SITE MANAGEMENT PLAN

PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

PART A

SITE DESCRIPTION AND MANAGEMENT APPROACH

September 1995

TABLE OF CONTENTS

SITE MANAGEMENT PLAN EXECUTIVE SUMMARY

PART A SUMMARY

1.0 INTRODUCTION 1-1
1.1 Purpose and Scope 1-1
1.2 Background and Authority 1-1
1.3 Report Organization 1-1
1.3.1 Existing Report 1-3
1.3.2 Future Additions 1-3

2.0 REGULATORY FRAMEWORK 2-1
2.1 Federal Authority 2-1
2.1.1 DERP-FUDS 2-2
2.1.2 Comprehensive Environmental Response, Compensation, and Liability Act of 1980 and the Superfund Amendments and Reauthorization Act of 1986 (CERCLA/SARA) 2-3
2.1.2.1 Implementing Regulations 2-3
2.1.2.2 The CERCLA Process 2-4
2.1.3 Resource Conservation and Recovery Act of 1976 (RCRA) 2-8
2.1.4 The Federal Facilities Compliance Act of 1992 (FFCA) 2-8
2.1.5 The National Environmental Policy Act (NEPA) 2-8
2.1.6 Other Environmental, Safety, and Occupational Health Laws and Regulations Applicable Under DERP-FUDS 2-8
2.1.6.1 Clean Water Act 2-10
2.1.6.2 Clean Air Act 2-10
2.1.6.3 Toxic Substances Control Act 2-10
2.1.6.4 Safe Drinking Water Act 2-11
2.1.6.5 Occupational Safety and Health Act 2-11
2.1.6.6 Endangered Species Act 2-11
2.1.6.7 National Historic Preservation Act of 1966 (NHPA), as Amended . . . 2-11
2.1.6.8 Army Regulations (AR) 200-1 2-12
2.1.6.9 Engineer Manual (EM) 385-1-1 2-12
2.1.6.10 Engineer Regulation (ER) 1110-1-263 2-12
2.2 Memoranda of Understanding (MOUs), Memoranda of Agreement (MOAs), and Interagency Agreements (IAGs) 2-12
2.3 Other Federal Agency Responsibilities at PBOW 2-13
2.4 State Authority 2-13
2.5 Applicable or Relevant and Appropriate Requirements (ARARs) 2-14
2.5.1 Federal ARARs 2-16
2.5.2 Ohio ARARs 2-16
2.6 Guidance for Potential Environmental Compliance Activities 2-48
2.6.1 Risk Assessment Guidance 2-48

TABLE OF CONTENTS
(Continued)

2.6.2 Wetlands Guidance 2-48
2.6.3 Historic Preservation Guidance 2-48
2.6.4 Threatened and Endangered Species Surveys Guidance 2-48

3.0 SITE SETTING 3-1
3.1 Site Location, Site Security, and Access 3-1
3.2 Site History 3-1
3.2.1 History of Past Operations 3-3
3.2.2 History of Current Operations 3-3
3.3 Physical Characteristics 3-4
3.3.1 Topography 3-4
3.3.2 Ecology 3-5
3.3.3 Soils 3-7
3.3.4 Geology 3-8
3.3.5 Hydrology 3-8
3.3.5.1 Surface Water 3-10
3.3.5.2 Ground Water 3-10
3.4 Areas of Concern 3-12
3.4.1 TNT Areas 3-12
3.4.2 Red Water Ponds 3-14
3.4.3 Underground Wastewater Flumes 3-15
3.4.4 Burn Grounds 3-16
3.4.5 Waste Lagoons 3-17
3.4.6 Ash Pits and Power Plants 3-18
3.4.7 Toluene Tank Areas 3-18
3.4.8 Rail Car Unloading Area/Sellite Area 3-19
3.4.9 Acid Areas 3-20
3.4.10 Pentolite Area 3-20
3.4.11 Garage and Maintenance Area 3-20
3.4.12 TNT Rail Car Loading Area 3-21
3.4.13 Sitewide Ground Water 3-21

4.0 SUMMARY OF PREVIOUS ENVIRONMENTAL INVESTIGATIONS 4-1
4.1 Previous Investigations 4-1
4.1.1 Ohio Environmental Protection Agency (OEPA), Preliminary Assessment, 1983 . 4-1
4.1.2 Ohio Army National Guard, Environmental Assessment 4-1
4.1.3 Warner, Osborn, Pardee, Environmental Resources Document, 1990 4-2
4.1.4 IT Corporation, Contamination Evaluation, 1991 4-2
4.1.5 Science Applications International Corporation (SAIC), Preliminary Assessment, 1991 4-2
4.1.6 EBASCO, Underground Storage Tank Corrective Actions Remedial Investigation/Feasibility Study, 1991 4-3
4.1.7 H+GCL, Environmental Investigation, 1992 4-3

TABLE OF CONTENTS
(Continued)

4.1.8 Morrison Knudsen, Site Investigation, 1994 4-4
4.1.9 Dames & Moore, Records Review Report, 1995 4-4
4.1.10 Bionetics Corporation, Species Survey, 1995 4-4
4.2 Current and Future Investigations 4-5
4.3 Review of Available Background Data 4-5
4.3.1 TNT Areas 4-5
4.3.2 Red Water Ponds 4-6
4.3.3 Underground Wastewater Flumes 4-6
4.3.4 Burn Grounds 4-6
4.3.5 Waste Lagoons 4-6
4.3.6 Ash Pits and Power Plants 4-6
4.3.7 Toluene Tank Areas 4-6
4.3.8 Rail Car Unloading/Sellite Area 4-7
4.3.9 Sitewide Ground Water 4-7
4.3.10 Acid Areas 4-7
4.3.11 Pentolite Area 4-7
4.3.12 Garage and Maintenance Area 4-7
4.3.13 TNT Rail Car Loading Area 4-7
4.4 Current Status of Site Characterization 4-7
4.4.1 TNT Areas 4-8
4.4.1.1 TNT Area A 4-8
4.4.1.2 TNT Area B 4-8
4.4.1.3 TNT Area C 4-9
4.4.2 Red Water Ponds 4-9
4.4.2.1 West Area Red Water Ponds 4-9
4.4.2.2 Pentolite Road Red Water Ponds 4-10
4.4.3 Underground Wastewater Flumes 4-11
4.4.4 Burn Grounds 4-11
4.4.4.1 Reservoir #2 Burn Ground 4-11
4.4.4.2 G-8 Burn Ground 4-11
4.4.4.3 Taylor Road Burn Ground 4-12
4.4.4.4 Snake Road Burn Ground 4-12
4.4.4.5 Fox Road Burn Ground 4-13
4.4.5 Waste Lagoons 4-14
4.4.6 Ash Pits and Power Plants 4-14
4.4.6.1 Ash Pit and Power Plant #1 4-14
4.4.6.2 Ash Pit and Power Plant #2 4-15
4.4.6.3 Ash Pit and Power Plant #3 4-15
4.4.7 Toluene Tank Areas 4-16
4.4.7.1 Upper Toluene Tank Area 4-16
4.4.7.2 Middle Toluene Tank Area 4-16
4.4.7.3 Lower Toluene Tank Area 4-17
4.4.8 Rail Car Unloading/Sellite Area 4-17

TABLE OF CONTENTS
(Continued)

4.4.9 Acid Areas 4-18
4.4.10 Pentolite Area 4-18
4.4.11 Garage and Maintenance Area 4-18
4.4.12 TNT Rail Car Loading Areas 4-19
4.4.13 Sitewide Ground Water 4-19
4.5 Recommendations 4-19
4.5.1 TNT Areas 4-20
4.5.2 Red Water Ponds 4-20
4.5.3 Underground Wastewater Flumes 4-20
4.5.4 Burn Grounds 4-20
4.5.5 Waste Lagoons 4-21
4.5.6 Ash Pits and Power Plants 4-21
4.5.7 Toluene Tank Areas 4-21
4.5.8 Rail Car Unloading/Sellite Area 4-21
4.5.9 Acid Areas 4-22
4.5.10 Pentolite Area 4-22
4.5.11 Garage Maintenance Area 4-22
4.5.12 TNT Rail Car Loading Areas 4-22
4.5.13 Sitewide Ground Water 4-23
4.5.14 Background Data 4-23

5.0 SITE MANAGEMENT OBJECTIVES 5-1
5.1 Environmental Restoration 5-1
5.2 Development of Data Quality Objectives 5-1
5.3 Safety Objectives 5-3
5.4 Quality Assurance Objectives 5-3
5.5 Community Relations Objectives 5-3
5.6 Coordination with NASA 5-4
5.7 Coordination with Regulatory Agencies 5-4

6.0 QUALITY ASSURANCE REQUIREMENTS 6-1
6.1 QAPP Requirements 6-1
6.2 Data Quality Objectives 6-2
6.3 Sample Containers, Sample Handling, and Custody Requirements 6-2
6.4 Analytical Methods and Holding Times 6-3
6.5 QA/QC Requirements 6-3
6.6 Chemicals of Concern and Analyte Groupings 6-4
6.7 Reporting Limits (Detection Limits) 6-4
6.8 Data Review and Validation 6-5
6.9 Data Assessment 6-5

7.0 SAMPLING AND ANALYSIS PLAN 7-1
7.1 SAP Requirements 7-1

TABLE OF CONTENTS
(Continued)

7.2 Sampling Requirements 7-3
7.2.1 General Procedures 7-4
7.2.1.1 Sample Documentation 7-4
7.2.1.2 Sample Containers and Sample Shipping 7-5
7.2.1.3 Sample Numbering 7-6
7.2.1.4 QA/QC Samples 7-6
7.2.1.5 Field Instrument Calibration 7-7
7.2.2 Surface and Subsurface Soil Sampling 7-7
7.2.3 Sediment and Surface Water Sampling 7-7
7.2.4 Ground-Water Sampling 7-8
7.3 Soil Borings 7-8
7.4 Monitoring Well Installation, Development, and Abandonment 7-9
7.4.1 Well Installation 7-9
7.4.2 Well Development 7-10
7.4.3 Well Abandonment 7-11
7.5 Aquifer Testing and Water Level Monitoring 7-11
7.6 Decontamination Procedures 7-12
7.7 Surveying 7-12
7.8 Investigative Derived Waste (IDW) 7-13

8.0 SITE-SPECIFIC SAFETY AND HEALTH PLAN 8-1
8.1 Purpose and Policy 8-1
8.1.1 Scope of Work 8-2
8.1.2 Project Team Organization 8-2
8.1.3 Safety Training 8-2
8.2 Regulations 8-4
8.2.1 Federal Safety and Health Regulations 8-4
8.2.2 State Safety and Health Regulations 8-4
8.2.3 Local Safety and Health Regulations 8-5
8.3 Documents 8-5
8.3.1 Federally-Mandated Documentation 8-5
8.3.2 Document Storage and Retention 8-6
8.4 Ordnance Explosive Waste (OEW) 8-6
8.5 Emergency Response and Contingencies 8-6
8.6 Communications 8-7

9.0 DOCUMENT CONTROL AND DATA MANAGEMENT 9-1
9.1 Document Control 9-1
9.2 Data Management 9-1
9.2.1 Data Entry Procedures 9-2
9.2.1.1 Manual Data Entry 9-2
9.2.1.2 Electronic Data Transfers 9-3
9.2.2 Database Field and Record Quality Control Methodologies 9-3

TABLE OF CONTENTS
(Continued)

9.2.3 Data Security 9-4
9.3 Coordination with NASA 9-4
9.4 Coordination with Regulatory Agencies 9-4

REFERENCES

VOLUME II, PART B, AREAS OF CONCERN

VOLUME III, PART C, PROJECT MANAGEMENT

LIST OF TABLES

Table 2-1 List of Potential Contaminants of Concern at PBOW, Based on Sampling Results and Past Activities 2-17
Table 2-2 Preliminary Federal Chemical-Specific ARARs for PBOW 2-18
Table 2-3 Preliminary Federal Location-Specific ARARs for PBOW 2-21
Table 2-4 Preliminary Federal Action-Specific ARARs for PBOW 2-25
Table 2-5 Preliminary State of Ohio ARARs for PBOW 2-28
Table 4-1 Summary of Results of PBOW Sediment Investigations 4-24
Table 4-2 Summary of Results of PBOW Surface Soil Investigations 4-26
Table 4-3 Summary of Results of PBOW Subsurface Soil Investigations 4-28
Table 4-4 Summary of Results of PBOW Ground-Water Investigations 4-30
Table 7-1 ASTM Methods for Field Sampling and Analysis Activities 7-2
Table 8-1 Responsibilities of On-Site Personnel 8-3

LIST OF FIGURES

Figure 1-1 Plum Brook Ordnance Works Vicinity Map 1-2
Figure 2-1 General CERCLA Remedial Process Flow Chart 2-5
Figure 2-2 Removal Action Flow Chart 2-6
Figure 2-3 Comparison of CERCLA and RCRA Processes 2-9
Figure 3-1 Plum Brook Ordnance Works Vicinity Map 3-2
Figure 3-2 Generalized Bedrock Stratigraphic Area 3-9
Figure 3-3 Regional Water-Bearing Zones in Bedrock Aquifers 3-11
Figure 3-4 Locations of Areas of Concern at PBOW 3-13
Figure 5-1 Data Quality Objective Process 5-2

LIST OF ACRONYMS

AEC	Atomic Energy Commission
AOC	area of concern
AR	army regulation
ARARs	applicable or relevant and appropriate requirements
AST	above-ground storage tank
ASTM	American Society for Testing and Materials
BD/DR	building demolition and debris removal
BTEX	benzene, toluene, ethylbenzene, xylene
CA	cooperative agreement
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CERCLIS	Comprehensive Environmental Response Compensation and Liability Information System
CLP	contract laboratory program
COC	contaminant of concern
CPR	cardio-pulmonary resuscitation
CWA	Clean Water Act
D&D	decontamination and decommissioning
DERA	Defense Environmental Restoration Account
DERP	Defense Environmental Restoration Program
D&M	Dames & Moore
DNT	2,4- or 2,6-dinitrotoluene
DOD	Department of Defense
DOT	Department of Transportation
DQO	data quality objective
DSMOA	Defense and State Memorandum of Agreement
EA	environmental assessment
EB	EBASCO Corporation
EE/CA	engineering evaluations and cost analyses
EM	USACE Engineering Manual
EO	executive order
EPA	Environmental Protection Agency
ER	USACE Engineering Regulation
FFCA	Federal Facilities Compliance Act
FS	feasibility study
FSP	field sampling plan
FUDS	formerly-used defense sites
GSA	General Services Administration
GW	ground water
HMX	cyclotetramethylene tetranitramine
HRS	hazard ranking system
HTF	Hypersonic Tunnel Facility
HTRW	hazardous, toxic, and radioactive wastes

List of Acronyms
(Continued)

IAG	interagency agreements
IDW	investigative-derived waste
IRP	Installation Restoration Program
IT	IT Corporation
MCL	maximum contaminant level
MCLGs	maximum contaminant level goals
MK	Morrison Knudsen
ml	milliliter
MOA	memorandum of agreement
MOU	memorandum of understanding
MSL	mean sea level
MW	monitoring well
NAAQS	National Ambient Air Quality Standards
NACA	National Advisory Committee for Aeronautics
NASA	National Aeronautics and Space Administration
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NIOSH	National Institute for Occupational Safety and Health
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
OAC	Ohio Administrative Code
ODNR	Ohio Department of Natural Resources
ODOT	Ohio Department of Transportation
OEPA	Ohio Environmental Protection Agency
OHANG	Ohio Army National Guard
OHPO	Ohio Historic Preservation Office
OEW	ordnance and explosive waste
OHW	other hazardous waste operations
OSHA	Occupational Safety and Health Administration
OSHD	Occupational Safety and Health Division
PA	preliminary assessment
PAH	polynuclear aromatic hydrocarbon
PARCC	precision, accuracy, representativeness, completeness, comparability
PBOW	Plum Brook Ordnance Works
PBRF	Plum Brook Reactor Facility
PBS	Plum Brook Station
PCB	polychlorinated biphenyls
PE	pentaerythrinol

List of Acronyms
(Continued)

PETN	pentaerythrinol tetranitrate
PMUs	project management units
POL	petroleum, oil, and lubricants
POTWs	publicly-owned treatment works
ppb	parts per billion
ppm	parts per million
PRP	potentially responsible parties
PSAP	project-specific sampling and analysis plan
PVC	polyvinyl chloride
QA	quality assurance
QAPP	quality assurance program plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RDX	cyclotrimethylene trinitamine
RI	remedial investigation
ROD	record of decision
SAIC	Science Applications International Corporation
SAP	sampling and analysis plan
SARA	Superfund Amendments and Reauthorization Act
SB	soil boring
SD	sediment
SDWA	Safe Drinking Water Act
SHPO	State Historic Preservation Officer
SI	site inspection
SMP	site management plan
SPCS	State Planar Coordinate System
SS	surface soil
SSHP	site-specific safety and health plan
SVOC	semi-volatile organic compound
SW	surface water
TBC	to-be-considered materials
TCA	trichloroethane
TCE	trichloroethene
TCLP	toxicity characteristics leachate procedure
TNT	2,4,6-trinitrotoluene
TPH	total petroleum hydrocarbons
TSCA	Toxic Substances Control Act
ug/ℓ	micrograms per liter
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
UST	underground storage tank

EXECUTIVE SUMMARY

Plum Brook Ordnance Works (PBOW) is located near Sandusky, Ohio, 50 miles west of Cleveland, Ohio, and four miles south of the Lake Erie Port of Sandusky. The site was acquired by the Department of Defense (DOD) in 1938 to manufacture 2,4,6-trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite. Production began on December 16, 1941 and continued through late 1945, yielding over 900 million pounds of these materials during this time. In December 1945, custody of PBOW was transferred to the U.S. Army Ordnance Department, and the U.S. Army Corps of Engineers (USACE) assumed responsibility for maintenance and custodial duties.

In 1956 the National Advisory Committee for Aeronautics (now known as the National Aeronautics and Space Administration, NASA) began leasing sections of PBOW from the Army. By 1963, approximately 6,400 acres of PBOW had been acquired by NASA for various aerospace research activities. Research and test activities were conducted by NASA at Plum Brook Station (PBS) throughout the 1960s and early 1970s.

Environmental remediation of the PBOW site is administered under the Defense Environmental Restoration Program for Formerly-Used Defense Sites (DERP-FUDS) program. This Site Management Plan (SMP) provides a management tool for conducting environmental restoration at PBOW. The SMP is divided into three sections:

- Part A - Site Description and Management Approach
- Part B - Areas of Concern
- Part C - Project Management

ES 1.0 PART A, SITE DESCRIPTION AND MANAGEMENT APPROACH

Part A contains a description of the regulatory framework, site setting, and past investigations and results. It also describes management objectives and guidelines for programs required for environmental remediation activities at PBOW. Part A includes the following sections:

- **Regulatory Framework** - describes the federal regulations governing restoration at PBOW including the DERP-FUDS program, including memoranda of agreement and/or understanding and interagency agreements. Identifies preliminary ARARs for PBOW. Provides guidance for preparation of risk assessments and other environmental studies that may be required at the site.

- **Site Setting** - portrays PBOW location, access, history, and physical characteristics. Describes location, history and physical characteristics of each Area of Concern (AOC).

- **Summary of Previous Environmental Investigations** - lists each major environmental study conducted at PBOW and provides a summary of the results of each investigation and recommendations for further study.

- **Site Management Objectives** - defines USACE objectives for performing restoration at PBOW including development of data quality objectives. Objectives for safety, quality assurance, community relations, and coordination with NASA and regulatory agencies.

- **Quality Assurance Requirements** - provides guidance for establishing the Quality Assurance Program Plan, data quality objectives, QA/QC requirements, data review and validation, and data assessment.

- **Sampling and Analysis Plan** - establishes guidelines for developing a sampling and analysis plan and sampling procedures. Also provides guidelines for soil borings; monitoring well installation, development, and abandonment; aquifer testing and water level monitoring; decontamination procedures; surveying; and investigative-derived waste.

- **Site-Specific Safety and Health Plan** - presents guidelines for preparing a site-specific safety and health plan for all field activities at PBOW. Describes establishment of scope of work, project team organization, and safety training. Federal, state, and local safety and health regulations are described. Safety and health documents, federally-mandated documentation and document storage and retention are described. Ordnance explosive waste, emergency response and contingencies, and communications guidelines are also presented.

- **Document Control and Data Management** - includes guidelines for document control and data management, such as manual and electronic data entry procedures, electronic data transfers, database field and record quality control methodologies, and data security.

ES 2.0 PART B, AREAS OF CONCERN

Part B describes the areas of potential contamination which are scattered over PBOW. These areas have been grouped by similarity of past activity into Areas of Concern (AOCs). The following is a brief description of the AOCs at PBOW identified as eligible for inclusion in the DERP-FUDS program.

ES 2.1 TNT Areas

During World War II, the PBOW facility housed operations for the manufacture of TNT and DNT in three primary areas referred to as TNT Area A (approximately 113 acres on the east side of PBOW), TNT Area B (approximately 48 acres in the southern portion of PBOW), and TNT Area C (approximately 113 acres

on the west side of PBOW). Between 1941 and 1945, the TNT manufacturing process at PBOW involved approximately 925 million pounds of nitric acid, 63.5 million pounds of sulfuric acid, and over 425 million pounds of toluene for the manufacture of almost 900 million pounds of TNT and DNT. Based on past site activities, nitroexplosives and residue from the TNT manufacturing process are likely COCs at the TNT areas.

ES 2.2 Red Water Ponds

During operation of the PBOW, process waste water, resulting from one of the final purification steps in the production of TNT, was discharged at the site. This waste water, referred to as "red water" because of its color, was transported to a waste water treatment and incineration area (Waste Water Disposal Plant #1) and discharged, via wooden flumes and elevated discharge pipes, to settling ponds located in two areas of the site:

- West Area Red Water Ponds, consisting of two irregular-shaped ponds referred to as West Pond and East Pond, located on the west side of PBOW. West and East Ponds together have a maximum capacity of 120,000 cubic yards of waste water and are separated by an earthen berm.

- Pentolite Road Red Water Ponds, located in the north central portion of PBOW, originally were approximately 200 ft × 400 ft with a maximum capacity of 182,000 cubic yards of waste water (D&M 1995). The ponds have since been backfilled following a 1977 breach. Retention dikes and sump pits were constructed at the site and the surface ditch was diverted to prevent further runoff of the red water.

ES 2.3 Underground Wastewater Flumes

The wastewater disposal systems at TNT Manufacturing Areas A, B, and C were comprised of above- and below-ground wooden flumes. The wooden flumes were used to carry liquid and solid wastes that accumulated in catch basins located at the wash houses at the three TNT areas. Wastes were transported from the catch basins by gravity flow to wooden settling tanks located in the northernmost portion of each TNT area, before being pumped to one of the red water ponds. The Underground Wastewater Flume lines are generally located:

- along the northern border of TNT Area A. The wastewater flumes and sewers from Area A carried liquid and solid waste to the Pentolite Road Red Water Ponds.

- in the northern portion of TNT Area B. The waste water from Area B was sent to the Pentolite Road Red Water Ponds.

- in the central and northern portions of TNT Area C, where waste water was piped to the West Area Red Water Ponds for disposal.

An estimate of the total piping associated with the flume lines is 20,825 feet of 4-inch pipe; 2,050 feet of 5-inch pipe; 11,250 feet of 6-inch pipe; and 8,875 feet of 10-inch pipe. The wooden flume lines often became clogged with TNT residue, and in some instances were completely plugged. The plugged lines were abandoned, and by-pass lines were constructed around the blocked areas to provide continual drainage of the waste water. Locations of by-pass lines were not documented. During decontamination and decommissioning (D&D) performed by both DOD and NASA, all known flumes were excavated and removed to the burning grounds for destruction. The locations of any remaining flumes at PBOW are unknown. Although a concerted D&D effort was aimed at removing and destroying all of the pipe and flumes, significant lengths of explosives-contaminated flumes may remain at the site. NASA has encountered previously unidentified flumes during construction activities at TNT Area A while installing water lines along Main Road.

ES 2.4 Burn Grounds

During the operation of PBOW, burn grounds were used by the Army for the disposal of explosive manufacturing wastes and out-of-specification ordnance. Five burn grounds have been identified, but it is suspected that other areas at PBOW may also have been used as burn grounds. There has been some disagreement on the location of the five known burn grounds; the following is the most recent description of their locations:

- Reservoir #2 Burn Ground, located in the northwestern portion of PBOW south of Reservoir #2.

- G-8 Burn Ground, located in the southwestern portion of PBOW near the intersection of Campbell Street and Patrol Road.

- Taylor Road Burn Ground, located approximately 300 feet southeast of Taylor Road and 300 feet east of Ransom Road.

- Snake Road Burn Ground, located in the southern portion of PBOW approximately 800 feet north of the intersection of West Scheid and Snake Roads, occupies an area of approximately 20,000 square feet. The area east of Snake Road was used by the Army between 1941 and 1963 for the destruction of explosives during the D&D of PBOW.

- Fox Road Burn Ground, located in the northeastern portion of PBOW north of Fox Road, was used for the burning of contaminated flume lines and other TNT-contaminated pipes.

During the period of TNT manufacturing, the burn grounds were used for destruction of hazardous (off-specification TNT, explosives, acids, and solvents) and non hazardous (asbestos and waste oil) materials. The burn grounds were also used for the destruction of explosives-contaminated waste water flumes, intermediate settling tanks, and catch basins from the TNT areas. Contaminated putty, packing, asbestos insulation removed from buildings, and excavated contaminated soils from the TNT and pentolite areas were also burned. Additional explosives and materials contaminated with TNT, DNT, pentolite, and asbestos were burned in these areas during D&D operations. The quantity of waste destroyed at the burn grounds is unknown.

ES 2.5 Waste Lagoons

Pentolite was manufactured at PBOW from March 1943 through August 1945. Wastewater generated from this process likely contained substantial concentrations of PE, PETN, TNT, and acetone. The wastewater was disposed in two waste water lagoons, or settling basins, located in the former pentolite dry storage area in what is now a grassy area north of Pentolite Road and south of the reactor facility, within the fenced area enclosing the reactor site. The lagoons were constructed of precast concrete blocks with asphalt-filled expansion joints placed on 4 to 6 inches of gravel or #4 stone; each lagoon basin measured approximately 100 feet by 140 feet. No information is available on the amount of waste water generated, the disposal of sludge, or the volume of waste water treated. Because the lagoons were removed and the pentolite area was graded for construction of the Plum Brook Reactor Facility (PBRF), the lagoons do not appear on current PBOW maps.

ES 2.6 Ash Pits and Power Plants

During the operational period of PBOW, ash pits served as disposal areas for fly ash and ash generated from the burning of coal at on-site power plants. Fly ash generated from each of the boilers in the power house collected in pits. Water was added to the ash and the water-ash slurry flowed through a sluice trench to the ash sump located at the end of the building. From the ash sump, the ash traveled through a pipeline to a nearby surface impoundment (ash pit). The three ash pits and power plants include:

- Ash Pit #1, associated with Power Station #1 (Building 201), is located south of Maintenance Road and north of the railroad tracks and the power house building.

- Ash Pit #2, associated with Power Station #2 (Building 501), is located west of Campbell Street, across the street from the power station. It is rectangular in shape and covers approximately 8,000 square feet. Waste Water Disposal Plant #2, also associated with Power Station #2, is located west of Ash Pit #2 opposite Pipe Creek.

- Ash Pit #3, associated with Power Station #3, is located west of Ransom Road and south of Maintenance Road. Historical records indicate that the ash pit was a bermed square-shaped depression occupying an area of approximately 7,500 square feet. NASA's K Site Test Facility was constructed at the site of Power Station #3.

Other potential sources of contamination related to the former power stations include releases from the below-grade fly ash sumps located at each power house, the above ground fuel storage tanks, and the coal storage yards.

ES 2.7 Toluene Tank Areas

During the active period of PBOW, six toluene storage tanks served as bulk storage for toluene used in the production of TNT. Each TNT production area had two above-ground toluene tanks of 200,000-gallon capacity each:

- Toluene Tanks 255 and 265, referred as the "Upper Toluene Tanks," supported TNT Area A during the operational period of PBOW and are located west of TNT Area A and Short Cut Road and south of Maintenance Road. The tanks are encircled by earthen dikes approximately 6 feet high. NASA renumbered these tanks as Tank 8951 (Tank 265) and Tank 8952 (Tank 255) and used them for fuel oil storage.

- Tanks 425 and 435, also known as the "Middle Toluene Tanks," supported TNT Area B during ordnance production. They are located northwest of TNT Area B near Taylor Road, and are currently empty.

- Tanks 645 and 655, or the "Lower Toluene Tanks," supported TNT Area C during PBOW operations. They are located southeast of TNT Area C near the intersection of Patrol Road and Taylor Road. Tank 645 was moved by NASA to the Reactor Area for fuel oil storage.

The tanks were decommissioned in 1945 by pumping out their contents, draining the transfer lines, and opening top and bottom flanges for ventilation.

ES 2.8 Rail Car Unloading Area/Sellite Area

The Rail Car Unloading Area, near the Garage and Maintenance Area on the north side of Maintenance Road between Ransom Road and Taylor Road, may have been used principally for unloading toluene and other chemicals from rail cars. It is estimated that more than 400 million pounds of toluene may have been unloaded at this site during the PBOW operational period. In addition, its proximity to the Garage and Maintenance Area may have led to its informal use for staging of equipment and supplies.

The Sellite Area, located west of the Rail Car Unloading Area, was used for the production and storage of sellite used for the TNT washing process. Extensive areas of bare soil and pieces of sulfur and slag were observed at the former Sellite Area during field reconnaissance by Dames & Moore. A shallow surface ditch which received runoff from the Sellite Area is located east of the Sellite Area.

ES 2.9 Acid Areas

During the operation of PBOW, acid areas were used by the Army for the manufacturing of nitric and sulfuric acids used in various stages of the manufacture of TNT and pentolite. Three areas of acid manufacturing have been identified at PBOW, referred to as Acid Area #1, Acid Area #2, and Acid Area #3. Acid Area #1 is located in the central portion of PBOW, south of the Garage and Maintenance Area. Acid Area #2 is located in the westernmost portion of PBOW, south of Maintenance Road and just east of Patrol Road, northwest of Pipe Creek. Acid Area #3 is located in the northwestern portion of PBOW, along Ransom Road north of Maintenance Road. Each acid area is roughly rectangular in shape and cover an area of approximately ten acres.

ES 2.10 Pentolite Area

During the operation of PBOW, the Pentolite Area was used by the Army for the manufacturing of pentolite. Pentolite was produced from March 1943 through August 1945 when PBOW ceased operation. The Pentolite Area was the only area at PBOW used for the production of pentolite. The area contained three pentolite lines with a designated capacity of 7,000 pounds per 24 hours. Two basins received wastewater generated during pentolite production. The volume of wastewater, specific treatment details, and sludge details are not known. The site is located in the north-central portion of PBOW, and lies within the boundaries of Ransom Road on the west, Pentolite Road on the south, and Patrol Road on the north and east. The exact size and shape of the site has not been determined.

The decommissioning of the Pentolite Area was begun in 1945 when ordnance manufacturing ceased. All buildings in the Pentolite Area were removed or burned in place. In 1956, the Pentolite Area was selected by NASA as the site for the construction of the PBRF. The entire pentolite area was graded to meet reactor site specifications, and potentially contaminated soil was removed to an unknown location or dispersed during construction. A Preliminary Assessment indicated that the wastewater generated during the manufacturing of pentolite probably contained significant concentrations of PE, PETN, acetone, and TNT.

ES 2.11 Garage and Maintenance Area

During the operation of PBOW, the Garage and Maintenance Area was likely used by the Army for the general maintenance of equipment and vehicles. Underground storage tanks (USTs) were installed in this area for the storage of gasoline, solvents, and waste oil. These USTs have subsequently been removed. The Garage and Maintenance Area was operational between 1941 to 1945, becoming decommissioned when PBOW ceased operations. The site is located in the central portion of PBOW along Maintenance Road. The Garage and Maintenance Area is currently used in support of NASA activities. Additional USTs were installed at this site in 1964 and 1982 for the storage of solvents and diesel fuel. These USTs have also been removed. Two USTs were installed by NASA in this area during 1990 for the storage of gasoline and diesel fuel, and are currently operational.

ES 2.12 TNT Rail Car Loading Areas

During the operation of PBOW, TNT was loaded onto rail cars for shipment from the site and to storage areas on the site. The locations of these TNT Rail Car Loading Areas are unknown, and reference to them has not been found in site documents. However, it is suspected that there was a loading area at each of the TNT manufacturing areas, located along now-abandoned rail spurs. The presence of the remnants of blast-protection walls adjacent to abandoned rail tracks at the southern end of TNT Area B suggests this as a possible location of a TNT Rail Car Loading Area. Construction of facilities in support of NASA activities may have altered or removed the loading areas, particularly at TNT Area A.

ES 2.13 Sitewide Ground Water

The potential for ground-water contamination exists at PBOW, although ground-water contamination has not been documented at the site. Ground-water contamination may have resulted from activities related to the operation of PBOW as well as later activities. The manufacturing and storage of acid and the storage and transport of process chemicals, including toluene and acetone, occurred at PBOW in support of the ordnance manufacturing. In addition, waste "red water" was transported via buried pipelines and flumes to treatment facilities, and from there to waste "red water" ponds for long-term storage. The possibility of spillage or leakage during storage, transport, and manufacturing of chemicals, wastes, and ordnance may have contributed to the contamination of ground water at the site. In addition, D&D activities may have contributed to ground-water contamination at the site.

ES 3.0 PART C, PROJECT MANAGEMENT

Part C, provides preliminary information necessary for the development of a Project Management Plan (PMP) for environmental remediation activities at PBOW. Part C includes the following sections:

- **Management Responsibilities** - defines the requirements for a PMP; provides a preliminary work breakdown structure (WBS); and defines organizational responsibilities for managing and conducting remedial activities at PBOW.

- **Administrative Record** - establishes the requirement for an Administrative Record (AR) for PBOW activities, and identifies USEPA guidance documents for this purpose. Defines the scope of the AR, the role of the local community in the AR, and State involvement in the AR process. Provides a model administrative record file structure, and guidance on developing and maintaining the AR.

- **Community Relations** - provides guidelines for establishing a community relations program for PBOW activities, along with requirements and guidelines for a community relations plan (CRP). Defines the makeup and responsibilities of the Remediation Advisory Board, and the general steps in conducting community relations activities.

- **AOC Rankings and Prioritization** - summarizes the Hazard Ranking System (HRS) scores applied to the PBOW AOCs in earlier studies. Based on the HRS scores, previous investigations, and the history of activities at the AOCs, each AOC is given a preliminary prioritization of 1, 2, or 3, with 1 being the highest priority.

- **Project Schedule** - establishes the requirements for a project schedule in the PMP, and provides a preliminary summary schedule for conducting remedial activities at each of the AOCs at PBOW, based on the priorities assigned to the AOCs in the previous Section.

- **Funding Requirements** - describes the requirements for including budget and cost estimates in the PMP, and provides a preliminary cost estimate, for planning purposes, for each phase of remedial investigation. These cost estimates are time-phased using the preliminary schedule developed for the previous Section, and rolled up by fiscal year to show maximum yearly costs for PBOW remediation through the assumed life of the project.

- **Updating the SMP** - defines the requirement for updating and revising the SMP, and describes the mechanism for incorporating changes into the document. References the document control process to be established for PBOW documents.

- **Management Resources** - contains resource requirements that must be included in the PMP. Provides information on locations and points-of-contact for PBOW resources, including maps, photos, historical documents, and investigation results.

- **Recommendations for Project Management** - provides recommendations for USACE project management to implement early in the site restoration process. Recommendations include: deciding the restoration prioritization; establishing background chemical data; initiating interagency coordination; developing the framework for the administrative record; initiating community relations; conducting site baseline mapping; preparing project plans and procedures; establishing document control procedures; and establishing a data management system.

PART A SUMMARY

Plum Brook Ordnance Works (PBOW) is located near Sandusky, Ohio, 50 miles west of Cleveland, Ohio, and four miles south of the Lake Erie Port of Sandusky. The site was acquired by the Department of Defense (DOD) in 1938 to manufacture 2,4,6-trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite. Production began on December 16, 1941 and continued through late 1945, yielding over 900 million pounds of these materials during this time. In December 1945, custody of PBOW was transferred to the U.S. Army Ordnance Department, and the U.S. Army Corps of Engineers (USACE) assumed responsibility for maintenance and custodial duties.

In 1956 the National Advisory Committee for Aeronautics (now known as the National Aeronautics and Space Administration, NASA) began leasing sections of PBOW from the Army. By 1963, approximately 6,400 acres of PBOW had been acquired by NASA for various aerospace research activities. Research and test activities were conducted by NASA at Plum Brook Station (PBS) throughout the 1960s and early 1970s.

Environmental remediation of the PBOW site is administered the Defense Environmental Restoration Program for Formerly-Used Defense Sites (DERP-FUDS) program. This Site Management Plan (SMP) provides a management tool for conducting environmental restoration at PBOW. The SMP is divided into three sections:

- Part A - Site Description and Management Approach
- Part B - Areas of Concern
- Part C - Project Management

This volume, Part A, provides contains a description of the regulatory framework, site setting, and past investigations and results. It also describes management objectives and guidelines for programs required for environmental remediation activities at PBOW. Part A includes the following sections:

- **Regulatory Framework** - describes the federal regulations governing restoration at PBOW including the DERP-FUDS program, including memoranda of agreement and/or understanding and interagency agreements. Identifies preliminary ARARs for PBOW. Provides guidance for preparation of risk assessments and other environmental studies that may be required at the site.

- **Site Setting** - portrays PBOW location, access, history, and physical characteristics. Describes location, history and physical characteristics of each Area of Concern (AOC).

- **Summary of Previous Environmental Investigations** - lists each major environmental study conducted at PBOW and provides a summary of the results of each investigation and recommendations for further study.

- **Site Management Objectives** - defines USACE objectives for performing restoration at PBOW including development of data quality objectives. Objectives for safety, quality assurance, community relations, and coordination with NASA and regulatory agencies.

- **Quality Assurance Requirements** - provides guidance for establishing the Quality Assurance Program Plan, data quality objectives, QA/QC requirements, data review and validation, and data assessment.

- **Sampling and Analysis Plan** - establishes guidelines for developing a sampling and analysis plan and sampling procedures. Also provides guidelines for soil borings; monitoring well installation, development, and abandonment; aquifer testing and water level monitoring; decontamination procedures; surveying; and investigative-derived waste.

- **Site-Specific Safety and Health Plan** - presents guidelines for preparing a site-specific safety and health plan for all field activities at PBOW. Describes establishment of scope of work, project team organization, and safety training. Federal, state, and local safety and health regulations are described. Safety and health documents, federally-mandated documentation and document storage and retention are described. Ordnance explosive waste, emergency response and contingencies, and communications guidelines are also presented.

- **Document Control and Data Management** - includes guidelines for document control and data management, such as manual and electronic data entry procedures, electronic data transfers, database field and record quality control methodologies, and data security.

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The Site Management Plan (SMP) provides a management tool for all of the partners in the remediation efforts at the former Plum Brook Ordnance Works (PBOW) (Figure 1-1). The SMP includes a compilation of the results of all investigations previously performed at the site to provide a baseline for all future investigations. The document presents the management approach for future investigations in the areas of quality assurance, sampling, data management, and safety and health. The SMP also identifies gaps in the existing characterization of the areas of concern and proposes a generalized site-wide strategy for future investigations.

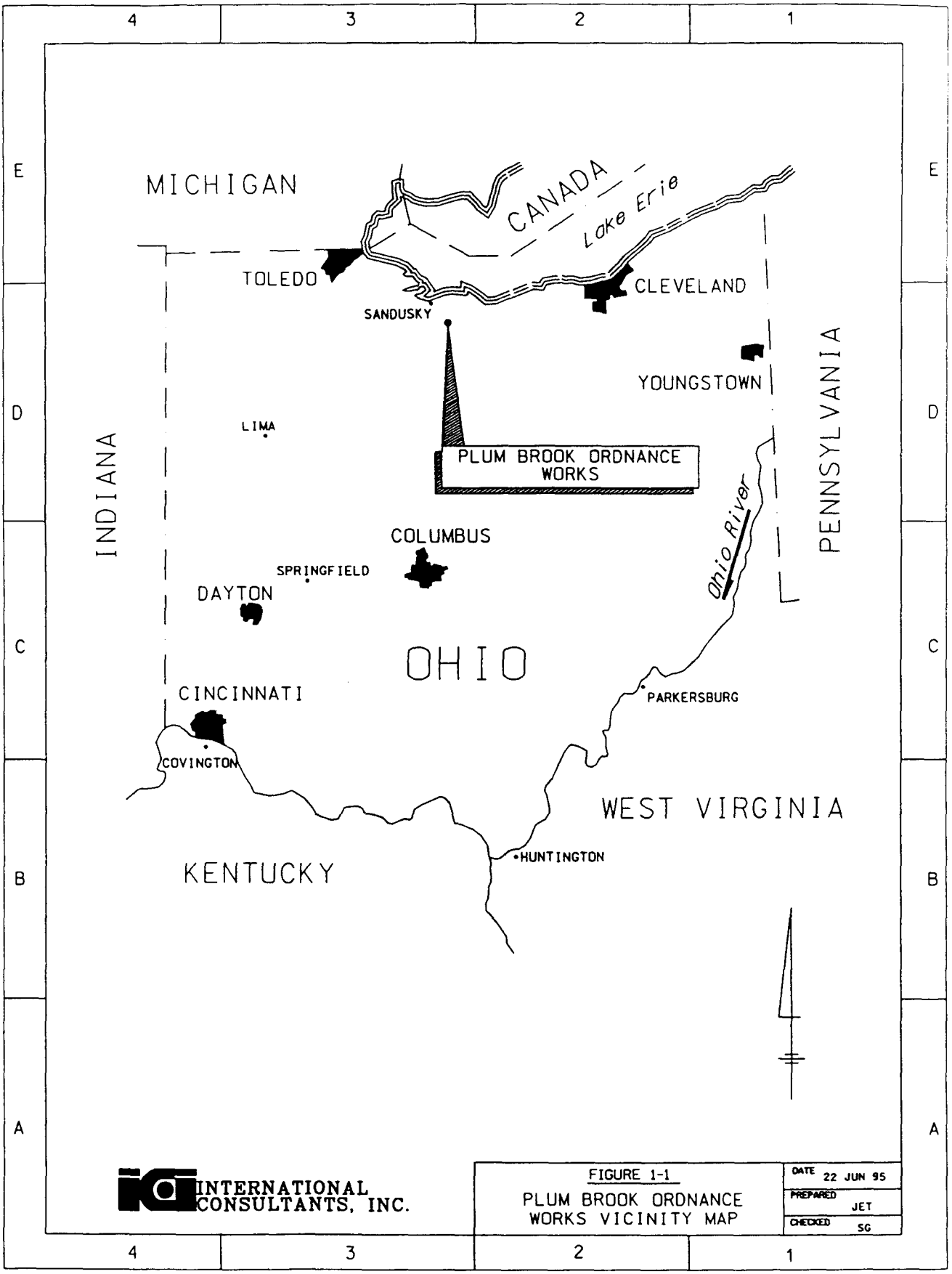
Information presented in this document has been drawn from existing PBOW documents; no primary research has been undertaken.

1.2 BACKGROUND AND AUTHORITY

The majority of the original PBOW site is currently owned and occupied by the National Aeronautics and Space Administration (NASA) which has named the site Plum Brook Station (PBS). NASA controls approximately 6,400 acres of the original 9,010-acre PBOW. Potential source areas of contamination resulting from PBOW activities areas are located throughout the facility. In addition, NASA has begun remediation activities at potential source areas for which it is responsible, such as underground storage tanks (USTs). Because the site is a formerly used defense site, remediation of PBOW source areas falls under the purview of the U.S. Army Corps of Engineers (USACE). Remediation of PBOW is currently administered under the Defense Environmental Restoration Program for Formerly-Used Defense Sites (DERP-FUDS) program. A detailed description of the background and authority of the PBOW remediation is included in Section 2.1.

1.3 REPORT ORGANIZATION

The SMP has been designed to function as a "living document" and will be updated as new information becomes available. The following describes the information included in this submittal and how the document is to be amended.


MICHIGAN
CANADA
Lake Erie
TOLEDO
SANDUSKY
CLEVELAND
YOUNGSTOWN
PENNSYLVANIA
LIMA
INDIANA
PLUM BROOK ORDNANCE WORKS
Ohio River
COLUMBUS
SPRINGFIELD
DAYTON
OHIO
CINCINNATI
PARKERSBURG
COVINGTON
WEST VIRGINIA
HUNTINGTON
KENTUCKY
INTERNATIONAL CONSULTANTS, INC.
FIGURE 1-1
PLUM BROOK ORDNANCE WORKS VICINITY MAP
DATE 22 JUN 95
PREPARED JET
CHECKED SG

1.3.1 Existing Report

The SMP is divided into three major sections:

- **Part A - Site Description and Management Approach** - contains a description of the regulatory framework, site setting, site investigations and results, management objectives, quality assurance requirements, sampling and analysis plans, site-specific health and safety plan, and document control and data management.

- **Part B - Areas of Concern** - presents detailed descriptions of each area of concern, including physical characteristics, site investigations and other studies, contaminants of concern, and the nature and extent of contamination, all based on existing information. A discussion of the current status of site characterization and the potential hazards to human health and the environment are also included.

- **Part C - Project Management** - includes a roadmap for completing the remediation of the PBOW with descriptions of management responsibilities, community relations and the Administrative Record, AOC investigation prioritization and scheduling, funding requirements, and management resources.

1.3.2 Future Additions

After its acceptance by USACE as a final document, changes will be made, as appropriate, to include updates on project plans and scopes, study results, interagency agreements, and any other relevant information. New information will be added as revisions to sections of the document, with page footers changed to reflect the revision number and date of change. A "revisions sheet" will be added to the front of the document which summarizes changes that have occurred. The table of contents will also be revised, as needed, with revision number and date in the page footers. Each revision will also include revisions to the list of references, with revised footers.

Included in the front of Part A of this document is a master distribution list which includes the name, position, address, telephone number, and number of copies for each person receiving the SMP. The appropriate number of copies of any and all additions and replacement table of contents pages are to be sent to the persons on the list, or to their replacements.

2.0 REGULATORY FRAMEWORK

This section contains a discussion of federal, state, and agency regulations pertinent to the remediation at PBOW, portions of which are currently owned by NASA. Potentially contaminated areas resulting from a variety of activities are scattered over PBOW. NASA has assumed responsibility for some potential source areas and is currently conducting remediation at some of these locations. Because the site is a formerly used defense site, PBOW may have been contaminated by defense activities. Remediation of these portions of the site would be administered under the Defense Environmental Restoration Program for Formerly-Used Defense Sites (DERP-FUDS) program. A description of the legislation applicable under DERP-FUDS is included in this section. Responsibilities of other federal agencies and Ohio agency involvement are also described here. Memoranda of understanding (MOUs), memoranda of agreement (MOAs), and interagency agreements (IAGs) which are in place, planned, or needed for the PBOW site are identified, and reporting requirements are included. This section also provides a discussion of the requirements for risk assessments, wetlands assessments, cultural resource surveys, and other compliance provisions that may be necessary for remediation of PBOW and would provide a basis for future decisions.

2.1 FEDERAL AUTHORITY

Remediation of PBOW can fall under any of a number of federal regulations and agency responsibilities. Of primary importance at PBOW is the DERP-FUDS program. This program designates the Secretary of the Army as the Executive Agent for Department of Defense (DOD) to conduct environmental restoration at FUDS. The Secretary further delegates the program management to the USACE. Acting on behalf of the Secretary of Defense, the Deputy Under Secretary of Defense for Environmental Security is responsible for overall DERP-FUDS policy and program budget guidance and provides program funds to the Army. the Secretary of the Army acts for and on behalf of DOD in the remediation of FUDS, regardless of which DOD component previously owned or used the site. The Assistant chief of Staff for Installation Management is the Army Staff proponent for the DERP-FUDS program, responsible for intermediate program oversight of the DERP-FUDS policy guidance, establishment of program goals and objectives, and approval of the annual workplan (unless otherwise noted, *DERP-FUDS Manual, 8 December 1993* is the reference for this section).

2.1.1 DERP-FUDS

The origins of the DERP program involve a number of DOD decisions in the early 1970's, beginning with a study to determine the extent of environmental consequences of abandoned military debris on federal lands in Alaska. A pilot environmental restoration program was initiated to respond to contamination at several Army installations which eventually expanded throughout DOD in 1976. The original scope was to prevent contamination from leaving DOD boundaries and clean up was only implemented when the property was leaving DOD control. Soon after passage of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the President delegated authority to DOD for clean up of active and formerly used defense sites, but activity remained focused on the Alaskan property. The Superfund Amendments and Reauthorization Act of 1986 (SARA, §211) required the Secretary of Defense to carry out DERP and established a transfer account, the Defense Environmental Restoration Account (DERA). Goals established for the DERP were: *identification, investigation, research and development, and clean up of contamination...correction of other environmental damage...demolition and removal of unsafe buildings and structures.* The program was to be administered consistent with §120 of CERCLA and carried out in consultation with an EPA administrator (USA 1993).

Programs included under DERP are: the Installation Restoration Program (IRP) for cleanup of active installations and FUDS; Other Hazardous Waste Operations (OHW) for research and development of remediation technology and pollution prevention; and Building Demolition and Debris Removal (BD/DR) for removal of unsafe structures. A FUDS is defined as *real property that was formerly owned by, leased to, possessed by, or otherwise under the operational control of the Secretary of Defense.* The DERP-FUDS program has three major phases:

- **Inventory** - site identification, records review to verify DOD ownership or usage, and a preliminary assessment
- **Study** - site inspection, if required to identify contamination; engineering evaluations and cost analyses (EE/CA) for removal actions; remedial investigation/feasibility study (RI/FS); and/or litigation, negotiation, and settlement with other parties to define and resolve DOD liability
- **Removal/remediation** - engineering design, removal and/or remedial actions, and/or operations and maintenance during remediation and/or for long-term monitoring, if required.

The DERP-FUDS program includes the following project categories: ineligible; no further action; hazardous, toxic, and radioactive wastes (HTRW) and third party sites; containerized HTRW; ordnance and explosive waste (OEW); and BD/DR.

Because the original PBOW was acquired by DOD in 1941 for the U.S. Army Plum Brook Ordnance Works and operated under their direction until late 1945, the PBOW is considered as a FUDS and any contamination on the property that is a result of these activities is the responsibility of the Army under the DERP-FUDS program.

The legislative context of DERP includes: the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the Superfund Amendments and Reauthorization Act of 1986 (SARA), the Resource Conservation and Recovery Act of 1976 (RCRA), the Federal Facility Compliance Act of 1992 (FFCA), the National Environmental Policy Act (NEPA), and other environmental, safety, and occupational health laws and regulations. A brief discussion of each follows.

2.1.2 Comprehensive Environmental Response, Compensation, and Liability Act of 1980 and the Superfund Amendments and Reauthorization Act of 1986 (CERCLA/SARA)

Among the objectives of CERCLA are: the clean up of abandoned hazardous sites; the prioritization of hazardous waste site remediation (the National Priorities List [NPL]); identification of potentially responsible parties (PRP) for payment of clean up; to set up a trust fund to finance clean ups with no identifiable PRP; and the development of remediation technology. DOD and the Army had implemented hazardous substance remediation at facilities prior to implementation of CERCLA.

2.1.2.1 Implementing Regulations

Under SARA Section 120, EPA created guidelines for active federal facilities to become subject to CERCLA and National Oil and Hazardous Substances Pollution Contingency Plan (NCP) regulations, requiring each *department, agency, and instrumentality of the United States to comply in the same manner as non-governmental agencies.* Section 120 of SARA:

- establishes a time frame for the characterization of hazards at federal HTRW sites
- stipulates that federal sites not listed on the NPL will comply with all state laws and regulations concerning removal and remediation, as long as these laws are equally applied in the private sector
- requires that EPA and agencies owning or operating federal facilities (or FUDS) enter into Interagency Agreements (IAGs) within 180 days of completion of an RI/FS to formalize "expeditious completion" of the remedial action. The IAG includes a description of the action, a schedule for completion, and provisions for any required long-term maintenance or operation. Under dispute resolution provisions in Executive Order 12580, EPA has the right to select the remedial action, if the parties are unable to agree.

SARA §121 stipulates that no state, federal, or local permits are required for on-site remedial activities, however, USACE may consider participating in an Ohio permitting process, or its equivalent, to facilitate coordination with those authorities and to satisfy the state agencies' concerns that Ohio regulations are being followed. USEPA has defined "on-site" to mean *the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action.* Therefore, any plumes of contaminated ground water or areas of airborne contamination extending beyond a site are also included in the cleanup. Section 121 also includes specifications on preferences for alternatives that *result in the permanent and significant reduction in the volume, toxicity, or mobility of contaminants* and that *off-site transport of contaminants with no treatment to reduce volume, toxicity, or mobility, should be the least favored alternative.*

NCP (40 CFR 300.1 to 300.7) is the regulation governing CERCLA and emergency response for oil and hazardous wastes. NCP regulations include: notification and response requirements for spills; requirements for preparedness planning; state involvement in the development of Applicable or Relevant and Appropriate Requirements (ARARs) and Records of Decision (ROD) approvals; natural resource damage assessments; PRP participation; the Administrative Record; and removal response authority for OEW.

2.1.2.2 The CERCLA Process

DERP follows the CERCLA process which includes the following steps (Figure 2-1):

- **Site discovery or notification** - this can take place through a review of regulatory compliance reports, investigations survey efforts, random observation, citizen petition, or other sources. At this point, the site is entered into the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS), EPA's computerized inventory of potential hazardous waste sites.

- **Preliminary assessment (PA)** - a limited scope investigation including record reviews, interviews, and a preliminary site reconnaissance to determine the level of threat to human health and the environment. The PA report recommends: no further investigation, further investigation, or emergency response actions.

- **Removal action** - an activity which is required due to an emergency or time-critical situation involving a direct threat to human health or the environment. One or more may take place at any time during the CERCLA process (Figures 2-1 and 2-2). The activity includes a preliminary evaluation of the release or threat of release, a determination of the necessity of the action, and PR. Threat of fire, explosion, and contamination of drinking water or sensitive ecosystems as well as existence of high levels of hazardous substances in bulk storage containers or in surface soils are the most common grounds for removal actions.

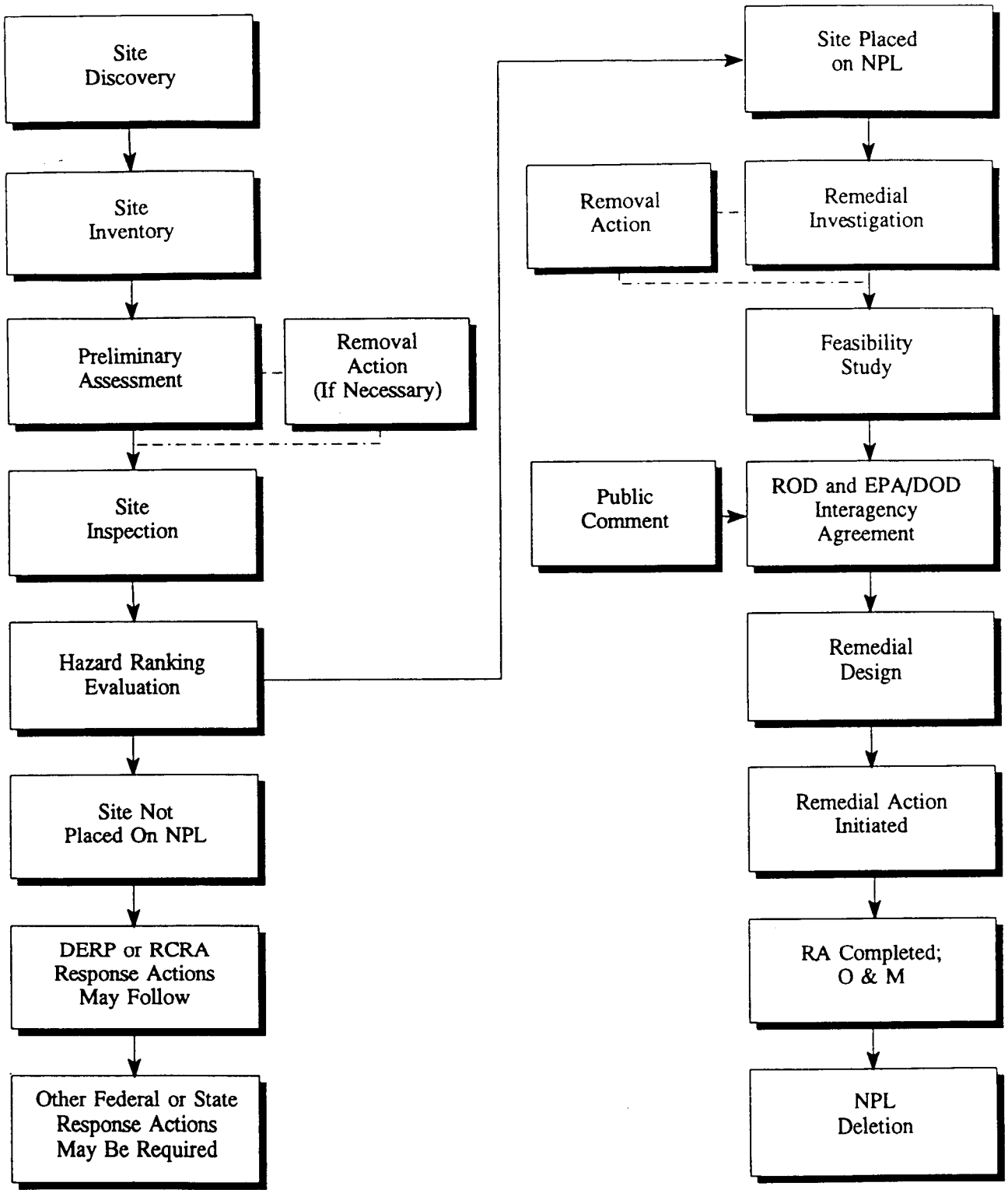


Figure 2-1. General CERCLA Remedial Process Flow Chart

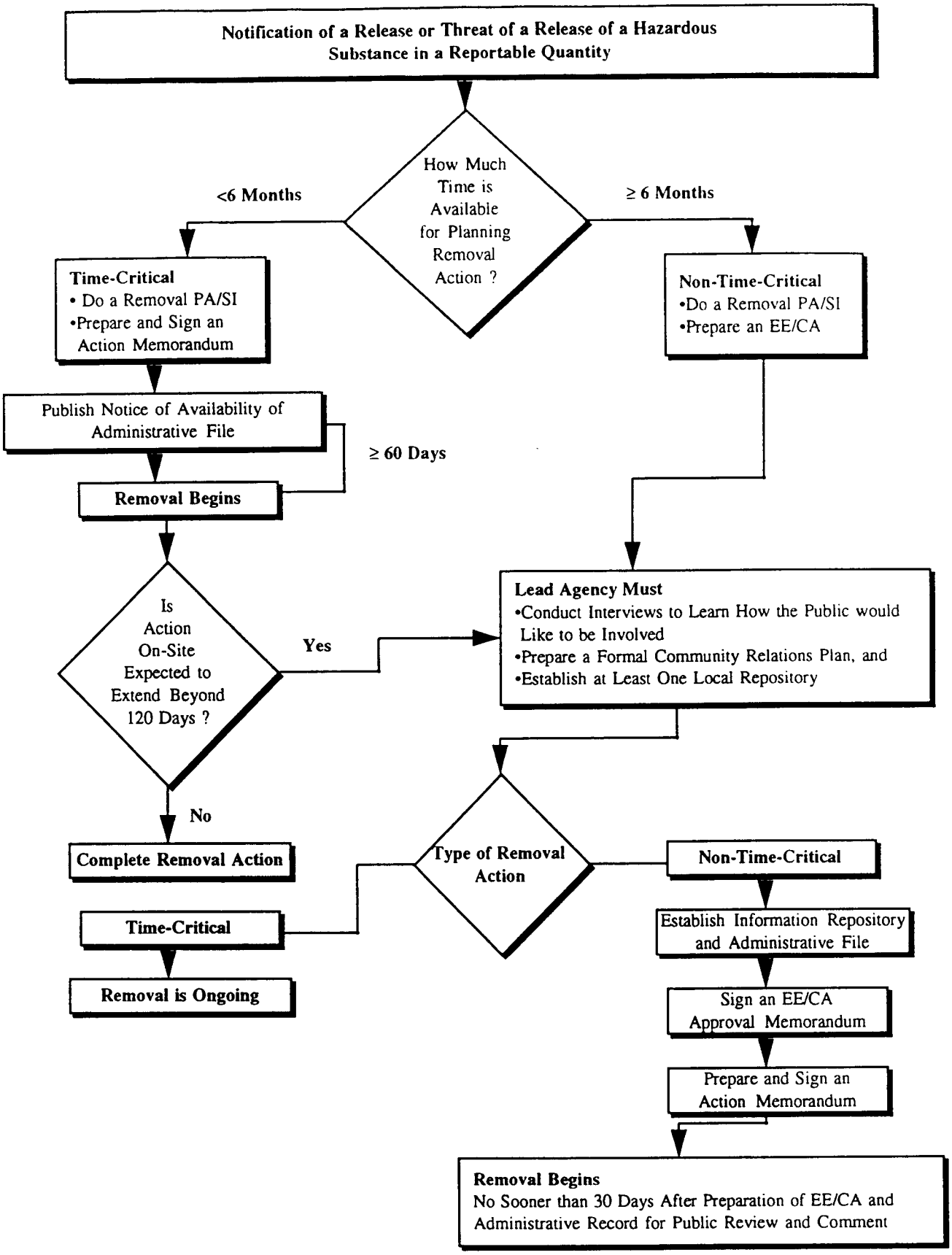


Figure 2-2. Removal Action Flow Chart

- **Site inspection (SI)** - if the PA recommends further study, an SI is performed, which is a more structured and formalized study. The SI includes sampling of wastes and the environment to determine potential contaminants and their release to the environment. A ranking of the site's potential threat is performed using the Hazard Ranking System.

- **Listing on the NPL** - if the HRS score exceeds 28.5, a site is considered eligible for the NPL, public comment is requested and, if there is a determination that the site should be added to the NPL, a Federal Register notice is published, in accordance with 40 CFR 300 Appendix B, noting the site's NPL status.

- **Remedial investigation (RI)** - conducted at all NPL sites, the RI characterizes the nature and extent of contamination and includes a risk assessment which identifies exposure pathways and the level of the threat to human health and the environment resulting from the release of contamination from the site.

- **Feasibility study (FS)** - based on the results of the RI, the FS identifies and ranks all feasible alternatives for remediation. Alternatives are evaluated using the evaluation criteria stipulated by 40 CFR 300.430:

  - overall protection of human health and the environment
  - compliance with ARARs
  - long- and short-term effectiveness
  - reduction of toxicity, mobility, or volume
  - implementability
  - state and community effectiveness
  - cost.

- **Record of Decision** - documents the selected remedy, including detailed descriptions of all facts, analyses, and policy determinations used in employing the evaluation criteria.

- **Remedial design** - the engineering design and construction specifications of the remedy including long-term monitoring and operation

- **Remedial action** - implementation of the remedial design

- **Removal from listing on the NPL** - after all remediation goals are met, public comment is requested and a Federal Register notice is published, in accordance with 40 CFR 300 Appendix B, noting the site's removal from NPL status.

At this point in time, various portions of the PBOW site are in different levels of the remediation process.

Certain requirements for community relations programs are stipulated in the NCP, SARA and EPA policies. Specific minimal requirements for community awareness and involvement are associated with NPL additions, removal actions, remedial responses, remedial investigations, feasibility studies, proposed

plan, records of decision, remedial design, and NPL deletions. Additional information on these activities can be found in *Community Relations in Superfund: A Handbook* (EPA 1992).

2.1.3 Resource Conservation and Recovery Act of 1976 (RCRA)

The Resource Conservation and Recovery Act of 1976 (RCRA) established a national strategy to manage solid and hazardous waste from cradle to grave. RCRA requires and stipulates specific tracking, record-keeping, transportation, storage, and disposal of hazardous materials. The RCRA process is very similar to the CERCLA process (Figure 2-3). RCRA requires corrective actions on all spills or releases, including action beyond facility boundaries, whenever necessary and with proper authority. Subparts of RCRA legislation include definitions of hazardous and medical waste and regulation of underground storage tanks (UST). Investigations of USTs abandoned prior to 17 October 1986 and not used by subsequent owners, may be eligible for DERA funding under DERP-FUDS.

2.1.4 The Federal Facility Compliance Act of 1992 (FFCA)

The Federal Facility Compliance Act of 1992 (FFCA), Public Law 102-386, amends RCRA to establish that federal facilities do not have sovereign immunity from RCRA (except Subtitle I), and are thus obligated to pay fines and penalties assessed under RCRA. Also included are provisions directing EPA to promulgate regulations identifying the point at which conventional and chemical military munitions become hazardous waste as well as safe transportation and storage of these wastes.

2.1.5 The National Environmental Policy Act (NEPA)

DOD has advised that DOD components are not required to comply with NEPA while undertaking a DERA-funded clean up. However, components should ensure that environmental analyses are being fulfilled, through either the CERCLA or RCRA process.

2.1.6 Other Environmental, Safety, and Occupational Health Laws and Regulations Applicable Under DERP-FUDS

As stated in the DERP-FUDS Manual, these

> *other laws and regulations will be considered potential ARARs depending on their applicability and relevance...In the case of non-NPL sites, other laws and regulations are applicable to all the work performed on the site.*

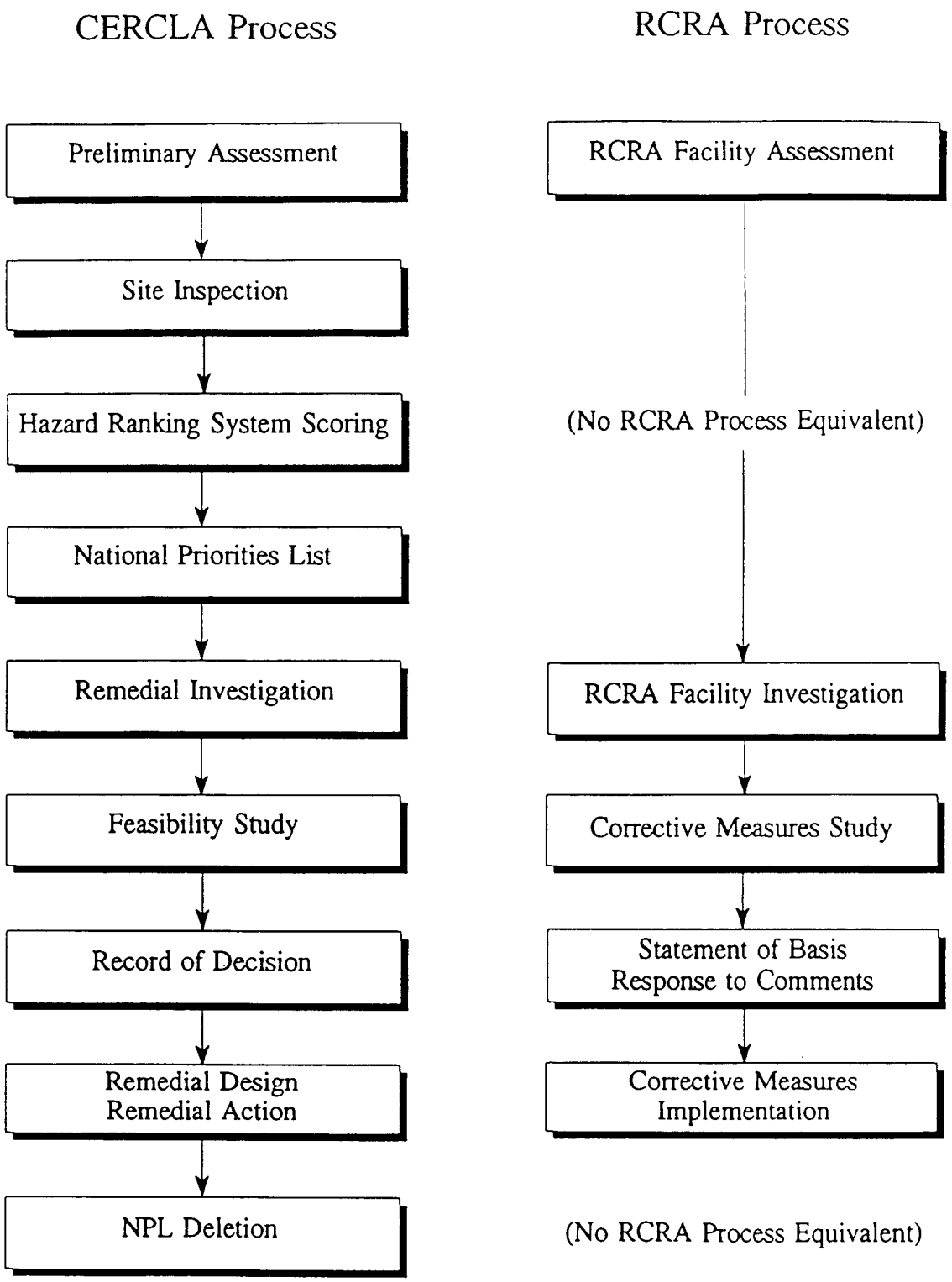


Figure 2-3. Comparison of CERCLA and RCRA Processes

Included here are the Clean Water Act, Clean Air Act, Toxic Substances Control Act, Safe Drinking Water Act, Occupational Safety and Health Act, Endangered Species Act, National Historic Preservation Act, Army Regulation 200-1, Engineer Manual 385-1-1, and Engineer Regulation 1110-1-263.

2.1.6.1 Clean Water Act

The Clean Water Act (CWA) was designed to restore and maintain the physical, chemical, and biological integrity of the nation's waters. Pollutant discharges into navigable waters are controlled through application of federal, state, and local discharge standards. Regulations most likely to affect remediation at PBOW are: surface water quality standards, permitting for discharge to surface waters, standards for indirect discharges to publicly-owned treatment works (POTWs), control of discharges of dredge and fill material into surface waters (wetlands), and stormwater management requirements.

2.1.6.2 Clean Air Act

The Clean Air Act (CAA) regulates emissions into the air to protect and enhance the quality of the nation's air. Stationary and mobile emissions are controlled through combined federal, state, and local programs. EPA has promulgated National Ambient Air Quality Standards (NAAQS), National Emission Standards for Hazardous Air Pollutants (NESHAPs), and New Source Performance Standards. The following activities at remediation sites may result in air pollution problems: air stripping to volatilize contaminants, thermal destruction, handling of contaminated soils, gaseous waste treatment, and biodegradation.

NAAQS primary standards for the protection of human health and secondary standards for the protection of public welfare have been developed for six critical pollutants: particulates, sulfur dioxide, ozone, nitrogen dioxide, carbon monoxide, and lead. NESHAPS most likely to affect remediation are those that address asbestos or radionuclides.

2.1.6.3 Toxic Substances Control Act

Of primary concern for the remediation at PBOW is §6(e) of the Toxics Substances Control Act (TSCA), which pertains to polychlorinated biphenyls (PCBs). This section describes PCB storage incidental to disposal, destruction, and spill cleanup policy.

2.1.6.4 Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water and authorizes drinking water standards and joint federal/state enforcement. Primary drinking water standards, maximum contaminant level standards (MCLS) are contaminant-specific and are set as close as feasible to maximum contaminant level goals (MCLGs). Secondary drinking water standards are primarily limits used by states to regulate the aesthetic quality of water supplies and are not enforceable at the federal level. SDWA regulations are applicable in remedial activities involving clean up of ground water or surface waters that are or may be used for drinking.

2.1.6.5 Occupational Safety and Health Act

The Occupational Safety and Health Act was developed to *assure so far as possible every working man and woman in the nation safe and healthful working conditions.* This Act sets and enforces health and safety standards that apply to remedial activities in two ways. Construction standards are applicable during remedial activities and the *Hazardous Waste Operations and Emergency Response Rule* (29 CFR 1910.120) requires protection of HTRW site workers during initial site characterization and analysis, monitoring and handling activities, and emergency response operations. The rule also specifies training and health monitoring of remediation workers.

2.1.6.6 Endangered Species Act

Under the Endangered Species Act, federal agencies must ensure that their activities do not jeopardize the existence of threatened or endangered species or result in the destruction or damage to critical habitat. Specific coordination with the U.S. Fish and Wildlife Service and/or the National Marine Fisheries Service is required under §7.

2.1.6.7 National Historic Preservation Act of 1966 (NHPA), as Amended

The National Historic Preservation Act (NHPA) requires federal agencies to determine whether any of its proposed activities will affect historic properties (properties on or eligible for inclusion on the National Register of Historic Properties) and to allow the Advisory Council on Historic Preservation review of the proposed activity. The Council has the authority to stop all work if it determines the agency has failed to allow adequate review. NHPA also outlines federal agency coordination with State Historic Preservation Officers (SHPOs) for cultural resource surveys; memoranda of agreement between agencies and the SHPO concerning ongoing activities; and mitigation plans for specific projects that affect historic properties.

SHPOs are particularly concerned about projects involving federal agencies releasing property. Once a property is beyond federal control, regulations regarding impacts to historic properties are no longer in effect, unless a proposed activity involves federal funding.

2.1.6.8 Army Regulation (AR) 200-1

AR 200-1, *Environmental Protection and Enhancement* prescribes Army policies, responsibilities, and procedures for the protection and preservation of environmental quality. AR 200-1 mandates compliance with all applicable federal, state, and local regulations concerning air and water quality, drinking water quality, hazardous wastes, toxic substances, and noise abatement (the Noise Control Act of 1972 and Aviation Safety and Noise Abatement Act of 1979). AR 200-1 also requires compliance with NEPA and the Federal Insecticide, Fungicide, and Rodenticide Act. It presents protocols for environmental program management and hazardous materials management.

2.1.6.9 Engineer Manual (EM) 385-1-1

EM 385-1-1, *Safety and Health Requirements Manual*, prescribes the safety and health requirements for all USACE and contractor activities and operations. Compliance with EM 385-1-1 is mandatory for all DERP-FUDS activities.

2.1.6.10 Engineer Regulation (ER) 1110-1-263

ER 1110-1-263, *Chemical Data Quality Management for Hazardous Waste Remedial Activities*, prescribes USACE and contractor responsibilities and procedures for planning and executing chemical data acquisition, including sampling and analysis. This includes OEW projects where environmental samples are collected for chemical analysis.

2.2 MEMORANDA OF UNDERSTANDING (MOUs), MEMORANDA OF AGREEMENT (MOAs), AND INTERAGENCY AGREEMENTS (IAGs)

There are no MOUs, MOAs, or IAGs currently in place regarding PBOW which specify USACE involvement.

The Defense and State Memorandum of Agreement (DSMOA) Cooperative Agreement (CA) program was developed to involve states and territories in the cleanup of DOD installations through the DERP. States and territories are reimbursed for technical services they provide in support of these activities through

DSMOA and CA. This program also fosters improved relations between states, military services, defense agencies, and DOD. OEPA has decided to participate in the remediation of PBOW through the DSMOA program.

2.3 OTHER FEDERAL AGENCY RESPONSIBILITIES AT PBOW

NASA took over 500 acres of the property in 1956 for the Plum Brook Reactor Facility. By 1963, approximately 6,400 acres had been acquired by NASA for various aerospace research activities, which continued through the early 1970s. NASA has responsibility for all contamination resulting from their activities during this period. In some cases, there may be joint responsibility on the part of USACE and NASA.

USEPA becomes involved in PBOW remediation if the site becomes eligible for listing on the NPL and in all CERCLA activities following the listing.

The Occupational Safety, and Health Administration (OSHA) may become involved in remedial activity through health and safety inspections or accident reports.

Coordination with the U.S. Fish and Wildlife Service would become necessary if a potential for disruption or destruction of threatened or endangered species as a result of remediation at PBOW is identified.

Specific responsibilities of USACE, USEPA, and other agencies that are outlined in MOU and/or IAG entered into hereafter will be included in future additions of this SMP.

2.4 STATE AUTHORITY

A number of Ohio agencies could become involved in remediation at PBOW including Ohio EPA (OEPA), the Ohio Department of Natural Resources (ODNR), the ODNR Division of Fish & Wildlife, the Ohio Historic Preservation Office (OHPO), and the Ohio Department of Transportation (ODOT).

Authority for Ohio regulation of air and water quality, drinking water standards, and hazardous materials and wastes has been delegated to OEPA. Remedial activities involving contaminant releases or clarification of contaminant standards would require coordination with OEPA. If PBOW becomes included on the NPL, the State of Ohio, as required by CERCLA/SARA, is afforded the opportunity to participate in remedial activities. Authority for these activities has been given to OEPA, Division of Emergency and Remedial Response. These activities can include:

- decisions on appropriateness of performance of PA and SI
- assignment of hazard ranking scoring responsibility
- long-term planning for state remedial action sites
- review and comment of RI/FS, removal actions, EE/CAs, RODs, and remedial design
- identification of State ARARs
- site visits and inspections
- meeting attendance
- liaison between the lead agency and public groups.

ODNR is responsible for managing the natural resources of Ohio. ODNR Division of Fish and Wildlife maintains listings of state species considered to be threatened or endangered as well as maps of known Ohio locations of threatened and endangered species on both federal and Ohio lists. Because PBS is a federal facility (NASA), ODNR does not have jurisdiction at the site.

As discussed in Section 2.1.6.7, coordination is required with OHPO for identifying need for cultural resource surveys, ongoing activities, and/or mitigation plans for specific projects that affect historic properties, including remedial activities.

If any hazardous waste or materials on PBOW are to be transported for disposal, ODOT regulations regarding the transport, manifesting, and labeling of these materials/wastes must be followed.

2.5 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Section 121(d)(2)(A) of CERCLA/SARA specifies that *remedial actions meet any federal standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate requirements (ARARs)* (USEPA 1988a). There are several circumstances in which ARARs may be waived:

- activity is an interim action within a remedial action and the final remedy will attain ARAR
- compliance results in a greater risk
- compliance is technically impracticable from an engineering perspective
- an alternative action will attain an equivalent standard of performance through the use of another method or approach
- inconsistent application (state ARARs)

- for Superfund-financed actions, if there is an imbalance between achieved risk levels and funding availability for other projects.

A requirement under other environmental laws may be either *applicable* or *relevant and appropriate*, but not both. Identification of ARARs must be done on a site-specific basis. First, a regulation must be considered for its applicability. As stated in the *CERCLA Compliance with Other Laws Manual:*

> *Applicable requirements means those clean up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance* (USEPA 1988b).

Applicability implies that the remedial action satisfies all the jurisdictional prerequisites of a requirement.

If a requirement is not applicable, one must consider whether it is both relevant and appropriate. As stated in *Guidance for Conducting RI/FS Under CERCLA*:

> *...those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. However, in some circumstances, a requirement may be relevant but not appropriate for the site-specific situation* (USEPA 1988b).

When analysis determines that a requirement is both relevant and appropriate, that requirement must be complied with to the same degree as if it were applicable.

Also included in this process are To-Be-Considered (TBC) materials. These are non-promulgated advisories or guidance issued by the federal or state governments that are not legally binding and do not have the status of potential ARARs. Often TBCs are considered with ARARs in the risk assessment used to determine clean up levels. Examples include chemical-specific standards for contaminants in soils, because they are proposed rather than promulgated. For ground water, EPA Health Advisories for nitroaromatics, Drinking Water Equivalent levels, and reference doses are all TBCs.

ARARs generally fall into three categories:

- **Chemical-specific** - *usually health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment* (USEPA 1988a). These ARARs constitute the clean up goals for the site. Selection of these ARARs is based on the contaminants of concern (COC) identified at the site. USEPA guidance defines COCs as chemicals *selected because of their intrinsic toxicological properties, because they are present in large quantities, or because they are presently in or potentially may move into critical exposure pathways* such as a drinking water supply. Table 2-1 includes a preliminary listing of potential COCs at PBOW.

- **Location-specific** - *restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in specific locations* (USEPA 1988a). Examples of special locations include floodplains, wetlands, historic places, and sensitive ecosystems or habitats.

- **Action-specific** - *usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes... triggered by the particular remedial activities that are selected to accomplish a remedy* (USEPA 1988a). Examples include treatment and/or containment of source material, engineering controls, and institutional controls such as deed or water use restrictions.

2.5.1 Federal ARARs

Federal statutes specifically cited in §121 include: the Solid Waste Disposal Act, TSCA, SDWA, CAA, CWA, and the Marine Protection Research and Sanctuaries Act. Tables 2-2, 2-3, and 2-4 include preliminary listings of potential chemical-specific, location-specific, and action-specific federal ARARs at PBOW.

2.5.2 Ohio ARARs

The revised NCP includes provision for meeting all state ARARs if they are more stringent than federal requirements. There are two points within the RI/FS at which the support agency (OEPA) must provide the lead agency with potential ARARs: at the time of site characterization (usually at the point of screening technologies and alternative development) and after the initial screening of alternatives. Table 2-5 includes a preliminary listing of potential State of Ohio ARARs at PBOW.

Table 2-1. LIST OF POTENTIAL CONTAMINANTS OF CONCERN AT PBOW BASED ON SAMPLING RESULTS AND PAST ACTIVITIES

1,1-Dichloroethene
1,1,1-Trichloroethane
1,3-Dinitrobenzene
1,3,5-Trinitrobenzene
2-Methyl napthalene
2-Butanone
2-Hexanone
2-Methylphenol
2-Nitroaniline
2,4-Dinitrotoluene
2,4,6-Trinitrotoluene
2,6-Dinitrotoluene
3-Nitroaniline
4-Methylphenol
4-Nitrophenol
4,4'-DDE
4,4'-DDT
Acenaphthene
Acenaphthylene
Acetone
Aldrin
Anthracene
Aroclor 1260
Arsenic
Barium
Benzene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(ghi)perlene
Benzo(k)fluoranthene
Benzoic acid
Benzyl alcohol
Bis(2-ethylexyl)phthalate
Bromodichloromethane
Carbon tetrachloride
Carbon disulfide
Chlorobenzene
Chloroform
Chloromethane
Chromium
Chrysene
Di-n-butyl phthalate
Dibenzo(a,h)anthracene
Dibenzofuran
Dieldrin
DNT
Fluoranthene
Fluorene
Heptachlor
Indeno(1,2,3-cd)pyrene
Iron
Lead
Manganese
Methoxychlor
Methylene chloride
Naphthalene
Nitrobenzene
Nitrotoluene
PETN
Phenanthrene
Pyrene
Silver
Sodium
Sulfate
TNT
Toluene
Total xylenes
Trichloroethene

TABLE 2-2. PRELIMINARY FEDERAL CHEMICAL-SPECIFIC ARARs FOR PBOW

Standard, Requirement, Criteria, or Limitation	Citation	Description
Solid Waste Disposal Act	42 USC Sec. 6901-6987	
Hazardous Waste Management System: General	40 CFR Part 260	Establishes procedures and criteria for modification or revocation of any provision in 40 CFR Parts 260-265.
Identification and Listing of Hazardous Waste	40 CFR Part 261	Defines those solid wastes which are subject to regulation as hazardous wastes under 40 CFR Parts 262-265 and Parts 270, 271, 124.
Safe Drinking Water Act	42 USC Sec. 300g	
National Primary Drinking Water Standards	40 CFR Part 141,142	Establishes health-based standards for public water systems (maximum contaminant levels).
National Secondary Drinking Water Standards	40 CFR Part 143	Establishes welfare-based standards for public water systems (secondary maximum contaminant levels).
Maximum Contaminant Level Goals	P.L. No. 99-339, 100 Stat. 642 (1986)	Establishes drinking water quality goals set at levels of no known or anticipated adverse health effects, with an adequate margin of safety.
Clean Water Act	33 USC Sec. 1251-1376	
Water Quality Criteria	40 CFR Part 131	Sets criteria for water quality based on toxicity to aquatic organisms and human health.
National Pretreatment	40 CFR Part 403	Sets standards to control pollutants which pass through or interfere with treatment processes in publicly owned treatment works or which may contaminate sewage sludge.

TABLE 2-2. Continued

Standard, Requirement, Criteria, or Limitation	Citation	Description
Clean Water Act (continued)		
Toxic Pollutant Effluent Standards	40 CFR Part 129	Establishes effluent standards or prohibitions for certain toxic pollutants: aldrin/dieldrin, DDT, endrin, toxaphene, benzidine, PCBs.
Toxic Substances Control Act	15 USC Sec. 2601-2629	
PCB Requirements	40 CFR Part 761	Establishes storage and disposal requirements for PCBs.
Clean Air Act	42 USC Sec. 7401-7642	
National Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50	Establishes standards for ambient air quality to protect public health and welfare (including standards for particulate matter and lead).
National Emission Standards for Hazardous Pollutants	40 CFR Part 61	Sets emission standards for designated hazardous pollutants.
Occupational Safety and Health Act	20 USC Sec. 651-678	Regulates worker health and safety.
D.O.T. Hazardous Material Transportation Regulations	49 CFR Parts 107, 171 - 177	Regulates transportation of hazardous materials.
Resource Conservation and Recovery Act	Section 3004(m)	Waives prohibition of land disposal of a particular hazardous waste if levels or methods of treatment substantially reduce toxicity or likelihood of migration of hazardous constituents to minimize short and long-term threats to human health and the environment.
General Approach Used by the Dioxin Disposal Advisory Group (DDAG) Regarding Pentachloro-phenol Waste (also PCBs), des Rosiers (1988)		Recommends a site evaluation method, cleanup levels, and treatment standards for sites known to be PCB, copper wire/core reclamation, or PCP wood treating sites.

TABLE 2-2. Continued

Standard, Requirement, Criteria, or Limitation	Citation	Description
Standards for Protection Against Radiation	10 CFR Part 20	Limits hazards caused by NRC-licensed activities.
Licensing Requirements for Land Disposal of Radioactive Waste	10 CFR Part 61	Establishes procedures, criteria, terms, and conditions for the issuing of licensing land disposal of radioactive wastes.

TABLE 2-3. PRELIMINARY FEDERAL LOCATION-SPECIFIC ARARs FOR PBOW

Standard, Requirement, Criteria, or Limitation	Citation	Description
Executive Order on Protection and Enhancement of the Cultural Environment	E.O. #11,593	Establishes consultation procedures and responsibilities of Federal agencies for historic preservation.
Historic Sites, Buildings and Antiquities Act	16 USC Sec. 461-467 40 CFR Sec. 6.301(a)	Requires Federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks to avoid undesirable impacts upon such landmarks.
Fish and Wildlife Conservation Act	16 USC Sec. 2901-2911	Encourages Federal agencies to utilize their statutory and administrative authority, to the maximum extent practicable and consistent with each agency's statutory responsibilities, to conserve and promote conservation of non-game fish and wildlife species.
EPA Ground-Water Protection Strategy	EPA Guidance	Establishes a ground-water classification system for protection of ground waters based on their value to society, use, and vulnerability.
Policy on Floodplains and Wetlands Assessments for CERCLA Actions	EPA Guidance Aug. 6, 1985	Discusses situations that require preparation of a floodplains or wetlands assessment and the factors which should be considered in preparing an assessment for response actions taken under CERCLA.
Wilderness Act	16 USC Sec. 1131 et seq	Federally owned areas designated as wilderness areas must be left unimpaired as wilderness and to preserve its wilderness.
Coastal Barrier Resources Act	16 USC Sec. 3501 et seq	
National Historic Preservation Act	16 USC Sec 470 40 CFR Sec. 6.301(B)	Requires Federal agencies to take into account the effect of any Federally-assisted undertaking or licensing on any district, site, building, structure, or object that is included in or eligible for inclusion in the national register of historic places.

TABLE 2-3. Continued

Standard, Requirement, Criteria, or Limitation	Citation	Description
Archaeological and Historic Preservation Act	16 USC Sec. 469 40 CFR Sec. 6.301(C)	Establishes procedures to provide for preservation of historical and archaeological data which might be destroyed through alteration of terrain as a result of a Federal construction project or a Federally licensed activity or program.
Fish and Wildlife Coordination Act	16 USC Sec. 661-666 40 CFR Sec. 6.302(G)	Requires consultation when Federal department or agency proposes or authorizes any modification of any stream or other water body and adequate provision for protection of fish and wildlife resources.
Control Actions in National Wildlife Refuge System	16 USC Sec. 668d et seq 50 CFR Part 27	Only actions allowed under 16 USC Sec. 668d(c) may be undertaken in areas that are part of the National Wildlife Refuge System.
Endangered Species Act	16 USC Sec. 1531-1543 50 CFR Part 200 50 CFR Part 402	Requires that Federal agencies insure that any action authorized, funded, or carried by the agency is not likely to jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify critical habitat.
Coastal Zone Management Act	16 USC Sec. 1451-1464	Prohibits Federal agencies from undertaking any activity in or affecting a state's coastal zone that is not consistent to the maximum extent practicable with a state's approved coastal zone management program.
Wild and Scenic Rivers Act	16 USC Sec. 1271-1287 40 CFR Sec. 6.302(E) 36 CFR Part 297	Establishes requirements applicable to water resource development projects affecting wild, scenic, or recreational rivers within or studied for inclusion in the National Wild and Scenic Rivers System.
Rivers and Harbors Act of 1899	33 USC Sec. 403 Sec. 10 Permit 33 CFR Parts 320-330	Requires permit for structures or work in or affecting navigable waters.

TABLE 2-3. Continued

Standard, Requirement, Criteria, or Limitation	Citation	Description
Executive Order on Protection of Wetlands	EO #11,990 40 CFR Sec. 6.302(A) and Appendix A	Requires Federal agencies to avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists.
Executive Order on Floodplain Management	EO #11,988 40 CFR Sec. 6.302(B) and Appendix A	Requires Federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid, to the maximum extent possible, the adverse impacts associated with direct and indirect development of a floodplain.

TABLE 2-4. PRELIMINARY FEDERAL ACTION-SPECIFIC ARARs FOR PBOW

Standard, Requirement, Criteria, or Limitation	Citation	Description
National Emission Standards for Hazardous Air Pollutants	40 CFR 61	Designates substances as hazardous air pollutants and establishes emission standards.
Solid Waste Disposal Act	42 USC Sec. 6901-6987	
Guidelines for the Thermal Processing of Solid Wastes	40 CFR Part 240	Prescribes guidelines for thermal processing of municipal-type solid wastes.
Guidelines for the Land Disposal of Solid Wastes	40 CFR Part 241	Establishes requirements and procedures for land disposal of solid wastes.
Guidelines for the Storage and Collection of Residential, Commercial, and Institutional Solid Waste	40 CFR Part 243	Establishes guidelines for collection of residential, commercial, and institutional solid wastes.
Source Separation of Materials Recovery Guidelines	40 CFR Part 246	Establishes requirements and recommended procedures for source separation by Federal agencies of residential, commercial, and institutional solid wastes.
Guidelines for Development and Implementation of State Solid Waste Management Plans	40 CFR Part 256	Establishes requirements for Federal approval of State programs to regulate open dumps.
Criteria for Classification of Solid Waste Disposal Facilities and Practices	40 CFR Part 257	Establishes criteria for use in determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment.
Standards Applicable to Generators of Hazardous Waste	40 CFR Part 262	Establishes standards for generators of hazardous waste.
Standards Applicable to Transporters of Hazardous Waste	40 CFR Part 263	Establishes standards which apply to persons transporting hazardous waste within the U.S. if the transportation requires a manifest under 40 CFR Part 262.

TABLE 2-4. Continued

Standard, Requirement, Criteria, or Limitation	Citation	Description
Solid Waste Disposal Act (continued)		
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR Part 264	Establishes minimum national standards which define the acceptable management of hazardous waste for owners and operators of facilities which treat, store, or dispose of hazardous waste.
• General Facility Standards	Subpart B	
• Preparedness and Prevention	Subpart C	
• Contingency Plan and Emergency Procedures	Subpart D	
• Manifest System, Record Keeping, and Reporting	Subpart E	
• Releases from Solid Waste Management Units	Subpart F	Creates ground water protection requirements includes both concentration standards and monitoring requirements.
• Closure and Post-Closure	Subpart G	
• Financial Requirements	Subpart H	
• Use and Management of Containers	Subpart I	
• Tanks	Subpart J	
• Surface Impoundments	Subpart K	
• Waste Piles	Subpart L	
• Land Treatment	Subpart M	
• Landfills	Subpart N	
• Incinerators	Subpart O	
Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage,and Disposal Facilities	40 CFR Part 265	Establishes minimum national standards that define the acceptable management of hazardous waste during the period of interim status and until certification of final closure or, if the facility is subject to post-closure requirements, until post-closure responsibilities are fulfilled.
Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities	40 CFR Part 266	Establishes requirements which apply to recyclable materials that are reclaimed to recover economically significant amounts of precious metals, including gold and silver.

TABLE 2-4. Continued

Standard, Requirement, Criteria, or Limitation	Citation	Description
Solid Waste Disposal Act (continued)		
Interim Standards for Owners and Operators of New Hazardous Waste Land Disposal Facilities	40 CFR Part 267	Establishes minimum national standards that define acceptable management of hazardous waste for new land disposal facilities.
Land Disposal Restrictions	40 CFR Part 268	Identifies hazardous wastes that are restricted from land disposal.
Hazardous Waste Permit Program	40 CFR Part 270	Establishes provisions covering basic EPA permitting requirements.
Underground Storage Tanks	40 CFR Part 280	Establishes regulations related to underground storage tanks.
Safe Drinking Water Act	42 USC Sec. 300g 40 CFR Part 136	Sets approved test methods for waste constituent monitoring.
Underground Injection Control Regulations	40 CFR Parts 144-47	Provides for protection of underground sources of drinking water.
Clean Water Act	33 USC Sec. 1251-1376	
National Pollutant Discharge Elimination System	40 CFR Parts 122 and 125	Requires permits for the discharge of pollutants from any point source into waters of the United States.
National Pretreatment	40 CFR Part 403	Sets standards to control pollutants which pass through or interfere with treatment processes in publicly owned treatment works or which may contaminate sewage sludge.
Toxic Pollutant Effluent Standards	40 CFR Part 129	Establishes effluent standards or prohibitions for certain toxic pollutants: aldrin/dieldrin, DDT, endrin, toxaphene, benzidine, PCBs.
Dredge or Fill Requirements (Section 404)	40 CFR Parts 230, 231 33 CFR Part 323	Requires permits for discharge of dredged or fill material into navigable waters.

TABLE 2-4. Continued

Standard, Requirement, Criteria, or Limitation	Citation	Description
Marine Protection, Research, and Sanctuaries Act	13 USC 1401-1445	Regulates ocean dumping.
Toxic Substances Control Act	15 USC Sec. 2601-2629 40 CFR Part 761	Establishes storage and disposal requirements for PCBs.
Surface Mining Control and Reclamation Act	30 USC Sec. 1201-1328	
Occupational Safety and Health Act	20 USC Sec. 651-678	Regulates worker health and safety.
Federal Mine Safety and Health Act	30 USC Sec. 801-962	Regulates working conditions in underground mines to assure safety and health of workers.
D.O.T. Hazardous Material Transportation Regulations	49 CFR Parts 107, 171-177	Regulates transportation of hazardous materials.
Resource Conservation and Recovery Act	Section 3020	Interim controls of hazardous waste injection.

Table 2-5. Preliminary State of Ohio ARARs for PBOW

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
1301:7-9-13	B-L,O	PETROLEUM UST CORRECTIVE ACTION	PROCEDURES FOR ASSESSING LUST SITES AND DETERMINING NEED FOR REMEDIATION. GIVES BRIEF SOW FOR REMEDIATION PLANS AND THEIR IMPLEMENTATION.	
3704.05	A-I	PROHIBITS VIOLATION OF AIR, POLLUTION CONTROL RULES	PROHIBITS EMISSION OF AN AIR CONTAMINANT IN VIOLATION SEC. 3704 OR ANY RULES, PERMIT, ORDER OR VARIANCE ISSUED PURSUANT TO THAT SECTION OF THE ORC.	CHEMICAL ACTION
3714.13		DEMOLITION DEBRIS FACILITIES - VIOLATIONS PROHIBITED	PROHIBITS VIOLATIONS OF ANY SECTION OF CHAPTER 3714 CONCERNING CONSTRUCTION AND DEMOLITION DEBRIS DISPOSAL FACILITIES OR ANY RULE OR ORDER ISSUED PURSUANT TO IT. DISPOSAL OF ASBESTOS IS SPECIFICALLY PROHIBITED WITHOUT AUTHORIZATION.	ACTION
3734.02	(G)	EXEMPTIONS TO SOLID & HAZ. WASTE T/S/D REQUIREMENTS	PROVIDES AUTHORITY AND CONDITIONS BY WHICH THE DIRECTOR MAY EXEMPT ANY PERSON FROM PERMITTING OR OTHER REQUIREMENTS GOVERNING THE GENERATION, STORAGE, TREATMENT, TRANSPORT OR DISPOSAL OF SOLID OR HAZARDOUS WASTE.	ACTION
3734.02	(H)	DIGGING WHERE HAZ OR SOLID WASTE FACILITY WAS LOCATED	FILLING, GRADING, EXCAVATING, BUILDING, DRILLING OR MINING ON LAND WHERE HAZARDOUS WASTE OR SOLID WASTE FACILITY WAS OPERATED IS PROHIBITED WITHOUT PRIOR AUTHORIZATION FROM THE DIRECTOR OF THE OHIO EPA.	LOCATION ACTION
3734.02.7	A,B	HANDLING LOW-LEVEL RADIOACTIVE WASTE PROHIBITED	A) PROHIBITS COMMINGLING LOW LEVEL RADIOACTIVE WASTE WITH ANY TYPE OF SOLID WASTE, HAZARDOUS WASTE, OR INFECTIOUS WASTE. B) NO OWNER OR OPERATOR OF A SOLID, INFECTIOUS OR HAZARDOUS WASTE FACILITY SHALL ACCEPT FOR TRANSFER, STORAGE, TREATMENT OR DISPOSAL OF ANY RADIOACTIVE WASTE.	CHEMICAL ACTION
3734.03		PROHIBITS OPEN DUMPING OR BURNING	PROHIBITS OPEN BURNING OR OPEN DUMPING OF SOLID WASTE OR TREATED OR UNTREATED INFECTIOUS WASTE.	ACTION LOCATION

Table 2-5. Continued

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
3734.04.1	A,C,D,G	EXPLOSIVE GAS MONITORING	REQUIRES EXPLOSIVE GAS MONITORING PLANS FOR SANITARY LANDFILLS AND PROVIDES AUTHORITY TO THE DIRECTOR OF OHIO EPA TO ORDER AN OWNER OR OPERATOR OF A FACILITY TO IMPLEMENT AN EXPLOSIVE GAS MONITORING AND REPORTING PLAN	LOCATION ACTION
3734.14.1		CONDITIONS FOR DISPOSAL OF ACUTE HAZARDOUS WASTE	PROHIBITS DISPOSAL OF ACUTE HAZARDOUS WASTE UNLESS IT: (1) CANNOT BE TREATED, RECYCLED OR DESTROYED; (2) HAS BEEN REDUCED TO ITS LOWEST LEVEL OF TOXICITY; AND (3) HAS BEEN COMPLETELY ENCAPSULATED OR PROTECTED TO PREVENT LEACHING.	CHEMICAL ACTION
3745-1-03		ANALYTICAL AND COLLECTION PROCEDURES	SPECIFIES ANALYTICAL METHODS AND COLLECTION PROCEDURES FOR SURFACE WATER DISCHARGES.	ACTION
3745-1-04	A,B,C,D,E	THE FIVE FREEDOMS FOR SURFACE WATER	ALL SURFACE WATERS OF THE STATE SHALL BE FREE FROM: A) OBJECTIONABLE SUSPENDED SOLIDS. B) FLOATING DEBRIS, OIL AND SCUM. C) MATERIALS THAT CREATE A NUISANCE. D) TOXIC, HARMFUL OR LETHAL SUBSTANCES. E) NUTRIENTS THAT CREATE NUISANCE GROWTH	CHEMICAL
3745-1-05	A,B,C	ANTIDEGRADATION POLICY FOR SURFACE WATER	PREVENTS DEGRADATION OF SURFACE WATER QUALITY BELOW DESIGNATED USE OR EXISTING WATER QUALITY. EXISTING INSTREAM USES SHALL BE MAINTAINED AND PROTECTED. THE MOST STRINGENT CONTROLS FOR TREATMENT SHALL BE REQUIRED BY THE DIRECTOR TO BE EMPLOYED FOR ALL NEW AND EXISTING POINT SOURCE DISCHARGES. PREVENTS ANY DEGRADATION OF STATE RESOURCE WATERS.	CHEMICAL
3745-1-06	A,B	MIXING ZONES FOR SURFACE WATER	(A) PRESENTS THE CRITERIA FOR ESTABLISHING NON-THERMAL MIXING ZONES FOR POINT SOURCE DISCHARGES (B) PRESENTS THE CRITERIA FOR ESTABLISHING THERMAL MIXING ZONES FOR POINT SOURCE DISCHARGES	CHEMICAL
3745-1-07	C	WATER QUALITY CRITERIA	ESTABLISHES WATER QUALITY CRITERIA FOR POLLUTANTS WHICH DO NOT HAVE SPECIFIC NUMERICAL OR NARRATIVE CRITERIA IDENTIFIED IN TABLES 7-1 THROUGH 7-1 6 OF THIS RULE.	CHEMICAL ACTION
3745-1-19		WATER USE DES FOR HURON RIVER	ESTABLISHES WATER USE DESIGNATIONS FOR STREAM SEGMENTS WITHIN THE HURON RIVER BASIN.	ACTION LOCATION
3745-15-06	A1,A2	MALFUNCTION & MAINTENANCE OF AIR POLL CONTROL EQUIPMENT	ESTABLISHES SCHEDULED MAINTENANCE AND SPECIFIES WHEN POLLUTION SOURCE MUST BE SHUT DOWN DURING MAINTENANCE	ACTION

Table 2-5. Continued

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
3745-15-07	A	AIR POLLUTION NUISANCES PROHIBITED	DEFINES AIR POLLUTION NUISANCE AS THE EMISSION OR ESCAPE INTO THE AIR FROM ANY SOURCE(S) OF SMOKE, ASHES, DUST, DIRT, GRIME, ACIDS, FUMES, GASES, VAPORS, ODORS AND COMBINATIONS OF THE ABOVE THAT ENDANGER HEALTH, SAFETY OR WELFARE OF THE PUBLIC OR CAUSE PERSONAL INJURY OR PROPERTY DAMAGE. SUCH NUISANCES ARE PROHIBITED.	ACTION
3745-16-02	B,C	STACK HEIGHT REQUIREMENTS	ESTABLISHES ALLOWABLE STACK HEIGHT FOR AIR CONTAMINANT SOURCES BASED ON GOOD ENGINEERING PRACTICE.	ACTION
3745-17-02	A,B,C	PARTICULATE AMBIENT AIR QUALITY STANDARDS	ESTABLISHES SPECIFIC STANDARDS FOR TOTAL SUSPENDED PARTICULATES.	CHEMICAL
3745-17-05		PARTICULATE NON-DEGRADATION POLICY	DEGRADATION OF AIR QUALITY IN ANY AREA WHERE AIR QUALITY IS BETTER THAN REQUIRED BY 3745-17-02 IS PROHIBITED	CHEMICAL LOCATION
3745-17-07	A-D	VISIBLE PARTICULATE EMISSION CONTROL	SPECIFIES THE ALLOWABLE OPACITY FOR PARTICULATE EMISSIONS; PROVIDES EXCEPTIONS FOR UNCOMBINED WATER, START-UP/SHUTDOWN OF FUEL BURNING EQUIPMENT, MALFUNCTIONS.	CHEMICAL
3745-17-08	A1,A2, B,D	EMISSION RESTRICTIONS FOR FUGITIVE DUST	ALL EMISSIONS OF FUGITIVE OUST SHALL BE CONTROLLED.	ACTION
3745-17-09	A,B,C	INCINERATOR PARTIC EMISSION & ODOR RESTRICTIONS	ESTABLISHES PARTICULATE EMISSION LIMITATIONS AND DESIGN-OPERATION REQUIREMENTS TO PREVENT THE EMISSION OF OBJECTIONABLE ODORS.	ACTION
3745-17-10	A,B,C	FUEL BURNING PARTIC EMISSION RESTRICTIONS	ESTABLISHES PARTICULATE EMISSION LIMITATIONS FOR FUEL BURNING EQUIPMENT.	ACTION
3745-18-02	A,B,C,D	SULFUR DIOXIDE AMBIENT AIR QUALITY STANDARDS	ESTABLISHES PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS FOR SULFUR DIOXIDE.	ACTION CHEMICAL
3745-18-04	A,B,C,E,F	SULFUR DIOXIDE MEASUREMENT METHODS AND PROCEDURES	SPECIFIES TESTING METHODS AND PROCEDURES FOR SULFUR DIOXIDE EMISSIONS COMPLIANCE TESTING	ACTION CHEMICAL
3745-18-05	A	SULFUR DIOXIDE AMBIENT MONITORING REQUIREMENTS	THE DIRECTOR OF THE OHIO EPA MAY REQUIRE ANY SOURCE OF SULFUR DIOXIDE EMISSIONS TO INSTALL, OPERATE AND MAINTAIN MONITORING DEVICES, MAINTAIN RECORDS AND FILE REPORTS.	ACTION CHEMICAL
3745-18-06	A-G	SULFUR DIOXIDE EMISSION LIMIT PROVISIONS	ESTABLISHES GENERAL LIMIT PROVISIONS FOR SULFUR DIOXIDE.	ACTION CHEMICAL

Table 2-5. Continued

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
3745-21-02	A,B,C	AMBIENT AIR QUALITY STANDARDS AND GUIDELINES	ESTABLISHES SPECIFIC AIR QUALITY STANDARDS FOR CARBON MONOXIDE, OZONE AND NON-METHANE HYDROCARBONS	CHEMICAL ACTION
3745-21-03	B,C,D	METHODS OF AMBIENT AIR QUALITY MEASUREMENT	SPECIFIES MEASUREMENT METHODS TO DETERMINE AMBIENT AIR QUALITY FOR THE FOLLOWING CONSTITUENTS: CARBON MONOXIDE, OZONE AND NON-METHANE HYDROCARBONS.	CHEMICAL ACTION
3745-21-05		NON-DEGRADATION POLICY	PROHIBITS SIGNIFICANT AND AVOIDABLE DETERIORATION OF AIR QUALITY.	ACTION
3745-21-07	A,B,G,I,J	ORGANIC MATERIALS EMISSION CONTROL: STATIONARY SOURCES	REQUIRES CONTROL OF EMISSIONS OF ORGANIC MATERIALS FROM STATIONARY SOURCES. REQUIRES BEST AVAILABLE TECHNOLOGY.	ACTION CHEMICAL
3745-21-08	A-E	CARBON MONOXIDE EMISSION CONTROL: STATIONARY SOURCES	REQUIRES ANY STATIONARY SOURCE OF CARBON MONOXIDE TO MINIMIZE EMISSIONS BY THE USE OF BEST AVAILABLE CONTROL TECHNOLOGIES AND OPERATING PRACTICES IN ACCORDANCE WITH BEST CURRENT TECHNOLOGY.	ACTION CHEMICAL
3745-23-01		NITROGEN DIOXIDE AMBIENT AIR QUALITY STANDARDS	ESTABLISHES A MAXIMUM AMBIENT AIR QUALITY STANDARD FOR NITROGEN DIOXIDE.	CHEMICAL ACTION
3745-23-02	A,B	MEASUREMENT METHODS FOR NITROGEN DIOXIDE	SPECIFIES METHODS OF MEASUREMENT FOR NITROGEN DIOXIDE TO DETERMINE AMBIENT AIR QUALITY.	ACTION CHEMICAL
3745-23-04		NITROGEN DIOXIDE NONDEGRADATION POLICY	PROHIBITS THE SIGNIFICANT AND AVOIDABLE DETERIORATION OF AIR QUALITY BY THE RELEASE OF NITROGEN DIOXIDE EMISSIONS.	ACTION CHEMICAL
3745-23-06		NITROGEN OXIDES EMISSION CONTROLS: STATIONARY SOURCE	REQUIRES THAT ALL STATIONARY SOURCES OF NITROGEN OXIDE MINIMIZE EMISSIONS BY THE USE OF THE LATEST AVAILABLE CONTROL TECHNIQUES AND OPERATING PRACTICES IN ACCORDANCE WITH BEST CURRENT TECHNOLOGY. ESTABLISHES LIMIT FOR NITROGEN OXIDE EMISSIONS FROM COMBUSTION.	ACTION CHEMICAL
3745-25-03		EMISSION CONTROL ACTION PROGRAMS	REQUIRES PREPARATION FOR AIR POLLUTION ALERTS, WARNINGS AND EMERGENCIES.	ACTION
3745-27-03	B	EXEMPTIONS TO SOLID WASTE REGULATIONS	DEFINES EXEMPTIONS TO SOLID WASTE REGULATIONS AND ESTABLISHES LIMITATIONS ON TEMPORARY STORAGE OF PUTRESCIBLE WASTE OR ANY SOLID WASTE WHICH CAUSES A NUISANCE OR HEALTH HAZARD. STORAGE OF PUTRESCIBLE WASTE BEYOND SEVEN DAYS IS CONSIDERED OPEN DUMPING.	ACTION

Table 2-5. Continued

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
3745-29-07	C,D,H	ADDITIONAL CRITERIA FOR ISW LANDFILLS	SITING CRITERIA SPECIFY MINIMUM SETBACK DISTANCES FROM PARKLANDS, GROUNDWATER SOURCES, MINES RIVERS, PROPERTY LINES, DOMICILES AND SURFACE WATER	
3745-29-08	C,D,E,F	CONSTRUCTION REQUIREMENTS FOR ISW LANDFILLS	SPECIFIES REQUIREMENTS FOR LINERS, TESTPADS, LEACHATE COLLECTION SYSTEMS, SURVEY MARKERS, SURFACE WATER CONTROL, GAS CONTROL, EARTHQUAKE RESISTANCE, CAPPING.	
3745-29-10	A-F	GROUNDWATER MONITORING PLAN FOR ISW LANDFILLS	REQUIRES GROUNDWATER MONITORING SYSTEM, LISTS CHEMICALS TO BE TESTED FOR, DISCUSSES STATISTICAL METHODS TO BE USED, REQUIRES CORRECTIVE ACTION PLANS IF CONTAMINATION IS FOUND.	
3745-29-11	B,G,H	FINAL CLOSURE OF ISW LANDFILLS	REQUIRES CAPPING, REGRADING, GROUNDWATER MONITORING, SURFACE WATER MANAGEMENT, LEACHATE CONTROL AND FENCING FOR CLOSED SITES.	
3745-29-14	A,B	POST CLOSURE CARE OF ISW LANDFILL	REQUIRES CONTINUING MAINTENANCE OF CAP, GROUNDWATER MONITORING SYSTEM, GAS CONTROL SYSTEM, LEACHATE CONTROL SYSTEM, SURFACE WATER CONTROL. MANDATES QUARTERLY INSPECTION. GENERALLY REQUIRES CARE FOR 30 YEARS AFTER CLOSURE.	
3745-31-05		WATER/AIR PERMIT CRITERIA FOR DECISION BY THE DIRECTOR	A PERMIT TO INSTALL (PTI) OR PLANS MUST DEMONSTRATE BEST AVAILABLE TECHNOLOGY (BAT) AND SHALL NOT INTERFERE WITH OR PREVENT THE ATTAINMENT OR MAINTENANCE OF APPLICABLE AMBIENT AIR QUALITY STANDARDS.	ACTION
3745-32-05		WATER QUALITY CRITERIA FOR DECISION BY THE DIRECTOR	SPECIFIES SUBSTANTIVE CRITERIA FOR SECTION 401 WATER QUALITY CRITERIA FOR DREDGING, FILLING, OBSTRUCTING OR ALTERING WATERS OF THE STATE	ACTION
3745-34-06		PROHIBITION OF UNAUTHORIZED INJECTION	UNDERGROUND INJECTION IS PROHIBITED WITHOUT AUTHORIZATION FROM THE DIRECTOR.	ACTION
3745-34-07		NO MOVEMENT OF FLUID INTO UNDERGROUND DRINKING WATER	THE UNDERGROUND INJECTION OF FLUID CONTAINING ANY CONTAMINANT INTO AN UNDERGROUND SOURCE OF DRINKING WATER IS PROHIBITED IF THE PRESENCE OF THAT CONTAMINANT MAY CAUSE A VIOLATION OF THE PRIMARY DRINKING WATER STANDARDS OR OTHERWISE ADVERSELY AFFECT THE HEALTH OF PERSONS.	

Table 2-5. Continued

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
3745-34-08		ELIMINATION OF CLASS IV WELLS	THE INJECTION OF HAZARDOUS OR RADIOACTIVE WASTE DIRECTLY INTO AN UNDERGROUND SOURCE OF DRINKING WATER IS PROHIBITED.	
3745-34-09		REQUIREMENTS FOR WELLS INJECTING HAZARDOUS WASTE	SPECIFIES REQUIREMENTS FOR THE INJECTION OF HAZARDOUS WASTES UNDERGROUND. SEE 3745-34-08 FOR LIMITATIONS.	
3745-34-10		WAIVER OF REQUIREMENT BY DIRECTOR	THE DIRECTOR MAY AUTHORIZE LESS STRINGENT REQUIREMENTS FOR AN INJECTION THAT DOES NOT OCCUR INTO, THROUGH OR ABOVE AN UNDERGROUND SOURCE OF DRINKING WATER.	
3745-34-13		CLASS V WELLS	SPECIFIES REQUIREMENTS FOR CLASS V WELLS. SEE 3746-34-04 FOR DEFINITIONS.	
3745-34-26		CONDITIONS APPLICABLE TO ALL PERMITS	SPECIFIES MINIMUM CONDITIONS TO BE APPLIED TO ALL UNDERGROUND INJECTIONS.	
3745-34-34		MECHANICAL INTEGRITY	SPECIFIES REQUIREMENTS TO BE MET TO ENSURE MECHANICAL INTEGRITY OF WELLS.	
3745-34-36		PLUGGING AND ABANDONING CLASS I WELLS	SPECIFIES REQUIREMENTS TO BE MET WHEN PLUGGING OR ABANDONING A CLASS I WELL. SEE 3746-34-04 FOR DEFINITIONS.	
3745-34-37		CONSTRUCTION REQUIREMENTS FOR CLASS I WELLS	SPECIFIES CONSTRUCTION AND SITING REQUIREMENTS FOR CLASS I WELLS.	ACTION LOCATION
3745-34-38		OPERATING, MONITORING & REPORTING REQ FOR CLASS I WELLS	SPECIFIES OPERATING, MONITORING AND REPORTING REQUIREMENTS NECESSARY FOR CLASS I WELLS.	
3745-50-221	A,B	PETITIONS TO EXCLUDE A LISTED WASTE AT A FACILITY	ALLOWS FOR PETITIONS TO EXCLUDE HAZARDOUS WASTES FROM A PARTICULAR FACILITY FROM THE LISTS IN RULES 3745-51-30 TO 3745-51-31 OF THE OAC. ALSO STATES THAT OHIO EPA WILL RECOGNIZE USEPA's DECISION TO GRANT OR DENY SUCH PETITIONS ON THE FEDERAL LEVEL.	ACTION
3745-50-311	A,B,C	RECYCLING VARIANCES FROM CLASSIFICATION AS A WASTE		
3745-50-312	A,B,C	STDS & CRITERIA FOR VARIANCES FROM CLASS AS A WASTE	PRESENTS CRITERIA BY WHICH DIRECTOR MAY GRANT REQUESTS FOR VARIANCE FROM CLASSIFYING CERTAIN MATERIALS AS A WASTE.	ACTION CHEMICAL

Table 2-5. Continued

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
3745-50-315	A	ADD'L REG OF CERTAIN HAZ WASTE RECYCLING ACTIVITIES	DIRECTOR MAY REGULATE HAZARDOUS WASTES OTHERWISE EXEMPTED BECAUSE OF RECYCLING ACTIVITIES AS HAZARDOUS WASTES ON A CASE-BY-CASE BASIS. THE CRITERIA TO MAKE THIS DECISION ARE PROVIDED BY THIS RULE.	ACTION CHEMICAL
3745-50-44	A	PERMIT INFO REQUIRED FOR ALL HAZ WASTE FACILITIES	ESTABLISHES THE SUBSTANTIVE HAZARDOUS WASTE PERMIT REQUIREMENTS NECESSARY FOR OHIO EPA TO DETERMINE FACILITY COMPLIANCE. INCLUDES INFORMATION SUCH AS FACILITY DESCRIPTION, WASTE CHARACTERISTICS, EQUIPMENT DESCRIPTIONS, CONTINGENCY PLAN, FACILITY LOCATION, TOPOGRAPHIC MAP. ETC.	ACTION
3745-50-44	C1	ADD'L PERMIT INFO: HAZ WASTE STORAGE IN CONTAINERS	ESTABLISHES THE SUBSTANTIVE HAZARDOUS WASTE PERMIT REQUIREMENTS NECESSARY FOR OHIO EPA TO DETERMINE ADEQUACY OF CONTAINER STORAGE. INCLUDES INFORMATION SUCH AS DESCRIPTION OF CONTAINMENT SYSTEM, DETAILED DRAWINGS, ETC. SEE OAC 3745-55-70 THROUGH 3745-55-78 FOR ADDITIONAL CONTAINER REQUIREMENTS.	ACTION
3745-50-44	C2	ADD'L PERMIT INFO: HAZ WASTE STORAGE/TREAT IN TANKS	ESTABLISHES SUBSTANTIVE HAZARDOUS WASTE PERMIT REQUIREMENTS NECESSARY FOR OHIO EPA TO DETERMINE ADEQUACY OF TANK TREATMENT AND STORAGE UNITS. INCLUDES INFORMATION SUCH AS ASSESSMENT OF STRUCTURAL INTEGRITY, DETAILED PLANS OF TANK SYSTEM(S). DESCRIPTION OF SECONDARY CONTAINMENT SYSTEM, ETC. SEE OAC 3745-55-90 THROUGH 3745-55-99 FOR ADDITIONAL REQUIREMENTS.	ACTION
3745-50-44	C3	ADD'L PERMIT INFO: HAZ WASTE STOR/TREAT IN SURF IMPOUND	ESTABLISHES SUBSTANTIVE HAZARDOUS WASTE PERMIT REQUIREMENTS NECESSARY FOR OHIO EPA TO DETERMINE ADEQUACY OF BOTH NEW SURFACE IMPOUNDMENTS AND EXTENSIONS OF EXISTING SURFACE IMPOUNDMENTS USED TO STORE OR TREAT HAZARDOUS WASTE. INCLUDES INFORMATION SUCH AS WASTE CHARACTERISTICS, DETAILED PLANS AND REPORTS, INFORMATION ON STRUCTURAL INTEGRITY, CLOSURE INFORMATION, ETC. SEE OAC 3745-56-20 THROUGH 3745-56-33 FOR ADDITIONAL SURFACE IMPOUNDMENT REQUIREMENTS.	ACTION

Table 2-5. Continued

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
3745-50-44	C9	ADD'L PERMIT INFO: HAZ WASTE T/S/D IN MISC UNITS	ESTABLISHES SUBSTANTIVE HAZARDOUS WASTE PERMIT REQUIREMENTS NECESSARY FOR OHIO EPA TO DETERMINE ADEQUACY OF MISCELLANEOUS UNITS USED TO TREAT OR STORE HAZARDOUS WASTE INCLUDES INFORMATION SUCH AS WASTE CHARACTERISTICS, DETAILED DESIGN PLANS AND REPORTS, CONTROL OF RUN-ON AND RUN-OFF, CLOSURE INFORMATION, ETC. SEE OAC 3745-57-90 THROUGH 3745-57-93 FOR ADDITIONAL REQUIREMENTS FOR MISCELLANEOUS UNITS.	ACTION
3745-50-58	E,I,J	HAZARDOUS WASTE FACILITY PERMIT CONDITIONS	ESTABLISHES GENERAL PERMIT CONDITIONS APPLIED TO ALL HAZARDOUS WASTE FACILITIES IN OHIO. INCLUDES CONDITIONS SUCH AS OPERATION AND MAINTENANCE, SITE ACCESS, MONITORING, ETC.	ACTION
3745-50-62	A,B,C,D	TRIAL BURN FOR INCINERATORS	SPECIFIES REQUIREMENTS OF A TRIAL BURN.	ACTION
3745-51-06	A,B,C(1)	REQUIREMENTS FOR RECYCLED MATERIALS	DEFINES RECYCLED HAZARDOUS WASTES AND ESTABLISHES SPECIFIC EXEMPTIONS FOR THESE WASTES FROM THE HAZARDOUS WASTE REGULATIONS.	ACTION CHEMICAL
3745-51-07	A,B	RESIDUES OF HAZ WASTES IN EMPTY CONTAINERS	EXEMPTS THE RESIDUES OF HAZARDOUS WASTES FROM EMPTY CONTAINERS FROM THE HAZARDOUS WASTE REGULATIONS. PROVIDES SPECIFIC DEFINITIONS FOR THESE RESIDUES.	ACTION
3745-52-11	A-D	EVALUATION OF WASTES	ANY PERSON GENERATING A WASTE MUST DETERMINE IF THAT WASTE IS A HAZARDOUS WASTE (EITHER THROUGH LISTING OR BY CHARACTERISTIC).	CHEMICAL ACTION
3745-52-20		HAZARDOUS WASTE MANIFEST - GENERAL REQUIREMENTS	REQUIRES A GENERATOR WHO TRANSPORTS OR OFFERS FOR TRANSPORTATION HAZARDOUS WASTE FOR OFF-SITE TREATMENT, STORAGE OR DISPOSAL TO PREPARE A UNIFORM HAZARDOUS WASTE MANIFEST	CHEMICAL ACTION
3745-52-22		HAZARDOUS WASTE MANIFEST - NUMBER OF COPIES	SPECIFIES THE NUMBER OF MANIFEST COPIES TO BE PREPARED	CHEMICAL ACTION
3745-52-23		HAZARDOUS WASTE MANIFEST - USE	SPECIFIES PROCEDURES FOR THE USE OF HAZARDOUS WASTE MANIFESTS INCLUDING A REQUIREMENT THAT THEY BE HAND SIGNED BY THE GENERATOR	CHEMICAL ACTION
3745-52-30		HAZARDOUS WASTE PACKAGING	REQUIRES A GENERATOR TO PACKAGE HAZARDOUS WASTE IN ACCORDANCE WITH U.S. DOT REGULATIONS FOR TRANSPORTATION OFF-SITE.	CHEMICAL ACTION

Table 2-5. Continued

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
3745-52-31		HAZARDOUS WASTE LABELING	REQUIRES PACKAGES OF HAZARDOUS WASTE TO BE LABELED IN ACCORDANCE WITH U.S.DOT REGULATIONS FOR OFF-SITE TRANSPORTATION.	CHEMICAL ACTION
3745-52-32		HAZARDOUS WASTE MARKING	SPECIFIES LANGUAGE FOR MARKING PACKAGES OF HAZARDOUS WASTE PRIOR TO OFF-SITE TRANSPORTATION	CHEMICAL ACTION
3745-52-33		HAZARDOUS WASTE PLACARDING	GENERATOR SHALL PLACARD HAZARDOUS WASTE PRIOR TO OFF-SITE TRANSPORTATION.	CHEMICAL ACTION
3745-52-34		ACCUMULATION TIME OF HAZARDOUS WASTE	IDENTIFIES MAXIMUM TIME PERIODS THAT A GENERATOR MAY ACCUMULATE A HAZARDOUS WASTE WITHOUT BEING CONSIDERED AN OPERATOR OF A STORAGE FACILITY. ALSO ESTABLISHES STANDARDS FOR MANAGEMENT OF HAZARDOUS WASTES BY GENERATORS.	CHEMICAL ACTION
3745-54-13	A	GENERAL ANALYSIS OF HAZARDOUS WASTE	PRIOR TO ANY TREATMENT, STORAGE OR DISPOSAL OF HAZARDOUS WASTES, A REPRESENTATIVE SAMPLE OF THE WASTE MUST BE CHEMICALLY AND PHYSICALLY ANALYZED.	CHEMICAL
3745-54-14	A,B,C	SECURITY FOR HAZARDOUS WASTE FACILITIES	HAZARDOUS WASTE FACILITIES MUST BE SECURED SO THAT UNAUTHORIZED AND UNKNOWING ENTRY ARE MINIMIZED OR PROHIBITED.	ACTION
3745-54-15	A,C	INSPECTION REQUIREMENTS FOR HAZARDOUS WASTE FACILITIES	HAZARDOUS WASTE FACILITIES MUST BE INSPECTED REGULARLY TO DETECT MALFUNCTIONS, DETERIORATIONS, OPERATIONAL ERRORS AND DISCHARGES. ANY MALFUNCTIONS OR DETERIORATIONS DETECTED SHALL BE REMEDIED EXPEDITIOUSLY.	ACTION
3745-54-17	A,B,C	REQ FOR IGNITABLE, REACTIVE OR INCOMPATIBLE HAZ WASTES	PRESENTS GENERAL PRECAUTIONS TO BE TAKEN TO PREVENT ACCIDENTAL IGNITION OR REACTION OF IGNITABLE, REACTIVE OR INCOMPATIBLE WASTES.	ACTION LOCATION
3745-54-18	A,B,C	LOCATION STANDARDS FOR HAZARDOUS WASTE T/S/D FACILITIES	RESTRICTS THE SITING OF HAZARDOUS WASTE FACILITIES IN AREAS OF SEISMIC ACTIVITY OR FLOODPLAINS.	LOCATION
3745-54-31		DESIGN & OPERATION OF HAZARDOUS WASTE FACILITIES	HAZARDOUS WASTE FACILITIES MUST BE DESIGNED, CONSTRUCTED, MAINTAINED AND OPERATED TO MINIMIZE THE POSSIBILITY OF FIRE, EXPLOSION OR UNPLANNED RELEASE OF HAZARDOUS WASTE OR HAZARDOUS CONSTITUENTS TO THE AIR, SOIL OR SURFACE WATER WHICH COULD THREATEN HUMAN HEALTH OR THE ENVIRONMENT.	ACTION

Table 2-5. Continued

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
3745-54-32	A,B,C,D	REQUIRED EQUIPMENT FOR HAZARDOUS WASTE FACILITIES	ALL HAZARDOUS WASTE FACILITIES MUST BE EQUIPPED WITH, EMERGENCY EQUIPMENT, SUCH AS AN ALARM SYSTEM, FIRE CONTROL EQUIPMENT AND A TELEPHONE OR RADIO.	ACTION
3745-54-33		TESTING & MAINTENANCE OF EQUIPMENT; HAZ WASTE FACILITIES	ALL HAZARDOUS WASTE FACILITIES MUST TEST AND MAINTAIN EMERGENCY EQUIPMENT TO ASSURE PROPER OPERATION.	ACTION
3745-54-34		ACCESS TO COMMUNICATIONS OR ALARM SYSTEM; HAZ WASTE FAC	WHENEVER HAZARDOUS WASTE IS BEING HANDLED, ALL PERSONNEL INVOLVED SHALL HAVE IMMEDIATE ACCESS TO AN INTERNAL ALARM OR EMERGENCY COMMUNICATION DEVICE.	ACTION
3745-54-35		REQUIRED AISLE SPACE AT HAZ WASTE FACILITIES	ADEQUATE AISLE SPACE SHALL BE MAINTAINED TO ALLOW UNOBSTRUCTED MOVEMENT OF PERSONNEL, FIRE EQUIPMENT, SPILL CONTROL EQUIPMENT AND DECONTAMINATION EQUIPMENT INTO ANY AREA OF THE FACILITY OPERATION IN THE EVENT OF AN EMERGENCY.	ACTION
3745-54-37	A,B	ARRANGEMENTS/AGREEMENTS WITH LOCAL AUTHORITIES	ARRANGEMENTS OR AGREEMENTS WITH LOCAL AUTHORITIES, SUCH AS POLICE, FIRE DEPARTMENT AND EMERGENCY RESPONSE TEAMS MUST BE MADE. IF LOCAL AUTHORITIES WILL NOT COOPERATE, DOCUMENTATION OF THAT NON-COOPERATION SHOULD BE PROVIDED.	ACTION
3745-54-52	A-F	CONTENT OF CONTINGENCY PLAN; HAZ WASTE FACILITIES	HAZARDOUS WASTE FACILITIES MUST HAVE A CONTINGENCY PLAN THAT ADDRESSES ANY UNPLANNED RELEASE OF HAZARDOUS WASTES OR HAZARDOUS CONSTITUENTS INTO THE AIR, SOIL OR SURFACE WATER. THIS RULE ESTABLISHES THE MINIMUM REQUIRED INFORMATION OF SUCH A PLAN.	ACTION
3745-54-53	A,B	COPIES OF CONTINGENCY PLAN; HAZARDOUS WASTE FACILITIES	COPIES OF THE CONTINGENCY PLAN REQUIRED BY 3745-54-50 MUST BE MAINTAINED AT THE FACILITY AND SUBMITTED TO ALL LOCAL POLICE DEPARTMENTS, FIRE DEPARTMENTS, HOSPITALS LOCAL EMERGENCY RESPONSE TEAMS AND THE OHIO EPA.	ACTION
3745-54-54	A	AMENDMENT OF CONTINGENCY PLAN; HAZ WASTE FACILITIES	THE CONTINGENCY PLAN MUST BE AMENDED IF IT FAILS IN AN EMERGENCY, THE FACILITY CHANGES (IN ITS DESIGN, CONSTRUCTION, MAINTENANCE OR OPERATION), THE LIST OF EMERGENCY COORDINATORS CHANGE OR THE LIST OF EMERGENCY EQUIPMENT.	ACTION
3745-54-55		EMERGENCY COORDINATOR; HAZARDOUS WASTE FACILITIES	AT ALL TIMES THERE SHOULD BE AT LEAST ONE EMPLOYEE EITHER ON THE PREMISES OR ON CALL TO COORDINATE ALL EMERGENCY RESPONSE MEASURES	ACTION

Table 2-5. Continued

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
3745-54-56	A-I	EMERGENCY PROCEDURES; HAZARDOUS WASTE FACILITIES	SPECIFIES THE PROCEDURES TO BE FOLLOWED IN THE EVENT OF AN EMERGENCY.	ACTION
3745-54-90		GROUND WATER PROTECTION; APPLICABILITY	ESTABLISHES CIRCUMSTANCES UNDER WHICH AN OPERATOR OF A HAZARDOUS WASTE FACILITY MUST IMPLEMENT A GROUND WATER PROTECTION PROGRAM OR A CORRECTIVE ACTION PROGRAM.	LOCATION ACTION
3745-54-91	A	REQ GROUND WATER PROGRAMS FOR HAZ WASTE FACILITIES	PRESENTS THE GROUND WATER MONITORING AND RESPONSE PROGRAMS REQUIRED FOR HAZARDOUS WASTE LAND-BASED UNITS.	ACTION
3745-54-92		GROUND WATER PROTECTION STANDARD; HAZ WASTE FACILITIES	COMPLIANCE MUST BE ATTAINED WITH THE CONDITIONS SPECIFIED IN THE PERMIT TO ENSURE THAT HAZARDOUS CONSTITUENTS (SEE, 3745-54-93) DO NOT EXCEED THE PROMULGATED LIMITS (SEE 3745-54-94).	ACTION CHEMICAL
3745-54-93	A,B	HAZARDOUS CONSTITUENTS IN GROUND WATER; HAZ WASTE FAC	REQUIRES THAT PERMIT SPECIFY HAZARDOUS CONSTITUENTS TO WHICH THE GROUND WATER PROTECTION STANDARD OF 3745-54-92 APPLIES. HAZARDOUS CONSTITUENTS ARE CONSTITUENTS IDENTIFIED IN THE APPENDIX OF THIS RULE THAT HAVE BEEN DETECTED IN GROUND WATER IN THE UPPERMOST AQUIFER UNDERLYING THE UNIT(S) AND AFTER REASONABLY EXPECTED TO BE IN OR DERIVED FROM WASTE CONTAINED IN THE UNIT(S).	CHEMICAL
3745-54-94	A,B	CONCENTRATION LIMITS FOR GROUND WATER; HAZ WASTE FAC	PRESENTS THE METHODOLOGY FOR DETERMINING CONCENTRATION LIMITS AND ALTERNATIVE CONCENTRATION LIMITS.	CHEMICAL
3745-54-95	A,B	POINT OF COMPLIANCE FOR GROUND WATER; HAZ WASTE FACIL	ESTABLISHES POINT OF COMPLIANCE AT VERTICAL SURFACE LOCATED AT THE HYDRAULICALLY DOWNGRADIENT LIMIT OF THE WASTE MANAGEMENT AREA THAT EXTENDS DOWN INTO THE UPPERMOST AQUIFER UNDERLYING THE UNIT(S)	ACTION CHEMICAL
3745-54-96	A,B,C	COMPLIANCE PERIOD FOR GROUND WATER; HAZ WASTE FACIL	A COMPLIANCE PERIOD DURING WHICH THE GROUND WATER PROTECTION STANDARDS APPLY WILL BE SPECIFIED IN THE PERMIT. RULE REQUIRES THAT THE COMPLIANCE PERIOD FOR A FACILITY UNDERGOING A CORRECTIVE ACTION PROGRAM WILL EXTEND UNTIL IT CAN BE DEMONSTRATED THAT THE GROUND WATER PROTECTION STANDARD OF OAC 3745-54-92 HAS NOT BEEN EXCEEDED FOR A PERIOD OF THREE CONSECUTIVE YEARS.	ACTION CHEMICAL

Table 2-5. Continued

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
3745-54-97	A-H	GEN GROUND WATER MONITORING REQUIREMENTS; HAZ WASTE FAC	PRESENTS GENERAL GROUND WATER MONITORING PROGRAM REQUIREMENTS. INCLUDES NUMBER, LOCATION AND DEPTH OF WELLS, CASING REQUIREMENTS, SAMPLING AND ANALYSIS PROCEDURES, ETC.	ACTION CHEMICAL
3745-54-98	A-I	GROUND WATER DETECTION MONITORING PROG; HAZ WASTE FAC	PRESENTS REQUIREMENTS OF GROUND WATER DETECTION PROGRAM.	ACTION CHEMICAL
3745-54-99	A-J	GROUND WATER COMPLIANCE MONITORING PROG; HAZ WASTE FAC	PRESENTS REQUIREMENTS OF GROUND WATER COMPLIANCE MONITORING PROGRAM.	ACTION CHEMICAL
3745-55-01	A-F	GROUND WATER CORRECTIVE ACTION PROGRAM; HAZ WASTE FAC	PRESENTS THE REQUIREMENTS OF A GROUND WATER CORRECTIVE ACTION PROGRAM THAT PREVENTS HAZARDOUS CONSTITUENTS FROM EXCEEDING THEIR RESPECTIVE CONCENTRATION LIMITS AT THE COMPLIANCE POINT BY EITHER REMOVAL OR TREATMENT OF THESE HAZARDOUS CONSTITUENTS.	ACTION CHEMICAL
3745-55-71		CONDITION OF CONTAINERS	CONTAINERS HOLDING HAZARDOUS WASTE MUST BE MAINTAINED IN GOOD CONDITION (NO RUST OR STRUCTURAL DEFECTS).	ACTION
3745-55-72		COMPATIBILITY OF WASTE WITH CONTAINERS	HAZARDOUS WASTES PLACED IN CONTAINER MUST NOT REACT WITH THE CONTAINER MATERIAL OR LINER MATERIAL.	ACTION
3745-55-73		MANAGEMENT OF CONTAINERS	CONTAINERS HOLDING HAZARDOUS WASTE MUST BE CLOSED (EXCEPT TO ADD OR REMOVE WASTE) AND MUST NOT BE HANDLED IN A MANNER THAT MAY RUPTURE THE CONTAINER OR CAUSE IT TO LEAK.	ACTION
3745-55-74		CONTAINER INSPECTIONS	REQUIRES AT LEAST WEEKLY INSPECTIONS OF CONTAINER STORAGE AREAS.	ACTION
3745-55-75	A,B,C,D	CONTAINER STORAGE AREA CONTAINMENT SYSTEM	REQUIRES THAT CONTAINER STORAGE AREAS HAVE A CONTAINMENT SYSTEM AND SPECIFIES THE MINIMUM REQUIREMENTS OF SUCH A SYSTEM.	ACTION
3745-55-76		CONTAINER REQUIREMENTS FOR IGNITABLE/REACTIVE WASTES	PRESENTS GENERAL PRECAUTIONS TO BE TAKEN TO PREVENT ACCIDENTAL IGNITION OR REACTION OF IGNITABLE OR REACTIVE WASTES THAT WILL BE STORED IN CONTAINERS.	ACTION CHEMICAL
3745-55-77	A,B,C	CONTAINER REQUIREMENTS FOR INCOMPATIBLE WASTES	PRESENTS GENERAL PRECAUTIONS TO BE TAKEN WHEN DEALING WITH INCOMPATIBLE WASTES.	ACTION CHEMICAL

Table 2-5. Continued

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
3745-55-78		CONTAINER CLOSURE REQUIREMENTS	SPECIFIES CLOSURE REQUIREMENTS FOR CONTAINERS AND CONTAINMENT SYSTEM.	ACTION
3745-55-91	A,B,D	ASSESSMENT OF EXISTING TANK SYSTEMS INTEGRITY	REQUIRES THAT EACH EXISTING TANK USED TO STORE OR TREAT HAZARDOUS WASTE THAT DOES NOT HAVE SECONDARY CONTAINMENT BE TESTED TO ASSURE TANK INTEGRITY.	ACTION
3745-55-92	A-G	DESIGN & INSTALLATION OF NEW TANK SYSTEMS OR COMPONENTS	REQUIRES A SECONDARY CONTAINMENT SYSTEM FOR TANKS AND ASSESSMENT TO DETERMINE TANK INTEGRITY.	ACTION
3745-55-93	A-G,I	CONTAINMENT AND DETECTION OF RELEASES FOR TANK SYSTEMS	REQUIRES SECONDARY CONTAINMENT AND LEAK DETECTION SYSTEMS FOR TANKS.	ACTION
3745-55-94	A,B,C	GENERAL OPERATING REQUIREMENTS FOR TANK SYSTEMS	SPECIFIES GENERAL OPERATING REQUIREMENTS FOR TANK SYSTEMS.	ACTION
3745-55-95	A-D	INSPECTIONS OF TANK SYSTEMS	REQUIRES INSPECTIONS AT LEAST ONCE EACH OPERATING DAY.	ACTION
3745-55-96	A,B,C,E	RESPONSE TO LEAKS OR SPILLS OF TANK SYSTEMS	REQUIRES THAT UNFIT TANKS BE REMOVED FROM USE AND FURTHER RELEASES BE PREVENTED.	ACTION
3745-55-97	A,B	CLOSURE AND POST-CLOSURE CARE FOR TANK SYSTEMS	SPECIFIES CLOSURE AND POST-CLOSURE REQUIREMENTS FOR TANK SYSTEMS.	ACTION
3745-55-98		TANK REQUIREMENTS FOR IGNITABLE/REACTIVE WASTES	PRESENTS GENERAL PRECAUTIONS TO BE TAKEN TO PREVENT ACCIDENTAL IGNITION OR REACTION OF IGNITABLE OR REACTIVE WASTES THAT ARE TREATED OR STORED IN TANKS.	ACTION
3745-55-99	A,B	TANK REQUIREMENTS FOR INCOMPATIBLE WASTES	PRESENTS GENERAL PRECAUTIONS TO BE TAKEN WHEN DEALING WITH POTENTIALLY INCOMPATIBLE WASTES THAT ARE STORED OR TREATED IN TANKS.	ACTION
3745-56-21	A-G	DESIGN & OPERATING REQUIREMENTS; SURFACE IMPOUNDMENTS	PRESENTS DESIGN AND OPERATING CRITERIA FOR SURFACE IMPOUNDMENTS.	ACTION
3745-56-26	A,B,C	MONITORING & INSPECTION OF SURFACE IMPOUNDMENTS	REQUIRES INSPECTION OF LINERS DURING CONSTRUCTION. ALSO REQUIRES WEEKLY AND AFTER STORM INSPECTIONS.	ACTION
3745-56-28	A,B,C	CLOSURE & POST-CLOSURE OF SURFACE IMPOUNDMENTS	PROVIDES CLOSURE AND POST-CLOSURE REQUIREMENTS FOR SURFACE IMPOUNDMENTS.	ACTION

Table 2-5. Continued

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
3745-56-29	A,B	SURFACE IMP. REQUIREMENTS FOR IGNITABLE/REACTIVE WASTES	PRESENTS GENERAL PRECAUTIONS TO BE TAKEN WHEN DEALING WITH POTENTIALLY IGNITABLE OR REACTIVE WASTES THAT ARE STORED OR TREATED IN SURFACE IMPOUNDMENTS.	ACTION CHEMICAL
3745-56-30		SURFACE IMPOUND. REQUIREMENTS FOR INCOMPATIBLE WASTES	PRESENTS GENERAL PRECAUTIONS TO BE TAKEN WHEN DEALING WITH POTENTIALLY INCOMPATIBLE WASTES THAT ARE STORED OR TREATED IN SURFACE IMPOUNDMENTS.	ACTION CHEMICAL
3745-56-31	A	CONSTRUCTION INSPECTIONS OF SURFACE IMPOUNDMENTS	ALLOWS OHIO EPA OPPORTUNITY TO INSPECT SURFACE IMPOUNDMENTS DURING CONSTRUCTION AND INSTALLATION.	ACTION
3745-56-33	A,B	SPECIAL REQUIREMENTS FOR F WASTES IN SURFACE IMPOUND.	PROHIBITS THE PLACEMENT OF HAZARDOUS WASTES F020, F021, F022, F023, F026 AND F027 IN SURFACE IMPOUNDMENTS.	ACTION CHEMICAL
3745-56-51	A-F	DESIGN & OPERATING REQUIREMENTS FOR WASTE PILES	SPECIFIES THE DESIGN AND OPERATION REQUIREMENTS FOR WASTE PILES. INCLUDES LINER SYSTEM, LEACHATE COLLECTION AND REMOVAL SYSTEM, WIND DISPERSAL PREVENTION AND RUN-ON/RUN-OFF CONTROL.	ACTION
3745-56-54	A,B	MONITORING & INSPECTION OF WASTE PILES	WASTE PILES MUST BE MONITORED DURING CONSTRUCTION OR INSTALLATION AND OPERATION. PRESENTS GENERAL PRECAUTIONS TO BE TAKEN WHEN DEALING WITH POTENTIALLY IGNITABLE OR REACTIVE HAZARDOUS WASTES THAT ARE STORED OR TREATED IN WASTE PILES.	ACTION
3745-56-57	A,B,C	WASTE PILE REQUIREMENTS FOR INCOMPATIBLE WASTES	PRESENTS GENERAL PRECAUTIONS TO BE TAKEN WHEN DEALING WITH POTENTIALLY INCOMPATIBLE WASTES THAT ARE TO BE STORED OR TREATED IN WASTE PILES	ACTION CHEMICAL
3745-56-58	A,B,C	CLOSURE & POST-CLOSURE CARE FOR WASTE PILES.	SPECIFIES CLOSURE AND POST-CLOSURE CARE REQUIREMENTS FOR WASTE PILES.	ACTION
3745-56-59	A	CONSTRUCTION INSPECTIONS FOR WASTE PILES	ALLOWS OHIO EPA THE OPPORTUNITY TO INSPECT WASTE PILES DURING CONSTRUCTION.	ACTION
3745-56-78	A-F	LAND TREATMENT UNSATURATED ZONE MONITORING	AN UNSATURATED ZONE MONITORING PROGRAM MUST BE ESTABLISHED FOR ALL LAND TREATMENT UNITS. THE REQUIREMENT OF THIS PROGRAM ARE PRESENTED BY THIS RULE.	ACTION CHEMICAL
3745-56-81	A,B	LAND TREATMENT REQUIREMENTS; IGNITABLE/REACTIVE WASTES	PROHIBITS THE APPLICATION OF IGNITABLE OR REACTIVE WASTE TO THE TREATMENT ZONE, EXCEPT UNDER CERTAIN CIRCUMSTANCES.	ACTION CHEMICAL

Table 2-5. Continued

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
3745-56-82		LAND TREATMENT REQUIREMENTS FOR INCOMPATIBLE WASTES	PROHIBITS THE PLACEMENT OF INCOMPATIBLE WASTE IN OR ON THE TREATMENT ZONE.	ACTION CHEMICAL
3745-56-83	A,B	SPECIAL REQUIREMENTS FOR F WASTES IN LAND TREATMENT	PROHIBITS THE PLACEMENT OF HAZARDOUS WASTES F020, F021, F022, F023, F026, AND F027 IN LAND TREATMENT UNITS.	ACTION CHEMICAL
3745-57-01	A-D	ENVIRONMENTAL PERFORMANCE STANDARDS; LAND-BASED UNITS	SPECIFIES LOCATION, DESIGN, CONSTRUCTION, OPERATION, MAINTENANCE AND CLOSURE REQUIREMENTS FOR LANDFILLS, WASTE PILES, SURFACE IMPOUNDMENTS AND UNDERGROUND INJECTION WELLS.	ACTION
3745-57-12	A,B	LANDFILL REQUIREMENTS FOR IGNITABLE/REACTIVE WASTES	PROHIBITS THE DISPOSAL OF IGNITABLE OR REACTIVE WASTE IN A LANDFILL, UNLESS THE WASTE IS TREATED, RENDERED OR MIXED SO THAT THE RESULTANT MATERIAL NO LONGER MEETS THE DEFINITION OF IGNITABLE OR REACTIVE WASTE.	ACTION CHEMICAL
3745-57-13		LANDFILL REQUIREMENTS FOR INCOMPATIBLE WASTES	PROHIBITS THE DISPOSAL OF INCOMPATIBLE WASTE IN THE SAME CELL OF A LANDFILL.	ACTION CHEMICAL
3745-57-16	A-E	DISPOSAL OF SMALL CONTAINERS OF HAZ WASTES IN OVERPACKS	LAB PACKS CONTAINING HAZARDOUS WASTE MAY BE PLACED IN A LANDFILL IF CERTAIN REQUIREMENTS ARE MET.	ACTION
3745-57-18	A,B	SPECIAL REQUIREMENTS FOR F WASTES IN LANDFILLS	PROHIBITS THE PLACEMENT OF HAZARDOUS WASTES F020, F021, F022, F023, F026 AND F027 IN LANDFILLS.	ACTION CHEMICAL
3745-57-41	A,B	WASTE ANALYSIS FOR INCINERATORS	REQUIRES WASTE ANALYSIS BE PERFORMED FOR TRIAL BURN AND FOR NORMAL OPERATION OF INCINERATOR.	CHEMICAL ACTION
3745-57-42	A,B,C	PRINCIPAL ORGANIC HAZARDOUS CONSTITUENTS; INCINERATORS	ESTABLISHES METHOD BY WHICH POHCS WILL BE SPECIFIED.	CHEMICAL ACTION
3745-57-43	A,B,C	PERFORMANCE STANDARDS FOR INCINERATORS	SPECIFIES PERFORMANCE STANDARDS THAT ALL INCINERATORS MUST MEET (DESTRUCTION REMOVAL EFFICIENCIES, HCL EMISSIONS, PARTICULATE EMISSIONS)	CHEMICAL ACTION
3745-57-44	C	INCINERATOR TRIAL BURNS - ALTERNATIVE DATA	REQUIRES TRIAL BURN TO DETERMINE FINAL OPERATING CONDITIONS.	ACTION CHEMICAL
3745-57-45	A-F	INCINERATOR OPERATING REQUIREMENTS	SPECIFIES GENERAL OPERATING REQUIREMENTS FOR ALL INCINERATORS.	ACTION
3745-57-47	A,B,C	MONITORING AND INSPECTION OF INCINERATORS	REQUIRES THE MONITORING OF CERTAIN PARAMETERS ON A CONTINUOUS BASIS AND INSPECTIONS OF EQUIPMENT.	ACTION CHEMICAL

Table 2-5. Continued

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
3745-57-51		CLOSURE OF INCINERATORS	REQUIRES THAT ALL HAZARDOUS WASTE AND HAZARDOUS WASTE RESIDUES BE REMOVED FROM THE INCINERATOR SITE.	ACTION
3745-57-91	A,B,C	ENVIRONMENTAL PERFORMANCE STANDARDS FOR MISC UNITS	ESTABLISHES LOCATION, DESIGN, CONSTRUCTION, OPERATION: MAINTENANCE AND CLOSURE REQUIREMENTS FOR MISCELLANEOUS UNITS USED TO TREAT, STORE OR DISPOSE OF HAZARDOUS WASTES.	ACTION CHEMICAL
3745-57-92		MONITORING, INSPECTING, ANALYZING, ... FOR MISC UNITS	REQUIRES THAT MONITORING, ANALYSIS, INSPECTION, RESPONSE, REPORTING AND CORRECTIVE ACTION BE CONDUCTED AS NECESSARY AT MISCELLANEOUS UNITS TO ASSURE THAT HUMAN HEALTH AND THE ENVIRONMENT ARE PROTECTED.	ACTION
3745-57-93		POST-CLOSURE CARE FOR MISC DISPOSAL UNITS	REQUIRES POST-CLOSURE CARE OF MISCELLANEOUS UNITS THAT ARE DISPOSAL UNITS AND OF TREATMENT OR STORAGE MISCELLANEOUS UNITS THAT LEAVE CONTAMINATED SOILS OR GROUND WATER AFTER CLOSURE.	ACTION
3745-58-42	B,C	PROHIBITIONS: HAZARDOUS WASTE BURNED FOR ENERGY RECOVERY	DESCRIBES THE TYPES OF FURNACES, BOILERS OR CEMENT KILNS IN WHICH HAZARDOUS WASTE MAY BE BURNED FOR ENERGY RECOVERY.	ACTION
3745-58-43	A,C	STANDARDS FOR GENERATORS OF HAZARDOUS WASTE FUEL	ESTABLISHES STANDARDS FOR GENERATORS OF HAZARDOUS WASTE WHICH IS USED AS A FUEL OR USED TO PRODUCE A FUEL. ALSO ESTABLISHES STANDARDS FOR GENERATORS WHO ARE ALSO BURNERS OF HAZARDOUS WASTE FUEL.	ACTION
3745-58-46	A,C,D,E	STANDARDS APPLICABLE TO BURNERS OF HAZARDOUS WASTE FUEL	SPECIFIES THE OPERATING REQUIREMENTS FOR INDUSTRIAL FURNACES AND BOILERS THAT BURN HAZARDOUS WASTE FUEL.	ACTION
3745-58-51	B	PROHIBITIONS: USED OIL BURNED FOR ENERGY RECOVERY	DESCRIBES THE TYPES OF FURNACES, BOILERS AND SPACE HEATERS IN WHICH USED OIL MAY BE BURNED FOR ENERGY RECOVERY.	ACTION
3745-59-01	C,E	HAZARD WASTES RESTRICTED FROM LAND DISPOSAL-EXCEPTIONS	LISTS TYPE OF RESTRICTED WASTES THAT MAY BE LAND DISPOSED. LISTS TYPE OF HAZARDOUS WASTES NOT SUBJECT TO LDRs.	ACTION
3745-59-07	A,B,C	WASTE ANALYSIS OF HAZARDOUS WASTE	GENERATOR SHALL TEST THE WASTE OR TEST AN EXTRACT OF THE WASTE ACCORDING TO THE FREQUENCY AND TEST METHODS DESCRIBED IN THE RULES, TO DETERMINE IF THE WASTE IS RESTRICTED FROM LAND DISPOSAL.	ACTION

Table 2-5. Continued

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
3745-59-09	B,C	SPECIAL RULES REGARDING WASTE THAT EXHIB A CHARACTERIST	PROHIBITS LAND DISPOSAL OF CHARACTERISTIC WASTE UNLESS THE WASTE COMPLIES WITH THE TREATMENT STANDARDS OF LISTED WASTES. IF THE WASTE IS BOTH LISTED AND EXHIBITS A CHARACTERISTIC, THE TREATMENT STANDARD FOR THE LISTED WASTE WILL OPERATE IN LIEU OF THE STANDARD FOR THE CHARACTERISTIC WASTE.	ACTION CHEMICAL
3745-59-30	A,B,C	WASTE SPECIFIC PROHIBITIONS	PROHIBITS SPENT SOLVENT WASTES OR CONTAMINATED SOIL AND DEBRIS RESULTING FROM A RESPONSE ACTION UNDER CERCLA OR RCRA TO BE LAND DISPOSED UNLESS GENERATOR MEETS TREATMENT STANDARDS (3745-59-40 TO 44) OR HAS BEEN GRANTED AN EXTENSION OR EXEMPTION.	ACTION CHEMICAL
3745-59-31	A,B,C,D	DIOXIN WASTE PROHIBITIONS	PROHIBITS ON-SITE DISPOSAL OF DIOXIN WASTE UNLESS IT MEETS TREATMENT STANDARDS OF RULES 3745-59-40 TO 44 OR THE GENERATOR HAS BEEN GRANTED AN EXTENSION OR EXEMPTION.	CHEMICAL ACTION
3745-59-32	A,D,E,F	CALIFORNIA LIST WASTES PROHIBITIONS	PROHIBITS LAND DISPOSAL OF FOLLOWING WASTES: 1. LIQUID WASTES WITH pH <2 OR pH=2. 2. LIQUID WASTES CONTAINING PCBs WITH CONC = 50 OR CONC > 50 PPM. 3. LIQUID WASTES WITH HALOGENATED ORGANIC LOADING OF > OR = 1,000mg/l AND LESS THAN 10,000 mg/l	CHEMICAL ACTION
3745-59-42	A,C,D	TREATMENT STANDARDS EXPRESSED AS SPECIFIED TECHNOLOGIES	ESTABLISHES TREATMENT STANDARDS FOR LIQUID HAZARDOUS WASTE CONTAINING PCBs, NON-LIQUID HAZARDOUS WASTE CONTAINING HALOGENATED ORGANIC COMPOUNDS (HOCS) AND LAB PACKS. RADIOACTIVE HAZARDOUS MIXED WASTES ARE NOT SUBJECT TO TREATMENT STANDARDS.	ACTION CHEMICAL
3745-59-43	A,B,C	TREATMENT STANDARDS EXPRESSED AS WASTE CONCENTRATIONS	IDENTIFIES THE RESTRICTED WASTES AND THE CONCENTRATIONS OF THEIR ASSOCIATED HAZARDOUS CONSTITUENTS WHICH MAY NOT BE EXCEEDED BY THE WASTE OR TREATMENT RESIDUAL FOR THE ALLOWABLE LAND DISPOSAL OF SUCH WASTE OR RESIDUAL.	CHEMICAL
3745-59-50	A,B,C,D,E	PROHIBITION ON STORAGE OF RESTRICTED WASTE	PROHIBITS ON-SITE STORAGE OF HAZARDOUS WASTES RESTRICTED FROM LAND DISPOSAL BEYOND A SPECIFIED TIME FRAME STATED IN THE RULE.	
3745-71-02		AMBIENT AIR QUALITY STANDARDS - LEAD	THE AMBIENT QUALITY STANDARD FOR LEAD SHALL BE A MAXIMUM ARITHMETIC MEAN OF 1.5 MICROGRAMS PER CUBIC METER DURING ANY CALENDAR QUARTER.	ACTION

Table 2-5. Continued

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
3745-81-11	A,B	MAXIMUM CONTAMINANT LEVELS FOR INORGANIC CHEMICALS	PRESENTS MAXIMUM CONTAMINANT LEVELS FOR INORGANICS.	CHEMICAL
3745-81-12	A,B,C	MAXIMUM CONTAMINANT LEVELS FOR ORGANIC CHEMICALS	PRESENTS MCLS FOR ORGANICS.	CHEMICAL
3745-81-13	A,B	MAXIMUM CONTAMINANT LEVELS FOR TURBIDITY	PRESENTS MCLS FOR TURBIDITY.	CHEMICAL
3745-81-14	A-E	MAXIMUM MICROBIOLOGICAL CONTAMINANT LEVELS	PRESENTS MCLS FOR MICROBIOLOGICAL CONTAMINANTS	CHEMICAL
3745-81-15	A,B	MAX CONTAMINANT LEVELS FOR RADIUM 226,228, GROSS ALPHAS	PRESENTS MCLS FOR RADIUM-226, RADIUM-228 AND GROSS ALPHA PARTICLE ACTIVITY.	CHEMICAL
3745-81-16	A,B	MAX CONTAM LEVELS FOR BETA PARTICLE & PHOTON RADIOACTIV	PRESENTS MCLS FOR BETA PARTICLE AND PHOTON RADIOACTIVITY FROM MAN-MADE RADIONUCLIDES.	CHEMICAL
3745-81-21	A,B	MICROBIOLOGICAL CONTAMINANT SAMPLING & ANALYTICAL REQ	PRESENTS SAMPLING AND ANALYTICAL REQUIREMENTS FOR MICROBIOLOGICAL CONTAMINANTS.	CHEMICAL
3745-81-22	A,B	TUBIDITY CONTAMINANT SAMPLING & ANALYTICAL REQUIREMENTS	PRESENTS SAMPLING AND ANALYTICAL REQUIREMENTS FOR TURBIDITY.	CHEMICAL
3745-81-23	A,E	INORGANIC CONTAMINANT MONITORING REQUIREMENTS	PRESENTS MONITORING REQUIREMENTS FOR INORGANIC CONTAMINANTS.	CHEMICAL
3745-81-24	A-E	ORGANIC CONTAMINANT MONITORING REQUIREMENTS	PRESENTS MONITORING REQUIREMENTS FOR ORGANIC CONTAMINANTS.	CHEMICAL
3745-81-25	A-D	ANALYTICAL METHODS FOR RADIOACTIVITY	PRESENTS ANALYTICAL METHODS FOR RADIOACTIVITY	CHEMICAL
3745-81-26	A,B,C	MONITORING FREQUENCY FOR RADIOACTIVITY	PRESENTS MONITORING REQUIREMENTS FOR RADIOACTIVITY	CHEMICAL
3745-81-27	A-E	ANALYTICAL TECHNIQUES	PRESENTS GENERAL ANALYTICAL TECHNIQUES FOR MCLS	CHEMICAL
3745-81-40	A,B,C	REQUIREMENTS FOR A VARIANCE FROM MCLS	PROVIDES CRITERIA BY WHICH DIRECTOR MAY GRANT VARIANCE FROM MCLS	CHEMICAL
3745-81-46		ALTERNATIVE TREATMENT TECHNIQUE VARIANCE	ALLOWS FOR THE USE OF ALTERNATIVE TREATMENT TECHNIQUES TO ATTAIN MCLS.	CHEMICAL
3745-81-60	A,B,C	SANITARY SURVEYS	SANITARY SURVEY REQUIREMENTS FOR SITES WHICH DO NOT COLLECT FIVE OR MORE ROUTINE TOTAL COLIFORM SAMPLES PER MONTH.	CHEMICAL ACTION

Table 2-5. Continued

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
3745-81-71	A,B	GEN REQ FOR FILTRATION & DISINFECTION FOR SURFACE WATER	TREATMENT STANDARDS FOR GIARDIA LAMBLIA, VIRUSES, HETEROTROPHIC PLATE COUNT BACTERIA, LEGIONELLA, TURBIDITY	ACTION CHEMICAL
3745-81-72	A,B	DISINFECTION OF WATER FROM SURFACE WATER SOURCES	DISINFECTION REQUIREMENTS AND TREATMENT OF SURFACE WATER	ACTION CHEMICAL
3745-81-73	A,B,C	FILTRATION OF WATER FROM SURFACE WATER SOURCES	CONVENTIONAL FILTRATION, SLOW SAND FILTRATION, OR OTHER FILTRATION TREATMENT TECHNOLOGIES FOR TREATMENT OF SURFACE WATER.	ACTION
3745-81-74	A-D	TURBIDITY AND DISINFECTION MONIT REQ. FOR SURFACE WATER	TURBIDITY AND DISINFECTION MONITORING REQUIREMENTS FOR SURFACE WATER SYSTEMS.	ACTION
3745-9-04	A,B	LOCATION/SITING OF NEW GW WELLS	MANDATES THAT GROUND WATER WELLS BE: A) LOCATED AND MAINTAINED SO AS TO PREVENT CONTAMINANTS FROM ENTERING WELL. B) LOCATED SO AS TO BE ACCESSIBLE FOR CLEANING AND MAINTENANCE.	LOCATION ACTION
3745-9-05	A1,B-H	CONSTRUCTION OF NEW GW WELLS	SPECIFIES MINIMUM CONSTRUCTION REQUIREMENTS FOR NEW GROUND WATER WELLS IN REGARDS TO CASING MATERIAL, CASING DEPTH, POTABLE WATER, ANNULAR SPACES, USE OF DRIVE SHOE, OPENINGS TO ALLOW WATER ENTRY, CONTAMINANT ENTRY.	ACTION
3745-9-06	A,B,D,E	CASING REQUIREMENTS FOR NEW GW WELLS	ESTABLISHES SPECIFIC REQUIREMENTS FOR WELL CASINGS, SUCH AS SUITABLE MATERIAL, DIAMETERS AND CONDITION.	ACTION
3745-9-07	A-F	SURFACE DESIGN OF NEW GW WELLS	ESTABLISHES SPECIFIC SURFACE DESIGN REQUIREMENTS, SUCH AS HEIGHT ABOVE GROUND, WELL VENTS, WELL PUMPS, ETC.	ACTION
3745-9-08	A,C	START-UP & OPERATION OF GW WELLS	REQUIRE DISINFECTION OF NEW WELLS AND USE OF POTABLE WATER FOR PRIMING PUMPS.	ACTION
3745-9-09	A-C,D1,E-G	MAINTENANCE & OPERATION OF GW WELLS	ESTABLISHES SPECIFIC MAINTENANCE AND MODIFICATION REQUIREMENTS FOR CASING, PUMP AND WELLS IN GENERAL.	ACTION
3745-9-10	A,B,C	ABANDONMENT OF TEST HOLES & GW WELLS	FOLLOWING COMPLETION OF USE, WELLS AND TEST HOLES SHALL BE COMPLETELY FILLED WITH GROUT OR SIMILAR MATERIAL OR SHALL BE MAINTAINED IN COMPLIANCE OF ALL REGULATIONS.	ACTION
3745-9-11		USE OF WELLS FOR DISPOSAL	NO PERSON SHALL USE ANY WELL TO INJECT OR REINJECT ANY SUBSTANCE INTO THE GROUND WITHOUT NECESSARY PERMITS.	ACTION

Table 2-5. Continued

Revised Code Section	Pertinent Paragraph	Title or Subject Of Regulation	Description Of Regulation	ARAR Type
3767.13		PROHIBITION OF NUISANCES	PROHIBITS NOXIOUS EXHALATIONS OR SMELLS AND THE OBSTRUCTION OF WATERWAYS.	ACTION CHEMICAL
3767.14		PROHIBITION OF NUISANCES	PROHIBITION AGAINST THROWING REFUSE, OIL, OR FILTH INTO LAKES, STREAMS, OR DRAINS.	ACTION CHEMICAL
6101.19		CONSERVANCY DISTRICTS	BOARD OF DIRECTORS OF A CONSERVANCY DISTRICT MAY MAKE AND ENFORCE RULES AND REGULATIONS PERTAINING TO CHANNELS, DITCHES, PIPES, SEWERS, ETC	ACTION
6111.04		ACTS OF POLLUTION PROHIBITED	POLLUTION OF WATERS OF THE STATE IS PROHIBITED	ACTION
6111.04.2		RULES REQUIRING COMPLIANCE WITH NATIONAL EFFLUENT STDS	ESTABLISHES REGULATIONS REQUIRING COMPLIANCE WITH NATIONAL EFFLUENT STANDARDS.	ACTION
6111.04.3		INJECTION OF SEWAGE OR WASTES INTO WELLS	ESTABLISHES A REGULATORY PROGRAM FOR THE INJECTION OF WASTES INTO WELLS THAT PREVENTS THE CONTAMINATION OF UNDERGROUND SOURCES OF DRINKING WATER.	ACTION
6111.07	A,C	WATER POLLUTION CONTROL REQUIREMENTS - DUTY TO COMPLY	PROHIBITS FAILURE TO COMPLY WITH REQUIREMENTS OF SECTIONS 6111.01 TO 6111.08 OR ANY RULES, PERMIT OR ORDER ISSUED UNDER THOSE SECTIONS.	ACTION

2.6 GUIDANCE FOR POTENTIAL ENVIRONMENTAL COMPLIANCE ACTIVITIES

To be included in this section are discussions of requirements for wetlands assessments, cultural resource surveys, risk assessments, and other compliance provisions that may be required as part of the remediation. Some of these activities have been recently completed or are in progress for PBS under NASA supervision. These include: a species survey completed in 1995; a wetlands delineation scheduled to begin in 1996; and an historic preservation study in progress and scheduled to be completed in 1996.

2.6.1 Risk Assessment Guidance

Reserved for future use.

2.6.2 Wetlands Guidance

Reserved for future use.

2.6.3 Historic Preservation Guidance

Reserved for future use.

2.6.4 Threatened and Endangered Species Surveys Guidance

Reserved for future use.

3.0 SITE SETTING

This section provides the general site background, the site history, and the physical characteristics of PBOW as a whole. Included are descriptions of site security and access, and brief descriptions of the Areas of Concern (AOCs) at PBOW.

3.1 SITE LOCATION, SITE SECURITY, AND ACCESS

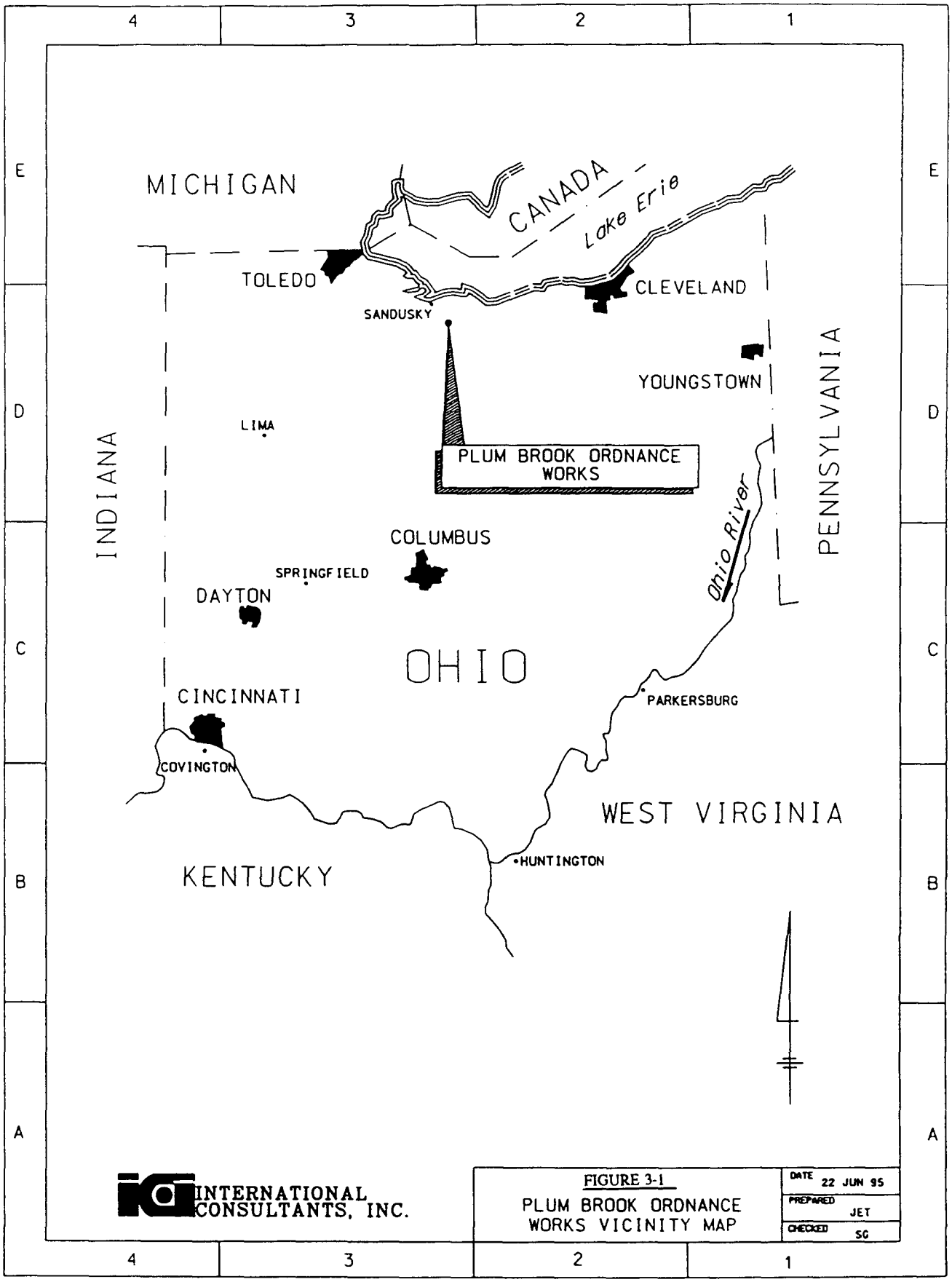
Plum Brook Ordnance Works (Plum Brook Station) is located near Sandusky, Ohio, four miles south of the Lake Erie Port of Sandusky (Figure 3-1). The site lies principally in Perkins Township, with much of the southeastern portion in Oxford Township. The eastern edge of the site extends into Huron and Milan Townships. The site is bounded by U.S. Route 250 on the east, County Road 43 on the west, Bogart Road on the north, and Mason Road on the south. Most of PBOW is situated on undisturbed forested land, while the area surrounding the site is rural and agriculturally developed. The National Aeronautics and Space Administration (NASA) maintains research facilities at the site. The site has a total of 62.5 miles of internal paved roads and 15.7 miles of railroad line most of which has been abandoned.

Entrance to the site can be achieved at the main gate at the intersection of Taylor Road and Columbus Avenue. Additional gates along the property boundary are secured unless direct access to a particular area is required. NASA security forces maintain 24-hour perimeter and site monitoring, and control access to the facility at the Columbus Avenue gate.

Site access is gained through the NASA Institutional Operations Office located in Building 7141 on PBS. Contractor work at the site must be coordinated through USACE Huntington and Nashville Districts, as well as NASA.

3.2 SITE HISTORY

This section includes descriptive and historic information on PBOW and Plum Brook Station (PBS) that are relevant to developing an understanding of potential contamination that may have resulted from past site activities.


MICHIGAN
CANADA
Lake Erie
TOLEDO
CLEVELAND
SANDUSKY
YOUNGSTOWN
PENNSYLVANIA
LIMA
INDIANA
PLUM BROOK ORDNANCE WORKS
Ohio River
COLUMBUS
SPRINGFIELD
DAYTON
OHIO
CINCINNATI
PARKERSBURG
COVINGTON
WEST VIRGINIA
HUNTINGTON
KENTUCKY
INTERNATIONAL CONSULTANTS, INC.
FIGURE 3-1
PLUM BROOK ORDNANCE WORKS VICINITY MAP
DATE 22 JUN 95
PREPARED JET
CHECKED SG

3.2.1 History of Past Operations

The original site was acquired by the Department of Defense (DoD) in 1938 for the manufacture of ordnance, and consisted of 9,009.32 acres of land plus 1.35 acres for a pump station (NASA Archives). In the early 1940s the U.S. Army contracted with the Trojan Powder Company to manufacture 2,4,6-trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite at PBOW. Production began on December 16, 1941 and continued through late 1945, ceasing two weeks after V-J Day (September 2, 1945). During the production period, over 900 million pounds of these materials were manufactured at PBOW (SAIC 1991). After the operation ceased, the area was turned over to the Army Ordnance Department, was renamed Plum Brook Depot, and was used for ammunition storage.

PBOW was placed in standby condition from 1945 to 1946. During this time, the Army conducted decontamination and decommissioning (D&D) of many of the buildings and structures associated with the manufacturing of ordnance (SAIC 1991). D&D included removal and relocation of all explosives to burning grounds for incineration. Where possible, remaining structures and buildings were burned in place. Drain lines and steam lines were flushed and dismantled; however, PBOW historical records do not indicate where they were flushed.

In December 1945, custody of PBOW was transferred from the Trojan Powder Company to the U.S. Army Ordnance Department, and the USACE assumed responsibility for maintenance and custodial duties at PBOW from January 1 through June 30, 1946. In August 1946, PBOW was transferred to the War Assets Administration. A contractor, Matthew-Levio and Sons, secured and maintained the property from 1946 to 1949. In 1949, PBOW was transferred to the General Services Administration (GSA), which oversaw the facility until August 1954. Additional decontamination efforts were undertaken by Ravenna Arsenal from 1954 to 1958.

3.2.2 History of Current Operations

In 1956 the National Advisory Committee for Aeronautics (NACA) began leasing sections of PBOW from the Army. An agreement was made in 1956 for a lease of 500 acres of the north portion of the site to construct and operate the Plum Brook Reactor Facility (PBRF). In 1958 NACA became NASA, which operated the PBRF between 1963 and 1973 under a license agreement with the Atomic Energy Commission (AEC). NASA currently has a license agreement with the Nuclear Regulatory Commission (NRC) for safe protective storage of the PBRF (SAIC 1991). By 1963, approximately 6,400 acres of PBOW had been acquired by NASA for various aerospace research activities. An additional 2,000 acres of surrounding property was acquired to serve as a buffer zone. Research and test activities were

conducted by NASA at PBOW throughout the 1960s and early 1970s. The major research facilities that emerged in the 1960s include:

- Liquid Hydrogen Pump Site (A Site Complex)
- High Energy Rocket Engine Research Facility (B1 Site Complex)
- Spacecraft Propulsion Research Facility (B2 Site Complex)
- Rocket Dynamics and Control Facility (B3 Site Complex)
- Turbo Pump Site (C Site Complex)
- Controls and Turbine Test Site (D Site Complex)
- Dynamics Stand (E Site Complex)
- Hydraulics Lab (F Site Facility)
- G Site Complex
- Fluorine Pump Site (I Site Complex)
- Oxidizer Hydraulics Lab (J Site Complex)
- Cryogenic Propellent Tank Site (K Site Complex)
- Hypersonic Tunnel Facility (HTF)
- Space Power Facility (SPF)

In 1973, The Ohio Army National Guard (OHANG) signed a use agreement with NASA to use the 604 acres known as Parcel #59 for training purposes. The agreement was extended in 1978 and again in 1983, 1988, and 1993, to last through November 13, 1998. Typically, The OHANG has used this property for the Army Readiness Training Program and as a maneuver training area for Engineer, Military Police, and Infantry Units. In 1978, NASA declared approximately 2,150 acres of land as excess (including Parcel #59), transferring ownership to the General Services Administration (GSA) for subsequent disposal. The efforts of the GSA to dispose of the property has been futile largely due to the presence of the waste water ponds resulting from PBOW activities. The Perkins Township Board of Education uses 46 of these acres as a bus transportation center. NASA controls the land associated with PBOW through ownership of title, use of easements, leases, permits, and ownership of development rights.

3.3 PHYSICAL CHARACTERISTICS

The physical characteristics of PBOW include topography, ecology, soil types, geology, and hydrology. A general description of these features is provided here for PBOW as a whole. The physical characteristics unique to each of the AOCs are described in Part B, Sections 2.0 through 14.0.

3.3.1 Topography

The PBOW site is located on relatively flat terrain resulting from glacial and lacustrine deposits from ancient glacial Lake Maumee, an extension of present-day Lake Erie. The site generally slopes gently

northward toward Lake Erie, with an average slope of the ground surface of less than six percent. Elevations at the site range from 625 feet above mean sea level (MSL) in the northern portions near Bogart Road, to 675 feet above MSL at the southern and western edges of the site. The flat terrain has since been disrupted by construction of basins, berms, ditches, and levees in conjunction with PBOW and NASA activities.

3.3.2 Ecology

There are six different vegetation habitats found at PBOW: grassland, brushland/oldfield, woodlands, structural, wetlands, and open water. The grassland habitat occupies the largest area at PBOW and contains native and introduced plants. Orchard grass, broomsedge, Kentucky bluegrass, switchgrass, and bluestream are typical grasses that occur in this habitat. Tree species found in this habitat include oak, hickory, maple or beech, and tulip-poplar. Controlled open burning of grassland is practiced in order to control nuisance weeds and enhance the growth of prairie grass species such as switchgrass, an excellent habitat for upland bird species.

Brushland/oldfield is the second most prevalent habitat at PBOW. Birds such as Flycatchers, Red-Winged Blackbird, Sparrows, Quail, and Ruffled Grouse are supported by this habitat. The cottontail rabbit is also found in this area. The shrubs and thickets provide food and shelter to the wildlife.

Woodland habitats are located at several different locations around PBOW. Pine trees and secondary deciduous trees are the prominent plant types located here.

Structural habitats include areas of mostly weedy plants, ornamental trees, and shrubs. Rats, mice, pigeons and starlings frequent this habitat.

Potential wetlands make up approximately 1.5 percent of the total area at PBOW. Sixteen acres of these wetlands contain water on a year-round basis. Forty acres are seasonal, remaining wet over most of the year but having a dry period during the summer. Another 30 acres are wet long enough to maintain a good stand of sedges and rushes and yet dry enough to allow the growth of grasses and forbs. Cattails, spikerushes, rushes, and sedges form the dominant vegetation in the wetlands. Many species of birds make use of the dense vegetation of the wetlands for escape and nesting cover.

Open water habitats are also located within the boundaries of PBOW. The red water ponds support sunfish, painted turtles, and snapping turtles. Wild ducks swim, feed, and nest in and around the ponds.

A species survey was conducted on PBS in 1995 which was designed to identify plant species, breeding birds, reptiles and amphibians, fish and lepidoptera (butterflies and moths) (Bionetics 1995). The primary emphasis was on identification of any federal or state-listed species occurring on the facility. All species encountered during the survey were identified. The only federally-listed species observed during the survey was the bald eagle (*Haliaeetus leucocephalus*). An individual adult was observed on one occasion in early June near one of the reservoirs. As nesting sties are located near PBS but not observed on the site, it was assumed that this adult was a sporadic visitor to the site, rather than a nesting resident.

The state-listed species found at PBS include:

- **Endangered:**
  least St. John's-wort (*Hypericum gymnanthum*)
  sedge wren (*Cistothorus platensis*)
  thin-leaf sedge (*Carex cephaloidea*)

- **Threatened:**
  grove sandwort (*Arenaria laterifolia*)
  field sedge (*Carex conoidea*)
  ashy sunflower (*Helianthus mollis*)
  upland sandpiper (*Bartramia longicauda*)

- **Potentially Threatened:**
  prairie false indigo (*Baptisia lactea*)
  broad winged sedge (*Carex alata*)
  round-fruited hedge hyssop (*Gratiola virginiana*)
  tall St. John's wort (*Hypericum majus*)
  Virginia meadow beauty (*Rhexia virginiana*)
  lance-leaved violet (*Viola lanceolata*)

- **Special Concern:**
  Blanding's turtle (*Emydoidea blandingii*)
  Eastern fox snake (*Elaphe vulpina gloydi*)
  smooth green snake (*Opheodrys vernalis*).

The authors of the study indicated that this survey represents data collected for a single survey season only and does not present a comprehensive survey. A drought during the study period also affected the results.

3.3.3 Soils

Based on mapping by the Ohio Department of Natural Resources (ODNR) in cooperation with the U.S. Department of Agriculture (USDA), three soil associations are present at PBOW: The Arkport-Galen Association, the Prout Association, and the Del Rey-Lenawee Association.

The Arkport-Galen Association is characterized by deep, nearly level to moderately sloping, well-drained soils that have a subsoil of loamy fine sand and fine sand, and occur on hills and ridges. These soils are formed in very fine sand deposited by wind and water as beaches, sand bars, and sand dunes. Arkport soils are mostly gently-sloping to moderately sloping and well-drained; they occupy the nearby higher ridges in the county. Galen soils are nearly level, moderately well-drained light-colored soils that formed in water-laid sandy deposits. These soils are found on uplands in all parts of the county. The Arkport Galen Association is made up of about 40% Arkport Soils, 30% Galen Soils, and 30% other minor soils. The soils are productive, and the crops respond well to fertilization. Wind erosion is a hazard in cultivated areas. Low permeability, poor drainage, severe limitation for septic tank absorption fields, and moderate shrink-swell potential are some of the characteristics of the soil association.

The Prout Association is found mostly in the southern portion of PBOW. The Prout series consists of nearly level to gently sloping, dark colored, somewhat poorly drained soils that formed on glacial till or lakebed deposits. The series is made up of about 30% Prout soil, 30% Prout soil deep variant, and 30% Fries soils and other minor soils. Permeability is moderate and surface runoff in these soils are moderate. Because of the high acidity of the soil and a seasonal high water table, productivity of the soils is low to moderate.

The Del Rey-Lenawee association is found in the north central and northwest portions of the site. This association consists of approximately 60% Del Rey soils, 30% Lenawee soils, and 10% other minor soils. Del Rey soils are somewhat poorly drained and light colored. Lenawee soils are nearly level to depressional, very poorly drained, and dark colored. Nearly all of this association is cropland. The soils are productive and crops respond well to fertilization. Poor drainage is the main limitation.

The Lewisburg Series is also seen in scattered parts of the Plum Brook Site. The Lewisburg Series consists of nearly level to gently sloping, light colored, medium-textured, moderately well drained soils that formed in high-lime glacial till. Runoff and permeability are moderately slow. Available moisture capacity is medium. Productivity is moderate if the soils are properly fertilized.

3.3.4 Geology

The site is situated on the glacial lacustrine plain of ancient Lake Maumee. The glacial deposits at PBOW are underlain by a gently eastward-dipping sequence of Paleozoic carbonate and clastic sedimentary rocks ranging in age from Cambrian to Devonian. The Silurian and Devonian formations that outcrop in Erie County are shown in the generalized geologic column provided in Figure 3-2.

Bedrock at PBOW consists of (from oldest to youngest) the Columbus Limestone, the Delaware Limestone, the Prout Limestone/Plum Brook Shale, and the Ohio shale (SAIC 1991). Columbus and Delaware Limestones occur in the western and northern parts of the site, and the Prout Limestone/Plum Brook Shale and the Ohio Shale occur in the southern part. The depth to bedrock across PBOW varies from zero to more than 25 feet, based on data obtained from the few soil borings that penetrated bedrock (MK 1994a).

The Columbus Limestone consists of dolomite and limestone, grading upward from dolomite having little calcium carbonate, to limestone containing 10% to 25% magnesium carbonate. The Delaware formation overlies the Columbus Limestone at the site. The Delaware is fine crystalline, hard, dense, and fossiliferous. The strata are generally uniformly bedded in layers less than one foot thick. Karst topography has selectively developed in some of the Silurian and Devonian carbonate bedrock in the northern and western portion of Erie County, resulting in cavernous porosity in some locations (SAIC 1991).

Overlying the Delaware Limestone is the Plum Brook Shale which in turn is overlain by Prout Limestone. The Prout Limestone is siliceous and hard, while the shale is soft and contains nodules of hard limestone. The shale is low in porosity, while the limestone is massive and moderately porous. Overlying the Prout Limestone is the Ohio Shale, which is black and thinly bedded. The Ohio Shale contains pyrite and abundant bituminous and carbonaceous matter, yielding natural gas in some locations.

3.3.5 Hydrology

This section summarizes the general surface water hydrology and the subsurface hydrogeology at PBOW as interpreted from topographic maps, soil borings, and monitoring wells installed at the site. The hydrologic characteristics unique to each of the AOCs are described in the Sections 2.0 through 14.0 of Part B of this SMP. In addition, a conceptual model of the ground-water system at PBOW is provided in Section 14.6 of Part B.

Age	Formation/Group	Depth to Top (ft)	Thickness (ft)a	Hydrologic Unitb	Rock Description
DEVONIAN	Ohio Shale	*	300	Zone 3	Shale: *black, thin-bedded with bituminous and carbonaceous material*
	Prout Limestone/ Plum Brook Shale	Surface	210		Shale: *light gray, calcareous*
	Delaware Limestone	40	50	Zone 1 and Zone 2	Limestone: *buff, earthy, fossiliferous, interbedded w/brown crystalline dolomite*
	Columbus Limestone	90	110		Limestone: *brown to gray, fine crystalline, fossiliferous, w/tan to buff-gray, partly sandy dolomite at base*
	Lucas Dolomite	200	70		Dolomite: *brown, crystalline, porous, cherty*
SILURIAN	Amherstburg Dolomite	270	20		Dolomite: *tan to gray, microcrystalline, slightly argillaceous*
	Bass Island Dolomite	290	30		Dolomite: *light- to brownish-gray, microcrystalline, w/minor gray or black shale*
	Salina	320	590		Dolomite: *anhydrite and shale sequence. Interbedded and intercalated. Dolomite is tan to brown and mostly tight. Scattered shale laminae. Few scattered oil stains. Some dolomite is shaly. Few massive beds of dolomite and anhydrite*

Notes:

a - Depth to formation, formation thickness, and lithology based on single borehole.

b - Refer to Figure 3-4 for areal distribution of Zones 1, 2, and 3.

* - The Ohio Shale was not encountered in the single borehole; it outcrops in the southeastern portion of the PBOW site.

INTERNATIONAL CONSULTANTS, INC.

FIGURE 3-2
GENERALIZED BEDROCK STRATIGRAPHIC AREA

DATE 15 MAY 95
PREPARED JET
CHECKED SG

3.3.5.1 Surface Water

Numerous ponds (man-made and natural) and streams lie within a 15-mile radius of PBOW. Lake Erie and Sandusky Bay are the largest nearby surface water bodies, located 3.5 miles to the north. The Huron River and its tributaries, located approximately 3.5 miles east of PBOW, are the major streams in the area.

Eleven streams pass through or originate on PBOW property. The streams flow northward and northeastward to converge into Ransom Brook, Storrs Ditch, Plum Brook, and Sawmill Creek, which all flow into Lake Erie. The drainage pattern is dendritic where streams are incised to bedrock; the drainage pattern on glacial deposits is erratic and poorly to moderately developed. Additionally, ditches totaling approximately 380,000 lineal feet are within PBOW (MK 1994a). The streams apparently receive part of their runoff from ground water. All streams may have zero flow in severe winter freezes and extended summer droughts. NASA currently monitors three streams for National Pollutant Discharge Elimination System (NPDES) discharge limits at PBOW: Ransom Brook, Kuebelar Ditch, and Plum Brook.

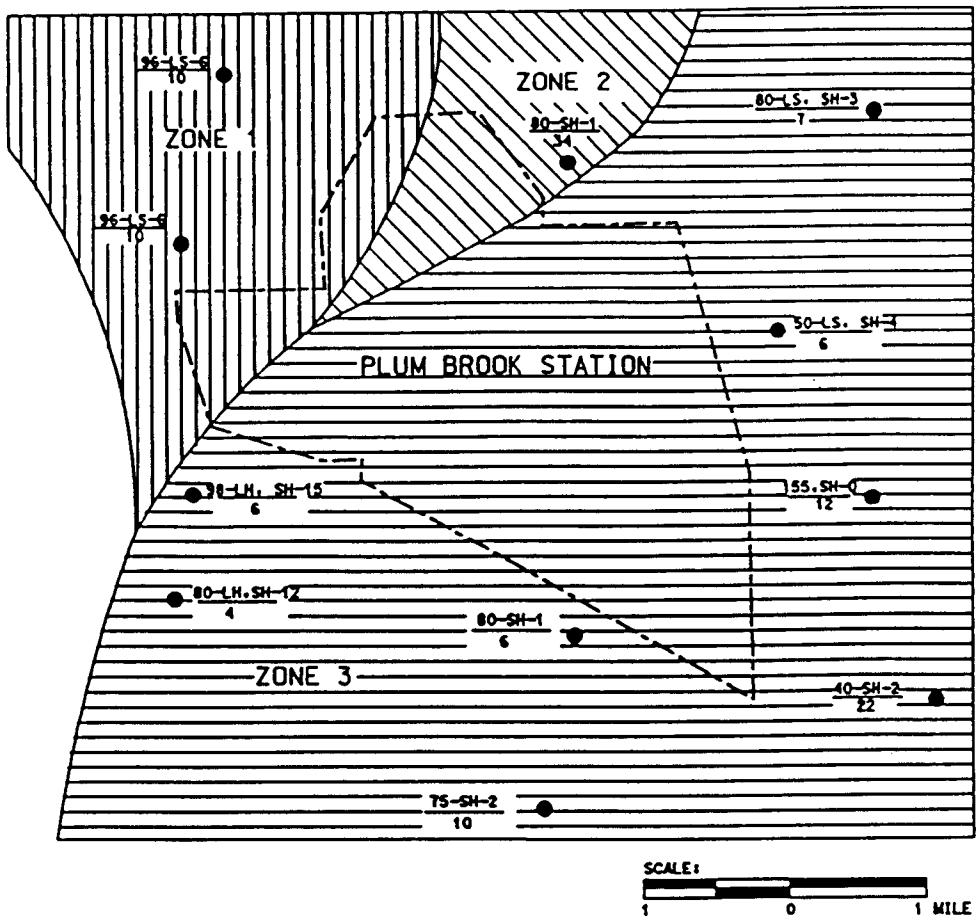
Seventeen isolated ponds and reservoirs, and three red water ponds (Part B Section 3.0), are located on the site. The pond levels generally remain high even during dry months, suggesting that the ponds are fed by shallow surficial ground water.

3.3.5.2 Ground Water

Two principal bedrock aquifers occur in the PBOW area, both of which supply drinking water to portions of Erie County. A highly productive limestone (carbonate) aquifer is used in the western portion of the county, and a poorly productive shale (clastic) aquifer is used to the east. The transition between the western carbonate aquifer and the eastern clastic aquifer occurs beneath PBOW (Figure 3-3). The glacial deposits at PBOW overlie both aquifers (SAIC 1991).

The Ohio Department of Natural Resources (ODNR) mapped three ground-water zones within the principal aquifers based on well yields. These zones are informally referred to as Zones 1, 2, and 3, shown in Figure 3-4. Zones 1 and 2 are developed in the carbonate aquifer, and Zone 3 is in either discontinuous sand and gravel deposits in the glacial till, or in the underlying bedrock shale (SAIC 1991).

Ground water within the carbonate aquifer occurs in a network of interconnected fractures, bedding plane joints, and solution channels. In some instances, dissolution has produced caverns in the limestone at depths of less than 100 feet, providing zones of cavernous porosity with very high ground-water yields (100 to 500 gallons per minute). The yields in the carbonate aquifer are highest to the west and decrease



LEGEND

ZONE 1 — AREAS IN WHICH YIELDS OF 100 TO 500 GALLONS PER MINUTE MAY BE DEVELOPED

ZONE 2 — AREAS IN WHICH YIELDS OF 5 TO 25 GALLONS PER MINUTE MAY BE DEVELOPED

ZONE 3 — AREAS IN WHICH YIELDS SELDOM EXCEED 3 GALLONS PER MINUTE

● Existing Domestic Wells

Depth (ft) — Water bearing formation
75-SH-2 — Yield (gpm)
10 — Depth to bedrock (ft)

SOURCE: Morrison-Knudsen 1994 a

INTERNATIONAL CONSULTANTS, INC.

FIGURE 3-3
REGIONAL WATER-BEARING ZONES IN BEDROCK AQUIFERS

DATE 12 JUL 95
PREPARED JET
CHECKED DBJ

to the east as the transition to the clastic aquifer is approached. The direction of ground-water flow in the carbonate aquifer is to the north to points of discharge in Lake Erie. The clastic aquifer that occurs in the eastern portion of PBOW has low yields because of the fine-grained nature of the shale. Locally, shales outcropping at the surface may be highly fractured from weathering, providing the shale with some capacity to store and transmit water (SAIC 1991).

The thin layer of glacial and lacustrine deposits overlying bedrock is not considered to be a major aquifer, although it does contain discontinuous layers of sand and gravel which may be water-bearing (SAIC 1991). Numerous water-bearing sand lenses have been encountered in the glacial deposits at PBOW at depths of less than 10 feet. Glacial till generally has a low hydraulic conductivity because of the high clay and silt content, making it a poor source of ground water. However, the till has an interconnected network of fractures in places that may enhance its capability for vertical ground-water flow. The sand and gravel lenses in the till may be a source of recharge for bedrock aquifers.

Water level depths encountered in boreholes at the site ranged from less than three feet to greater than 15 feet, with most water levels occurring between five and ten feet below the surface. A number of boreholes drilled at the site did not encounter ground water either because of shallow bedrock or extensive low-permeability layers in the glacial till. The surficial ground water generally flows in a northerly or northeasterly direction (MK 1994a), but local variations are common, especially near surface bodies of water (H^+GCL 1992).

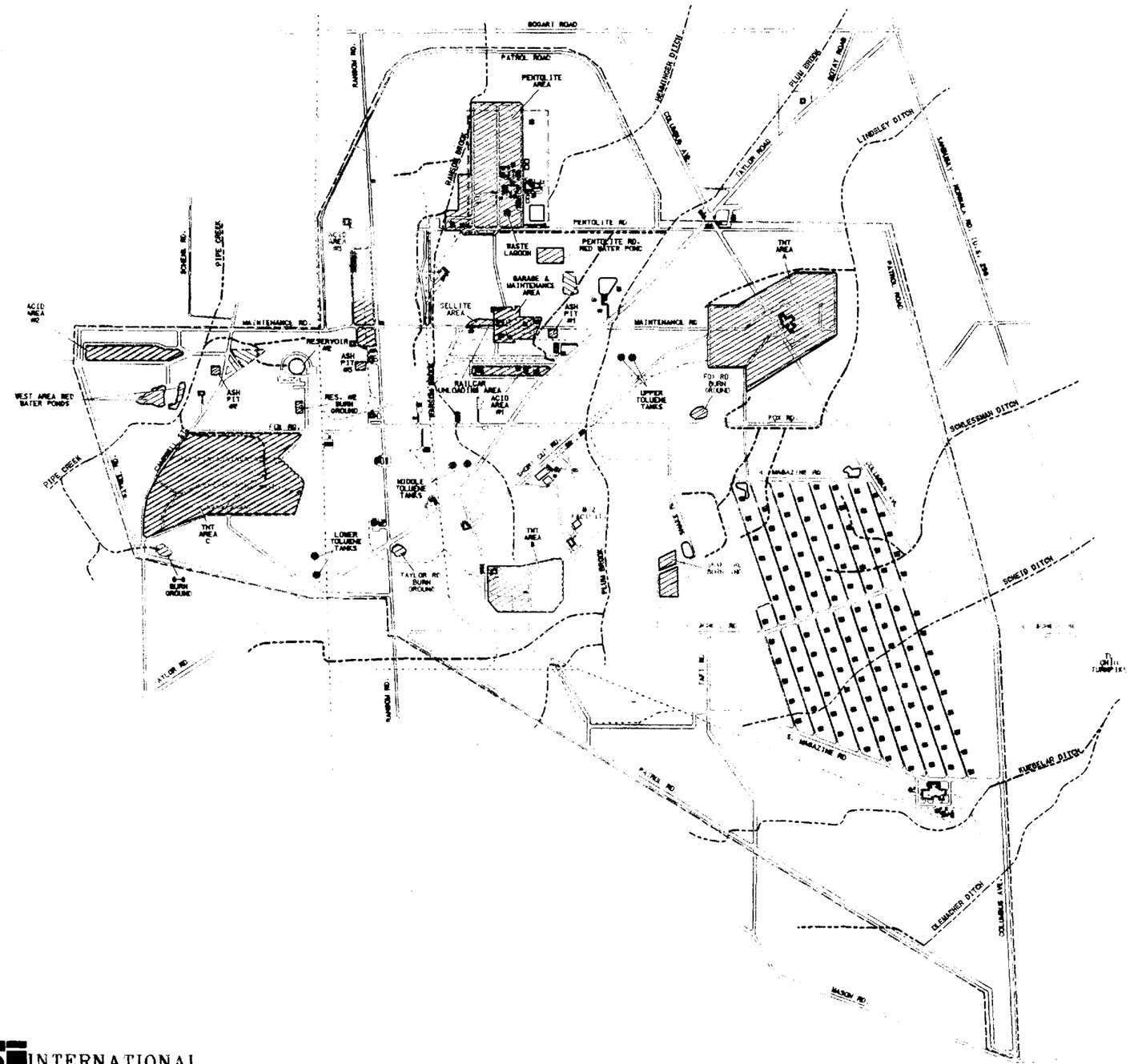
3.4 AREAS OF CONCERN

Areas of potential contamination are scattered over PBOW. These areas have been grouped by similarity of past activity into Areas of Concern (AOCs), shown in Figure 3-4. The following is a brief description of the AOCs at PBOW identified as eligible for inclusion in the DERP-FUDS program. Detailed information on each AOC is available in Part B, Sections 2.0 through 14.0.

3.4.1 TNT Areas

During World War II, the PBOW facility housed operations for the manufacture of TNT and DNT in three primary areas referred to as TNT Areas A, B, and C:

- TNT Area A comprises approximately 113 acres on the east side of PBOW. Engineering Building 7141, presently owned and operated by NASA, is located on the site.



PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

0 500 1000 2000
SCALE IN FEET

LEGEND:
- STREAM
- RAILROAD
- PBS BOUNDARY FENCE
- AREA OF CONCERN
- MIS-LOCATED AOC (Sampled by M-K, 1994a)

INTERNATIONAL CONSULTANTS, INC.

FIGURE 3-4
LOCATIONS of AREAS of CONCERN (AOCs) at PBOW

DATE	12 JUL 95
PREPARED	JET
CHECKED	DBJ

- TNT Area B occupies approximately 48 acres in the southern portion of PBOW. The NASA Hypersonic Tunnel Facility (HTF) is located on the northwest side of the area, and the B2 facility is located immediately northeast of Area B.

- TNT Area C, located on the west side of PBOW, covers approximately 113 acres and does not contain any NASA buildings or facilities.

Between 1941 and 1945, the TNT manufacturing process at PBOW involved approximately 925 million pounds of nitric acid, 63.5 million pounds of sulfuric acid, and over 425 million pounds of toluene for the manufacture of almost 900 million pounds of TNT and DNT (SAIC 1991). The manufacturing process generated waste "red water" as a by-product which has been documented as having caused sizable fish kills and discoloration and pollution of Sandusky Bay (SAIC 1991).

In 1955, preliminary decontamination and decommissioning (D&D) of the TNT areas was initiated. Records indicate that substantial decontamination was performed at TNT Area A (over 16,000 lbs of TNT were removed), but TNT Areas B and C were not decontaminated as thoroughly. Site records do not indicate that other waste disposal activities occurred at the TNT areas either during PBOW operations or following World War II. However, D&D operations and accidental spills, either from PBOW or later activities, may have occurred at these sites.

Based on past site activities, nitroexplosives and residue from the TNT manufacturing process are likely COCs at the TNT areas. A summary of the results of past investigations at the TNT areas is included in Section 4.3.

3.4.2 Red Water Ponds

During operation of the PBOW, process waste water, resulting from one of the final purification steps in the production of TNT, was discharged at the site. This waste water, referred to as "red water" because of its color, was transported to a waste water treatment and incineration area (Waste Water Disposal Plant #1) and discharged, via wooden flumes and elevated discharge pipes, to settling ponds located in two areas of the site:

- West Area Red Water Ponds, consisting of two irregular-shaped ponds referred to as West Pond and East Pond, located on the west side of PBOW. West and East Ponds together have a maximum capacity of 120,000 cubic yards of waste water and are separated by an earthen berm.

- Pentolite Road Red Water Ponds, located in the north central portion of PBOW, originally were approximately 200 ft × 400 ft with a maximum capacity of 182,000 cubic yards of waste water (D&M 1995). The ponds have since been backfilled following a 1977 breach. Retention dikes,

and sump pits were constructed at the site and the surface ditch was diverted to prevent further runoff of the red water.

During the years that NASA operated the site, leakage and seepage has been observed on occasion from the red water ponds. During the latest instances in 1990 and 1991, the Ohio EPA and the National Response Center were contacted and water samples were taken. None of the NPDES limits for outfall 003 (Plum Brook weir) were exceeded as a result of the discharge, but levels of iron, nickel, nitrate, sulfate, and zinc at the discharge were significantly higher than upstream levels. Concentrations of explosives were below the detection limit of the analytical method. The amount of red water released to the pentolite ditch is unknown, but the estimated flow rate during the 1990 release was five gallons per minute (MK 1994a).

3.4.3 Underground Wastewater Flumes

The wastewater disposal systems at TNT Manufacturing Areas A, B, and C were comprised of above- and below-ground wooden flumes. The wooden flumes were used to carry liquid and solid wastes that accumulated in catch basins located at the wash houses at the three TNT areas. Wastes were transported from the catch basins by gravity flow to wooden settling tanks located in the northernmost portion of each TNT area, before being pumped to one of the red water ponds. The Underground Wastewater Flume lines are generally located in:

- TNT Area A along the northern border of the TNT area, near Engineering Building 7141 which currently houses NASA administrative offices. During PBOW operation, the wastewater flumes and sewers from Area A carried liquid and solid waste to the Pentolite Road Red Water Ponds.
- TNT Area B in the northern portion of the area. The waste water from Area B was sent to the Pentolite Road Red Water Ponds.
- TNT Area C in the central and northern portions of the area, where waste water was piped to the West Area Red Water Ponds for disposal.

An estimate of the total piping associated with the flume lines is 20,825 feet of 4-inch pipe; 2,050 feet of 5-inch pipe; 11,250 feet of 6-inch pipe; and 8,875 feet of 10-inch pipe. The wooden flume lines often became clogged with TNT residue, and in some instances were completely plugged. The plugged lines were abandoned, and by-pass lines were constructed around the blocked areas to provide continual drainage of the waste water. Locations of by-pass lines were not documented.

Following World War II, the Army conducted D&D work on many of the buildings and structures associated with the manufacturing of ordnance, including the Underground Wastewater Flumes. The TNT manufacturing areas underwent further decontamination by NASA from 1963 to 1965 and all known flumes were excavated and removed to the burning grounds for destruction. The locations of any remaining flumes at PBOW are unknown. Although a concerted D&D effort was aimed at removing and destroying all of the pipe and flumes, significant lengths of explosives-contaminated flumes may remain at the site (SAIC 1991). NASA has encountered previously unidentified flumes during construction activities at TNT Area A while installing sewer lines along Maintenance Road.

3.4.4 Burn Grounds

During the operation of PBOW, burn grounds were used by the Army for the disposal of explosive manufacturing wastes and out-of-specification ordnance. Five burn grounds have been identified, but it is suspected that other areas at PBOW may also have been used as burn grounds. There has been some disagreement on the location of the five known burn grounds; the following is the most recent description of their locations (D&M 1995):

- Reservoir #2 Burn Ground, located in the northwestern portion of PBOW south of Reservoir #2.
- G-8 Burn Ground, located in the southwestern portion of PBOW near the intersection of Campbell Street and Patrol Road.
- Taylor Road Burn Ground, located approximately 300 feet southeast of Taylor Road and 300 feet east of Ransom Road.
- Snake Road Burn Ground, located in the southern portion of PBOW approximately 800 feet north of the intersection of West Scheid and Snake Roads, occupies an area of approximately 20,000 square feet. The area east of Snake Road was used by the Army between 1941 and 1963 for the destruction of explosives during the D&D of PBOW.
- Fox Road Burn Ground, located in the northeastern portion of PBOW north of Fox Road, was used for the burning of contaminated flume lines and other TNT-contaminated pipes.

The TNT manufacturing facilities were constructed in 1941 and operated until 1945. During this time, the burn grounds were used for destruction of hazardous (off-specification TNT, explosives, acids, and solvents) and non hazardous (asbestos and waste oil) materials. The burn grounds were also used for the destruction of explosives-contaminated waste water flumes, intermediate settling tanks, and catch basins from the TNT areas. Contaminated putty, packing, asbestos insulation removed from buildings, and

excavated contaminated soils from the TNT and pentolite areas were also burned. The quantity of waste destroyed at the burn grounds is unknown.

In 1955, preliminary decontamination and decommissioning (D&D) of the TNT areas was initiated. D&D included removal and relocation of all explosives and materials contaminated with TNT, DNT, pentolite, and asbestos to a burn ground where they were burned.

Before the transfer of property to NASA in 1963, Reservoir #2 Burn Ground and G-8 Burn Ground were decontaminated. The burn grounds located at Taylor Road, Fox Road, and Snake Road have been used in the past by NASA for waste disposal (SAIC 1991). Also, a fire training area was at one time located at the Snake Road Burn Ground (H^+GCL 1992). Hazardous materials disposed in these burn grounds may have included waste oils, solvents, and other chemicals. A fire at the Snake Road Burn Ground in 1973 may have been caused by the spontaneous combustion of chemicals and oils dumped together (SAIC 1991).

3.4.5 Waste Lagoons

Pentolite was manufactured at PBOW from March 1943 through August 1945. Wastewater generated from this process likely contained substantial concentrations of PE, PETN, TNT, and acetone (SAIC 1991). The wastewater was disposed in two waste water lagoons, or settling basins, located in the former pentolite dry storage area in what is now a grassy area north of Pentolite Road and south of the reactor facility, within the fenced area enclosing the reactor site (SAIC 1991). The lagoons were constructed of precast concrete blocks with asphalt-filled expansion joints placed on 4 to 6 inches of gravel or #4 stone (SAIC 1991). Each lagoon basin measured approximately 100 feet by 140 feet (D&M 1995). No information is available on the amount of waste water generated, the disposal of sludge, or the volume of waste water treated. Because the lagoons were removed and the pentolite area was graded for construction of the Plum Brook Reactor Facility (PBRF), the lagoons do not appear on current PBOW maps.

In 1956, the Pentolite Area, including the area of the Waste Lagoons, was selected by NASA as the site for the construction of the PBRF. The entire Pentolite Area was graded to meet reactor site specifications, and lagoon-contaminated soil was probably removed or dispersed during construction.

3.4.6 Ash Pits and Power Plants

During the operational period of PBOW, ash pits served as disposal areas for fly ash and ash generated from the burning of coal at on-site power plants. There were three power stations at PBOW corresponding to Power and Maintenance Areas 1, 2, and 3. Fly ash generated from each of the boilers in the power house collected in pits. Water was added to the ash and the water-ash slurry flowed through a sluice trench to the ash sump located at the end of the building. From the ash sump, the ash traveled through a pipeline to a nearby surface impoundment (ash pit) (D&M 1995):

- Ash Pit #1, associated with Power Station #1 (Building 201), is located south of Maintenance Road and north of the railroad tracks and the power house building (D&M 1995).

- Ash Pit #2, associated with Power Station #2 (Building 501), is located west of Campbell Street, across the street from the power station. It is rectangular in shape and covers approximately 8,000 square feet. Waste Water Disposal Plant #2, also associated with Power Station #2, is located west of Ash Pit #2 opposite Pipe Creek.

- Ash Pit #3, associated with Power Station #3, is located west of Ransom Road and south of Maintenance Road. Historical records indicate that the ash pit was a bermed square-shaped depression occupying an area of approximately 7,500 square feet (D&M 1995). NASA's K Site Test Facility was constructed at the site of Power Station #3.

Other potential sources of contamination related to the former power stations include releases from the below-grade fly ash sumps located at each power house, the above ground fuel storage tanks, and the coal storage yards (D&M 1995).

3.4.7 Toluene Tank Areas

During the active period of PBOW, six toluene storage tanks served as bulk storage for toluene used in the production of TNT. Each TNT production area had two above-ground toluene tanks of 200,000-gallon capacity each:

- Toluene Tanks 255 and 265, referred as the "Upper Toluene Tanks," supported TNT Area A during the operational period of PBOW. They are located west of TNT Area A and Short Cut Road and south of Maintenance Road. The tanks are encircled by earthen dikes approximately 6 feet high. NASA renumbered these tanks as Tank 8951 (Tank 265) and Tank 8952 (Tank 255) and used them for fuel oil storage.

- Tanks 425 and 435, also known as the "Middle Toluene Tanks," supported TNT Area B during ordnance production. They are located northwest of TNT Area B near Taylor Road, and are currently empty.

- Tanks 645 and 655, or the "Lower Toluene Tanks," supported TNT Area C during PBOW operations. They are located southeast of TNT Area C near the intersection of Patrol Road and Taylor Road. Tank 645 was moved by NASA to the Reactor Area for fuel oil storage (MK 1994a).

The tanks were decommissioned in 1945 by pumping out their contents, draining the transfer lines, and opening top and bottom flanges for ventilation.

In January 1989, there was a leak reported from Tank 8951 (formerly 265) which originally (in 1976) contained approximately 185,000 gallons of heating oil. The area around the tank was discolored, a fuel oil odor was noticed, and fuel oil seepage was observed on the eastern side of the tank. Six to eight inches of affected soil and vegetation were removed from the contaminated area and taken to a burn ground for incineration. Approximately 230 gallons of fuel oil and sludge were removed from the bottom of the drain valve and absorbent matting was used to soak up oil which seeped from underneath the tank. It was believed that the seepage was contained within the berm (D&M 1995).

3.4.8 Rail Car Unloading Area/Sellite Area

The Rail Car Unloading Area, near the Garage and Maintenance Area on the north side of Maintenance Road between Ransom Road and Taylor Road, may have been used principally for unloading of toluene and other chemicals from rail cars. It is estimated that more than 400 million pounds of toluene may have been unloaded at this site during the PBOW operational period.

The Sellite Area, located west of the Rail Car Unloading Area, was used for the production and storage of sellite used for the TNT washing process (D&M 1995). Extensive areas of bare soil and pieces of sulfur and slag were observed at the former Sellite Area during field reconnaissance by Dames & Moore (1995). A shallow surface ditch which received runoff from the Sellite Area is located east of the Sellite Area (D&M 1995).

The decommissioning of the Rail Car Unloading Area was begun in 1945 when ordnance manufacturing ceased. No other post-operational activities are known to have occurred in this area. However its proximity to the Garage and Maintenance Area may have led to its informal use for staging of equipment and supplies.

3.4.9 Acid Areas

During the operation of PBOW, acid areas were used by the Army for the manufacturing of nitric and sulfuric acids used in various stages of the manufacture of TNT and pentolite. Three areas of acid manufacturing have been identified at PBOW, referred to as Acid Area #1, Acid Area #2, and Acid Area #3. Acid Area #1 is located in the central portion of PBOW, south of the Garage and Maintenance Area. Acid Area #2 is located in the westernmost portion of PBOW, south of Maintenance Road and just east of Patrol Road, northwest of Pipe Creek. Acid Area #3 is located in the northwestern portion of PBOW, along Ransom Road north of Maintenance Road. Each acid area is roughly rectangular in shape and cover an area of approximately ten acres.

3.4.10 Pentolite Area

During the operation of PBOW, the Pentolite Area was used by the Army for the manufacturing of pentolite. Pentolite was produced from March 1943 through August 1945 when PBOW ceased operation (D&M 1995). The site is located in the north-central portion of PBOW, and lies within the boundaries of Ransom Road on the west, Pentolite Road on the south, and Patrol Road on the north and east. The exact size and shape of the site has not been determined.

The Pentolite Area was the only area at PBOW used for the production of pentolite. The area contained three pentolite lines with a designated capacity of 7,000 pounds per 24 hours. Two basins received wastewater generated during pentolite production. The volume of wastewater, specific treatment details, and sludge details are not known (D&M 1995). The PA conducted by SAIC (1991) indicates that the wastewater generated during the manufacturing of pentolite probably contained significant concentrations of PE, PETN, acetone, and TNT.

The decommissioning of the Pentolite Area was begun in 1945 when ordnance manufacturing ceased. All buildings in the Pentolite Area were removed or burned in place (D&M 1995). In 1956, the Pentolite Area was selected by NASA as the site for the construction of the PBRF. The entire pentolite area was graded to meet reactor site specifications, and potentially contaminated soil was removed to an unknown location or dispersed during construction.

3.4.11 Garage and Maintenance Area

During the operation of PBOW, the Garage and Maintenance Area was likely used by the Army for the general maintenance of equipment and vehicles. Underground storage tanks (USTs) were installed in this

area for the storage of gasoline, solvents, and waste oil (SAIC 1991). These USTs have subsequently been removed. The Garage and Maintenance Area was operational between 1941 to 1945, becoming decommissioned when PBOW ceased operations. The site is located in the central portion of PBOW along Maintenance Road.

The Garage and Maintenance Area is currently used in support of NASA activities. Additional USTs were installed at this site in 1964 and 1982 for the storage of solvents and diesel fuel. These USTs have also been removed. Two USTs were installed by NASA in this area during 1990 for the storage of gasoline and diesel fuel, and are currently operational.

3.4.12 TNT Rail Car Loading Areas

During the operation of PBOW, TNT was loaded onto rail cars for shipment from the site to storage areas on the site. The locations of these TNT Rail Car Loading Areas are unknown, and reference to them has not been found in site documents. However, it is suspected that there was a loading area at each of the TNT manufacturing areas, located along now-abandoned rail spurs. The presence of the remnants of blast-protection walls adjacent to abandoned rail tracks at the southern end of TNT Area B suggests this as a possible location of a TNT Rail Car Loading Area. Construction of facilities in support of NASA activities may have altered or removed the loading areas, particularly at TNT Area A.

3.4.13 Sitewide Ground Water

The potential for ground-water contamination exists at PBOW, although ground-water contamination has not been documented at the site. Ground-water contamination may have resulted from activities related to the operation of PBOW as well as later activities.

The manufacturing and storage of acid and the storage and transport of process chemicals, including toluene and acetone, occurred at PBOW in support of the ordnance manufacturing. In addition, waste "red water" was transported via buried pipelines and flumes to treatment facilities, and from there to waste "red water" ponds for long-term storage. The possibility of spillage or leakage during storage, transport, and manufacturing of chemicals, wastes, and ordnance may have contributed to the contamination of ground water at the site. In addition, D&D activities may have contributed to ground-water contamination at the site.

4.0 SUMMARY OF PREVIOUS ENVIRONMENTAL INVESTIGATIONS

This section presents a description of previous, current, and planned investigations at PBOW. Included are: site investigations, feasibility studies, remedial actions, wetlands assessments, and others, as applicable.

4.1 PREVIOUS INVESTIGATIONS

There have been several major investigations performed at PBOW: preliminary assessments by OEPA and SAIC; an environmental assessment by the Ohio National Guard; a contamination evaluation by IT Corporation; an environmental investigation by H^+GCL; a site investigation by Morrison Knudsen; an environmental study by Warner/Osborn/Pardee; and a records review report conducted by Dames & Moore. In addition, USEPA reviewed PBS for NASA in 1994 and made a determination of "No Further Remedial Action Planned". Specific locations for wells and sampling points can be found in the AOC-specific sections of Part B (Sections 2.0 through 14.0).

4.1.1 Ohio Environmental Protection Agency (OEPA), Preliminary Assessment, 1983

OEPA conducted a preliminary assessment (PA) at PBOW in 1983. The purpose of this PA was to investigate the red water ponds and the 1981 spill of polychlorinated biphenyls (PCBs) (D&M 1995).

4.1.2 Ohio Army National Guard, Environmental Assessment

The Ohio Army National Guard (OHANG) initiated and conducted an environmental assessment (EA) of PBOW in the 1980s to gather information concerning potential contamination at the West Area Red Water Ponds prior to a land transfer from NASA to the OHANG. Soil, sediment, and water samples from the West Area Red Water Ponds were collected and analyzed for TNT; PETN; 2,4-DNT; 2,6-DNT; and metals. The average values of TNT and DNT detected in the sediment samples were 0.32 ppm and 0.01 ppm, respectively. Lead was detected in these sediments above background. No contamination of Pipe Creek, either upstream or downstream of the West Area Red Water Ponds, was indicated (D&M 1995).

4.1.3 Warner, Osborn, Pardee, Environmental Resources Document, 1990

This report was prepared as partial fulfillment of NASA's NEPA requirements. The document describes environmental resources at the Lewis Research Center Cleveland Site and at Plum Brook Station including land, air, and water resources; noise; biotic resources; floodplains and wetlands; solid and hazardous waste management; historic resources; socioeconomics; utilities; and transportation.

4.1.4 IT Corporation, Contamination Evaluation, 1991

A contamination evaluation was conducted by IT Corporation (1991), contracted to the USACE Nashville District, to review records and perform evaluations, visual site inspections, and field investigations of Pentolite Road Red Water Ponds, West Area Red Water Ponds, Snake Road Burn Ground, and Taylor Road Burn Ground. IT installed four ground-water monitoring wells: IT-MW-01, IT-MW-02, IT-MW-05, and IT-MW-06. The wells were designed to intercept ground water influenced by percolation from red water retention ponds; monitor the quality of ground water migrating toward the site boundary; and provide background control. Twenty-one soil samples were collected for chemical analysis from specific areas targeted as having potential for contamination associated with the operation, maintenance, and deactivation of the site. One upgradient soil boring (IT-SB-19), located at the southern extreme of PBOW was collected to determine background concentrations of compounds at the site. Samples were analyzed for VOCs, SVOCs, nitroaromatic compounds, nitrates, sulfates, pH, and metals. Additional soil samples were collected for geotechnical analysis.

Results of analytical testing indicated no soil or ground-water contamination from VOCs. Nitroaromatic compounds were detected in the soil at Waste Disposal Area 1 (Pentolite Road Red Water Ponds) and at the Scheid Road Burn Ground (Snake Road Burn Ground). Elevated metals (sodium and manganese) were detected in soils at Waste Disposal Area 1 and Waste Disposal Area 2 (West Area Red Water Ponds). Chromium was detected in the ground water at Waste Disposal Area 2. Sulfates and nitrates were also detected at elevated levels at Waste Disposal Areas 1 and 2. Surface water samples were found to be free from contamination with the exception of small amounts of butyl benzyl phthalate, some metals, and nitrates in isolated samples.

4.1.5 Science Applications International Corporation (SAIC), Preliminary Assessment, 1991

A Preliminary Assessment was conducted by SAIC for NASA in 1991 to evaluate past waste management and hazardous materials handling practices, and to identify potential sources of environmental contamination. SAIC identified 14 locations (referred to in the report as operable units) which may have

experienced environmental contamination either during PBOW or during NASA's operations. The PBOW locations studied under this PA included:

- Pentolite Road and West Area Red Water Ponds
- TNT Areas A, B, and C
- Underground Wastewater Flumes
- Five burn grounds: Burn Ground #1, Burn Ground #2, Fox Road Burn Ground, Taylor Road Burn Ground, and Snake Road Burn Ground.
- Waste Lagoons
- Ash Pits #1 and #3
- Rail Car Unloading Area/Sellite Area
- Upper, Middle, and Lower Toluene Tanks.

COCs identified by SAIC were primarily nitroaromatics, heavy metals, acetone, methylene chloride, bisphthalate, solvents, petroleum hydrocarbons, and asbestos, as described in detail in Part B.

4.1.6 EBASCO, Underground Storage Tank Corrective Actions Remedial Investigation/Feasibility Study, 1991

The primary objectives of the investigation were to compile all available data for each of the four NASA underground storage tank areas (UST Areas); determine the contaminants at each UST Area; determine which constituents were logically and physically linked to the reported contents of former USTs; and identify the pathways by which any residual contaminants could spread. The presence or absence of contaminants at each UST Area was to be documented to enable the design of a targeted analytical program for any future characterization that may be required.

4.1.7 H+GCL, Environmental Investigation, 1992

H+GCL conducted an environmental investigation of Snake Road Burn Ground for NASA in 1992. The investigation was conducted to characterize possible ground-water and surface water contamination due to the use of this area as an uncontrolled burn ground. A total of nine soil borings were drilled, four of which were completed as monitoring wells. The soil samples were analyzed for VOCs, SVOCs, herbicides, pesticides, PCBs, total mercury and lead, TNT, DNT, cyclotrimethylene trinitramine (RDX), cyclotetramethylene tetranitramine (HMX), TCLP metals, TPH-(G), and TPH-(D). The soil samples contained low levels of VOCs, SVOCs, and TPH; however, soil samples from the background location established for the investigation also had low levels of SVOCs, TPH, and acetone. Ground-water samples contained very low concentrations of benzene, chromium, lead, silver, and zinc. Nitroaromatics,

pesticides, and herbicides were not detected in any of the soil samples analyzed during this field investigation.

4.1.8 Morrison Knudsen, Site Investigation, 1994

In 1994, Morrison Knudsen (1994a) conducted a site investigation (SI) of PBOW, under contract to NASA, to collect information concerning conditions at the facility sufficient to assess the threat posed to human health and the environment and to determine the need for any additional investigation. This investigation included reviewing previous information, sampling environmental media, evaluating hazard ranking system (HRS) factors, and gathering additional site information. PBOW was divided into five project management units (PMUs) designed to characterize the potential sources of environmental contamination.

Sediment, surface soil, subsurface soil, surface water, and ground-water samples were collected from the PMUs and were analyzed for VOCs, SVOCs, heavy metals, pesticides, PCBs, and nitroaromatic compounds. Sample analysis identified limited contamination in several areas of the site.

4.1.9 Dames & Moore, Records Review Report, 1995

Dames & Moore (1995), under contract to USACE Nashville District, conducted a records and historical document review and compiled a report detailing PBOW operations. Site documents, photographs, aerial photographs, and past environmental investigation reports were reviewed. Information based on personal interviews with past and present PBOW and NASA-PBS employees was also included in this report.

4.1.10 Bionetics Corporation, Species Survey, 1995

A species survey was conducted on PBS for NASA in 1995 which was designed to identify plant species, breeding birds, reptiles and amphibians, fish and lepidoptera (butterflies and moths) (Bionetics 1995). The primary emphasis was on identification of any federal or state-listed species occurring on the facility. All species encountered during the survey were identified. The only federally-listed species observed during the survey was the bald eagle (*Haliaeetus leucocephalus*). A number of state-listed species were also found at PBS. The authors of the study indicated that this survey represents data collected for a single survey season only and does not present a comprehensive survey. A drought during the study period also affected the results.

4.2 CURRENT AND FUTURE INVESTIGATIONS

An environmental investigation is underway for the TNT areas and the red water ponds to determine the nature and extent of contamination in these areas (D&M 1994). Sample locations were chosen in the TNT area where there is a high probability of contamination, based on the locations of buildings and process lines. Twenty-six shallow subsurface sampling locations have been collected at each TNT area, and analyzed for metals and nitroaromatic compounds. Shallow monitoring wells also were installed at the TNT areas: two at TNT Area A, one at TNT Area B, and four at TNT Area C. Ground water was tested for nitroaromatics, total metals, and dissolved metals. Eight new bedrock wells were also installed at various locations at PBOW. The bedrock ground-water samples have been tested for VOCs and SVOCs in addition to the parameters for the shallow wells. Sediment sampling in ditches in TNT Area C was also conducted. The results of the analyses are forthcoming.

Extensive sampling and analysis of soils and sediments for nitroaromatics and metals was conducted for both red water pond areas. Surface water samples were collected and analyzed for nitroaromatics, total suspended solids, total metals, dissolved metals, and biological activity. Two additional shallow monitoring wells and one bedrock were installed at the West Area Red Water Ponds, and three new shallow wells at the Pentolite Road Red Water Ponds. Ground water was tested for nitroaromatics, total metals, and dissolved metals. Bedrock ground-water samples were tested for VOCs and SVOCs. The analytical results of these investigations are also forthcoming.

4.3 REVIEW OF AVAILABLE BACKGROUND DATA

Background chemical analytical values for COCs in various media for PBOW in general have not yet been determined. Background samples have been collected in all sampling media at PBOW, but only at a few locations. Monitoring well IT-MW-01 in the south-central part of PBOW may be suitable for background for the PBOW site as a whole. The following sections provide information on sampling locations from previous investigations that may be suitable for ground-water background for specific AOCs.

4.3.1 TNT Areas

Monitoring well MK-MW-24 is located south (upgradient) of TNT Area A (MK 1994a) and may serve as background at this location. Monitoring well MK-MW-16 was installed south (upgradient) of TNT Area B, and may serve as a background location for ground water at this location. Background sampling sites have not been identified for TNT Area C.

4.3.2 Red Water Ponds

Monitoring well MK-MW-12 was installed upgradient from the West Area Red Water Ponds and can serve as a background well for that site. Background locations specific to the Pentolite Road Red Water Ponds have not been established.

4.3.3 Underground Wastewater Flumes

Monitoring well MK-MW-24 is located south (upgradient) of TNT Area A (MK 1994a) and may serve as a background location for this TNT area and its associated wastewater flumes. Monitoring well MK-MW-16, installed south (upgradient) of TNT Area B (MK 1994a), may serve as a background location for the wastewater flumes in this TNT area. Additional background sampling sites for the flume areas have not been identified.

4.3.4 Burn Grounds

Monitoring well IT-MW-01 (IT 1991a) is upgradient of Taylor Road Burn Ground and can serve as a background well for this site. Based on the water table map of Snake Road Burn Ground (H^+GCL 1992), monitoring well GCL-MW-01 is located upgradient of this site and can be used for local soil and ground-water background data.

4.3.5 Waste Lagoons

Monitoring well EB-RA-01 was installed south (upgradient) of the Waste Lagoons and may serve as a background reference for ground water at this location.

4.3.6 Ash Pits and Power Plants

There are no monitoring wells or sample locations that can be used as background for the Ash Pits.

4.3.7 Toluene Tank Areas

There are no monitoring wells or sample locations that are suitable for background for the toluene tank areas.

4.3.8 Rail Car Unloading Area/Sellite Area

There are no monitoring wells or sample locations that are suitable for background for the Rail Car Unloading Area/Sellite Area.

4.3.9 Sitewide Ground Water

Background chemical analytical values for COCs in ground water for PBOW have not yet been established. Two monitoring wells, IT-MW-01 (IT 1991a) and MK-MW-16 (MK 1994a), were installed near the southern boundary of the site to serve as background wells for PBOW in general, but additional sampling points are needed to establish background values with statistical validity.

4.3.10 Acid Areas

There are no monitoring wells or sample locations that are suitable for background for the acid areas.

4.3.11 Pentolite Area

Monitoring well EB-RA-01 (EBASCO 1991) was installed south of the Waste Lagoons and may serve as a background well for the Pentolite Area.

4.3.12 Garage and Maintenance Area

There are no monitoring wells or sample locations that are suitable for background for the Garage and Maintenance Area.

4.3.13 TNT Rail Car Loading Areas

There are no monitoring wells or sample locations that are suitable for background for the TNT Rail Car Loading Areas.

4.4 CURRENT STATUS OF SITE CHARACTERIZATION

The nature and extent of contamination at PBOW has been evaluated to a limited extent in past investigations. The results are summarized here. Tables 4-1 through 4-4, at the end of this section include summary information on sampling results for sediments, surface soils, subsurface soils, and ground water,

respectively. The analytes listed in the table were included because each was detected in at least one sample at PBOW. The values indicated in the tables are the maximum values found during analyses. Gray areas on the tables indicate those AOCs for which no sampling in that particular medium has been conducted. Sediment sampling results have been assigned to the upstream AOC closest to the sampling point. However, the sediment sampling points could contain contamination from any upstream source, including off-site sources. Surface soil samples were taken from the upper 6 inches of soils. Detailed information is available in Sections 2.0 through 14.0 of Part B of this SMP.

4.4.1 TNT Areas

The presence of contamination at the TNT areas has been investigated to a limited extent in the Site Inspection conducted by Morrison Knudsen (1994a), the results of which are summarized here for each of the TNT areas.

4.4.1.1 TNT Area A

Two sediment and two surface water samples were collected in Lindsley Ditch adjacent to TNT Area A. Organic compounds were not detected in the surface water samples, but low levels of VOCs and pesticides were found in the sediments. Both sediment samples contained minor acetone and SVOCs (particularly PAH), and low levels of DDT and dieldrin were detected in both sediment samples. One sediment sample contained minor methoxychlor, a pesticide.

A single surface soil sample was collected in the southwestern corner of TNT Area A near a railroad spur. Chemical analysis did not reveal the presence of COCs in this sample.

Subsurface soil samples were collected from the upper two feet of soil borings. Only minor SVOCs (primarily PAH) were detected in two of the three borings.

Morrison Knudsen installed three wells in TNT Area A (MK 1994a). Analyses performed on groundwater samples from these wells detected only 22 µg/ℓ of bis(2-ethylhexyl)phthalate, in MK-MW-24.

4.4.1.2 TNT Area B

One sediment and one surface water sample were collected near the origin of Ransom Brook immediately north of TNT Area B. This sampling point is near a former location of a TNT storage facility and is considered to be a possible point of entry for surface water contaminants. Organic compounds were not

detected in the surface water, however, the sediment sample contained acetone, SVOCs, and 2,4,6-TNT (25,000 ppb).

One surface soil sample was collected near the location of a trough used to carry TNT product to the storage areas. Minor amounts of toluene (33 ppb) were detected in this sample.

The upper two feet of soil was collected for analysis in two soil borings. Morrison Knudsen (1994a, Figure 4-2) indicated both 2,4,6-TNT (12,000 ppb) and 2,6-DNT (60 ppb) were detected in one.

Two monitoring wells were installed adjacent to TNT Area B. Morrison Knudsen (1994a, Figure 4-2) reported the presence of bis(2-ethylhexyl)phthalate at a concentration of 12 ppb in the well located north (downgradient) of the area. This well corresponds to the soil boring in which nitroaromatic compounds were detected.

4.4.1.3 TNT Area C

Sediment and surface water samples were collected just downstream of the confluence of Pipe Creek and a small tributary just north of TNT Area C. The sampling point was considered the most likely point of entry of contaminants to the stream from this area. Organic compounds were not detected in the surface water sample, and only minor SVOCs (PAH) were detected in the sediment sample from this location.

Three surface soil samples were collected in and around TNT Area C. The analyses of these samples detected very low quantities of toluene, and one contained minor concentrations of SVOCs (PAH).

There have been no subsurface soil investigations or ground-water monitoring wells located at or near TNT Area C.

4.4.2 Red Water Ponds

A number of studies have been conducted on the surface water and sediments of the two red water pond areas. Each of the pond areas is discussed separately here.

4.4.2.1 West Area Red Water Ponds

Three surface soil samples were collected north of the West Area Ponds at a lime sludge disposal area. No VOCs were detected in the surface soil samples, however several SVOCs were found, primarily coal

tar derivatives and PCB's. In 1984, a surface soil sample from the spoils area at West Pond had concentrations of 0.2 ppm of 2,4-DNT and 13.6 ppm of 2,6-DNT (OHARNG 1984). Because new techniques and methods for nitroaromatics analyses have been in place since 1991, these soil and sediment results may not be comparable with more recent information.

Subsurface soil samples were collected for analysis in the vicinity of the West Area Red Water Ponds and were analyzed for VOCs, SVOCs, total metals, total sulphate, nitrates, pH, and nitroaromatic compounds. Nitroaromatic compounds were detected in only minor quantities, a manganese concentration (2,600 ppm) significantly higher than the background sample was detected, sodium concentrations in two samples were significantly above the measured background levels, and elevated sulfate and nitrate values were detected.

In the West Area Red Water Ponds, 34 bottom sediment samples were collected in a grid pattern from West Pond by Ohio National Guard environmental health personnel, and screened for TNT and DNT derivatives (Burgess and Niple, Ltd. 1985). Average values of TNT and DNT in the sediments were 0.0374 ppm and 0.0018 ppm, respectively. Lead was also detected in these sediments at a concentration slightly above background. Morrison-Knudsen (1994a) analyzed surface water and sediment samples from Pipe Creek near the West Area Red Water Ponds. Samples were analyzed for VOCs, SVOCs, and nitroaromatics. Only minor SVOCs were detected.

One ground-water monitoring well was installed at the West Area Red Water Ponds. Ground-water samples were analyzed for VOCs, SVOCs, total metals, total sulfate, nitrates, pH, and nitroaromatic explosive compounds. Acetone in small amounts, and significant concentrations of 2,6-DNT, were detected in the ground water during two separate studies. Elevated chromium concentrations and elevated sulfate concentrations were also detected.

4.4.2.2 Pentolite Road Red Water Ponds

In 1977, a thin layer of salt-like crystalline material on the soil at the Pentolite Road Ponds Area was collected by NASA laboratory personnel. Analysis indicated high levels of sulfate concentrations, interpreted as sodium sulfate from the neutralization of waste acid (D&M 1995).

Morrison-Knudsen (1994a) analyzed surface water and sediment samples from a drainage ditch along Pentolite Road, north of the Pentolite Road Pond area. Samples were analyzed for VOCs, SVOCs, and nitroaromatics. No samples from the Pentolite Road ditch showed detectable levels of contaminants.

Subsurface soil samples were collected for analysis in the vicinity of the Pentolite Road Red Water Ponds. The soil samples were analyzed for VOCs, SVOCs, total metals, total sulfate, nitrates, pH, and nitroaromatic compounds. The analyses revealed concentrations greater than or equal to 740 ppb of 2,6-DNT and 2,4-DNT. Some sodium concentrations were also significantly above the measured background levels.

One monitoring well was installed at the Pentolite Red Water Ponds Area (IT 1991a). Ground-water samples were analyzed for VOCs, SVOCs, total metals, total sulfate, nitrates, pH, and nitroaromatic compounds. The well was also sampled during the Site Inspection conducted by Morrison-Knudsen (1994a). Only minor acetone and SVOCs were detected in the ground-water samples.

4.4.3 Underground Wastewater Flumes

The Underground Wastewater Flumes are located within the TNT areas. The status of site characterization of the flume areas is the same as their respective TNT areas, which are discussed in Section 4.4.1.

4.4.4 Burn Grounds

Several of the burn grounds have been investigated in independent studies at PBOW. IT Corporation (1991a) examined Taylor Road and Snake Road Burn Grounds; H^{+}GCL (1992) investigated Snake Road Burn Ground; and Morrison Knudsen (1994a) sampled G-8 and Fox Road Burn Grounds. In addition, Morrison Knudsen (1994a) sampled sediment and surface water in a tributary of Pipe Creek downstream from the location believed to be "Burn Ground #1." However, this location for Reservoir #2 Burn Ground is believed to be incorrect (D&M 1995). Each of the sites currently accepted as burn grounds is discussed in this section.

4.4.4.1 Reservoir #2 Burn Ground

No sediment, surface water, surface soil, subsurface soil, or ground-water samples have been taken at Reservoir #2 Burn Ground.

4.4.4.2 G-8 Burn Ground

One sediment and one surface water sample were collected at the head of a small stream which feeds Pipe Creek in the southwest corner of G-8 Burn Ground. Minor quantities of SVOCs (PAH) were detected in the sediment sample but not in the surface water.

Two surface soil samples were collected at G-8 Burn Ground (MK 1994a). Samples were analyzed for VOCs, SVOCs, total metals, total sulfate, nitrate, pH, and nitroaromatic explosive compounds. Minor SVOCs were detected in only one sample.

No subsurface soil samples have been collected at the G-8 Burn Ground.

No monitoring wells have been installed at the G-8 Burn Ground.

4.4.4.3 Taylor Road Burn Ground

No sediment, surface water, or surface soil samples have been taken from the Taylor Road Burn Ground.

Subsurface soil samples were collected from two soil borings at the Taylor Road Burn Ground (IT 1991a). The samples were analyzed for VOCs, SVOCs, total metals, sulfate, nitrates, pH, and nitroaromatic compounds. Methylene chloride was detected in one sample; bis(2-ethylhexyl)phthalate concentrations ranged between 380 and 1200 ppb in one sample; and arsenic, barium, chromium, iron, lead, manganese, and sodium were detected above background levels.

No monitoring wells have been installed at the Taylor Road Burn Ground.

4.4.4.4 Snake Road Burn Ground

No sediment, surface water, or surface soil samples have been taken from the Snake Road Burn Ground.

Subsurface soil samples were collected from two soil borings at the Snake Road Burn Ground (IT 1991). The samples were analyzed for VOCs, SVOCs, total metals, sulfate, nitrates, pH, and nitroaromatic compounds. Acetone was detected in two samples at more than 2,000 ppb; methylene chloride was detected in two samples at 8 ppb to 10 ppb; bis(2-ethylhexyl)phthalate ranged between 380 and 1200 ppb in four samples; a concentration of 0.093 ppm of 1,3,5-trinitrobenzene was detected in one sample; and arsenic, barium, chromium, iron, lead, manganese, and sodium were detected above background levels.

Subsurface soil samples were also collected at Snake Road Burn Ground for the Phase I site characterization conducted by H^{+}GCL (1992). A total of nine soil borings were drilled for this investigation and analyzed for VOCs, SVOCs, PCBs, pesticides, herbicides, TPH (gasoline and diesel), TCLP metals, and nitroaromatic compounds. The following is a brief description of the results:

- Low levels of acetone, 1,1-dichloroethane, 1,1,1-trichloroethane, and 2-butanone were detected in three soil borings.

- Eight SVOCs were detected at levels below the quantitation limit. Of these eight compounds, three (2-methylnaphthalene, phenanthrene, and naphthalene) were detected in more than half the samples.

- Bis(2-ethylhexyl)phthalate was detected in one boring at 220 µg/kg.

- The analytical results for TCLP metals in soil were below the RCRA TCLP thresholds for characterizing hazardous waste.

- The TPH (gasoline) results ranged from 0.6 to 14 mg/kg, and TPH (diesel) concentrations were below detection limits in all but one sample (86 mg/kg). The recommended action level for petroleum-based contamination in soils in Ohio is 1 mg/kg or background.

- PCBs were detected in two samples(980 µg/kg and 100 µg/kg). These values are below USEPA's recommended cleanup guideline of 10,000 µg/kg, but exceed the RCRA proposed action level of 90 µg/kg.

- Nitroaromatics, pesticides, and herbicides were not detected.

Ground water was sampled from four monitoring wells installed around Snake Road Burn Ground. Acetone was found in ground water in all but one well, but at levels below the proposed RCRA action level of 4,000 µg/kg. Benzene was detected in one well at a concentration of 1 µg/kg, below the MCL for benzene (5 µg/kg). Arsenic, chromium, lead, and silver were also detected in the ground water, but below the MCL for these metals.

4.4.4.5 Fox Road Burn Ground

Surface soil samples were collected at Fox Road Burn Ground and were analyzed for VOCs, SVOCs, total metals, total sulfate, nitrate, pH, and nitroaromatic explosive compounds (MK 1994a). Toluene was detected in four samples ranging from 5 to 23 ppb.

No subsurface soil samples have been taken from the Fox Road Burn Ground.

No monitoring wells have been installed at the Fox Road Burn Ground.

4.4.5 Waste Lagoons

One sediment sample and one surface water sample were collected in Hemminger Ditch downgradient from the Waste Lagoons (MK 1994a). The sampling point is thought to be a possible point of entry to surface waters for contaminants from the Waste Lagoons, and may also be a point of entry for contaminants from the USTs that were near the Reactor Facility. Acetone was detected in the sediment sample (66 ppb) along with minor amounts of chloroform. Other COCs were not detected in sediment or surface water samples.

No surface or subsurface soil samples have been collected in the vicinity of the Waste Lagoons.

A single monitoring well is located upgradient of the Waste Lagoons, an additional six monitoring wells are located in the former UST areas, downgradient of the Waste Lagoons (EBASCO 1991; MK 1994c). Ground-water samples from these wells were analyzed for petroleum products only.

4.4.6 Ash Pits and Power Plants

No sampling has been conducted at either of the three ash pits at PBOW. This is partly because of initial difficulties in determining their precise locations. In the PA, SAIC (1991) placed Ash Pit #1 at a location north of Maintenance Road northeast of the Garage and Maintenance Area, and in their site inspection Morrison Knudsen (1994a) analyzed surface soil samples from this location. However, based on a thorough records search, Dames & Moore (1995) put the location of this ash pit south of Maintenance Road north of Power Plant #1. Also, SAIC (1991) did not determine a location for Ash Pit #2, however Dames & Moore later identified its location from site records, verified by a site walkover (D&M 1995). Each of the ash pits, along with their associated power plants, is discussed below.

4.4.6.1 Ash Pit and Power Plant #1

Sediment and surface water samples have not been collected at or near Ash Pit and Power Plant #1.

Surface soil samples were not collected at Ash Pit #1. One surface soil sample was collected west of former Power Station #1 near Ash Pit #1 and one was collected north of Maintenance Road near the ash pit location mis-identified by SAIC (MK 1994a). Neither location had COCs above background values.

No subsurface soil samples have been collected in the immediate vicinity of the ash pits.

No ground water monitoring wells are located at the ash pits. Five monitoring wells, located near Ash Pit #1, were installed to investigate contamination from petroleum products at a former UST site at the Garage and Maintenance Area.

4.4.6.2 Ash Pit and Power Plant #2

Two sediment and surface water samples collected from Pipe Creek to investigate contamination from the Red Water Ponds are also near Ash Pit #2 and may reflect contamination from the ash pit and the power plant. One sediment sample contained minor VOCs and SVOCs.

Two surface soil samples were collected east of Ash Pit #2 behind the power station to investigate the site identified by SAIC (1991) as a burn ground. Toluene was detected in one at a concentration of 19 ppb, along with minor concentrations of other contaminants.

No subsurface soil samples have been collected at the ash pits.

No ground water monitoring wells are located at the ash pits.

4.4.6.3 Ash Pit and Power Plant #3

Two surface water and sediment samples were collected from Ransom Brook northeast and downstream of Ash Pit #3, and may reflect contamination from the ash pit or power plant. One sediment sample had minor quantities of acetone, toluene, and SVOCs. The VOC and SVOC contamination detected in this sample may have resulted from activities at the Rail Car Unloading Area or the Sellite Area.

Two surface soil samples were collected to the north and south of K Site Test Facility near Ash Pit #3 (MK 1994a). Heavy metals were not detected above regional background levels in either of these surface soil samples.

No subsurface soil samples have been collected at the ash pits.

No ground water monitoring wells are located in the vicinity of Ash Pit #3.

4.4.7 Toluene Tank Areas

The toluene tank areas were sampled by Morrison Knudsen (1994a) for surface soils, subsurface soils, and ground water. The analytical results are described below.

4.4.7.1 Upper Toluene Tank Area

One surface water and one sediment sample were collected from Plum Brook near the Upper Toluene Tank Area. A number of SVOCs (PAH) were found in the sediment sample, along with minor amounts of toluene. No contamination was detected in any of the surface water samples.

No surface soil samples have been obtained from the Upper Toluene Tank Area.

Two subsurface soil samples were collected for analysis from soil borings from the Upper Toluene Tank Area (MK 1994a). The samples were analyzed for VOCs, SVOCs, total metals, sulfate, nitrates, pH, and nitroaromatic compounds. One subsurface soil sample contained acetone, toluene, and SVOCs (PAH) in minor quantities.

One monitoring well is located within the earthen dike surrounding Tank 265 in the Upper Toluene Tank Area (MK 1994a). Ground water samples were analyzed for VOCs, SVOCs, total metals, total sulfate, nitrate, pH, and nitroaromatic explosive compounds. Analysis of one sample indicated the presence of VOCs and SVOCs in the ground water.

4.4.7.2 Middle Toluene Tank Area

One surface water sample and one sediment sample were collected from Ransom Brook near the Middle Toluene Tank Area. Acetone was detected in the sediment sample at a value of 21 ppb. Minor SVOCs and inorganic compounds were also detected in the sediment sample.

One surface soil sample was obtained from the Middle Toluene Tank Area, collected from the low diked area between the two tanks. Neither VOCs, SVOCs, nor nitroaromatic compounds were detected in this sample.

Subsurface soil samples were collected for analysis from one soil boring from the Middle Toluene Tank Area (MK 1994a). The samples were analyzed for VOCs, SVOCs, total metals, sulfate, nitrates, pH, and nitroaromatic compounds. No VOCs, SVOCs, or nitroaromatics were detected.

No monitoring wells have been installed at the Middle Toluene Tank Area.

4.4.7.3 Lower Toluene Tank Area

No surface water, sediment, or surface soil samples have been collected from the Lower Toluene Tank Area.

Subsurface soil samples were collected for analysis from two soil borings from the Lower Toluene Tank Area (MK 1994a). The samples were analyzed for VOCs, SVOCs, total metals, sulfate, nitrates, pH, and nitroaromatic compounds. No VOCs or nitroaromatics were detected in the samples. However, Bis(2-ethylhexyl)phthalate (an SVOC) was detected in minor quantities in both boreholes.

Two monitoring wells were installed at the Lower Toluene Tank Area (MK 1994a). Ground-water samples were analyzed for VOCs, SVOCs, total metals, sulfate, nitrate, pH, and nitroaromatic compounds. Contaminants were not detected in either monitoring well.

4.4.8 Rail Car Unloading/Sellite Area

One sediment sample and one surface water sample were collected in Ransom Brook adjacent to the Rail Car Unloading Area. This location was selected as a possible point of entry to surface waters for contaminants from the Rail Car Unloading Area. No organic compounds were detected in the surface water sample, but acetone was detected at a concentration of 94 ppb in the sediment sample. Other VOCs, SVOCs, and nitroaromatic compounds were detected in the sediments, but most were below the quantitation limit.

Two surface soil samples were collected near the Rail Car Unloading Area west of the Garage and Maintenance Area. Only minor VOCs and SVOCs were detected in these samples.

Three surface soil samples were obtained from the Sellite Area just west of the Rail Car Unloading Area near the intersection of Maintenance Road and the abandoned rail spur. Each of these samples contained minor quantities of toluene, and samples MK-SS-35 and MK-SS-34 contained moderate levels of bis(2-ethylhexyl) phthalate and coal tar derivatives.

A single subsurface soil sample was collected. No VOCs were detected, however, a number of SVOC compounds, including PAH, were detected.

One ground-water monitoring well was installed along the western edge of the Garage Maintenance Area near the Rail Car Unloading Area. The analysis of ground water collected from this well showed levels of 1,1-dichloroethane, 1,1,1-trichloroethane, and toluene. These solvents are likely related to UST leakage at the Garage and Maintenance Area rather than to activities at the Rail Car Unloading Area (MK 1994a). SVOCs were also detected at low levels in the ground water.

4.4.9 Acid Areas

No sediment, surface water, surface soil, or subsurface soil sampling has been conducted specifically for the acid areas.

No monitoring wells have been installed at the acid areas.

4.4.10 Pentolite Area

No sediment or surface water sampling was conducted specifically for the Pentolite Area. However, one sediment sample and one surface water sample were collected in Hemminger Ditch downgradient from the Waste Lagoons. This sampling point is a possible point of entry to surface waters for contaminants from the Pentolite Area, and may also be a point of entry for contaminants from the Reactor Facility. Analysis of the sediment samples indicated the presence of acetone (66 ppb) along with minor amounts of chloroform. No contamination was detected in surface water sample.

No surface or subsurface soil samples have been collected at the Pentolite Area.

Ground-water monitoring wells were installed at the former PBRF UST site (EBASCO 1991, MK 1994c, IT 1991a). However, samples from these wells were analyzed for petroleum-related products, not for the Pentolite Area COCs.

4.4.11 Garage and Maintenance Area

Except for the monitoring wells installed to investigate the former UST areas, the Garage and Maintenance Area has not been examined for the presence of contamination related to PBOW activities.

4.4.12 TNT Rail Car Loading Area

The presence of contamination has been examined at the TNT Areas, including the Rail Car Loading Areas, through the SI conducted by Morrison Knudsen (1994a). The TNT Areas are discussed in Section 4.4.1.

4.4.13 Sitewide Ground Water

Fifty monitoring wells have been installed at PBOW to investigate the nature of ground-water contamination in the surficial aquifer. The bedrock aquifer has not been investigated at PBOW. Results of chemical analyses of ground water are summarized below:

- Analysis of ground water from well IT-MW-02 at the West Area Red Water Ponds detected low levels of acetone, 2,6-DNT, and 2,4-DNT, attributable to contamination from the ponds. Well IT-MW-02 also contained elevated levels of sulfate, possibly representing contamination from sulfuric acid from Acid Area 2 (IT 1991a).

- Ground water from well MK-MW-20 located at the site of the toluene tanks near TNT Area A (Tanks 255 and 265), had elevated levels of toluene, 2-methylphenol, benzyl alcohol, and 4-methylphenol (MK 1994a). The toluene is attributable to PBOW activities; the other compounds may be a consequence of NASA's use of these tanks for fuel storage.

- Minor quantities of acetone were detected in the monitoring wells at Snake Road Burn Ground, and benzene was detected in one well (H^{+}GCL 1992).

- Analyses of ground water from former UST areas revealed contamination only at the former UST area at the Garage and Maintenance Area (EBASCO 1991). Chloroethane, dichloroethane, dichloroethene, trichloroethane, and trichloroethene were detected in several wells at this location.

4.5 RECOMMENDATIONS

This section describes additional investigations that may be necessary to define source areas of contamination, characterize potential migration pathways, or identify potential receptors and exposure pathways. Any further investigations suggested here are not intended to be requirements for future work at these AOCs. They are suggested for consideration for future work, to be implemented only if determined necessary through the site scoping process.

4.5.1 TNT Areas

The investigations being conducted at the TNT Areas (D&M 1994) should be sufficient to determine the presence of contamination in soil and ground water at these sites and to conduct a limited risk assessment. If soil contamination is found, additional soil sampling may be needed to determine the extent of soil contamination at these sites.

4.5.2 Red Water Ponds

The focused RI being conducted at the red water pond areas (D&M 1994) is believed to be sufficient to determine the nature and extent of contamination at these sites and to conduct a risk assessment. If contamination is detected in the bedrock well near the West Area Ponds, it is recommended that additional monitoring wells be installed in bedrock downgradient of both pond areas, and the bedrock aquifer monitored regularly for contaminants of concern.

4.5.3 Underground Wastewater Flumes

The focused RI being conducted at the TNT areas should be sufficient to determine the presence of contamination at these sites and to conduct a limited risk assessment. However, the Underground Wastewater Flumes are not specifically targeted in this study, and additional subsurface soil sampling may be required to characterize the flume areas, especially because the location of remaining flumes is unknown. A systematic search for the buried wastewater flumes and sewer lines may need to be undertaken, perhaps using a geophysical technique such as ground-penetrating radar. Surface water and sediment sampling and analysis in Ransom Brook north of TNT Area B may be needed to confirm the high value of 2,4,6-TNT found in MK-SD-07, and to trace contaminant migration in the brook.

4.5.4 Burn Grounds

Additional investigations in the remaining burn grounds are suggested to determine the nature and extent of contamination at these sites. Surface soils should be statistically sampled to delineate the extent of contamination and to locate possible hot spots. Sediment samples should be selected from drainages in and adjacent to the burn grounds to determine the potential for contaminant transport from surface runoff. Installation of shallow and bedrock monitoring wells should be considered at or near the burn grounds during the ongoing site-wide ground-water investigation (D&M 1994) to monitor for contaminants in the shallow and deep aquifers.

4.5.5 Waste Lagoons

Additional investigations for the Waste Lagoons may be needed to determine the nature and extent of residual contamination, if any, at this site. Surface soils in these areas should be sampled to delineate the extent of contamination and sediment samples should be analyzed for COCs. A single monitoring well should also be considered in the Waste Lagoons Area to test for COCs in the ground water.

4.5.6 Ash Pits and Power Plants

Further investigation of the ash pit and power plant areas is recommended to determine the nature and extent of contamination in these areas. In particular, surface and subsurface soil investigations at the ash pits are needed to delineate the extent of the ash pits and the nature of heavy metals contamination in these areas. A soil background evaluation is also recommended to determine background levels of metals in the soils. The ongoing site-wide ground-water investigation (D&M 1994) may be sufficient to detect ground-water contamination from the ash pits, provided that the ground water is analyzed for heavy metals.

4.5.7 Toluene Tank Areas

Additional sediment, soil, surface water, and ground-water investigations are recommended to determine the nature and extent of contamination in the toluene tank areas. The ongoing site-wide ground-water investigation (D&M 1994) should provide sufficient coverage to monitor potential ground-water contamination from the toluene tank areas. However, it is recommended that: (1) sediment and surface water be sampled and analyzed at the Lower Toluene Tank Area; (2) surface soils be systematically sampled at the toluene tank areas to determine the extent of contamination at these sites; and (3) ground-water contamination detected at the Upper Toluene Tanks be further examined with monitoring wells to determine if a contaminant plume exists in the ground water, and what its extent is.

4.5.8 Rail Car Unloading/Sellite Area

Additional investigations are recommended at the Rail Car Unloading/Sellite Area to further delineate the nature and extent of contamination. Surface and subsurface soil sampling is recommended, and additional sediment and surface water sampling is recommended for the ditches adjacent to the site. Monitoring wells should be installed between the site and Ransom Brook to monitor possible ground-water contamination and determine the direction of ground-water flow.

4.5.9 Acid Areas

An investigation of the acid areas is needed to determine the nature and extent of contamination. A Preliminary Assessment (PA) of the acid areas should first be conducted to evaluate the potential for contamination at these sites. If the need for additional investigations is indicated by the PA, a Site Inspection (SI) should be conducted to determine if contamination is present, and the nature of the contamination. Sediment and surface soil sampling and analysis, in particular, are recommended for the SI. Additional studies at the acid areas will depend on the results of the SI, but may include further examination of sediment, surface and subsurface soils, and ground water.

4.5.10 Pentolite Area

An investigation of the Pentolite Area is suggested to determine the nature and extent of contamination. A PA of this AOC should first be conducted to evaluate the potential for contamination at the site. If the need for additional investigations is indicated by the PA, an SI should be conducted to determine if contamination is present, and the nature of the contamination. Surface and subsurface soil sampling and analysis, in particular, are recommended for the SI. Additional studies at the Pentolite Area will depend on the results of the SI, but may include further examination of surface and subsurface soils, and ground water.

4.5.11 Garage and Maintenance Area

An investigation of the Garage and Maintenance Area is suggested to determine the nature and extent of contamination. A PA of this AOC should first be conducted to evaluate the potential for contamination at the site, including a thorough review of the results of the UST investigations conducted in this area (EBASCO 1991). If the need for additional investigations is indicated, an SI should be conducted to determine if contamination is present, and the nature of the contamination. Surface and subsurface soil sampling and analysis, in particular, are recommended for the SI. Additional studies at the Garage and Maintenance Area will depend on the results of the SI, but may include further examination of surface and subsurface soils, and ground-water sampling from existing wells.

4.5.12 TNT Rail Car Loading Areas

The focused RI for the TNT Areas may be sufficient to determine the nature and extent of contamination at these sites, including the TNT loading areas. However, the locations of the TNT Rail Car Loading Areas are not known, and a reconnaissance of the areas should be conducted to locate the loading areas

and evaluate their potential for contributing to the contamination at the TNT Areas. Further work at the TNT loading areas may best be conducted as a subset of investigations of the respective TNT Areas, depending on the actual locations of the loading areas.

4.5.13 Sitewide Ground Water

The sitewide ground-water investigation planned for the focused RI being conducted by Dames & Moore should be sufficient to determine the nature and extent of contamination of the surficial and bedrock ground water at the site. The following recommendations for additional work should be considered in future scoping:

- If significant contamination is found in the ground water, additional monitoring wells, both surficial and bedrock, may be needed to track contaminant migration or determine contaminant source areas.
- Aquifer testing has been done in only one monitoring well at PBOW, well IT-MW-02 (IT 1991). Additional aquifer testing should be considered for wells installed in both the surficial and bedrock aquifers for the sitewide ground-water investigation (D&M 1994).
- Additional ground-water background data may be needed to support a risk assessment.
- If significant contamination is detected in the ground water at PBOW, hydrologic and transport modelling may be needed to predict contaminant fate and transport at the site.

4.5.14 Background Data

A statistical evaluation of existing site-wide background data should be considered to evaluate their usefulness to support a risk assessment for the AOCs. Additional background sampling should also be considered for all AOCs.

Analyte	TNT Area A	TNT Area B	TNT Area C	Pentolite Rd RWP	West Area RWP	"Burn Ground #1"	Reservoir #2 BG	G-8 Burn Ground	Fox Road BG	Taylor Road BG	Snake Road BG	Waste Lagoons	"Ash Pit #1"	Ash Pit #1	Ash Pit #2	Ash Pit #3	Lower Toluene Tanks	Middle Toluene Tanks	Upper Toluene Tanks	Rail Car Unloading Area/Sellite Area	Acid Areas	Pentolite Area	Garage Maintenance Area	TNT Rail Car Loading Areas
VOCs																								
1,1-Dichloroethane	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
1,1-Dichloroethene	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
1,1,1-Trichloroethane	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
2-Butanone	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
2-Hexanone	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
Acetone	U	U	U		NA	10J		U	U				NA	U	10J	U		U		U				
Benzene	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
Bromodichloromethane	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
Carbon tetrachloride	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
Carbon disulfide	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
Chlorobenzene	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
Chloroform	U	0J	U		NA	U		U	U				NA	U	U	U		U		U				
Chloromethane	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
Methylene chloride	U	U	U		NA	U		U	U				NA	U	U	U		U		2J				
Toluene	U	33.00	4J		NA	19		1J	23				NA	U	19.00	U		1J		54B				
Total xylenes	0.9J	U	U		NA	1J		U	U				NA	U	U	U		U		U				
Trichloroethene	U	U	U		NA	U		U	U				NA	U	U	U		U		1J				
SVOCs																								
2-Methyl naphthalene	U	U	U		NA	320J		U	U				NA	U	U	U		U		U				
2-Methylphenol	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
2-Nitroaniline	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
2,4-Dinitrotoluene	U	U	U		200[a]	U		U	U				NA	U	U	U		U		U				
2,4,6-Trinitrotoluene	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
2,6-Dinitrotoluene	U	U	U		13,600[a]	U		U	U				NA	U	U	U		U		U				
3-Nitroaniline	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
4-Methylphenol	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
4-Nitrophenol	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
Acenaphthene	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
Acenaphthylene	U	U	U		NA	U		U	U				NA	U	U	U		U		190J				
Anthracene	U	U	U		NA	U		U	U				NA	U	U	U		U		98J				
Benzo(a)anthracene	U	U	140J		NA	U		140J	U				NA	U	U	U		U		920				
Benzo(a)pyrene	U	U	U		NA	U		U	U				NA	U	U	U		U		680				
Benzo(b)fluoranthene	U	U	190J		NA	46J		92J	32J				NA	U	U	U		U		2400				
Benzo(ghi)perylene	U	U	U		NA	U		U	U				NA	U	U	U		U		280J				
Benzo(k)fluoranthene	U	U	79J		NA	U		41J	U				NA	U	U	U		U		800				
Benzoic acid	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
Benzyl alcohol	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
Bis(2-ethylhexyl)phthalate	U	44J	U		NA	U		99J	U				NA	U	U	U		230J		23,000E				
Chrysene	U	U	U		NA	U		U	U				NA	U	U	U		U		1500				
Di-n-butyl phthalate	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
Dibenzo(a,h)anthracene	U	U	U		NA	U		U	U				NA	U	U	U		U		91J				
Dibenzofuran	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
Fluoranthene	U	U	340J		NA	U		140J	U				NA	U	U	U		U		2,100				
Fluorene	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
Indeno(1,2,3-cd)pyrene	U	U	U		NA	U		U	U				NA	U	U	U		U		430				
Napthalene	U	U	U		NA	240J		U	U				NA	U	U	U		U		U				

Table 4-1. Summary Results of PBOW Sediment Investigations

Analyte	TNT Area A	TNT Area B	TNT Area C	Pentolite Rd RWP	West Area RWP	"Burn Ground #1"	Reservoir #2 BG	G-8 Burn Ground	Fox Road BG	Taylor Road BG	Snake Road BG	Waste Lagoons	"Ash Pit #1"	Ash Pit #1	Ash Pit #2	Ash Pit #3	Lower Toluene Tanks	Middle Toluene Tanks	Upper Toluene Tanks	Rail Car Unloading Area/Sellite Area	Acid Areas	Pentolite Area	Garage Maintenance Area	TNT Rail Car Loading Areas
Nitrobenzene	U	U	U		NA	U		U	U				NA	U	U	U		U		U				
Phenanthrene	U	U	160J		NA	130J		U	U				NA	U	U	U		U		460				
Pyrene	U	U	350J		NA	U		U	U				NA	U	U	U		U		1,500				
Pesticides																								
4,4'-DDE	NA	NA	NA		NA	NA		NA	NA				NA	NA	NA	NA		NA		NA				
4,4'-DDT	NA	NA	NA		NA	NA		NA	NA				NA	NA	NA	NA		NA		NA				
Aldrin	NA	NA	NA		NA	NA		NA	NA				NA	NA	NA	NA		NA		NA				
Aroclor 1240	NA	NA	NA		NA	NA		NA	NA				NA	NA	NA	NA		NA		NA				
Aroclor 1260	NA	NA	NA		NA	NA		NA	NA				NA	NA	NA	NA		NA		NA				
Dieldrin	NA	NA	NA		NA	NA		NA	NA				NA	NA	NA	NA		NA		NA				
Heptachlor	NA	NA	NA		NA	NA		NA	NA				NA	NA	NA	NA		NA		NA				
Methoxychlor	NA	NA	NA		NA	NA		NA	NA				NA	NA	NA	NA		NA		NA				
Metals																								
Arsenic	NA	NA	NA		NA	NA		NA	NA				NA	NA	NA	NA		NA		NA				
Barium	NA	NA	NA		NA	NA		NA	NA				NA	NA	NA	NA		NA		NA				
Chromium	NA	NA	NA		NA	NA		NA	NA				NA	NA	NA	NA		NA		NA				
Chrysene	NA	NA	NA		NA	NA		NA	NA				NA	NA	NA	NA		NA		NA				
Iron	NA	NA	NA		NA	NA		NA	NA				NA	NA	NA	NA		NA		NA				
Lead	NA	NA	NA		NA	NA		NA	NA				NA	NA	NA	NA		NA		NA				
Manganese	NA	NA	NA		NA	NA		NA	NA				NA	NA	NA	NA		NA		NA				
Silver	NA	NA	NA		NA	NA		NA	NA				NA	NA	NA	NA		NA		NA				
Sodium	NA	NA	NA		NA	NA		NA	NA				NA	NA	NA	NA		NA		NA				
Sulfate	NA	NA	NA		NA	NA		NA	NA				NA	NA	NA	NA		NA		NA				
Total silver	U	U	U		NA	U		0.06B	U				U	U	U	U		U		U				
Total arsenic	2.3	39.4	U		NA	U		U	3				1.8	10.7	U	8.5		3.1		21.7				
Total chromium	5	10.4	18.7		NA	20.1		10.9	8.2				5.1	8.2	20.1	13.7		8.6		10				
Total lead	3.8	29.3	U		NA	U		U	20.4				5.9	18.5	U	6.9		7.6		21.4				
Nitroexplosives																								
1,3-Dinitrobenzene	U	U	U		NA	U		U	U				NA	NA	U	NA		U		U				
1,3,5-Trinitrobenzene	U	U	U		NA	U		U	U				NA	NA	U	NA		U		U				
2,4,6-Trinitrotoluene	U	U	U		NA	U		U	U				NA	NA	U	NA		U		U				
Nitrotoluene	U	U	U		NA	U		U	U				NA	NA	U	NA		U		U				
PETN	U	U	U		U	U		U	U				NA	NA	U	NA		U		U				
TNT	U	U	U		U	U		U	U				NA	NA	U	NA		U		U				
DNT	U	U	U		U	U		U	U				NA	NA	U	NA		U		U				

Sources: [a] H'GCL, [b]TT, [c]Burgess & Niple, [d]Battelle, MK all others.

J Estimated value.

U Compound was analyzed for but not detected.

E Compound exceeded CLP calibration range but was within instrument linear range.

NA Not analyzed.

B Analyte was found in the associated blank as well as the sample.

Table 4-1. Continued

Analyte	TNT Area A	TNT Area B	TNT Area C	Pentolite Rd RWP	West Area RWP	"Burn Griund #1"	Reservoir #2 BG	G-8 Burn Ground	Fox Road BG	Taylor Road BG	Snake Road BG	Waste Lagoons	"Ash Pit #1"	Ash Pit #1	Ash Pit #2	Ash Pit #3	Lower Toluene Tanks	Middle Toluene Tanks	Upper Toluene Tanks	Rail Car Unloading Area/Sellite Area	Acid Areas	Pentolite Area	Garage Maintenance Area	TNT Rail Car Loading ARea
VOCs																								
1,1-Dichloroethane	U	U		NA	NA	U				NA	11[a]						U	U	U	U				
1,1-Dichloroethene	U	U		NA	NA	U				NA	U						U	U	U	U				
1,1,1-Trichloroethane	U	U		NA	NA	U				NA	64[a]						U	U	U	2J				
2-Butanone	U	U		NA	NA	U				NA	6BJ[a]						U	U	U	U				
2-Hexanone	U	U		U	U	U				2J[b]	3J[b]						U	U	U	U				
Acetone	U	1J		11,000[b]	2,300E[b]	U				U	4,300[b]						U	U	36J	U				
Benzene	U	U		NA	NA	U				NA	NA						U	U	U	U				
Bromodichloromethane	U	U		NA	NA	U				NA	<6[a]						U	U	U	U				
Carbon tetrachloride	U	U		U	1J[b]	U				3J[b]	4J[b]						U	U	U	U				
Carbon disulfide	U	U		NA	NA	U				NA	NA						U	U	U	U				
Chlorobenzene	U	U		NA	NA	U				NA	NA						U	U	U	1BJ				
Chloroform	U	U		NA	NA	U				NA	<7[a]						U	U	U	U				
Chloromethane	U	U		NA	NA	U				NA	U						U	U	U	U				
Methylene chloride	U	8		9[b]	10[b]	U				10[b]	23B[a]						U	U	U	U				
Toluene	11J	U		U	4J[b]	U				4J[b]	4J[b]						U	U	4J	U				
Total xylenes	U	U		NA	NA	U				NA	NA						U	U	U	U				
Trichloroethene	U	U		NA	NA	U				NA	NA						U	U	U	U				
SVOCs																								
2-Methyl naphthalene	U	U		NA	NA	U				NA	450J[a]						U	U	U	79J				
2-Methylphenol	U	U		NA	NA	U				NA	NA						U	U	U	U				
2-Nitroaniline	U	U		NA	NA	U				NA	NA						U	U	U	U				
2,4-Dinitrotoluene	U	U		x-1[b]	x-2[b]	U				NA	NA						U	U	U	U				
2,4,6-Trinitrotoluene	U	12,000		NA	NA	U				NA	NA						U	U	U	U				
2,6-Dinitrotoluene	U	60		x-3[b]	x-4[b]	U				U	NA						U	U	U	U				
3-Nitroaniline	U	U		NA	NA	U				NA	NA						U	U	U	U				
4-Methylphenol	U	U		NA	NA	U				NA	NA						U	U	U	U				
4-Nitrophenol	U	U		NA	NA	U				NA	NA						U	U	U	U				
Acenaphthene	U	U		NA	NA	U				NA	NA						U	U	U	U				
Acenaphthylene	33J	U		NA	NA	U				NA	NA						U	U	U	60J				
Anthracene	U	U		NA	NA	U				NA	NA						U	U	24J	56J				
Benzo(a)anthracene	220J	U		NA	NA	U				NA	U						U	U	92J	260J				
Benzo(a)pyrene	160J	U		NA	NA	U				NA	NA						U	U	60J	230J				
Benzo(b)fluoranthene	230J	U		NA	NA	U				NA	44J[a]						U	U	86J	340J				
Benzo(ghi)perylene	74J	U		NA	NA	U				NA	NA						U	U	32J	100J				
Benzo(k)fluoranthene	110J	U		NA	NA	U				NA	NA						U	U	39J	160J				
Benzoic acid	U	U		NA	NA	U				NA	NA						U	U	U	28J				
Benzyl alcohol	U	U		NA	NA	U				NA	NA						U	U	U	U				
Bis(2-ethylhexyl)phthalate	U	U		450[b]	340J[b]	U				400[b]	1,200[b]						970	U	83J	60J				
Chrysene	160J	U		NA	NA	U				NA	55J[a]						U	U	76J	240J				
Di-n-butyl phthalate	U	U		NA	NA	130J				NA	82J[a]						U	U	U	U				
Dibenzo(a,h)anthracene	U	U		NA	NA	U				NA	NA						U	U	U	27J				
Dibenzofuran	U	U		NA	NA	U				NA	NA						U	U	U	U				
Fluoranthene	300J	U		NA	NA	89J				NA	NA						U	U	210J	510				
Fluorene	U	U		NA	NA	U				NA	NA						U	U	U	U				
Indeno(1,2,3-cd)pyrene	96J	U		NA	NA	U				NA	NA						U	U	39J	140J				
Napthalene	U	U		NA	NA	U				NA	160J[a]						U	U	U	U				

Table 4-2. Summary Results of PBOW Surface Soil Investigations

Analyte	TNT Area A	TNT Area B	TNT Area C	Pentolite Rd RWP	West Area RWP	"Burn Griund #1"	Reservoir #2 BG	G-8 Burn Ground	Fox Road BG	Taylor Road BG	Snake Road BG	Waste Lagoons	"Ash Pit #1"	Ash Pit #1	Ash Pit #2	Ash Pit #3	Lower Toluene Tanks	Middle Toluene Tanks	Upper Toluene Tanks	Rail Car Unloading Area/Sellite Area	Acid Areas	Pentolite Area	Garage Maintenance Area	TNT Rail Car Loading ARea
Nitrobenzene	U	U		0.48[a]	NA	U				U	U						U	U	U	U				
Phenanthrene	91J	U		NA	NA	U				NA	70J[a]						U	U	120J	220J				
Pyrene	250J	U		NA	NA	U				NA	47J[a]						U	U	150J	390				
Pesticides																								
4,4'-DDE	NA	NA		NA	NA	NA				NA	NA						NA	NA	NA	NA				
4,4'-DDT	NA	NA		NA	NA	NA				NA	NA						NA	NA	NA	NA				
Aldrin	NA	NA		NA	NA	NA				NA	NA						NA	NA	NA	NA				
Aroclor 1240	NA	NA		NA	NA	NA				NA	NA						NA	NA	NA	NA				
Aroclor 1260	NA	NA		NA	NA	NA				NA	NA						NA	NA	NA	NA				
Dieldrin	NA	NA		NA	NA	NA				NA	NA						NA	NA	NA	NA				
Heptachlor	NA	NA		NA	NA	NA				NA	NA						NA	NA	NA	NA				
Methoxychlor	NA	NA		NA	NA	NA				NA	NA						NA	NA	NA	NA				
Metals																								
Arsenic	NA	NA		U	U	NA				7[b]	2[b]						NA	NA	NA	NA				
Barium	NA	NA		U	U	NA				51.3[b]	58.9[b]						NA	NA	NA	NA				
Chromium	NA	NA		U	U	NA				U	U						NA	NA	NA	NA				
Iron	NA	NA		U	U	NA				15,400[b]	15,600[b]						NA	NA	NA	NA				
Lead	NA	NA		U	U	NA				10[b]	50[b]						NA	NA	NA	NA				
Manganese	NA	NA		263[b]	2,600[b]	NA				300[b]	129[b]						NA	NA	NA	NA				
Silver	NA	NA		U	U	NA				U	0.5[b]						NA	NA	NA	NA				
Sodium	NA	NA		U	U	NA				110[b]	80[b]						NA	NA	NA	NA				
Sulfate	NA	NA		NA	NA	NA				NA	NA						NA	NA	NA	NA				
Total silver	U	U		NA	NA	U				U	U						U	0.13B	0.03B	U				
Total arsenic	20.9B	25.4		NA	NA	U				NA	NA						0.9B	U	5.5	U				
Total chromium	9	7.8		NA	NA	17.5				NA	NA						4.2	8.5	15.1	10.1				
Total lead	6.2	19,700		NA	NA	11.6				NA	NA						19.1	U	9.2	U				
Nitroexplosives																								
1,3-Dinitrobenzene	U	U		6.4[b]	0.59[b]	U				U	U						U	U	U	U				
1,3,5-Trinitrobenzene	U	U		15[b]	3.4[b]	U				U	0.93[b]						U	U	U	U				
2,4,6-Trinitrotoluene	U	12,000		U	U	U				U	U						U	U	U	U				
Nitrotoluene	U	U		U	U	U				U	U						U	U	U	U				
PETN	U	U		NA	NA	U				U	U						U	U	U	U				
TNT	U	U		NA	NA	U				U	U						U	U	U	U				
DNT	U	U		NA	NA	U				U	U						U	U	U	U				

Sources: [a] HGCL, [b]TT, [c]Burgess & Niple, [d]Battelle, MK all others.

J Estimated value.

U Compound was analyzed for but not detected.

E Compound exceeded CLP calibration range but was within instrument linear range.

NA Not analyzed.

B Analyte was found in the associated blank as well as the sample.

X: Dinitrotoluenes were analyzed as nitroaromatics (NA) and as SVOCs with different results: x-1 = 20mg/kg as NA, 11,000ug.kg as SVOC; x-2 = .91mg/kg as NA, 620J ug.kg as SVOC; x-3 = 2.7 mg/kg as NA, 1700 ug/kg as SVOC; x-4 = U for both.

Table 4-2. Continued

Analyte	TNT Area A	TNT Area B	TNT Area C	Pentolite Rd RWP	West Area RWP	"Burn Ground #1"	Reservoir #2 BG	G-8 Burn Ground	Fox Road BG	Taylor Road BG	Snake Road BG	Waste Lagoons	"Ash Pit #1"	Ash Pit #1	Ash Pit #2	Ash Pit #3	Lower Toluene Tanks	Middle Toluene Tanks	Upper Toluene Tanks	Rail Car Unloading Area/Sellite Area	Acid Areas	Pentolite Area	Garage Maintenance Area	TNT Rail Car Loading ARea
VOCs																								
1,1-Dichloroethane	U	2J	U	U	U	U		U	U			U			U	U		U	U	U				
1,1-Dichloroethene	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
1,1,1-Trichloroethane	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
2-Butanone	U	10J	U	2J	U	U		U	U			U			U	11J		U	U	11J				
2-Hexanone	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
Acetone	25	53	U	17	U	U		U	U			66			U	94		21	U	94				
Benzene	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
Bromodichloromethane	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
Carbon tetrachloride	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
Carbon disulfide	U	U	U	U	U	U		U	2J			U			U	U		U	U	U				
Chlorobenzene	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
Chloroform	U	U	U	U	U	U		U	U			2J			U	U		U	U	U				
Chloromethane	U	U	U	U	U	U		U	U			4J			U	4J		U	U	4J				
Methylene chloride	0.9J	1J	U	U	U	U		U	U			U			U	5J		U	U	5J				
Toluene	U	U	U	2J	U	U		U	9			U			U	13J		1J	2J	13J				
Total xylenes	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
Trichloroethene	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
SVOCs																								
2-Methyl naphthalene	U	60J	U	U	U	U		U	39J			U			U	U		U	U	U				
2-Methylphenol	U	U	U	U	U	54J		U	U			U			U	U		U	U	U				
2-Nitroaniline	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
2,4-Dinitrotoluene	170J	200J	U	U	U	U		U	U			U			U	U		U	140J	U				
2,4,6-Trinitrotoluene	U	25,000	U	U	U	U		U	U			U			U	U		U	U	U				
2,6-Dinitrotoluene	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
3-Nitroaniline	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
4-Methylphenol	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
4-Nitrophenol	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
Acenaphthene	U	U	U	U	U	U		U	26J			U			U	U		U	U	U				
Acenaphthylene	U	U	U	U	U	U		U	140J			U			U	U		U	110J	U				
Anthracene	U	U	U	U	U	U		U	270J			U			U	U		U	110J	U				
Benzo(a)anthracene	U	U	U	U	U	U		450J	960			U			U	46J		U	730	46J				
Benzo(a)pyrene	76J	100J	U	U	U	U		710J	660			U			U	U		U	560	U				
Benzo(b)fluoranthene	200J	260J	U	U	U	82J		730J	1,100			U			U	59J		U	880	59J				
Benzo(ghi)perylene	U	U	U	U	U	U		490J	160J			U			U	U		U	130J	U				
Benzo(k)fluoranthene	U	U	U	U	U	U		780J	420J			U			U	26J		U	370J	26J				
Benzoic acid	U	U	U	U	U	U		U	U			U			U	10J		U	U	10J				
Benzyl alcohol	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
Bis(2-ethylhexyl)phthalate	U	3,800B	U	570	U	U		U	130J			U			U	U		U	U	U				
Chrysene	120J	150J	U	U	U	51J		730J	730			U			U	43J		U	530	43J				
Di-n-butyl phthalate	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
Dibenzo(a,h)anthracene	U	U	U	U	U	U		U	46J			U			U	U		U	44J	U				
Dibenzofuran	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
Fluoranthene	220J	240J	180J	U	180J	40J		1,000J	1,900			U			U	U		U	970	U				
Fluorene	U	U	U	U	U	U		U	110J			U			U	U		U	U	U				
Indeno(1,2,3-cd)pyrene	U	U	U	U	U	U		610J	210J			U			U	U		U	180J	U				
Napthalene	U	U	U	U	U	U		U	U			U			U	U		U	U	U				

Table 4-3. Summary Results of PBOW Subsurface Soil Investigations

Analyte	TNT Area A	TNT Area B	TNT Area C	Pentolite Rd RWP	West Area RWP	"Burn Ground #1"	Reservoir #2 BG	G-8 Burn Ground	Fox Road BG	Taylor Road BG	Snake Road BG	Waste Lagoons	"Ash Pit #1"	Ash Pit #1	Ash Pit #2	Ash Pit #3	Lower Toluene Tanks	Middle Toluene Tanks	Upper Toluene Tanks	Rail Car Unloading Area/Sellite Area	Acid Areas	Pentolite Area	Garage Maintenance Area	TNT Rail Car Loading ARea
Nitrobenzene	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
Phenanthrene	82J	140J	160J	U	160J	U		340J	850			U			U	23J		U	200J	U				
Pyrene	160J	200J	120J	U	120J	U		1,100J	1,500			U			U	U		U	1100	23J				
Pesticides																								
4,4'-DDE	U	U	U	NA	NA	NA		NA	NA			NA			NA	NA		NA	NA	NA				
4,4'-DDT	U	9.8J	U	NA	NA	NA		NA	NA			NA			NA	NA		NA	NA	NA				
Aldrin	U	U	U	NA	NA	NA		NA	NA			NA			NA	NA		NA	NA	NA				
Aroclor 1240	U	U	U	NA	NA	NA		NA	NA			NA			NA	NA		NA	NA	NA				
Aroclor 1260	U	U	U	NA	NA	NA		NA	NA			NA			NA	NA		NA	NA	NA				
Dieldrin	2.7J	U	U	NA	NA	NA		NA	NA			NA			NA	NA		NA	NA	NA				
Heptachlor	U	U	U	NA	NA	NA		NA	NA			NA			NA	NA		NA	NA	NA				
Methoxychlor	29	U	U	NA	NA	NA		NA	NA			NA			NA	NA		NA	NA	NA				
Metals																								
Arsenic	NA	NA	NA	NA	NA	NA		NA	NA			NA			NA	NA		NA	NA	NA				
Barium	NA	NA	NA	NA	NA	NA		NA	NA			NA			NA	NA		NA	NA	NA				
Chromium	NA	NA	NA	NA	NA	NA		NA	NA			NA			NA	NA		NA	NA	NA				
Iron	NA	NA	NA	NA	NA	NA		NA	NA			NA			NA	NA		NA	NA	NA				
Lead	NA	NA	NA	NA	Z[c]	NA		NA	NA			NA			NA	NA		NA	NA	NA				
Manganese	NA	NA	NA	NA	NA	NA		NA	NA			NA			NA	NA		NA	NA	NA				
Silver	NA	NA	NA	NA	NA	NA		NA	NA			NA			NA	NA		NA	NA	NA				
Sodium	NA	NA	NA	NA	NA	NA		NA	NA			NA			NA	NA		NA	NA	NA				
Sulfate	NA	NA	NA	NA	NA	NA		NA	NA			NA			NA	NA		NA	NA	NA				
Total silver	U	U	0.14B	0.03B	0.14B	U		0.14B	U			U			U	U		U	U	U				
Total arsenic	U	U	U	U	U	8.1		U	7.8			4.7			8.1	102		12.6	9.8	102				
Total chromium	8.3	13.6	14.4	12.5	14.4	13.5		14.4	19.8			10.9			13.5	20.9		18.1	7.4	20.9				
Total lead	38.3	27.5	U	30.5	U	11.2		U	11.2			10.5			11.2	83		24.7	9.4	83				
Nitroexplosives																								
1,3-Dinitrobenzene	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
1,3,5-Trinitrobenzene	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
2,4,6-Trinitrotoluene	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
Nitrotoluene	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
PETN	U	U	U	U	U	U		U	U			U			U	U		U	U	U				
TNT	U	U	U	U	320[c]	U		U	U			U			U	U		U	U	U				
DNT	U	U	U	U	10[c]	U		U	U			U			U	U		U	U	U				

Sources: [a] H[+]GCL, [b]IT, [c]Burgess & Niple, [d]Battelle, MK all others.

J Estimated value.

U Compound was analyzed for but not detected.

E Compound exceeded CLP calibration range but was within instrument linear range.

NA Not analyzed.

B Analyte was found in the associated blank as well as the sample.

Z Lead was detected at slightly elevated concentrations, but the quantity was not mentioned in the text.

Table 4-3. Continued

Analyte	TNT Area A	TNT Area B	TNT Area C	Pentolite Rd RWP	West Area RWP	"Burn Ground #1"	Reservoir #2 BG	G-8 Burn Ground	Fox Road BG	Taylor Road BG	Snake Road BG	Waste Lagoons	"Ash Pit #1"	Ash Pit #1	Ash Pit #2	Ash Pit #3	Lower Toluene Tanks	Middle Toluene Tanks	Upper Toluene Tanks	Rail Car Unloading Area/Sellite Area	Acid Areas	Pentolite Area	Garage Maintenance Area	TNT Rail Car Loading Areas
VOCs																								
1,1-Dichloroethane	U	U		NA	NA						NA						U		U	18				
1,1-Dichloroethene	U	U		NA	NA						NA						U		U	8				
1,1,1-Trichloroethane	U	U		NA	NA						NA						U		U	360E				
2-Butanone	U	U		NA	NA						NA						U		33J	U				
2-Hexanone	U	U		NA	NA						NA						U		U	U				
Acetone	U	U		7J[b]	12[b]						46*						U		110J	U				
Benzene	U	U		NA	NA						1J*						U		10J	U				
Bromodichloromethane	U	U		NA	NA						NA						U		U	U				
Carbon tetrachloride	U	U		NA	NA						NA						U		U	U				
Carbon disulfide	U	U		4J[b]	U						NA						U		U	U				
Chlorobenzene	U	U		NA	NA						NA						U		U	U				
Chloroform	U	U		U	U						NA						U		U	U				
Chloromethane	U	U		NA	NA						NA						U		U	U				
Methylene chloride	U	U		NA	NA						5BJ*						U		U	U				
Toluene	U	U		U	U						NA						U		36,000S	2J				
Total xylenes	U	U		U	U						NA						U		8J	U				
Trichloroethene	U	U		NA	NA						NA						U		U	U				
SVOCs																								
2-Methyl naphthalene	U	U		NA	NA						NA						U		U	U				
2-Methylphenol	U	U		NA	NA						NA						U		520S	U				
2-Nitroaniline	U	U		U	2J[b]						NA						U		U	U				
2,4-Dinitrotoluene	U	U		U	160[b]						NA						U		U	U				
2,4,6-Trinitrotoluene	U	U		NA	NA						NA						U		U	U				
2,6-Dinitrotoluene	U	U		U	27[b]						NA						U		U	U				
3-Nitroaniline	U	U		U	13J[b]						NA						U		U	U				
4-Methylphenol	U	U		NA	NA						NA						U		190S	U				
4-Nitrophenol	U	U		U	3J[b]						NA						U		U	U				
Acenaphthene	U	U		NA	NA						NA						U		U	U				
Acenaphthylene	U	U		NA	NA						NA						U		U	U				
Anthracene	U	U		NA	NA						NA						U		U	U				
Benzo(a)anthracene	U	U		NA	NA						NA						U		U	U				
Benzo(a)pyrene	U	U		NA	NA						NA						U		U	U				
Benzo(b)fluoranthene	U	U		NA	NA						NA						U		U	U				
Benzo(ghi)perylene	U	U		NA	NA						NA						U		U	U				
Benzo(k)fluoranthene	U	U		NA	NA						NA						U		U	U				
Benzoic acid	U	U		NA	NA						NA						U		13SJ	U				
Benzyl alcohol	U	U		NA	NA						NA						U		13	U				
Bis(2-ethylhexyl)phthalate	22	12		2J[b]	2J[b]						NA						U		U	3J				
Chrysene	U	U		NA	NA						NA						U		U	U				
Di-n-butyl phthalate	U	U		NA	NA						NA						U		U	U				
Dibenzo(a,h)anthracene	U	U		NA	NA						NA						U		U	U				
Dibenzofuran	U	U		NA	NA						NA						U		U	U				
Fluoranthene	U	U		NA	NA						NA						U		U	U				
Fluorene	U	U		NA	NA						NA						U		U	U				
Indeno(1,2,3-cd)pyrene	U	U		NA	NA						NA						U		U	U				
Napthalene	U	U		NA	NA						NA						U		U	U				

Table 4-4. Summary Results of PBOW Ground-Water Investigations

Analyte	TNT Area A	TNT Area B	TNT Area C	Pentolite Rd RWP	West Area RWP	"Burn Ground #1"	Reservoir #2 BG	G-8 Burn Ground	Fox Road BG	Taylor Road BG	Snake Road BG	Waste Lagoons	"Ash Pit #1"	Ash Pit #1	Ash Pit #2	Ash Pit #3	Lower Toluene Tanks	Middle Toluene Tanks	Upper Toluene Tanks	Rail Car Unloading Area/Sellite Area	Acid Areas	Pentolite Area	Garage Maintenance Area	TNT Rail Car Loading Areas
Nitrobenzene	U	U		NA	NA						NA						U		U	U				
Phenanthrene	U	U		NA	NA						NA						U		U	U				
Pyrene	U	U		NA	NA						NA						U		U	U				
Pesticides																								
4,4'-DDE	NA	NA		NA	NA						NA						NA		NA	NA				
4,4'-DDT	NA	NA		NA	NA						NA						NA		NA	NA				
Aldrin	NA	NA		NA	NA						NA						NA		NA	NA				
Aroclor 1240	NA	NA		NA	NA						NA						NA		NA	NA				
Aroclor 1260	NA	NA		NA	NA						NA						NA		NA	NA				
Dieldrin	NA	NA		NA	NA						NA						NA		NA	NA				
Heptachlor	NA	NA		NA	NA						NA						NA		NA	NA				
Methoxychlor	NA	NA		NA	NA						NA						NA		NA	NA				
Metals																								
Arsenic	NA	U		U	U						NA						NA		U	U				
Barium	NA	32.6B		U	U						NA						NA		51.7B	71.3B				
Chromium	NA	U		U[b]	0.12[b]						NA						NA		U	U				
Iron	NA	19,500		U	U						NA						NA		U	174				
Lead	NA	U		U	U						NA						NA		U	U				
Manganese	NA	U		.053[b]	3[b]						NA						NA		U	U				
Silver	NA	U		U	U						NA						NA		U	U				
Sodium	NA	9,100		17[b]	441[b]						NA						NA		246,000	13,100				
Sulfate	NA	NA		U	950[b]						NA						NA		NA	NA				
Total silver	NA	U		NA	NA						6[a]						4,330B		U	U				
Total arsenic	NA	124		NA	NA						6.8[a]						43		20	54				
Total chromium	NA	159		NA	NA						22[a]						18.6		57.1	103				
Total lead	NA	340		NA	NA						9.1[a]						46		23	160				
Nitroexplosives																								
1,3-Dinitrobenzene	NA	NA		U	U						NA						U		U	U				
1,3,5-Trinitrobenzene	NA	NA		U	U						NA						U		U	U				
2,4,6-Trinitrotoluene	NA	NA		U	U						NA						U		U	U				
Nitrotoluene	NA	NA		U	U						NA						U		U	U				
PETN	NA	NA		NA	NA						NA						U		U	U				
TNT	NA	NA		U	U						NA						U		U	U				
DNT	NA	NA		U	U						NA						U		U	U				

Sources: [a] H'GCL, [b]IT, [c]Burgess & Niple, [d]Battelle, MK all others.

J Estimated value.

U Compound was analyzed for but not detected.

E Compound exceeded CLP calibration range but was within instrument linear range.

NA Not analyzed.

B Analyte was found in the associated blank as well as the sample.

Table 4-4. Continued

5.0 SITE MANAGEMENT OBJECTIVES

This section contains a description of the goals of environmental restoration at PBOW. Also included are objectives for data quality, safety, quality assurance, community relations, and coordination with NASA and regulatory agencies.

5.1 ENVIRONMENTAL RESTORATION

The primary goal of the PBOW remedial program is to effect clean up of the site to agreed-upon levels using the most practicable methods in a cost- and time-effective manner. Accomplishment of this program requires establishing effective relationships among all parties involved: NASA, USACE Huntington District, USACE Nashville District, USEPA Region V, Ohio EPA, and other state agencies. An effective community relations program is required to ensure public involvement. The program also requires implementation of a well-developed program management plan which establishes an achievable sampling and analysis plan which will result in a clear depiction of the nature and extent of contamination at all suspect areas of the site with legally-defensible data. A monitored safety and health plan is to be initiated to ensure worker safety during remedial activity.

5.2 DEVELOPMENT OF DATA QUALITY OBJECTIVES

USEPA has developed a data quality objectives (DQO) process as a tool for project managers to determine the type, quantity, and quality of data required to make decisions and to develop a more efficient sampling and analysis program. DQOs are qualitative and quantitative statements that:

- State the problem
- Identify the Decision
- Identify inputs to the decision
- Define the study boundaries
- Develop the decision rule
- Specify tolerable limits on decision errors
- Optimize the design.

Remedial activities at PBOW will be developed using the DQO methodology provided in *Guidance for the Data Quality Objectives Process* (USEPA 1994) and shown in Figure 5-1.

STEP 1 - STATE THE PROBLEM

Consisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem.

↓

STEP 2 - IDENTIFY THE DECISION

Identify what questions the study will attempt to resolve, and what actions may result.

↓

STEP 3 - IDENTIFY THE INPUTS TO THE DECISION

Identify the information that needs to be obtained and the measurements that need to be taken to resolve the decision statement.

↓

STEP 4 - DEFINE THE STUDY BOUNDARIES

Specify the time period and spatial area to which decisions will apply. Determine when and where data should be collected.

↓

STEP 5 - DEVELOP A DECISION RULE

Define the statistical parameter of interest, specify the action level, and integrate the previous DQO outputs into a single statement that describes the logical basis for choosing among alternative actions.

↓

STEP 6 - SPECIFY TOLERABLE LIMITS ON DECISION ERRORS

Define the decision maker's tolerable decision error rates based on a consideration of the consequences of making an incorrect decision.

↓

STEP 7 - OPTIMIZE THE DESIGN

Evaluate information from the previous steps and generate alternative data collection designs. Choose the most resource-effective design that meets all DQOs.

FIGURE 5-1. DATA QUALITY OBJECTIVE PROCESS

5.3 SAFETY OBJECTIVES

As mandated by CERCLA §111(c)(6), programs must be implemented *to protect the safety and health of workers involved in response to hazardous substance releases, removals, or remedial actions.* USACE has developed safety and health requirements for all USACE activities, including remediation, which are defined in EM 385-1-1. A guidance document, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities,* has been developed by a four-agency committee consisting of the National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard, and USEPA. These guideline documents include descriptions of methods for increasing safety and health of workers in areas such as training, health monitoring, emergency plans, accident reporting, hazard identification, sanitation, personal protective clothing, site control, air monitoring, decontamination, and waste handling.

All activities associated with remediation at PBOW will comply with USACE and OSHA/NIOSH guidelines. Section 8.0 presents guidance for the preparation of the Site-Specific Safety and Health Plan for PBOW.

5.4 QUALITY ASSURANCE OBJECTIVES

The overall quality assurance (QA) program for investigative sampling at PBOW is to provide legally- and scientifically-defensible data of known quality. QA objectives are designed to support decisions to be made concerning remediation of AOCs. PBOW QA requirements, presented in Section 6.0, establish the responsibilities and administrative methods by which PBOW remedial activities are implemented under USACE ER 1110-1-263. Compliance with these requirements ensures maintenance of the highest standards of quality, consistency, communication, and control of sampling, analysis, and document preparation at PBOW.

5.5 COMMUNITY RELATIONS OBJECTIVES

An effective community relations program is based on establishing a two-way dialog designed to not only keep local citizens informed about site progress, but to also allow them the opportunity to provide input to site decisions. Initiation of these programs should be accomplished early in the remediation program. To date, USACE personnel have maintained an open dialog with community leaders and the media. As remedial activities proceed, a focused community relations plan will be developed to facilitate community involvement with site activities and to formalize USACE methods to inform the public on site activities

as well as methods for conflict resolution. Guidance for a community relations program for PBOW is included in Section 3.0 of Part C.

5.6 COORDINATION WITH NASA

Effective communication with NASA, established early in the remedial process, is essential for the implementation of a well-coordinated remedial effort, particularly with the potential for areas of joint responsibility. Shared sampling and analysis programs, treatment, or removal projects would be cost-effective, would identify and potentially resolve sitewide issues, and would reduce the overall time required for cleanup for both agencies.

5.7 COORDINATION WITH REGULATORY AGENCIES

USACE works closely with federal, state, and local agencies in the execution of all projects. Regulatory agencies are routinely given the opportunity to fully participate in evaluation and oversight of remedial activities on DERP-FUDS properties. Coordination with agencies is begun early in any remedial activity to establish good working relationships. Regulatory agencies requiring coordination include: USEPA, state EPAs, Advisory Council on Historic Preservation, state historic preservation officers, U.S. Department of the Interior, U.S. Fish and Wildlife Service, and state departments of natural resources (Divisions of the Ohio Department of Natural Resources), among others.

Interactions with federal and state agencies are well-defined when a site is included on the NPL. An IAG negotiated between DOD and USEPA in 1988 stipulates model language for NPL sites, and USACE routinely enters into IAGs during the RI/FS phase of NPL sites. DOD responsibilities are detailed in the DERP-FUDS Program Manual.

6.0 QUALITY ASSURANCE REQUIREMENTS

The overall quality assurance (QA) philosophy for the investigative work at PBOW is to provide measurement tools and procedures to ensure that data collected will be defensible and of known quality. As such, the environmental data must meet quality assurance objectives designed to support decisions to be made regarding the areas of concern (AOCs).

The USACE has adopted USEPA Region V guidance on the establishment of quality assurance requirements. USACE document ER 1110-1-263, *Chemical Data Quality Management for Hazardous Waste Remedial Activities* (USACE 1990), also provides management responsibilities and procedures for all USACE investigative and remedial activities at hazardous waste sites, to ensure that the analytical data are of sufficient quality to their meet intended purpose. Appendix D of ER 1110-1-263 provides guidance on the preparation of the Quality Assurance Project Plan (QAPP) (Chemical Data Acquisition Plan) required for environmental investigations. The USACE document EM 200-1-3, *Requirements for the Preparation of Sampling and Analysis Plans*, provides guidelines for the preparation of the Sampling and Analysis Plan (SAP), including the QAPP. Standard methods and procedures promulgated by the USEPA and the American Society of Testing Materials (ASTM) will also be followed as applicable.

The QAPP together with the Field Sampling Plan (FSP) make up the SAP required for every investigation at PBOW. Requirements for the QAPP are described in this section. Requirements for the FSP and SAP are discussed in Section 7.0.

6.1 QAPP REQUIREMENTS

The QAPP provides guidance for investigative, remedial, and monitoring projects to ensure that data are of sufficient quality to meet intended project objectives. Data quality depends not only on how carefully an analytical method is carried out, but also on the sample point selection, sampling procedures, sample integrity, and analytical methods selected. Each of these criteria is defined during project scoping when data quality objectives are established for the project, and are specified in the QAPP, which becomes part of the Project-Specific SAP (PSAP). The required format and contents of a QAPP are found in ER 1110-1-263. The QAPP must include, at a minimum, the following sections:

- Project Description
- Project Organization and Responsibilities
- Data Quality Objectives (DQOs)

- Sampling Locations and Procedures
- Sample Custody and Holding Times
- Analytical Procedures
- Calibration Procedures and Frequency
- Internal QC Checks
- Calculation of Data Quality Indicators
- Corrective Actions
- Data Reduction, Validation, and Reporting
- Preventive Maintenance
- Performance and System Audits
- QC Reports to Management.

The QAPP must be reviewed and approved by USACE prior to beginning field work. Copies of the approved QAPP will be sent to all addressees on the SMP distribution list. Should PBOW, or any source area at PBOW, become listed on the NPL, the QAPP must also be approved by the lead agency's project officer, with additional approvals as required by interagency agreements or memoranda of understanding.

6.2 DATA QUALITY OBJECTIVES

To generate data that will meet the contract objectives, it is necessary to define the types of decisions that will be made, and to identify the intended use of the data. For each investigation at PBOW, Data Quality Objectives (DQOs) will be developed which define data quality requirements based on the intended use of the data. DQOs are necessary to obtain sufficient data of known defensible quality for their intended use. The DQO development process assists in determining the appropriate sample handling procedures; analytical methods; precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters; and practical analytical quantitation limits.

In the DQO process, a number of steps must occur during project scoping for each phase of the project to identify all necessary data needs to complete the project (see Figure 5-1). While each phase will have different information requirements, and therefore different data needs, the data requirements of the entire project must be recognized to optimize each phase and to avoid unnecessary or redundant sampling and analysis. This process will ultimately lead to a comprehensive sampling and analysis protocol for each phase of the project. USACE technical project planning guidance (EM 200-1-3) will be used during development of the DQOs for data collection (USACE 1994a).

6.3 SAMPLE CONTAINERS, SAMPLE HANDLING, AND CUSTODY REQUIREMENTS

Sample handling procedures will be specified in the QAPP, and will be in accordance with the guidance provided in EM 200-1-3 (USACE 1994a). Specific requirements for sample containers and preservatives

are provided in Appendix I of EM 200-1-3. Requirements for packaging and shipping of samples are specified in Appendix F of EM 200-1-3.

Chain-of-custody procedures provide documentation of the handling of each sample from the time it is collected until it is destroyed. Chain-of-custody procedures are implemented so that a record is maintained of sample collection, transfer of samples between personnel, sample shipping, and receipt by the laboratory. The chain-of-custody record serves as a legal record of possession of the sample. Chain-of-custody is initiated with the collection of the sample, and remains with the sample at all times. Custody requirements are provided in EM 200-1-3, along with sample chain-of-custody forms. In addition to the custody record, custody seals are used on sample containers and shipping coolers to discourage tampering.

6.4 ANALYTICAL METHODS AND HOLDING TIMES

The specific analytical methods to be used for PBOW investigations depend upon project objectives, site-specific chemicals of concern, and the data needs and uses described in the SAP. In general, data quality requirements for risk assessment are more stringent than for other objectives for which these data will be used. To generate data of sufficient quality to be used for risk assessment, USEPA Contract Laboratory Program (CLP) methodologies, or SW-846 Methods and Methods for Chemical Analyses of Water and Wastes, will be used to analyze samples collected at PBOW sites. Samples analyzed for nitroaromatic compounds will use EPA Method 8330 for soils and EPA Method 8330/609 for water samples. Acceptable analytical methods are provided in EM 200-1-3. The sample preparation/extraction and analysis methods used for a site investigation will be specified in the QAPP.

Holding time for an analyte is defined as the maximum allowable time between sample collection and analysis or extraction, based on the analyte of interest, stability factors, and sample preservative used. Samples will be sent to the laboratory as soon as possible after collection by overnight courier service to minimize the possibility of exceeding holding times. Holding times will be consistent with the applicable methodologies identified in the QAPP, and will be assigned in accordance with ER 1110-1-263, Appendix D. Site-specific requirements for holding times will be defined in the QAPP.

6.5 QA/QC REQUIREMENTS

USACE requires that quality control (QC) and quality assurance (QA) samples be collected and analyzed by the contract laboratory and the USACE QA laboratory, respectively (ER 1110-1-263, USACE 1990). These QC and QA samples include splits or replicates of field samples, rinsate blanks, trip blanks, and background soil and water samples. QC samples, which represent approximately ten percent of the field

samples, help the contractor identify and diagnose problems related to sampling and analysis. QA samples, which also represent approximately ten percent of the field samples, are sent to a USACE QA laboratory for government monitoring of sampling and contract laboratory performance. Guidance on chemical quality assurance is provided in ER 1110-1-263 (USACE 1990).

6.6 CHEMICALS OF CONCERN AND ANALYTE GROUPINGS

Based on historical activities and previous investigations, the chemicals of concern (COCs) at PBOW are primarily nitroaromatic compounds and heavy metals. General categories of solvents, fuels, and waste oil, as well as typical landfill and combustion wastes, are other potential COCs at PBOW AOCs. Categories of COCs are listed below.

Inorganics:
- heavy metals
- sulfate and nitrate residues
- asbestos

Organics:
- nitroaromatic compounds
- pesticides/PCBs
- polynuclear aromatic hydrocarbons (PAHs)
- benzene, ethylbenzene, toluene, xylenes (BTEX)
- fuels
- waste oil
- chlorinated hydrocarbons and other volatile halogenated hydrocarbons
- solvents
- acids
- paint and varnish derivatives

Specific COCs for each AOC at PBOW are discussed in Part B, Sections 2.0 through 14.0 of this SMP.

6.7 REPORTING LIMITS (DETECTION LIMITS)

The project-required reporting limits for chemical analyses will be provided in the QAPP. These are the reporting limits that the laboratory must be able to meet, based on the analysis of pure water and using the analytical methods specified for that site. Suggested reporting limits are provided in ER 1110-1-263, Appendix D. Specific reporting limit requirements may vary depending on the eventual use of the data, the applicable regulations, and the decisions which need to be made at the site. Normally, the DQO process will establish reporting limit requirements, recognizing that not all data will be used for risk assessment.

6.8 DATA REVIEW AND VALIDATION

All analytical data generated by the contract laboratory shall be extensively reviewed prior to report generation, in accordance with EM 200-1-3, to assure the validity of the reported data. This internal review process shall consist of data generation, data reduction, a minimum of three levels of documented review, and data reporting. In each stage, the review process shall be documented using an appropriate checklist form that is signed and dated by the reviewer.

Following internal review and reporting, an independent validation of the data will be conducted by personnel independent of the laboratory generating the data. Validation procedures shall follow USEPA *Functional Guidelines for Organic Data Review*, and *Functional Guidelines for Evaluating Inorganic Analyses*. Analyses not specifically covered by National Functional Guidelines will be validated using method QA/QC requirements or the DQOs specified in the Laboratory Quality Management Plan for the investigative work.

Ten percent of the full data deliverables will be validated using the above guidelines. In addition, 100 percent of the data will be verified by reviewing for compliance with field QA/QC requirements. Analytical laboratory results will be verified using criteria for QC data specified in the QAPP for the respective EPA methodologies. The QC elements checked for data packages include:

- Completeness of the data package
- Review of the laboratory narrative information
- Compliance with required holding times
- Presence or absence of analytes in method blanks and field blanks
- Results of analysis of laboratory control samples
- Recoveries of surrogate spikes in samples
- Results of analysis of matrix spike samples, laboratory duplicates, and field duplicate samples.

6.9 DATA ASSESSMENT

Data assessment is defined as an evaluation of quality issues that could affect the major data uses. In general, the objectives of environmental investigations are to identify and quantify the nature and extent of contamination, and to support an evaluation of the risk to human health and the environment. The data assessment is conducted to determine if the data are of sufficient quality to support these objectives.

For laboratory analytical data, QA objectives will be specified in the QAPP. The objectives will define indicators of the quality of the data which will be used in the assessment to evaluate data acceptability

and usability. Data quality indicators for analytical data will be expressed in terms of the precision, accuracy, completeness, representativeness, comparability, and sensitivity required. The DQO process will establish the intended use of the data for decision making, and the acceptability criteria for the data.

In conjunction with the analytical data review, other information, including field observations and previously collected data, will be evaluated in the assessment of the usability of the data. Results of the data assessment will be presented in an appendix to the site investigation report.

7.0 SAMPLING AND ANALYSIS PLAN

A Sampling and Analysis Plan (SAP) is required for the collection of environmental data at all USACE sites. The SAP describes the project requirements for all field activities, laboratory activities, and contract deliverables related to the acquisition and reporting of chemical data for hazardous, toxic, and radioactive waste response activities. SAPs for all work at PBOW will be prepared in accordance with USACE Engineering Manual (EM) 200-1-3, *Requirements for the Preparation of Sampling and Analysis Plans* (USACE 1994a). SAPs prepared in accordance with this guidance are intended to be functionally equivalent to USEPA sampling and analysis plans, field sampling plans, and quality assurance project plans prepared under CERCLA, and to data collection quality assurance plans and data management plans prepared under RCRA.

To reflect EPA guidance, the SAP is divided into two parts: a field sampling plan (FSP) and a quality assurance project plan (QAPP). The FSP addresses the field activities, including all aspects of drilling and sampling. The QAPP addresses the data quality objectives, specific quality assurance (QA) and quality control (QC) activities, and laboratory activities designed to achieve the data quality goals of the project. Requirements for the QAPP are addressed in Section 6.0 of this SMP. The remainder of this section addresses the requirements of the FSP.

Guidance document EM 200-1-3 contains the requirements for the format and content of SAPs. Procedural guidelines are also contained in EM 1110-1-4000, *Monitoring Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites* (USACE 1994b); American Society for Testing and Materials (ASTM) procedures; and Sections 3745-54 and 3745-55 of the Ohio Administrative Code (OAC). More detailed information concerning specific Ohio regulations on field activities is included in Section 2.0. A listing of ASTM field sampling and analysis methodologies that are to be followed for PBOW remediation activities is included in Table 7-1.

7.1 SAP REQUIREMENTS

The SAP presents guidance for standards and techniques required to ensure that data collection activities will be comparable to, and compatible with, previous data collection activities performed at the site, while providing a mechanism for planning and approving field activities. Because each investigative study performed at PBOW will have site-specific sampling goals and requirements, a project-specific SAP (PSAP) is to be completed prior to initiation of each sampling program at PBOW.

Table 7-1. ASTM Methods for Field Sampling and Analysis Activities

Field Activity	ASTM Standard
Particle-size analysis of soils	D 422-63
Soil investigation and sampling by auger borings	D 1452-80
Penetration test and split-barrel sampling of soils	D 1586-84
Thin-walled tube sampling of soils	D 1587-83
Diamond core drilling for site investigation	D 2113-83
Visual-manual description and identification of soils	D 2488-93
Decontamination of field equipment at nonradioactive waste sites	D 5088-90
Decommissioning of ground-water wells, vadose zone monitoring devises, boreholes, and other devices for environmental activities	D-5299-92
Field logging of subsurface exploration of soil and rock	D 5434-93
Pore-liquid sampling from the vadose zone	D 4696-92
Selection of aquifer-test field and analytical procedures in determination of hydraulic properties by well techniques	D 4043-91
Data elements to describe a ground-water site	D 5408-93, D 5409-93, D 5410-93, D 5254-92
Soil gas sampling and monitoring in the vadose zone	D 4700-91, D 5314-92
Design and installation of ground-water monitoring wells in aquifers	D 5092-90
Classification of soils for engineering purposes	D 2487-93
Preserving and transporting soil samples	D 4220-89
Analysis of nitroaromatic and nitroamine explosive in soil	D 5143-91
Deep, quasi-static, cone, and friction-cone penetration tests of soil	D 3441-86
Density of soil and rock in-place at depths below the surface	D 5195-91
Determining subsurface liquid levels in a borehole or monitoring well	D 4750-87
Water content of soil and rock in-place	D 5220-92
Ring-lined barrel sampling of soils	D 3550-84
Investigating and sampling of soil and rock	D 420-93
Wet/dry preparation of soil samples for particle-size analysis and determination of soil constants	D 421-85, D 2217-85

Source: Annual Book of ASTM Standards, 1994.

Scoping for each PSAP is to be accomplished in accordance with USEPA's *Guidance for Planning for Data collection in Support of Environmental Decision Making Using the Data Quality Objectives Process.* The required format and contents of a PSAP are found in EM 200-1-3. Each PSAP must address, at a minimum, the following items:

FSP Requirements:

- Project description
- Project organization and responsibilities
- Scope and objectives
- Description of field activities, including sampling rationale and objectives
- Documentation requirements
- Sample packaging and shipping
- Investigative-derived wastes
- Project schedule

QAPP Requirements:

- Data quality objectives
- Sampling locations and procedures
- Sample custody and holding times
- Analytical procedures
- Calibration procedures and frequency
- Internal QC checks
- Calculation of data quality indicators
- Corrective actions
- Data reduction, validation, and reporting
- Preventive maintenance
- Performance and system audits
- QC reports to management.

Environmental sampling at PBOW should not be initiated until the PSAP has received the necessary approval(s). Each PBOW PSAP is to be approved by the USACE Nashville District, and the USACE Huntington District. Copies of the approved PSAP will be sent to all addressees on the SMP distribution list. Should the PBOW site become listed on the NPL, the PSAP must also be approved by the lead agency's project officer, with additional approvals as required by interagency agreements or memoranda of understanding. The PSAP also must address the need to coordinate sampling activities with NASA, particularly in areas of PBOW that may have site-specific sampling requirements, such as the reactor facility.

7.2 SAMPLING REQUIREMENTS

Sampling procedures for environmental investigations at PBOW shall follow the guidance provided in EM 200-1-3. A successful sampling program requires:

- Sampling methodologies which allow the collection of representative samples based upon data needs.
- Proper sampling devices that minimize the disturbance to, and chemical composition of, the medium being sampled.
- Decontamination procedures that reduce the potential for cross-contamination between sampling points.
- Proper sampling containers and preservation techniques to maximize the integrity of the samples during handling, storing, and shipping.
- A QA/QC program that enhances the confidence in the analytical results.

This section describes the general sampling procedures to be used at PBOW, and provides guidance for the sampling of surface and subsurface soils, sediments and surface water, and ground water at the site.

7.2.1 General Procedures

The principal goal of an environmental investigation is to collect samples that are representative of site conditions so that an accurate assessment of contamination can be made with a minimum level of uncertainty. This requires the use of proven sampling practices that are consistently applied during all phases of site investigations. These include the use of standard field documentation forms, sample containers, sample handling and shipping procedures, sample numbering systems, field QA/QC samples, and calibration of field instruments.

7.2.1.1 Sample Documentation

When samples are collected for analysis of chemical or physical parameters, documentation such as chain-of-custody and sample analysis request forms, custody seals, and field logbooks will be completed, as specified in EM 200-1-3. Information on site conditions, soil borings and monitoring wells, sampling results, and field data should be recorded in field logbooks. Each field logbook is to be a weather-resistant, bound, survey-type field book with non-removable numbered pages and is to be assigned a specific logbook number. Any deviations from the prescribed drilling or sampling procedures should also be included in the logbook. Documentation errors will be corrected by drawing a single line through the incorrect entry, making the correction, and initialing the new entry.

In addition to the logbooks, some data will be entered directly onto forms designed for specific applications:

- Field memo form: includes a summary of daily drilling and sampling activities, weather, visitors, delays, and comments such as depth at which water was first encountered during drilling, depth at which boring diameters changed, depth at which tools or equipment were lost, and depth at which any discoloration, odor, root holes, disturbed bedding, cavities, or weathered zones were observed.

- Sample collection log: one for each type of sample to be collected (surface soils, water, etc.). The logs will contain sample location, depth, soil type, any foreign materials present, and any deviations from the PSAP.

- Boring log: indicating field personnel, drill rig, boring diameter, type of sample, lithologic description, reference elevation, fluid levels, hole depths, GSA color, sample interval, magnetometer readings, USCS symbols, and percentages of gravel, fines, and sand.

- Well completion form: includes the well number, site geologist, date construction was begun and completed, problems encountered, borehole depth, casing schedule and depth, and the intervals and volumes of cement grout, bentonite seals, and sand pack used. Also included are the type of sand pack used, the screened interval, and actual calculations of annular volumes.

- Chain-of-custody form: each with a unique number and containing the sample location, signature of the person taking the sample, number of samples, types of analyses to be completed, and the date and time the samples were taken. The form also indicates the name of the person taking custody of the sample at the laboratory, and the date and time of arrival.

- Instrument calibration log: includes the date and time of calibration, name of staff member performing the calibration, and results of all field calibrations and equipment maintenance, identified with a unique number assigned to each instrument (manufacturer's serial numbers and/or corporate/project instrument identification number).

During QA review of logbooks and forms, any corrections that have to be made will be completed by drawing a single line through the incorrect information, entering the correct information, and entering the initials of the person making the correction.

7.2.1.2 Sample Containers and Sample Shipping

Sample containers will be prepared in accordance with the guidance provided in EM 200-1-3 (USACE 1994a). Normally, sample containers with preservatives are supplied by the analytical laboratory according to the specifications in the QAPP. All containers will be labeled with the date, sample designation, project name, collector's name, time of collection, and parameters to be analyzed.

When samples are sent to the laboratory for analysis, documentation such as chain-of-custody and sample analysis request forms, custody seals, and logbooks will be completed, as specified in EM 200-1-3. Samples are normally shipped in plastic or metal coolers, packed with ice or "blue ice" to keep the samples chilled to 4° C, and sent to the laboratory by overnight express carrier. Each sample jar or bottle is sealed in its own plastic bag and placed upright in the cooler, packed so as not to touch adjacent sample jars. Chain-of-custody documentation is packed in a plastic sleeve fastened to the inside lid of the cooler, and the cooler is taped shut, with custody seals added to discourage tampering.

7.2.1.3 Sample Numbering

A consistent sample numbering system should be used to identify each sample collected and submitted for analysis. The sample numbers should be used on sample labels, sample tracking matrix forms, chain-of-custody forms, field logbooks, and all other applicable documentation. The example numbering system shown below is taken from EM 200-1-3. This system identifies the sample type and location (AABBB), the sample sequence number (CC), date (MM/DD/YY), and sample interval for subsurface soils (00-00):

For soil and bedrock:	AABBB-CC/MMDDYY/00-00
For water:	AABBB-CC/MMDDYY
For QC samples:	AABBB-CC/MMDDYY

Example: SB001-01/061395/04-06 refers to soil boring SB001, sample number 1 from this boring, sampled on June 13 1995, from a sampling depth of 4 to 6 feet.

Suggested sample designations are: (1) SS for surface soils; (2) SB for soil borings; (3) SD for sediment; (4) SW for surface water; and (5) GW for ground water.

7.2.1.4 QA/QC Samples

The QA/QC program is an integral part of the environmental investigations conducted at PBOW. The applicability and appropriateness of the field sampling protocol can be verified by the inclusion of a program of scheduled field control samples, such as field replicates (duplicates, splits, field spikes) and blanks (equipment rinsates, field blanks, trip blanks). All field control samples shall be handled exactly as the environmental samples. A brief description of QA/QC samples is included here:

- Field replicates: samples taken at a particular location or time to assess error associated with sample heterogeneity, sampling methodology applicability, and sample handling techniques. These include: field duplicates - replicates of field samples which are sent blind to the contractor's lab for analysis; split samples - replicates sent to the government QA lab for analysis; and field spikes - replicates to which a known quantity of analyte is added in the field and sent blind to the lab (these are not commonly used on USACE projects).

- Field (bottle) blanks: analyte-free (deionized) water or certified clean sand which is transferred to the appropriate sample containers in the field, and submitted for analysis. They are used to assess the potential incidental contamination due to the field operations (exposure to air) or contamination due to the sample container. (Not commonly used on USACE projects, but may be required by regulator preference.)

- Rinsate (equipment) blanks: samples of analyte-free (deionized) water which are rinsed over decontaminated sampling equipment, collected, and submitted for analysis which are used to assess cross-contamination from the sampling equipment and the effectiveness of the decontamination procedure.

- Trip blanks: samples of organic-free (deionized) water that are prepared in the lab, shipped with the other sample containers, and returned to the lab unopened in each shipping container that contains aqueous VOC samples. They are used to evaluate the potential for contamination that may occur during shipping and handling.

7.2.1.5 Field Instrument Calibration

Field testing and monitoring equipment should be inspected and calibrated before use. Standards and manuals for all equipment should be kept on-site and in good condition. Each time an instrument is used, it should be checked against specified standards. All equipment will be maintained according to manufacturers' specifications. The date, time, and results of all field calibrations and equipment maintenance should be noted in an instrument calibration log in which each instrument is uniquely identified by manufacturer or corporate serial number.

7.2.2 Surface and Subsurface Soil Sampling

Collection of surface and subsurface soil samples shall be in accordance with EM 200-1-3. Surface soil samples are generally defined as those from a depth of 1 to 12 inches, and are most often taken with a hand auger or a scoop. Subsurface soil samples are those taken below 12 inches, and can be taken with either a hand auger (up to about five feet deep) or a drill rig. The sampling techniques employed depend on field conditions, the nature and depth of soil being sampled, and the objectives of the sampling program. Additional guidance on sampling equipment and techniques can be found in EM 1110-2-1907, *Soil Sampling*.

7.2.3 Sediment and Surface Water Sampling

Sediment samples from ponds, streams, water-filled foundations, or sumps should be collected using an Eckman dredge, bucket auger, or similar device, following procedures discussed in EM 200-1-3. Specific

procedures for sediment sampling should be established based on the sampling equipment selected. Excess liquid should be decanted from the sediment sample prior to its placement in the sample container. Physical characteristics of the samples should be noted in the field logbook and on the sample collection form.

Surface water samples from standing water, ponds, seeps, and streams shall be collected in accordance with the procedures discussed in EM 200-1-3. If practical, prior to sample collection, the pH, specific conductivity, and visual appearance of the water should be recorded in the field logbook and on the sampling form. If sampling in a stream, the sample should be collected upstream of where the sampler is standing to minimize the introduction of sediment in the sample. Also, if surface sediment samples are to be collected from the same location, the water sample should be collected first to minimize the introduction of sediment in the water sample.

Information on sampling times, dates, locations, depths, and other pertinent information should be recorded in the field logbook and on the sample collection forms. Sampling locations should be marked with a surveyor's stake or flag which remains in place until the location is surveyed.

7.2.4 Ground-Water Sampling

Sampling of newly installed wells should take place no sooner than 14 days after well development has been completed. Recommended sampling techniques and equipment are provided in EM 200-1-3. It is incumbent on the sampling personnel to collect samples that are as representative as possible of the aquifer. To this end, the wells should be purged prior to sampling until pH, conductivity, and temperature stabilize. Stabilization will be established by at least three consecutive readings, where one casing volume is removed between each reading. Determinations of consistent pH, conductivity, and temperature should be accomplished in accordance with EM 200-1-3. Air should not be used to pump water from the well, as this may affect the VOC content of the water. Purge water should be collected in 55-gallon drums and managed as investigative-derived waste (IDW) (Section 7-8).

After purging, sample water should be withdrawn slowly and carefully to avoid agitation, and placed in pre-preserved sample containers for shipment to the laboratory. Samples for VOC analysis should be poured into 40-ml vials, creating a positive meniscus, and capped with no bubbles trapped in the sample. Samples for metals analysis should be collected in two separate containers, one for filtered water and one for unfiltered water. A 0.45-micron filter is suggested for the filtered sample. Information on sampling times, dates, locations, water level depths, and other pertinent information should be recorded in the field logbook and on the sample collection forms.

7.3 SOIL BORINGS

Soil borings will be drilled and sampled in accordance with EM 200-1-3. Soil borings less than five feet in depth may be advanced by a stainless steel hand (bucket) auger or a stainless steel split-core sampler. Borings over five feet in depth are to be drilled using a suitable drilling technique such as hollow-stem auger. The drilling method should be selected by the project geologist, working with the drilling subcontractor, to assure compliance with the sampling objectives established in the scoping process.

Physical properties of soils encountered in boreholes will be described on boring logs. Soils will be classified using the Unified Soil Classification System (USCS) to describe moisture content, particle size and distribution, degree of sorting, plasticity, and consistency in accordance with ASTM Procedure D 2488, *Visual-Manual Description and Identification of Soils*. Other descriptions will include Geological Society of America (GSA) color, angularity, and signs of contamination. Health and safety monitoring instrument readings (e.g., HNu and LEL readings) and sampler penetration rates (e.g., "blow counts") will also be indicated on the boring logs.

Upon completion of a soil boring, if a well is not being installed, the borehole will be abandoned with a grout/cement mixture. A suggested grout mixture is 95 pounds of Type I or II portland cement to 5 pounds of powdered bentonite with 7 to 7.5 gallons of water. The grout mixture should be gravity fed into the borehole as the augers or casing are removed. After 24 hours the borehole should be checked for settlement and additional grout added if needed. After the grout mixture has hardened, the borehole should be covered with a minimum of six inches of native topsoil. Borehole abandonment will be documented in field notebooks.

Borehole locations should be staked and flagged until they can be surveyed (Section 7.7).

Drill cuttings will be stored in DOT-approved 55-gallon drums labelled with the boring/well number from which they were taken, and disposed as described in Section 7.8.

7.4 MONITORING WELL INSTALLATION, DEVELOPMENT, AND ABANDONMENT

Monitoring wells at PBOW will be installed in accordance with EM 110-1-4000 (USACE 1994b), and ASTM D 5092-90, *Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers*. Additional guidance on the installation, development, and abandonment of monitoring wells at PBOW is provided in this Section.

7.4.1 Well Installation

Monitoring wells installed in the upper glacial material will be single-cased wells constructed of at least two-inch inside diameter threaded flush-joint PVC riser pipe and screen. The boring should allow at least 2 inches of annular space between the borehole wall and all sides of the centered riser and screen.

Wells to be installed in bedrock should be constructed in such a manner as to seal off the upper aquifer before drilling into the bedrock aquifer. This may be accomplished by installing a surface casing two to four feet into unweathered bedrock and grouting it in place. The borehole for the well riser and screen is then drilled through the grout to the desired depth in bedrock. Borings, casings, and riser pipes should be of sufficient diameter to allow two inches of annular space between borehole walls and pipe. Well installation should be in accordance with ASTM D 5092-90.

Screen slot size and filter pack grain size are determined on the basis of sieve analyses in at least one sample collected from the screened interval. One foot of filter pack sand will be placed in the borehole prior to installation of the well screen and riser. If hollow-stem auger drilling is used, the well screen and casing will be installed in the borehole through the augers to prevent cave-in during retraction of the auger string. As the augers are removed, filter materials should be pumped in using a tremie pipe. At no time should there be more than one foot of space below the lead auger and the top of the sand pack, or more than one foot of filter materials in the augers. In most cases the sand pack material will extend at least two feet above the well screen. A three- to five-foot thick bentonite seal should be placed above the sand pack, depth permitting. After the bentonite has been hydrated and allowed to expand, the remaining annular space between the top of the seal and ground surface should be grouted (through a tremie pipe) from the top of the bentonite seal to ground surface.

A five-foot length of protective, clean steel casing with a locking cap should be installed over the well pipe to a depth below the frost line. An internal mortar collar should be placed within the steel protective casing and outside the well casing to a height of 0.5 feet above ground surface. A square concrete pad no less than five feet square and four inches thick should be constructed around the well, sloping away from the well. An internal drainage hole should be drilled through the steel casing just above the mortar collar. After the grout has thoroughly set, the protective steel casing should be painted and a well identification number painted on the casing. Three protective steel posts, each extending five feet above ground surface, should be set radially around the well close to the edge of the pad.

After the well is installed and the surface completion is finished, the well is surveyed for location and elevation. The survey should provide an accuracy of 0.1 foot horizontally, and 0.01 foot vertically. The survey point will be the top of the well casing at a notch cut into the northern side of the pipe.

7.4.2 Well Development

Well development of new wells should take place no sooner than 48 hours, and no longer than 7 calendar days, after placement of the internal mortar collar. New wells should be developed using a submersible pump, bailer, and/or surge block. The use of air to develop a well is not allowed. Development should continue until discharging water is clear to the unaided eye and the sediment thickness remaining in the well is less than 1 percent of the screen length. If yields permit, at least five times the volume of standing water in the well should be removed. If water was added to the borehole during drilling, five times the amount of water added should be recovered during development, in addition to five times the volume of standing water.

During development, field measurements of pH, conductivity, temperature, and physical characteristics (clarity, color, turbidity, and odor) should be made and recorded. Well development will continue until pH, conductivity, and temperature have stabilized, and the water has clarified. Once the field supervisor has determined that a well has been fully developed, a 1-pint sample is captured in a clear glass jar. The sample is agitated to suspend any solids present and a color photograph is taken against a white background, with a color chart included for reference.

Well development water will be stored in labeled DOT-approved 55-gallon drums and disposed as described in Section 7.8.

7.4.3 Well Abandonment

Monitoring wells that require abandonment will be decommissioned in accordance with Ohio Administrative Code 3745-9-10 and ASTM Procedure D 5299-92, *Decommissioning of Ground-Water Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities.* Wells that may require decommissioning include: (1) those that have been damaged or improperly designed or installed and are no longer useful; (2) wells that have been installed across a confining zone and may be a conduit for contaminants into the deeper aquifer; and (3) wells that are no longer useful or have been replaced. Approval for well abandonment must be received from USACE Huntington, USACE Nashville, and NASA Plum Brook Station before decommissioning can proceed. Well abandonment personnel shall be certified by the Ohio Department of Natural Resources.

7.5 AQUIFER TESTING AND WATER LEVEL MONITORING

Field permeability may be evaluated for new wells by performing slug tests after well development. Selected existing wells may also be slug tested after redevelopment, if required. The rate at which the head recovers should be recorded and evaluated to determine in situ hydraulic conductivity. Pressure transducers and electronic data loggers may be used so that several tests can be performed simultaneously.

To determine the hydraulic gradient at the site, water levels in all monitoring wells should be measured within a single consecutive 10- to 12-hour period. Depth to water should be measured to the nearest 0.01 foot from the marking on the riser (inner casing) from which the well elevation has been surveyed. Ground-water levels should be recorded by depth measured and by elevation.

7.6 DECONTAMINATION PROCEDURES

A stringent decontamination and inspection program will be followed for all environmental investigations to prevent cross-contamination, and to maintain the integrity of soil and water samples. The procedure for decontaminating field sampling equipment should be in accordance with ASTM Method D 5088-90, *Decontamination of Field Equipment at Non-Radioactive Waste Sites*. As explained in this Method, the decontamination solutions and sequence may vary depending on the contaminants of concern. Therefore, the decontamination process should be described in detail in the PSAP.

A decontamination station will be established for each site project involving borehole drilling and sampling. Decontamination stations should be constructed to contain and control all decontamination fluids, and allow all fluids to be easily collected in 55-gallon drums. The station also should be constructed to allow drill rigs to be positioned on the station for decontamination.

All equipment that may contact the interior of a hole or that may contact other equipment that will enter a hole (e.g., drill rods, augers, and other tools) shall be thoroughly cleaned at the decontamination station prior to use in any hole. Cleaning should include steam or high-pressure hot water from a steam cleaner. Because no tools or drilling equipment may contact the ground or any other source of contamination prior to use, tools are to be stored on raised metal racks (not wooden pallets) or on polyethylene-covered pallets. If contamination occurs, the tool must be re-cleaned, as specified. The drill rig shall be cleaned prior to each use and prior to mobilization to another borehole location.

Sampling equipment such as split spoons and stainless steel utensils may be decontaminated at the sampling site. All decontamination fluids must be captured and stored in 55-gallon drums as IDW for later disposal, as described in Section 7.8.

7.7 SURVEYING

Locations of sampling points, boreholes, and monitoring wells should be surveyed by a professional surveyor. All horizontal coordinates should be referenced to the State Planar Coordinate System (SPCS); elevations should be referenced to the 1929 National Geodetic Vertical Datum (NGVD).

Horizontal coordinates for all sampling points, boreholes, and monitoring wells should be measured to the nearest 0.1 foot. Elevations of sampling points and boreholes should also be measured to the nearest 0.1 foot, referenced to the NGVD. Monitoring wells should be measured at the top of the well casing to the nearest 0.01 foot. The measurement point at a monitoring well should be clearly and permanently marked with a notch on the north side of the riser pipe.

Existing permanent control monuments should be used for survey control points, where possible. If existing monuments are not available, new control monuments should be provided, after consultation with USACE. Each new control monument should be located horizontally to the nearest 0.1 foot and referenced to the previously established site coordinate system. The elevation of each monument should be measured to the nearest 0.01 foot and referenced to the NGVD. Each monument should consist of a standard 4-inch-diameter brass or aluminum plate embedded permanently in concrete. Identification, elevation, and coordinates should be inscribed on the plate.

7.8 INVESTIGATIVE DERIVED WASTE (IDW)

All drill cuttings will be stored in DOT-approved 55-gallon drums labelled with the boring/well number from which they were taken. If results of the soil sampling analysis indicate that the cuttings are non-hazardous, the cuttings can be disposed on site with the approval of USACE and NASA environmental managers. If the cuttings are believed to contain a regulated waste, the drums will be further labeled in accordance with USEPA regulations and stored on-site pending disposal.

Monitoring well development water, purge water, and decontamination fluids will also be stored in DOT-approved 55-gallon drums, appropriately labeled to identify the type of waste and the well from which it was derived. If results of ground-water analyses indicate that the development and purge waste waters are non-hazardous, they may be disposed on site with the approval of USACE and NASA environmental

managers. If the waste waters are believed to contain a regulated waste, the drums will be further labeled in accordance with USEPA regulations and stored on-site pending proper disposal. Waste fluids from decontamination will be sampled and analyzed, and, depending on the analytical results, disposed on site or stored on-site pending proper disposal. The results of IDW analysis and the management and disposal of IDW will be described in an IDW report prepared by the contractor responsible for the IDW.

8.0 SITE-SPECIFIC SAFETY AND HEALTH PLAN

As mandated by CERCLA §111(c)(6), programs must be implemented *to protect the safety and health of workers involved in response to hazardous substance releases, removals, or remedial actions.* USACE has developed safety and health requirements for all USACE activities, including remediation, which are defined in EM 385-1-1 *Safety and Health Requirements Manual* (October 1992). A guidance document, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, has been developed by a four-agency committee consisting of the National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard, and USEPA. These guidance documents include descriptions of methods for increasing the safety and health of workers in areas such as training, health monitoring, emergency plans, accident reporting, hazard identification, sanitation, personal protective clothing, site control, air monitoring, decontamination, and waste handling.

A Site-Specific Safety and Health Plan (SSHP) will be developed to address any and all activities to be performed at PBOW. Required equipment, safety procedures, emergency response actions, and precautions described in the SSHP shall be in accordance with the requirements detailed in EM 385-1-1.

The overall objective of the SSHP for the investigative field activities at PBOW is to provide guidance and requirements for carrying out activities with a minimum of injury to workers. The SSHP shall detail safety requirements for performing investigative work such as sampling, construction, demolition, site surveying, and all other field activities conducted at PBOW. All contractors and subcontractors shall be required to abide by the SSHP. All safety and health plans developed by contractors and subcontractors shall comply with the SSHP at a minimum.

The SSHP will undergo internal review by the contractor and comply with established Quality Control/Quality Assurance plans. A review process which includes the USACE and the National Aeronautics and Space Administration (NASA) will be developed and implemented.

8.1 PURPOSE AND POLICY

The purpose of this Section of this SMP is to establish personnel protection standards and mandatory safety practices and procedures for all work conducted at the PBOW, and to provide guidance for the preparation of the SSHP.

The provisions of the SSHP at PBOW are mandatory for all on-site field personnel. Any supplemental plans used by subcontractors shall, at a minimum, conform to the SSHP. All personnel who engage in PBOW project activities must be familiar with this plan and sign a form indicating their intent to comply with its requirements.

8.1.1 Scope of Work

Field tasks to be performed at PBOW may include: soil and water sampling and analysis; soil boring and well installation; surface and subsurface soil sampling; soil gas analysis; ground water, surface water, and sediment sampling; contaminant movement and migration studies; surveying; and safety and health surveillance, exposure assessments, toxicity assessments, and air monitoring.

8.1.2 Project Team Organization

The project management team includes the project manager, the field team leader, and the site safety officer. Table 8-1 outlines the responsibilities of all on-site personnel that may be associated with a PBOW project.

8.1.3 Safety Training

All on-site personnel shall be appropriately trained in accordance with 29 CFR 1910.120. Training shall include first aid, hazardous waste safety procedures, emergency response actions, and the fitting of personal protective equipment. Personnel shall be qualified and experienced with the types of field operations to be carried out at PBOW. Personnel trained in first aid and CPR shall maintain current certifications. Because the facility is currently operated by the National Aeronautics and Space Administration (NASA), all on-site personnel will be required to view a required NASA Safety indoctrination video.

Each day, prior to the commencement of field activities, each employee working on-site, including subcontract personnel, shall be given a safety briefing by the Site Safety Officer or Field Team Leader. The briefing shall address potential hazards and risks that may be encountered during the day. Additional training in the use of safety equipment, emergency medical procedures, emergency notification procedures, accident prevention, hazard awareness, the daily work plan, and site orientation will ensure safe and effective work accomplishment.

Table 8-1. Responsibilities of On-Site Personnel

Title	Accountability/Authority	Specific Responsibilities
Project Manager	Reports to upper-level management. Has authority to direct investigation operations. Assumes total control over site activities	• Prepares and organizes review of the situation, Work Plan, Site Safety Plan, and the field team. • Obtains permission for site access and coordinates activities with appropriate officials. • Ensures the work is competed on schedule. • Briefs field teams on specific assignments. • Uses the Site Safety & Health Officer to ensure safety and health requirements are met. • Prepares the final report and support files on response activities. • Serves as the liaison with public officials.
Site Safety Officer	Advises the Project Manager on all aspects of safety and health on site. Officer stops work if any operation threatens worker, public health, or safety.	• Periodically inspects protective clothing and equipment. • Ensures that protective clothing and equipment are properly stored and maintained. • Controls entry and exit at the Access Points. • Confirms each team member's suitability for work based on a physician's recommendation. • Monitors the work parties for signs of stress, such as cold exposure, heat stress, and fatigue. • Implements the SSHP. • Conducts periodic inspections to determine if the SSHP is being followed. • Knows emergency procedures, evacuation routes, and the telephone numbers of emergency response personnel, hospitals, and poison control center. • Notifies, when necessary, local public emergency officials. • Coordinates emergency medical care. • Sets up decontamination solutions appropriate for the type of chemical contamination on site. • Controls decontamination of all equipment, personnel, and samples from contaminated areas. • Assures proper disposal of contaminated clothing and materials. • Ensures all required equipment is available. • Advises medical personnel of potential exposures and consequences. • Notifies emergency response personnel by telephone or radio in the event of an emergency. • Reports to Project Manager.
Field Team Leader	Responsible for field operations and safety.	• Manages field operations. • Executes the Work Plan and schedule. • Enforces safety procedures. • Coordinates with the Site Safety Officer in determining required protection level for workers. • Enforces site control. • Documents field activities and sample collection. • Serves as liaison with public officials. • Reports to Project Manager.
Work Team Supervisor	Responsible for oversight of individual Work Team.	• Ensures that work team completes assigned task in accordance with the Work Plan and Site-Specific Safety and Health Plan. • Reports to Field Team Leader and Site Safety Officer.
Work Team	Drillers, sampler technicians, etc.	• Safely completes the on-site tasks required to fulfill the Work Plan. • Complies with Site Safety Plan that a work plan must consist of at least two people. • Notifies Site Safety Officer or supervisor of suspected unsafe conditions. • Reports to Work Team Supervisor.

The SSHP will address the need for site-specific training when working in proximity of NASA facilities. For example, site-specific training may be required for personnel working in the vicinity of the NASA reactor area. Training for personnel in this area will be approved by NASA officials prior to implementation.

8.2 REGULATIONS

To comply with current safety and health, as well as environmental, regulations, on-site workers and contractors will need site-specific training in all applicable local, state, and federal laws.

8.2.1 Federal Safety and Health Regulations

The implementation of a SSHP is mandated by CERCLA §111(c)(6). All pertinent and applicable portions of 29 CFR §1926 *Safety and Health Regulations for Construction* shall be observed. These regulations govern the health and safety of workers who will be involved in site response which uses methods from the general construction industry, such as fall protection, personal protective equipment, and occupational health and environmental controls. These regulations also address the protection of the worker when utilizing tools, machinery, and equipment, as well as performing tasks such as electrical work, motor vehicle operation, mechanized equipment operation, and performing demolition operations.

Federal safety and health regulations concerning hazardous waste site workers are enforced by the Occupational Safety & Health Administration. Applicable Federal regulations which shall be observed by all on-site workers and subcontractors include:

- 29 CFR §1910.120 *Hazardous Waste Operations & Emergency Response*
- 29 CFR §1910.38 *Employee Emergency Plans and Fire Prevention Plans*
- 29 CFR §1910.1200 *Hazard Communication*

8.2.2 State Safety and Health Regulations

The State of Ohio has implemented regulations regarding the safety and health of on-site Emergency Response and Hazardous Waste Operations personnel. These operations are enforced on the state level by the State of Ohio Occupational Safety and Health Division (OSHD), as well as the Ohio Department of Health, and the Fire Marshal of the State of Ohio. Ohio Revised Code 4167 establishes the duties and authority of the OSHD. Ohio Administrative Code 4121 *Building Industry - Precautions During Construction* establishes laws and regulations governing the safety and health of workers engaged in construction and demolition activities.

8.2.3 Local Safety and Health Regulations

All personnel involved in response and cleanup actions at PBOW shall be made aware of any applicable local regulations which are different or more stringent than state or federal regulations. These include any local fire ordinances, notifications, permits, community right-to-know laws, hazard communication laws, or local water protection ordinances.

8.3 DOCUMENTS

During remedial action activities at PBOW, the documentation of activities related to safety and health is necessary to establish an accurate record of performance while on site. The following documents are the minimum forms and documents to be used by project personnel to track on-site activities at PBOW:

- Safety and Health Plan acceptance form: signifies understanding and compliance with SSHP.
- Accident report form: completed in the event of accident or injury while on the job site.
- Chain-of-custody form: tracks the handling, transportation, and delivery of samples to the laboratory.
- Tailgate safety meeting log: completed daily at the morning safety meeting, details safety topic discussed and attendees at meeting.
- Air-purifying respirator use log: establishes the activities surrounding the use and maintenance of air-purifying respirators.
- Self-contained breathing apparatus use log: establishes the activities surrounding the use and maintenance of self-contained breathing apparatus.
- Daily report: describes daily activities performed on the site.

8.3.1 Federally-Mandated Documentation

All site workers who will be involved in the investigation and remediation activities are required by Federal law to complete 40 hours of OSHA-approved training in hazardous waste site work (29 CFR 1910.120). Supervisors are required to have completed an additional eight hours of supervisor's training. Workers who wear air-purifying respirators for over 30 days per year are required to document fit-testing of the respirator every six months. All on-site personnel shall be required to undergo a physical examination prior to beginning work and every year thereafter, while involved in PBOW field work. All documentation concerning these requirements shall be submitted to the Site Safety and Health Officer and

the Project Manager for review prior to a worker commencing activities. This documentation will be maintained on file at the field office for the duration of the project.

8.3.2 Document Storage and Retention

Documentation of all activities shall be kept in a central location at the USACE Huntington District Office, with additional copies in the files of the subcontractor. Documents shall be retained a minimum of thirty years to satisfy all federal records retention regulations.

8.4 ORDNANCE EXPLOSIVE WASTE (OEW)

Because the PBOW was involved in the production of explosives and defense-related ordnance, the SSHP must address the possibility of encountering waste with potentially explosive characteristics during field investigations. Additionally, because by-products from the production of explosive substances can also be volatile, reactive, or explosive, precautions shall be taken to minimize the risks associated with these substances.

OEW is considered to be the most significant explosion hazard at PBOW. OEW operations shall be conducted by personnel experienced with the identification and handling of ordnance. OEW operations shall only be conducted during daylight hours, and shall not be conducted during electrical storms or other severe weather conditions. The buddy system shall be observed at all times for all field activities. All personnel engaged in OEW operations shall be trained in explosive safety and capable of recognizing hazardous explosive conditions.

In the event of an explosion or fire, all nonessential personnel shall evacuate the site and necessary support and backup personnel will be requested. On-site personnel and site supervisory personnel shall take whatever actions are necessary to ensure the safety of on-site and off-site personnel in adjoining areas. Workers performing duties in the Exclusion Zone shall assemble at the decontamination station.

8.5 EMERGENCY RESPONSE AND CONTINGENCIES

The SSHP shall address emergency procedures to be used in the event of an illness, injury, or accident on the job site. All essential personnel will be made aware of the route to the nearest hospital or trauma care facility. The SSHP will include telephone numbers for emergency response personnel (including fire, police, ambulance, and spill response teams) and the designated emergency care facility. A map showing the route to the assigned emergency care facility will be made a part of the SSHP.

8.5.6 COMMUNICATIONS

Due to the size of PBOW, it will be necessary to assign two-way radio communicators to essential supervisory personnel. All field team leaders will be required by the SSHP to be equipped with two-way radios. At least one two-way radio, located at the command control facility, will be a NASA radio used to quickly relay emergency information directly to or from on-site NASA personnel.

Off-site communications will also be required. The SSHP will assign a predetermined location, usually the command control center, which will serve as a point of off-site communications. This will consist of either a telephone system installed by a licensed contractor or a mobile cellular telephone. The telephone system must be capable of reaching all predetermined emergency numbers.

9.0 DOCUMENT CONTROL AND DATA MANAGEMENT

This section establishes requirements and provides guidance for document control and data management for PBOW activities. Document inventory and filing systems for the administrative record suggested here are in accordance with EPA guidance for activities under CERCLA. Guidance for establishing an administrative record filing system is provided in Part C of this SMP, Section 3.0.

9.1 DOCUMENT CONTROL

Controlling changes to guidance and decision documents will help assure that all participants in the remedial activities at PBOW have standardized, updated documentation from which to work. This section presents guidelines for controlling the preparation, issue, and change of documents. Documents requiring control are those that specify quality requirements or prescribe activities affecting quality.

A document control coordinator should be assigned for PBOW documents. The Document Control Coordinator is responsible for:

- Administering the control system for documents generated for PBOW
- Issuing approved documents
- Distributing controlled documents
- Maintaining an index of controlled documents
- Maintaining a controlled document distribution list

Controlled document recipients will be responsible for acknowledging document receipt, assuring that the latest authorized documents are in use, and marking, destroying, or returning obsolete or superseded documents.

9.2 DATA MANAGEMENT

Data management consists of those activities required to collect, archive, and retrieve field and analytical results in an accurate and consistent manner. The data management system to be used on PBOW projects will be compatible with the requirements of the program Sampling and Analysis Plan (SAP) developed for PBOW investigations. The database system for PBOW investigations will be used to facilitate the storage, retrieval, and interpretation of field and laboratory data. Input will consist of field sampling information, chemical analytical data, and surveying information. The database system should have the

capacity to incorporate other field data (e.g., boring logs, sample logs), as necessary. The following information at a minimum, will be entered in the project database:

- Survey data
- Boring and soil classification logs
- Monitoring well construction and development
- Field screening results
- Groundwater monitoring data
- Slug test results
- Sample collection logs
- Laboratory analytical results
- Data validation results
- Geotechnical testing results.

9.2.1 Data Entry Procedures

Data collected for PBOW remedial activities should be able to be either manually or electronically entered into the database system. To facilitate data entry, the computer screens for manual data entry should be similar in format to the field data collection forms. Electronic transfer of data requires that the data be formatted to be compatible with USACE databases.

9.2.1.1 Manual Data Entry Procedures

Data that are not electronically transferred should be keyed into the database after the appropriate field form has been verified to ensure that it is accurate and complete. The data should first be keyed into a temporary input table. When each form has been entered, the data should be electronically checked against a standards table consisting of predefined "values" for all fields established on the field forms. These fields may include sample numbers, character types, dates, units, chemical names, among others. If the electronic check finds that a specified field does not match a predefined standard, that field should be flagged and the data entry technician prompted to check the original document to verify that the entered value matches the original form. After the data have been entered and any required changes have been made, the entered data should be printed and checked against the original field forms. The entered data should not be downloaded to the appropriate database file and table until these procedures have been completed and all required changes or corrections have been made, thus ensuring the accuracy of the completed database.

9.2.1.2 Electronic Data Transfers

Electronic data transfers, such as laboratory analytical data, should be downloaded into a temporary input file and electronically checked against a "standards" table. For laboratory data this check should include chemical names, chemical numbers, units of measure, method number, detection limits, and laboratory qualifiers. If any fields do not compare with those established in the standards, the affected field(s) should be flagged for checks against the Certificates of Analysis. Once the electronic standards check has been completed, the analytical data file should be printed, including any flags, and checked against the Certificates of Analysis for accuracy and completeness. The data should be downloaded into the database only after this process has been completed.

9.2.2 Database Field and Record Quality Control Methodologies

All data generated for PBOW should be checked according to standard QA/QC procedures. Field forms should be photocopied, all data fields should be checked and highlighted on the duplicate (QA) copy, and any required changes or corrections should be written on the QA copy in red ink. The form should then be returned to the generator for corrections, if required. The corrected form should be rechecked to verify the corrections, and the original should be signed off by the checker. Data entered into the database will be subject to the same QA/QC requirement, including printing the data, checking and highlighting against the original document, and making necessary changes or corrections in accordance with the established procedures before the data become resident in the database.

The validity of the reports produced from the database are dependent on the quality of the data and the accuracy with which they were entered into the database. Data should not become "resident" on the database until they have been input and verified. To accomplish this task, the following series of data checks should be performed:

- Field data should be recorded on standard field forms.
- The field manager should review all field forms for completeness and consistency.
- Original field forms should be sent to the project manager or data manager for data entry.
- Data that are downloaded electronically (such as laboratory analytical results) should first be entered into a temporary file within the database, checked electronically against the standards file (CAS numbers, compound names, units, etc.), and printed out and checked against hard copies (such as Certificates of Analysis) by the manager prior to downloading into the database.

After these diagnostics are performed, incorrect fields should be corrected. Documentation of the corrective action will be archived in the project files.

9.2.3 Data Security

After the accuracy of the data set has been verified, the data must be protected from indiscriminate alteration by system users. This is accomplished by limiting access to project data files. The Project Manager or Data Manager will establish a restricted list of those persons allowed access to the data files. Among those with access to the database, only a minimum number of clearly identified individuals should have the authority to modify data, while others should only be authorized to query data and print reports. In addition, the database should be backed-up at regular intervals to magnetic tape to ensure that data are not lost due to equipment malfunctions.

9.3 COORDINATION WITH NASA

Effective communication with NASA, established early in the remedial process, is essential for the implementation of a well-coordinated remedial effort, particularly with the possibility of areas of joint responsibility. With respect to document control issues, NASA should be a recipient of controlled documents, and should maintain these documents in the NASA project files. The USACE Project Manager will provide NASA with an updated copy of the PBOW database on a regular basis.

9.4 COORDINATION WITH REGULATORY AGENCIES

USACE works closely with federal, state, and local agencies in the execution of all projects. Regulatory agencies are routinely given the opportunity to fully participate in evaluation and oversight of remedial activities on DERP-FUDS properties. Coordination with agencies is begun early in any remedial activity to establish good working relationships. Regulatory agencies requiring coordination may include: USEPA, Ohio EPA, the Advisory Council on Historic Preservation, the Ohio Historic Preservation Officer, U.S. Department of the Interior, U.S. Fish and Wildlife Service, and the Ohio Department of Natural Resources, among others. The regulatory agencies may require copies of some PBOW controlled documents.

LIST OF REFERENCES

Battelle, 1984. "Letter to Kate Wilson, Ohio EPA, Northwest District, 1035 Devlac, Bowling Green, Ohio", for Results of Environmental Screening Analyses Performed on Pink Water Samples from NASA's Plum Brook Station, January 4, 1984.

Bower, Amy, 1995. Personal Communication. (NASA Institutional Operations Manager).

Burgess and Niple, Ltd., 1985. "Letter to Ohio National Guard, Adjutant General's Department, Agoh-Qm-Pc, 2825 West Granville Road, Worthington, Ohio", for Results of Water Samples from NASA's Plum Brook Station, September 26, 1985.

Dames & Moore, 1994. "Work Plan for HTW Investigation, Plum Brook Ordnance Works, Plum Brook Station/NASA, Sandusky, Ohio." October, 1994.

Dames & Moore, 1995. "Records Review Report, Plum Brook Ordnance Works, Sandusky, Ohio." (Draft) April 27, 1995.

EBASCO Environmental, 1989. "Site Assessment for Tanks #7132-1, #7132-2 and #7132-3 at Plum Brook Station." December, 1989.

EBASCO Environmental, 1990a. "Closure Assessment for Tanks 21, 22, and 23 at Plum Brook Station, Sandusky, Ohio." May, 1990.

EBASCO Environmental, 1990b. "Final Work Plan for the UST Corrective Actions Remedial Investigation/Feasibility Study, NASA Lewis Research Center Plum Brook Station." August, 1990.

EBASCO Environmental, 1991. "NASA Plum Brook Station Underground Storage Tank Corrective Actions Remedial Investigation/Feasibility Study: Phase I Report." November, 1991.

H$^+$GCL, 1992. "Phase I Site Characterization of Disposal Area Three, Plum Brook Station, Ohio." June 5, 1992.

IT Corporation, 1989. "Work Plan for Contamination Evaluation at the Former Plum Brook Ordnance Works, Sandusky, Ohio." September, 1989.

IT Corporation, 1991. "Engineering Report for the Contamination Evaluation at the Former Plum Brook Ordnance Works, Sandusky, Ohio." January, 1991.

Morrison Knudsen Ferguson Group, 1993. "Preliminary Site Investigation Report, Remediation of Contaminated Underground Storage Tank Sites: Phase I, 100% Submittal." January 28, 1993.

Morrison Knudsen Ferguson Group, 1994a. "Site Inspection Report, Plum Brook Station, Sandusky, Ohio: Volume 1." January, 1994.

REFERENCES
(Continued)

Morrison Knudsen Ferguson Group, 1994b. "Closure Work Plan, Garage/Maintenance Area, NASA Plum Brook Station." May 20, 1994.

Morrison Knudsen Ferguson Group, 1994c. "Closure Work Plan, Reactor Area, NASA Plum Brook Station." May 20, 1994.

Science Applications International Corporation (SAIC), 1991. "Plum Brook Station Preliminary Assessment." June, 1991.

USACE, 1990. Chemical Data Quality Management for Hazardous Waste Remedial Activities. ER 1110-1-263.

USACE, 1994a. Requirements for the Preparation of Sampling and Analysis Plans. EM 200-1-3.

USACE, 1994b. Monitoring Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites. EM 1110-1-4000.

USACE, 1995. Personal Communication. Huntington Office. May 1995.

U.S. Army DERP-FUDS Manual. December 8, 1993.

USEPA, 1988a. CERCLA Compliance with other laws manual, Part I: Interim Final, Washington, DC.

USEPA, 1988b. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA: Interim Final Washington, DC.

USEPA, 1992. Community Relations in Superfund: A Handbook.