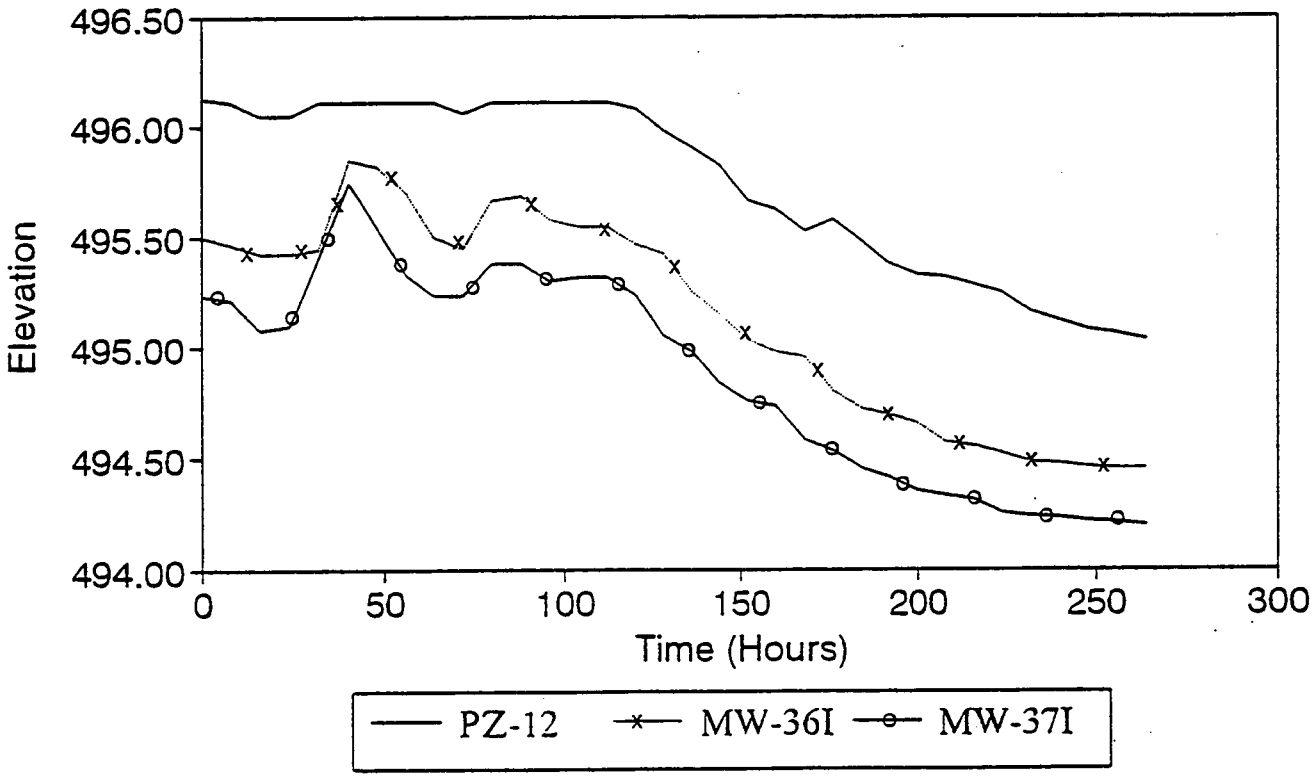
FIGURE 3-4

ERM

ERM-Midwest, inc.
Environmental Resources Management

PROJECT\539-10-02\1002F345.DWG

REV. 1: MAY 1994



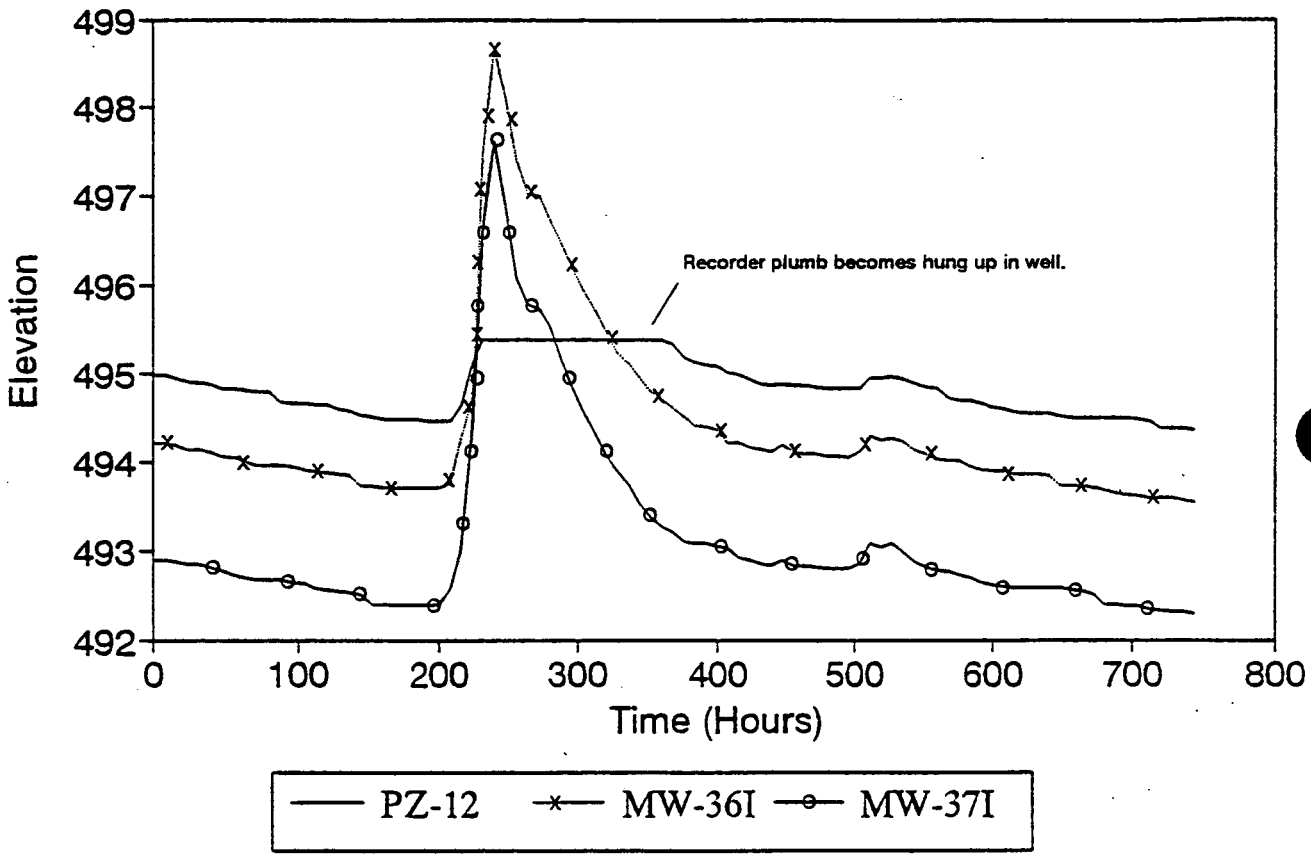
PRRS WATER LEVEL MEASUREMENTS
AUGUST 7 – 18, 1992
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE
3-46

ERM

ERM-Midwest, inc.
Environmental Resources Management

PROJECT\539-10-02\1002F346.DWG



000328

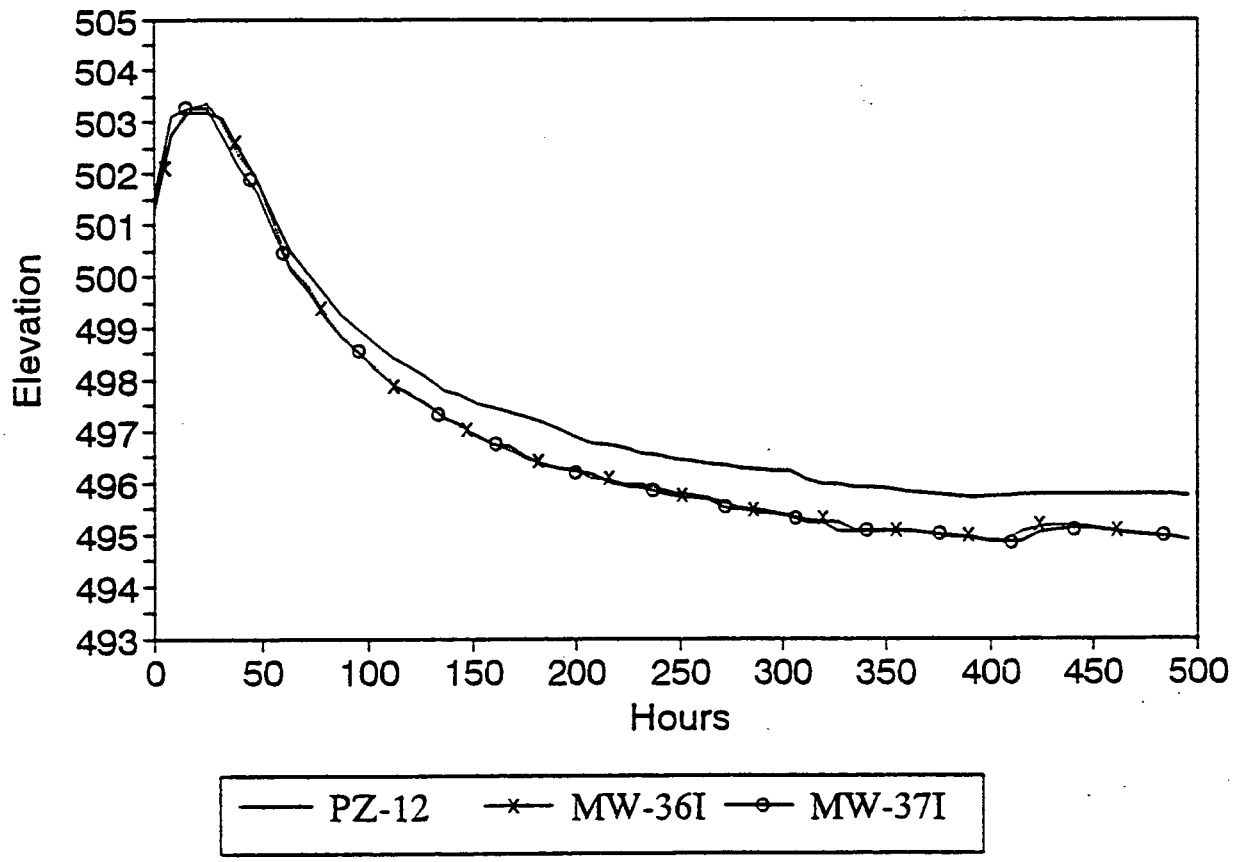
PRRS WATER LEVEL MEASUREMENTS
AUGUST 18 - SEPTEMBER 21, 1992
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 3-47

ERM

ERM-Midwest, inc.
Environmental Resources Management

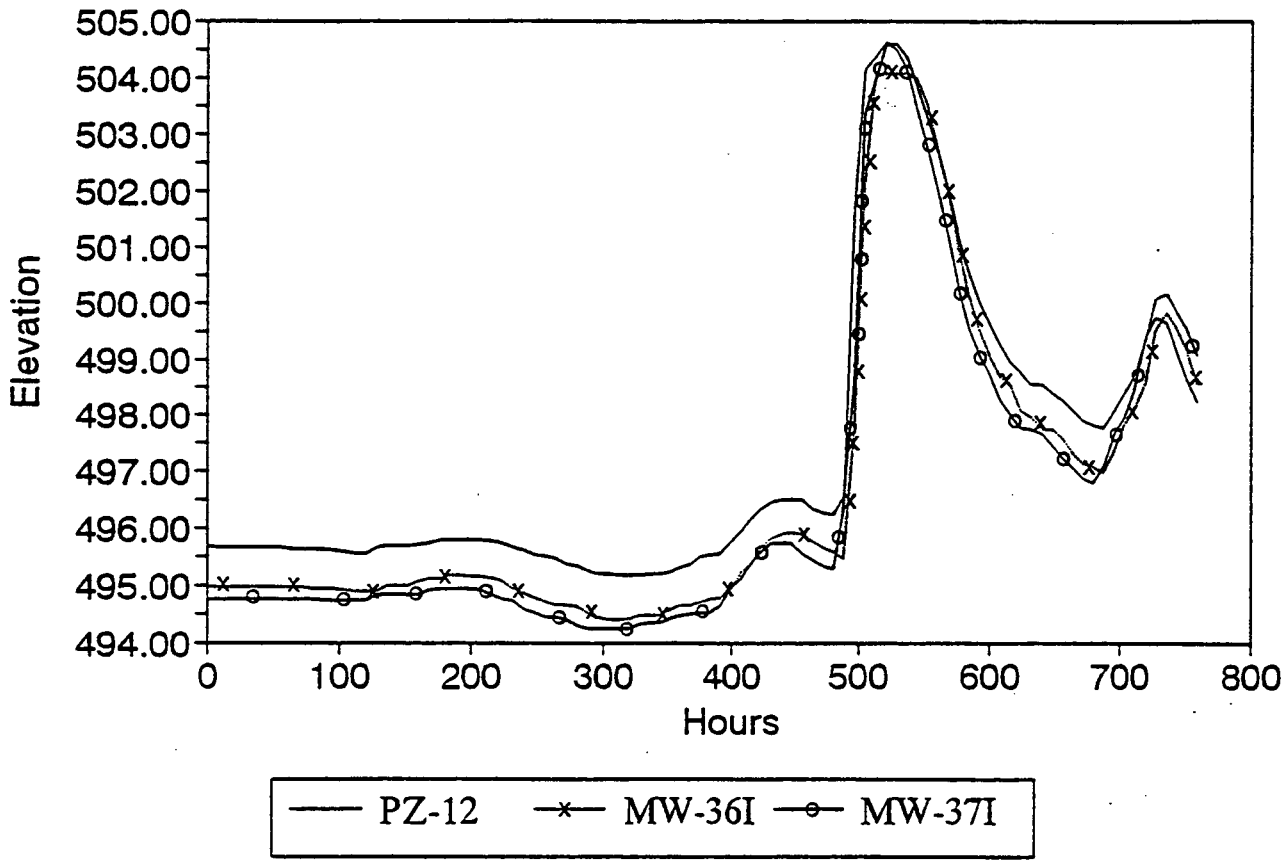
PROJECT\539-10-02\1002F347.DWG



000329

ERM	PRRS WATER LEVEL MEASUREMENTS NOVEMBER 23 – DECEMBER 15, 1992 PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO	FIGURE 3-48
	ERM-Midwest, inc. Environmental Resources Management	

PROJECT\539-10-02\1002F348.DWG



000320

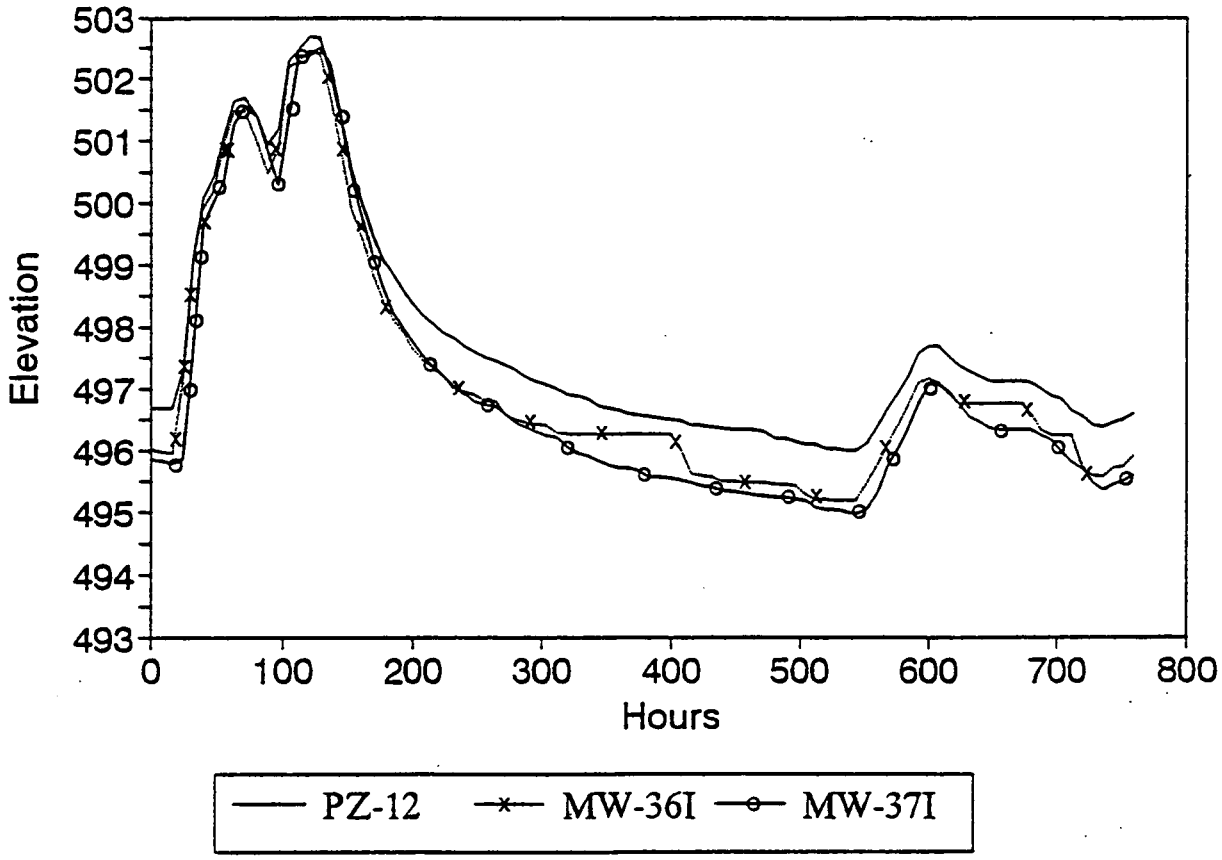
PRRS WATER LEVEL MEASUREMENTS
DECEMBER 15, 1992 – JANUARY 20, 1993
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 3-4

ERM

ERM-Midwest, inc.
Environmental Resources Management

PROJECT\539-10-02\1002F349.DWG



000331

ERM

PRRS WATER LEVEL MEASUREMENTS
JANUARY 20 – FEBRUARY 25, 1993
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE
3-50

ERM-Midwest, inc.
Environmental Resources Management

PROJECT\539-10-02\1002F350.DWG

In an adjunct study performed by K-V Associates, Inc., findings verified that the average flow direction is southeast (154° from True North). Measured groundwater flow direction from this study is consistent with the observed direction shown in Figures 3-31 through 3-39. In addition to flow direction, the average flow rate was measured at 2.7 ft/day. The K-V Associates, Inc. report is attached as Appendix G.

3.10.2.3 Groundwater Use and Quality

Groundwater Use

Groundwater use in the Study Area has been addressed in Section 3.3.4. and 3.3.6.

Study Area Water Quality

As a result of an inquiry by the Crosby Township Trustees in April 1962, the Ohio Department of Health visited the Study Area and collected groundwater samples from three locations on the RNC property (two from lagoons and one from the RNC production well) and one from a now abandoned filling station along New Haven Road.

In July 1962, groundwater samples were collected from an additional 12 wells located within a 1 mile radius of the manufacturing operations. Four of the 12 wells were located upgradient of operations. Although analytical methods in 1962 were not as inclusive as today's standards require, results indicated that water collected from the ponds and two wells located adjacent to and downgradient of the Companies' properties contained volatile organic chemicals. Testing was insufficient to verify the presence of inorganic chemicals.

In 1972, the Ohio EPA collected groundwater samples from nine residential/industrial wells adjacent to the Companies' property. Included in the sampling were the RNC production well, two Mobil production wells, and the Mobil drinking water well. These analyses produced results that indicated elevated concentrations of sodium, potassium, nitrogen ammonia, sulfates, phenols, MBAS

and high TOC, COD values (Ohio EPA 1973). The Companies only have records of the Ohio EPA's continuing monitoring of the Steel Corp. Company and the C&O railroad station wells until October 1981 and the RNC production well and the Jasper Stevens well until January 1984.

As part of its monitoring program the Feed Materials Production Center (now FEMP) operated by NLO, Inc., sampled 13 wells within the vicinity of its study area in December 1981. Six of those wells fall within the PRRS Study Area. Results of those tests indicated that radioactivity in the groundwater related to activities at the FEMP had impacted the groundwater as far south as the A&W/Mobil production wells.

In August 1982 the U.S. Geological Survey sampled 76 wells in the area for uranium and other constituents (Sedam 1984). Results of that study verify the previous FEMP January 1981 study concerning the extent of radioactive contamination at the Study Area.

In 1985, the Ohio Department of Health tested Mobil Chemical Corporation's now-abandoned drinking water well. Testing included gross alpha, gross beta, uranium and potassium-40. Results of those tests indicated that radioactive levels in the groundwater attributable to gross alpha, gross beta and uranium were above background for the area and recommended that the well not be used for drinking water purposes (Ohio Department of Health 1986).

In August 1993 the FEMP began extraction of uranium-contaminated groundwater from an area which includes part of the PRRS Study Area. The FEMP groundwater withdrawal wells are intended to extract the contaminated groundwater before it migrates further downgradient.

Chemical Properties

As discussed in Section 2.9, chemical parameters included CLP organics plus cumene, CLP semivolatiles, CLP inorganics, CLP pesticides/PCBs and general

parameters. General parameters included ammonia, chloride, phosphorus, sulfate, pH and radionuclides, including potassium-40, gross alpha, gross beta, and total uranium. Tables 3-33 through 3-39 show results of analyses for parameters in groundwater that were detected at levels above background. The nature and extent of these parameters are discussed in Section 4.0.

3.11 Groundwater Flow Modeling

As discussed in Section 2.11, Groundwater Modeling, the PRRS groundwater flow and solute transport modeling effort encompassed the development of a regional flow model, a local flow model and two solute transport models (A complete groundwater and solute transport modeling report is enclosed as Appendix C). This section of the RI report discusses the outcome of the groundwater flow modeling effort in relation to a primary purpose of the model to "... assist with the interpretation and characterization of groundwater flow and contaminant transport at the Study Area..." Note that only the groundwater flow component of the modeling is discussed here. The solute transport modeling is discussed in Section 4.0.

3.11.1 Regional Flow Model

A regional groundwater flow model was developed to help refine the modeling parameters for the more Study Area-specific, local flow model. The regional groundwater flow model covered an area encompassing the Study Area and several major groundwater flow system fluxes, including pumping well fields, a river and streams. The calibration and sensitivity testing of the regional groundwater flow model provided additional support to the set of hydrologic and hydrogeologic parameters chosen for input to the local groundwater flow model.

3.11.1.1 Conceptualization of the Regional Model

The HST3D model requires that the modeling domain (vertical and horizontal extent of the area of interest) be identified by specifying parameter values at specific

REV. 1: MAY 1994

TABLE 3-33

DISSOLVED METALS DETECTED ABOVE BACKGROUND IN THE GROUNDWATER(+)

PADDYS RUN ROAD SITE

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round(++)	Value
Antimony (39 ug/l)								
DOE-2394	3	42.1	SB-59	*	53.6			
Arsenic (3 ug/l)								
MW-02S	1	4.9	MW-16S	2	18.0	DOE-3126	1	3.3
MW-02S	2	6.9	MW-16S	3	19.5	SC-1	2	85.9
MW-02S	3	10.0	MW-16S	4	7.6	SC-1	3	36.0
MW-02S	4	8.3	MW-20S	3	3.9	SC-2	2	27.4
MW-03S	3	25.4	MW-21S	1	38.8	SC-2	3	5.7
MW-03S	4	34.0	MW-21S	2	47.4	SC-2	4	13.0
MW-04S	3	443.0	MW-21S	3	204.0	SB-36	*	275.0
MW-04S	4	393.0	MW-21S	4	33.7	SB-37	*	130.0
MW-05S	3	241.0	MW-21D	3	16.9	SB-38	*	303.0
MW-05S	4	85.7	MW-22S	4	4.0	SB-39	*	52.8
MW-06S	3	367.0	MW-23S	4	3.1	SB-40	*	101.0
MW-06S	4	421.0	MW-24S	2	88.2	SB-42	*	49.2
MW-07S	2	43.2	MW-24S	3	74.4	SB-43	*	312.0
MW-07S	3	30.9	MW-24S	4	45.5	SB-44	*	125.0
MW-07S	4	21.0	MW-24I	3	7.8	SB-45	*	123.0
MW-08S	1	336.0	MW-25S	3	9.0	SB-46	*	66.0
MW-08S	3	138.0	MW-25S	4	14.0	SB-48	*	33.6
MW-08S	4	63.3	MW-27S	3	3.9	SB-49	*	7.7
MW-09D	2	23.4	MW-30I	4	3.5	SB-50	*	11.9
MW-09D	3	35.6	MW-30S	3	23.8	SB-52	*	124.0
MW-09D	4	29.5	MW-30S	4	16.5	SB-53	*	54.4
MW-10S	1	29.2	MW-31I	4	24.3	SB-55	*	77.1
MW-10S	2	51.8	MW-33I	3	48.3	SB-56	*	64.7
MW-10S	3	67.0	MW-33I	4	99.6	SB-60	*	61.6
MW-10S	4	31.8	MW-34S	3	271.0	SB-61	*	63.0
MW-11S	1	173.0	MW-34S	4	14.2	SB-62	*	59.1
MW-11S	2	147.0	MW-39S	4	34.4	SB-66	*	82.4
MW-11S	3	316.0	MW-41S	4	4.8	SB-67	*	555.0
MW-11S	4	295.0	MW-42S	SUP.2	6.0	SB-74	*	8.2
MW-12S	2	79.0	DOE-2094	1	97.9	SB-81	*	74.8
MW-12S	3	244.0	DOE-2094	2	178.0	EVERS	2	138.0
MW-12S	4	189.0	DOE-2094	3	230.0	EVERS	3	56.8
MW-13S	1	275.7	DOE-2094	4	294.0	EVERS	4	58.0
MW-13S	2	173.0	DOE-2126	3	5.0	WEBER 1	2	7.2
MW-13S	3	314.0	DOE-2129	1	65.8	WEBER 1	3	10.0
MW-13S	4	270.0	DOE-2129	2	8.1	WEBER 1	4	10.0
MW-14S	1	187.0	DOE-2129	3	528.0	WEBER 3	2	10.1
MW-14S	2	146.0	DOE-2129	4	374.0	WEBER 3	3	16.4
MW-14S	3	265.0	DOE-2392	SUP.2	14.6	RNCC	2	3.1
MW-14S	4	189.0	DOE-2393	3	9.7	RNCC	3	8.2
MW-15S	1	224.0	DOE-2393	4	16.2	RNCC	4	15.7
MW-15S	2	300.0	DOE-2559	4	27.1			
MW-15S	3	4.8	DOE-3094	4	4.6			
Cadmium (5 ug/l)								
MW-03S	2	5.7	MW-05S	1	5.3			
Chromium (4 ug/l)								
MW-03S	1	13.7	MW-05S	3	10.2	MW-18S	4	7.5
MW-03S	2	14.0	MW-05S	4	11.6	MW-19S	4	5.0
MW-03S	3	7.4	MW-06S	1	37.2	MW-32S	3	5.6
MW-03S	4	8.8	MW-06S	2	26.4	MW-32S	4	6.5
MW-04S	3	12.5	MW-06S	3	63.2	MW-33I	3	6.1

See notes at the end of this table for explanation of symbols and abbreviations.

TABLE 3-33 (Continued)
DISSOLVED METALS DETECTED ABOVE BACKGROUND IN THE GROUNDWATER(+)
PADDYS RUN ROAD SITE

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round(++)	Value
Chromium (4 ug/l) Continued								
MW-04S	4	7.4	MW-06S	4	78.0	DOE-3126	3	6.4
MW-05S	1	17.2	MW-18S	1	14.0	SB-79	*	4.9
MW-05S	2	21.8	MW-18S	2	18.0	EVERS	2	7.0
Copper (60 ug/l)								
MW-33I	4	68.5	ESTES	4	76.3	ROLFES	1	127.0
Nickel (27 ug/l)								
MW-01S	3	124.0	MW-18S	1	74.5	MW-29S	4	70.6
MW-01S	4	30.4	MW-18S	2	126.0	MW-32S	4	55.3
MW-03S	1	37.4	MW-18S	3	49.2	SC-2	1	62.7
MW-06S	3	50.7	MW-18S	4	38.6	SC-2	4	29.0
MW-06S	4	57.5	MW-27S	4	30.5			
Silver (13 ug/l)								
DOE-2126	1	234.0	ESTES	2	13.8			
Selenium (4 ug/l)								
MW-34S	4	15.0						
Zinc (258 ug/l)								
MW-24D	SUP.2	1590.0	ESTES	4	466.0	ROLFES	4	275.0
ESTES	2	298.0	ROLFES	3	356.0			
Barium (122 ug/l)								
MW-10S	1	157.0	MW-16S	2	128.0	MW-28S	4	774.0
MW-11S	1	191.0	MW-21I	4	129.0	MW-34S	3	123.0
MW-11S	2	129.0	MW-21S	1	537.0	MW-34S	4	274.0
MW-11S	3	151.0	MW-21S	2	591.0	MW-36S	3	184.0
MW-11S	4	166.0	MW-21S	3	487.0	MW-36S	4	181.0
MW-12S	1	128.0	MW-21S	4	428.0	DOE-2094	1	738.0
MW-13S	1	552.0	MW-22S	4	183.0	DOE-2094	2	772.0
MW-13S	2	646.0	MW-24S	2	602.0	DOE-2094	3	756.0
MW-13S	3	459.0	MW-24S	3	488.0	DOE-2094	4	593.0
MW-13S	4	600.0	MW-24S	4	672.0	DOE-2394	3	145.0
MW-14S	1	387.0	MW-25S	3	325.0	DOE-2559	4	330.0
MW-14S	2	451.0	MW-25S	4	212.0	DOE-3094	1	195.0
MW-14S	3	609.0	MW-27S	3	347.0	DOE-3094	2	188.0
MW-14S	4	540.0	MW-27S	4	178.0	DOE-3094	3	91.8
MW-15S	1	252.0	MW-28S	3	577.0	DOE-3094	4	143.0
MW-15S	2	450.0						
Manganese (537 ug/l)								
MW-03S	1	1060.0	MW-14S	4	703.0	MW-24S	4	671.0
MW-03S	2	1260.0	MW-15S	1	613.0	MW-25S	3	1480.0
MW-03S	3	637.0	MW-15S	3	1560.0	MW-25S	4	1650.0
MW-03S	4	769.0	MW-15S	4	1450.0	MW-27S	3	732.0
MW-06S	1	539.0	MW-16S	1	4070.0	MW-28S	3	653.0
MW-10S	1	719.0	MW-16S	2	4100.0	MW-28S	4	866.0
MW-10S	2	721.0	MW-16S	3	2720.0	MW-33I	3	611.0
MW-10S	4	572.0	MW-16S	4	2440.0	MW-33I	4	741.0
MW-11S	1	1010.0	MW-21S	1	666.0	MW-34S	3	1670.0
MW-11S	2	875.0	MW-21S	2	809.0	MW-34S	4	1900.0
MW-11S	3	830.0	MW-21S	3	705.0	MW-41S	4	550.0
MW-11S	4	1140.0	MW-21S	4	632.0	DOE-2559	4	805.0
MW-12S	1	758.0	MW-22S	2	947.0	SB-35	*	670.0
MW-12S	2	630.0	MW-22S	4	1600.0	SB-52	*	1470.0
MW-14S	1	914.0	MW-24S	2	880.0	SB-53	*	1520.0
MW-14S	2	657.0	MW-24S	3	822.0	SB-60	*	621.0
MW-14S	3	903.0						

See notes at the end of this table for explanation of symbols and abbreviations.

000336

TABLE 3-33 (Continued)
DISSOLVED METALS DETECTED ABOVE BACKGROUND IN THE GROUNDWATER(+)
PADDYS RUN ROAD SITE

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round(++)	Value
Aluminum (367 ug/l)								
MW-22S	4	5610.0	MW-33I	4	600.0			
Cobalt (7 ug/l)								
MW-24S	3	8.1						
Magnesium (33589 ug/l)								
MW-03S	1	256000.0	MW-13S	2	38900.0	MW-33I	4	49100.0
MW-03S	2	286000.0	MW-14S	1	35300.0	MW-34S	3	46600.0
MW-03S	3	161000.0	MW-14S	2	34000.0	MW-34S	4	40400.0
MW-03S	4	215000.0	MW-14S	3	36600.0	MW-36S	3	34700.0
MW-04S	3	174000.0	MW-14S	4	33900.0	MW-36S	4	35500.0
MW-04S	4	142000.0	MW-15S	1	38800.0	MW-37I	SUP.2	115000.0
MW-05S	1	40000.0	MW-15S	2	41400.0	MW-37S	3	35100.0
MW-05S	3	77400.0	MW-15S	3	36500.0	MW-39S	4	54100.0
MW-05S	4	45100.0	MW-18S	2	77700.0	MW-40S	4	46500.0
MW-06S	1	36300.0	MW-18S	3	241000.0	DOE-2094	1	43300.0
MW-06S	2	67100.0	MW-18S	4	38100.0	DOE-2094	2	43600.0
MW-07S	1	51300.0	MW-21I	4	33700.0	DOE-2094	3	37500.0
MW-07S	2	39000.0	MW-21S	1	37100.0	DOE-2094	4	37300.0
MW-07S	3	52600.0	MW-21S	2	37900.0	DOE-2129	2	36300.0
MW-07S	4	44700.0	MW-21S	3	39000.0	DOE-2129	3	35300.0
MW-08S	1	46300.0	MW-21S	4	38100.0	DOE-2129	4	35100.0
MW-08S	2	56900.0	MW-22S	4	38200.00	DOE-2393	3	35200.0
MW-08S	3	59400.0	MW-23S	2	33700.0	DOE-2393	4	34100.0
MW-08S	4	42500.0	MW-23S	3	35000.0	SC-1	2	38400.0
MW-09D	1	33900.0	MW-24S	3	35600.0	SB-53	*	102000.0
MW-09D	2	34800.0	MW-24S	4	40000.0	SB-59	*	105000.0
MW-09D	3	35400.0	MW-29S	SUP.2	40000.0	SB-60	*	81500.0
MW-09D	4	38000.0	MW-31S	3	51700.0	SB-79	*	72800.0
MW-10S	1	39500.0	MW-31S	4	47400.0	SB-80	*	34100.0
MW-10S	2	38700.0	MW-32S	3	38900.0	SB-81	*	54900.0
MW-12S	1	39500.0	MW-32S	4	49000.0	ESTES	4	33700.0
MW-12S	3	34000.0	MW-33I	3	53400.0	RNCC	4	35000.0
MW-13S	1	45800.0	SB-51	*	78500.0			
MW-24S	2	40400.0	SB-52	*	94000.0			
Calcium (138549 ug/l)								
MW-10S	1	141000.0	MW-22S	2	190000.0	MW-34S	4	195000.0
MW-18S	2	179000.0	MW-22S	4	171000.0	MW-37I	SUP.2	527000.0
MW-18S	3	551000.0	MW-29S	4	142000.0	MW-37S	3	144000.0
MW-21S	3	145000.0	MW-29S	*	170000.0	MW-37S	4	145000.0
MW-21S	4	142000.0	MW-34S	3	144000.0	DOE-2394	3	141000.0
MW-22S	1	141000.0						
Sodium (60457 ug/l)								
MW-03S	1	109000.0	MW-07S	2	62300.0	MW-13S	1	172000.0
MW-03S	2	124000.0	MW-08S	1	124000.0	MW-13S	2	186000.0
MW-03S	3	126000.0	MW-08S	2	106000.0	MW-13S	3	190000.0
MW-03S	4	109000.0	MW-08S	3	77200.0	MW-13S	4	204000.0
MW-04S	3	308000.0	MW-10S	2	80200.0	MW-14S	1	210000.0
MW-04S	4	230000.0	MW-10S	3	105000.0	MW-14S	2	221000.0
MW-05S	1	531000.0	MW-10S	4	100000.0	MW-14S	3	214000.0
MW-05S	2	794000.0	MW-11S	1	173000.0	MW-14S	4	220000.0
MW-05S	3	419000.0	MW-11S	2	300000.0	MW-15S	1	274000.0
MW-05S	4	496000.0	MW-11S	3	330000.0	MW-15S	2	259000.0
MW-06S	1	1270000.0	MW-11S	4	298000.0	MW-15S	3	156000.0
MW-06S	2	938000.0	MW-12S	1	517000.0	MW-15S	4	206000.0
MW-06S	3	4050000.0	MW-12S	2	214000.0	MW-16S	1	94700.0
MW-06S	4	2250000.0	MW-12S	3	523000.0	MW-16S	2	84700.0
MW-07S	1	70000.0	MW-12S	4	179000.0	MW-18S	1	133000.0

See notes at the end of this table for explanation of symbols and abbreviations.

TABLE 3-33 (Continued)
DISSOLVED METALS DETECTED ABOVE BACKGROUND IN THE GROUNDWATER(+)
PADDYS RUN ROAD SITE

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round(++)	Value
Sodium (60457 ug/l) - (Continued)								
MW-18S	2	493000.0	MW-41S	4	95400.0	SB-50	*	134000.0
MW-18S	3	470000.0	DOE-2094	3	73600.0	SB-51	*	79200.0
MW-18S	4	125000.0	DOE-2094	4	77800.0	SB-52	*	104000.0
MW-21D	4	63100.0	DOE-2129	1	92600.0	SB-54	*	124000.0
MW-21I	3	69600.0	DOE-2129	2	137000.0	SB-55	*	132000.0
MW-21I	4	76200.0	DOE-2129	3	158000.0	SB-56	*	132000.0
MW-21S	2	66900.0	DOE-2129	4	119000.0	SB-57	*	95800.0
MW-21S	4	61100.0	SC-2	1	108000.0	SB-58	*	67900.0
MW-24S	2	84600.0	SC-1	2	82200.0	SB-59	*	92100.0
MW-24S	3	63500.0	SC-2	2	67300.0	SB-60	*	81600.0
MW-24S	4	76300.0	SC-2	3	68600.0	SB-61	*	251000.0
MW-31I	4	73800.0	SB-36	*	66400.0	SB-66	*	258000.0
MW-31S	3	145000.0	SB-38	*	471000.0	SB-67	*	379000.0
MW-31S	4	127000.0	SB-39	*	64500.0	SB-68	*	202000.0
MW-32S	3	150000.0	SB-40	*	177000.0	SB-70	*	66900.0
MW-32S	4	182000.0	SB-43	*	182000.0	SB-72	*	147000.0
MW-33I	3	160000.0	SB-44	*	224000.0	SB-73	*	93000.0
MW-33I	4	129000.0	SB-45	*	65700.0	SB-75	*	124000.0
MW-34S	3	171000.0	SB-48	*	69100.0	SB-76	*	272000.0
MW-34S	4	113000.0	SB-62	*	93700.0	SB-79	*	251000.0
MW-39S	4	124000.0	SB-63	*	205000.0	SB-81	*	144000.0
MW-40S	4	147000.0	SB-64	*	62800.0	ESTES	3	79500.0
SC-2	4	82500.0	SB-65	*	76400.0	ESTES	4	115000.0
Potassium (5021 ug/l)								
MW-03S	1	59500.0	MW-11S	2	43400.0	MW-18S	3	174000.0
MW-03S	2	53600.0	MW-11S	3	45300.0	MW-18S	4	97600.0
MW-03S	3	65400.0	MW-11S	4	39400.0	MW-19S	2	5290.0
MW-03S	4	47600.0	MW-12S	1	70200.0	MW-20S	1	28200.0
MW-04S	3	334000.0	MW-12S	2	55300.0	MW-20S	2	28600.0
MW-04S	4	206000.0	MW-12S	3	64700.0	MW-20S	3	26600.0
MW-05S	1	231000.0	MW-12S	4	44800.0	MW-20S	4	26200.0
MW-05S	2	609000.0	MW-13S	1	84100.0	MW-21D	1	349000.0
MW-05S	3	173000.0	MW-13S	2	81200.0	MW-21D	2	392000.0
MW-05S	4	396000.0	MW-13S	3	59500.0	MW-21D	3	462000.0
MW-06S	1	1530000.0	MW-13S	4	54500.0	MW-21D	4	499000.0
MW-06S	2	1030000.0	MW-14I	3	32200.0	MW-21I	3	268000.0
MW-06S	3	2510000.0	MW-14I	4	19200.0	MW-21I	4	264000.0
MW-06S	4	3160000.0	MW-14S	1	139000.0	MW-21S	1	32300.0
MW-07S	1	106000.0	MW-14S	2	126000.0	MW-21S	2	35300.0
MW-07S	2	198000.0	MW-14S	3	121000.0	MW-21S	3	23500.0
MW-07S	3	69300.0	MW-14S	4	105000.0	MW-21S	4	26900.0
MW-07S	4	39200.0	MW-15D	1	9020.0	MW-24I	3	6930.0
MW-08S	1	137000.0	MW-15D	2	9070.0	MW-24I	4	6930.0
MW-08S	2	156000.0	MW-15D	3	10100.0	MW-24D	SUP.2	11500.0
MW-08S	3	117000.0	MW-15D	4	17100.0	MW-24S	2	74700.0
MW-08S	4	74700.0	MW-15S	1	197000.0	MW-24S	3	58800.0
MW-09D	1	54400.0	MW-15S	2	197000.0	MW-24S	4	56400.0
MW-09D	2	58500.0	MW-15S	3	131000.0	MW-25S	3	30500.0
MW-09D	3	41700.0	MW-15S	4	115000.0	MW-25S	4	19800.0
MW-09D	4	41800.0	MW-16S	1	61300.0	MW-27S	3	8940.0
MW-10S	1	69100.0	MW-16S	2	55500.0	MW-27S	4	8290.0
MW-10S	2	39100.0	MW-16S	3	47300.0	MW-28S	3	32700.0
MW-10S	3	48600.0	MW-16S	4	30300.0	MW-28S	4	33900.0
MW-10S	4	32800.0	MW-18S	1	279000.0	MW-30I	3	7450.0
MW-11S	1	96600.0	MW-18S	2	254000.0	MW-30S	3	26400.0

See notes at the end of this table for explanaton of symbols and abbreviations.

000338

TABLE 3-33 (Continued)
DISSOLVED METALS DETECTED ABOVE BACKGROUND IN THE GROUNDWATER(+)
PADDYS RUN ROAD SITE

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round(++)	Value
Potassium (5021 ug/l) - (Continued)								
MW-30S	4	23000.0	DOE-3094	2	268000.0	SB-59	*	46100.0
MW-31I	4	31200.0	DOE-3094	3	200000.0	SB-60	*	26700.0
MW-31S	3	138000.0	DOE-3094	4	225000.0	SB-61	*	117000.0
MW-31S	4	124000.0	SC-1	1	234000.0	SB-62	*	121000.0
MW-32S	3	420000.0	SC-1	2	294000.0	SB-63	*	124000.0
MW-32S	4	434000.0	SC-1	3	256000.0	SB-64	*	42200.0
MW-33I	3	131000.0	SC-2	1	132000.0	SB-65	*	216000.0
MW-33I	4	115000.0	SC-2	2	162000.0	SB-66	*	480000.0
MW-34S	3	70100.0	SC-2	3	155000.0	SB-67	*	913000.0
MW-34S	4	57600.0	SC-2	4	173000.0	SB-68	*	359000.0
MW-35S	3	18600.0	SB-35	*	19300.0	SB-69	*	16400.0
MW-35S	4	10600.0	SB-36	*	80200.0	SB-70	*	19100.0
MW-35S	SUP.2	7370.0	SB-37	*	66600.0	SB-72	*	96800.0
MW-36I	SUP.2	55700.0	SB-38	*	36500.0	SB-73	*	200000.0
MW-36S	3	49400.0	SB-39	*	19400.0	SB-74	*	31000.0
MW-36S	4	51200.0	SB-40	*	55200.0	SB-75	*	223000.0
MW-37I	SUP.2	11900.0	SB-42	*	26700.0	SB-76	*	271000.0
MW-39S	4	182000.0	SB-43	*	71700.0	SB-77	*	7430.0
MW-40S	4	95500.0	SB-44	*	50600.0	SB-79	*	117000.0
MW-41S	4	29600.0	SB-45	*	41800.0	SB-80	*	50000.0
DOE-2094	1	155000.0	SB-46	*	22900.0	SB-81	*	108000.0
DOE-2094	2	173000.0	SB-48	*	39600.0	EVERS	1	120000.0
DOE-2094	3	194000.0	SB-49	*	57100.0	EVERS	2	172000.0
DOE-2094	4	191000.0	SB-50	*	99600.0	EVERS	3	117000.0
DOE-2129	1	30300.0	SB-51	*	58900.0	EVERS	4	86000.0
DOE-2129	2	54500.0	SB-52	*	119000.0	RNCC	1	59000.0
DOE-2129	3	48800.0	SB-53	*	97500.0	RNCC	2	62600.0
DOE-2129	4	63100.0	SB-54	*	62700.0	RNCC	3	50700.0
DOE-2393	3	8860.0	SB-55	*	227000.0	RNCC	4	49200.0
DOE-2393	4	7250.0	SB-56	*	68500.0	WEBER 2	1	7880.0
DOE-2559	4	32500.0	SB-57	*	35800.0	WEBER 3	2	8870.0
DOE-2561	SUP.2	7150.0	SB-58	*	37800.0	AW-2	3	15700.0
DOE-3094	1	241000.0						

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(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)The groundwater samples were collected as follows: Round 1 (ENSR)-May 1990; Round 2 (ENSR)-July/August 1990; Round 3 (ERM)-January/February 1991; Round 4 (ERM)-May 1991; Sup. 1-September/October 1992; Sup. 2-October 1992.

*Groundwater sample taken from soil boring in October 1992.

Sample ID Key:
DOE-2394 - U.S. DOE FEMP Monitor Well
MW-025 - PRRS Monitor Well
SC-1 - Steel Corp. Monitor Well
SB-36 - PRRS Soil Boring
Estes, Rolfes - Domestic Wells
AW, EVERS, HPF, RNCC, STEEL, WEBER - Industrial Wells

TABLE 3-34
TOTAL METALS DETECTED ABOVE BACKGROUND IN GROUNDWATER SAMPLES(+)
PADDYS RUN ROAD SITE

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round(++)	Value
Antimony (15 ug/l)								
MW-02S	4	31.3	MW-33I	4	31.7	DOE-3094	4	22.0
MW-04S	4	30.7				SB-59	*	135.0
Arsenic (33 ug/l)								
MW-01S	3	171.0	MW-15S	3	394.0	SB-37	*	329.0
MW-03S	4	70.9	MW-16S	3	540.0	SB-49	*	41.4
MW-04S	3	442.0	MW-18S	4	61.2	SB-50	*	633
MW-04S	4	220.0	MW-21S	3	98.0	SB-52	*	39.8
MW-06S	3	291.0	MW-21S	4	65.4	SB-53	*	56.8
MW-06S	4	260.0	MW-24S	3	64.2	SB-54	*	39.4
MW-07S	3	104.0	MW-24S	4	37.3	SB-55	*	77.1
MW-08S	3	228.0	MW-30S	3	595.0	SB-56	*	45.7
MW-08S	4	55.8	MW-32S	3	178.0	SB-61	*	319.0
MW-09D	3	37.3	MW-33I	3	180.0	SB-62	*	597.0
MW-10S	3	250.0	MW-33I	4	68.2	SB-64	*	465.0
MW-11S	3	1140.0	MW-34S	3	183.0	SB-65	*	294.0
MW-11S	4	181.0	DOE-2094	3	190.0	SB-67	*	555.0
MW-12S	3	178.0	DOE-2094	4	179.0	SB-68	*	2030.0
MW-12S	4	63.0	DOE-2129	3	492.0	SB-70	*	136.0
MW-13S	3	871.0	DOE-2129	4	286.0	SB-75	*	62.3
MW-13S	4	191.0	DOE-3095	4	68.7	SB-77	*	780.0
MW-14S	3	729.0	EVERS	3	72.6	SB-80	*	41.4
MW-14S	4	107.0	WEBER 2	4	30.0	SB-81	*	77.2
Beryllium (7 ug/l)								
MW-22S	3	15.6	STEEL 1	3	7.1			
Cadmium (3 ug/l)								
MW-01S	3	8.3	MW-05S	3	5.4	MW-22S	3	7.0
MW-03S	4	5.8	MW-11S	3	5.1	MW-37S	3	5.8
MW-04S	3	5.8	MW-14S	3	6.4	STEEL 1	3	35.0
Chromium (188 ug/l)								
MW-01S	3	643.0	MW-14S	3	241.0	MW-22S	3	363.0
MW-11S	3	216.0	MW-18S	3	217.0			
Copper (196 ug/l)								
MW-01S	3	394.0	MW-16S	3	314.0	MW-30S	3	235.0
MW-05S	3	1680.0	MW-22S	3	479.0	MW-32S	3	203.0
MW-11S	3	481.0	MW-23S	3	272.0	MW-37S	3	247.0
MW-13S	3	430.0	MW-29S	3	255.0	STEEL 1	3	697.0
MW-14I	3	341.0	MW-30I	3	442.0	SB-59	*	234.0
MW-14S	3	924.0						
Lead (67 ug/l)								
MW-01D	3	80.8	MW-14S	3	208.0	MW-30I	3	129.0
MW-01S	3	194.0	MW-16S	3	113.0	MW-30S	3	89.4
MW-05S	3	279.0	MW-19S	3	73.0	MW-37S	3	86.2
MW-07S	3	70.4	MW-21S	3	72.6	DOE-2095	3	89.4
MW-11S	3	262.0	MW-22S	3	311.0	STEEL 1	3	634.0
MW-12S	3	79.7	MW-29S	3	88.3	SB-53	*	73.2
MW-14I	3	85.7						
Mercury (0.2 ug/l)								
MW-02S	3	0.22	MW-12S	4	0.220	MW-29S	3	0.29
MW-04S	3	0.6	MW-13S	3	0.22	MW-30S	3	0.22
MW-05S	3	15.0	MW-14S	3	0.32	MW-41S	4	0.230
MW-05S	4	1.1	MW-15S	3	0.22	DOE-2554	4	0.230
MW-07S	3	0.25	MW-16S	3	0.27	STEEL 1	3	0.74
MW-10S	3	0.3	MW-18S	3	0.3	SB-53	*	0.23
MW-11S	3	1.0	MW-22S	3	0.58	SB-59	*	0.24
MW-12S	4	0.220						
Nickel (143 ug/l)								
MW-01S	3	1230.0	MW-16S	3	228.0	MW-30S	3	159.0
MW-01S	4	157.0	MW-22S	3	453.0	MW-32S	3	170.0
MW-11S	3	354.0	MW-23S	3	185.0	MW-37S	3	146.0
MW-13S	3	255.0	MW-29S	4	154.0	STEEL 1	3	178.0
MW-14S	3	563.0	MW-30I	3	276.0			

See notes at the end of this table for explanation of symbols and abbreviations.

000010

TABLE 3-34 (Continued)
TOTAL METALS DETECTED ABOVE BACKGROUND IN GROUNDWATER SAMPLES(+)
PADDYS RUN ROAD SITE

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round(++)	Value
Zinc (420 ug/l)								
MW-01S	3	782.0	MW-14S	3	1220.0	MW-29S	3	550.0
MW-05S	3	526.0	MW-16S	3	623.0	MW-30I	3	874.0
MW-11S	3	1020.0	MW-22S	3	1520.0	MW-37S	3	440.0
MW-13S	3	670.0	MW-23S	3	603.0	SB-59	*	658.0
MW-14I	3	487.0	MW-24D	11	2030.0	STEEL 1	3	3350.0
Barium (184 ug/l)								
MW-01S	3	957.0	MW-16S	3	3290.0	MW-30I	3	366.0
MW-01S	4	239.0	MW-19S	3	382.0	MW-30S	3	6340.0
MW-02S	3	368.0	MW-20S	3	293.0	MW-30S	4	426.0
MW-02S	4	250.0	MW-21S	3	1230.0	MW-32S	3	475.0
MW-03S	3	188.0	MW-21S	4	597.0	MW-34S	3	532.0
MW-04S	3	289.0	MW-22S	3	1990.0	MW-34S	4	292.0
MW-05S	3	352.0	MW-23S	3	1260.0	MW-35S	3	284.0
MW-07S	3	1200.0	MW-24S	3	510.0	MW-35S	4	369.0
MW-10S	3	427.0	MW-24S	4	616.0	MW-37S	3	979.0
MW-11S	3	3330.0	MW-25S	3	433.0	MW-41S	4	205.0
MW-11S	4	190.0	MW-25S	4	207.0	DOE-2094	3	722.0
MW-12S	3	695.0	MW-27S	3	925.0	DOE-2094	4	694.0
MW-12S	4	293.0	MW-27S	4	314.0	DOE-2394	3	255.0
MW-13S	3	4490.0	MW-28S	3	572.0	DOE-2559	4	310.0
MW-13S	4	558.0	MW-28S	4	751.0	STEEL 1	3	1050.0
MW-14S	3	4820.0	MW-29S	3	552.0	SB-59	*	428.0
MW-14S	4	512.0	MW-29S	4	216.0			
MW-15S	3	811.0						
Iron (186690 ug/l)								
MW-01S	3	425000.0	MW-14S	3	445000.0	MW-30S	3	258000.0
MW-10S	3	228000.0	MW-15S	3	209000.0	MW-32S	3	221000.0
MW-11S	3	1310000.0	MW-16S	3	339000.0	STEEL 1	3	211000.0
MW-12S	3	236000.0	MW-22S	3	477000.0	SB-59	*	292000.0
MW-13S	3	729000.0	MW-30I	3	207000.0			
Manganese (11390 ug/l)								
MW-01S	3	18800.0	MW-14S	3	61900.0	MW-22S	3	18900.0
MW-11S	3	66700.0	MW-15S	3	22400.0	MW-30S	3	58900.0
MW-12S	3	17200.0	MW-16S	3	72500.0	MW-37S	3	15000.0
MW-13S	3	59400.0						
Vanadium (42 ug/l)								
MW-01S	3	232.0	MW-13S	3	183.0	MW-23S	3	190.0
MW-02S	3	51.9	MW-14S	3	272.0	MW-24I	3	50.6
MW-02S	4	65.6	MW-15S	3	87.8	MW-27S	3	81.3
MW-03S	3	50.3	MW-16S	3	210.0	MW-29S	3	160.0
MW-04S	3	68.0	MW-19S	3	110.0	MW-30I	3	249.0
MW-05S	3	57.5	MW-21S	4	68.1	SB-52	*	46.3
MW-07S	3	131.0	MW-22S	3	623.0	SB-53	*	62.1
MW-10S	3	101.0	MW-30S	3	116.0	SB-59	*	153.0
MW-11S	3	313.0	MW-32S	3	147.0	SB-60	*	42.8
MW-12S	3	114.0	MW-37S	3	125.0	SB-78	*	57.1
MW-20S	3	94.9	STEEL 1	3	303.0	SB-80	*	55.7
MW-21S	3	111.0						
Aluminum (17982 ug/l)								
MW-01S	3	46300.0	MW-14S	3	113000.0	MW-29S	3	67000.0
MW-02S	3	24500.0	MW-15S	3	25100.0	MW-30I	3	84100.0
MW-02S	4	27900.0	MW-16S	3	67700.0	MW-30S	3	39900.0
MW-04S	3	25600.0	MW-19S	3	51500.0	MW-32S	3	46700.0
MW-05S	3	25700.0	MW-20S	3	39500.0	MW-37S	3	39100.0
MW-07S	3	35900.0	MW-21S	3	51100.0	STEEL 1	3	146000.0
MW-10S	3	26000.0	MW-21S	4	26200.0	SB-53	*	24600.9
MW-11S	3	104000.0	MW-22S	3	325000.0	SB-59	*	54500.0
MW-12S	3	27000.0	MW-23S	3	77000.0	SB-78	*	22400.0
MW-13S	3	52300.0	MW-27S	3	32600.0	SB-80	*	19700.0

See notes at the end of this table for explanation of symbols and abbreviations.

TABLE 3-34 (Continued)
TOTAL METALS DETECTED ABOVE BACKGROUND IN GROUNDWATER SAMPLES(+)
PADDYS RUN ROAD SITE

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round(++)	Value
Cobalt (21 ug/l)								
MW-01S	3	127.0	MW-16S	3	105.0	MW-30I	3	101.0
MW-04S	3	26.5	MW-19S	3	54.7	MW-30S	3	144.0
MW-07S	3	31.8	MW-20S	3	35.5	MW-32S	3	43.1
MW-09D	3	22.1	MW-21S	3	47.8	MW-37S	3	103.0
MW-10S	3	38.1	MW-21S	4	25.8	DOE-2095	3	23.8
MW-11S	3	195.0	MW-22S	3	182.0	STEEL 1	3	81.7
MW-12S	3	50.0	MW-23S	3	73.1	SB-53	*	23.8
MW-13S	3	118.0	MW-24I	3	22.3	SB-59	*	67.7
MW-14S	3	178.0	MW-27S	3	30.6	SB-78	*	22.9
MW-15S	3	59.8	MW-29S	3	67.2	SB-80	*	28.8
Magnesium (76441 ug/l)								
MW-01S	3	238000.0	MW-14I	3	76700.0	MW-29S	4	184000
MW-02S	4	79100.0	MW-14S	3	712000.0	MW-30I	3	251000.0
MW-03S	3	254000.0	MW-15S	3	159000.0	MW-30S	3	242000.0
MW-03S	4	221000.0	MW-16S	3	455000.0	MW-31S	4	84500.0
MW-04S	3	602000.0	MW-18S	3	236000.0	MW-32S	3	1130000.0
MW-04S	4	261000.0	MW-19S	3	237000.0	MW-34S	3	147000.0
MW-05S	3	270000.0	MW-21S	4	94400.0	DOE-2392	SUP.2	167000.0
MW-07S	3	343000.0	MW-22S	3	545000.0	STEEL 1	3	81300.0
MW-10S	3	167000.0	MW-23S	3	344000.0	SB-52	*	171000.0
MW-11S	3	684000.0	MW-27S	3	287000.0	SB-53	*	187000.0
MW-12S	3	262000.0	MW-29S	3	315000.0	SB-59	*	516000.0
MW-12S	4	159000.0	MW-36I	SUP.2	114000.0	SB-60	*	210000.0
MW-13S	3	325000.0	MW-37S	3	132000.0	SB-78	*	95300.0
MW-20S	3	101000.0	MW-40S	4	88700.0	SB-80	*	194000.0
MW-21S	3	124000.0	DOE-2095	3	89500.0	SB-81	*	111000.0
Calcium (238165 ug/l)								
MW-01S	3	1210000.0	MW-15S	3	480000.0	MW-34S	3	390000.0
MW-02S	3	364000.0	MW-16S	3	1350000.0	MW-36I	SUP.2	298000.0
MW-02S	4	258000.0	MW-18S	3	545000.0	MW-37S	3	585000.0
MW-03S	3	370000.0	MW-19S	3	655000.0	DOE-2095	3	276000.0
MW-04S	3	1520000.0	MW-20S	3	331000.0	DOE-2392	SUP.2	515000.0
MW-04S	4	350000.0	MW-21S	3	867000.0	DOE-2558	SUP.2	298000.0
MW-05S	3	497000.0	MW-21S	4	330000.0	SB-52	*	454000.0
MW-07S	3	1040000.0	MW-22S	3	1260000.0	SB-53	*	455000.0
MW-09D	3	240000.0	MW-23S	3	1590000.0	SB-59	*	1280000.0
MW-10S	3	619000.0	MW-27S	3	880000.0	SB-60	*	695000.0
MW-11S	3	2320000.0	MW-29S	3	1080000.0	SB-78	*	309000.0
MW-12S	3	896000.0	MW-29S	4	568000.0	SB-80	*	655000.0
MW-12S	4	465000.0	MW-30I	3	718000.0	SB-81	*	239000.0
MW-13S	3	1190000.0	MW-30S	3	671000.0			
MW-14S	3	1740000.0	MW-32S	3	2340000.0			
Sodium (189339 ug/l)								
MW-04S	3	289000.0	MW-11S	4	299000.0	SB-61	*	264000.0
MW-04S	4	243000.0	MW-12S	3	439000.0	SB-66	*	246000.0
MW-05S	3	406000.0	MW-13S	4	213000.0	SB-67	*	468000.0
MW-05S	4	547000.0	MW-14S	3	193000.0	SB-68	*	197000.0
MW-06S	3	4260000.0	MW-14S	4	211000.0	SB-76	*	270000.0
MW-06S	4	2510000.0	MW-15S	4	199000.0	SB-79	*	311000.0
MW-11S	3	287000.0	MW-18S	3	432000.0			

See notes at the end of this table for explanation of symbols and abbreviations.

000342

TABLE 3-34 (Continued)
TOTAL METALS DETECTED ABOVE BACKGROUND IN GROUNDWATER SAMPLES(+)
PADDYS RUN ROAD SITE

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round(++)	Value
Potassium (6045 ug/l)								
MW-01S	3	13200.0	MW-21S	4	31600.0	DOE-2558	SUP.2	6530.0
MW-02S	3	6800.0	MW-22S	3	38200.0	DOE-2559	4	30600.0
MW-02S	4	6420.0	MW-23S	3	17700.0	DOE-2561	SUP.2	6860.0
MW-03S	3	60900.0	MW-24I	3	10100.0	DOE-3094	3	197000.0
MW-03S	4	46000.0	MW-24I	4	6400.0	DOE-3094	4	214000.0
MW-04S	3	319000.0	MW-24S	3	55500.0	EVERS	3	115000.0
MW-04S	4	248000.0	MW-24S	4	52300.0	STEEL 1	3	263000.0
MW-05S	3	166000.0	MW-24D	SUP.2	11900.0	STEEL 2	3	169000.0
MW-05S	4	401000.0	MW-25S	3	30800.0	STEEL 2	4	159000.0
MW-06S	3	3000000.0	MW-27S	3	15700.0	RNCC	4	45200.0
MW-06S	4	3500000.0	MW-27S	4	8480.0	WEBER 2	4	80100.0
MW-07S	3	75200.0	MW-28S	3	32300.0	SB-37	*	63100.0
MW-07S	4	37600.0	MW-28S	4	33500.0	SB-47	*	51100.0
MW-08S	3	107000.0	MW-29S	3	16900.0	SB-48	*	36000.0
MW-08S	4	80200.0	MW-30I	3	24000.0	SB-49	*	57600.0
MW-09D	3	40700.0	MW-30S	3	31900.0	SB-50	*	130000.0
MW-09D	4	43800.0	MW-30S	4	22500.0	SB-52	*	113000.0
MW-10S	3	50100.0	MW-31I	4	29800.0	SB-53	*	91700.0
MW-10S	4	34100.0	MW-31S	3	126000.0	SB-54	*	40200.0
MW-11S	3	57700.0	MW-31S	4	111000.0	SB-55	*	203000.0
MW-11S	4	41200.0	MW-32S	3	415000.0	SB-56	*	83000.0
MW-12S	3	66900.0	MW-32S	4	339000	SB-57	*	40500.0
MW-12S	4	46100.0	RNCC	3	48700.0	SB-58	*	38100.0
MW-25S	4	19200.0						
MW-13S	3	77100.0	MW-33I	3	121000.0	SB-59	*	55300.0
MW-13S	4	57300.0	MW-33I	4	108000.0	SB-60	*	27700
MW-14I	3	23000.0	MW-34S	3	69000.0	SB-61	*	127000.0
MW-14I	4	18400.0	MW-34S	4	66700.0	SB-62	*	106000.0
MW-14S	3	137000.0	MW-35S	3	20000.0	SB-63	*	119000.0
MW-14S	4	99900.0	MW-35S	4	11200.0	SB-64	*	48400.0
MW-15D	3	9610.0	MW-35S	SUP.2	6630.0	SB-65	*	210000.0
MW-15D	4	11400.0	MW-36S	3	46300.0	SB-66	*	466000.0
MW-15S	3	142000.0	MW-36S	4	45400.0	SB-67	*	846000.0
MW-15S	4	112000.0	MW-36I	SUP.2	52300.0	SB-68	*	388000.0
MW-16S	3	56000.0	MW-37S	3	11200.0	SB-69	*	20500.0
MW-16S	4	28400.0	MW-37I	SUP.2	13600.0	SB-70	*	26400.0
MW-18S	3	161000.0	MW-39S	4	189000.0	SB-72	*	91000.0
MW-18S	4	91800.0	MW-40S	4	94500.0	SB-73	*	178000.0
MW-19S	3	13700.0	MW-41S	4	30300.0	SB-74	*	63600.0
MW-20S	3	32200.0	DOE-2094	3	171000.0	SB-75	*	309000.0
MW-20S	4	26300.0	DOE-2094	4	186000.0	SB-76	*	419000.0
MW-21D	3	503000.0	DOE-2129	3	47300.0	SB-77	*	21400.0
MW-21D	4	479000.0	DOE-2129	4	58500.0	SB-78	*	7780.0
MW-21I	3	272000.0	DOE-2392	SUP.2	14600.0	SB-79	*	359000.0
MW-21I	4	256000.0	DOE-2393	3	9130.0	SB-80	*	47800.0
MW-21S	3	35500.0	DOE-2393	4	7180.0	SB-81	*	109000.0

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(+)The number in the parenthesis after each constituent is the background value; sample values are reported in the same unit as the background value.

(++)The groundwater samples were collected as follows: Round 1 (ENSR)-May 1990; Round 2 (ENSR)-July/August 1990; Round 3 (ERM)-January/February 1991; Round 4 (ERM)-May 1991; Sup. 1-September/October 1992; Sup. 2-October 1992.

*Groundwater sample taken from soil boring in October 1992.

Sample ID Key:
DOE-2394 - U.S. DOE FEMP Monitor Well
MW-025 - PRRS Monitor Well
SC-1 - Steel Corp. Monitor Well
SB-36 - PRRS Soil Boring
Estes, Rolfes - Domestic Wells
AW, EVERS, HPF, RNCC, STEEL, WEBER - Industrial Wells

TABLE 3-35
VOLATILE ORGANIC COMPOUNDS DETECTED ABOVE BACKGROUND IN THE GROUNDWATER
PADDYS RUN ROAD SITE(+)*

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round(++)	Value
Benzene (5 ug/l)								
MW-01D	4	8.0	MW-13S	1	2200.0	MW-16S	1	83.0
MW-10S	1	670.0	MW-13S	2	1300.0	MW-16S	4	6.0
MW-10S	2	140.0	MW-13S	3	1400.0	MW-21D	4	62.0
MW-10S	4	440.0	MW-13S	4	1300.0	MW-22S	4	30.0
MW-11S	1	6300.0	MW-14S	1	660.0	MW-24S	2	49.0
MW-11S	2	2800.0	MW-14S	2	420.0	MW-36S	4	8.0
MW-11S	3	12000.0	MW-14S	3	380.0	MW-40S	4	55.0
MW-11S	4	120000.0	MW-14S	4	530.0	MW-41S	4	3500.0
MW-12S	1	2100.0	MW-15S	1	570.0	DOE-2094	1	7.0
MW-12S	2	1900.0	MW-15S	2	1400.0	SB-40	*	67.0
MW-12S	3	2400.0	MW-15S	3	370.0	SB-47	*	2700.0
1,2-Dichloroethane (5 ug/l)								
MW-41S	4	120.0						
Ethylbenzene (5 ug/l)								
MW-01D	4	110.0	MW-14S	4	6200.0	MW-28S	4	14.0
MW-01S	4	35.0	MW-15S	1	1200.0	MW-31S	3	12000.0
MW-06S	4	52.0	MW-15S	2	1100.0	MW-31S	4	7000.0
MW-10S	1	15000.0	MW-15S	3	270.0	MW-31I	4	34.0
MW-10S	2	2700.0	MW-15S	4	19.0	MW-34S	3	19000.0
MW-10S	3	6200.0	MW-16S	1	300.0	MW-34S	4	6200.0
MW-10S	4	6200.0	MW-16S	3	350.0	MW-36S	4	36.0
MW-11S	1	230000.0	MW-16S	4	84.0	MW-37S	4	420.0
MW-11S	2	16000.0	MW-20D	4	73.0	MW-40S	4	12000.0
MW-11S	3	240000.0	MW-21D	1	8.0	MW-41S	4	16000.0
MW-11S	4	3100000.0	MW-21D	4	520.0	DOE-2559	4	240.0
MW-12S	1	17000.0	MW-21S	1	14000.0	SB-36	*	50.0
MW-12S	2	17000.0	MW-21S	2	10000.0	SB-37	*	60.0
MW-12S	3	24000.0	MW-21S	3	12000.0	SB-38	*	1300.0
MW-12S	4	39000.0	MW-21S	4	7300.0	SB-39	*	20.0
MW-13S	1	27000.0	MW-21I	3	470.0	SB-40	*	5800.0
MW-13S	2	15000.0	MW-21I	4	88.0	SB-42	*	16.0
MW-13S	3	14000.0	MW-22S	4	160.0	SB-43	*	7800.0
MW-13S	4	24000.0	MW-24S	2	130.0	SB-44	*	20.0
MW-14S	1	3800.0	MW-24I	4	18.0	SB-46	*	1000.0
MW-14S	2	3900.0	MW-25S	3	1300.0	SB-47	*	2200.0
MW-14S	3	2400.0	MW-25S	4	2400.0			
Methylene Chloride (13 ug/l)								
MW-01S	1	22.0	MW-13S	3	1100.0	DOE-2126	2	14.0
MW-10S	1	3500.0	MW-14S	1	170.0	EVERS	2	16.0
MW-10S	2	250.0	MW-14S	2	670.0	SB-39	*	30.0
MW-11S	1	22000.0	MW-15S	2	190.0	SB-40	*	20.0
MW-11S	2	1600.0	MW-16S	2	250.0	SB-42	*	26.0
MW-12S	1	8700.0	MW-21S	1	15000.0	SB-44	*	18.0
MW-13S	1	1200.0	MW-21S	2	6500.0	SB-47	*	4600.0
MW-13S	2	1200.0						
Toluene (5 ug/l)								
MW-01D	4	210.0	MW-10S	1	37000.0	MW-10S	4	9100.0
MW-01S	4	66.0	MW-10S	2	2900.0	MW-11S	1	300000.0
MW-06S	4	90.0	MW-10S	3	8000.0	MW-11S	2	130000.0

See notes at the end of this table for explanation of symbols and abbreviations.

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TABLE 3-35 (Continued)
VOLATILE ORGANIC COMPOUNDS DETECTED ABOVE BACKGROUND IN THE GROUNDWATER
PADDYS RUN ROAD SITE(+)*

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round(++)	Value
Toluene (5 ug/l) - Continued								
MW-11S	3	430000.0	MW-20S	4	6.0	MW-34S	3	16000.0
MW-11S	4	3300000.0	MW-21D	4	1200.0	MW-36S	4	150.0
MW-12S	1	100000.0	MW-21S	1	52000.0	MW-37S	4	430.0
MW-12S	2	120000.0	MW-21S	2	22000.0	MW-40S	4	29000.0
MW-12S	3	110000.0	MW-21S	3	28000.0	MW-41S	4	1400.0
MW-12S	4	84000.0	MW-21S	4	19000.0	MW-31I	4	8.0
MW-13S	1	77000.0	MW-21I	3	1400.0	SB-37	*	76.0
MW-13S	2	49000.0	MW-21I	4	240.0	SB-38	*	2600.0
MW-13S	3	51000.0	MW-22S	4	460.0	SB-39	*	49.0
MW-13S	4	42000.0	MW-24I	4	32.0	SB-40	*	23000.0
MW-14S	1	2300.0	MW-25S	3	290.0	SB-42	*	37.0
MW-14S	2	580.0	MW-25S	4	590.0	SB-44	*	82.0
MW-14S	3	280.0	MW-28S	4	22.0	SB-46	*	870.0
MW-14S	4	3000.0	MW-29S	4	6.0	SB-47	*	13000.0
MW-16S	1	7.0	MW-31S	3	3800.0	SB-80	*	20.0
MW-20D	4	140.0	MW-31S	4	860.0			
Acetone (3.3 ug/l)								
MW-14S	1	900.0	MW-22S	1	19.0	STEEL 1	1	18.0
MW-15D	1	30.0	MW-24I	4	5.0	EVERS	1	14.0
MW-16S	1	13.0	MW-24D	*	11.0	HPF	1	16.0
MW-21I	3	94.0	DOE-2126	2	10.0	SB-80	*	290.0
MW-21S	3	9100.0	DOE-2127	SUP.2	370.0			
2-Hexanone (3.3 ug/l)								
MW-06S	4	4.0						
Xylenes (5 ug/l)								
MW-01D	4	56.0	MW-15S	1	4000.0	MW-29S	4	37.0
MW-01S	4	18.0	MW-15S	2	9100.0	MW-31S	3	3200.0
MW-06S	4	150.0	MW-15S	3	3000.0	MW-31S	4	1600.0
MW-09D	4	21.0	MW-15S	4	18.0	MW-31I	4	24.0
MW-10S	1	48000.0	MW-16S	1	900.0	MW-34S	3	40000.0
MW-10S	2	11000.0	MW-16S	2	300.0	MW-34S	4	14000.0
MW-10S	3	13000.0	MW-16S	3	7900.0	MW-36S	4	130.0
MW-10S	4	860.0	MW-16S	4	100.0	MW-37S	4	1400.0
MW-11S	1	820000.0	MW-20D	4	38.0	MW-40S	4	3700.0
MW-11S	2	61000.0	MW-21S	1	67000.0	MW-41S	4	6800.0
MW-11S	3	340000.0	MW-21S	2	65000.0	DOE-2559	4	1000.0
MW-11S	4	9600000.0	MW-21S	3	55000.0	STEEL 1	1	11.0
MW-12S	1	54000.0	MW-21S	4	25000.0	SB-35	*	7.0
MW-12S	2	65000.0	MW-21I	3	2300.0	SB-36	*	240.0
MW-12S	3	26000.0	MW-21I	4	59.0	SB-37	*	270.0
MW-12S	4	18000.0	MW-21D	4	240.0	SB-38	*	4800.0
MW-13S	1	92000.0	MW-22S	4	76.0	SB-39	*	85.0
MW-13S	2	69000.0	MW-24S	2	1100.0	SB-40	*	26000.0
MW-13S	3	69000.0	MW-24S	3	770.0	SB-42	*	120.0
MW-13S	4	7800.0	MW-24S	4	2000.0	SB-43	*	26000.0
MW-14S	1	18000.0	MW-24I	4	8.0	SB-44	*	93.0
MW-14S	2	20000.0	MW-25S	3	2600.0	SB-46	*	3900.0
MW-14S	3	9000.0	MW-25S	4	7800.0	SB-47	*	7500.0
MW-14S	4	1200.0	MW-28S	4	7.0	SB-80	*	22.0
MW-14I	4	9.0						

See notes at the end of this table for explanation of symbols and abbreviations.

TABLE 3-35 (Continued)
VOLATILE ORGANIC COMPOUNDS DETECTED ABOVE BACKGROUND IN THE GROUNDWATER
PADDYS RUN ROAD SITE(+)*

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round(++)	Value
Cumene (5.0 ug/l)								
MW-01D	4	89.0	MW-15S	3	3000.0	MW-31I	4	54.0
MW-01S	4	27.0	MW-15S	4	310.0	MW-34S	3	37000.0
MW-06S	4	69.0	MW-16S	1	690.0	MW-34S	4	17000.0
MW-09D	4	9.0	MW-16S	2	5400.0	MW-35S	4	7.0
MW-10S	1	18000.0	MW-16S	3	7900.0	MW-36S	4	16.0
MW-10S	2	1800.0	MW-16S	4	4100.0	MW-37S	4	530.0
MW-10S	3	18000.0	MW-20D	4	59.0	MW-40S	4	10000.0
MW-10S	4	4500.0	MW-21D	1	7.0	MW-41S	4	9200.0
MW-11S	1	260000.0	MW-21D	4	330.0	DOE-2094	1	230.0
MW-11S	2	6200.0	MW-21S	1	19000.0	DOE-2094	3	81.0
MW-11S	3	340000.0	MW-21S	2	24000.0	DOE-2094	4	87.0
MW-11S	4	2900000.0	MW-21S	3	29000.0	DOE-2559	4	2400.0
MW-12S	1	7200.0	MW-21S	4	13000.0	DOE-2559	5	130.0
MW-12S	2	9800.0	MW-21I	3	710.0	DOE-2127	*	1400.0
MW-12S	3	26000.0	MW-21I	4	46.0	SB-35	*	120.0
MW-12S	4	37000.0	MW-22S	4	100.0	SB-36	*	340.0
MW-13S	1	15000.0	MW-24S	2	260.0	SB-37	*	69.0
MW-13S	2	9700.0	MW-24S	4	4900.0	SB-38	*	1200.0
MW-13S	3	7700.0	MW-24S	3	2100.0	SB-39	*	96.0
MW-13S	4	11000.0	MW-24I	4	130.0	SB-40	*	8500.0
MW-14S	1	5400.0	MW-25S	3	3900.0	SB-42	*	1300.0
MW-14S	2	7100.0	MW-25S	4	5300.0	SB-43	*	5200.0
MW-14S	3	9000.0	MW-28S	4	13.0	SB-44	*	14.0
MW-14S	4	6900.0	MW-31S	3	17000.0	SB-46	*	1600.0
MW-15S	1	1100.0	MW-31S	4	11000.0	SB-47	*	3500.0
MW-15S	2	4900.0						

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(+)The number in parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)The groundwater samples were collected as follows: Round 1 (ENSR)-May 1990; Round 2(ENSR)-July/August 1990; Round 3 (ERM)-January/February 1991; Round 4 (ERM)-May 1991; Sup. 1-September/October 1992; Sup. 2-October 1992.

* Groundwater sample taken from soil boring in October 1992.

Sample ID Key:
DOE-2394 - U.S. DOE FEMP Monitor Well
MW-025 - PRRS Monitor Well
SC-1 - Steel Corp. Monitor Well
SB-36 - PRRS Soil Boring
Estes, Rolfes - Domestic Wells
AW, EVERS, HPF, RNCC, STEEL, WEBER - Industrial Wells

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TABLE 3-36
SEMIVOLATILE ORGANIC COMPOUNDS DETECTED
ABOVE BACKGROUND IN THE GROUNDWATER(+)
PADDYS RUN ROAD SITE

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round(++)	Value
Acenaphthene [DL (10 ug/l)]								
MW-11S	4	230.0						
Acenaphthylene [DL (10 ug/l)]								
MW-11S	4	180.0						
Anthracene [DL (10 ug/l)]								
MW-11S	4	210.0						
Benzo(a)pyrene [DL (10 ug/l)]								
MW-11S	4	200.0						
Benzo(b)fluoranthene [DL (10 ug/l)]								
MW-11S	4	240.0						
Benzo(k)fluoranthene [DL (10 ug/l)]								
MW-11S	4	270.0						
Bis(2-chloroisopropyl)ether [DL (10 ug/l)]								
MW-13S	4	71.0						
Bis(2-ethylhexyl)phthalate (10 ug/l)								
MW-01D	2	15.0	MW-13S	4	490.0	MW-21I	4	26.0
MW-06S	1	13.0	MW-14I	4	12.0	MW-31I	4	11.0
MW-06S	4	67.0	MW-15D	4	56.0	MW-34S	4	720.0
MW-10S	1	11.0	MW-18D	1	28.0	MW-41S	4	33000.0
MW-11S	1	180.0	MW-19S	4	23.0	MW-24D	SUP.2	210.0
MW-11S	2	610.0	MW-21D	1	12.0	MW-36I	SUP.2	70.0
MW-11S	4	80000.0	MW-21D	4	140.0	DOE-3126	1	17.0
MW-12S	2	720.0	MW-21S	1	45.0	SB-51	*	11.0
MW-12S	4	7300.0	MW-21S	2	22.0			
4-Bromophenyl Phenyl Ether [DL (10 ug/l)]								
MW-11S	4	120.0						
4-Chlorophenyl Phenyl Ether [DL (10 ug/l)]								
MW-11S	4	190.0						
1,2-Dichlorobenzene [DL (10 ug/l)]								
MW-13S	4	45.0	MW-31S	3	11.0	MW-31	4	11.0
1,4-Dichlorobenzene (3.8 ug/l)								
AW-2	4	7.0	MW-34S	3	6.0			
Diethyl Phthalate [DL (10 ug/l)]								
MW-12S	4	25.0	MW-24D	SUP.2	210.0			
Dimethyl Phthalate [DL (10 ug/l)]								
MW-11S	4	120.0						
Di-n-butyl Phthalate [DL (10 ug/l)]								
MW-11S	4	100.0	MW-12S	4	15.0	MW-13S	4	15.0
2,4-Dinitrotoluene (2.1 ug/l)								
MW-11S	3	8.0	AW-2	4	4.0			
Di-n-octyl Phthalate (1.5 ug/l)								
MW-09D	4	3.0	MW-13S	4	210.0	DOE-2095	1	2.0
MW-11S	4	610.0	MW-20D	4	2.0			
MW-12S	2	57.0	MW-21I	3	2.0			

See notes at the end of this table for explanation of symbols and abbreviations.

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TABLE 3-36 (Continued)
SEMIVOLATILE ORGANIC COMPOUNDS DETECTED
ABOVE BACKGROUND IN THE GROUNDWATER(+)
PADDYS RUN ROAD SITE

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round(++)	Value
Fluoranthene [DL (10 ug/l)]								
MW-11S	4	120.0						
Fluorene [DL (10 ug/l)]								
MW-11S	4	210.0	MW-13S	1	14.0			
Hexachlorobenzene (3.8 ug/l)								
MW-11S	4	120.0	AW-2	4	8.0			
Naphthalene [DL (10 ug/l)]								
MW-11S	2	30.0	MW-21S	1	21.0	MW-21S	3	29.0
MW-11S	4	100.0	MW-21S	2	21.0	SB-35	*	17.0
MW-12S	2	21.0						
Phenanthrene [DL (10 ug/l)]								
MW-11S	2	23.0	MW-11S	4	300.0	MW-12S	2	16.0
Pyrene [DL (10 ug/l)]								
MW-11S	4	110.0						
Benzyl Alcohol [DL (10 ug/l)]								
MW-11S	1	14.0	MW-12S	2	23.0	MW-14S	4	13.0
MW-11S	2	13.0	MW-12S	4	18.0	MW-40S	4	110.0
MW-11S	3	22.0	MW-13S	3	13.0			
Dibenzofuran [DL (10 ug/l)]								
MW-11S	4	240.0						
2-Methylnaphthalene [DL (10 ug/l)]								
MW-12S	2	13.0	MW-21S	3	42.0	MW-35S	SUP.2	45.0
MW-21S	1	21.0	MW-21S	4	12.0	SB-35	*	45.0
MW-21S	2	35.0						
2,4-Dimethylphenol [DL (10 ug/l)]								
MW-10S	1	51.0	MW-13S	4	150.0	MW-21I	4	150.0
MW-10S	2	26.0	MW-14S	1	87.0	MW-24S	2	15.0
MW-10S	3	65.0	MW-14S	2	55.0	MW-31S	3	84.0
MW-10S	4	33.0	MW-14S	3	48.0	MW-31S	4	200.0
MW-11S	1	260.0	MW-14S	4	83.0	MW-34S	3	69.0
MW-11S	2	360.0	MW-15S	1	300.0	MW-34S	4	73.0
MW-11S	3	150.0	MW-15S	2	95.0	MW-40S	4	14.0
MW-11S	4	190.0	MW-15S	3	31.0	STEEL 1	1	18.0
MW-12S	1	100.0	MW-15S	4	68.0	STEEL 2	1	34.0
MW-12S	2	160.0	MW-21S	1	20.0	SB-38	*	16.0
MW-12S	3	67.0	MW-21S	2	62.0	SB-40	*	16.0
MW-12S	4	130.0	MW-21S	4	19.0	SB-43	*	34.0
MW-13S	1	170.0	MW-21D	4	14.0	SB-45	*	51.0
MW-13S	2	60.0	MW-21I	3	11.0	SB-47	*	21.0
MW-13S	3	130.0						
Pentachlorophenol [DL (50 ug/l)]								
MW-11S	4	530.0						
Phenol [DL (10 ug/l)]								
MW-11S	1	63.0	MW-12S	2	26.0	MW-15S	1	82.0
MW-11S	2	35.0	MW-12S	3	14.0	MW-15S	2	15.0
MW-11S	3	34.0	MW-12S	4	13.0	MW-24D	SUP.2	430.0
MW-12S	1	30.0	MW-13S	1	12.0			
2-Methylphenol [DL (10 ug/l)]								
MW-10S	1	14.0	MW-12S	1	85.0	MW-21S	1	66.0
MW-10S	2	21.0	MW-12S	2	160.0	MW-21S	2	31.0
MW-10S	3	22.0	MW-12S	3	72.0	MW-21S	3	24.0
MW-10S	4	26.0	MW-12S	4	100.0	MW-21I	3	21.0
MW-11S	1	240.0	MW-13S	1	95.0	MW-21I	4	81.0
MW-11S	2	150.0	MW-13S	2	29.0	MW-21D	4	16.0
MW-11S	3	110.0	MW-13S	3	98.0	MW-40S	4	71.0
MW-11S	4	130.0	MW-14S	4	35.0			

See notes at the end of this table for explanation of symbols and abbreviations.

000348

TABLE 3-36 (Continued)
SEMIVOLATILE ORGANIC COMPOUNDS DETECTED
ABOVE BACKGROUND IN THE GROUNDWATER(+)
PADDYS RUN ROAD SITE

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round(++)	Value
4-Methylphenol [DL (10 ug/l)]								
MW-10S	1	45.0	MW-12S	3	70.0	MW-21S	3	29.0
MW-10S	2	18.0	MW-12S	4	140.0	MW-21D	4	30.0
MW-10S	3	19.0	MW-13S	1	170.0	MW-21I	4	13.0
MW-10S	4	16.0	MW-13S	2	72.0	MW-31S	4	11.0
MW-11S	1	550.0	MW-13S	3	150.0	MW-34S	3	32.0
MW-11S	2	260.0	MW-14S	4	16.0	MW-40S	4	21.0
MW-11S	3	300.0	MW-15S	1	13.0	SB-40	*	13.0
MW-11S	4	280.0	MW-21S	1	35.0	SB-45	*	21.0
MW-12S	1	190.0	MW-21S	2	34.0	SB-47	*	20.0
MW-12S	2	200.0						
Benzoic Acid [DL (50 ug/l)]								
MW-11S	1	390.0	MW-12S	2	64.0	MW-34S	3	88.0
MW-11S	2	110.0	MW-13S	2	64.0	MW-11S	4	1700.0

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(+)The number in the parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)The groundwater samples were collected as follows: Round 1 (ENSR)-May 1990; Round 2 (ENSR)-July/August 1990; Round 3 (ERM)-January/February 1991; Round 4 (ERM)-May 1991; Sup. 1-September/October 1992; Sup. 2-October 1992.

*Groundwater sample taken from soil boring in October 1992.

Sample ID Key:
DOE-2394 - U.S. DOE FEMP Monitor Well
MW-025 - PRRS Monitor Well
SC-1 - Steel Corp. Monitor Well
SB-36 - PRRS Soil Boring
Estes, Rolfes - Domestic Wells
AW, EVERS, HPF, RNCC, STEEL, WEBER - Industrial Wells

TABLE 3-37
PESTICIDES/PCBs DETECTED ABOVE BACKGROUND IN THE GROUNDWATER(+) PADDYS RUN ROAD SITE

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round(++)	Value
Aldrin [DL (5 ng/l)]								
SB-36	*	7.0						
Delta BHC [DL (5 ng/l)]								
MW-13S	2	13.0						
4,4'-DDT [DL (10 ng/l)]								
MW-05S	2	14.0	MW-13S	3	3300.0	MW-22S	1	13.0
MW-11S	3	2100.0	MW-13S	4	2500.0	MW-22S	2	120.0
MW-12S	1	1600.0	MW-14S	3	280.0			
MW-12S	2	4400.0	MW-15S	3	11.0			
MW-12S	4	4700.0	MW-21S	2	7900.0			
4,4'-DDD [DL (10 ng/l)]								
MW-15S	3	440.0						
Dieldrin [DL (10 ng/l)]								
MW-22S	2	19.0	WEBER 2	1	21.0	ROLFES	1	34.0
MW-34S	4	1300.0						
Endosulfan II [DL (10 ng/l)]								
MW-15S	1	17.0	MW-15S	2	11.0			
Endosulfan Sulfate [DL (10 ng/l)]								
MW-11S	2	9200.0	MW-12S	4	17000.0	MW-14S	1	0.830
MW-11S	3	17000.0	MW-13S	3	16000.0	MW-14S	4	1100.0
MW-12S	3	2000.0						
Endrin [DL (10 ng/l)]								
MW-15S	3	160.0						
Heptachlor [DL (5 ng/l)]								
MW-13S	2	65.0	ESTES	2	7.6			
ESTES	1	7.3	SB-37	*	20.0			
Heptachlor Epoxide [DL 10 ng/l)]								
MW-15S	3	15.0						
p,p'-Methoxychlor [DL (50 ng/l)]								
MW-15S	3	70.0	MW-15S	4	2100.0			
Endrin Ketone [DL (10 ng/l)]								
MW-12S	2	2200.0						

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(+)The number in parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)The groundwater samples were collected as follows: Round 1 (ENSR)-May 1990; Round 2 (ENSR)-July/August 1990; Round 3 (ERM)-January/February 1991; Round 4 (ERM)-May 1991; Sup. 1-September/October 1992; Sup. 2-October 1992.

*Groundwater sample taken from soil boring in October 1992.

Sample ID Key:
DOE-2394 - U.S. DOE FEMP Monitor Well
MW-025 - PRRS Monitor Well
SC-1 - Steel Corp. Monitor Well
SB-36 - PRRS Soil Boring
Estes, Rolfes - Domestic Wells
AW, EVERS, HPF, RNCC, STEEL, WEBER - Industrial Wells

000350

TABLE 3-38
GENERAL PARAMETERS DETECTED ABOVE BACKGROUND IN THE GROUNDWATER(+)
PADDYS RUN ROAD SITE

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round(++)	Value
Ammonia (398 ug/l)								
MW-04S	3	4000.0	MW-16S	2	4200.0	DOE-2559	4	1900.0
MW-04S	4	2200.0	MW-16S	3	4800.0	DOE-3094	1	2700.0
MW-05S	1	2300.0	MW-16S	4	2300.0	DOE-3094	2	1800.0
MW-05S	3	1800.0	MW-18S	1	500.0	DOE-3094	3	400.0
MW-05S	4	1500.0	MW-19S	1	700.0	DOE-3094	4	1600.0
MW-06S	1	14000.0	MW-19S	4	400.0	DOE-3126	3	500.0
MW-06S	2	16000.0	MW-21D	1	2100.0	STEEL 1	1	700.0
MW-06S	3	13000.0	MW-21D	2	2100.0	STEEL 1	2	700.0
MW-06S	4	12000.0	MW-21D	3	800.0	STEEL 1	3	700.0
MW-07S	1	400.0	MW-21D	4	1600.0	STEEL 2	1	22000.0
MW-07S	2	400.0	MW-21S	1	10000.0	STEEL 2	2	600.0
MW-07S	3	500.0	MW-21S	2	3200.0	STEEL 2	3	6800.0
MW-10S	1	5900.0	MW-21S	3	2400.0	STEEL 2	4	1500.0
MW-10S	2	2700.0	MW-21S	4	3000.0	AW-2	1	600.0
MW-10S	3	3800.0	MW-21I	3	2400.0	SB-38	*	5100.0
MW-10S	4	6400.0	MW-21I	4	1900.0	SB-40	*	1400.0
MW-11S	1	80000.0	MW-22S	1	400.0	SB-43	*	19000.0
MW-11S	2	60000.0	MW-22S	3	700.0	SB-44	*	40000.0
MW-11S	3	42000.0	MW-22S	4	400.0	SB-45	*	1100.0
MW-11S	4	27000.0	MW-24S	2	2800.0	SB-46	*	400.0
MW-12S	1	37000.0	MW-24S	3	2700.0	SB-47	*	5400.0
MW-12S	2	36000.0	MW-24S	4	3000.0	SB-50	*	800.0
MW-12S	3	11000.0	MW-25S	3	1000.0	SB-51	*	800.0
MW-12S	4	27000.0	MW-27S	3	400.0	SB-52	*	500.0
MW-13S	1	11000.0	MW-28S	3	1400.0	SB-53	*	600.0
MW-13S	2	15000.0	MW-28S	4	600.0	SB-55	*	500.0
MW-13S	3	15000.0	MW-31S	3	400.0	SB-61	*	1200.0
MW-13S	4	13000.0	MW-34S	3	17000.0	SB-62	*	1100.0
MW-14S	1	37000.0	MW-34S	4	6700.0	SB-63	*	2100.0
MW-14S	2	32000.0	MW-40S	4	1600.0	SB-66	*	700.0
MW-14S	3	32000.0	MW-41S	4	700.0	SB-67	*	4400.0
MW-14S	4	38000.0	DOE-2094	1	5500.0	SB-68	*	600.0
MW-14I	3	2900.0	DOE-2094	2	3000.0	SB-72	*	600.0
MW-14I	4	1300.0	DOE-2094	3	5600.0	SB-73	*	2900.0
MW-15D	1	400.0	DOE-2094	4	4100.0	SB-75	*	4700.0
MW-15S	1	64000.0	DOE-2095	4	400.0	SB-76	*	1100.0
MW-15S	2	36000.0	DOE-2129	1	1400.0	SB-79	*	400.0
MW-15S	3	16000.0	DOE-2129	3	500.0	SB-81	*	500.0
MW-16S	1	8300.0						
Chloride (100000 ug/l)								
MW-04S	3	170000.0	MW-15S	3	110000.0	MW-32S	4	200000.0
MW-04S	4	120000.0	MW-18S	1	140000.0	DOE-2094	1	140000.0
MW-05S	3	140000.0	MW-18S	2	1000000.0	DOE-2094	2	120000.0
MW-05S	4	120000.0	MW-18S	3	2000000.0	DOE-3094	1	120000.0
MW-13S	4	110000.0	MW-21D	4	130000.0	DOE-3094	2	120000.0
MW-14S	4	130000.0	MW-32S	3	180000.0	ESTES	4	150000.0
MW-15S	1	140000.0						
Total Organic Carbon (33113 ug/l)								
MW-06S	4	67000.0	MW-21I	4	46000.0	MW-25S	3	74000.0
MW-11S	4	990000.0	MW-21S	4	54000.0	MW-34S	4	100000.0
MW-14S	3	500000.0	MW-24S	4	100000.0	DOE-2094	4	55000.0
Nitrate (32 ug/l)								
MW-07S	3	100.0	MW-14S	3	200.0			

See notes at the end of this table for explanation of symbols and abbreviations.

TABLE 3-38 (Continued)
GENERAL PARAMETERS DETECTED ABOVE BACKGROUND IN THE GROUNDWATER(+)
PADDYS RUN ROAD SITE

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round(++)	Value
Total Phosphorus (12.367 mg/l)								
MW-02S	3	16.0	MW-30S	3	14.0	SB-54	*	51.0
MW-03S	3	480.0	MW-31S	3	46.0	SB-55	*	75.0
MW-03S	4	300.0	MW-31S	4	45.0	SB-57	*	59.0
MW-04S	3	470.0	MW-32S	3	130.0	SB-58	*	31.0
MW-04S	4	68.0	MW-32S	4	160.0	SB-59	*	130.0
MW-05S	4	400.0	MW-33I	3	130.0	SB-60	*	160.0
MW-06S	3	1500.0	MW-33I	4	96.0	SB-61	*	120.0
MW-06S	4	1900.0	MW-39S	4	69.0	SB-62	*	350.0
MW-07S	3	110.0	MW-40S	4	43.0	SB-63	*	470.0
MW-07S	4	29.0	DOE-2126	3	19.0	SB-64	*	100.0
MW-08S	3	67.0	DOE-2126	4	20.0	SB-65	*	470.0
MW-08S	4	43.0	DOE-2129	3	42.0	SB-66	*	490.0
MW-09D	3	44.0	DOE-2129	4	35.0	SB-67	*	1900.0
MW-09D	4	22.0	DOE-3094	4	14.0	SB-68	*	2400.0
MW-10S	3	18.0	STEEL 1	3	90.0	SB-69	*	190.0
MW-11S	3	82.0	RNCC	3	27.0	SB-70	*	150.0
MW-12S	3	52.0	RNCC	4	24.0	SB-72	*	340.0
MW-14S	3	34.0	EVERS	3	29.0	SB-73	*	490.0
MW-18S	3	97.0	SB-36	*	23.0	SB-74	*	800.0
MW-19S	3	14.0	SB-37	*	70.0	SB-75	*	1700.0
MW-21D	3	49.0	SB-48	*	26.0	SB-76	*	1300.0
MW-21D	4	48.0	SB-51	*	35.0	SB-79	*	260.0
MW-21I	4	21.0	SB-52	*	81.0	SB-80	*	36.0
MW-22S	3	15.0	SB-53	*	64.0	SB-81	*	87.0
MW-23S	3	14.0						
Dissolved Phosphorous (.437 mg/l)								
MW-02S	3	3.3	MW-15D	3	4.7	MW-40S	4	35.0
MW-02S	4	2.0	MW-15D	4	2.4	MW-41S	4	6.0
MW-03S	3	230.0	MW-16S	3	3.1	MW-42S	SUP.2	0.7
MW-03S	4	300.0	MW-16S	4	3.1	DOE-2094	3	2.5
MW-04S	3	1.7	MW-18S	3	96.0	DOE-2094	4	2.6
MW-04S	4	58.0	MW-21D	3	48.0	DOE-2126	3	19.0
MW-05S	3	230.0	MW-21D	4	48.0	DOE-2126	4	18.0
MW-05S	4	350.0	MW-21I	3	14.0	DOE-2127	SUP.2	1.1
MW-06S	3	410.0	MW-21I	4	19.0	DOE-2129	3	40.0
MW-06S	4	2000.0	MW-24D	SUP.2	0.9	DOE-2129	4	34.0
MW-07S	3	49.0	MW-25S	3	0.7	DOE-2393	3	7.4
MW-07S	4	30.0	MW-25S	4	0.6	DOE-2393	4	7.2
MW-08S	3	69.0	MW-26S	3	0.47	DOE-2554	4	0.55
MW-08S	4	45.0	MW-26S	SUP.2	0.5	DOE-2558	SUP.2	0.5
MW-09D	3	21.0	MW-27S	4	2.9	DOE-3094	3	5.0
MW-09D	4	20.0	MW-29S	3	4.4	DOE-3094	4	12.0
MW-10S	3	1.0	MW-30I	3	1.8	STEEL 1	3	66.0
MW-10S	4	2.5	MW-30S	3	4.1	STEEL 2	3	1.2
MW-11S	3	1.0	MW-30S	4	4.4	STEEL 2	4	0.6
MW-11S	4	1.2	MW-31S	3	49.0	WEBER 1	2	1.6
MW-12S	3	8.2	MW-31S	4	52.0	WEBER 1	3	1.0
MW-12S	4	16.0	MW-32S	3	140.0	WEBER 3	3	5.6
MW-13S	3	0.69	MW-32S	4	140.0	EVERS	3	28.0
MW-13S	4	1.0	MW-33I	3	130.0	EVERS	4	23.0
MW-14I	3	3.3	MW-33I	4	90.0	RNCC	3	24.0
MW-14S	3	2.6	MW-34S	3	3.7	RNCC	4	24.0
MW-14S	4	4.0	MW-34S	4	3.1	SB-35	*	7.1
MW-15S	3	0.75	MW-39S	4	58.0	SB-36	*	27.0

See notes at the end of this table for explanation of symbols and abbreviations.

000352

TABLE 3-38 (Continued)
GENERAL PARAMETERS DETECTED ABOVE BACKGROUND IN THE GROUNDWATER(+)
PADDYS RUN ROAD SITE

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round(++)	Value
Dissolved Phosphorous (.437 mg/l) Continued								
SB-37	*	26.0	SB-52	*	76.0	SB-66	*	190.0
SB-38	*	2.9	SB-53	*	54.0	SB-67	*	420.0
SB-39	*	9.3	SB-54	*	34.0	SB-68	*	160.0
SB-40	*	5.7	SB-55	*	60.0	SB-69	*	27.0
SB-42	*	0.8	SB-56	*	47.0	SB-70	*	69.0
SB-43	*	1.1	SB-57	*	1500.0	SB-72	*	320.0
SB-44	*	1.5	SB-58	*	20.0	SB-73	*	410.0
SB-45	*	2.8	SB-59	*	65.0	SB-74	*	54.0
SB-46	*	1.1	SB-60	*	75.0	SB-75	*	750.0
SB-47	*	7.7	SB-61	*	110.0	SB-76	*	150.0
SB-48	*	24.0	SB-62	*	55.0	SB-79	*	250.0
SB-49	*	25.0	SB-63	*	160.0	SB-80	*	31.0
SB-50	*	31.0	SB-64	*	52.0	SB-81	*	72.0
SB-51	*	35.0	SB-65	*	61.0			
Sulfate (123.07 mg/l)								
MW-04S	4	190.0	MW-12S	1	760.0	DOE-2394	3	190.0
MW-05S	1	190.0	MW-22S	1	150.0	DOE-2394	4	220.0
MW-05S	2	200.0	MW-22S	2	200.0	ROLFES	1	160.0
MW-05S	4	160.0	MW-22S	4	170.0	ROLFES	2	140.0
MW-06S	1	180.0	MW-29S	3	190.0	ROLFES	4	160.0
MW-06S	3	210.0	MW-29S	SUP.2	180.0	SB-57	*	520.0
MW-06S	4	180.0	MW-34S	4	240.0	SB-58	*	150.0
MW-11S	1	360.0	DOE-2394	2	140.0	SB-67	*	150.0

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(+)The number in parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)The groundwater samples were collected as follows: Round 1 (ENSR)-May 1990; Round 2 (ENSR)-July/August 1990; Round 3 (ERM)-January/February 1991; Round 4 (ERM)-May 1991; Sup. 1-September/October 1992; Sup. 2-October 1992.

Sample ID Key:
DOE-2394 - U.S. DOE FEMP Monitor Well
MW-025 - PRRS Monitor Well
SC-1 - Steel Corp. Monitor Well
SB-36 - PRRS Soil Boring
Estes, Rolfes - Domestic Wells
AW, EVERS, HPF, RNCC, STEEL, WEBER - Industrial Wells

TABLE 3-39
RADIOLOGICAL PARAMETERS DETECTED ABOVE BACKGROUND IN THE GROUNDWATER(+) PADDYS RUN ROAD SITE

Sample ID	Round(++)	Value	Sample ID	Round(++)	Value	Sample ID	Round (++)	Value
Gross Alpha (579.27 pCi/l)								
MW-01S	3	690.0	MW-15S	4	600.0	SB-74	*	730.0
MW-06S	4	2400.0	SB-68	*	960.0	SB-75	*	770.0
Gross Beta (365.393 pCi/l)								
MW-01S	3	610.0	MW-15S	3	390.0	MW-32S	3	490.0
MW-05S	2	690.0	MW-15S	4	500.0	SC-1	3	430.0
MW-06S	1	1500.0	MW-21D	3	370.0	SB-68	*	1700.0
MW-06S	2	880.0	MW-21D	4	460.0	SB-74	*	1100.0
MW-06S	3	2400.0	MW-23S	2	390.0	SB-75	*	1100.0
MW-14S	1	630.0	MW-23S	3	390.0	RNCC	4	370.0
MW-14S	2	370.0	MW-27S	4	510.0			
Potassium-40 (189.817 pCi/l)								
MW-01S	2	200.0	MW-21D	1	270.0			
MW-04S	3	270.0	MW-21D	2	270.0	SB-50	*	710.0
MW-04S	4	310.0	MW-21D	3	400.0			
MW-05S	1	270.0				SB-54	*	190.0
MW-05S	2	270.0	MW-21I	4	290.0	SB-55	*	220.0
MW-05S	4	420.0	MW-23S	2	320.0	SB-56	*	410.0
MW-06S	1	1700.0	MW-29S	3	230.0	SB-59	6	360.0
MW-06S	2	730.0				SB-61	6	250.0
MW-06S	3	2500.0				SB-64	*	210.0
MW-06S	4	2500.0	MW-32S	3	410.0	SB-65	*	420.0
MW-07S	2	190.0	MW-32S	4	430.0	SB-66	*	510.0
MW-07S	3	190.0	MW-39S	4	240.0	SB-67	*	800.0
MW-10S	1	330.0	MW-42S	SUP.2	440.0	SB-68	*	3200.0
MW-13S	3	200.0	DOE-2094	1	190.0	SB-70	*	370.0
MW-14S	1	590.0	DOE-2094	3	180.0	SB-72	*	220.0
MW-14S	2	330.0	DOE-3094	2	220.0	SB-73	*	280.0
MW-14S	3	200.0	DOE-3094	4	300.0	SB-74	*	1500.0
MW-15S	3	270.0	SC-1	1	290.0	SB-75	*	1100.0
MW-16S	1	210.0	SC-1	2	210.0	SB-76	*	330.0
MW-18S	1	230.0	SC-1	3	460.0	SB-77	*	690.0
MW-18S	2	190.0	SC-2	4	240.0	SB-79	*	400.0
			SB-36	*	270.0			

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(+)The number in parenthesis after each chemical is the background value; sample values are reported in the same unit as the background value.

(++)The groundwater samples were collected as follows: Round 1 (ENSR)-May 1990; Round 2 (ENSR)-July/August 1990; Round 3 (ERM)-January/February 1991; Round 4 (ERM)-May 1991; Sup. 1-September/October 1992; Sup. 2-October 1992.

*Groundwater sample taken from soil boring in October 1992.

Sample ID Key:
DOE-2394 - U.S. DOE FEMP Monitor Well
MW-025 - PRRS Monitor Well
SC-1 - Steel Corp. Monitor Well
SB-36 - PRRS Soil Boring
Estes, Rolfes - Domestic Wells
AW, EVERS, HPF, RNCC, STEEL, WEBER - Industrial Wells

000354

points, known as nodes. To satisfy this requirement, the modeling domain was divided into a finite difference grid of 28 nodes east-west by 37 nodes north-south and into four node layers. The planar representation of the regional flow model and its relation to the PRRS study are presented in Figure 3-51.

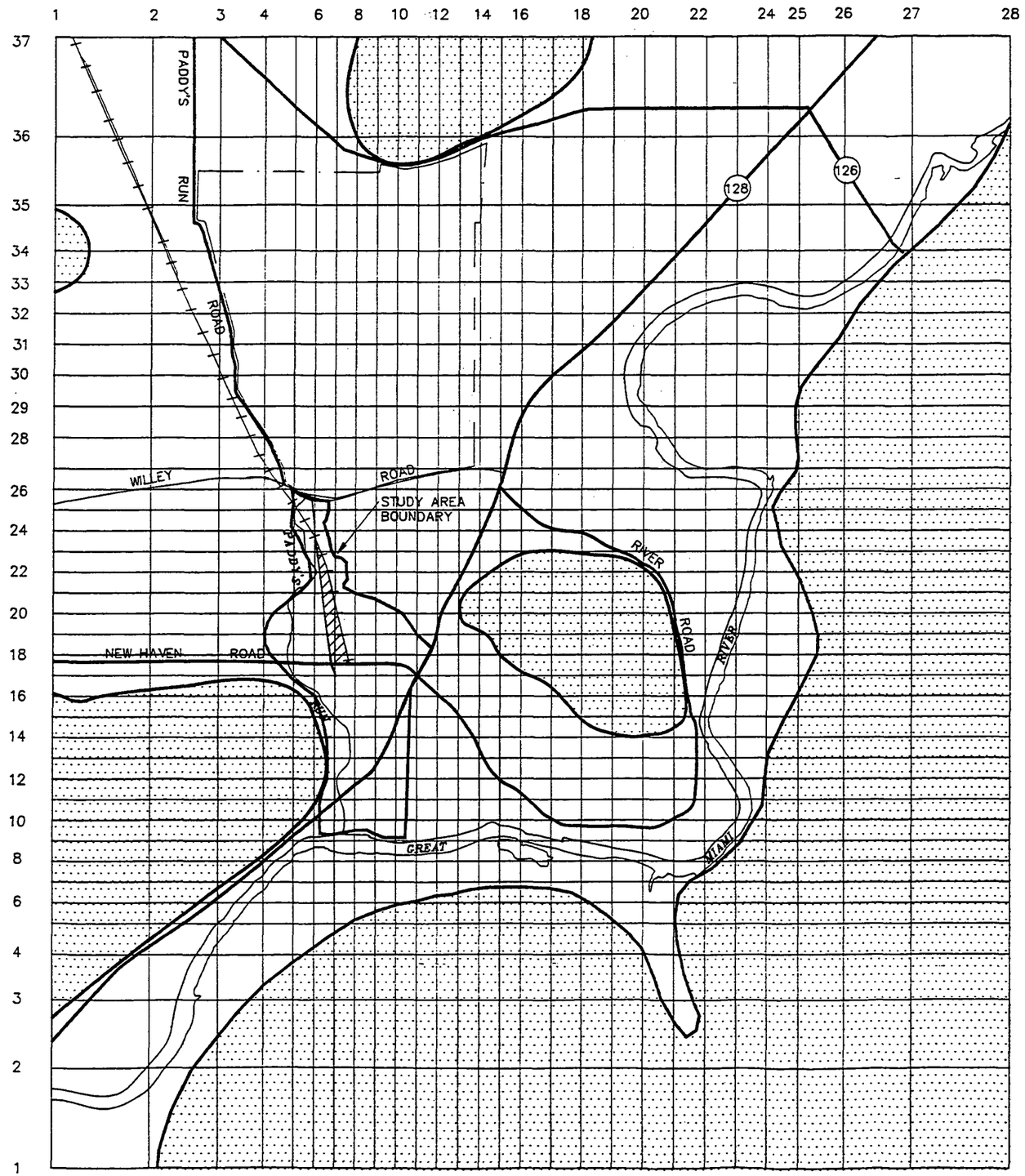
Once the model domain had been divided into discrete cells, represented by the modeling nodes, hydraulic parameters (e.g., hydraulic head, aquifer porosity, horizontal and vertical hydraulic conductivity, among others), internal sources and sinks (e.g., pumping wells, rivers, and streams) and boundary conditions (e.g., constant pressure head and no flow) were specified. The initial specification of the hydraulic parameters was based upon the selection of representative values from a review of regional and Study Area-specific data. The boundary conditions were likewise defined based on a hydrogeologic evaluation of the aquifer system.

3.11.1.2 Calibration and Sensitivity

Model calibration is a systematic process through which data input is adjusted within the range of reported regional or Study Area-specific data to obtain an approximate match between the simulated and the observed hydraulic head values. The primary input data adjusted for the PRRS regional groundwater flow model included:

- Boundary conditions (e.g., specified pressures)
- Stream characteristics (e.g., depth of flow and streambed leakance)
- Rainfall recharge
- Hydraulic conductivities

The calibration criteria for the groundwater flow models were specified in the Phase II Work Plan (ERM 1991a) and included a graphical comparison and an evaluation of residuals (e.g., the difference in computed and observed head values for a specific node). The flow model calibration evaluation criteria used in this study are presented in Table 3-40. The regional flow model was initially calibrated to an extensive regional groundwater data set collected in 1986 and later calibrated (and thus verified) to a Study Area-specific data set collected in 1991. A comparison of the observed versus simulated, calibrated hydraulic heads for the 1986 data is presented in Figure 3-52. Tables 3-41 and 3-42 summarize the calibration results of



GRAPHIC SCALE

3000 0 1500 3000 6000

(IN FEET)
1 inch = 3000 ft.

LEGEND

BEDROCK OUTCROP (AT SURFACE)

PADDYS RUN ROAD SITE
COMPANIES FACILITY
PROPERTY BOUNDARY

000356

REGIONAL FLOW MODEL PLANAR NODE SPECIFICATIONS PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO	FIGURE 3-51

ERM ERM-Midwest, inc.
Environmental Resources Management

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TABLE 3-40
PRIMARY CALIBRATION EVALUATION CRITERIA FOR FLOW MODELING
PADDYS RUN ROAD SITE

Designation	Description	Acceptable Range	Optimum Value
1. Graphical comparison	Comparison of contour maps of observed and simulated values.	Not quantifiable.	Not quantifiable
2. R1 OR mean of residuals	R1 is the ratio of the mean of the residuals (the difference between observed and computed values) to the mean of the observed values.	-5% < R1 < +5% OR -1 feet < mean of residuals < +1 feet	0% 0 feet
3. R2 OR mean of the absolute values of residuals	R2 is the ratio of the mean of absolute residuals to the mean of the observed values.	R2 < 5% OR mean of absolute values of residuals < 2 feet	0% 0 feet
4. Percent of residuals within ± one standard deviation of observed values	Example: for 40 observations then 5% of observations (i.e., two residuals (40x0.05=2)) can fall outside of the one standard deviation of observed values.	95% - 100%	100%
*5. Residual standard deviation	—	0 - 3 feet	0 feet
*6. R3	R3 is the ratio of variance in residuals to the variance in observed values.	0 - 15%	0%
*7. R4	R4 is the regression coefficient between the observed and computed heads.	0.90 - 1.0	1.0
*8. R5	R5 is the ratio of the coefficient of variation (the standard deviation divided by the mean) of the observed values to the computed values	80 - 120%	100%
9. Model water balance error	This error is calculated by HST3D and termed the "fractional imbalance" by the code.	-15% < model water balance error < +15%	0.0

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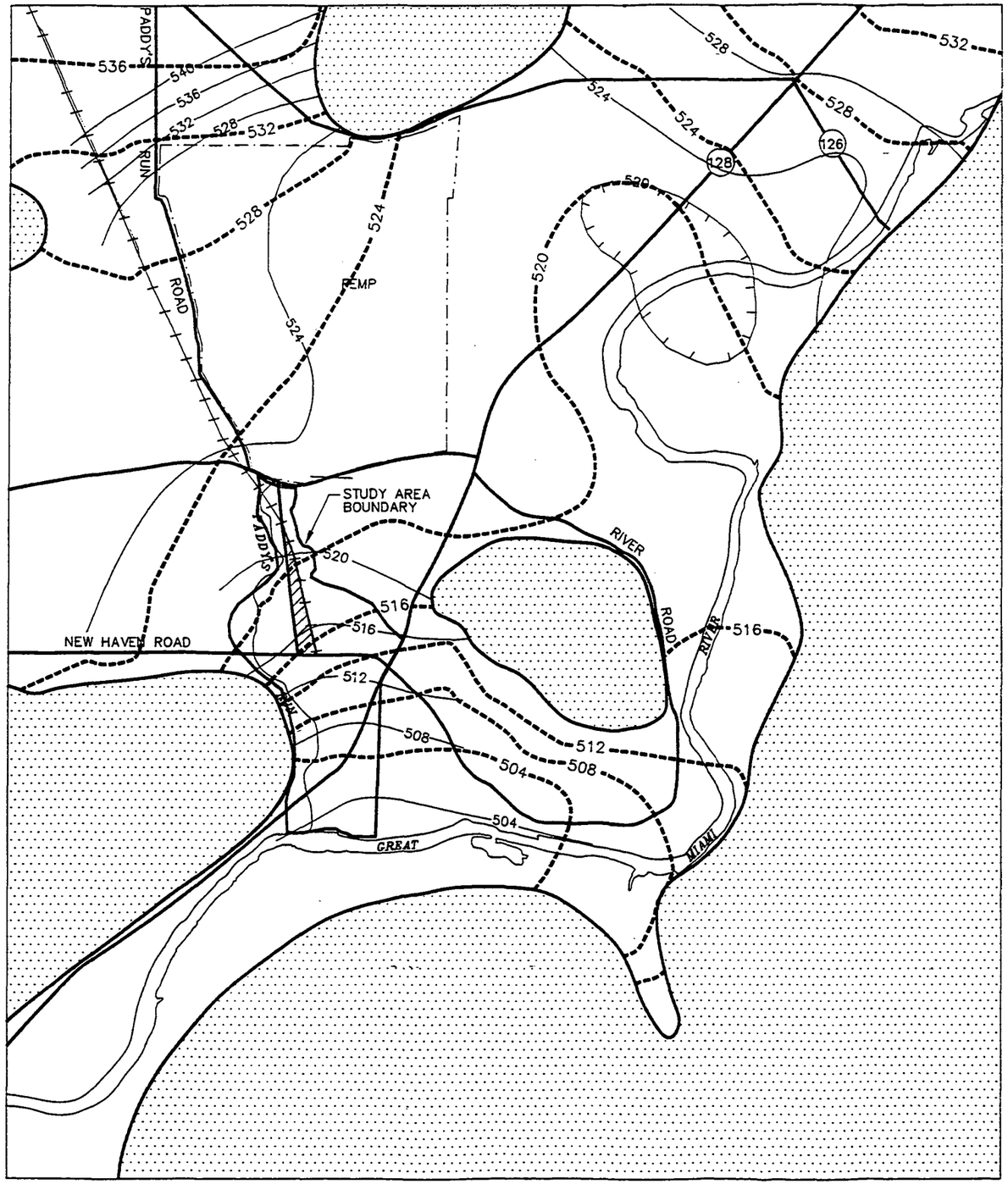
NOTES:

*These criteria are expanded from those presented in the Phase II Work Plan (ERM, 1991).



GRAPHIC SCALE

3000 0 1500 3000 6000

(IN FEET)
1 inch = 3000 ft.

LEGEND

BEDROCK OUTCROP (AT SURFACE)

PADDYS RUN ROAD SITE
COMPANIES FACILITY
PROPERTY BOUNDARY

520 — OBSERVED 1986 GROUND WATER CONTOUR (FEET ABOVE MSL)

512 - - - SIMULATED 1986 GROUNDWATER CONTOUR (FEET ABOVE MSL)

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NOTE: "OBSERVED" CONTOURS
SOURCE FOR WATER LEVEL DATA: IT (DEC. 1990)
MANUAL CONTOURING USED [SURFER (GOLDEN SOFTWARE, 1989) NOT APPLIED]

NOTE: SIMULATED-HEAD CONTOURS
BASED ON SURFER (GOLDEN STATE SOFTWARE, 1989)
PLOT OF MODEL RESULTS USING INVERSE DISTANCE METHOD

COMPARISON OF OBSERVED AND SIMULATED 1986 GROUNDWATER LEVEL ELEVATIONS PADDYS RUN ROAD SITE HAMILTON COUNTY, OHIO	FIGURE 3-52

ERM ERM-Midwest, inc.
Environmental Resources Management

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TABLE 3-41
1986 REGIONAL FLOW MODEL CALIBRATION PERFORMANCE
PADDYS RUN ROAD SITE

Well I.D.	Model Coordinates			Observed Water Level Elev. (FAMSL)	Computed Water Level Elev. (FAMSL)	Residual Error (ft.)	Residual Absolute Error (ft.)
	I	J	K				
R-B	3	37	4	541.9	540.5	1.39	1.39
WW-1	25	37	4	528.2	531.1	-2.88	2.88
O-3	21	36	4	526.5	523.8	2.66	2.66
PALLET-CO	3	35	4	525.4	530.8	-5.42	5.42
B-1	26	35	4	522.3	526.4	-4.08	4.08
WK-1	27	35	4	525.5	527.1	-1.62	1.62
FMPC-11	3	34	4	524.6	529.1	-4.53	4.53
FMPC-3	4	34	3	524.1	528.4	-4.27	4.27
FMPC-10	6	34	3	523.6	527.3	-3.65	3.65
FMPC-13-S	11	34	4	522.9	523.7	-0.80	0.80
IT-3	14	34	4	522.5	522.2	0.28	0.28
IT-4	17	34	4	521.9	520.8	1.12	1.12
K-3	21	34	4	511.4	517.6	-6.20	6.20
EL-1	24	34	4	522.9	523.1	-0.24	0.24
B-3	16	33	4	520.2	521.2	-0.99	0.99
B-2	18	33	4	520.6	519.6	1.01	1.01
B-1	19	32	4	521.3	518.2	3.09	3.09
K-2N	22	34	4	514.3	519.8	-5.45	5.45
K-1	22	33	4	518.8	518.7	0.08	0.08
K-4	24	33	4	520.6	522.9	-2.25	2.25
ER-1	26	33	4	525.9	525.0	0.94	0.94
FMPC-8-S	5	32	4	524.1	526.0	-1.91	1.91
B-4	20	32	4	520.3	516.6	3.67	3.67
FMPC-9	4	31	3	526.4	526.0	0.43	0.43
IT-2	13	31	4	522.9	522.1	0.80	0.80
H-127	18	31	3	522.3	519.5	2.82	2.82
SW-4A	20	30	4	519.1	518.8	0.30	0.30

TABLE 3-41
1986 REGIONAL FLOW MODEL CALIBRATION PERFORMANCE
PADDYS RUN ROAD SITE

Well I.D.	Model Coordinates			Observed Water Level Elev. (FAMSL)	Computed Water Level Elev. (FAMSL)	Residual Error (ft.)	Residual Absolute Error (ft.)
	I	J	K				
SW-3A	20	30	4	518.3	518.8	-0.50	0.50
FMPC-18-S	4	30	4	525.3	525.4	-0.10	0.10
IT-1	10	30	4	523.2	522.9	0.28	0.28
O-2W	16	29	4	522.4	520.9	1.52	1.52
O-2E	17	29	4	522.2	520.5	1.73	1.73
BPH	3	28	3	525.0	525.3	-0.26	0.26
FMPC-16-S	4	28	4	524.8	524.4	0.37	0.37
FMPC-14-D	6	27	3	524.1	522.9	1.16	1.16
IT-6	8	27	4	523.1	522.3	0.83	0.83
IT-5	11	27	4	522.7	521.5	1.16	1.16
BLK	14	27	4	522.5	521.1	1.42	1.42
H-105	4	26	4	523.4	523.7	-0.25	0.25
FMPC-17-D	5	26	3	523.9	523.0	0.94	0.94
FMPC-15-S	7	26	4	523.1	522.2	0.89	0.89
HK-D	7	25	1	521.5	521.8	-0.27	0.27
BHMPH-D	16	25	3	522.4	520.7	1.70	1.70
DS	6	23	4	521.8	521.2	0.64	0.64
7-8A	6	23	4	520.7	521.2	-0.46	0.46
H-122	5	23	4	521.4	521.7	-0.29	0.29
12-7A	1	21	4	527.4	527.9	-0.45	0.45
DE	12	21	4	519.9	517.9	1.97	1.97
H-115	6	18	2	518.7	517.7	0.96	0.96
RE	7	18	4	515.7	516.4	-0.68	0.68
H-126	11	17	4	512.6	510.3	2.29	2.29
H-124	9	13	3	505.8	504.2	1.56	1.56
H-129	14	14	4	507.7	504.6	3.11	3.11

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TABLE 3-41
1986 REGIONAL FLOW MODEL CALIBRATION PERFORMANCE
PADDYS RUN ROAD SITE

Well I.D.	Model Coordinates			Observed Water Level Elev. (FAMSL)	Computed Water Level Elev. (FAMSL)	Residual Error (ft.)	Residual Absolute Error (ft.)
	I	J	K				
H-128	6	12	4	506.8	505.6	1.22	1.22
16-1-S	18	9	4	504.3	503.7	0.65	0.65

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SUMMARY:

Observed Mean	=	521.3
Computed Mean	=	521.4
Error Mean	=	-0.1
ABS ERR Mean	=	1.6
Observed Variance	=	35.46
Error Variance	=	4.96
Computed Variance	=	42.03
Obs STD	=	5.95
Comp STD	=	6.48
Err STD	=	2.23
Coeff. of Variation (OBS)	=	0.011
Coeff. of Variation (COMP)	=	0.012
R1 (ERR Mean/OBS Mean)	=	-0.02%
R2 (ABS ERR Mean/OBS Mean)	=	0.32%
R3 (ERR VAR/OBS VAR)	=	13.98%
R4 (CORR COEF)	=	0.939
R5 (Coeff. of Var. (OBS)/Coeff. of Var. (COMP)	=	91.9%
Fractional Imbalance	=	-0.90%

TABLE 3-42
1991 REGIONAL FLOW MODEL CALIBRATION PERFORMANCE
PADDYS RUN ROAD SITE

Well I.D.	Model Coordinates			Observed Water Level Elev. (FAMSL)	Computed Water Level Elev. (FAMSL)	Residual Error (ft.)	Residual Absolute Error (ft.)
	I	J	K				
PZ-03	7	20	4	514.80	517.84	-3.00	3.00
PZ-04	10	19	4	515.50	514.48	1.00	1.00
PZ-05	10	20	4	516.70	516.07	0.59	0.59
PZ-06	7	23	4	521.50	519.72	1.74	1.74
PZ-07	6	22	4	520.30	519.48	0.82	0.82
PZ-08	6	21	4	516.00	519.10	-3.14	3.14
PZ-09	8	19	4	515.80	516.10	-0.28	0.28
PZ-10	8	20	4	517.20	517.13	0.11	0.11
MW-01S	6	23	4	521.50	520.14	1.31	1.31
MW-01D	6	23	2	521.50	520.13	1.37	1.37
MW-02S	7	21	4	520.20	518.52	1.63	1.63
MW-03S	7	20	4	515.20	517.84	-2.61	2.61
MW-04S	7	20	4	515.20	517.84	-2.60	2.60
MW-05S	7	20	4	515.30	517.84	-2.58	2.58
MW-06S	7	20	4	515.30	517.84	-2.55	2.55
MW-07S	7	19	4	514.50	517.03	-2.49	2.49
MW-08S	7	19	4	516.40	517.03	-0.64	0.64
MW-09D	7	19	3	516.20	517.08	-0.90	0.90
MW-10S	7	18	4	513.50	515.41	-1.96	1.96
MW-11S	7	18	4	513.50	515.41	-1.94	1.94
MW-12S	7	18	4	513.40	515.41	-2.03	2.03
MW-13S	8	18	4	512.80	514.19	-1.44	1.44
MW-14S	8	18	4	514.30	514.19	0.09	0.09
MW-14I	8	18	3	514.40	514.18	0.18	0.18
MW-15S	7	18	4	512.60	515.41	-2.81	2.81
MW-15D	7	18	3	512.70	515.40	-2.66	2.66
MW-16S	7	18	4	513.00	515.41	-2.41	2.41
MW-18S	7	20	4	517.90	517.84	0.08	0.08

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TABLE 3-42
1991 REGIONAL FLOW MODEL CALIBRATION PERFORMANCE
PADDYS RUN ROAD SITE

Well I.D.	Model Coordinates			Observed Water Level Elev. (FAMSL)	Computed Water Level Elev. (FAMSL)	Residual Error (ft.)	Residual Absolute Error (ft.)
	I	J	K				
MW-18D	7	20	3	517.80	517.84	-0.04	0.04
MW-19S	7	17	4	513.70	513.45	0.26	0.26
MW-20S	8	17	4	511.70	512.10	-0.37	0.37
MW-20D	8	17	2	511.90	512.09	-0.17	0.17
MW-21S	8	17	4	511.30	512.10	-0.85	0.85
MW-21I	8	17	3	511.40	512.09	-0.74	0.74
MW-21D	8	17	2	511.40	512.09	-0.74	0.74
MW-22S	10	17	4	511.20	510.10	1.13	1.13
MW-23S	10	15	4	507.10	506.41	0.70	0.70
MW-24S	8	14	4	506.50	505.07	1.46	1.46
MW-24I	8	14	3	506.60	505.05	1.54	1.54
MW-25S	8	14	4	506.80	505.07	1.74	1.74
MW-26S	7	13	4	504.50	503.25	1.28	1.28
MW-27S	8	13	4	503.90	503.30	0.55	0.55
MW-28S	9	12	4	504.50	501.64	2.83	2.83
MW-29S	7	11	4	499.10	498.68	0.45	0.45
MW-30S	7	18	4	514.50	515.41	-0.93	0.93
MW-30I	7	18	3	514.50	515.40	-0.89	0.89
MW-31S	9	18	4	513.90	513.04	0.85	0.85
MW-31I	9	18	3	513.90	512.99	0.88	0.88
MW-32S	7	20	4	516.90	517.84	-0.90	0.90
MW-33I	7	19	3	516.10	517.08	-0.96	0.96
MW-34S	7	18	4	515.30	515.41	-0.13	0.13
MW-35S	10	12	4	502.50	501.68	0.84	0.84
MW-36S	8	10	4	497.00	498.01	-0.97	0.97
MW-37S	9	10	4	496.90	498.51	-1.60	1.60
MW-38S	9	18	4	513.40	513.04	0.40	0.40
MW-39S	8	19	4	515.30	516.10	-0.76	0.76

TABLE 3-42
1991 REGIONAL FLOW MODEL CALIBRATION PERFORMANCE
PADDYS RUN ROAD SITE

Well I.D.	Model Coordinates			Observed Water Level Elev. (FAMSL)	Computed Water Level Elev. (FAMSL)	Residual Error (ft.)	Residual Absolute Error (ft.)
	I	J	K				
MW-40S	8	18	4	512.40	514.19	-1.82	1.82
MW-41S	7	19	4	515.80	517.03	-1.27	1.27
2095	6	24	4	522.00	520.67	1.28	1.28
3095	6	24	3	522.00	520.67	1.32	1.32
2126	5	20	4	517.50	519.37	-1.89	1.89
3126	5	20	3	517.80	519.40	-1.59	1.59
2129	7	19	4	516.20	517.03	-0.85	0.85
2393	6	19	4	517.10	517.99	-0.93	0.93
2554	5	18	4	516.60	518.16	-1.52	1.52

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SUMMARY

Observed Mean	=	513.4
Computed Mean	=	513.9
Error Mean	=	-0.45
ABS ERR Mean	=	1.27
Observed Variance	=	30.38
Error Variance	=	2.08
Computed Variance	=	33.50
Obs STD	=	5.51
Comp STD	=	5.79
Err STD	=	1.44
Coeff. of Variation (OBS)	=	0.011
Coeff. of Variation (COMP)	=	0.011
R1 (ERR Mean/OBS Mean)	=	-0.09%
R2 (ABS ERR Mean/OBS Mean)	=	0.25%
R3 (ERR VAR/OBS VAR)	=	6.85%
R4 (CORR COEF)	=	0.968
R5 (Coeff. of Var. (OBS)/Coeff. of Var. (COMP))	=	95.3%
Fractional Imbalance	=	-1.1%

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TABLE 3-43
CALIBRATED REGIONAL GROUNDWATER FLOW MODEL INPUT PARAMETERS
PADDYS RUN ROAD SITE

Model Parameter	Reported Range	Modeled Value
Fluid Compressibility	3.03E-06 to 3.22E-06 psi^{-1}	3.03E-06 psi^{-1}
Reference Pressure	NA	0.0 psi
Reference Temperature	34.2-82.8°F.	60°F.
Fluid Density	62.37 - 62.42 lb/ft^3	62.4 lb/ft^3
Fluid Viscosity	0.836 to 1.7513 cP	1.138 cP
Absolute Atmospheric Pressure	1.01325E+05 Pa	1.01325E+05 Pa
K_h aquifer	134 - 600 ft/day	350 - 450 ft/day
K_v aquifer	2.5 - 60 ft/day	35 - 45 ft/day
K_h clay	NA	0.35 ft/day
K_v clay	0.00030 - 0.43 ft/day	.35 ft/day
K_h bedrock	0.1 - 13 ft/day	0.67 ft/day
K_v bedrock	NA	0.67 ft/day
Porosity	0.20 - 0.25	0.225
Bulk Vertical Compressibility	NA	0.0
Elevation of top of clay confining unit @ FEMP	455 - 469 ft (MSL)	455 ft (MSL)
Elevation of bottom of clay confining unit	425 - 450 ft (MSL)	445 ft (MSL)

ABBREVIATIONS:

PPT: Rainfall precipitation
NA: Not applicable or available
g: Acceleration of gravity
K: Hydraulic conductivity
(K_v = vertical K; K_h = horizontal K)
GMR: Great Miami River
ft(MSL): Feet above mean sea level
k: Intrinsic permeability
D: Fluid density
L: Leakance through streambed
b: Bed thickness
v: Viscosity
PR: Paddys Run

TABLE 3-43 (Continued)
CALIBRATED REGIONAL GROUNDWATER FLOW MODEL INPUT PARAMETERS
PADDYS RUN ROAD SITE

Model Parameter	Reported Range	Modeled Value
Range of elevation of water table	504 - 542 ft (MSL)	496 - 553 ft (MSL)
Range of elevation of top of bedrock	334 - 600 + ft (MSL)	380 - 553 ft (MSL)
Leakance of GMR and PR	0.34 - 0.74 day^{-1}	0.5 day^{-1}
K_y of GMR and PR streambeds	NA	0.5 ft/day
b of GMR and PR streambeds	NA	1.0 ft
Width of GMR	200 - 346 ft	300 ft
Depth of flow in GMR	5.4 - 5.7 ft	6 ft/5 ft
Elevation of GMR streambed	479 - 527 ft (MSL)	495 - 524 ft (MSL)
Width of PR	2.8 to 28 ft	20 ft
Depth of flow in PR	0 - 1.83 ft	1.0 ft/0.5 ft
Elevation of PR streambed	NA	522 - 503 ft (MSL)
Pump Rate SOWC Wells 1 & 2	8.74E + 05 - 1.50E + 06 ft^3/day	1.16E + 06 ft^3 day each
Pump Rate A & W Wells 1 & 2	19,251 - 21,656 ft^3/day	21,500 ft^3/day each
Pump Rate FEMP Well	56,000 ft^3/day	56,000 ft^3/day
Pump Rate RNCC Well	481 ft^3/day	481 ft^3/day
Net PPT Recharge	4 - 21 in/yr	0.0014 - 0.0032 ft/day (6 - 14 in/yr)
g	2.4E + 11 ft/day^2	2.4E + 11 ft/day^2

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ABBREVIATIONS:

PPT: Rainfall precipitation
NA: Not applicable or available
g: Acceleration of gravity
K: Hydraulic conductivity
(K_v = vertical K; K_h = horizontal K)
GMR: Great Miami River
ft(MSL): Feet above mean sea level
k: Intrinsic permeability
D: Fluid density
L: Leakance through streambed
b: Bed thickness
v: Viscosity
PR: Paddys Run

the PRRS regional groundwater flow model for 1986 and 1991 water level data, respectively. In these tables, well identification, model cell/node (i,j,k) coordinates, observed heads, and computed heads are given. Also, Tables 3-41 and 3-42 provide a summary of the primary calibration criteria results. Additional details on the calibration evaluation are provided in Appendix C. The rationale for selected modeling parameters is summarized in Table 3-30.

The calibrated input values for the hydraulic parameters are summarized in Table 3-43. These values represent a best estimate for theoretical average conditions in the aquifer system. In nature, groundwater flow parameter values vary spatially as a result of aquifer heterogeneities. The numerical simulation of a natural system simplifies the heterogeneity into discrete blocks of a uniform parameter value. Additionally, more than one combination of aquifer parameter values may result in the same hydraulic head distribution, and, therefore, non-unique modeling solutions are typical. The goal is to calibrate the flow model using a combination of parameter values that best describe the system based on Study Area-specific data. Sensitivity testing was performed to evaluate the effect that variation of specific input parameters may have on the calibrated model results.

Sensitivity analysis was performed on the following parameters:

- Recharge
- Riverbed leakance
- Hydraulic conductivity (vertical and horizontal)
- Stream flow depth

The parameter values used for the sensitivity testing for both the 1986 and 1991 regional groundwater flow models are summarized in Table 3-44.

3.11.1.3 Results and Conclusions

The regional groundwater flow model was successfully calibrated to two sets of groundwater level data (April 1986 and May 1991), which generally represent average groundwater flow conditions. The representation of average groundwater flow conditions by the April 1986 and May 1991 groundwater level data sets is

TABLE 3-44
REGIONAL FLOW MODEL SENSITIVITY ANALYSIS SUMMARY
PADDYS RUN ROAD SITE

Parameter	Reported Range	Calib. Value	Values Sensitivity Tested	Note (a)
Recharge (inches/yr)	4-15	6 and 14	3 and 7 9 and 21	50% less 50% more
River Leakance (day^{-1})	0.5	0.5	0.25 1.0	50% less 50% more
K_h (equifer) (feet/day)	60-600	350 and 450	175 and 225 467 and 600	25% less 33% more
K/K_h (equifer)	1/10	1/10	1/100 1/5	90% less 100% more
River stage (depth of flow) (feet)	PR: 0-1.83 GMR: 0-5.7	PR: 0.5 GMR: 5.0	PR: 0.25 GMR 2.5	50% less
			PR: 0.75 GMR: 7.5	50% more

(a) Values tested were x% less or more than the calibrated values.

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supported by the similarities observed in groundwater levels measured during other months between 1986 and 1992 (see Section 3.10.2.2). In addition, the data from April 1986 and May 1991 represent the most complete and best distributed data on record for the area. Calibration criteria, set prior to initiation of the groundwater flow modeling, were satisfied. Development of the regional model and the sensitivity testing resulted in a refined set of data for input to the local groundwater flow model. Sensitivity testing of selected model input parameters within reported ranges indicated the groundwater flow model was most sensitive to changes in specified pressure boundary conditions, fluctuations in the depth of flow in the Great Miami River and Paddys Run Stream, and horizontal hydraulic conductivity.

3.11.2 Local Flow Modeling

Upon completion of the calibration and sensitivity testing of the regional flow model, a local groundwater flow model was developed. The primary purpose of the local flow model was to assist with the characterization of local flow processes and to support contaminant transport modeling. The general procedure for developing the local flow model was consistent with the approach for the regional flow model and was previously discussed in Section 2.11.1 and 2.11.2.

3.11.2.1 Conceptualization of Local Model

The modeling domain for the local flow model, which approximately encompassed the boundaries of the PRRS study area, was divided into a finite difference grid of 40 nodes (east-west) by 81 nodes (north-south) with four node layers. The planar representation of the local flow model and its relation to the PRRS study are presented in Figure 3-53.

Note that the nodes are evenly spaced on 100 foot intervals. The even spacing of the grid nodes was utilized to minimize the potential for numerical errors in the contaminant transport model (which used the same grid system). In addition, this higher resolution model (in comparison with the regional flow model) allowed for a

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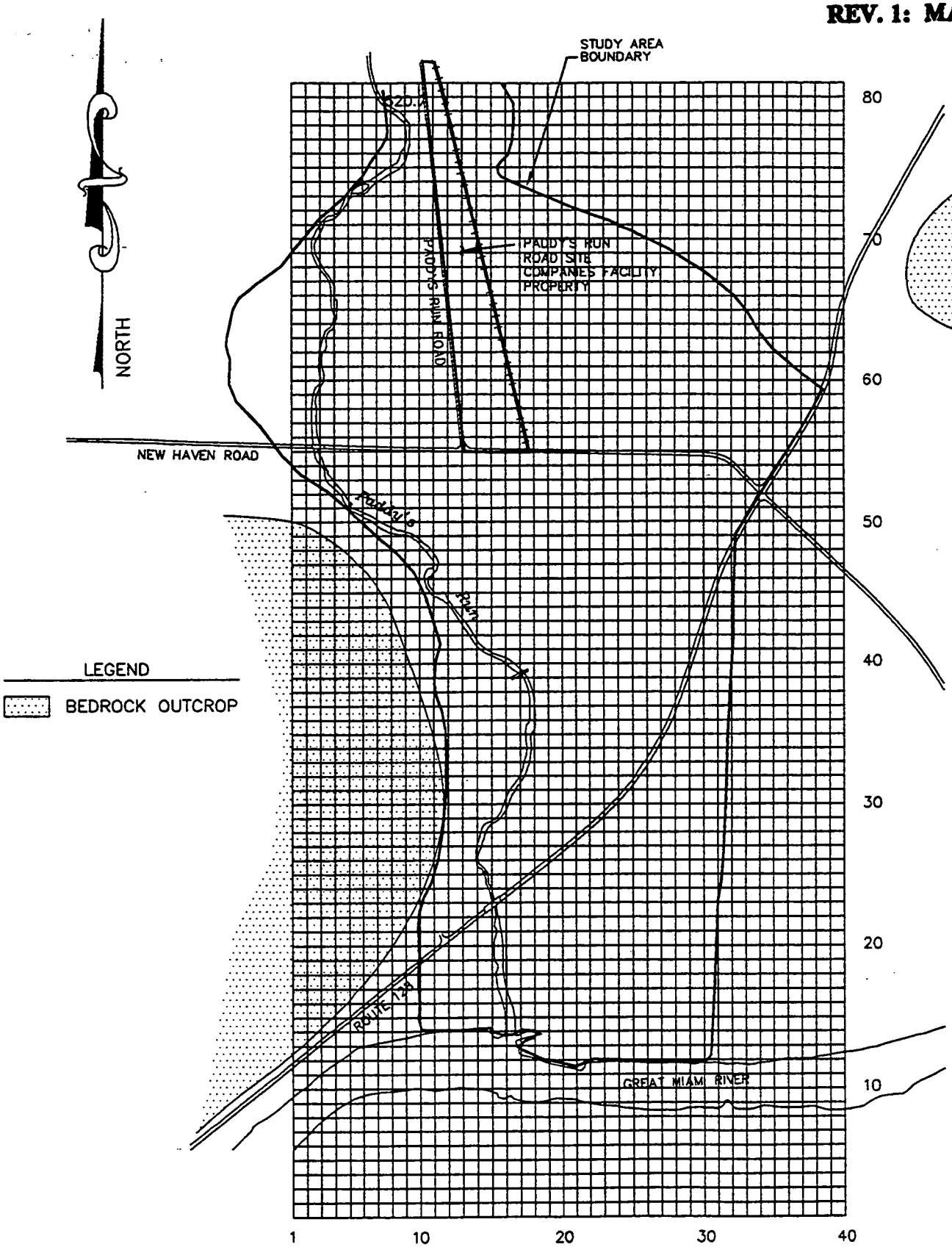

GRAPHIC SCALE

1000 0 500 1000 2000

(IN FEET)
1 inch = 1000 ft.

LOCAL FLOW MODEL
PLANAR NODE SPECIFICATION
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE

ERM-Midwest, inc.
Environmental Resources Management

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more realistic simulation of boundary conditions and stream, river and bedrock locations.

Similar to and consistent with the regional flow model, values for the required flow parameters were specified for each of the identified model nodes. Table 3-30 summarizes the reported ranges for different model parameters and the parameter values chosen for the regional groundwater flow model. Few differences exist, as discussed below, between the parameter values used in the regional and local flow models. The initial input to the local flow model was based upon the calibrated regional flow model.

Rainfall recharge for the local groundwater flow model was refined and slightly revised from the regional model recharge. Recharge in some areas in the vicinity of and just south of the PRRS of the local model was reduced in comparison to the regional model. This reduction was based on the finding of an abundance of fine-grained formation materials in the unsaturated zone and the presence of pavement at A&W and RNC sites. Generally, this reduction had a negligible effect on groundwater elevations in the local model. Sensitivity testing with the regional model also shows that a reduction in recharge of this magnitude has only a small effect on groundwater elevations (and, consequently, groundwater flow).

To support solute transport model calibration, the ratio of vertical to horizontal hydraulic conductivity (Kv/Kh) was decreased from 1/10 (regional model) to 1/100 (local model). A Kv/Kh of 1/10 was originally chosen based on similar values being suggested for the area in other modeling investigations (GeoTrans 1985 and IT December 1990). However, sensitivity testing with the regional groundwater flow model suggested that a Kv/Kh of 1/100 provided slightly better calibration. This lower ratio assisted in a better calibration of the transport model. Consequently, a Kv/Kh of 1/100 was used. (Horizontal hydraulic conductivities of 350 ft/d and 450 ft/d were retained.)

The boundary conditions for the local flow model were also based upon the results of the calibrated regional flow models. To "drive" the flow through the Study Area,

specified constant pressure head boundaries were established for the northern and southern portions of model domain. The east and west model boundaries were defined as no-flow boundaries.

3.11.2.2 Calibration

As in the regional flow model, the local flow model was calibrated by adjusting several hydrologic and hydrogeologic parameters within their reported ranges for the PRRS area. The primary parameters used to achieve calibration included:

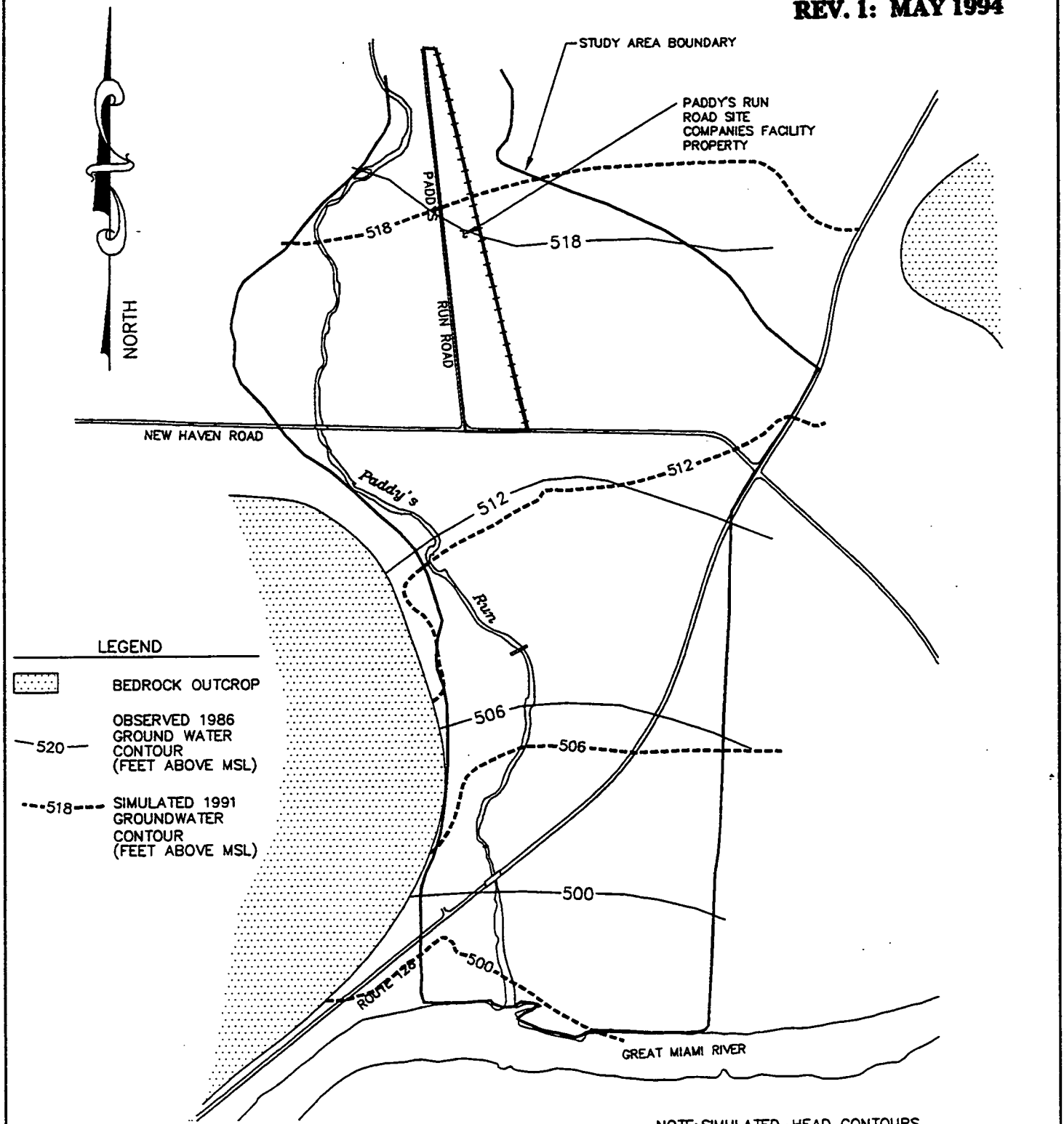
- Specified pressure boundary conditions
- Rainfall recharge
- Hydraulic conductivities

Again, consistent with the regional flow modeling, the 1986 (consisting of eight data points in modeling domain) and 1991 (consisting of 63 data points in modeling domain) data sets were utilized for flow model calibration. The calibration criteria were the same as previously discussed for the regional flow model calibration.

The local flow model was calibrated, meeting the specified criteria, for both the 1986 and 1991 data sets. A comparison of the observed versus estimated, calibrated hydraulic heads for the 1991 data is presented in Figure 3-54.

3.11.2.3 Results and Conclusions

The local groundwater flow model was successfully calibrated (i.e., satisfied pre-established criteria) to two sets of groundwater elevation data, which generally represent average groundwater flow conditions at the PRRS. (See Tables 3-45 and 3-46.) During calibration of the model to 1986 and 1991 conditions, it was found that in general, water levels were approximately 1 foot lower for 1991 than for 1986. Consequently, two sets of boundary conditions (specified constant pressure head boundaries and depth of flow in the Great Miami River and Paddys Run stream) were modified from the 1986 model calibration to achieve calibration in 1991 data. Consistent with the regional model, specified constant pressure head boundary



NOTE: "OBSERVED" CONTOURS
SOURCE FOR WATER LEVEL DATA: ERM (SEPT. 1992)
MANUAL CONTOURING USED
[SURFER (GOLDEN SOFTWARE, 1989) NOT APPLIED]

NOTE: SIMULATED-HEAD CONTOURS
BASED ON SURFER
(GOLDEN STATE SOFTWARE, 1989)
PLOT OF MODEL RESULTS USING
INVERSE DISTANCE METHOD

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GRAPHIC SCALE

1000 0 500 1000 2000

(IN FEET)
1 inch = 1000 ft.

COMPARISON OF OBSERVED AND SIMULATED 1991 GROUNDWATER TABLE ELEVATIONS
PADDYS RUN ROAD SITE
HAMILTON COUNTY, OHIO

FIGURE 3-54

ERM-Midwest, inc.
Environmental Resources Management

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TABLE 3-45
LOCAL FLOW MODEL CALIBRATION PERFORMANCE - APRIL 1986
PADDYS RUN ROAD SITE

Well I.D.	Model Coordinates			Observed Water Level Elev. (FAMSL)	Computed Water Level Elev. (FAMSL)	Residual Error (ft.)	Residual Absolute Error (ft.)
	I	J	K				
H-115	11	58	4	518.70	515.56	3.14	3.14
H-122	1	76	4	521.40	519.62	1.78	1.78
H-124	26	32	3	505.80	505.74	0.06	0.06
H-126	36	50	4	512.60	511.10	1.50	1.50
H-128	13	27	4	506.80	505.03	1.77	1.77
DE	35	71	4	519.90	517.41	2.49	2.49
RE	19	60	4	515.70	515.25	0.45	0.45
7-8A	11	80	4	520.70	520.32	0.38	0.38

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SUMMARY

Observed Mean	=	515.2
Computed Mean	=	513.8
Error Mean	=	1.4
ABS ERR Mean	=	1.4
Observed Variance	=	33.62
Error Variance	=	1.03
Computed Variance	=	30.47
Obs STD	=	5.80
Comp STD	=	5.52
Err STD	=	1.01
Coeff. of Variation (OBS)	=	0.17
Coeff. of Variation (COMP)	=	0.18
R1 (ERR Mean/OBS Mean)	=	0.28%
R2 (ABS ERR Mean/OBS Mean)	=	0.28%
R3 (ERR VAR/OBS VAR)	=	3.06%
R4 (CORR COEF)	=	0.985
R5 (Coeff. of Var. (OBS)/Coeff. of Var. (COMP))	=	95.2%
Fractional Imbalance	=	0.90%

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TABLE 3-46
1991 LOCAL FLOW MODEL CALIBRATION PERFORMANCE
PADDYS RUN ROAD SITE

Well I.D.	Model Coordinates			Observed Water Level Elev. (FAMSL)	Computed Water Level Elev. (FAMSL)	Residual Error (ft.)	Residual Absolute Error (ft.)
	I	J	K				
MW-18D	15	68	2	517.80	517.20	0.60	0.60
MW-20D	17	48	2	511.70	511.29	0.41	0.41
MW-21D	21	48	2	511.30	511.19	0.11	0.11
MW-09D	14	61	2	516.20	515.94	0.26	0.26
MW-15D	16	55	2	512.70	514.07	-1.37	1.37
MW-01D	11	80	2	521.50	519.92	1.58	1.58
DOE-3126	5	65	3	517.80	517.28	0.52	0.52
MW-14I	17	55	3	514.40	513.93	0.47	0.47
MW-21I	21	48	3	511.40	511.30	0.10	0.10
MW-24I	20	38	3	506.60	508.21	-1.61	1.61
MW-30I	14	54	3	514.50	514.05	0.45	0.45
MW-31I	22	55	3	513.90	513.37	0.53	0.53
MW-33I	15	61	3	516.10	515.75	0.35	0.35
DOE-2126	5	65	4	517.50	517.21	0.29	0.29
DOE-2129	14	61	4	516.20	515.81	0.39	0.39
DOE-2393	9	61	4	517.10	516.23	0.87	0.87
DOE-2554	5	56	4	516.60	515.50	1.10	1.10
MW-01S	11	80	4	521.50	519.99	1.51	1.51
MW-02S	12	71	4	520.20	518.03	2.17	2.17
MW-03S	13	66	4	515.20	516.96	-1.76	1.76
MW-04S	13	66	4	515.20	516.96	-1.76	1.76
MW-05S	14	66	4	515.30	516.89	-1.59	1.59
MW-06S	15	65	4	515.30	516.60	-1.30	1.30
MW-07S	14	63	4	514.50	516.25	-1.75	1.75
MW-08S	15	62	4	516.40	515.94	0.46	0.46
MW-10S	14	58	4	513.50	515.09	-1.59	1.59
MW-11S	15	58	4	513.50	514.98	-1.48	1.48

TABLE 3-46 (Continued)
1991 LOCAL FLOW MODEL CALIBRATION PERFORMANCE
PADDYS RUN ROAD SITE

Well I.D.	Model Coordinates			Observed Water Level Elev. (FAMSL)	Computed Water Level Elev. (FAMSL)	Residual Error (ft.)	Residual Absolute Error (ft.)
	I	J	K				
MW-12S	16	58	4	513.40	514.87	-1.47	1.47
MW-13S	17	56	4	512.80	514.23	-1.43	1.43
MW-14S	17	55	4	514.30	513.96	0.34	0.34
MW-15S	16	55	4	512.70	514.08	-1.38	1.38
MW-16S	14	56	4	513.00	514.59	-1.59	1.59
MW-18S	15	68	4	517.90	517.23	0.67	0.67
MW-19S	12	51	4	513.70	513.51	0.19	0.19
MW-20S	17	48	4	511.70	511.83	-0.13	0.13
MW-21S	21	48	4	511.30	511.42	-0.12	0.12
MW-22S	28	49	4	511.20	511.24	-0.04	0.04
MW-23S	29	40	4	507.10	508.59	-1.49	1.49
MW-24S	20	38	4	506.50	508.25	-1.75	1.75
MW-25S	18	37	4	506.80	507.97	-1.17	1.17
MW-26S	16	29	4	504.50	504.22	0.28	0.28
MW-27S	21	29	4	503.90	504.87	-0.97	0.97
MW-28S	23	25	4	502.50	503.58	-1.08	1.08
MW-29S	14	22	4	499.10	501.51	-2.41	2.41
MW-30S	14	54	4	514.50	514.06	0.44	0.44
MW-31S	22	55	4	513.90	513.42	0.48	0.48
MW-32S	16	65	4	516.90	516.52	0.38	0.38
MW-34S	15	57	4	515.30	514.73	0.57	0.57
MW-35S	28	24	4	502.50	503.51	-1.01	1.01
MW-36S	21	14	4	497.00	499.57	-2.57	2.57
MW-37S	24	14	4	496.90	499.83	-2.93	2.93
MW-38S	26	54	4	513.40	512.79	0.61	0.61
MW-39S	20	59	4	515.30	514.72	0.58	0.58
MW-40S	20	56	4	512.40	513.90	-1.50	1.50

TABLE 3-46 (Continued)
1991 LOCAL FLOW MODEL CALIBRATION PERFORMANCE
PADDYS RUN ROAD SITE

Well I.D.	Model Coordinates			Observed Water Level Elev. (FAMSL)	Computed Water Level Elev. (FAMSL)	Residual Error (ft.)	Residual Absolute Error (ft.)
	I	J	K				
MW-41S	14	59	4	515.80	515.34	0.46	0.46
PZ-03	13	64	4	514.80	516.55	-1.75	1.75
PZ-04	27	62	4	515.50	514.89	0.61	0.61
PZ-05	28	66	4	516.70	515.89	0.81	0.81
PZ-06	15	80	4	521.50	519.71	1.79	1.79
PZ-07	10	76	4	520.30	519.19	1.11	1.11
PZ-08	11	69	4	516.00	517.69	-1.69	1.69
PZ-09	19	62	4	515.80	515.57	0.23	0.23
PZ-10	19	67	4	517.20	516.73	0.47	0.40

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SUMMARY:

Observed Mean	=	513.1
Computed Mean	=	513.4
Error Mean	=	-0.3
ABS ERR Mean	=	1.0
Observed Variance	=	29.57
Computed Variance	=	22.43
Error Variance	=	1.38
Obs STD	=	5.44
Comp STD	=	4.74
Err STD	=	1.17
Coeff. of Variation (OBS)	=	0.18
Coeff. of Variation (COMP)	=	0.21
R1 (ERR Mean/OBS Mean)	=	-0.06%
R2 (ABS ERR Mean/OBS Mean)	=	0.19%
R3 (ERR VAR/OBS VAR)	=	4.65%
R4 (CORR COEF)	=	0.983
R5 (Coeff. of Var. (OBS)/Coeff. of Var. (COMP))	=	87.2%
Fractional Imbalance	=	1.92%

nodes were decreased by an amount equivalent to 1 foot of head, and the depth of flow in the Great Miami River and Paddys Run Stream were decreased by approximately 1 foot and 0.5 foot, respectively, to achieve calibration of the local flow model to 1991 data.

Rainfall recharge for the local flow model was refined and slightly revised from the regional flow model recharge. Recharge in some areas in the vicinity of and just south of the PRRS was reduced in comparison to the regional model based upon the abundance of fine-grained materials in the unsaturated zone and the presence of pavement at the A&W and RNC properties. Generally, this reduction had a negligible effect on groundwater elevations in the local flow model. Sensitivity testing with the regional model also shows that a reduction in recharge of this magnitude has only a small effect on groundwater elevations (and, consequently, groundwater flow).

To support solute transport model calibration, the ratio of vertical to horizontal hydraulic conductivity was decreased from 1/10 to 1/100. (Note that the calibrated horizontal conductivities were not modified). Sensitivity testing with the regional flow model suggested that a ratio of 1/100 provided slightly better flow model calibration and this lower ratio value assisted in the calibration of the local solute transport model.