OHIO E.P.A.

DEC 16 2011

ENTERED DIRECTOR'S JOURNAL

BEFORE THE
OHIO ENVIRONMENTAL PROTECTION AGENCY

In the Matter of:

United States Department of Energy :
Portsmouth Gaseous Diffusion Plant :
P.O. Box 700 :
Piketon, Ohio 45661-0700 :

Director's Final
Findings and Orders

Fluor-B&W Portsmouth LLC
1862 Shyville Road
Suite 216
Piketon, OH 45661

Respondents

I certify this to be a true and accurate copy of the official documents as filed in the records of the Ohio Environmental Protection Agency.

By: Date: 12/16/2011

PREAMBLE

It is hereby agreed by and among the Parties hereto as follows:

I. JURISDICTION

These Director's Final Findings and Orders ("Orders") are issued to the U.S. Department of Energy (" DOE") and Fluor-B&W Portsmouth LLC ("FBP") pursuant to the authority vested in the Director of Environmental Protection ("Director") under chapters 3745 and 6111 of the Ohio Revised Code ("ORC") and the solid and hazardous waste laws in ORC chapter 3734, including ORC sections 3734.13, 3734.20, 3734.02(A) and 3734.02(G).

II. PURPOSE OF THESE ORDERS

The purpose of these Orders is:

1. To integrate the on-site work required for specific units under Section V of the Consent Decree and under the Ohio Administrative Code with the requirements of Section VII of the Consent Decree, and requirements of the Administrative Order by Consent in order to avoid duplication of effort, and efficiently perform sitewide ground water monitoring and surveillance and maintenance activities at PORTS;

2. To recognize that a substantial portion of the tasks required under existing approved closure plans for certain units have been completed in accordance with those closure plans and to provide for the incorporation of the remaining tasks

Maintenance Plans and to terminate any further obligation under the existing closure plans;

3. To provide exemptions from specific solid and hazardous waste requirements of the Ohio Administrative Code as necessary to accomplish Purpose 1, above.

III. PARTIES BOUND

These Orders shall apply to and be binding upon the Respondents, their assigns and successors in interest. With respect to Respondent DOE, no change in ownership or operation of the Site will in any way alter Respondent DOE's responsibilities under these Orders, except as provided by law. The obligations of Respondent FBP under these Orders shall terminate when Respondent FBP is no longer responsible pursuant to contract with Respondent DOE to perform work under these Orders; provided, however, that this Section of the Orders does not absolve Respondent FBP from any liability for any violation which occurs prior to the termination of such contract. Except as otherwise expressly provided herein, Respondents' obligations under these Orders may be altered only by written approval of the Director.

IV. DEFINITIONS

Words used in these Orders shall have their ordinary meaning, except as defined in this Section or the relevant statute or regulation.

A. "Site" shall mean all areas within the property boundary of the Portsmouth Gaseous Diffusion Plant ("PORTS") and any other areas that received or potentially received or released "hazardous substances, pollutants, or contaminants" originating from PORTS as defined in the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended, ("CERCLA"), 42 U.S.C. section 9601, et seq.

B. "Hazardous Waste Management Unit" ("HWMU") shall mean a contiguous area of land on or in which hazardous waste is placed or the largest area in which there is significant likelihood of mixing hazardous waste constituents in the same area [40 CFR section 260.10; Ohio Administrative Code ("OAC") rule 3745-50-10].

C. "IGWMP" shall mean the Integrated Ground Water Monitoring Plan, as approved by Ohio EPA, and which is attached to these Orders as Attachment B.

D. "Party" shall mean Respondent DOE, Respondent FBP, or the Ohio Environmental Protection Agency ("Ohio EPA" or "OEPA"). "Parties" shall mean Respondent DOE, Respondent FBP and Ohio EPA.

E. "Solid Waste Disposal Facility" ("SWDF") shall mean any site, location, tract of land, installation or building used for incineration, composing, sanitary landfilling, or other methods of disposal of solid wastes (OAC rule 3745-27-01(S)(24)).

F. "Consent Decree" shall mean the consent decree filed by Respondent DOE and the State of Ohio on September 1, 1989, in Civil Action Number C2-89-732, in United States District Court for the Southern District of Ohio, Eastern Division.

G. "Administrative Order by Consent" shall mean the administrative order by consent entered into by the Respondent DOE, Ohio EPA and U.S. EPA on August 12, 1997, for the purpose of defining oversight roles for Ohio EPA and U.S. EPA and certain performance obligations for Respondent DOE, and which replaced the earlier version of the ACO, as amended.

H. "Surveillance and Maintenance Plan" ("S&M Plan") shall mean the plan to be submitted and approved pursuant to Order number 16, below, which provides for post closure care and/or operation and maintenance of each of several units; following approval, the S&M Plan shall be incorporated by reference and attached to these Orders as Attachment C.

V. FINDINGS OF FACT

A. The Director of Environmental Protection hereby makes the following findings:

1. The Respondent DOE owns PORTS, a former gaseous diffusion plant, located in Pike County, Ohio, approximately twenty (20) miles north of the City of Portsmouth. Respondent DOE is responsible for decontamination and decommissioning (D&D) of the gaseous diffusion process buildings and associated facilities, environmental restoration, waste management, uranium programs, and management of other non-leased facilities at PORTS. Pursuant to section 1403 (a) of the Energy Policy Act of 1992 (Public Law 102-486), Respondent DOE leased uranium enrichment facilities at PORTS to the United States Enrichment Corporation (USEC). Pursuant to the Energy Policy Act, including section 1403 (d), Respondent DOE has retained responsibility for certain cleanup activities with respect to conditions existing before July 1, 1993, the date that uranium enrichment operations at PORTS were assumed by USEC. On September 30, 2011, USEC returned control of all gaseous diffusion plant buildings and facilities to Respondent DOE.

2. PORTS commenced operations in 1954. PORTS operations are located on a 15.1 square kilometer (3,777 acres) parcel of federally owned land. Several rural communities lie within a few kilometers of PORTS.

3. Respondent FBP is a limited liability company incorporated in the state of Ohio, and licensed to do business in the state of Ohio on November 4, 2009. Respondent

FBP has contracted with Respondent DOE to carry out certain day-to-day activities at PORTS, including certain cleanup activities.

4. The Respondents are each a "person" as defined in ORC section 3734.01(G) and Ohio Administrative Code ("OAC") rule 3745-50-10.

5. The Respondents generate or have generated "hazardous waste" as that term is defined in section 1003(5) of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act ("RCRA") as amended, 42 U.S.C. section 6903 (5) and in ORC section 3734.01 (J) and OAC rules 3745-50-10 and 3745-51-03.

6. The Respondents generate or have generated "solid waste" as that term is defined in ORC section 3734.01 (E) and OAC rule 3745-27-01(S)(23).

7. The principal radioactive elements present in waste materials handled at the facility are uranium and technetium. The principal non-radioactive hazardous wastes known to be generated at PORTS are those exhibiting characteristics of ignitability, toxicity (TCLP) for chromium, lead, and cadmium, and various listed wastes including: spent halogenated solvents such as TCE; spent non-halogenated solvents; as well as small quantities of laboratory chemicals such as vanadium pentoxide, aniline, formaldehyde, formic acid, and lead acetate.

8. On August 18, 1980, Respondent DOE submitted a notification of hazardous waste activity at the facility as required by section 3010 (a) of RCRA, 42 U.S.C. section 6930 (a), and on July 12, 1984, Respondent DOE filed a RCRA Part A permit application as required by section 3005(a) of RCRA, 42 U.S.C. section 6925(a), to treat, store, and dispose of hazardous waste at the Facility. Subsequently, Respondent DOE filed a RCRA Part A permit application revision on September 9, 1988. OEPA transmitted PORTS' RCRA Part B Permit Application to the Ohio Hazardous Waste Facility Board on March 18, 1993, and the Board issued a permit to Respondent DOE, effective on August 21, 1995; the permit authorizes Respondent DOE to store certain hazardous and mixed wastes in two storage facilities (X-326 and X-7725) at PORTS. The permit was renewed on March 25, 2011 and authorized Respondents DOE and FBP to store certain hazardous and mixed wastes in one storage facility in the X-326. The permit does not address ground water monitoring requirements.

9. On June 30, 1989, Ohio EPA received final authorization from U.S. EPA to administer the hazardous waste program in Ohio; such authorization includes the authority to regulate the hazardous waste component of mixed waste. See 54 Fed. Reg. 27173. Ohio EPA's hazardous waste program authorization has since been expanded to include authorization to implement corrective action requirements under RCRA. 10. On September 1, 1989, Respondent DOE and the State of Ohio filed a Consent Decree, Civil Action Number C2-89-732, in United States District Court for the Southern District of Ohio, Eastern Division ("Consent Decree"), for the purpose of addressing certain hazardous waste compliance issues at PORTS. The Consent

Decree requires the performance of corrective actions at PORTS, in addition to other requirements.

11. On September 27, 1989, U.S. EPA and Respondent DOE entered into an Administrative Consent Order, U.S. EPA Docket Number V-W-9OR-03, for the performance of response action/corrective actions at PORTS.

12. In August of 1994, the 1989 Administrative Consent Order ("ACO, as amended") was amended to, among other things, include Ohio as a party for the purpose of recovering its oversight costs from Respondent DOE.

13. On August 2, 1995, Ohio EPA issued a letter which referenced a meeting in which Respondent DOE and Ohio EPA agreed to the integration of closure and corrective action/response action for certain HWMUs.

14. On October 4, 1995, Respondent DOE and Ohio EPA entered into Director's Final Findings and Orders which approved Respondent DOE's site treatment plan for all land disposal restricted hazardous wastes in storage at PORTS.

15. On August 12, 1997, the Respondent DOE, Ohio EPA, and U.S. EPA entered into the Administrative Order by Consent for the purpose of defining oversight roles for Ohio EPA and U.S. EPA and certain performance obligations for Respondent DOE, which replaced the earlier version of the ACO, as amended. Pursuant to this Administrative Order by Consent, Ohio EPA assumed the lead oversight role from U.S. EPA for all remedial and corrective action activities at PORTS.

16. The corrective action/response action process being conducted at PORTS employs a Quadrant approach, in which PORTS is divided into four Quadrants for the purposes of organizing and facilitating the corrective action/response action process. The Quadrants are based approximately on the direction of groundwater flow at PORTS.

17. Consistent with Section VII of the Consent Decree and the Administrative Order by Consent, Respondents have agreed to implement the corrective actions/response actions selected in the Decision Documents for each Quadrant.

18. Pursuant to the requirements of Sections VII and VIII of the Consent Decree and provisions of the Administrative Order by Consent, Respondent DOE is responsible for conducting certain ground water monitoring requirements at PORTS. Pursuant to requirements of Section V of the Consent Decree and provisions of the Administrative Order by Consent, Respondent DOE conducts closure and post closure care of certain HWMUs and solid waste disposal facilities ("SWDF") at PORTS.

19. Attachment A, incorporated by reference herein, identifies those SWDFs and those HWMUs which will be subject to one or more exemptions pursuant to this Order.

The exemptions facilitate the integration process which consists of deferring the timing and procedural requirements applicable to certain units, and includes the unification of all site-wide groundwater monitoring requirements.

20. The SWDFs and HWMUs identified in Attachment A are subject to requirements for closure, investigation and/or remediation pursuant to Section V and/or Section VII of the Consent Decree. The SWDFs and HWMUs identified in Attachment A are all "Waste Units" pursuant to Section 2.16 of the Consent Decree and as used in Section VII. of the Consent Decree.

21. The SWDFs and HWMUs identified in Attachment A are subject to schedules for closure, investigation and/or remediation pursuant to the Consent Decree. These schedules are based upon discussions between the Respondent DOE and Ohio EPA, and are subject to change pursuant to the procedures required by the Consent Decree.

22. On January 27, 1999, Ohio EPA approved the Integrated Ground Water Monitoring Plan, ("IGWMP"), which is designed to integrate site-wide ground water monitoring activities at PORTS by encompassing all ground water monitoring requirements and the goals of multiple regulatory programs in order to maximize resources to support corrective action and to minimize the potential for conflicts in requirements between regulatory programs. Revisions to the IGWMP have occurred as necessary to incorporate changes and are based on a review of monitoring data and the outcome of remedial actions. These revisions are reviewed and approved by Ohio EPA in accordance with Section VII Amendment of Attachments.

23. SWDFs X-749A, X-735 Industrial Solid Waste Landfill, and X-749S (also known as the Low Level Disposal Unit) completed certification of closure on June 7, 1994, November 6, 1998, and February 9, 1993, respectively, at which times the 30 year post closure care period began, in accordance with OAC rules 3745-27-14 or 3745-29-14 for each unit. Ohio EPA accepted the certification of closure for the referenced units on November 12, 1996, December 28, 1998, and March 8, 1993, respectively. SWDFs X-749A, X-735 Industrial Solid Waste Landfill, and X-749S are subject to the requirements of post closure plans submitted in accordance with OAC rules 3745-27-11 or 3745-29-11 and approved on April 9, 1992, January 23, 1998, and July 17, 1991, respectively.

24. OAC rule 3745-29-01(B) defines an "industrial solid waste landfill facility" as a sanitary landfill facility which exclusively disposes one or any combination of industrial solid wastes as defined in OAC rule 3745-29-01(A). OAC rule 3745-29-01(A) defines "industrial solid waste" as a type of solid waste generated by manufacturing or industrial operations. SWDFs X-749A and X-749S are sanitary landfill facilities where industrial solid wastes were disposed and, currently, are subject to OAC Chapter 3745-27.

25. Pursuant to ORC section 3734.02 (G) and OAC rule 3745-50-31, the Director may by order exempt any person generating, storing, treating, disposing of or transporting hazardous waste in such quantities or under such circumstances that, in

the determination of the Director, are unlikely to adversely affect the public health or safety or the environment from any requirement to obtain a permit or license, comply with the manifest system or comply with other requirements of ORC chapter 3734.

26. The SWDFs listed in Attachment A are subject to the ground water monitoring requirements contained within OAC rules 3745-27-10 or 3745-29-10 and 3745-30-08. Compliance with the ground water monitoring requirements outlined within the IGWMP, Attachment B, instead of with the requirements of OAC rules 3745-27-10(C)(10) or 3745-30-08(C)(8), for the SWDFs listed in Attachment A, is unlikely to adversely affect the public health or safety or the environment.

27. On March 18, 1999, the Director issued an exemption order to Respondent DOE and Respondent Bechtel Jacobs Company LLC, then contractor for Respondent DOE that provided exemptions similar to those provided in this Order. Respondent DOE has operated the groundwater monitoring required by the Consent Decree corrective action pursuant to that Order since March 18, 1999.

27. By letters dated October 19, 2011 and October 24, 2011, respectively, Respondent DOE and Respondent FBP each submitted an application for the exemptions contained in these Orders.

28. If the Respondents conduct an RCRA/CERCLA integrated remediation process in accordance with the requirements and schedules contained in or referenced in these Orders, it is unlikely that public health or safety or the environment will be adversely affected within the meaning of ORC section 3734.02(G).

29. Where a variance to the rules promulgated under ORC Chapter 3734. is granted, the Director has determined that such an action is appropriate and reasonable to prevent the creation of a nuisance or a hazard to the public health or safety or the environment, and that the construction and operation of the solid waste facility in the manner allowed by the variance and any terms or conditions imposed as part of the variance will not create a nuisance or a hazard to the public health or safety or the environment.

VI. ORDERS

1. The Respondents shall implement the IGWMP, Attachment B, except that, to the extent that the IGWMP requires tasks specific to radiological contamination, and/or tasks specific to off-site residential monitoring, such tasks shall not be specifically enforceable under this Order. Where a task involves both radiological contamination and non-radiological contamination, only the portions of the task involving non-radiological contamination shall be specifically enforceable through this Order. Implementation shall occur pursuant to Order 16, below.

2. The Respondents are hereby exempted from complying with the rules contained in OAC chapters 3745-65 and 3745-66 for the HWMUs listed in Attachment A, *provided*, that the Respondents shall comply with the substantive requirements of the rules contained in OAC chapters 3745-54 and 3745-55 for the HWMUs listed in Attachment A, through the remedial processes of Section VII of the Consent Decree, except as provided below.

3. The Respondents are hereby exempted from complying with the rules contained in OAC chapter 3745-27, for the X-749S SWDF, and for the X-749A Classified Materials Disposal Facility, *provided* that the Respondents comply with the substantive requirements of OAC Chapter 3745-29 for those units, except as provided below.

4. The Respondents are hereby exempted from complying with OAC rule 3745-30-08-(C)(8) for the X-735S Industrial Solid Waste Landfill, and for the X-749A Classified Materials Disposal Facility.

5. The Respondents are hereby granted a variance for the X-749S Industrial Solid Waste Landfill, the X-749A Classified Materials Disposal Facility, and X-735 SWDF, from complying with the requirement contained in OAC rule 3745-29-14(A)(4) to submit a written summary to the appropriate Ohio EPA district office not later than fifteen days after the date of the inspection required by this rule, *provided* that Respondents submit the written summary otherwise required by this rule within fifteen days following the end of the calendar year quarter in which the inspection occurred.

6. The Respondents are hereby exempted from complying with OAC rule 3745-29-10 and 3745-30-08 for the X-749S Industrial Solid Waste Landfill. The X-749S Industrial Solid Waste Landfill will be monitored together with the X-749N HWMU as a single groundwater monitoring unit in accordance with OAC rule 3745-54-99, except as provided below.

7. The Respondents are hereby exempted from complying with OAC rule 3745-54-98 for the X-735N Hazardous Waste Landfill. The X-735N Hazardous Waste Landfill will be monitored together with the X-735S Industrial Solid Waste Landfill as a single groundwater monitoring unit pursuant to the exemption in paragraph 4, above.

8. The Respondents are hereby exempted from complying with OAC rule 3745-54-99(G) for the following HWMUs: X-231B, X-701C, X-740, X-701B, X-230J7, X-616, X-735N, and X-749.

9. The Respondents are hereby exempted from complying with OAC rule 3745-55-12(A)(1) for the following HWMUs: X-230J7, X-701C, X-744Y, X-231B, and X-701B, *provided* that the CMS/CMIs necessary for the completion of remediation which are required by the Consent Decree, are submitted by Respondents in accordance with the schedule approved pursuant to the Consent Decree.

10. The Respondents are hereby exempted from complying with OAC rule 3745-55-13 for the following HWMUs: X-230J7, X-701C, X-744Y, X-231B, and X-701B, *provided* that the Respondents implement the Corrective Measures Implementation Work Plan in accordance with the schedule approved pursuant to the Consent Decree.

11. The Respondents are hereby exempted from complying with OAC rule 3745-55-15 for the following HWMUs: X-230J7, X-701C, X-744Y, X-231B, and X-701B, *provided* that the Respondents submit the Corrective Measures Implementation Final Report in accordance with the schedule approved pursuant to the Consent Decree, and the Certification Report, contained therein, meets the requirements of closure certification.

12. The Respondents are hereby exempted from complying with OAC rule 3745-55-20 for the following HWMUs: X-749, X-231B, X-701C, X-701B, X-230J7, X-616 and X-744Y, *provided* that the Respondents submit an Operation & Maintenance Monitoring Final Report which meets the requirements of a post-closure certification.

13. The Respondents are hereby exempted from complying with OAC rule 3745-55-18(A) for the following HWMUs: X-231B, X-701C, X-701B, X-230J7, and X-744Y, *provided* that the Respondents submit the Corrective Measures Implementation Workplan, which includes the Operation & Maintenance Plan, in accordance with the schedule approved pursuant to the Consent Decree and for the HWMUs X-231B, X-701C, X-701B, X-230J7 and X-744Y the Operation & Maintenance Plan must include the substantive requirements contained in OAC rule 3745-55-18 (B) through (D).

14. The Respondents are hereby exempted from complying with OAC rule 3745-55-18(A) for the following HWMUs: X-616, X-749N and X-735N.

15. a. No later than twenty (20) days after the effective date of this Order, Respondents shall submit a Surveillance and Maintenance Plan ("the S&M Plan") providing for post closure care and/or operation and maintenance (excluding groundwater monitoring requirements, which are provided in the IGWMP) of each of the following units: SWDFs X-749A, X-735S Industrial Solid Waste Landfill and X-749S (also known as the Low Level Disposal Unit), and HWMUs X-616, X749N, and X-735N. The S&M Plan shall meet the following standards:

i. For the SWDFs X-749A, X-735S Industrial Solid Waste Landfill and X-749S (also known as the Low Level Disposal Unit), the S&M Plan must include all the requirements for post closure stated in the closure/post closure plans which were approved for those units on April 9, 1992, January 23, 1998, and July 17, 1991, respectively.

ii. For HWMUs X-616, X749N, and X-735N the S&M Plan must include all the requirements for post closure stated in the closure/post closure plans which were approved for those units on August 13, 1992, July 14, 1989, and September 13, 1993, respectively.

iii. For any other unit Respondents choose to incorporate into the S&M Plan, the S&M Plan shall incorporate all post closure and/or operation and maintenance requirements which exist at the time of submittal of the S&M Plan.

b. Respondents' S&M Plan shall be subject to review and approval by Ohio EPA. If Ohio EPA provides Respondents with a written statement of deficiencies in the S&M Plan, Respondents shall submit to Ohio EPA, within thirty (30) days of receipt of the statement of deficiencies, a revised S&M Plan that satisfactorily addresses the stated deficiencies.

c. Ohio EPA may either approve the S&M Plan as submitted or as revised, or approve it with modifications. If Ohio EPA modifies the S&M Plan as submitted or revised, the modified plan shall become the approved S&M Plan. Upon approval, the S&M Plan shall be incorporated by reference into this Order as Attachment C.

d. Upon implementation of the IGWMP and S&M Plan as described in Order 16, below, Respondents' obligations under the previously approved closure plans or post closure care plans for the units specified in Attachment A are satisfied, and the closure plan or post closure care plan terminates.

16. Respondents shall commence implementation of the IGWMP and the S&M Plan together as of the effective date of this order .

VII. AMENDMENT OF ATTACHMENTS

1. Amendment of the IGWMP (Attachment B) or the S&M Plan (Attachment C):

a. The IGWMP or the S&M Plan may be amended by mutual, written agreement of the parties, according to the procedures described below.

b. In the event that Respondents identify a need to amend the approved IGWMP or approved S&M Plan, Respondents shall submit an amended plan to Ohio EPA. Upon receipt of an amended plan, Ohio EPA may either approve the amended plan, as submitted, or disapprove and provide comments describing changes required before approval. Upon approval by Ohio EPA of the amended plan, Respondents shall implement the approved plan in accordance with the schedule approved pursuant to the Consent Decree.

c. In the event that Ohio EPA identifies a need to amend the approved plan, Respondents shall, within twenty (20) days of receipt of written notice from Ohio

EPA of the need to amend the approved plan, submit an amended plan proposal. Upon receipt of an amended groundwater monitoring plan, Ohio EPA may either approve the amended plan, as submitted, or disapprove and provide comments describing changes required before approval. Upon approval of the amended plan by Ohio EPA, Respondents shall implement the approved plan in accordance with the schedule approved pursuant to the Consent Decree.

VIII. PROJECT MANAGERS

Within five (5) days of the effective date of these Orders, Respondents shall each notify Ohio EPA, in writing, of the name, address and telephone number of their designated Project Manager and Alternate Project Manager. Any Party may change its designated Project Manager by notifying the other Parties, in writing, ten (10) business days before the change if possible.

Each Project Manager shall be the primary contact regarding the implementation of these Orders. The Project Managers shall meet periodically, as appropriate, to discuss progress and problems regarding the implementation of these Orders

IX. NOTICE

All documents to be submitted pursuant to these Orders shall be submitted to the following persons at the following addresses:

Ohio EPA:

Ohio Environmental Protection Agency
Southeast District Office
Division of Emergency & Remedial Response
Attn: Project Manager
2195 Front Street
Logan, Ohio 43138

and

Ohio Environmental Protection Agency
Division of Hazardous Waste Management
Attn: Manager, Compliance Assurance Section
Lazarus Government Center
P.O. Box 1049
Columbus, Ohio 43216-1049

For deliveries to the building:

Scott J. Nally, Director
Ohio Environmental Protection Agency
Lazarus Government Center
Division of Hazardous Waste Management
122 South Front Street
Columbus, Ohio 43215
Attn: Manager, Engineering and Risk Assessment Section

or to such persons and addresses as may hereafter be otherwise specified in writing.

X. OTHER APPLICABLE LAWS

Nothing in these Orders shall be construed as waiving or compromising in any way the applicability and enforcement of any other statutes or regulations' applicability to the Respondents' activities at the Site. Ohio EPA reserves all rights and privileges except as specified herein. Respondents reserve all defenses they may have.

XI. RESERVATION OF RIGHTS

Nothing contained in these Orders shall be construed as restricting any rights or obligations contained in the Administrative Order by Consent and/or the Consent Decree. Nothing contained herein shall be construed to prevent the Ohio EPA from seeking legal or equitable relief to enforce the terms of these Orders or from taking other administrative, legal or equitable action, as deemed appropriate and necessary, including the revocation of exemptions, as necessary, and including seeking penalties against Respondents for noncompliance with these Orders. Nothing contained herein shall be construed to prevent Ohio EPA from exercising its lawful authority to require the Respondents to perform additional activities at the Site, pursuant to ORC chapter 3734 or any other applicable law in the future. If any section or subsection of the IGWMP, performance of which is a condition of an exemption, is amended by mutual agreement pursuant to Section VII., the Director reserves the right to revoke the exemption, unless he determines that such amendment is unlikely to adversely affect the public health or safety or the environment.

Nothing herein shall restrict the right of Respondents to raise any administrative, legal or equitable claim or defense with respect to such further actions that Ohio EPA may seek to require of the Respondents. Nothing in these Orders shall be construed as a waiver of Respondent DOE's jurisdiction over source, by-product, or special nuclear materials under the Atomic Energy Act, 42 U.S.C. section 2201, et seq. Nothing in the preceding sentence alters Respondents' duty to comply with these Orders.

The Director reserves the right to revoke these Orders, or any portion hereof, upon a determination by Ohio EPA that such revocation is necessary to protect human health or safety or the environment. The Respondents reserve the right to seek administrative or judicial review of any such revocation.

It is Ohio EPA's position that the Anti-Deficiency Act, 31 U.S.C. section 1341, as amended, does not apply to any obligations set forth in these Orders, and that obligations herein are not affected by Respondent DOE's failure to obtain adequate funds or appropriations from Congress. It is Respondents' position that the obligations set forth in these Orders are subject to the provisions of the Anti-Deficiency Act and are subject to the availability of funding. The Parties agree that it is premature to raise and resolve the validity of such positions at this time.

XII. OTHER CLAIMS

Nothing in these Orders shall constitute or be construed as a release from any claim, cause of action or demand in law or equity against any persons, firm, partnership or Corporation, not a signatory to these Orders, for any liability arising out of or relating to the operation of the Respondent DOE's Site.

XIII. SIGNATORIES

Each undersigned representative of a Party signatory to these Orders certifies that he or she is fully authorized to enter into the terms and conditions of these Orders and to legally bind such party to this document.

XV. WAIVER

The Respondents agree that these Orders are lawful and reasonable. The Respondents, by acceptance of these Orders, agree to comply with all conditions of these Orders and acknowledge the Respondents' failure to do so may result in further legal action by Ohio EPA.

The Respondents hereby waive the right to appeal or otherwise challenge the issuance of these Orders. Nothing in these Orders shall affect the Respondents' rights to seek administrative or judicial review of other final actions by the Director pursuant to ORC section 3745.04 or other applicable law.

Ohio EPA and the Respondents agree that in the event that these Orders are appealed by any other party to the Environmental Review Appeals Commission, or any court, the Respondents retain the right to intervene and participate in such appeal in support of these Orders. In such event, the Respondents shall continue to comply with these Orders notwithstanding such appeal and intervention unless these Orders are stayed, vacated, or modified.

IT IS SO ORDERED AND AGREED:

Ohio Environmental Protection Agency

By: ______________________ 12/14/11
Scott J. Nally, Director Date

IT IS SO AGREED:

U.S. Department of Energy:

By: W.E. Murphie Date: 11/7/11
Signature

W. E. MURPHIE
Printed Name

Manager PPPO
Title

Fluor-B&W Portsmouth LLC:

By: W.B. Jameson Date: 10/31/2011
Signature

Woodrow B. Jameson
Printed Name

Program Manager
Title

REVIEWED SBC LEGAL

ATTACHMENT A

Unit Name	Description	Quadrant	Unit Type for Groundwater Monitoring	Unit Type for S&M Activities
X-231B*	Oil Biodegradation Plot	Quadrant I	HWMU	Corrective Action
X-744Y*	Storage Yard	Quadrant II	HWMU	Corrective Action
X-230J7*	Holding Pond	Quadrant II	HWMU	Corrective Action
X-701B*	Holding Pond	Quadrant II	HWMU	Corrective Action
X-701C*	Neutralization Pit	Quadrant II	HWMU	Corrective Action
X-740*[a]	Waste Oil Handling Facility	Quadrant III	HWMU\Corrective Action	HWMU (soils only)
X-616**	Chromium Sludge Lagoon	Quadrant III	HWMU	HWMU
X-749 N**	Landfill	Quadrant I	HWMU	HWMU
X-749 S***	Landfill	Quadrant I	HWMU	SWDF
X-735 N**	Landfill	Quadrant IV	SWDF	HWMU
X-735 S***	Landfill	Quadrant IV	SWDF	SWDF
X-749A***	Landfill	Quadrant I	SWDF	SWDF

* HWMUs to be addressed under the RCRA Corrective Action\CERCLA Process. These units are addressed under the schedule for completion of remedial activity at the site.

*[a] HWMU closed in accordance with approved closure plan for soils only. Groundwater to be addressed under RCRA Corrective Action\CERCLA Process.

** HWMUs closed in accordance with approved closure plans and are considered to be in post closure groundwater monitoring. Continued groundwater monitoring to be conducted as part of the IGWMP.

*** SWDF closed in accordance with approved closure plans. Continued groundwater monitoring to be conducted as part of the IGWMP.

ATTACHMENT B

INTEGRATED GROUNDWATER MONITORING PLAN FOR THE PORTSMOUTH GASEOUS DIFFUSSION PLANT, PIKETON, OHIO

Department of Energy

Portsmouth/Paducah Project Office
1017 Majestic Drive, Suite 200
Lexington, Kentucky 40513
(859) 219-4000

NOV 24 2010

Ms. Maria Galanti
Ohio Environmental Protection Agency
Southeast District Office
2195 Front Street
Logan, Ohio 43138

PPPO-03-998664-10

Mr. Harry Sarvis
Ohio Environmental Protection Agency
50 West Town Street Suite 700
Columbus, Ohio 43215

Dear madam and Sir:

INTEGRATED GROUNDWATER MONITORING PLAN FOR THE PORTSMOUTH GASEOUS DIFFUSION PLANT, PIKETON, OHIO (DOE/PPPO/03-0032&D4)

The Department of Energy (DOE) is submitting the enclosed *Integrated Groundwater Monitoring Plan for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE/PPPO/03-0032&D4) to the Ohio Environmental Protection Agency (Ohio EPA) for approval.

A summary crosswalk table of the changes is included in the front cover of the document. DOE will initiate monitoring in accordance with this document beginning the calendar quarter following Ohio EPA approval.

If you have any questions or require additional information, please contact Kristi Wiehle of my staff at (740) 897-5020.

Sincerely,

Joel B. Bradburne
Portsmouth Site Lead
Portsmouth/Paducah Project Office

Enclosure:
Integrated Groundwater Plan for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio

cc w/enclosure:
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January 3, 2011

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RE: **Integrated Ground Water Monitoring Plan**

Dear Sir and Madame:

Pursuant to the requirements of the Ohio Consent Decree and the 1999 Director's Findings and Orders for Integration, Ohio EPA has completed the review of the Integrated Ground Water Monitoring Plan submitted on November 29, 2010. The purpose of the Integrated Ground Water Monitoring Plan is to provide one document which integrates the regulatory and technical requirements for ground water monitoring at PORTS. There have been six revisions to the plan which were approved by Ohio EPA and implemented by US DOE since 1999.

Ohio EPA and US DOE have had several meetings and discussions to outline the necessary requirements and revisions to the latest submittal. As such, Ohio EPA has no comments on the submitted plan and it is therefore approved in accordance with the requirements of the Ohio Consent Decree.

If you have any questions regarding this correspondence, please do not hesitate to contact me at 740-380-5289 or maria.galanti@epa.ohio.gov.

Sincerely,

M Galanti

Maria Galanti
Site Coordinator
Division of Emergency and Remedial Response

MG/jg

cc: Melody Stewart, DHWM, Ohio EPA, Southeast District Office
Dr. Linda Bauer, LPP, Inc.
Vincent Adams, Site Director, PPPO-PORTS
William Murphie, Manager, Portsmouth/Paducah Project Office

DOE/PPPO/03-0032&D4

Integrated Groundwater Monitoring Plan for the Portsmouth Gaseous Diffusion Plant Piketon, Ohio

This document is approved for public release per review by:

Henry H. Thomas	08/24/2010
PORTS Classification/Information Office	Date

DOE/PPPO/03-0032&D4

Integrated Groundwater Monitoring Plan for the Portsmouth Gaseous Diffusion Plant Piketon, Ohio

Date Issued—September 2010

Prepared by
CDM, a Joint Venture
under subcontract LPP 05SC003

Prepared for the
U.S. Department of Energy
Portsmouth/Paducah Project Office
Document Control Number: 1205-01.01.05.09.01-03995

LATA/PARALLAX PORTSMOUTH, LLC
managing the
Environmental Remediation Activities at the
Portsmouth Gaseous Diffusion Plant
under contract DE-AC24-05OH20192
for the
U.S. DEPARTMENT OF ENERGY

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CONTENTS

FIGURES

TABLES

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ACRONYMS

AOC	area of concern
BRC	Big Run Creek
CAS	Cleanup Alternatives Study
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
COC	chain-of-custody
DFF&O	Director's Final Findings and Orders
DIUF	deionized ultra-filtered
DNAPL	dense non-aqueous phase liquid
DOE	U.S. Department of Energy
EDD	East Drainage Ditch
EPA	Environmental Protection Agency
GWQA	*Ground-Water Quality Assessment of Four RCRA Units for the Portsmouth Gaseous Diffusion Plant* [Martin Marietta Energy Systems (MMES) 1989a]
HRC®-X	Hydrogen Release Compound®-extended release formula
LBC	Little Beaver Creek
LNAPL	light non-aqueous phase liquid
IGWMP	*Integrated Groundwater Monitoring Plan*
IRM	Interim Remedial Measure
ISWL	Industrial Solid Waste Landfill
MMES	Martin Marietta Energy Systems
mg/kg	milligram per kilogram
µg/L	microgram per liter
µS/cm	microsiemen per centimeter
NHP	North Holding Pond
NPDES	National Pollutant Discharge Elimination System
O&M	operation and maintenance
OAC	Ohio Administrative Code
Ohio EPA	Ohio Environmental Protection Agency
PCB	polychlorinated biphenyl
pCi/L	picocurie per liter
PEMS	Project Environmental Measurements System
PK	Peter Kiewit
PORTS	Portsmouth Gaseous Diffusion Plant
ppb	part per billion
ppm	part per million
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SWL	static water level
SWMU	solid waste management unit
TCE	trichloroethene
UND	Unnamed Southwest Drainage Ditch
VOA	volatile organic analysis
VOC	volatile organic compound
WDD	West Drainage Ditch

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1. INTRODUCTION

Groundwater and surface water monitoring at the U.S. Department of Energy (DOE) Portsmouth Gaseous Diffusion Plant (PORTS) was initiated in the 1980s. Since that time, numerous investigative studies and routine monitoring programs have provided much geologic and hydrogeologic information at PORTS.

The purpose of the *Integrated Groundwater Monitoring Plan* (IGWMP) is to capture in a single document the following regulatory and legal requirements for groundwater monitoring at PORTS:

- regulatory requirements of the Ohio Administrative Code (OAC),
- closure documents,
- the 1989 Administrative Consent Order between DOE and the U.S. Environmental Protection Agency (EPA), as amended in 1994 and 1997, which the Ohio Environmental Protection Agency (Ohio EPA) became a party to in 1994,
- the 1989 Consent Decree between the DOE and the State of Ohio, and
- DOE Orders.

The IGWMP integrates into a single, unified document the regulatory and technical requirements for groundwater monitoring at PORTS. Per the Director's Final Findings and Orders (DFF&O), journalized on March 18, 1999, the IGWMP "is designed to integrate site-wide groundwater monitoring activities at PORTS by encompassing all groundwater monitoring requirements and the goals of multiple regulatory programs in order to maximize resources to support corrective action and to minimize the potential for conflicts in requirements between regulatory programs."

The initial IGWMP dated November 1998 was approved by Ohio EPA for implementation beginning in the second quarter of 1999. Revisions to the IGWMP are reviewed and approved by Ohio EPA. Previous revisions of the IGWMP were dated and implemented as follows:

- January 2001 (effective the first quarter of 2001 through fourth quarter of 2001),
- October 2001 (effective the first quarter of 2002 through fourth quarter of 2002),
- October 2002 (effective the first quarter of 2003 through fourth quarter of 2003),
- October 2003 (effective the first quarter of 2004 through fourth quarter of 2004),
- October 2004 (effective the first quarter of 2005 through fourth quarter of 2007), and
- August 2007 (effective the first quarter of 2008 through second quarter of 2009).

This IGWMP revision will replace the IGWMP dated June 2009 and implemented in the third quarter of 2009. This revision incorporates changes based on a review of monitoring data and current remedial actions.

The IGWMP is designed to minimize the potential for confusion in interpreting requirements and to maximize resources for collecting the data needed for sound decision making. Keeping the intent of the regulatory directives and the objectives of various monitoring programs in mind, the IGWMP is designed to establish all groundwater monitoring requirements for PORTS. Ultimately this document will facilitate the efficient collection of groundwater monitoring data, simplify the process of conducting regulatory audits of the program, and improve the collection and representativeness of data needed to make the decisions required in the corrective action process.

DOE Order 5400.5, *Radiation Protection of the Public and the Environment,* requires radiological monitoring. These radiological monitoring requirements are included in the IGWMP so that groundwater and surface water monitoring requirements associated with the IGWMP monitoring locations are captured in a single plan.

1.1 OVERVIEW OF APPROACH

The IGWMP establishes economies of scale for groundwater monitoring by focusing activities over larger areas rather than on individual wells or waste management units within an area. Specifically, the identity and location of the appropriate subset of monitoring wells, the identity of constituents for sampling, and the frequency of sampling are determined on the basis of an evaluation of historical monitoring results, process knowledge, and other information and requirements from previous investigations conducted at PORTS. The process of integrating groundwater monitoring at PORTS is shown schematically in Figure 1. DOE will implement changes to the IGWMP beginning in the calendar quarter following Ohio EPA approval, except for changes that have been previously approved by Ohio EPA and are already being implemented by DOE.

The IGWMP is organized into three large-scale divisions: Sections 1 through 3 comprise the introduction, background, history, and the regulatory and technical considerations for the groundwater monitoring program at PORTS; Sections 4 through 8 contain the monitoring programs for each of the quadrants at PORTS, surface water, and water supply monitoring; and Sections 9 through 11 discuss additional monitoring and procedures.

2. HISTORY OF GROUNDWATER MONITORING AT PORTS

The pre-integrated groundwater monitoring program at PORTS (monitoring prior to the second quarter of 1999) was conducted in accordance with the OAC, the 1989 Consent Decree between the DOE and the State of Ohio, and the 1989 Administrative Consent Order between DOE and the U.S. EPA (as amended in 1994 and 1997). Ohio EPA became a party to the U.S. EPA Administrative Consent Order in 1994. Routine groundwater monitoring was conducted at Resource Conservation and Recovery Act (RCRA) Subtitle C interim status units in accordance with OAC 3745-65 and OAC 3745-66, and at RCRA Subtitle D solid waste disposal units in accordance with OAC 3745-27 and 3745-29. Additionally, routine groundwater and surface water monitoring requirements were included in Closure/Post Closure Plans, Interim Remedial Measure (IRM) Plans, Corrective Measure Plans, and other Administrative Action documents. These plans and documents were written and approved in accordance with the regulations and/or the Consent Order and the Consent Decree. A listing of these documents includes the following:

- Ground-Water Quality Assessment of Four RCRA Units for the Portsmouth Gaseous Diffusion Plant
- Detection Monitoring Plan for the X-230J7 Holding Pond
- Closure Plan for the X-230J7 Holding Pond
- Closure Plan for the X-231B Oil Biodegradation Plot
- X-231B Oil Biodegradation Plot Closure Options Study
- X-231B Technology Demonstration Assessment Report
- X-231B Consolidated Closure Plan
- Decision Document for the X-611A Lime Sludge Lagoons
- Closure Plan for the X-616 Surface Impoundments
- Post Closure Plan for the X-616 Surface Impoundments
- Closure Plan for the X-701B Holding Pond and Sludge Containment Ponds
- X-701B Technology Demonstration Assessment Report
- Consolidated Closure Plan for the X-701B Holding Pond and Sludge Containment Ponds
- Closure Plan for the X-735 Landfill (Northern Portion)
- Final Closure/Post Closure Plan for the X-735 Industrial Solid Waste Landfill
- Closure Plan for the X-749 Contaminated Materials Disposal Facility, Northern Portion
- Closure Plan for the X-749 Contaminated Materials Disposal Facility, Southern Portion
- Interim Remedial Measures Plan for the X-749
- Closure Plan for the X-749A Classified Materials Disposal Facility
- Interim Measures Plan for the Peter Kiewit Landfill
- Peter Kiewit Landfill Cleanup Alternatives Study/Corrective Measures Study (CAS/CMS)
- Decision Document for the Peter Kiewit Landfill

The *Ground-Water Quality Assessment of Four RCRA Units for the Portsmouth Gaseous Diffusion Plant* (GWQA) (MMES 1989a) was completed in accordance with RCRA requirements in 1989. The document summarized the results of studies conducted at four units at PORTS regulated under RCRA: the X-701B Holding Pond, the X-231B Southwest Oil Biodegradation Plots, the X-749 Contaminated Materials Disposal Facility, and the X-616 Chromium Sludge Surface Impoundments. As a result of the groundwater contamination discovered during the GWQA investigation, an assessment monitoring program for the X-701B, the X-231B, and the X-749 was proposed by DOE and approved by the Ohio EPA in 1989. Routine groundwater monitoring has been conducted in the vicinity of these four units since 1989. The assessment monitoring program for the X-616 facility was initiated prior to the GWQA.

Another comprehensive effort at PORTS required by the Consent Order and the Consent Decree was a RCRA Facility Investigation (RFI), conducted from 1991 to 1996, which included the investigation of 143 solid waste management units (SWMUs). The RFI identified a number of SWMUs as potential sources for groundwater contamination and confirmed the results of the GWQA. Some areas identified in the RFI as potential concerns associated with contamination include the following:

- X-120 Old Training Facility (Quadrant I)
- Quadrant I Groundwater Investigative Area [includes the X-231B volatile organic compound (VOC) plume], also known as the Five-Unit Area
- Quadrant II Groundwater Investigative Area, also known as the Seven-Unit Area
- X-740 Waste Oil Handling Facility (Quadrant III)

Other areas noted as containing potential sources of contamination include the following:

- X-749 Contaminated Materials Disposal Facility (Quadrant I)
- Peter Kiewit (PK) Landfill (Quadrant I)
- X-749A Classified Materials Landfill (Quadrant I)
- X-611A Former Lime Sludge Lagoons (Quadrant IV)
- X-734 Old Sanitary Landfill (Quadrant IV)
- X-734A&B Construction Spoils Landfills (Quadrant IV)
- X-735 Landfill (Quadrant IV)

Based upon the results of the RFI, it was determined that groundwater monitoring should continue at some facilities, and special groundwater studies should be implemented at others in order to obtain additional data necessary for the development of corrective measure studies.

Under both RCRA Subtitle C and RCRA Subtitle D and prior to implementation of the IGWMP, detection monitoring was performed at units where there was no statistically significant exceedence of threshold levels of contaminants or indicator parameters at downgradient wells. In the event of such an occurrence, the groundwater contaminant plume associated with the unit would have been characterized during an assessment monitoring program. The assessment monitoring was performed on a quarterly basis under an approved groundwater quality assessment plan. The assessment monitoring program was conducted to continually characterize the extent and rate of migration, and the concentration of leachate or leachate-derived constituents in the groundwater upon determining a significant change in levels of contaminants or indicator parameters at downgradient wells.

Under the pre-integrated program, routine groundwater monitoring was required on a quarterly, semiannual, or annual basis at seven RCRA Subtitle C interim status hazardous waste units at PORTS. Detection monitoring was required at three units: (1) the X-701C Neutralization Pit, (2) the X-735 RCRA Landfill (northern portion of X-735), and (3) the X-230J7 Holding Pond. Assessment monitoring was required at two units not yet closed: (1) the X-231B Southwest Oil Biodegradation Plot, and (2) the X-701B Holding Pond, and at two units that were certified closed: (1) the X-616 Chromium Sludge Surface Impoundments, and (2) the X-749 North Contaminated Materials Storage Yard.

Under the pre-integrated program, routine groundwater monitoring was also conducted at three RCRA Subtitle D solid waste disposal units: the X-735 Industrial Solid Waste Landfill (southern portion of X-735), the X-749A Classified Materials Disposal Facility (certified closed), and the X-749 South Contaminated Materials Disposal Facility. Assessment monitoring was performed at the X-749 South

Contaminated Materials Disposal Facility due to the site's proximity to the X-749 northern portion. The northern portion is a RCRA Subtitle C facility which has been associated with a groundwater contamination plume, however, a determination that the X-749 South Contaminated Materials Disposal Facility is a source of groundwater contamination has not been made. With the approval of the regulatory authority, and with their acknowledgment that the X-749 southern portion is not regulated as a hazardous waste unit, both the X-749 units are monitored as one unit.

On January 27, 1999, Ohio EPA approved the IGWMP for PORTS. On March 18, 1999, a DFF&O was journalized that governs the requirements and exemptions under multiple regulatory programs applicable to future IGWMP revisions. Implementation of the IGWMP began in the second quarter (April through June) of 1999.

Groundwater monitoring at the X-735 Landfills and X-749A Classified Materials Disposal Facility (part of the Quadrant I Groundwater Investigative Area) is conducted in accordance with OAC 3745-29-10 as promulgated on June 1, 1994. This rule was in effect when the March 1999 DFF&O was journalized. Ohio EPA agrees that groundwater monitoring at these two areas will be conducted in accordance with the 1994 version of OAC 3745-29-10 as delineated in the IGWMP in lieu of monitoring these units in accordance with subsequent revisions to the rule. Appendix G provides a copy of OAC 3745-29-10 as promulgated on June 1, 1994.

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3. DEVELOPMENT OF AN INTEGRATED GROUNDWATER MONITORING PLAN

PORTS can more efficiently achieve groundwater monitoring/remediation objectives by integrating and consolidating monitoring requirements. In order to optimize the groundwater monitoring activities at PORTS, the monitoring program at a given Area of Concern (AOC) integrates historical information, the regulatory requirements stipulated in the regulations or other administrative directives, as well as requirements necessary to support corrective measures.

3.1 TECHNICAL CONSIDERATIONS FOR OPTIMIZING GROUNDWATER MONITORING

Groundwater monitoring resources are optimized by conducting a detailed evaluation of those systematic elements that would constitute an effective and efficient groundwater monitoring program: network configuration and well selection, sampling frequency(ies), analytical parameters, data interpretation and reporting, and monitoring program evaluation. Optimization of these elements is based on technical considerations, calculations, estimates, historical trends, and professional judgment. The following sections describe the process used at PORTS to evaluate the existing groundwater monitoring program, including general suggestions for changes.

3.1.1 Groundwater AOCs

The process of developing an integrated groundwater monitoring program at PORTS began by selecting or designating relatively large-scale contamination areas called groundwater AOCs. AOCs at PORTS are generally large areas containing multiple source/release sites contributing to physically contiguous or co-mingled contaminant plumes, or remediation concerns that are the subject of corrective actions or RCRA closures. By focusing monitoring activities over AOCs rather than on individual waste management units, the IGWMP establishes economies of scale for groundwater monitoring, and resources are used more efficiently.

The IGWMP designates AOCs on the basis of areas previously identified in three documents, or series of documents: the 1989 GWQA, the RFI Reports (DOE 1996b, DOE 1996c, DOE 1996d, and DOE 1996e), and the *Background Sampling Investigation of Soil and Groundwater Final Report* (DOE 1996a). The GWQA was discussed in Section 2. The RFI Reports (DOE 1996b, DOE 1996c, DOE 1996d, and DOE 1996e) delineated additional groundwater AOCs associated with predominantly VOC contamination. Additionally, areas were noted as containing potential sources of groundwater contamination. Figure 2 shows the groundwater AOCs at PORTS.

3.1.2 Well Selection and Network Configuration

Monitoring wells were selected to serve one or more of the following broad technical objectives: source/release monitoring, plume monitoring, and remedial action effectiveness monitoring. Source monitoring is designed to monitor as close as feasible to potential sources of groundwater contamination such as landfills and holding ponds. Plume monitoring is designed to assess the concentrations and extent of known contaminant plumes. Remedial action effectiveness monitoring is designed to evaluate the performance of interim remedial measures, corrective actions, or technology demonstrations. These broad technical purposes approximate the regulatory definitions of detection monitoring and assessment monitoring.

A single monitoring well may serve two or more of the technical objectives noted above. For instance, a well near a barrier wall at the edge of a landfill and located in the center of a groundwater plume would serve all three objectives. Wells may also be monitored for other purposes such as exit pathway monitoring or residential monitoring. More wells than necessary may be available to meet technical objectives for a given area. Therefore, additional technical information is used to determine the specific wells used for each area. Specific wells and the monitoring network's configuration have been determined on the basis of the following information:

- *Potentiometric data* is used to select at least one upgradient well. Regional flow data will be used if local flow is radial. Potentiometric data is also used to select appropriate upgradient and downgradient wells for monitoring potential or existing sources; plume extent, rate of migration, and concentration; and areas where remedial measures have been installed.

- *Well spacing* information is used to select wells which will adequately delineate contaminant plumes and address variations in hydraulic conductivity and flow directions.

- *Geochemical-process parameters* are used to help understand contaminant fate-and-transport mechanisms.

- *Soil boring and subsurface geologic data* is used to assure that at least one Gallia and one Berea well are located near the area of highest overall contamination, and to assure that selected wells are screened in the appropriate formation.

3.1.3 Sampling Frequency

Sampling frequencies of a well or wells may be changed during the implementation of the IGWMP due to changes in water quality results of the well or wells. A change to a more frequent sampling schedule may be necessary when:

- wells are at plume margins,
- concentrations are changing,
- flow velocities are high,
- parameters are detected that are mobile in groundwater, or
- when the Sunbury shale is thin (less than 2.5 inches) or absent at Berea wells.

A change to a less frequent sampling schedule may occur when:

- wells are at the center of plumes,
- concentrations vary slightly over time based upon historic data,
- wells are in hydrogeologic strata where flow velocities are low,
- parameters are detected that have low mobility in groundwater, or
- when the Sunbury shale is thick at Berea wells.

3.1.4 Analytical Parameters

Changes in the analytical parameters for groundwater sampling at PORTS (see Table 1) are selected on the basis of the following information:

- *Historical data* is used to identify potential chemicals of concern. Most groundwater AOCs have abundant historical data that can be used to safely infer long-term water-quality trends. Rather than requesting the same set of sample analyses for each well for each monitoring event, which is not an effective use of resources, the evaluation considers historical data trends to minimize the number of laboratory analyses needed for a given sampling event without sacrificing important information and without increasing risk to either human health or the environment. For example, on a historical basis selected VOCs and occasionally technetium-99 have proven to be very effective early indicators for plume migration. It is in fact much more effective than the existing process of using anions and cations. The approach used to develop the IGWMP relies heavily on parameters that indicate sudden plume movement, such as trichloroethene (TCE), to determine whether the analysis of additional parameters is necessary.

- *Relative mobility* of actual (or potential) contaminants is used in conjunction with contaminant transport knowledge about specific analytes. Some analytes migrate faster in groundwater than others; for instance, TCE moves much faster than polychlorinated biphenyls (PCBs). This information is used to tailor monitoring to the velocity of groundwater for each AOC.

- *Geochemical-process parameters* are used to help assess conditions favorable for natural attenuation or biological degradation of chlorinated solvents, or to help understand fate-and-transport mechanisms.

- *Conventional indicator parameters* (e.g., chlorides, sulfates) may be used in areas requiring source monitoring, and to a lesser degree, plume monitoring. Such parameters are often useful in determining characteristics unique to an individual groundwater area, or contaminant plume.

3.2 SPECIAL SHORT-TERM STUDY PROCESS

Over the course of long-term monitoring at PORTS, questions may arise about specific contaminant releases or transport mechanisms, or the application of a specific remediation technology that cannot be answered by the data collected under the integrated monitoring program outlined in the IGWMP. To address this need, the IGWMP allows for the inclusion of special monitoring activities that are highly focused on specific groundwater problems. Specific special studies may be proposed by the Ohio EPA or by DOE and implemented through an approved work plan. Specific special studies are discussed in Section 9 if long-term monitoring at PORTS is affected. The results of a special study may be presented in a separate report(s) and summarized in the annual Groundwater Monitoring Report (see Section 3.3.3).

3.3 EVALUATIONS AND REPORTING

The evaluation and reporting of information and data generated as a result of implementing the IGWMP are required by the Ohio EPA. Evaluations include, but are not limited to, the following: statistical analysis, trend analysis, and the evaluation of analytical results to ensure achievement of data quality objectives. Reporting of the data and the results of the evaluations are scheduled to occur on a routine basis of not less than annually. The Ohio EPA has also requested timely reporting by DOE of any event that may warrant any revision to the IGWMP prior to submission of the next respective annual report. Such finding may include the following: a significant increase in contaminant concentration, contamination discovered in previously uncontaminated monitoring well(s), and significant changes in groundwater flow direction. Such events may also prompt the initiation of a special short-term study as described in Section 3.2. The following sections describe the required statistical evaluations and reporting for the integrated groundwater monitoring program.

3.3.1 Statistical Evaluations and Reporting

Two units included in the integrated groundwater monitoring program, the X-749A Classified Materials Disposal Facility and the X-735 Industrial Solid Waste Landfill, are subject to monitoring programs under OAC 3745-29-10 (as promulgated June 1, 1994, see Appendix G).

The monitoring programs for these units include the statistical evaluation of analytical results in order to determine if leachate or leachate-derived constituents from these units have impacted the surrounding groundwater. These evaluations are completed as described in Appendix F and Sections 4.2.4 and 7.2.4, respectively.

If the statistical evaluations performed under a detection monitoring program indicate a statistically significant increase after verification resampling as described in Appendix F, DOE will notify the Ohio EPA in accordance with OAC 3745-29-10(D)(7)(b). The notification will identify the wells and parameters that have shown a statistically significant change.

As described in OAC 3745-29-10(D)(7)(c) for detection monitoring programs, DOE may choose to demonstrate that a source other than the landfill caused the contamination or that the statistically significant increase resulted from error in the sampling, analysis, statistical evaluation, or natural variation in groundwater quality. This demonstration may take the form of a special study as described in Section 3.2. A report documenting this demonstration will be submitted to the Ohio EPA within 105 days of reporting the statistically significant change (unless otherwise agreed to by Ohio EPA) and may include a request to continue the detection monitoring program. If DOE cannot successfully show that the identified contamination was not caused by the landfill, DOE will initiate an assessment monitoring program in accordance with OAC 3745-29-10(E), except for modifications otherwise approved by the Ohio EPA.

3.3.2 Assessment and Corrective Measures Reporting

DOE will follow, if and where monitoring results make applicable, OAC 3745-29-10(E) for assessment monitoring and reporting requirements, and OAC 3745-29-10(F) for corrective measures requirements, except for modifications otherwise approved by the Ohio EPA.

3.3.3 Annual Reporting

The integrated groundwater monitoring program defined in this document includes the preparation and submittal to the Ohio EPA of an annual Groundwater Monitoring Report. This report will be submitted by April 1 and will contain a summary of the groundwater monitoring completed during the previous year.

In addition to a summary and overview analysis of the groundwater data for each of the four quadrants, which may include graphs and charts necessary to explain fundamental changes in the data or the understanding of the data, the annual Groundwater Monitoring Report will specifically note any significant changes in the data occurring during the previous year. The report will especially note any anomalies in the groundwater quality or any changes in the monitoring programs at the X-749A or the X-735 Landfills. A description of any special studies conducted during the previous year will also be included, as well as descriptions of the rate, extent and concentration level of the existing contaminant plumes. Information about the groundwater treatment facilities, results of the surface water and water supply monitoring, and trends in the groundwater quality will also be provided.

Laboratory analytical data, groundwater elevations, and statistical analysis collected during the previous year will be presented in summary tables. The concentration and extent of the contaminant plumes will be shown on figures and the groundwater elevations will be shown on potentiometric surface water maps.

The format and content of the annual Groundwater Monitoring Report will be governed by the data collected and the evaluations performed during the previous year. Therefore, the report may be modified over time in order to best meet the needs of the Ohio EPA and DOE. Furthermore, results provided in the annual report may dictate that changes be made to the IGWMP. Changes to the IGWMP will be approved by the Ohio EPA.

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4. QUADRANT I

Two groundwater AOCs are located in Quadrant I, which is in the southern portion of the site: the X-749/X-120/PK Landfill Area and the Quadrant I Groundwater Investigative Area/X-749A Classified Materials Landfill Area. These areas are discussed in Sections 4.1 and 4.2, respectively.

4.1 X-749 CONTAMINATED MATERIALS DISPOSAL FACILITY/X-120 OLD TRAINING FACILITY/PK LANDFILL AREA

The following sections contain an introduction and facility history of the X-749/X-120/PK Landfill Area and the regulatory and technical considerations for optimizing groundwater monitoring in this AOC. Section 4.1 concludes with discussions regarding regulatory evaluations and reporting for the X-749/X-120/PK Landfill Area.

4.1.1 Background and History

In the southern portion of Quadrant I, groundwater concerns focus on three contaminant sources: the X-749 Contaminated Materials Disposal Facility (both north and south portions), the X-120 Old (Goodyear) Training Facility, and the PK Landfill. Integrating the monitoring programs for each of the three areas into one plan provides for increased efficiency of data collection, enhances the decision making process, and minimizes the possibility of errors or confusion. A brief history of these units and their associated remedial actions is presented in this section. Additional historical information specific to the X-749 groundwater monitoring wells and analytical results is presented in Section 4.1.3.

4.1.1.1 X-749 Contaminated Materials Disposal Facility

The X-749 Contaminated Materials Disposal Facility is located in the south-central section of the facility. The landfill covers approximately 11.5 acres and was built in an area of highest elevation within the southern half of PORTS. Operation of the landfill was from 1955 to 1990, during which time buried wastes were generally contained in metal drums or other containers that were compatible with the waste.

The landfill is divided into a northern portion and southern portion. The northern portion is approximately 200,000 square ft and contains waste contaminated with industrial solvents, waste oils from plant compressors and pumps, sludges that were classified as hazardous, and low-level radioactive materials. The southern portion is approximately 130,000 square ft and contains non-hazardous, low-level radioactive scrap materials.

The X-749 facility was included in the 1989 GWQA. An assessment monitoring program for this unit was proposed in the 1989 GWQA. This assessment monitoring program was implemented at the completion of the GWQA investigation.

Separate closure plans for the northern and southern portions of the unit were prepared based on historical information about the types of waste disposed in each area; i.e., the closure plan for the northern portion was prepared in accordance with hazardous waste regulations and the closure plan for the southern portion was prepared in accordance with solid waste regulations. Closure of both units occurred concurrently and was completed in 1992 in accordance with both approved closure plans. Because a groundwater contaminant plume underlies both portions, and because they are adjacent to each other and were closed together, the X-749 Contaminated Materials Disposal Facility is considered a single unit for the purposes of groundwater monitoring. Therefore, in this document, the term "X-749" refers to the entire unit, including both the north and south portions, unless otherwise designated.

Elements of the closure included installation of a multimedia cap, a barrier wall along the north side and northwest corner of X-749, and subsurface groundwater drains on the northern half of the east side and the southwest corner, including one groundwater extraction well within each of the groundwater drains. The barrier wall and subsurface drains extend down to bedrock. After collection, groundwater is pumped from the subsurface drains to the X-622 Groundwater Treatment Facility, where the groundwater is treated prior to discharge in accordance with the applicable National Pollutant Discharge Elimination System (NPDES) permit.

In 2001, Ohio EPA issued the Decision Document for Quadrant I, which identified the selected remedial measures for X-749 Contaminated Materials Disposal Facility. An additional barrier wall was installed around the eastern and southern portions of X-749. Installation of this barrier wall required removal of the eastern groundwater extraction well installed during closure of the unit.

In 2007-2008, two additional groundwater extraction wells (X749-EW05G and X749-EW06G) were installed in the groundwater collection trench on the southwest side of the X-749 Contaminated Materials Disposal Facility to provide further control of contaminants emanating from the landfill. The extraction wells began operating in January 2008.

Phytoremediation was also required by the Decision Document to control groundwater flow and remove VOCs from portions of the X-749 groundwater plume. Hybrid poplar trees were planted in areas east, south, and west of the X-749 Landfill during 2002-2003. Additional groundwater monitoring wells were installed to monitor the effect of the trees on the groundwater plume.

A preliminary evaluation of the X-749/X-120 phytoremediation system, the *Preliminary Evaluation Report for the X-749/X-120 Phytoremediation System at the Portsmouth Gaseous Diffusion Plant* (DOE 2008c) was completed in January 2008. The trees selected for the phytoremediation system had just begun to develop sufficient leaf area (approximately equal to root volume) so that groundwater was transpired through the trees; therefore, a complete system evaluation could not be completed. Water level data and tree core sampling results indicated that contaminated groundwater was being transpired by the trees; however, the volume of contaminated groundwater uptake by the trees was uncertain. Continued operation of the phytoremediation system was recommended in order for the trees to grow and develop a more extensive root system.

In the early 1990s, the leading edge of the contaminated groundwater plume emanating from X-749 was determined to be approaching the southern boundary of the PORTS reservation. In 1994, an IRM subsurface barrier wall (X-749 South Barrier Wall) was completed across a portion of the facility's southern boundary. The X-749 South Barrier Wall, which extends from the surface into the Sunbury Shale, was designed to inhibit migration of the plume off plant property.

In 2004, injection of a reductive dechlorination compound, Hydrogen Release Compound®-extended release formula (HRC-X), was performed near the X-749 South Barrier Wall to remediate VOCs in this area. Selected wells were monitored for additional parameters to monitor and evaluate the effectiveness of the HRC-X in remediating VOCs. Sampling data collected through the second quarter of 2006 indicated that optimal reductive dechlorination of chlorinated solvents was briefly achieved in the treatment zones but was no longer effective due to depletion of the HRC-X.

In 2007, four groundwater extraction wells (X749-EW01G, X749-EW02G, X749-EW03G, and X749-EW04G) were installed in the X-749 South Barrier Wall area. These groundwater wells were successful in reducing the VOC concentrations detected in groundwater in the X-749 South Barrier Wall Area. In 2010, three additional groundwater extraction wells (X749-EW07G, X749-EW08G, and X749-EW09G) were installed within the X-749/X-120 plume to provide additional control and remediation of the plume. Chapter 9, Section 9.2.1 provides additional information about the current special studies and/or remedial activities in the X-749/X-120 groundwater plume.

4.1.1.2 X-120 Old Training Facility

The X-120 Old (Goodyear) Training Facility covered an area of approximately 11.5 acres near the present day XT-847 building. The X-120 facility, which no longer exists, included a machine shop, metal shop, paint shop, and several warehouses used during the construction of PORTS in the 1950s. The shops may have used solvents and various other materials. Disposal practices of these solvents are unknown.

A groundwater contaminant plume associated with this facility contains primarily TCE and lesser concentrations of other VOCs. The upgradient portion of the X-120 plume co-mingles with a portion of the X-749 plume; however, downgradient the X-120 plume migrates independently to the southwest. In 1996, a horizontal well was installed along the approximate axis of the X-120 plume. This well passively transmitted (by gravity drainage) contaminated groundwater to the X-625 Groundwater Treatment Facility. In July 2003, operation of the X-625 Groundwater Treatment Facility ceased and the horizontal well discharge was capped because of the limited amount of groundwater that was being treated at the facility. In 2010, a groundwater extraction well (X749-EW09G) was installed within the X-120 portion of the groundwater plume to remediate higher concentrations of VOCs present in groundwater in this area of the plume.

4.1.1.3 PK Landfill

The PK Landfill is located west of Big Run Creek just south of the X-230K Holding Pond. The landfill, which began operations in 1952, was used as a salvage yard, burn pit, and trash area during the construction of PORTS. After the initial construction, the disposal site was operated as a sanitary landfill until 1968, when soil was graded over the site and the area was seeded with native grasses. No manifests or records exist that characterize the material in the landfill.

During site investigations, intermittent seeps were observed emanating from the PK Landfill into Big Run Creek. In 1993, sampling was conducted at three of the seeps and at Big Run Creek approximately 40 ft downstream of the seeps. Sample results indicated that the seeps contained vinyl chloride; however, no vinyl chloride was detected in Big Run Creek.

In 1994, an IRM was implemented that involved the portion of Big Run Creek contiguous to the PK Landfill. This portion of Big Run Creek was relocated approximately 50 ft to the east. A groundwater collection system was installed in the old creek channel to capture the seeps emanating from the landfill. Contaminated groundwater is pumped from the collection system to the X-622 Groundwater Treatment Facility. The PK Landfill IRM required sampling of the groundwater collection system on a quarterly basis.

In accordance with the provisions of various regulatory requirements, the final Decision Document for the PK Landfill was issued by the Ohio EPA in July 1996, and the U.S. EPA in May 1997. The Decision Document required:

- continued operation of seep collection system on the east side of the landfill,

- a landfill cap to contain wastes and reduce water infiltration that meets the requirements of RCRA, Subtitle D, and

- environmental monitoring to ensure that the final remedial action is protective.

The PK Landfill Decision Document also required evaluation of the leachate volumes flowing to the seep collection system to determine the need for a vertical subsurface barrier (barrier wall) to minimize lateral migration of contaminants. The RCRA Subtitle D landfill cap completed at the PK Landfill in 1998 did not include the installation of a vertical barrier.

In April 1997, contaminated seeps were noted in the tributary to Big Run Creek on the south side of the PK Landfill. It was believed that these seeps were the result of the groundwater plume associated with the X-749 facility intersecting the ground surface at this location. The X-749/X-120 groundwater plume is near the western and southern boundary of the PK Landfill and the groundwater potentiometric surface is near the actual surface elevation in this area. The groundwater flow in the PK Landfill area was from the northwest to southeast.

As a result of the seeps discovered in April 1997, a second collection system was constructed south and east of the PK Landfill boundary in October 1997 to contain the groundwater plume migrating toward Big Run Creek. This additional collection system was tied into the previously installed system that delivers collected water to the X-622 Groundwater Treatment Facility.

After the 5-year evaluation of the remedial actions at the PK Landfill was completed in 2002 [*X-611A Prairie and the X-749B Peter Kiewit Landfill Five-Year Evaluation Report for the Portsmouth Gaseous Diffusion Plant* (DOE 2002)], DOE developed the *Comprehensive Monitoring Plan for the X-749 and Peter Kiewit Landfill Areas* (DOE 2003a) to address Ohio EPA comments on the report. The plan described additional data to be collected to evaluate the remedial measures in place at the X-749 and PK Landfills and to determine whether additional remedial measures were needed, such as a barrier wall north and west of the PK Landfill. The *Annual (2004) Summary Report of the Comprehensive Monitoring Plan Data for the X-749/Peter Kiewit Landfill Areas* (DOE 2005) determined that the remedial measures in place were performing as expected and a barrier wall was not necessary.

The second five-year review for the PK Landfill was completed in 2008. The *Second Five-Year Review for the X-749B Peter Kiewit Landfill* (DOE 2008e) found that the remedial actions implemented at the PK Landfill (the groundwater collection systems, landfill cap, and institutional controls) were achieving remedial action objectives by eliminating exposure pathways and reducing the potential for contaminant transport. Concentrations of many of the VOCs detected in groundwater at the PK Landfill were decreasing significantly. In addition, VOCs detected at the PK Landfill were not detected in surface water samples collected from Big Run Creek adjacent to or downstream from PK Landfill. Monitoring data continued to indicate that a barrier wall north and west of the PK Landfill was not necessary.

4.1.2 Regulatory Considerations for Optimizing Groundwater Monitoring

Regulatory requirements for the X-749/X-120/PK Landfill Area are summarized in the following section. As noted previously, the X-749 Contaminated Materials Disposal Facility comprises two units: a northern unit and a southern unit. Groundwater monitoring at the northern portion was governed by the hazardous waste regulations and an approved closure plan written in accordance with those regulations.

Groundwater monitoring at the southern portion of the X-749 was governed by the solid waste regulations and an approved closure plan written in accordance with the solid waste regulations.

The closure plan for the southern portion included essentially the same requirements as specified in the northern portion closure plan; however, it also included a requirement that three surface water locations be monitored during closure of the unit. Other discrepancies between the two post-closure groundwater monitoring sections also existed.

It should also be noted that only three wells were included in the groundwater monitoring system described in the initial closure plans; however, as part of the pre-integrated monitoring program, 29 wells associated with the X-749 groundwater plume were routinely monitored with results reported to the Ohio EPA annually. Most of the wells were added to the original monitoring system as part of the 1989 GWQA, to support the 1994 X-749 IRM, or to further delineate the extent of the X-749 groundwater contaminant plume in accordance with OAC 3745-65-90 to 3745-65-94. All parameters specified in the closure plans have been monitored at the three wells specified in the closure plans. The remaining wells were monitored for a different list of parameters.

The PK Landfill lies within or adjacent to the X-120 and X-749 contaminant plumes and is considered part of the X-749/X-120/PK Landfill AOC. To optimize the groundwater monitoring program in this area, a monitoring program was developed to accomplish the objectives of monitoring the existing groundwater contamination plume (rate, extent, and concentration) while providing for the collection of additional information which indicates whether or not the PK Landfill is a continuing source of groundwater contamination, and whether or not additional contaminants (in addition to those already identified), are leaching from the X-749 unit. The pre-integrated requirements for conducting groundwater monitoring at the PK Landfill were specified in the Operation and Maintenance (O&M) Plan for the PK Landfill Corrective Measures Implementation (CMI).

A consolidated, integrated monitoring program for this facility eliminates potential confusion or overlaps between the hazardous waste requirements and the solid waste requirements, while efficiently providing information necessary to determine the best alternative for the corrective actions to be implemented at this facility.

4.1.3 Technical Considerations for Optimizing Groundwater Monitoring

The integrated monitoring program, including all well names, monitoring frequencies, and parameters for the X-749, the X-120, and the PK Landfill areas is presented in Appendix A, Table A-1. However, each unit within the area is presented individually in this section to clarify the technical objectives in selecting the wells, frequencies, and parameters. Because many wells will meet one or more technical objectives for more than one unit, the parameter and frequency selection for wells meeting a particular objective may not be identical.

A known VOC groundwater contaminant plume emanates from X-749. Routine groundwater monitoring has occurred for X-749 since 1990. Prior to implementation of the IGWMP, analytical parameters for X-749 wells typically included VOCs, physical parameters, radiological parameters, metals, and inorganics. The specific list of VOCs varied from year to year; however, the primary plume VOCs were always included in the list (32 VOCs were included). The radiological parameters always included technetium-99 and total uranium. However, historical data indicates that only technetium-99 was a consistent plume constituent (since technetium-99 is a beta emitter, gross beta results generally mimic technetium-99 results). Physical parameters typically included temperature, pH, and specific conductance. Changes in sampling methodology also allowed some measurements of the physical parameters turbidity and dissolved oxygen. Hazardous metals parameters typically included cadmium, chromium, and lead. These metals are not believed to be associated with the VOC/technetium-99 plume at X-749/X-120 as a number of mid-plume wells have shown no detections for these metals. Other parameters at this unit have included metals and other inorganics used for mass balance and water quality analysis. These parameters included calcium, iron, magnesium, potassium, sodium, chloride, sulfate, and alkalinity. In addition to the parameters analyzed for each of the X-749 wells, a number of other parameters were included for the three closure wells (X749-26G, X749-32G, and X749-36G). These mid-plume wells were sampled for additional organics, radionuclides, metals, and other inorganics. These additional parameters were typically not detected or were below drinking water standards.

Figures A-1 and A-2 in Appendix A show the integrated monitoring wells and integrated monitoring parameters, respectively, for the X-749/X-120/PK Landfill.

4.1.3.1 X-749 Contaminated Materials Disposal Facility

The X-749 Contaminated Materials Disposal Facility is a landfill (source) with a groundwater contaminant plume for which a number of remedial actions have been performed including a cap, barrier walls, groundwater collection systems, and phytoremediation. Therefore, source monitoring, plume monitoring, and remedial action effectiveness monitoring are all conducted at X-749. Table A-1 in Appendix A lists the location/purpose, analytical parameters, and sampling frequency for each well that is part of the monitoring program for the X-749 Contaminated Materials Disposal Facility.

Source monitoring is performed to detect changes in contaminant concentrations emanating from the X-749 Contaminated Materials Disposal Facility. Sampling of selected wells near the source on a biennial basis for the additional parameters contained in the Appendix to OAC 3745-54-98 is also conducted to determine if all hazardous constituents that may be present are identified. The following wells provide source monitoring for the X-749 Contaminated Materials Disposal Facility: X749-04G (upgradient), X749-06G (downgradient), X749-07G (downgradient), X749-08G (downgradient), X749-09GA (downgradient), and X749-10GA (downgradient).

Plume monitoring at X-749 is performed to determine the extent and concentration of the X-749 plume. Although the X-749 and X-120 plumes coalesce, plume monitoring for these units is presented separately in this section of the IGWMP.

The X-749 wells screened in the Berea sandstone were historically monitored at the same frequency as Gallia wells at this unit (prior to implementation of the IGWMP). The X-749 groundwater contaminant plume resides in the Gallia sand and gravel that overlies the Berea sandstone. However, a relatively impermeable layer of Sunbury shale separates the Gallia from the Berea in most of the area (the Sunbury is absent in the eastern portion of the X-749 plume near Big Run Creek), thus preventing the migration of groundwater from the Gallia into the Berea. Berea wells have shown no indication of X-749 plume contaminants, even in Berea wells that underlie the center of the X-749 Gallia groundwater contaminant plume. Groundwater flow velocities in the Berea are slower than in the Gallia, so even if X-749 plume constituents were able to migrate through the Sunbury shale into the Berea, these contaminants would move very slowly within the Berea. Therefore, Berea wells associated with the X-749/X-120 plume are generally sampled less frequently than Gallia wells.

Each of the wells used for remedial action effectiveness monitoring at X-749 is also used for plume monitoring at this unit. Table A-1 in Appendix A provides the monitoring frequency and parameters for the wells that monitor the X-749 area.

4.1.3.2 X-120 Old Training Facility

At X-120, no source of groundwater contamination has been identified, therefore source monitoring is not conducted for this unit. However, a known groundwater contaminant plume exists for X-120, so plume monitoring is performed. Wells in the northwestern portion of the monitoring area provide this plume monitoring (see Table A-1, Figure A-1, and Figure A-2 in Appendix A).

In 1996, the X-120 horizontal well was installed along the axis of the X-120 groundwater plume. This well passively transmitted (by gravity drainage) contaminated groundwater to the X-625 Groundwater Treatment Facility. In July 2003, operation of the X-625 Groundwater Treatment Facility ceased and the horizontal well discharge was capped because of the limited amount of groundwater that was being treated at the facility. In 2010, a groundwater extraction well (X749-EW09G) was installed within the X-120 portion of the groundwater plume to remediate higher concentrations of VOCs present in groundwater in this area of the plume.

4.1.3.3 PK Landfill

The following wells provide upgradient source monitoring for the PK Landfill: PK-10G, PK-11G, and X749-20G.

In 1994, a portion of Big Run Creek contiguous to the PK Landfill was relocated to the east side of the creek valley. An interceptor trench was installed in the old Big Run Creek channel to capture seeps emanating from the landfill. Wells to the east of the PK Landfill and the interceptor trench, downgradient from the PK Landfill, monitor the effectiveness of this remedial action at the PK Landfill. Figure A-1 in Appendix A shows the wells that monitor the PK Landfill.

4.1.4 Evaluations and Reporting

Pre-integrated regulatory requirements concerning data evaluations and data reporting included the assessment and annual reporting of the concentration, rate of migration, and extent of the X-749 groundwater plume. However, monitoring of groundwater for the entire X-749/X-120/PK Landfill Area will more effectively determine whether remediation activities are sufficiently protective of human health and the environment. The groundwater data for X-749/X-120/PK Landfill will be prepared and submitted annually to the Ohio EPA by April 1, as part of the annual Groundwater Monitoring Report.

4.2 QUADRANT I GROUNDWATER INVESTIGATIVE AREA/X-749A CLASSIFIED MATERIALS DISPOSAL FACILITY

The following sections contain an introduction and facility history of the Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility and the regulatory and technical considerations for optimizing groundwater monitoring in this AOC. Section 4.2 concludes with discussions regarding regulatory evaluations and reporting for the Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility. The integrated monitoring program, including all well names, monitoring frequencies, and parameters for the Quadrant I Groundwater Investigative Area and the X-749A Classified Materials Disposal Facility are presented in Appendix A, Table A-2 and in Figures A-3 and A-4.

4.2.1 Background and History

In the northern portion of Quadrant I, groundwater concerns focus on two areas: the Quadrant I Groundwater Investigative Area (also called the Five-Unit Area) and the X-749A Classified Materials Disposal Facility. A brief history of these units and their associated remedial actions is presented in this section. Additional historical information specific to the X-231B groundwater monitoring wells and analytical results is presented in Section 4.2.3.

4.2.1.1 Quadrant I Groundwater Investigative Area

During the RFI of Quadrant I, VOC contamination (primarily TCE) of the groundwater was detected in the Quadrant I Groundwater Investigative Area. A number of potential sources for groundwater contamination in this area were investigated during the RFI including X-231A Southeast Oil Biodegradation Plot, X-231B Southwest Oil Biodegradation Plot, X-600 Coal-Fired Steam Plant, X-600A Coal Storage Yard, X-621 Coal-Pile-Runoff Treatment Facility, X-626 Recirculating Cooling Water Pump House and Cooling Tower, X-710 Technical Services Building (including X-710A Neutralization Pit and X-710 Radioactive Wastewater Tank), X-749A Classified Materials Disposal Facility (discussed separately in Section 4.2.1.2), and the X-760 Pilot Investigation Building/X-770 Mechanical Testing Facility. The X-231B Southwest Oil Biodegradation Plot is the only unit for which routine groundwater monitoring was required by Ohio EPA (see Section 4.2.2); therefore, only the history of X-231B is included in this section. The history of the other units can be found in the *Quadrant I RFI Final Report* (DOE 1996b).

The X-231B Southwest Oil Biodegradation Plot was used from 1976 to 1983 for land application of contaminated oil/solvent mixtures generated from the enrichment process and maintenance activities. The X-231B is located west of the X-600 Coal-Fired Steam Plant, and consisted of two disposal plots, each surrounded by an elevated soil berm, which were periodically fertilized and disced to enhance aeration and promote biological degradation of waste oil. The X-231B Southwest Oil Biodegradation Plot was not operated as a RCRA regulated land treatment unit.

The X-231B Southwest Oil Biodegradation Plot was included in the 1989 GWQA, during which a VOC groundwater contaminant plume was shown to be emanating from this unit. An assessment monitoring program for this unit was proposed in the 1989 GWQA. Sampling completed in the 1990s after completion of the GWQA indicated that the X-231B groundwater plume is actually commingled with other contaminated groundwater as part of the Quadrant I Groundwater Investigative Area plume. The X-231B was the only unit within the Quadrant I Groundwater Investigative Area plume for which routine assessment monitoring was required by Ohio EPA; however, the monitoring wells selected for this unit were also effective at monitoring the downgradient portions of the entire plume.

DOE and Ohio EPA worked to develop a closure plan for the X-231B from the mid 1980s through 1995, at which time Ohio EPA approved the plan. Closure of the unit included in-situ treatment of the soil to remove VOCs and installation of an interim soil cover over the unit. Three groundwater extraction wells were installed in the Gallia south of the X-231B Southwest Oil Biodegradation Plot and aligned across the central portion of the VOC plume. The extracted groundwater is treated at the X-622 Groundwater Treatment Facility. Ohio EPA approved the "interim closure" in 1995, but indicated that final remediation of the unit would be integrated into the RCRA Corrective Action Program.

In March 1999, Ohio EPA issued the DFF&O that integrated final remediation of the X-231B into the RCRA corrective action process for the Quadrant I Groundwater Investigative Area. The Decision Document issued by Ohio EPA required installation of multimedia caps over both the X-231A and X-231B oil biodegradation plots and installation of 11 additional groundwater extraction wells in the Quadrant I Groundwater Investigative Area. Installation of the multimedia caps was completed in 2000. Operation of the 11 new groundwater extraction wells began in 2002. Extracted groundwater is treated in the X-622 Groundwater Treatment Facility.

A five-year review of these remedial actions (groundwater extraction wells and multimedia caps) was submitted to Ohio EPA in 2008. The *First Five-Year Review for the Five-Unit Groundwater Investigative Area and X-231A/X-231B Oil Biodegradation Plots* (DOE 2008a) found that the remedial actions had eliminated potential exposure pathways to contaminants of concern and reduced concentrations of trichloroethene in the groundwater. However, the extraction wells were not removing VOCs from the groundwater beneath the area as effectively as originally predicted by the groundwater model used to develop the Decision Document. The model most likely overestimated the transmissive properties of the Gallia water-bearing zone in the Quadrant I Groundwater Investigative Area, thereby overestimating the predicted rate of plume reduction. The possible presence of VOC sources not included in the model may have also prevented the contaminant plume from achieving the size and volume reductions predicted by the model. An additional groundwater extraction well was installed in 2009 in the western portion of the plume, south of the X-326 Process Building, to address a possible VOC source beneath the building.

In 2008 and 2010, soil sampling completed as part of the demolition of the X-770 Mechanical Testing Facility (in the northern portion of the groundwater plume in the Quadrant I Groundwater Investigative Area) identified areas of vadose zone soil contaminated with VOCs. These areas of contaminated soil, south and east of the former X-770 building, were removed in 2010. Removal of these VOC source areas is expected to reduce concentrations of VOCs in groundwater and shorten the length of time needed to remediate the groundwater plume in the Quadrant I Groundwater Investigative Area.

4.2.1.2 X-749A Classified Materials Disposal Facility

The X-749A Classified Materials Disposal Facility is a six acre unit located just south of the plant's main administration building (X-100 Building), and immediately east and northeast of the X-600 Coal-Fired Steam Plant and the X-231B, respectively. The location of this facility is shown in Appendix A, Figure A-3.

The facility was operational from 1953 to 1988 as a landfill for the disposal of wastes whose nature was classified or whose content might include classified information. Available records indicate that the contents of the facility include aluminum dross (slag), security ashes, barrier scrap, tube sheets, seal parts, floor sweepings (lube oil and sawdust that may contain PCBs, asbestos, and radionuclides), and parts from a nickel powder processing plant that may contain nickel carbonyl. Available records indicate that contents underwent decontamination, as necessary, before disposal in the unit.

Waste materials disposed of in the landfill are classified under the Atomic Energy Act. Security regulations require that any classified waste placed in a trench must receive at least four ft of soil cover or an equivalent barrier to visual or physical access within the same day. A description of the other types of materials disposed includes magnetic media (computer tapes, floppy disks, etc.) that contained or might have contained classified information, classified documents (both as shredded material and as ashes from burned documents), decontaminated machine parts whose nature (function, design, etc.) or materials of construction were classified, and process equipment from a metal working plant that manufactured machine parts for PORTS.

The X-749A Classified Materials Disposal Facility is no longer in operation. Historically, the generation of classified waste at PORTS was highly dependent on activities at the plant. During process upgrades, large amounts of obsolete process equipment and classified information may have been disposed of at X-749A. During its use, a trench typically was surveyed and marked by plant engineering to accommodate a specific amount of waste that had already accumulated aboveground or was anticipated as a result of a specific renovation or demolition project. The trench was excavated to approximately fourteen ft deep and filled with eight ft of waste materials. The remaining six ft was backfilled with native clay overburden. The surface was compacted with a tracked bulldozer. If a depression was created by the compaction, extra clay was mounded on the trench surface and recompacted. Normally, trenches were opened and filled one at a time.

Active use of the landfill ceased in 1988. The DFF&O issued on December 1, 1988, required the submittal of a Closure Plan for the X-749A Classified Materials Disposal Facility. On December 31, 1988, the DOE and the Ohio EPA finalized plans to close the solid waste landfill by installing a multi-media clay cover over the six acre facility. A Closure Plan for the X-749A facility was submitted in May 1989. The Closure Plan was written in accordance with the requirements of the OAC Chapter 3745-27 in effect at that time. The closure plan was revised to incorporate Ohio EPA comments in December 1989, June 1990, September 1990, and October 1991. The closure plan was approved by the Ohio EPA on April 9, 1992.

Closure of the landfill was accomplished in two phases in accordance with the approved closure plan. The first phase of construction was to install a drainage system on the west side of the landfill to collect surface water run-off. This phase was begun in January 1993 and was completed on May 26, 1993. The drainage system collects run-off from the landfill and drains surface water into a permitted discharge location where it is monitored before leaving the plant property. Work on the second phase, construction of the multi-layered cap, began in mid-May 1993 and was finished in just less than a year. Final surface grading and seeding were completed on the X-749A Classified Materials Disposal Facility in April 1994. The X-749A Classified Materials Disposal Facility was closed in place, with the inventory left undisturbed. The independent engineer's certification of closure was submitted in June 1994 and approved by Ohio EPA on January 13, 1995.

4.2.2 Regulatory Considerations for Optimizing Groundwater Monitoring

Regulatory requirements for the Quadrant I Groundwater Investigative Area and the X-749A Classified Materials Disposal Facility are summarized in the following sections.

4.2.2.1 Quadrant I Groundwater Investigative Area

There are no pre-integrated regulatory requirements for groundwater monitoring at the Quadrant I Groundwater Investigative Area, with the exception of the requirements for monitoring the X-231B Southwest Oil Biodegradation Plot. The pre-integrated regulatory requirements governing groundwater monitoring at the X-231B are contained in the approved consolidated closure plan. Routine groundwater monitoring has also been conducted at the X-231B monitoring wells specified in the GWQA. Since the requirements of the closure plan have been in effect, there have not been any instances where contradictory requirements, or instances of confusing direction, have been encountered. Therefore, based on the regulatory history of the groundwater monitoring conducted at this facility, no changes to the monitoring program other than those indicated by technical considerations are included herein.

4.2.2.2 X-749A Classified Materials Disposal Facility

Requirements for groundwater monitoring at the X-749A were identified in the approved closure plan for the X-749A Classified Materials Disposal Facility. However, the requirements specified in the approved closure plan differed slightly from the requirements for groundwater monitoring specified in the 1990 version of OAC 3745-27-10 (solid waste regulations).

After the requirements of the closure plan had been in effect, the Ohio EPA promulgated new solid waste regulations in 1994 that included requirements for conducting groundwater monitoring. However, the monitoring program at the X-749A was not modified to incorporate these changes. Instead, groundwater monitoring at the X-749A was changed to follow the requirements for industrial solid waste regulations (OAC 3745-29-10) upon implementation of the IGWMP in 1999. Groundwater monitoring at the X-749A in accordance with the industrial solid waste regulations is more appropriate due to the type of waste disposed of in the X-749A. This change also makes the monitoring program at the X-749A consistent with the monitoring program of the other solid waste unit at PORTS (the X-735 Landfills, Section 7.2), while providing information necessary to determine whether or not leachate or leachate-derived constituents from the X-749A unit have adversely impacted the groundwater surrounding the unit.

Assessment monitoring was conducted at the X-749A Classified Materials Disposal Facility in 1997, 2000-2001, and 2007-2009. In 1997, pH was shown to be anomalously low in well X749A-02G. Because no contaminants were detected in the groundwater surrounding the unit, the Director of the Ohio EPA, in a letter dated December 11, 1997, approved DOE's request to reinstate the detection monitoring program at the X-749A facility.

In 2000, an assessment monitoring program was initiated at the X-749A because of a statistically significant increase in the concentration of alkalinity in well X749A-14G. Alkalinity was one of the parameters added to the statistical evaluation of data at this unit upon implementation of the IGWMP in 1999. Historical data indicated that the concentration of alkalinity in this well had been higher than the upper tolerance limit for several years. The assessment monitoring program completed in 2001 determined that a release from the landfill had not occurred and recommended additional upgradient (background) wells and a new statistical procedure for data evaluation as part of resuming the detection monitoring program for this unit (see Sections 4.2.3.2 and 4.2.4).

Assessment monitoring was initiated in 2007 based on an exceedence of the control limits for alkalinity in well X749A-01G. Alkalinity was also determined to be elevated in well X231A-01G. The assessment monitoring program determined that neither well X749A-01G nor well X231A-01G yielded groundwater samples that were representative of groundwater quality directly downgradient of the X-749A Landfill. Three new wells were installed to monitor groundwater quality on the west side of the X-749A Landfill (downgradient in 2007-2009). Ohio EPA approved the return to a detection monitoring program at the X-749A Landfill in March 2010.

4.2.3 Technical Considerations for Optimizing Groundwater Monitoring

The integrated monitoring program, including all well names, monitoring frequencies, and parameters for the Quadrant I Groundwater Investigative Area and the X-749A Classified Materials Disposal Facility are presented in Appendix A, Table A-2. Each unit within the area is presented individually in this section to clarify the technical objectives in selecting the wells, frequencies, and parameters. Because many wells will meet one or more technical objectives for more than one unit, the parameter and frequency selection for wells meeting a particular objective may not be identical.

As stated in Section 4.2.1.1, a known VOC groundwater contaminant plume exists within the Quadrant I Groundwater Investigative Area. Groundwater has been routinely monitored in portions of this area since 1990. In other PORTS plumes where wells have gone from below-detection to above-detection for plume contaminants, VOCs are typically first detected at the leading edge of the plume. No such correlation has been noted for metals or any other parameters at this unit. Therefore, VOCs are monitored more frequently than other parameters at this area.

Prior to implementation of the IGWMP, analytical parameters for the Quadrant I Groundwater Investigative Area wells typically included VOCs, physical parameters, radiological parameters, metals, and inorganics. The specific list of VOCs varied from year to year; however, the primary plume VOCs were always included in the list (32 VOCs were included). The radiological parameters always included technetium-99 and total uranium. Physical parameters typically included temperature, pH, and specific conductance. Some pre-IGWMP sampling events included measurements of the physical parameters turbidity and dissolved oxygen.

Prior to implementation of the IGWMP, hazardous metals parameters typically included barium, lead, and nickel, and sometimes cadmium and manganese. These metals are not believed to be associated with the VOC plume at the Quadrant I Groundwater Investigative Area as a number of mid-plume wells have shown no detections for these metals. Other parameters at this unit have included metals and other inorganics used for mass balance and water quality analysis. These parameters include calcium, iron, magnesium, potassium, sodium, chloride, sulfate, and alkalinity. Other parameters monitored at this unit included nitrates, total organic carbon, total organic halogens, and fluoride per the X-231B Consolidated Closure Plan.

Figures A-3 and A-4 in Appendix A show the integrated monitoring wells and integrated monitoring parameters, respectively, for the Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility.

4.2.3.1 Quadrant I Groundwater Investigative Area

The Quadrant I Groundwater Investigative Area consists of several potential sources for groundwater contamination. It includes a groundwater contaminant plume for which a number of remedial actions have been performed. Therefore, source monitoring, plume monitoring, and remedial action effectiveness monitoring are all conducted at the Quadrant I Groundwater Investigative Area.

Source monitoring is performed to detect changes in contaminant concentrations emanating from X-231A and X-231B. Sampling of selected wells near the source on a biennial basis for the additional parameters contained in the Appendix to OAC 3745-54-98 is also conducted to determine if all hazardous constituents that may be present are identified. The following wells provide source monitoring for X-231A and X-231B: X231A-01G (downgradient), X231A-04G (upgradient), X231B-02G (upgradient), X231B-03G (downgradient), and X231B-06G (downgradient).

Plume monitoring at the Quadrant I Groundwater Investigative Area is performed to determine the extent and concentration of the contamination. Although the eastern margin of the Quadrant I

Groundwater Investigative Area coincides with the western margin of X-749A, there is no VOC plume observed that is associated with X-749A.

The X-231B wells screened in the Berea sandstone were historically monitored at the same frequency as Gallia wells at this unit (prior to implementation of the IGWMP). The Quadrant I Groundwater Investigative Area contaminant plume resides in the Gallia sand and gravel that overlies the Berea sandstone. A relatively impermeable layer of Sunbury shale separates the Gallia from the Berea in this area that limits the downward migration potential of groundwater from the Gallia into the Berea. Berea wells have historically shown no indication of the Quadrant I Groundwater Investigative Area plume contaminants, including Berea wells which underlie the center of the plume. Groundwater flow velocities in the Berea are slower than in the Gallia; therefore, contaminants would move very slowly within the Berea if the plume constituents were able to migrate through the Sunbury shale into the Berea. Therefore, the Berea wells associated with the Quadrant I Groundwater Investigative Area Plume are generally sampled less frequently than Gallia wells.

Each of the wells used for remedial action effectiveness monitoring at X-231B is also used for plume monitoring at this unit. Table A-2 in Appendix A lists the location/purpose, analytical parameters, and sampling frequency for each well that is part of the monitoring program for the Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility. Locations of the extraction wells installed in this area are included on Figures A-3 and A-4 in Appendix A so that the effect of the extraction wells on the groundwater plume and/or specific monitoring wells can be evaluated.

4.2.3.2 X-749A Classified Materials Disposal Facility

Routine groundwater monitoring has occurred at X-749A since 1993. Eleven wells, all screened in the Gallia, were initially used to monitor this unit. The wells used to monitor this area varied somewhat between 1993 and 1999, prior to implementation of the IGWMP.

Although the eastern margin of the Quadrant I Groundwater Investigative Area coincides with the western margin of X-749A, there is no VOC plume associated with X-749A; therefore, only source monitoring is performed at X-749A. Groundwater flows in the vicinity of the X-749A Classified Materials Disposal Facility can fluctuate from southeast to southwest because of remedial actions in progress at the Quadrant I Groundwater Investigative Area; therefore, background (upgradient) wells and compliance (downgradient) wells at the X-749A can also change. Appendix F provides the evaluation methodologies for monitoring at the X-749A Classified Materials Disposal Facility. All integrated wells, parameters, and frequencies for this AOC are presented in Appendix A, Table A-2.

4.2.4 Evaluations and Reporting

Pre-integrated data evaluations and data reporting for the Quadrant I Groundwater Investigative Area included an evaluation of the concentration, rate of migration, and extent of the existing contaminated groundwater plume in the vicinity of the X-231B Area. Verification and validation of the laboratory analytical data were also required. Pre-integrated data evaluations and reporting for the X-749A Classified Materials Disposal Facility included verification and validation of the laboratory analytical data, the completion of a statistical evaluation of the data, and reporting on a semi-annual basis.

In accordance with the 1999 DFF&O (Integration Administrative Consent Order), comprehensive groundwater data for the Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility is evaluated annually and included in the annual Groundwater Monitoring Report submitted to the regulators by April 1 of each year. A statistical analysis is conducted for the X-749A wells as described in Appendix F.

As requested by Ohio EPA during the first five-year review for the Quadrant I Groundwater Investigative Area, the concentrations of TCE and VOCs detected in groundwater monitoring wells in the Quadrant I Groundwater Investigative Area will be evaluated annually to assess the performance of the extraction wells and determine whether any extraction wells in the Five-Unit Area could be shut down. The results of this assessment will be provided in the Annual Groundwater Monitoring Report.

5. QUADRANT II

Two groundwater AOCs are located in Quadrant II, which is in the eastern portion of the site: the Quadrant II Groundwater Investigative Area and the X-701B Holding Pond. These areas are discussed in Sections 5.1 and 5.2, respectively. One additional area in Quadrant II, the X-633 Pumphouse/Cooling Towers Area, is also monitored as a result of a completed special study (see Section 9.1).

5.1 QUADRANT II GROUNDWATER INVESTIGATIVE AREA

The following sections contain an introduction and facility history of the Quadrant II Groundwater Investigative Area and the regulatory and technical considerations for optimizing groundwater monitoring in this AOC. Section 5.1 concludes with discussions regarding regulatory evaluations and reporting for the Quadrant II Groundwater Investigative Area. The integrated monitoring program, including all well names, monitoring frequencies, and parameters for the Quadrant II Groundwater Investigative Area is presented in Appendix B, Table B-1, Figure B-1, and Figure B-2.

5.1.1 Background and History

In the western portion of Quadrant II, groundwater concerns are focused on the Quadrant II Groundwater Investigative Area (also called the Seven-Unit Area). During the RFI of Quadrant II, VOC contamination (primarily TCE) of the groundwater was detected in the Quadrant II Groundwater Investigative Area. A number of potential sources for groundwater contamination exist within this area. These potential sources include Process Lines, X-700 Chemical Cleaning Facility, X-701C Neutralization Pit, X-705 Decontamination Building, and the X-720 Maintenance Building. The X-701C Neutralization Pit is the only unit for which routine groundwater monitoring was required by the Ohio EPA (see Section 5.1.2); therefore, only the history of X-701C is included in this section. The history of the other units can be found in the *Quadrant II RFI Final Report* (DOE 1996c).

The X-701C Neutralization Pit was an 18 ft deep, 25 ft by 25 ft, open-topped neutralization pit that received process effluents and basement sump wastewaters from the X-700 Chemical Cleaning Facility from approximately 1953 to 1988, when the X-701C was deactivated. Waste received included acid and alkali solutions, and rinse water contaminated with VOCs resulting from metal cleaning operations. Wastes were released on a batch basis to the X-701C Neutralization Pit, where lime was added to neutralize the pH. When the X-701C Neutralization Pit was in use, effluent was discharged (at different times) to the X-701B Holding Pond and the X-616 Liquid Effluent Control Facility. From late 1988 until early 1992, some wash water and decontamination solutions were occasionally pumped from tanks in the X-700 Chemical Cleaning Facility directly to the X-701C Neutralization Pit and then discharged to a temporary carbon treatment system located inside the X-700 Chemical Cleaning Facility.

The soil and groundwater in the vicinity of the X-701C Neutralization Pit were sampled as part of the Quadrant II RFI in 1991. Results of this sampling showed that the X-701C was located within an existing VOC groundwater plume for which multiple sources were likely, as evidenced by the configuration of the plume. To determine whether X-701C contributed to this plume, routine detection monitoring was required by the Ohio EPA. Detection monitoring was conducted from 1993 until implementation of the IGWMP. The detection monitoring plan was not typical because of the size of X-701C and its location in an existing contaminated groundwater plume. Detection monitoring at X-701C used the three existing wells installed into the Gallia sand (X701-68G, X701-69G, and

X701-70G). These wells surround X-701C; however, they were not adequate to monitor the entire Quadrant II Groundwater Investigative Area plume.

Due to the nature of the wastewaters discharged to the X-701C Neutralization Pit, a closure plan for the unit was developed in accordance with Ohio hazardous waste regulations. The closure plan was submitted to the Ohio EPA in July 1992. The closure plan was revised to incorporate Ohio EPA comments and resubmitted in April 1994. In March 1995, Ohio EPA submitted a Notice of Deficiency and additional comments on the closure plan. In April 1995, Ohio EPA and DOE agreed that DOE would not submit a revised closure plan for the X-701C Neutralization Pit until after the two parties could meet to discuss integration of the closure of several units (including X-701C) with the RCRA Corrective Action process.

In a letter dated August 2, 1995, the Ohio EPA detailed procedures to be followed by both Ohio EPA and DOE prior to the development of the DFF&O that would address the integration of the closure of the X-701C with the RCRA corrective action process. The letter further stated that the DFF&O would supersede the X-701C Closure Plan, and that DOE was to remove wastewater and sludge from the X-701C Pit, decontaminate the unit, and, if contamination was discovered, remove the bricks and dispose of them as hazardous waste. The decontamination and sampling work was completed in 1996. The X-701C Neutralization Pit was removed in 2001 in accordance with a work plan approved by Ohio EPA that met the substantive RCRA closure requirements for this area. Oxidant was introduced into the excavation after the pit was removed to address VOC contamination in this area.

The X-720 Neutralization Pit, at the northeast corner of the X-720 Maintenance Building in the southeastern portion of the Quadrant II Groundwater Investigative Area, was removed in 1998. Removal of contaminated soil near the former neutralization pit was completed in 2001.

Special sampling of well X333-01G, which is approximately 650 ft north of well X705-04G (the northwest edge of the VOC plume in the Quadrant II Groundwater Investigative Area) was conducted in September 2004 and the first quarter of 2008 to determine whether the plume in the Quadrant II Groundwater Investigative Area extended north to well X333-01G. TCE was not detected in well X333-01G in either sampling event.

In 2009, an investigation was conducted in the Quadrant II Groundwater Investigative Area to identify potential sources of groundwater contamination in the eastern and southeastern portions of the plume and to further define the western portion of the groundwater plume. The investigation determined that the western edge of the groundwater plume is further west than previously known and appears to extend beneath the X-330 Process Building. The investigation also identified continuing sources of VOC contamination in the southeastern portion of the plume near the former X-720 Neutralization Pit and in the vicinity of the X-700T Aboveground Storage Tank. Chapter 9, Section 9.2.2.1, provides additional information about the current special study and remedial action taking place to address these source areas.

5.1.2 Regulatory Considerations for Optimizing Groundwater Monitoring

Prior to implementation of the IGWMP, routine groundwater monitoring was conducted at three X-701C groundwater monitoring wells. The intent of the monitoring program proposed in the X-701C Pit Closure Plan was to determine if the unit was contributing to the existing plume; therefore, it was considered a detection monitoring program. Alternatives for groundwater remediation in the vicinity of X-701C were evaluated in the *Quadrant II CAS/CMS Final Report* (DOE 2001).

With implementation of the IGWMP in 1999, changes to the monitoring program included converting from a detection monitoring program at the X-701C to an assessment monitoring program for the Quadrant II Groundwater Investigative Area. This conversion enabled monitoring of the rate of migration, extent, and concentration of the entire Quadrant II Groundwater Investigative Area plume. This conversion was in addition to those changes dictated by technical considerations.

5.1.3 Technical Considerations for Optimizing Groundwater Monitoring

The integrated monitoring program, including all, well numbers, monitoring frequencies, and parameters for the Quadrant II Groundwater Investigative Area, is presented in Appendix B, Table B-1. Because many wells will meet one or more technical objectives for more than one unit, the parameter and frequency selection for wells meeting a particular objective may not be identical.

As stated in Section 5.1.1, a known groundwater VOC contamination plume emanates from multiple potential or historic sources within the Quadrant II Groundwater Investigative Area. The majority of wells within this plume were only sampled during Phase I and Phase II of the Quadrant II RFI. However, detection monitoring was performed at three wells surrounding X-701C (X701-68G, X701-69G, and X701-70G) from 1993 until implementation of the IGWMP. Because this unit was located within a known VOC plume, detection monitoring was somewhat inconclusive, although higher VOC concentrations were found in well X701-69G, which was typically upgradient of X-701C.

A primary technical consideration for this area is that groundwater is being drawn into the building sumps at X-700 and X-705. Approximately 10 million gallons of contaminated groundwater per year are removed by these sumps for treatment at the X-627 Groundwater Treatment Facility, which replaced the X-622T Groundwater Treatment Facility in September 2004. Synoptic water level measurements in the area have shown that groundwater flow in the Quadrant II Groundwater Investigative Area is toward these sumps that are in the interior of the plume. Therefore, it is believed that the plume will continue to be drawn toward the sumps.

Prior to implementation of the IGWMP, analytical parameters for the X-701C wells included organics, physical parameters, radiological parameters, metals, and inorganics. Organics generally included total organic carbon, total organic halogens, phenolics, and VOCs. The specific list of VOCs varied from year to year; however, the primary plume VOCs were always included in the list. The radiological parameters always included technetium-99 and total uranium. Physical parameters typically included temperature, pH, and specific conductance. Some sampling events also included measurements of additional physical parameters (turbidity and dissolved oxygen). Other routinely monitored parameters at this unit included metals and other inorganics used for charge balance and water quality analysis. These parameters include calcium, iron, magnesium, potassium, sodium, chloride, sulfate, and alkalinity.

Hazardous metals parameters previously sampled for typically included cadmium, chromium, lead, manganese, and nickel. These metals are not believed to be associated with the VOC/technetium-99 plume at the Quadrant II Groundwater Investigative Area because metals were not consistently detected in the X-701C monitoring wells and a number of mid-plume wells showed no detections for these metals during the RFI. However, sporadic elevated levels of these metals were detected in samples with high turbidity. Low-flow sampling techniques are being used to provide more consistent metals results. Elevated levels of gross alpha, gross beta, and technetium-99 have also been detected in this area. Low-flow sampling was conducted during the period from 1998 through the first quarter of 1999 for a Special Metals Study in accordance with specifications of the 1998 version of the IGWMP. This study concluded that low-flow sampling methods reduce turbidity of samples compared to samples collected with a bailer.

Decreases in specific metal concentrations, gross alpha, and gross beta activities also corresponded with decreases in turbidity [see *Special Study for Metals and Radiological Parameters in Groundwater* (DOE 2000B)].

The Quadrant II Groundwater Investigative Area consists of several potential sources for groundwater contamination. Because the potentiometric surface indicates that the plume is migrating inward (toward the X-700 and X-705 building sumps), emphasis is placed on assessing the plume (plume monitoring) rather than monitoring specific sources.

Plume monitoring at the Quadrant II Groundwater Investigative Area is performed to determine the extent and concentration of the contamination. The investigation conducted in this area in 2009 (see Section 5.1.1) determined that the former X-701C unit was not a continuing source of groundwater contaminants; therefore, a well near the former X-720 Neutralization Plot is monitored on a biennial basis for the additional parameters contained in the Appendix to OAC 3745-54-98 to determine if all hazardous constituents that may be present are identified. Table B-1 in Appendix B lists the location/purpose, analytical parameters, and sampling frequency for each well that is part of the monitoring program for the Quadrant II Groundwater Investigative Area. Figures B-1 and B-2 in Appendix B show the integrated monitoring network and integrated monitoring parameters, respectively, for the Quadrant II Groundwater Investigative Area.

The Quadrant II Groundwater Investigative Area contaminant plume resides in the Gallia sand and gravel that overlies a relatively impermeable layer of Sunbury shale. The Sunbury shale separates the Gallia from the Berea in most of the Quadrant II area, thus limiting the downward migration potential of groundwater from the Gallia into the Berea. The Sunbury shale thins westward and is absent in the far western portion of Quadrant II. Due to groundwater extraction by the sumps in the X-705 building, and the confined nature of the groundwater in the Berea, there is a strong upward gradient from the Berea to the Gallia in the western portion of Quadrant II. This upward gradient prevents migration of contaminants downward from the Gallia into the Berea.

Historically, none of the Quadrant II Groundwater Investigative Area plume contaminants have been detected in the Berea wells in this area. Groundwater flow velocities in the Berea are slower than in the Gallia, so that even if the plume constituents were able to migrate through the Sunbury shale into the Berea, these contaminants would move very slowly within the Berea.

5.1.4 Evaluations and Reporting

As part of the pre-integrated monitoring program, required data evaluations and data reporting for the Quadrant II Groundwater Investigative Area included an evaluation of the concentration, rate of migration, and extent of the existing contaminated groundwater plume in the vicinity of the X-701C Area. Verification and validation of the laboratory analytical data were also required, as well as a statistical analysis of the following parameters: pH, specific conductance, total organic carbon, and total organic halogens. The results were reported annually to the regulators by March 1.

The results of the integrated monitoring of the Quadrant II Groundwater Investigative Area will be evaluated in the annual Groundwater Monitoring Report for PORTS, including an evaluation of the concentration, rate, and extent of the existing plume, and will be submitted to the regulators by April 1 of each year. A statistical analysis is no longer conducted for the X-701C monitoring wells.

5.2 X-701B HOLDING POND

The following sections contain an introduction and facility history of the X-701B Holding Pond Area and the regulatory and technical considerations for optimizing groundwater monitoring in the X-701B Holding Pond AOC. Section 5.2 concludes with discussions regarding the regulatory evaluations and reporting for the X-701B Holding Pond Area.

5.2.1 Background and History

In the eastern portion of Quadrant II, groundwater concerns focus on three areas: the X-701B Holding Pond, the X-230J7 Holding Pond, and the X-744G Bulk Storage Building. Integrating the monitoring programs for the three areas into one plan provides economy of scale savings and reduces the possibility of errors or omission in data. The X-701B Pond and the X-230J7 Pond are the only units for which routine groundwater monitoring was required prior to implementation of the IGWMP; therefore, only the history of those units is included in this section. The history of the X-744G unit can be found in the *Quadrant II RFI Final Report* (DOE 1996c). Additional historical information specific to the X-701B groundwater monitoring wells and analytical results is presented in Section 5.2.3.

5.2.1.1 X-701B Holding Pond

The X-701B Holding Pond was an unlined, 200-ft by 50-ft pond which was intended for the neutralization and settling of metal-bearing wastewater and acidic wastewater. The X-701B Holding Pond was in use from 1954 to November 1988. Most of the metal-bearing and corrosive wastes discharged to the pond (via the X-701C) originated at the X-700 Chemical Cleaning Facility and the X-705 Decontamination Building. Solvents, specifically TCE, were commonly used throughout the X-701B area from 1955 until 1991. It is assumed that many improper land disposal activities took place, but the origins and release dates of the TCE in the groundwater remain unknown. Beginning in 1974 and continuing until 1988, slaked lime was added to the X-701B influent at the X-701E Neutralization Facility to neutralize the low pH and induce precipitation. This precipitation caused large amounts of sludge to accumulate in the pond, which was dredged annually. The pond was last dredged in 1985. The sludge recovered during dredging was stored in two retention basins located northwest of X-701B.

The X-701B East and West Retention Basins were unlined sludge retention basins used for the settling, dewatering, and storage of sludge removed from the X-701B Holding Pond. The East Retention Basin was the first of the two basins to be constructed. Built in 1973, the east basin was approximately 220 ft by 65 ft (narrowing to 25 ft wide in the northeast corner) and the basin bottom was 3½ ft below land surface. The east basin was in use from 1973 until about 1980. The West Retention Basin was built in 1980, when the east basin reached capacity. The west basin was approximately 220 ft by 45 ft (narrowing to 35 ft wide in the northern portion) and the basin bottom was three ft below land surface. The west basin was in use from 1980 until 1988.

In the mid 1980s, a number of monitoring wells were installed near X-701B. Dense non-aqueous phase liquid (DNAPL) consisting primarily of separate phase TCE was found in one of these wells, X701-BW2G. Several hundred gallons of TCE and TCE emulsion were removed from this well. Subsequently, DNAPL was also found in an extraction well near X-701B. Significant quantities of DNAPL potentially still remain in the Gallia and serve as a continuing source for groundwater contamination.

The X-701B Holding Pond was included in the 1989 GWQA, and an assessment monitoring program was proposed in the final document because groundwater in the X-701B area was found to be contaminated with several VOCs, of which TCE was the most predominant. The assessment monitoring program was initiated following approval of the GWQA report. A closure plan for this unit was submitted to the Ohio EPA in June 1988. A list of groundwater monitoring wells was included in the plan but was cited as a tentative list pending completion of the GWQA. The closure plan was revised twice in 1989 and was approved by the Ohio EPA in July 1989. In 1989, PORTS initiated a phased closure of the unit. As part of the first phase, sludge and one ft of soil was excavated from the holding pond and the two retention basins. The sludge was dewatered, placed in containers, and transported to on-site storage. The retention basins were backfilled, graded, and seeded.

A Closure Options Study was completed and submitted to the Ohio EPA in March 1990 and approved in March 1992. Because a narrow TCE plume extended from the X-701B Holding Pond east along the south side of the X-230J7 Pond toward Little Beaver Creek, a groundwater interceptor trench was installed in 1991 as part of IRM activities to prevent contaminated groundwater from discharging into Little Beaver Creek.

In 1992, a Technology Demonstration Assessment at the X-701B unit was completed and submitted to the Ohio EPA in July and approved in December 1992. In April 1993, PORTS submitted a revised closure plan that included relevant portions of the Closure Options Study and the Technology Demonstration Report. The revised closure plan (Consolidated Closure Plan) was further revised in October 1994 and approved by the Ohio EPA in March 1995. The second phase of closure at the X-701B began in 1994 and included construction of a groundwater pump-and-treat system and in-situ treatment of the soils in the bottom of the holding pond with thermally enhanced vapor extraction. Limestone rip-rap and gravel were placed on the bottom of the holding pond to support the soil treatment equipment.

Use of thermally enhanced vapor extraction was terminated after it failed to achieve identified performance standards; however, the limestone rip-rap and gravel material remains in the holding pond and a gravel access road remains on the northeast side of the pond. In a letter dated August 2, 1995, the Ohio EPA detailed procedures to be followed by both Ohio EPA and DOE prior to integration of the closure of the X-701B with the RCRA corrective action process. The letter further stated that DOE was to install a dewatering system in the bottom of the pond and pipe collected water to the recovery well #1 vault for subsequent treatment at the X-623 Groundwater Treatment Facility. These activities were completed in 1995. Additional technology demonstration projects to remediate VOCs at the X-701B Holding Pond Area include *in situ* chemical oxidation and underground steam stripping/hydrous pyrolysis.

In December 2003, Ohio EPA issued the X-701B Decision Document. Remedial actions required for soil in the X-701B area include removal of contaminated soil in the western portion of the area and consolidation of the soil under two landfill caps to be constructed over the X-701B Holding Pond/East Retention Basin and the West Retention Basin. Two landfill caps will be constructed so that an existing storm water drainage pipe will not be covered. Groundwater remediation was initiated in October 2006 by injection of a chemical oxidant in the source area of the western portion of the groundwater plume. Six injection events took place between October 2006 and October 2008.

Upon completion of the sixth injection event in October 2008, data evaluated by DOE and Ohio EPA indicated that additional oxidant injections would not be able to address the TCE source area in the upper portion of the Sunbury formation. Therefore, Ohio EPA has approved an interim remedial action to directly mix oxidant into the contaminated soils of the Minford, the entire thickness of the Gallia, and the upper Sunbury within the source area of the western portion of the plume. During this interim remedial action, groundwater monitoring wells in the western portion of the plume (the area west of Perimeter Road and north of the X-744G building) will be removed from the IGWMP monitoring program and monitored as required by the interim remedial action (see Section 9.2.2.2).

5.2.1.2 X-230J7 Holding Pond

The X-230J7 Holding Pond consists of a holding pond and an oil retention basin. The holding pond system was constructed in 1981 to control sedimentation resulting from stormwater run-off. The primary source of the water in the system is once-through non-contact cooling water and surface run-off. Effluent from the X-701B Holding Pond was discharged through the X-230J7 Holding Pond until November 1988. The X-230J7 Holding Pond was regulated as a hazardous waste surface impoundment because effluent containing hazardous waste (primarily TCE) was discharged to the X-230J7 Holding Pond.

As stated in Section 5.2.1.1, a narrow TCE plume extending from near the X-701B Holding Pond east along the south side of the X-230J7 ponds toward Little Beaver Creek was identified in the Quadrant II RFI. The only hazardous constituents detected in sediments at X-230J7 were polynuclear aromatic hydrocarbons. The only hazardous constituent detected in surface water at X-230J7 was TCE.

A detection monitoring program for the X-230J7 Holding Pond was developed in May 1992; however, Ohio EPA found the plan to be deficient. Ohio EPA approved a closure plan and associated groundwater monitoring plan in June 1995, but subsequently withdrew approval as a result of negotiations with DOE. A risk-based plan was submitted to Ohio EPA in November 1996, but DOE subsequently requested formal withdrawal of the plan due to agency concerns regarding its adequacy. The closure and groundwater monitoring requirements for the unit were formally integrated into the RCRA corrective action process in March 1999.

5.2.2 Regulatory Considerations for Optimizing Groundwater Monitoring

Pre-integrated regulatory requirements for groundwater assessment monitoring at the X-701B Area include those requirements included in the GWQA, as well as the approved consolidated closure plan for the X-701B Holding Pond. Although groundwater monitoring was included in the closure plan for the X-230J7 Holding Pond, the plan was not approved, and routine monitoring in the area was limited to monitoring the plume associated with the X-701B Holding Pond. The pre-integrated regulatory requirements governing groundwater monitoring at the X-701B are contained in the approved consolidated closure plan. Because the requirements of the X-701B closure plan were in effect, no contradictory requirements or instances of confusing direction have been encountered. Therefore, on the basis of regulatory history of the groundwater monitoring conducted at this facility, no changes to the monitoring program other than those indicated by technical considerations are included.

5.2.3 Technical Considerations for Optimizing Groundwater Monitoring

The integrated monitoring program, including all well numbers, monitoring frequencies, and parameters for the X-701B Holding Pond Area is presented in Appendix B, Table B-2. Because many wells will meet one or more technical objectives for more than one unit, the parameter and frequency selection for wells meeting a particular objective may not be identical.

As stated in Section 5.2.1.1, a known VOC groundwater contaminant plume emanates from X-701B. Groundwater has been routinely monitored in portions of this area since 1990 although the unit was monitored prior to 1990 as part of a number of special sampling events including the 1989 GWQA. In other PORTS plumes where wells have gone from below detection limits to above detection limits for plume contaminants, VOCs are typically first detected, which indicates that these constituents migrate at the leading edge of the plume. No such correlation has been noted for metals or any other parameters at this unit. Therefore, VOCs are monitored more frequently than other parameters at this area.

Prior to implementation of the IGWMP, the sampling frequency was quarterly from 1990 to 1999 for all wells at this unit. Wells were generally sampled by bailer through 1996. Since January 1997, most wells have been sampled by a low-flow technique using bladder pumps. Pre-IGWMP analytical parameters for the X-701B wells typically included VOCs, physical parameters, radiological parameters, metals, and inorganics. The specific list of VOCs varied from year to year; however, the primary plume VOCs were always included in the list. The radiological parameters always included technetium-99 and total uranium. Physical parameters typically included temperature, pH, and specific conductance. Some sampling events included measurements of additional physical parameters (turbidity and dissolved oxygen). Hazardous metals parameters typically included cadmium, chromium, lead, and nickel. Other parameters at this unit included metals and other inorganics used for mass balance and water quality analysis. These parameters include calcium, iron, magnesium, potassium, sodium, chloride, sulfate, and alkalinity.

Table B-2 in Appendix B lists the location/purpose, analytical parameters, and sampling frequency for each well that is part of the monitoring program for the X-701B Holding Pond. Figures B-3 and B-4 in Appendix B show the integrated monitoring network and integrated monitoring parameters, respectively, for the X-701B Holding Pond.

5.2.3.1 X-701B Holding Pond

Monitoring wells in the X-701B Holding Pond area provide a combination of source monitoring, plume monitoring, and/or remedial action effectiveness monitoring. The plume monitoring wells are also used to assess remedial action effectiveness. Table B-2 in Appendix B lists the location/purpose, analytical parameters, and sampling frequency for each well that is part of the monitoring program for the X-701B Holding Pond area.

The X-701B wells screened in the Berea sandstone were historically monitored at the same frequency as Gallia wells at this unit (prior to implementation of the IGWMP). The X-701B VOC plume resides in the Gallia sand and gravel that overlies the Berea sandstone. A relatively impermeable layer of Sunbury shale separates the Gallia from the Berea in this area, thus limiting the downward migration potential of groundwater from the Gallia into the Berea. Berea wells that underlie the plume have historically shown no indication of the X-701B plume contaminants. Groundwater flow velocities in the Berea are slower than in the Gallia, so that even if the plume constituents were able to migrate through the Sunbury shale into the Berea, these contaminants would move very slowly within the Berea. Therefore, the Berea wells selected for the X-701B Area are generally sampled less frequently than Gallia wells.

5.2.3.2 X-230J7 Holding Pond

The X-230J7 Holding Pond is located along the northern edge of the X-701B VOC plume; therefore, all monitoring for X-230J7 is incorporated into the X-701B plume monitoring program. Four monitoring wells surround X-230J7 (X230J7-01GA, X230J7-02GA, X230J7-03GA, and X230J7-04GA), and these wells are included in the X-701B plume monitoring program. Wells X230J7-01GA, X230J7-02GA, and X230J7-03GA, are located south of X-230J7 and within the X-701B plume. Well X230J7-04GA is located north of X-230J7 and outside of the X-701B plume.

5.2.4 Evaluations and Reporting

Pre-integrated data evaluations and data reporting for the X-701B Holding Pond Area included an evaluation of the concentration, rate of migration, and extent of the existing contaminated groundwater plume in the vicinity of the X-701B Area. Verification and validation of the laboratory analytical data were also required. The results were reported annually to the regulators by March 1.

The results of the integrated monitoring of the X-701B Holding Pond Area will be evaluated in the annual Groundwater Monitoring Report for PORTS, which will be submitted to the regulators by April 1 of each year.

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6. QUADRANT III

Two groundwater AOCs are located in Quadrant III, which is in the western portion of the site: the X-616 Chromium Sludge Surface Impoundments and the X-740 Waste Oil Handling Facility. These areas are discussed in Sections 6.1 and 6.2, respectively.

6.1 X-616 CHROMIUM SLUDGE SURFACE IMPOUNDMENTS

The following sections contain an introduction and facility history of the X-616 Chromium Sludge Surface Impoundments and the regulatory and technical considerations for optimizing groundwater monitoring in this AOC. Section 6.1 concludes with discussions regarding regulatory evaluations and reporting for the X-616 Chromium Sludge Surface Impoundments.

6.1.1 Background and History

A portion of the X-616 Liquid Effluent Control Facility system consisted of two unlined surface impoundments that were used from 1976 to 1985 for storage of sludge generated by the treatment of recirculating cooling water blowdown from the PORTS process cooling system. A hexavalent chromium-based corrosion inhibitor was used in the cooling water system. The chromium in the blowdown was reduced to a trivalent chromium at the X-616 Liquid Effluent Control Facility by adding sulfur dioxide to the water, which produced sulfurous acid. The resulting chromium hydroxide sludge was then precipitated in a clarifier by pH adjustment with slaked lime and a polymer coagulant. The sludge was then pumped to the X-616 Chromium Sludge Surface Impoundments for storage.

From February to May 1987, treated process effluent from the X-700 Chemical Cleaning Facility, via the X-701C Neutralization Pit, was diverted to the X-616 Liquid Effluent Control Facility to reduce the high concentration of suspended solids discharged from the X-701B Holding Pond. In addition, chlorinated organic solvents were discovered in the X-700 Chemical Cleaning Facility basement sump that discharged to the X-701C Neutralization Pit.

The X-616 Chromium Sludge Surface Impoundments were initially identified as a hazardous waste unit requiring closure in December 1986. A closure plan was subsequently prepared and submitted to the Ohio EPA and the U.S. EPA in June 1988. The plan was revised to incorporate Ohio EPA comments in February 1989 and May 1989, and was approved in July 1989. The Ohio EPA mandated that clean closure of the unit shall not be certified until the results of a groundwater quality assessment, which indicates that the impoundments have not adversely impacted the groundwater, were submitted to the Ohio EPA. As part of the closure, the chromium sludge and surrounding soil were removed from the impoundments and placed in special cells in the X-735 Landfill.

The X-616 Chromium Sludge Surface Impoundments were included in the GWQA completed in 1989. Based on the results of the GWQA and other sampling data, the Ohio EPA determined that the unit could not be clean closed because of the presence of groundwater contamination at the site that was potentially due to releases from the X-616 Chromium Sludge Surface Impoundments. Ohio EPA also mandated a modification to the closure plan and the development and submittal of a post-closure plan for the X-616 Chromium Sludge Surface Impoundments that included post-closure groundwater monitoring. Revised pages to the closure plan were submitted in October 1991, and a post-closure plan was submitted in December 1991. The revised closure plan was approved by the Ohio EPA in March 1992, and the post-closure plan was approved in August 1992.

During the GWQA study for the X-616 Chromium Sludge Surface Impoundments, 22 groundwater monitoring wells were sampled. Some VOCs were found in isolated wells at concentrations below 10 parts per billion (ppb). In November 1989, four wells were sampled for analytes as defined in 40 CFR, Part 264, Appendix IX and elevated levels of total chromium were detected. In 1990, quarterly sampling for chromium was conducted at 12 wells, and some total chromium results exceeded regulatory limits. By the completion of the GWQA, a total of 28 monitoring wells had been installed in the vicinity: 3 in the Minford clay/silt, 20 in the Gallia sand, and 5 in the Berea sandstone.

Quarterly assessment monitoring was performed at X-616 Chromium Sludge Surface Impoundments through calendar year 1993. This unit was certified closed in 1993, and was monitored semi-annually under an approved post closure plan from 1994 through implementation of the IGWMP. Since the GWQA, groundwater monitoring has focused primarily on the detection of metals (from the treatment of recirculating cooling water) and VOCs (from the X-700 Chemical Cleaning Facility process effluent).

6.1.2 Regulatory Considerations for Optimizing Groundwater Monitoring

The pre-integrated regulatory requirements governing groundwater monitoring at the X-616 Chromium Sludge Surface Impoundments are contained in the approved post-closure plan. Since the requirements of the post-closure plan have been in effect, there have not been any instances where contradictory requirements, or instances of confusing direction, have been encountered. Therefore, based on the regulatory history of the groundwater monitoring conducted at this facility, no changes to the monitoring program other than those indicated by technical considerations are recommended.

6.1.3 Technical Considerations for Optimizing Groundwater Monitoring

Prior to implementation of the IGWMP, isolated detections for metals and VOCs were identified in a number of wells in the X-616 Area. Routine groundwater monitoring at the X-616 Chromium Sludge Surface Impoundments has occurred since 1990 for metals and since 1991 for VOCs.

Wells were typically sampled by bailer until late 1996. Since December 1996, wells generally have been sampled by low-flow techniques using bladder pumps. Prior to implementation of the IGWMP, analytical parameters for X-616 wells included VOCs, physical parameters, radiological parameters, metals, and inorganics. The specific list of VOCs varied from year to year; however, the few VOCs that were constituents of concern for X-616 Chromium Sludge Surface Impoundments were always included in the list. The radiological parameters included technetium-99 and total uranium. Physical parameters included temperature, pH, and specific conductance. Some sampling events included measurements of additional physical parameters (turbidity and dissolved oxygen). Other parameters at this unit included metals and other inorganics used for mass balance and water quality analysis. These parameters include calcium, iron, magnesium, potassium, sodium, chloride, sulfate, and alkalinity.

While VOCs are not a major concern in the X-616 Chromium Sludge Surface Impoundments Area, VOCs (primarily TCE) were detected in four wells (X616-09G, X616-16G, X616-20B, and X616-28B) routinely sampled for this unit prior to implementation of the IGWMP. Three of these wells (X616-09G, X616-16G, and X616-20B) are grouped near the southwest corner of X-616.

During development of the IGWMP, it was believed that natural attenuation would cause VOC concentrations to continue to decrease in these wells. Historical monitoring results of groundwater for this unit (prior to implementation of the IGWMP) indicated that annual sampling would be sufficient to monitor such attenuation.

Prior to implementation of the IGWMP, analyses were performed for the hazardous metals barium, cadmium, chromium, lead, manganese, and nickel. Historically, well X616-05G is the only well with chromium concentrations that consistently exceed the drinking water standard (100 ppb). However, sporadic elevations of these metals were detected in samples with high turbidity. These metals are not believed to occur as a plume at the X-616 because the metals were not consistently detected, they were seldom in any spatial pattern resembling a plume, they do not correspond to wells that have VOC contamination, and the dissolved (filtered metals) were generally much lower than the total (unfiltered) metals. Low-flow, low-turbidity sampling techniques used since December 1996 provide more consistent metals results.

Results of the GWQA and routine assessment monitoring prior to the IGWMP indicated that radionuclides are not present in the groundwater beneath this unit, with the exception of technetium-99, which was sporadically detected at levels below 3790 picocuries per liter (pCi/L) (the preliminary remediation goal). These results are believed to be analytical anomalies.

Table C-1 in Appendix C lists the location/purpose, analytical parameters, and sampling frequency for each well that is part of the monitoring program for the X-616 Chromium Sludge Surface Impoundments. Figure C-1 in Appendix C shows the integrated monitoring network for the X-616 Chromium Sludge Surface Impoundments.

6.1.4 Evaluations and Reporting

Pre-integrated regulatory requirements concerning data evaluations and data reporting included the assessment of the concentration, rate of migration, and extent of groundwater contaminants associated with the X-616 Chromium Sludge Surface Impoundments. Verification and validation of the laboratory analytical data were also required because hazardous constituents associated with the X-616 Chromium Sludge Surface Impoundments were detected. All data was presented in the annual RCRA report for PORTS, which was submitted to the regulators by March 1 of each year.

Because the integrated monitoring program for the X-616 Chromium Sludge Surface Impoundments AOC continues to be an assessment monitoring program, the data will continue to be reported in the annual Groundwater Monitoring Report for PORTS by April 1 of each year.

6.2 X-740 WASTE OIL HANDLING FACILITY

The following sections contain an introduction and facility history of the X-740 Waste Oil Handling Facility and the regulatory and technical considerations for optimizing groundwater monitoring in this AOC. Section 6.2 concludes with discussions regarding regulatory evaluations and reporting for the X-740 Waste Oil Handling Facility AOC.

6.2.1 Background and History

The former X-740 Waste Oil Handling Facility, which was demolished in 2006, was located on the western half of the PORTS plant site immediately south of the X-530A switchyard. The X-740 Area includes approximately 5 acres encompassing the former X-740 Waste Oil Handling Facility, the X-109A Personnel Monitoring Building, and the area west of X-740 and X-109A that was formerly occupied by an electric power substation used during plant construction. The only remaining evidence of the substation is concrete pads. A VOC groundwater plume extends approximately 700 ft west of the former X-740 Building. The X-740 Waste Oil Handling Facility operated from 1983 until 1991. The tank/sump was only operated until 1990. The units were initially identified as hazardous waste management units in 1991.

The facility was constructed in 1982 and consisted of a diked concrete pad, a roof, corrugated steel siding on three sides and a plastic windbreak on the fourth side. The unit was approximately 120 ft by 50 ft. During its period of operation, the facility was used as an inventory and staging facility for waste oil and waste solvents that were generated from various plant operational and maintenance activities. The drums were staged at the facility pending analysis of their contents and subsequent final disposition. Empty drums, resulting from combining partially full drums, were crushed in a hydraulic drum crusher located in the northwest corner of the X-740 building and then disposed of at the X-735 Landfill. The tank, or sump, was installed in 1986 and was used to collect residual waste oil and waste solvents from the drum crushing operation. No drainage system was associated with the tank/sump area.

Closure plans for both of the X-740 units were developed and submitted to the Ohio EPA as a result of the determination of the units' status. Both closure plans were written in accordance with OAC 3745-66. The closure plan for the tank/sump was submitted in April 1991, revised in May 1992, and approved in September 1992. The closure plan for the facility was submitted in April 1991, revised in May 1992, and approved in September 1992.

The Quadrant III RFI Phase I field investigation was conducted from June 1992 through August 1992. The Quadrant III confirmatory investigation was conducted in November and December 1992. Closure activities began in May 1993. During these operations, unexpected soil contamination was discovered beyond the boundaries stipulated in the approved closure plan. As a result, an extension to the closure schedule was requested in order to determine the extent of the contamination, and to prepare an amended closure plan. In November 1993, an amended closure plan was submitted which combined the closure of the building and the tank/sump. The Ohio EPA approved the amended closure plan for the combined X-740 facility in June 1994.

Phase II of the RFI conducted at this facility was combined with additional closure activities performed in September and October of 1994. During these investigations, groundwater contamination was identified, but was thought to be associated with a demolished substation utilized during former construction activities at PORTS. Therefore, in 1995, in accordance with the approved closure plan, it was determined that the X-740 unit and adjacent soils would be closed under the RCRA closure process to risk-based closure levels and groundwater contamination in the vicinity would be addressed through the CMS/CMI process.

The amended closure plan approved in 1994 was revised in May of 1996 to incorporate the findings of a human health risk assessment conducted to support completing a risk-based closure of the unit. The revised closure plan was subsequently submitted to the Ohio EPA for approval. After the public was given the opportunity to submit comments and no comments were received, Ohio EPA approved the risk-based closure on December 31, 1997.

The *Quadrant III CAS/CMS Final Report* (DOE 1998), submitted in April 1998, presented alternatives for remediation of the contaminated groundwater in the vicinity of the X-740 Waste Oil Handling Facility. In May 1999, Ohio EPA finalized the Quadrant III Decision Document identifying phytoremediation as the preferred remedy for cleanup of groundwater in the vicinity of the X-740 Waste Oil Handling Facility. The phytoremediation system was installed in 1999.

In 2003, a five-year review was completed for the X-740 groundwater plume to evaluate the effectiveness of the phytoremediation system. The report, entitled *Five-Year Evaluation Report for the X-740 Phytoremediation Project* (DOE 2003b), indicated that the trees in the phytoremediation system did not noticeably affect the overall groundwater flow in the Gallia at this area, although the trees appeared to influence water levels in individual wells. Upon review of the 2003 Five-Year Evaluation Report, the Ohio EPA required another evaluation of this area in three years to determine if the phytoremediation system is effective in remediating the groundwater plume. The *Supplemental Evaluation to the Five-Year Evaluation Report for the X-740 Phytoremediation System* (DOE 2007b), submitted to Ohio EPA in January 2007, found that the phytoremediation system had not performed as predicted by groundwater modeling included in the *Quadrant III CAS/CMS Final Report* (DOE 1998).

DOE evaluated other remedial options for this area, and three rounds of oxidant injections (modified Fenton's reagent) were completed in 2008. Data indicated that the oxidant had little effect on TCE contamination in soil and groundwater. DOE is currently evaluating additional remedial options for this area. As requested by Ohio EPA, the X-740 area was removed from the routine IGWMP monitoring program and will be evaluated under a special study (see Section 9.2.3) to determine the best approach to remediate the groundwater plume in this area.

6.2.2 Regulatory Considerations for Optimizing Groundwater Monitoring

The original closure plans written for the X-740 unit (X-740 Waste Storage Facility and the X-740 Hazardous Waste Storage Tank) both stated there was no evidence of groundwater contamination, and neither closure plan addressed the installation of additional monitoring wells, or the completion of additional groundwater sampling. However, the amended closure plan, which combined the closure of the two separate units, included measures to address the unexpected contamination discovered at the facility during initial closure operations. The amended plan also described the installation of groundwater monitoring wells and the collection of groundwater samples. These efforts were to be coordinated with the RFI efforts in order to define the extent of the identified contamination.

The results of the closure/RFI sampling indicated that closure activities, or risk-based closure activities, of the X-740 unit were complete. Furthermore, contamination in the soil did not indicate a definitive source for the groundwater contamination identified in the vicinity of the former X-740 facility. The RFI recommended that the western edge of the plume be further defined by conducting additional groundwater sampling, but stated that a final evaluation of whether or not additional delineation of the plume was necessary would be addressed in the Quadrant III CAS/CMS. It is anticipated that data resulting from implementation of the integrated monitoring plan for the X-740 Waste Oil Handling Facility Area described herein will be adequate to evaluate the effectiveness of the CMI in remediating the groundwater contamination.

6.2.3 Technical Considerations for Optimizing Groundwater Monitoring

A known VOC plume exists near the former X-740 Waste Oil Handling Facility. Results from previous sampling events have shown that the former X-740 Waste Oil Handling Facility is not likely the source for this contamination. The objective for monitoring this unit will be to determine the effectiveness of the CMI on the extent and concentration of the X-740 plume contamination.

The Sunbury Shale is absent at X-740; therefore, the Gallia Sand is in contact with the Berea Sandstone. As a result, the VOC contaminant plume is detectable in both Gallia and Berea wells. The plume will migrate more quickly in the Gallia because the hydraulic conductivity is higher in the Gallia than in the Berea.

6.2.4 Evaluations and Reporting

Data from the former X-740 Waste Oil Handling Facility were not routinely evaluated prior to implementation of the IGWMP.

The former X-740 Waste Oil Handling Facility is currently monitored under a special study (see Section 9.2.3). Groundwater monitoring data collected as part of the special study will be summarized in the annual Groundwater Monitoring Report for PORTS, which is submitted to the regulators by April 1 of each year.

7. QUADRANT IV

Three groundwater AOCs are located in Quadrant IV, which is in the northern portion of the site: the X-611A Former Lime Sludge Lagoons, the X-735 Landfills, and the X-734 Landfills. These areas are discussed in Sections 7.1, 7.2, and 7.3, respectively. Two additional areas in Quadrant IV, the X-533 Switchyard Area and the former X-344C Hydrogen Fluoride Storage Building, are also monitored as a result of completed special studies or characterizations (see Section 9.1).

7.1 X-611A FORMER LIME SLUDGE LAGOONS

The following sections contain an introduction and facility history of the X-611A Former Lime Sludge Lagoons and the regulatory and technical considerations for optimizing groundwater monitoring in this AOC. Section 7.1 concludes with discussions regarding regulatory evaluations and reporting for the X-611A Area. The integrated monitoring program, including all well names, monitoring frequencies, and parameters for the X-611A Former Lime Sludge Lagoons Area is presented in Appendix D, Table D-1. Well locations are shown in Figure D-1.

7.1.1 Background and History

The X-611A Area consists of three unlined sludge retention lagoons constructed in 1954. The lagoons were constructed in a low-lying area that included Little Beaver Creek. To accommodate construction of the X-611A Lime Sludge Lagoons, approximately 1500 ft of Little Beaver Creek was relocated to a new channel just east of the lagoons. The lagoons were referred to as the north, middle, and south lagoons. Together they covered a surface area of approximately 18 acres, and had a maximum combined volume of approximately 295,000 cubic yards.

Unconsolidated material cut from the construction area was used to form the elevated earthen dikes that make up the sides of the lagoons. Construction documents suggest that the majority of the unconsolidated material that was overlying the Sunbury in this area was used to construct the earthen dikes; therefore, it is believed that the Sunbury forms much of the bottom surface of the X-611A Lime Sludge Lagoons. In general, lagoon depths ranged between 12 and 14 ft, and depths generally increased from west to east.

Between 1954 and 1960, the X-611A Lime Sludge Lagoons received waste lime sludge from the X-611 Water Treatment Plant. Between 1956 and 1957, the X-611A lagoons also received recirculating cooling water and chromium contaminated lime sludge resulting from chromate reduction activities performed in a storm sewer system. Receipt of waste lime sludge from the X-611 Water Treatment Plant was discontinued in 1960; subsequently, the sludge process lines to the X-611A Lime Sludge Lagoons were disconnected.

Sludge in the X-611A Lime Sludge Lagoons consisted primarily of white, saturated lime. Sparse, grassy vegetation became established in the western portions of all three lagoons, and the eastern portions of the lagoons contained shallow surface water. In October 1995, approximately 10 acres of land south of the X-611A lagoons were delineated as a jurisdictional wetland by the U.S. Army Corps of Engineers. Approximately 0.4 acres of this wetland is between the south boundary of the X-611A lagoons and Little Beaver Creek. The remaining 9.6 acres of wetland habitat are south of Little Beaver Creek.

Phase I of the Quadrant IV RFI (which included the X-611A SWMU) was conducted between December 1992 and April 1993. Phase II of the investigation was conducted between February 1994 and July 1994. Additional sampling of the sediments to determine the extent of PCB contamination in the middle lagoon and chromium contamination in the north lagoon was conducted in July 1994.

In June 1996, the Ohio EPA and U.S. EPA issued a Decision Document for the X-611A Former Lime Sludge Lagoons that specified the selected remedy to be used to achieve the remedial goals. This selected remedy required the following actions: 1) placement of a minimum 2 ft-thick soil cover over the lagoons, 2) development of a prairie habitat on the soil cover placed over the north, middle, and south lagoons, 3) construction of a soil berm outside the northern boundary of the north lagoon to facilitate shallow accumulation of water in this low-lying area, and 4) groundwater monitoring to ensure that no contaminants of concern are migrating to the groundwater. Construction of the selected remedy was completed in 1996. Ohio EPA approved the CMI in September 1997.

In 2002, a five-year review was completed for the X-611A Former Lime Sludge Lagoons to evaluate the effectiveness of the corrective measures implemented at this area. The report, *X-611A Prairie and the X-749B Peter Kiewit Landfill Five-Year Evaluation Report* (DOE 2002), found that the soil cover and prairie habitat constructed at the X-611A Former Lime Sludge Lagoons was meeting the remedial action objectives for this unit by eliminating exposure pathways to the contaminants of concern in the sludge at this area.

The *Second Five-Year Review for the X-611A Prairie* (DOE 2008) was submitted to Ohio EPA in 2008. The report found that the soil cover and prairie habitat continued to meet the remedial action objectives for this unit by eliminating exposure pathways to the contaminants in the sludge at this area.

7.1.2 Regulatory Considerations for Optimizing Groundwater Monitoring

Prior to implementation of the IGWMP, regulatory requirements for groundwater monitoring were included in the O&M Plan developed as part of the corrective action for the X-611A Former Lime Sludge Lagoons. Under the requirements of the O&M Plan, there were no instances where contradictory requirements, or instances of confusing direction, were encountered. Therefore, based on the regulatory history of the groundwater monitoring conducted at this facility, no changes to the monitoring program other than those indicated by technical considerations, are included.

7.1.3 Technical Considerations for Optimizing Groundwater Monitoring

The integrated monitoring program, including all well numbers, monitoring frequencies, and parameters for the X-611A Former Lime Sludge Lagoons, is presented in Appendix D, Table D-1. As part of the pre-integrated monitoring program, this unit was monitored semiannually at six wells for the metals beryllium and chromium as well as PCBs, specifically Arochlor-1242 and Arochlor-1248.

Historically, PCBs have not been detected in PORTS groundwater, except when dissolved in DNAPL such as at X-701B. PCBs have been detected in the DNAPL at X-701B at concentrations greater than 500 parts per million (ppm), yet PCBs are not detected in the surrounding groundwater. For example, the DNAPL removed from an extraction well at X-701B (X236-1) contained primarily TCE, but also had PCB concentrations in excess of 500 ppm. However, PCBs were not detected in nearby monitoring well X701-14G, even though TCE concentrations in this well exceeded 200,000 ppb which indicates that the PCBs are relatively insoluble and do not readily migrate through the Gallia unless dissolved in DNAPL.

Previously, PCBs were detected in some of the soil samples from the middle lagoon at X-611A. However, PCBs have not been detected in any of the groundwater samples collected at this unit. Because of their relative insolubility, the PCBs would not be expected to migrate from the soil into the groundwater. There is no evidence of DNAPL, or any VOCs, at this unit which might otherwise allow the PCBs to migrate. Therefore, the integrated monitoring program includes total PCBs for this unit only once every five years for use in the five-year evaluation of the remedial action.

Only source monitoring is performed for the X-611A Former Lime Sludge Lagoons. The locations of integrated wells are shown in Appendix D, Figure D-1. Table D-1 in Appendix D lists the location/purpose, analytical parameters, and sampling frequency for each well that is part of the monitoring program for the X-611A Former Lime Sludge Lagoons.

7.1.4 Evaluations and Reporting

Pre-integrated regulatory requirements directed by the O&M Plan concerning data evaluations and data reporting included annual evaluations completed to determine if the contaminants of concern were impacting the surrounding groundwater. Verification and validation of the laboratory analytical data were also completed.

Because an integrated approach to groundwater monitoring has been developed in this document, data for the X-611A Former Lime Sludge Lagoons will be reported in the annual Groundwater Monitoring Report submitted to the Ohio EPA by April 1 of each year.

7.2 X-735 LANDFILLS

The following sections contain an introduction and facility history of the X-735 Landfills and the regulatory and technical considerations for optimizing groundwater monitoring in this AOC. Section 7.2 also includes discussions regarding regulatory evaluations and reporting for the X-735 Area. The integrated monitoring program, including all well names, monitoring frequencies, and parameters for the X-735 Landfills is presented in Appendix D, Table D-2. Figure D-2 in Appendix D shows the integrated monitoring network for the X-735 Landfills.

7.2.1 Background and History

Several distinct waste management units are contained within the X-735 Landfills. The main units consist of the hazardous waste landfill, referred to as the X-735 Landfill (Northern Portion), and the X-735 Industrial Solid Waste Landfill (ISWL). The X-735 ISWL includes the industrial solid waste cells, asbestos disposal cells, and the closed chromium sludge monocells A and B. The chromium sludge monocells contain a portion of the chromium sludge generated during the closure of the X-616 Chromium Sludge Surface Impoundments (see Section 6.1).

Initially, a total of 17.9 acres was approved by the Ohio EPA and Pike County Department of Health for landfill disposal of conventional solid wastes. The landfill began operation in 1981, and the original design of the facility included 15 cells for solid waste disposal. The term "cells" refers to sections of the landfill that outline the locations where trenches were constructed for material disposal. Waste disposal was accomplished by shallow land burial using the trench and fill method. Wastes were delivered to the landfill by compactor trucks, pickup trucks and dump trucks, and unloaded near the active trench. The waste was then spread and compacted by a bulldozer and/or landfill compactor. Daily cover material (soil) was applied to the compacted solid waste at the end of each work day.

Previous PORTS investigations indicated that approximately 12,000 pounds of wipe rags contaminated with solvents had inadvertently been disposed in Cells 1 through 6 of the landfill. Historical data indicated that the wipe rags contaminated with solvents most likely contained methyl ethyl ketone, which has a hazardous waste code of F005. The contaminated rags were immediately removed from the solid waste stream by instituting new management controls to isolate contaminated rags as hazardous waste.

Waste disposal in Cells 1 through 6 ceased at the end of December 1991. Ohio EPA subsequently determined that Cells 1 through 6 were to be closed as a RCRA hazardous waste landfill. Consequently, this unit of the sanitary landfill was identified as the X-735 Landfill (Northern Portion). A buffer zone was left unexcavated to provide space for groundwater monitoring wells and a space between the RCRA landfill unit and the remaining southern portion, the X-735 ISWL. A Closure/Post Closure Plan for the hazardous X-735 Landfill (Northern Portion) was submitted to the Ohio EPA in June 1991, and resubmitted with revisions in December 1992. The submittal and subsequent revisions were approved in September 1993. Additional groundwater monitoring wells were installed in the buffer area as part of the closure. Routine groundwater monitoring has been conducted at the X-735 Landfills since 1991.

In October 1991, DOE submitted a plan to Ohio EPA Southeast District Office for utilization of the remainder of the X-735 Landfill. The remaining portion of the landfill is referred to as the X-735 ISWL and includes a solid waste section and an asbestos waste section. The X-735 ISWL, not including the chromium sludge monocells, encompasses a total area of approximately 4.1 acres. The proposed utilization plan for the X-735 ISWL was approved by the Ohio EPA in November 1991.

In 1997, the Ohio EPA denied the approval of a Permit to Install for modifications to the X-735 ISWL, and issued the DFF&O requiring DOE to cease accepting waste, prepare a revision to the Closure/Post Closure Plan submitted in June 1993, and to initiate closure of the X-735 ISWL by January 31, 1998.

A revised Closure/Post Closure Plan for the X-735 ISWL had previously been submitted in April 1995. The plan was revised and resubmitted in April 1997 following incorporation of Ohio EPA comments dated September 1995 and November 1996. The plan was again revised to incorporate Ohio EPA comments, and resubmitted in October 1997. The X-735 ISWL ceased accepting waste on December 31, 1997, and the closure plan was approved by the Ohio EPA on January 23, 1998. Closure of the unit was completed in 1998.

Assessment monitoring was conducted at the X-735 Landfills in 1997-1998 and 2000-2002 and was initiated again in 2005. The program at the southern portion changed to an assessment monitoring program in August 1997 while the program at the northern portion continued to be a detection monitoring program. This change was due to the statistically significant increase in the sulfate concentration in well X735-05GA. Subsequent sampling under the assessment program indicated that the sulfate concentration in well X735-05GA was not due to a release of leachate or leachate-derived constituents but was most likely the result of natural variation in the groundwater quality. The Ohio EPA therefore granted DOE's April 1998 request to reinstate the detection monitoring program for the X-735 ISWL in a letter dated June 29, 1998.

An assessment monitoring program was initiated at the X-735 Landfills in 2000 because of a statistically significant increase in the concentrations of alkalinity, sodium, sulfate, and/or total dissolved solids at wells X735-17B, X735-18B, X735-19G, and X735-20B. Statistical evaluation of these monitoring parameters was not required at these wells, which were part of the monitoring program for the X-735 Landfill (Northern Portion), until implementation of the IGWMP in 1999. Historical data from these wells indicated that the concentrations of these parameters usually exceeded the upper tolerance limit calculated based on data from three upgradient wells. The assessment monitoring program, completed in 2002, determined that a release had not occurred from the landfill and recommended additional upgradient (background) wells and a new statistical procedure for data evaluation as part of resuming the detection monitoring program for this unit (see Sections 7.2.3 and 7.2.4).

Assessment monitoring was initiated at the X-735 Landfills in 2005 following the second consecutive exceedence of a control limit for total dissolved solids in well X735-21G. Based on the results of the assessment monitoring program, Ohio EPA concluded that a small release of leachate is occurring, or has occurred, from the X-735 Landfills and that the release consists of alkalinity, cobalt, mercury, nickel, sodium, and total dissolved solids. Although DOE was not able to conclusively determine if a release was occurring or had occurred, DOE moved forward and submitted the *Corrective Measures Plan for the X-735 Landfill* (DOE 2007a) pursuant to OAC Rule 3745-29-10(F) (as effective June 1, 1994). The Corrective Measures Plan was approved by Ohio EPA in March 2008.

Appendix F provides the evaluation methodologies for monitoring at the X-735 Landfills. Appendix D, Table D-2 provides the analytical parameters and sampling frequencies for the X-735 wells.

7.2.2 Regulatory Considerations for Optimizing Groundwater Monitoring

As noted previously, the X-735 Landfills comprise two units: a northern hazardous waste disposal unit and a southern non-hazardous waste disposal unit. Prior to implementation of the IGWMP, groundwater monitoring at the northern portion was governed by the hazardous waste regulations and an approved closure plan written in accordance with those regulations. Groundwater monitoring at the southern portion of the X-735 was governed by the solid waste regulations and a Groundwater Quality Assessment Plan.

In accordance with the 1999 DFF&O (Administrative Integration Consent Order), this document provides a consolidated, integrated monitoring program for the X-735 Landfills to eliminate potential confusion and overlaps between the hazardous waste requirements and the solid waste requirements, while efficiently providing information necessary to determine if a release of leachate or leachate-derived constituents has adversely impacted the groundwater beneath the X-735 Landfills.

7.2.3 Technical Considerations for Optimizing Groundwater Monitoring

Prior to implementation of the IGWMP, analytical parameters for X-735 Landfills historically included VOCs, physical parameters, radiological parameters, and inorganics including metals. The specific list of parameters varied from year to year; depending on the regulatory status of this area (see Section 7.2.1). Physical parameters included temperature, pH, and specific conductance. Some sampling events also included measurements of additional physical parameters (turbidity and dissolved oxygen). Other parameters measured at this unit included metals and other inorganics used for mass balance and water quality analysis. These parameters include calcium, iron, magnesium, potassium, sodium, chloride, sulfate, and alkalinity.

Figure D-2 in Appendix D shows the integrated monitoring network for the X-735 Landfills. Table D-2 in Appendix D lists the location/purpose, analytical parameters, and sampling frequency for each well that is part of the monitoring program for the X-735 Landfills. Appendix F provides the evaluation methodologies for monitoring at the X-735 Landfills.

7.2.4 Evaluations and Reporting

Pre-integrated regulatory requirements concerning data evaluations and data reporting included verification and validation of the laboratory analytical data and the quarterly (for the northern portion) or semi-annual (for the southern portion) statistical evaluations completed to determine if leachate or leachate-derived constituents are impacting the surrounding groundwater. Pre-integrated statistical evaluations for the northern, hazardous landfill included a comparison of analytical data to background upper tolerance limits specified in the closure plan. Tolerance limits were established for the following parameters: arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, and turbidity. Pre-integrated statistical evaluations conducted for the southern, industrial landfill included a tolerance interval procedure used for the following parameters: total dissolved solids, sodium, chloride, sulfate, and alkalinity. An intra-well comparison was conducted for sulfate (only) in well X735-05GA. As part of the pre-integrated monitoring program, a summary report for the northern portion of the facility was presented in the annual RCRA report for PORTS, which was submitted to the regulators by March 1 of each year. The pre-integrated monitoring program also included the submittal of results of the evaluations for the southern portion of the landfill on a semi-annual basis, within 75 days of sampling the wells.

In accordance with the 1999 DFF&O (Integration Administrative Consent Order), comprehensive groundwater data for the X-735 Landfills is evaluated annually and included in the annual Groundwater Monitoring Report submitted to the regulators by April 1 of each year. A statistical analysis is conducted for the X-735 wells as described in Appendix F.

7.3 X-734 LANDFILLS

The following sections contain an introduction and facility history of the X-734 Landfills and the regulatory and technical considerations for optimizing groundwater monitoring in this AOC. Section 7.3 concludes with discussions regarding regulatory evaluations and reporting. The integrated monitoring program, including all wells, monitoring frequencies, and parameters is presented in Appendix D, Table D-3. Figure D-3 in Appendix D shows the monitoring wells that are part of the integrated monitoring network for the X-734 Landfills.

7.3.1 Background and History

The X-734 Landfills AOC consists of three landfill units; the X-734 Old Sanitary Landfill, the X-734A Construction Spoils Landfill, and the X-734B Construction Spoils Landfill. The X-734 Old Sanitary Landfill has a total area of approximately 3.8 acres, the X-734A Construction Spoils Landfill has a total area of approximately 3.5 acres, and the X-734B Construction Spoils Landfill has a total area of approximately 4.6 acres. Waste disposal activities at the X-734 Old Sanitary Landfill was discontinued in 1981 when the X-735 Landfill began operations. Waste disposal operations at the X-734A and X-734B Construction Spoils Landfills were discontinued in 1985.

Dumping and filling techniques used at X-734 consisted of solid wastes being delivered to the landfill by a compactor truck that deposited the refuse over the face of the fill. After being crushed under a bulldozer, the fill was covered with several inches of coal ash from the X-600 Steam Plant. The ash was packed to form a hard layer and to provide a base for the next layer of trash.

Detailed records of materials disposed in the landfill were not kept. However, waste known to be disposed of at X-734 include: trash and garbage, construction spoils, and waste containing unspecified levels of heavy metals. While not substantiated, plant personnel have indicated that organic solvents may have been disposed of in the unit. The X-734A Construction Spoils Landfill has a total area of approximately 3.5 acres. In March 1985 empty drums were being disposed in the spoil area; the practice was subsequently discontinued.

Disposal of radioactive materials was not permitted in X-734, X-734A, or X-734B. The approved waste stream included the following: construction spoils, trees, railroad ties, broken concrete, stumps, roots, brush, rotten wood, and other wastes from clearing and grubbing operations. While not substantiated, other materials reportedly disposed of at X-734B may have included sanitary waste from contractors for the gaseous centrifuge enrichment plant, empty paint cans, empty 55-gal drums, and uranium-contaminated soil from the X-342 area. The results from composite soil samples taken from the X-342 area before burial indicated that the uranium content varied from 14 to 240 milligrams per kilogram (mg/kg).

Monitoring well sampling data collected before the RFI indicated the possibility of elevated levels of TCE, total organic halogens, and Freon-113 in one of three wells near the unit; however, available data were insufficient for statistical confirmation.

Ohio EPA issued a Decision Document for the X-734 Landfills in 1999. Remedial actions required by the Decision Document included construction of a multimedia cap over the northern portion of the landfills and a soil cap over the southern portion of the area. These caps were installed in 1999 and 2000.

The *First Five-Year Review for the X-734 Landfill Area* (DOE 2008b) found that construction of the caps on the landfills was achieving remedial action objectives by 1) isolating contaminants in soil and sediment from potential receptors, and 2) preventing contaminants in soil and sediment from migrating to groundwater and surface water.

7.3.2 Regulatory Considerations for Optimizing Groundwater Monitoring

The X-734, X-734A, and X-734B Landfills were closed in accordance with the solid waste regulations in effect at that time, and no groundwater monitoring of the units was required. However, the X-734 Landfills Area has been capped as part of the remedial actions required for Quadrant IV. Therefore, remedial action effectiveness monitoring is included in the IGWMP for the X-734 Landfills Area.

7.3.3 Technical Considerations for Optimizing Groundwater Monitoring

In the X-734 Landfills area, the geologic formations (and hydrogeologic properties) beneath the landfills are influenced by the pre-construction surface topography. The Gallia and Berea become absent in the northern and eastern portions of the area due to erosion by the North Drainage Ditch and Little Beaver Creek, respectively. Prior to construction of PORTS, Little Beaver Creek and the North Drainage Ditch incised deep valleys in the X-734 Landfills area through the Berea Sandstone and upper portion of the Bedford Shale. In the early 1950s, a large amount of compacted fill was placed across the Little Beaver Creek valley to construct the railroad bridge and spur to PORTS, which is on the west side of the X-734 Landfills area. The X-734 Old Sanitary Landfill construction debris, sanitary waste, and fly ash were subsequently placed in the valley between the railroad embankment on the west and the North Drainage Ditch and Little Beaver Creek on the east and north, respectively. The thickest area of waste occurs at the northeastern point of the X-734 Landfill and is underlain by the Bedford Shale.

In the northern portion of the area, the Gallia and Berea units are absent. Bedrock wells, designated with a "B" at the end of the well name, are screened in the Bedford Shale. Wells screened in the unconsolidated material above the bedrock are designated with a "G" at the end of the well name. High downward gradients are observed between the wells screened in the unconsolidated materials (or fill) and the Bedford wells, e.g., X734-18G and X734-17B. The Bedford is an effective aquitard and the rate of vertical flow from the unconsolidated materials into the Bedford is very slow.

In general, the water levels measured in the base of the unconsolidated materials in the area of the landfills are at or below the pre-PORTS construction topography, which indicates a low potential for lateral groundwater flow through the waste. The limited amount of groundwater that intersects the erosional surface flows along the eroded bedrock surface below any fill or disposal waste that is present.

Groundwater monitoring was not routinely performed at this unit prior to inclusion of the unit in the IGWMP. The groundwater monitoring data for X-734 is limited primarily to that collected during Phase I of the RFI and one round of special sampling in January 1998. Additionally, detailed data concerning the amounts and types of waste disposed in the landfills are also unavailable.

Pre-IGWMP analytical data for the X-734 groundwater monitoring wells have shown detectable levels of VOCs at several wells. The highest levels of VOCs were found in well X734-09G, which had TCE concentrations of less than 100 ppb in both of the two sampling events. Several of the deeper wells in the Bedford shale have shown various hydrocarbon constituents; however, these constituents are believed to be naturally occurring. The Bedford shale is known to produce hydrocarbons in certain areas. Neither technetium-99 nor uranium were detected in the groundwater at this unit during the RFI.

Figure D-3 in Appendix D presents the integrated monitoring network for the X-734 Landfills. Table D-3 in Appendix D lists the location/purpose, analytical parameters, and sampling frequency for each well that is part of the monitoring program for the X-734 Landfills.

7.3.4 Evaluations and Reporting

Because an integrated approach to groundwater monitoring has been developed in this document, a Groundwater Monitoring Report will be completed for the entire PORTS site, including the X-734 Landfills AOC, and will be submitted to the Ohio EPA by April 1 of each year.

8. SURFACE WATER AND WATER SUPPLY MONITORING

Additional monitoring at PORTS that supports an integrated approach to groundwater monitoring includes sampling selected surface water locations and surrounding residents' water supplies (drinking water wells). These programs are discussed in the following sections.

8.1 SURFACE WATER MONITORING

Surface water monitoring is conducted at PORTS for both the groundwater monitoring program and NPDES Permits. Because the NPDES Program is not considered a groundwater-related program, it is not discussed in this document.

Surface water sampling from Little Beaver Creek (LBC), Big Run Creek (BRC), the Unnamed Southwest Drainage Ditch (UND), West Drainage Ditch (WDD), North Holding Pond (NHP), and the East Drainage Ditch (EDD) is conducted quarterly as part of the integrated monitoring program. This sampling is conducted because the streams and drainage channels have been determined to be groundwater discharge areas and may indicate the discharge of contamination. A summary of the surface water monitoring sites and a sampling location map are included in Appendix E.

8.2 WATER SUPPLY MONITORING

Routine monitoring of residential drinking water sources is completed at PORTS in accordance with the requirements of Section VIII of the September 1989 Consent Decree between the State of Ohio and DOE. Prior to implementation of the IGWMP, residential water supply monitoring was conducted in accordance with the *Offsite Residential Drinking Water Quality Monitoring Plan* (MMES 1989b) approved by the Ohio EPA on May 10, 1989. The monitoring program described in this section is a revision to the monitoring plan developed in 1989. Chapter 10, Section 10.1.5, discusses collection of water supply samples.

The purpose of the program is to determine whether residential drinking water sources have been adversely affected by plant operations. While this program may provide an indication of contaminant transport off-site, it should not be interpreted as an extension of the on-site groundwater monitoring program, which bears the responsibility for detection of contaminants and determining the rate and extent of contaminant movement. Due to the lack of knowledge of how residential wells were constructed and to the presence of various types of pumps, which may not be ideal equipment for sampling, in residential wells, data from this program will not be used in hydrogeologic or geochemical investigations. The PORTS water supply is also sampled as a part of this program.

Appendix E, Table E-2, identifies the drinking water sources participating in the program, analytical parameters, and sampling frequencies. Sampling locations may be added or deleted as resident requests and program requirements dictate. Typically, sampling locations are deleted when a resident obtains a public water supply. Sampling locations are added upon request if there is a probable hydrogeologic connection between PORTS and the resident's water supply.

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9. SPECIAL SHORT-TERM STUDIES

As discussed in Section 3.2, special short-term evaluations can be triggered by additional data needs, physical changes at an AOC (for example, new site conditions or new data), changes in monitoring policy, or the need to evaluate technical demonstrations or innovative remediation technologies. Future special studies may be proposed by the Ohio EPA or by DOE and implemented through an approved work plan.

The following sections describe those special studies that have been conducted or are planned at PORTS that have had or may have long-term impact on IGWMP monitoring. Completed special studies that did not affect the IGWMP are not necessarily included in this chapter.

9.1 COMPLETED SPECIAL STUDIES

Numerous special studies have been conducted since implementation of the IGWMP on April 1, 1999. A special study for metals and radiological parameters, *Special Study for Metals and Radiological Parameters in Groundwater*, (DOE 2000b), investigated ten AOCs as identified by DOE and Ohio EPA to evaluate potential metals and radiological groundwater contamination and was completed in 2000. The report includes an evaluation of the data as well as conclusions regarding the potential for metals or radiological contamination in the areas investigated. Based on the report findings, monitoring for selected metals has been conducted in specific IGWMP wells that monitor the PK Landfill (part of the X-749/X-120/PK Landfill monitoring area), X-701B Holding Pond, and X-734 Landfills. The X-633 Pumphouse/Cooling Towers Area (Quadrant II) and the X-533 Switchyard Area (Quadrant IV) have also been added to the IGWMP.

In addition, investigations have been conducted to corroborate previous studies regarding residual manganese and radionuclides in groundwater. DOE conducted a study in 2000 to determine the potential effects of permanganate injection (from pilot projects to remediate VOC contamination in Quadrants I and II) on residual manganese concentrations in groundwater. Monitoring for manganese has been conducted for selected IGWMP wells in Quadrants I and II. The *Radionuclide Verification Investigation Risk Estimate for the Portsmouth Gaseous Diffusion Plant* (DOE 2000a) indicated that the rate and extent of radiological contaminants at PORTS had been adequately defined by previous studies.

Characterization to determine the extent of soil and groundwater contamination in the vicinity of the former X-344C Hydrogen Fluoride Storage Building was conducted in 2009. Two VOCs, *cis*-1,2-dichloroethene and *trans*-1,2-dichloroethene, were detected at concentrations below 2 micrograms per liter (μg/L) in well X344C-01G, which is south of the former facility. Based on these detections, the X-344C area and well X344C-01G have been added to the IGWMP and will be sampled annually for VOCs as described in Appendix D, Table D-5.

Additional special studies or investigations have taken place within the IGWMP monitoring areas. The Background and History section for the monitoring area provides additional information about completed special studies or investigations.

9.2 CURRENT SPECIAL STUDIES

IGWMP data are evaluated annually to determine whether changes to monitoring requirements in some wells or areas are necessary and/or feasible. Based on this evaluation, changes in monitoring may be proposed in future IGWMP revisions.

The following special studies were being conducted or planned during 2009-2010. Based on the results of these studies, changes may be made to the IGWMP in the future, as warranted.

9.2.1 Quadrant I

In 2007, DOE developed the *Work Plan for the X-749/X-120 Area Groundwater Optimization Project* (DOE 2007). Completed projects that were part of the work plan included installation and monitoring of three new off-site monitoring wells to determine the rate and extent of the X-749 plume migration in the South Barrier Wall area, additional monitoring of 22 wells in the X-749/X-120 plume, installation of additional extraction wells at the X-749 Landfill and in the X-749 South Barrier Wall area, and installation of monitoring wells within the X-749 Landfill.

In 2010, the *Addendum to the Work Plan for the X-749/X-120 Area Groundwater Optimization Project* (DOE 2010) was prepared. Installation of three additional extraction wells was initiated to provide further control and remediation of the X-749/X-120 groundwater plume. One extraction well (X749-EW09G) was installed in the X-120 portion of the plume to remediate higher concentrations of VOCs in groundwater in this area. Two extraction wells (X749-EW07G and X749-EW08G) were installed upgradient from the X-749 South Barrier Wall area to further remediate the southern and western portions of the plume. The monitoring program for the X-749/X-120 plume has been revised to monitor the performance of these wells.

9.2.2 Quadrant II

The following special studies are in progress in Quadrant II.

9.2.2.1 Quadrant II Groundwater Investigative Area

In 2009, a special investigation was conducted in the Quadrant II Groundwater Investigative Area to identify potential sources of TCE in the southern and eastern areas of the plume and to further define the western boundary of the plume. The investigation identified areas of higher TCE concentrations in the southeastern portion of the plume that appear to be associated with continuing sources of TCE near the former X-720 Neutralization Pit and the X-700T Aboveground Storage Tank.

Based on these results, a pilot study of enhanced anaerobic bioremediation is being planned to remediate VOCs in groundwater in the southeastern portion of the plume in the Quadrant II Groundwater Investigative Area. Results of this pilot study will be summarized in the annual Groundwater Monitoring Report.

9.2.2.2 X-701B Holding Pond

One of the remedial actions selected in the Decision Document for the X-701B Holding Pond, oxidant injection, was conducted in the source area from October 2006 through October 2008 (see Section 5.2.1.1). Because the oxidant injections were not able to address the contaminant source in the upper

Sunbury formation, direct mixing of oxidant into soils in the source area has been approved by Ohio EPA. Groundwater monitoring wells in the western area of the plume, which includes the source area, have been removed from routine monitoring required by the IGWMP and are monitored as part of an interim remedial action. Results of the monitoring will be summarized in the annual Groundwater Monitoring Report.

9.2.3 Quadrant III

A project is underway in the groundwater plume near the former X-740 Waste Oil Handling Facility to enhance remediation of this groundwater plume. Oxidant injections were completed during May, July, and September of 2008 in selected portions of plume; however, data collected during this special study indicated that the oxidant had little or no effect on TCE contamination in soil and groundwater. An evaluation was then conducted to identify other remedial options for this area. A pilot study of enhanced anaerobic bioremediation is underway to remediate VOCs in groundwater in the area. Results of the monitoring completed as part of this special study will be summarized in the annual Groundwater Monitoring Report.

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10. SAMPLING AND ANALYSIS

The following sections describe the procedures and techniques for obtaining information associated with groundwater samples collected at PORTS. Sections 10.1 through 10.4 describe sample collection activities, Section 10.5 discusses analytical procedures, and Section 10.6 contains information on sample quality assurance and quality control (QA/QC). Section 10 concludes with a description of the data management plan.

The Project Environmental Measurements System (PEMS) is an electronic data management system that is used to support environmental data collection at PORTS. PEMS is used in all phases of sampling from creating sample labels and chain-of-custody (COC) forms to sample tracking and analyses reporting. All samples and QA/QC samples collected under the IGWMP are assigned unique sequential identification numbers in PEMS. Each sample can be traced to its point of origin through PEMS.

10.1 SAMPLE COLLECTION

Several procedures for sample collection have been developed for site-wide use in the groundwater monitoring program at PORTS. These procedures are maintained on site and are available for review by Ohio EPA. The following sections briefly describe the process for obtaining water level measurements, detecting immiscible layers, well purging techniques, obtaining field parameter measurements and sample withdrawal methods.

10.1.1 Water Level Measurements

The static water level (SWL) elevation of a well is measured and recorded prior to each well sampling event in accordance with applicable procedure(s). The total depth of the well is also measured and recorded if possible. If a total depth measurement is not possible (for instance, if a dedicated bladder pump is installed in the well), then the historical total depth measurement may be used. The SWL and total depth are required to calculate the well bore volume and purge volume and to provide a check for identifying siltation problems. The SWL and total depth are measured from a permanent reference point located at the top of the monitoring well casing (or from the north side of the casing if a permanent reference is not present). If the monitoring well has a bladder pump installed, then the measurement is taken from the bladder pump cap. The bladder pump cap is at the same level as the permanent reference point.

The SWLs are also collected semiannually from predetermined wells (groundwater wells and piezometers) to generate groundwater flow maps for the Gallia and the Berea formations. The SWLs are collected in the shortest reasonable time to obtain accurate data on groundwater flow. To the extent possible, water levels in a given area are collected in a single day. The water level snapshots are typically completed site-wide within three days.

10.1.2 Detection of Immiscible Layers

Before purging and sample collection, wells that have historically exhibited high concentrations (greater than 100 ppm) of an organic constituent are often inspected for the presence of light nonaqueous-phase liquid (LNAPL) and DNAPL. Sampling this groundwater may result in anomalously high concentrations of dissolved and emulsified contaminants in the well. DNAPL, specifically separate phase TCE, has been detected at PORTS. Wells with typical TCE concentrations greater than 100 ppm have historically been inspected for DNAPL, but, DNAPL was not detected in any of these routinely monitored wells. Most of these wells are now equipped with dedicated bladder pumps, which yield optimal samples if the pump remains stationary prior to sampling. The pumps in these wells would have to be removed prior to inspection for DNAPL. Therefore, because of the sampling history at these wells, and to allow the most representative groundwater samples, these wells will not be inspected for DNAPL during each sampling event. However, they may occasionally be inspected for DNAPL as conditions warrant.

An interface probe may be used to identify the presence, level, and thickness of non-aqueous phase liquids in the well. The interface probe is slowly lowered into the well, and the depth to organic liquid and the organic liquid/water interface(s) are carefully recorded to establish a measurement of the free product thickness. Free-floating product is measured at the potentiometric surface, and DNAPL immiscible layers are detected by lowering the probe to the bottom of the well. A transparent bailer may be used in place of an interface probe to check for the presence of LNAPL or DNAPL. The bailer can be lowered less than two ft into the water column to check for LNAPL or lowered to the bottom of the well to check for DNAPL. The liquid in the bailer can then be visually inspected for the presence of a separate phase. If free product is detected, field personnel will document the measured thickness of the layer on the well sampling log. If free product is detected, the well may, or may not, be sampled.

10.1.3 Well Purging

The water standing in a well before purging is not representative of formation groundwater. Therefore, monitoring wells are purged before sampling to remove any water that is not representative of the groundwater. If conventional purging is conducted, the standing water in the well and filter pack is purged. If micro-purging is conducted, water in the pump and discharge line is purged, and additional groundwater is purged until stabilization is achieved as verified through field measurements. Purging of the wells is typically accomplished using approved bladder pumps, impeller pumps (such as Redi-flow), or bailers. However, gas-lift pumps, peristaltic pumps, or other purging devices may be used in certain applications, though not typically for regulatory sampling. The purge water is containerized and treated on-site in one of the groundwater treatment facilities.

All wells are purged until stabilization has been achieved to ensure that fresh formation water rather than stagnant water is sampled. This is determined by stabilization of the indicator parameters (i.e., pH, specific conductance, and temperature). When conventional purging is conducted, in most instances, a volume equal to approximately three well volumes is removed before sampling. However, some wells are incapable of yielding this much groundwater. In these instances, the well is purged dry and allowed to recover until a sufficient volume of groundwater is present in the well to allow sampling. This usually occurs in 0.3 to 4 hours, but sometimes up to 24 hours is required before sampling can occur. If the well does not recharge sufficiently within 24 hours, it will be noted as a dry well on the well sampling log.

10.1.4 Field Parameters

Temperature, pH, and specific conductance are measured in the field with portable field instruments once purging has been initiated and at specific intervals during the purging process. This ensures that groundwater stabilization has occurred. Other field parameters such as turbidity, dissolved oxygen, or redox potential may also be collected, and these parameters may or may not be used as stabilization parameters. Many of the field parameters are typically measured in a parameter cup at specified purge intervals. However, the field measurements also may be continuously measured as the groundwater is pumped through a flow-through cell. If a flow-through cell is used, the field parameter measurements are recorded at specified time intervals, usually 10 minutes, but always a minimum of 5 minutes. If conventional purging methods are used, the field parameter measurements are recorded after the removal of each well volume. Typically three to five well volumes are removed to achieve stabilization during conventional well purging.

Field parameters are considered to be stabilized when, during two consecutive measurements, the temperature is within 1°C, pH is within 0.2 units, and specific conductance is within 10% for readings over 500 microsiemens per centimeter (μS/cm) or within 50 μS/cm for readings less than or equal to 500 μS/cm. If the field parameters still fail to stabilize, the field sampling team leader may make a field decision to proceed with sampling, provided he or she documents this decision on the sampling log. If the well is purged dry, these data are measured in the field before and after sample collection.

The temperature of a groundwater sample can be measured with a thermometer or other approved equipment such as a combination pH/temperature meter. Temperature measurements are required to calibrate most instruments such as pH meters or conductivity meters unless these instruments automatically compensate for temperature. Probes for temperature, conductivity, pH or other parameters are routinely cleaned between samples. However, to avoid possible cross-contamination resulting from probes, samples that are collected for laboratory analyses do not come in contact with field instruments.

Other analyses performed in the field may include screening of the well site and well head for radiation and organic vapors. This information is also recorded on the sampling log.

10.1.5 Sample Withdrawal

After monitoring wells have been sufficiently purged, groundwater samples are collected using dedicated bladder pumps or dedicated/disposable Teflon and/or stainless steel bailers. Sampling techniques are utilized that minimize agitation and aeration of the samples.

Samples from residential wells should be collected from as close to the wellhead as possible. In addition, samples should not be collected from sources through which the water has been filtered, softened, or otherwise treated. If possible, pressure or holding tanks should be bypassed. Basement or outside faucets are more likely to meet these criteria and are preferred sampling points.

All private wells must be purged before sample collection. If the plumbing is not purged, samples taken from a tap or faucet will not be representative of the aquifer; therefore, evacuating the plumbing and/or water storage tank before obtaining any samples is essential. The resident shall be informed as to the volume of water to be purged and the reason. Many off-site locations are low recharge wells, thus the potential for temporarily dewatering the well is high. If possible, the samplers shall provide information to allow residents to make informed decisions as to whether the well purging is acceptable. If the volume of water to be purged is unacceptable to the resident, the sample will not be collected, and this information will be noted on the sampling log.

10.2 SAMPLE PRESERVATION AND HANDLING

The following sections describe the sample containers and routine sample preservation and handling techniques utilized during the collection of groundwater samples at PORTS.

10.2.1 Sample Containers

Various containers are used when collecting groundwater samples. Sample containers are typically specified by the analytical laboratory in accordance with the analytical method. Sample containers are purchased as "certified clean" from a laboratory supplier. Bottle lot numbers and certification records shall be maintained.

10.2.2 Sample Preservation

Because many chemical constituents and physicochemical parameters evaluated in the sampling and analysis program are not chemically stable, sample preservation is required. The most prevalent sample preservation methods used at PORTS are pH control and the maintenance of sample temperature at 4°C plus or minus 2°C. The pH of samples may be reduced to less than 2 by the addition of acid to the sample containers or increased by adding a base to a pH greater than 12. Samples are preserved as required by the analytical laboratory and the analytical method.

10.2.3 Sample Handling

Samples for volatile organic analysis (VOA) are collected in such a way that no headspace exists in the sample containers; this process minimizes the possibility of loss of organic compounds through volatilization. Groundwater samples that are to be analyzed for dissolved metals or total mobile metals may be filtered through an appropriate media to remove any residual particulate material that could alter the preserved metals content in the sample. Samples are packed, screened, and transported to the laboratory.

10.3 CHAIN-OF-CUSTODY

To ensure the security of samples from collection to final disposition, a COC form is used. A COC form is completed before transfer of sample custody. The COC form provides an accurate written record that can be used to trace the possession and handling of samples from the time of collection through data analysis and reporting. The basic components of the COC program include sample labels, field records, and COC forms.

If samples are shipped off-site, a signed or initialed custody seal is affixed to the shipping container to ensure that the samples have not been disturbed during transportation.

10.4 FIELD DOCUMENTATION

Field activities are documented on sample log forms pertaining to the type of sampling performed. A separate log form is used to record field data at each sampling location. The forms are completed in the field before leaving the site. Sampling locations are identified on the applicable sampling log form.

10.5 ANALYTICAL PROCEDURES

Analytical parameters are based on contaminants detected during groundwater quality assessments performed at the facility and on potential contaminants associated with activities conducted at the facility. Table 1 and the tables contained in Appendices A through D identify the analytical suites utilized for the integrated groundwater monitoring program. The selected analytical methods (and their associated precision, accuracy, and detection limits) provide sufficient data for statistical analysis of the results and are determined and documented in the data review and evaluation process (Section 10.7.3).

10.6 QA/QC PROCEDURES

The following sections describe the site-specific QA/QC procedures to be used during groundwater monitoring activities at PORTS.

In defining the number of field blanks required, it is important to note that a sampling event for purposes of the groundwater monitoring programs at PORTS is defined as the time it takes to complete one round of quarterly sampling. Trip blanks, equipment rinseates, field blanks, and duplicates are defined in the following sections.

10.6.1 Field QA/QC Samples

QA/QC samples collected during routine groundwater sampling activities are described in the following sections, including the collection of trip blanks, equipment rinseates, field blanks, and field duplicates.

10.6.1.1 Trip blanks

Trip blanks are used to detect contamination by VOCs during sample shipping and handling. Trip blanks are prepared using 40-milliliter VOA vials of deionized ultra-filtered (DIUF) water (or water that meets or exceeds the standards for DIUF water) that are filled in the sample preparation area, transported to the sampling site, and transported to the analytical laboratory with VOC samples. Trip blanks are not opened in the field. One trip blank accompanies each cooler containing VOC samples. Each trip blank is stored at the laboratory with associated samples and analyzed with those samples. Trip blanks are typically analyzed only for VOCs. The appropriate QA/QC data is recorded on the associated sampling log.

10.6.1.2 Equipment rinseates

Equipment rinseates are samples of DIUF water (or water that meets or exceeds the standards for DIUF water) that has been used to rinse decontaminated sampling equipment. "Decontaminated" sampling equipment includes equipment that is decontaminated in the field or lab as well as disposable equipment that is purchased clean from the manufacturer and disposed of after use. Equipment rinseates help assess the effectiveness of decontamination. If more than one type of equipment is used to obtain samples for a particular matrix, an equipment rinseate for each type of sampling equipment will be tracked. For example, if groundwater samples are collected by both bailer and pump, an equipment rinseate for each type of equipment will be identified on the sampling log. However, equipment rinseates are not collected from equipment that is dedicated to a monitoring well (e.g. dedicated bladder pumps). Equipment rinseates include pump rinses, rinseate blanks, and equipment blanks.

Pump rinses are rinseate samples collected from decontaminated purge pumps. These samples are collected at a rate of 1 pump rinse per 10 pump uses (i.e., 1 pump rinse for 1 to 10 groundwater samples; 2 pump rinses for 11 to 20 samples).

Rinseate blanks are defined here as equipment rinseates for disposal bailers. These samples were collected at a rate of one per case of 12 bailers prior to implementation of the IGWMP; however, five years of rinseate samples did not detect any bailer contamination. In addition, PORTS now receives documentation from the bailer manufacturer that bailers from a given lot are pulled from the same sheet of Teflon. Currently bailers are used infrequently for sample collection; therefore, one equipment rinseate sample from a disposal bailer will be collected in each quarter that bailers are used for IGWMP sampling. If a bailer is used to collect a sample, the lot number of the bailer used is noted on the associated sampling log to allow tracking in the event of bailer contamination. Rinseate blanks are typically analyzed for nearly all routine groundwater parameters; however, certain parameters that typically are below detection may be eliminated to reduce the hazards and waste associated with their analyses (e.g. cyanide). Equipment rinseates are analyzed for the same analytes as the samples collected that day.

Equipment blanks are equipment rinseates for other miscellaneous equipment (i.e. gloves, dippers). This category may also be used for rinseate samples from equipment that has not yet been decontaminated.

Equipment rinseates are collected in the same container types used for the analytical samples. Equipment rinseates are preserved and handled in the same manner as analytical samples. QC sample information is recorded on the appropriate sampling log.

10.6.1.3 Field blanks

Field blanks are collected at one per ten sampling locations. Field blanks are preserved bottles taken to the sampling location and filled with water that meets or exceeds the standards for DIUF water. The field blank will be analyzed for all analytes of concern for the sampling location. The appropriate QC data is recorded on the appropriate sampling log.

10.6.1.4 Field duplicates

Field duplicates are QA/QC samples collected from the same location, at the same time, and from the same sampling device as the actual sample. For example, if a bailer is used to collect a VOC analysis, the same bailer-full of groundwater that is used for the VOC analysis is also used for the duplicate sample, if possible. Field duplicates are collected at one per ten sampling locations per well field or sampling program (surface water and water supply monitoring). The sample and its field duplicate will have the same set of parameters. Sampling sites where duplicates are collected are selected so that all analytes of concern are included. Care is taken to routinely collect duplicates from wells where known contamination exists. The appropriate QA/QC data is recorded on the appropriate sampling log.

10.6.2 Laboratory QA/QC

The PORTS analytical laboratory, as well as all contract laboratories used by PORTS, follow an established QA/QC program for sampling, handling, and analysis. The analytical methods are based on *Test Methods for Evaluating Solid Waste - Physical/Chemical Methods*, (U.S. EPA, most recent edition) and/or *Methods for Chemical Analysis of Water and Waste* (U.S. EPA, most recent edition). Methods and procedures are applied to organic and inorganic constituents.

10.7 DATA MANAGEMENT

Data management procedure(s) have been developed to insure effective and consistent handling of data generated from groundwater sampling activities conducted at PORTS. Data related to groundwater investigations at PORTS are collected as part of effluent monitoring and environmental surveillance activities. Groundwater investigations at PORTS have resulted in the development of two discrete types of databases: a hydrogeological database and a spatial database. The hydrogeological database encompasses analytical data for samples collected from on-site monitoring wells and off-site monitoring wells, monitoring well water level data, and water quality data for groundwater treatment units. The spatial database includes a personal computer Geographic Information System reference map of PORTS and engineering drawings of plant facilities and waste disposal areas. DOE PORTS maintains a repository for validated groundwater analytical data and much of the geologic, hydrogeologic, and geotechnical data.

10.7.1 Field Data

Data generated during the groundwater monitoring program is collected by field personnel and recorded on applicable sampling logs. Field data is reviewed by the sampling team supervisor or designee for completeness; the field data is maintained in a database file. At a minimum, field parameters include pH, temperature, specific conductance, groundwater elevations, and well depth (when appropriate). Data entered into the field database are the stabilized pH, temperature, and specific conductance. Data generated during the groundwater monitoring program are collected by field personnel and recorded on applicable sampling logs. In addition, the field database tracks QC samples (identified in Section 10.6.1) associated with each sample.

10.7.2 Analytical Data

Analytical data are obtained from the analytical laboratory in written as well as digital format. It should be noted, however, that all raw data and data not included on the laboratory report must be maintained by that laboratory as a record for 3 years and should be available for audit review upon 30-day notice.

10.7.3 Evaluation of Field and Analytical Data

The laboratory review of analytical results include laboratory QA/QC samples (i.e. calibrations, holding times, and spikes) required for analytical procedures. Analytical data not meeting the prescribed quality, as described in the analytical procedure, are qualified by the laboratory and reported. If an inquiry into a laboratory result is necessary, the laboratory is contacted and the quality assurance file is reviewed.

Subsequently, an evaluation of the QA/QC samples associated with each sample from the field is conducted. Field data are examined for acceptance and development of required field documentation, which includes QA/QC sampling requirements, such as duplicates, and trip, field and equipment rinseate blanks. Trip, field and equipment rinseate blanks are reviewed to determine if any cross contamination may have occurred during the collection, transport or storage of the samples. In the event that an organic or a metal constituent is detected in a QA/QC blank, the constituent may be qualified.

Analytical laboratory data is independently validated to provide a systematic process for reviewing data against established QA/QC criteria. The data validation and verification process is described in procedures maintained at PORTS. At a minimum, the following items are evaluated for data validation (as applicable):

- Gas chromatograph/mass spectrometer tuning documentation: results, data and time
- Initial calibration: results, date and (for organics) time
- Continuing calibration: results, date, and (for organics) time
- Internal standard peak areas and retention time summaries
- Blank: results of all associated blanks, date of run
- Surrogates: recovery results
- Alpha chemical tracer (yields): results
- Spikes: results and dates
- Spike duplicates: results and dates
- Laboratory duplicates (replicates): results and dates
- Pesticides and PCB calibrations

The validation contractor will provide appropriate data, including data qualifiers. Independent data validation will help reveal whether the analytical laboratory is providing quality data and may identify systemic inaccuracies for correction.

10.7.4 Database Management

All analytical data will be entered into a computerized data base and categorized as quantitative, qualitative, or unusable. Invalid or unusable data will not be included as part of the interpretation process.

11. MONITORING WELL INSPECTIONS

Groundwater monitoring well inspection and maintenance is conducted on a routine basis in order to extend the life of the existing wells, maintain compliance with appropriate regulations and guidance, and to ensure that representative water levels and water quality samples can be obtained. Wells which are routinely sampled as part of the IGWMP are inspected on a quarterly basis in accordance with the applicable procedure. A checklist is used to note observations made during the inspection, and includes the following items:

- *Locked* - The lock appears to be in and should remain in good working order until the next inspection.
- *Locking Cap Hinge/Hasp OK* - The hinge and hasp appears to be in and should remain in good working order until the next inspection.
- *Grout to Land Surface* - Cement/grout level inside the outer casing is slightly above ground level in the void between the well casing and the protective outer casing for wells without gravel above the cement/grout layer.
- *Well Cap OK* - The monitoring well cap appears to be in and should remain in good working order until the next inspection.
- *Outer Casing OK* - The casing is not cracked, dented, bent, crimped or severely rusted and appears firmly imbedded in the cement pad. The well label is legible and not peeling.
- *Gravel Present* - The void between the well casing and the outer casing is filled with gravel to a level above weep hole. The gravel is only required if the outer protective casing diameter is greater than 2 times the diameter of the well casing.
- *Cement Pad* - Approximately 3 ft by 3 ft pad, not cracked or chipped, tapered away from the outer casing and at least slightly above ground level. There should be no evidence of frost heaving.
- *Weep Hole Present* - A weep hole has been bored in the outer casing to allow for drainage. If a well lacks an inner casing, no weep hole should be present and this column marked "n/a."

If any problems are noted during the inspections, a schedule to repair or rehabilitate wells is developed and updated throughout the year. Additionally, any problems reported by personnel other than the designated inspector are added to the repair/rehabilitation schedule as they are identified.

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12. REFERENCES

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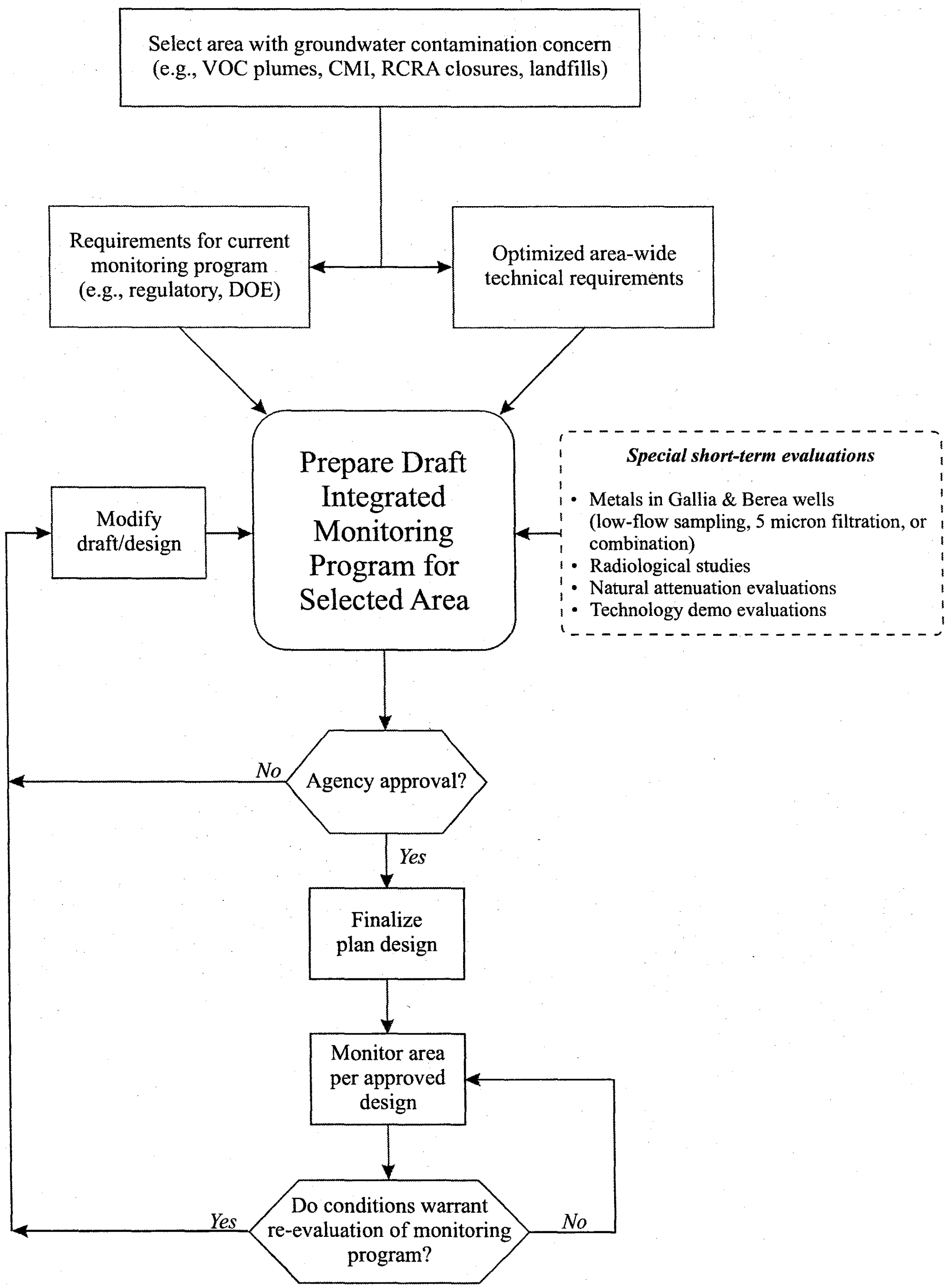

Figure 1. Process flow for the PORTS Integrated Groundwater Monitoring Plan.

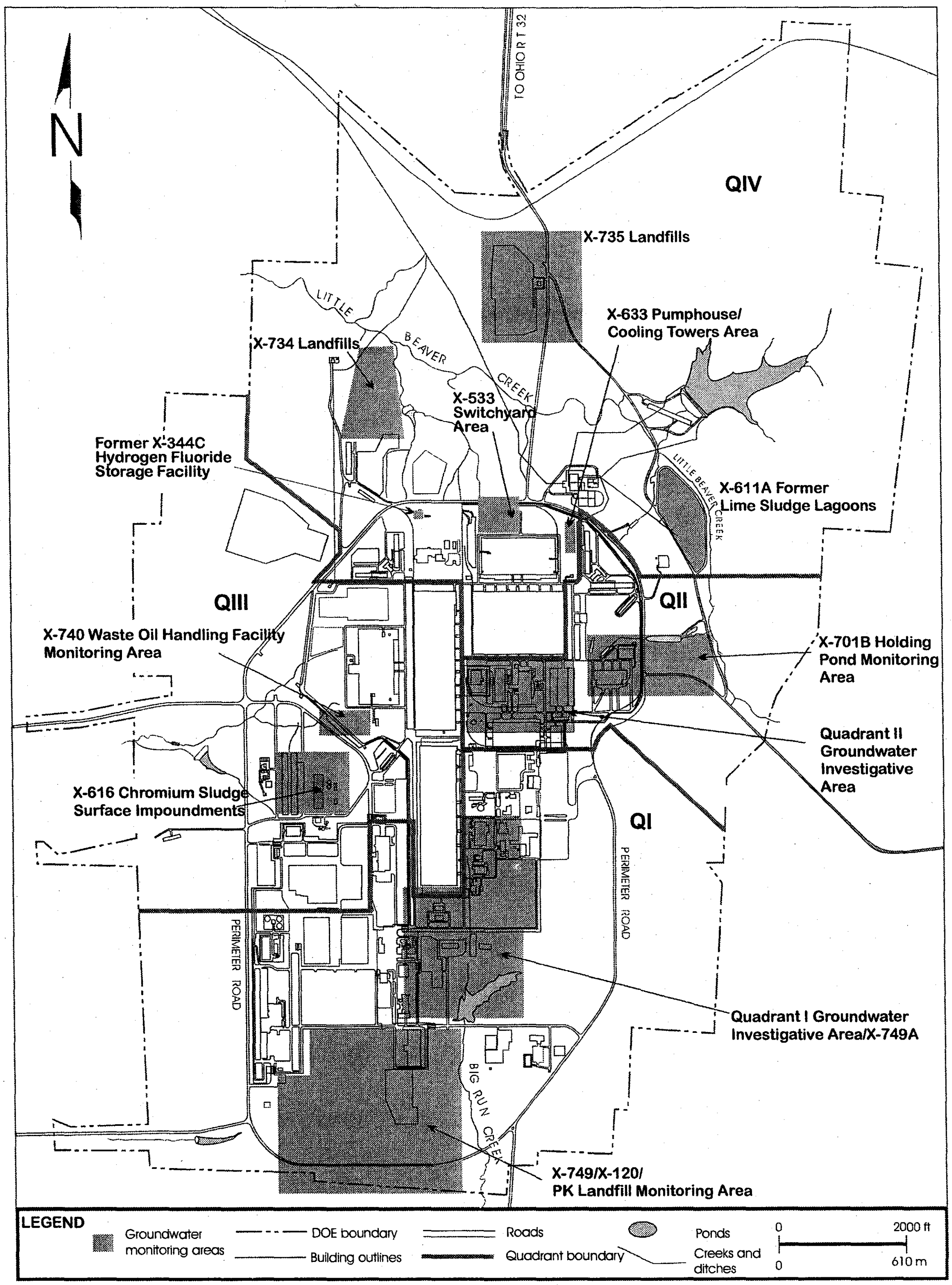

Figure 2. Groundwater areas of concern.

Table 1. Integrated groundwater analytical suites for the Portsmouth Gaseous Diffusion Plant

Parameter suite	Analyte	Method number[a]
LF1	Landfill parameters #1: Chloride Sulfate Alkalinity Total dissolved solids Total metals: Na	 300 300 310.1 or 2320B SM 2540 C 6010 or 6020
LF2	Landfill parameters #2: Volatile organic compounds: V1 parameters and the following: 1,1,1,2-tetrachloroethane, 1,2,3-trichloropropane, 1,2-dibromo-3-chloropropane, 1,2-dibromoethane, 1,2-dichloropropane, 2-hexanone, acrylonitrile, bromochloromethane, *cis*-1,3-dichloropropene, dibromomethane, iodomethane, styrene, *trans*-1,3-dichloropropene, *trans*-1,4-dichloro-2-butene, vinyl acetate Total metals: Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Tl, V, Zn Ammonia Chemical oxygen demand Nitrite/nitrate	 8260 6010 or 6020 350.2 410.1 353.2
LF3	Landfill parameters #3: Total metals: Co, Hg, Ni	6010 or 6020 and 7470 (Hg)
LF5	Landfill parameters #5: Chloride Sulfate Alkalinity Total dissolved solids Total metals: Na Ammonia Chemical oxygen demand Nitrite/nitrate	 300 300 310.1 or 2320B SM 2540 C 6010 or 6020 350.2 410.1 353.2
M2	Total metals #2: Be, Cd, Cr, Mn, Ni	6010 or 6020
M3	Total metals #3: Cr	6010 or 6020
M4	Total metals #4: Be, Cr	6010 or 6020
M5	Total metals #5: Cd, Ni	6010 or 6020

Table 1. Integrated groundwater analytical suites for the Portsmouth Gaseous Diffusion Plant (continued)

Parameter suite	Analyte	Method number[a]
R1	Radionuclides #1: transuranics (Am-241, Np-237, Pu-238, Pu-239/240), technetium-99, total uranium, isotopic uranium (U-233/234, U-235, U-236, U-238)	
R2	Radionuclides #2: technetium-99, total uranium, isotopic uranium (U-233/234, U-235, U-236, U-238)	
V1	Volatile organic compounds #1: 1,1,1-trichloroethane, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichlorobenzene, 1,2-dichloroethane, 1,4-dichlorobenzene, 2-butanone, 4-methyl-2-pentanone, acetone, benzene, bromodichloromethane, bromoform, bromomethane, carbon disulfide, carbon tetrachloride, chlorobenzene, chloroethane, chloroform, chloromethane, *cis*-1,2-dichloroethene, dibromochloromethane, ethylbenzene, methylene chloride, tetrachloroethene, toluene, *trans*-1,2-dichloroethene, trichloroethene, trichlorofluoromethane, vinyl chloride, xylenes (1,2-dimethylbenzene and M+P xylene)	8260
WQ1	Water quality parameters #1: Alkalinity Chloride Sulfate Total dissolved solids	 310.1 or 2320B 300 300 SM 2540 C
IX	Appendix to OAC rule 3745-54-98 (Appendix IX)	Various

Field measurements taken at each well: water level, temperature, pH, dissolved oxygen, specific conductance, and turbidity.

[a]Samples are analyzed for the listed analyte(s) in accordance with the referenced method number or equivalent. Standard approved methods do not exist for radiological parameters; therefore, method numbers are not listed for these analytes.

APPENDIX A

QUADRANT I SUMMARY TABLES AND FIGURES

TABLES

FIGURES

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Table A-1. Integrated monitoring at the X-749/X-120/PK Landfill

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters[a]
PK-PL6	Monitors sump of groundwater collection trench for northern portion of the PK Landfill	Quarterly	V1-Q
PK-PL6A	Monitors sump of groundwater collection trench for southern portion of the PK Landfill and east lobe of X-749 plume	Quarterly	V1-Q
WP-03G	Monitors off site south of the X-749 plume	Quarterly	V1-Q, R2-B
WP-07G	Monitors off site south of the X-749 plume	Quarterly	V1-Q, R2-B
X749-44G	Monitors western edge of X-749 South Barrier Wall	Quarterly	V1-Q, R2-B
X749-45G	Monitors center of X-749 South Barrier Wall	Quarterly	V1-Q, R2-B
X749-67G	Monitors southern portion of X-749 plume	Quarterly	V1-Q, M2-B, R2-B
X749-97G	Monitors DOE property boundary downgradient of X-749 South Barrier Wall	Quarterly	V1-Q, R2-B
X749-102G	Monitors DOE property boundary west of X-749 South Barrier Wall	Quarterly	V1-Q
X749-103G	Monitors southwestern portion of monitoring area	Quarterly	V1-Q
X749-PZ04G	Monitors area upgradient of X-749 South Barrier Wall	Quarterly	V1-Q, M2-B, R2-B
X749-PZ05G	Monitors area upgradient of X-749 South Barrier Wall	Quarterly	V1-Q
PK-10G	Monitors northern upgradient boundary of X-120 plume and west perimeter of PK Landfill	Semiannual	V1-S
PK-11G	Monitors upgradient of boundary of PK Landfill	Semiannual	V1-S, M2-B
PK-14G	Monitors downgradient of the PK collection system	Semiannual	V1-S, M2-B
PK-15B	Monitors downgradient of the PK collection system	Semiannual	V1-S
PK-16G	Monitors downgradient of the PK collection system	Semiannual	V1-S
PK-17B	Monitors downgradient of the X-749 IRM collection system	Semiannual	V1-S, M2-B
PK-18B	Monitors downgradient of the PK collection system	Semiannual	V1-S
PK-19B	Monitors downgradient of the X-749 IRM collection system	Semiannual	V1-S, M2-B
PK-21B	Monitors downgradient of the X-749 IRM collection system	Semiannual	V1-S

Table A-1. Integrated monitoring at the X-749/X-120/PK Landfill (continued)

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters[a]
STSW-101G	Monitors southern portion of X-749 plume	Semiannual	V1-S, R2-B
STSW-102G	Monitors southern portion of X-749 plume	Semiannual	V1-S, R2-B
WP-01G	Monitors off site south of the X-749 plume	Semiannual	V1-S, R2-B
WP-02G	Monitors off site south of the X-749 plume	Semiannual	V1-S, R2-B
WP-04G	Monitors off site south of the X-749 plume	Semiannual	V1-S, R2-B
WP-05G	Monitors off site south of the X-749 plume	Semiannual	V1-S, R2-B
WP-06G	Monitors off site south of the X-749 plume	Semiannual	V1-S, R2-B
X120-11G	Monitors northwestern portion of X-749/X-120 plume and extraction well X749-EW09G	Semiannual	V1-S, M2-B
X749-06G	Monitors western perimeter of X-749 Landfill; within middle of plume; provides monitoring of trench/cap	Semiannual	V1-S, R2-B
X749-07G	Monitors western perimeter of X-749 Landfill, middle of plume, and X-749 trench/cap	Semiannual	V1-S, R1-B, IX-B
X749-08G	Monitors southern perimeter of X-749 Landfill and X-749 trench/cap	Semiannual	V1-S, R1-B, IX-B
X749-09GA	Monitors eastern perimeter of X-749 Landfill and X-749 cap	Semiannual	V1-S, M2-B
X749-10GA	Monitors eastern perimeter of X-749 Landfill and X-749 cap	Semiannual	V1-S, R1-B, IX-B
X749-13G	Monitors southeastern portion of X-749 plume and extraction well X749-EW07G	Semiannual	V1-S, R2-B
X749-21G	Monitors northeastern portion of plume	Semiannual	V1-S
X749-22G	Monitors eastern portion of monitoring area	Semiannual	V1-S
X749-23G	Monitors eastern portion of X-749 plume	Semiannual	V1-S
X749-24G	Monitors eastern portion of monitoring area	Semiannual	V1-S

Table A-1. Integrated monitoring at the X-749/X-120/PK Landfill (continued)

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters[a]
X749-26G	Monitors middle of X-749 plume	Semiannual	V1-S, R2-B
X749-27G	Monitors X-749 plume west of X-749 Landfill	Semiannual	V1-S, R2-B
X749-33G	Monitors middle of X-749 plume	Semiannual	V1-S, R2-B
X749-37G	Monitors middle of X-749 plume	Semiannual	V1-S, R2-B
X749-38G	Monitors southern portion of X-749 plume	Semiannual	V1-S
X749-41G	Monitors northern portion of X-749/X-120 plume and extraction well X749-EW09G	Semiannual	V1-S
X749-42G	Monitors western portion of X-749/X-120 plume	Semiannual	V1-S
X749-54B	Monitors Berea south of PK Landfill	Semiannual	V1-S, R2-B
X749-96G	Monitors DOE property boundary downgradient of X-749 South Barrier Wall	Semiannual	V1-S
X749-98G	Monitors DOE property boundary downgradient of X-749 South Barrier Wall	Semiannual	V1-S
X749-104G	Monitors southeastern portion of monitoring area	Semiannual	V1-S
X749-105G	Monitors DOE property boundary at western edge of X-749 South Barrier Wall	Semiannual	V1-S
X749-106G	Monitors phytoremediation system and western portion of X-749/X-120 plume	Semiannual	V1-S, R2-B
X749-107G	Monitors phytoremediation system and western portion of X-749/X-120 plume	Semiannual	V1-S
X749-108G	Monitors phytoremediation system and western portion of X-749/X-120 plume	Semiannual	V1-S, R2-B
X749-109G	Monitors phytoremediation system and area north of Perimeter Road	Semiannual	V1-S, R2-B
X749-110G	Monitors phytoremediation system and plume north of Perimeter Road	Semiannual	V1-S, R2-B
X749-113G	Monitors phytoremediation system and middle of X-749 plume	Semiannual	V1-S, R2-B
X749-BG9G	Monitors southeastern corner of X-749 Landfill	Semiannual	V1-S

Table A-1. Integrated monitoring at the X-749/X-120/PK Landfill (continued)

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters[a]
X749-PZ02G	Monitors eastern portion of monitoring area	Semiannual	V1-S, R2-B
X749-PZ03G	Monitors area upgradient of X-749 South Barrier Wall	Semiannual	V1-S
X749-PZ06G	Monitors southwestern portion of X-749 plume	Semiannual	V1-S
X749-PZ10G	Monitors east of X-749 Landfill	Semiannual	V1-S, R2-B
X749-WPW	Monitors X-749 groundwater interceptor trench	Semiannual	V1-S, R1-B
PK-09G	Monitors northern portion of X-749/X-120 plume	Annual	V1-A
X120-05G	Monitors northern portion of X-749/X-120 plume	Annual	V1-A
X120-08G	Monitors western portion of X-749 plume	Annual	V1-A, R2-B
X120-10G	Monitors western portion of X-749/X-120 plume	Annual	V1-A
X749-04G	Monitors northern perimeter of X-749 Landfill	Annual	V1-A
X749-05G	Monitors western side of X-749 Landfill	Annual	V1-A
X749-20G	Monitors eastern portion of X-749 plume and western PK Landfill perimeter	Annual	V1-A, R2-B
X749-28G	Monitors middle of X-749 plume	Annual	V1-A, R2-B
X749-29G	Monitors middle of X-749 plume	Annual	V1-A
X749-30G	Monitors middle of X-749 plume	Annual	V1-A
X749-35G	Monitors eastern portion of X-749 plume and southern PK Landfill perimeter	Annual	V1-A
X749-36G	Monitors X-749 plume west of X-749 Landfill	Annual	V1-A
X749-40G	Monitors northern portion of X-749 plume	Annual	V1-A
X749-43G	Monitors western portion of X-749/X-120 plume	Annual	V1-A
X749-50B	Monitors Berea below center of plume	Annual	V1-A
X749-51B	Monitors Berea east of X-749 Landfill	Annual	V1-A

Table A-1. Integrated monitoring at the X-749/X-120/PK Landfill (continued)

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters[a]
X749-64B	Monitors Berea beneath the southern X-749 Gallia plume	Annual	V1-A, R2-B
X749-66G	Monitors western portion of monitoring area at Perimeter Road	Annual	V1-A
X749-68G	Monitors southeastern portion of plume	Annual	V1-A, R2-B
X749-99M	Monitors Minford at DOE property boundary	Annual	V1-A
X749-100M	Monitors Minford at DOE property boundary	Annual	V1-A
X749-101M	Monitors Minford at DOE property boundary	Annual	V1-A
X749-114G	Monitors northwest portion of monitoring area	Annual	V1-A
X749-115G	Monitors the area north of the X-749 Landfill	Annual	V1-A
X749-120G	Monitors within the landfill at the west boundary wall paired with well X749-06G	Annual	V1-A, R2-B
X749-121G	Monitors within the X-749 Landfill (middle portion)	Annual	V1-A, R2-B
X749-122G	Monitors within the X-749 Landfill (southern portion)	Annual	V1-A
X749-PZ07G	Monitors western portion of X-749/X-120 plume	Annual	V1-A
F-27G	Monitors Gallia downgradient of the X-120 plume	Biennial / odd	V1-B
MH GW-4	Monitors PK groundwater collection system	Biennial / odd	V1-B
MH GW-5	Monitors PK groundwater collection system	Biennial / odd	V1-B
PK-07G	Monitors area east of X-749 Landfill and west of PK Landfill	Biennial / odd	V1-B
PK-08G	Monitors northern margin of X-749 plume north of X-749 Landfill	Biennial / odd	V1-B
X120-03G	Monitors northern upgradient margin of X-749 plume perimeter	Biennial / odd	V1-B
X120-06B	Monitors Berea beneath X-120 plume	Biennial / odd	V1-B
X120-09G	Monitors western portion of X-749/X-120 plume	Biennial / odd	V1-B

Table A-1. Integrated monitoring at the X-749/X-120/PK Landfill (continued)

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters[a]
X749-14B	Monitors Berea near Big Run Creek	Biennial / odd	V1-B, R2-B
X749-60B	Monitors Berea in the southern X-749 Gallia plume	Biennial / odd	V1-B
X749-111G	Monitors eastern portion of monitoring area	Biennial / odd	V1-B
X749-112G	Monitors eastern portion of monitoring area	Biennial / odd	V1-B
X749-PZ01G	Monitors eastern portion of monitoring area	Biennial / odd	V1-B
X749-PZ08G	Monitors northern portion of monitoring area; generally upgradient	Biennial / odd	V1-B
X749-PZ09G	Monitors within the landfill (northeast side) paired with well X749-PZ10G	Biennial / odd	V1-B, R2-B
X749-PZ11G	Monitors within the landfill (east side) paired with well X749-10GA	Biennial / odd	V1-B, R2-B
X749-PZ12G	Monitors within the landfill (southeast side) paired with well X749-09GA	Biennial / odd	V1-B, R2-B
X749-PZ13G	Monitors within the landfill (south side)	Biennial / odd	V1-B, R2-B

[a]Table 1 defines the parameter suites (M2, R1, R2, V1, and IX). Parameter suites are followed by a letter that indicates the monitoring frequency. Q = quarterly; S = semiannual; A = annual; B = biennial.

Table A-2. Integrated monitoring at the Quadrant I Groundwater Investigative Area/ X-749A Classified Materials Disposal Facility

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters[a]
X-749A Classified Materials Disposal Facility wells			
X749A-02G	Monitors southeast corner of the X-749A	Semiannual	LF1-S, LF2-A, R2-B
X749A-03G	Monitors south (downgradient) of the X-749A	Semiannual	LF1-S, LF2-A, R2-B
X749A-04G	Monitors east of the X-749A	Semiannual	LF1-S, LF2-A, R2-B
X749A-07G	Monitors north (upgradient) of the X-749A	Semiannual	LF1-S, LF2-A, R2-B
X749A-12G	Monitors west of the X-749A	Semiannual	LF1-S, LF2-A, R2-B
X749A-14G	Monitors east of the X-749A	Semiannual	LF1-S, LF2-A, R2-B
X749A-16G	Monitors east of the X-749A	Semiannual	LF1-S, LF2-A, R2-B
X749A-17G	Monitors west of the X-749A	Semiannual	LF1-S, LF2-A, R2-B
X749A-18G	Monitors west of the X-749A	Semiannual	LF1-S, LF2-A, R2-B
X749A-19G	Monitors west of the X-749A	Semiannual	LF1-S, LF2-A, R2-B
Quadrant I Groundwater Investigative Area plume wells			
X231B-02G	Monitors within the Quad I GW Investigative Area plume at the eastern margin of X-231B	Semiannual	V1-S, M2-B, R2-B
X231B-03G	Monitors within the Quad I GW Investigative Area plume at the eastern margin of X-231B	Semiannual	V1-S, R1-B, IX-B
X231B-06G	Monitors within the Quad I GW Investigative Area plume at the western margin of X-231B	Semiannual	V1-S, R1-B, IX-B
X326-09G	Monitors the western portion of the Quad I GW Investigative Area plume	Semiannual	V1-S, M2-B, R2-B
X626-07G	Monitors the northern portion of the Quad I GW Investigative Area plume	Semiannual	V1-S, M2-B, R2-B
X770-17GA	Monitors the northern portion of the Quad I GW Investigative Area plume near the former X-770 building	Semiannual	V1-S

Table A-2. Integrated monitoring at the Quadrant I Groundwater Investigative Area/ X-749A Classified Materials Disposal Facility (continued)

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters[a]
X230K-14G	Monitors the southern portion of the Quad I GW Investigative Area plume	Annual	V1-A
X230K-15G	Monitors the southern portion of the Quad I GW Investigative Area plume	Annual	V1-A
X231A-01G	Monitors the eastern portion of the Quad I GW Investigative Area plume	Annual	V1-A, M2-A, R2-B
X231A-02G	Monitors within the Quad I GW Investigative Area plume at the western margin of X-231A	Annual	V1-A, M2-B, R2-B
X231A-04G	Monitors within the Quad I GW Investigative Area plume at the northern margin of X-231A	Annual	V1-A, M2-B, R2-B
X231B-12G	Monitors the southwestern edge of the Quad I GW Investigative Area plume	Annual	V1-A
X231B-14G	Monitors within the Quad I GW Investigative Area plume southeast of X-231B	Annual	V1-A
X231B-15G	Monitors within the Quad I GW Investigative Area plume near extraction well X231B-B10G	Annual	V1-A
X231B-16G	Monitors the southwestern margin of Quad I GW Investigative Area plume	Annual	V1-A
X231B-20G	Monitors the western portion of the Quad I GW Investigative Area plume	Annual	V1-A
X231B-23G	Monitors within the Quad I GW Investigative Area plume near extraction wells X231B-B11G and X231B-B12G	Annual	V1-A
X231B-32B	Monitors the Berea beneath the southern portion of the Quad I GW Investigative Area plume	Annual	V1-A
X231B-36G	Monitors the northern portion of the Quad I GW Investigative Area plume	Annual	V1-A
X231B-37G	Monitors the southern portion of the Quad I GW Investigative Area plume	Annual	V1-A
X326-10G	Monitors the western portion of the Quad I GW Investigative Area plume	Annual	V1-A
X749A-09G	Monitors the Quad I GW Investigative Area plume near extraction well X622-EW08G	Annual	V1-A
X760-03G	Monitors the northern portion of the Quad I GW Investigative Area plume between the X-760 and X-770 buildings	Annual	V1-A
X760-07G	Monitors the northern portion of the Quad I GW Investigative Area plume	Annual	V1-A

Table A-2. Integrated monitoring at the Quadrant I Groundwater Investigative Area/ X-749A Classified Materials Disposal Facility (continued)

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters[a]
X231B-07G	Monitors the middle of the Quad I GW Investigative Area plume east of the X-326 building	Biennial / odd	V1-B
X231B-11G	Monitors the western portion of the Quad I GW Investigative Area plume	Biennial / odd	V1-B
X231B-24B	Monitors the Berea beneath the Quad I GW Investigative Area plume near extraction well X231B-B10G	Biennial / odd	V1-B
X231B-29G	Monitors the northern portion of the Quad I GW Investigative Area plume	Biennial / odd	V1-B
X231B-38G	Monitors the western margin of the Quad I GW Investigative Area plume	Biennial / odd	V1-B
X710-01G	Monitors the northern margin of the Quad I GW Investigative Area plume	Biennial / odd	V1-B
X760-02G	Monitors the northeastern margin of the Quad I GW Investigative Area plume	Biennial / odd	V1-B

[a]Table 1 defines the parameter suites (LF1, LF2, M2, R1, R2, V1, and IX). Parameter suites are followed by a letter or number that indicates the monitoring frequency. S = semiannual; A = annual; B = biennial.

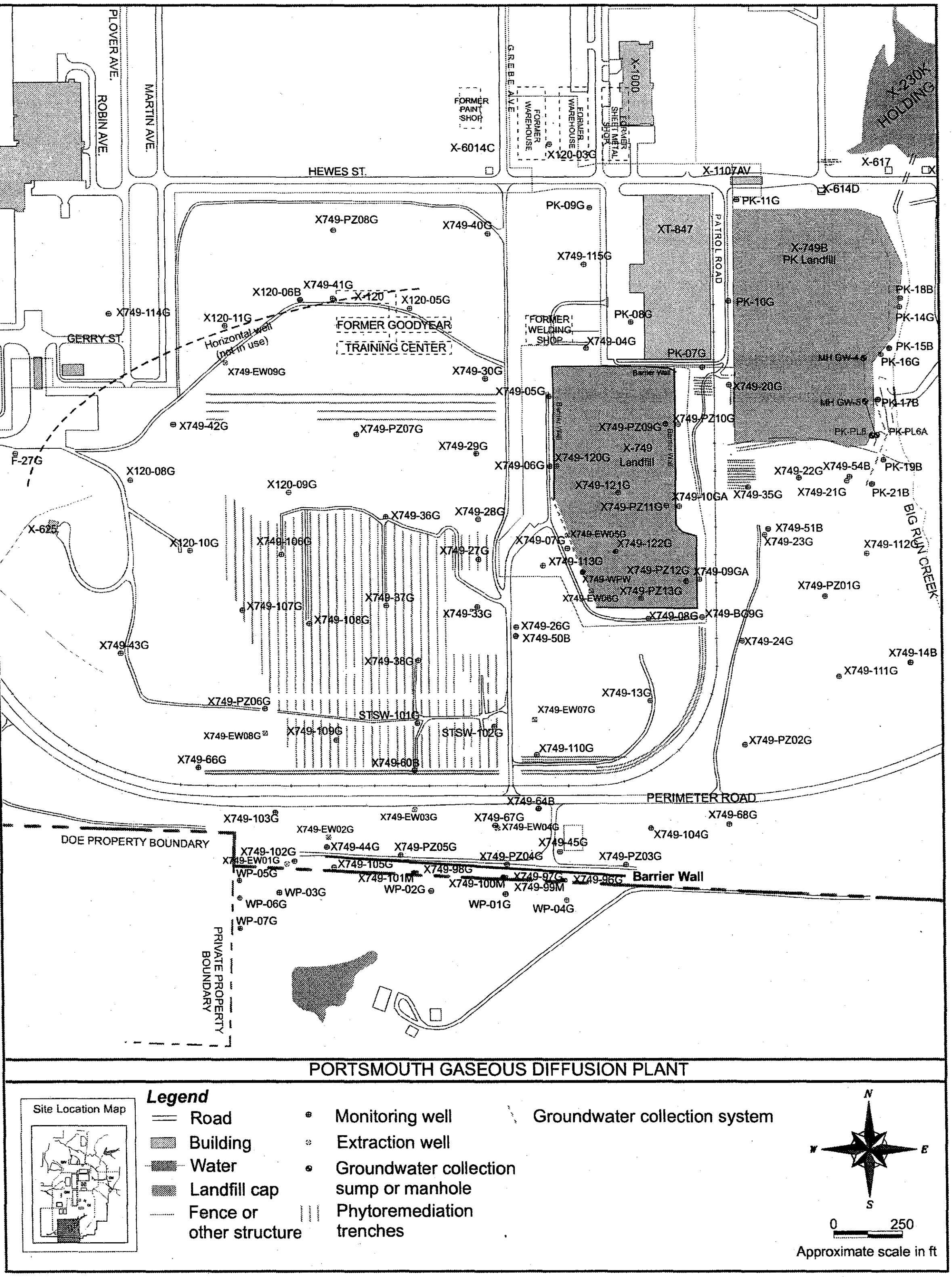

Figure A-1. Integrated monitoring wells X-749/X-120/PK Landfill.

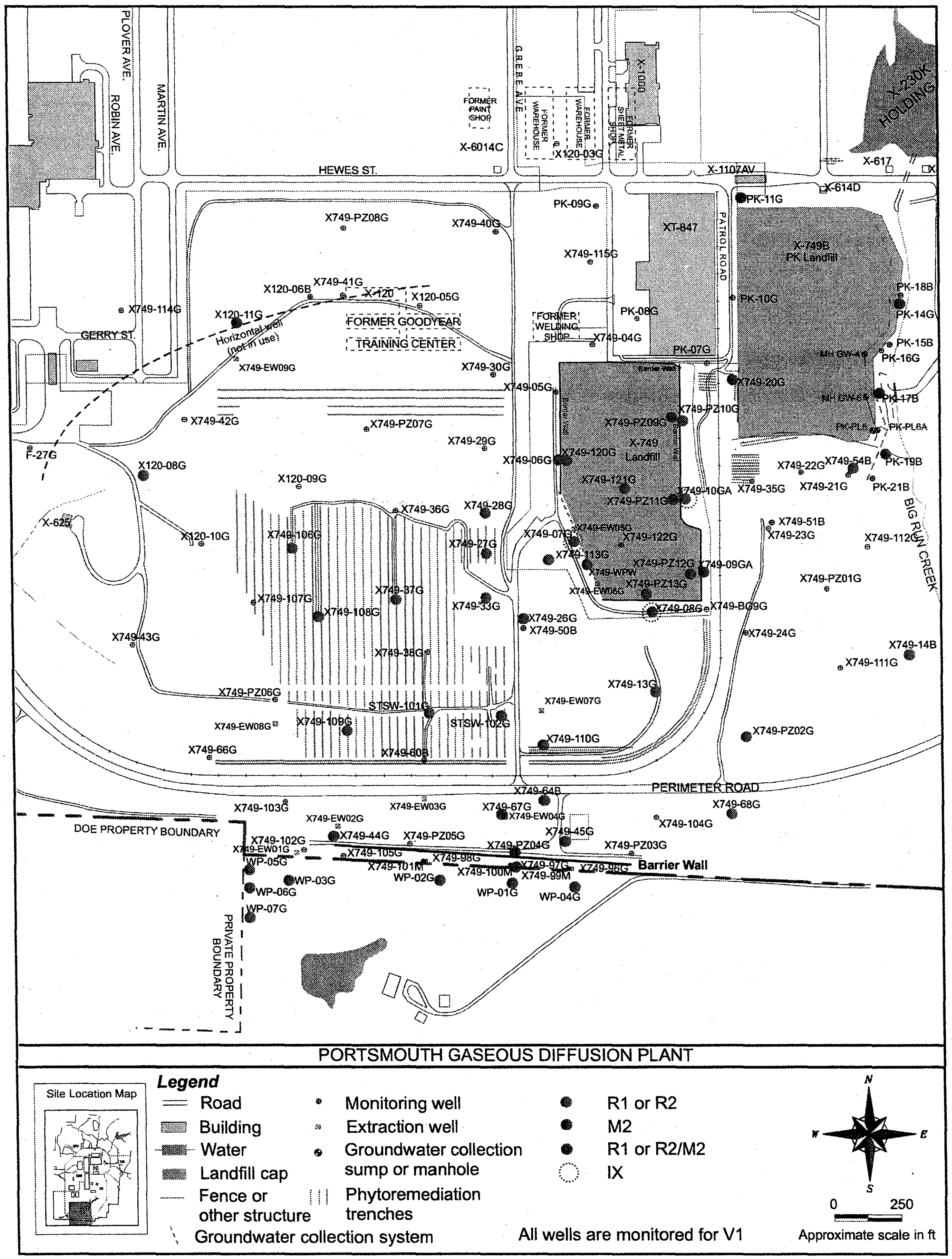

Figure A-2. Integrated monitoring parameter suites X-749/X-120/PK Landfill.

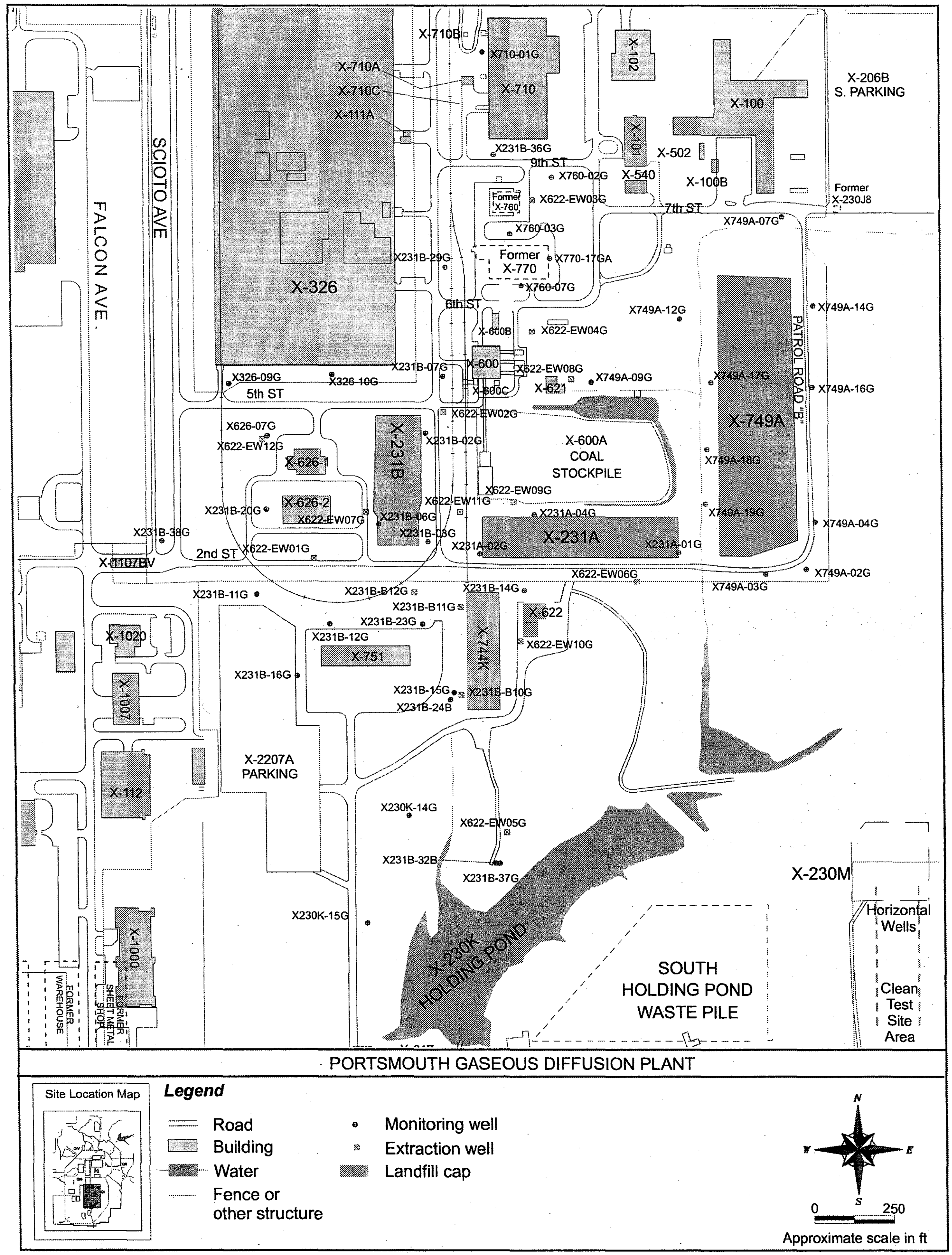

Figure A-3. Integrated monitoring wells Quadrant I Groundwater Investigative Area/ X-749A Classified Materials Disposal Facility.

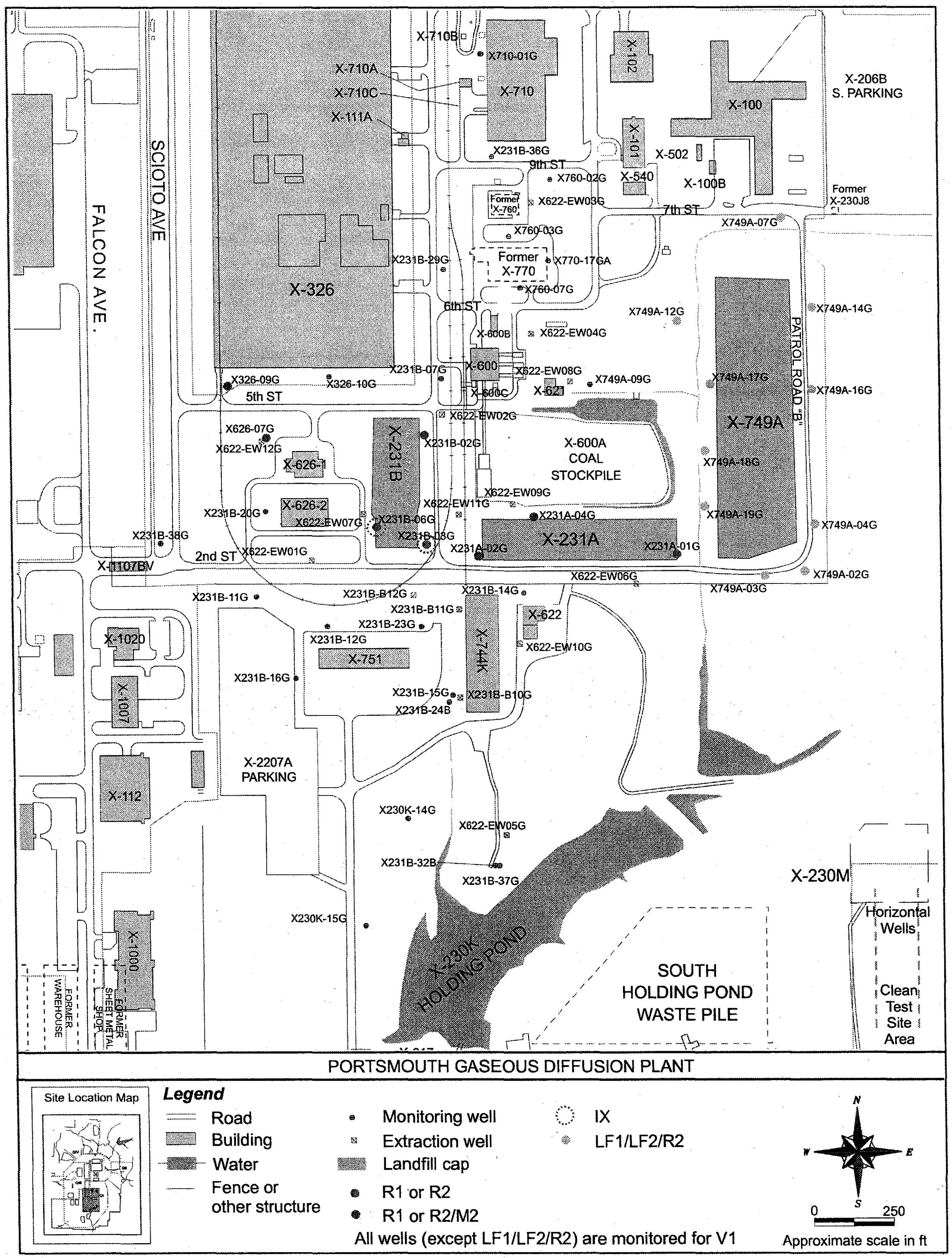

Figure A-4. Integrated monitoring parameter suites Quadrant I Groundwater Investigative Area/ X-749A Classified Materials Disposal Facility.

APPENDIX B

QUADRANT II SUMMARY TABLES AND FIGURES

TABLES

FIGURES

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Table B-1. Integrated monitoring at the Quadrant II Groundwater Investigative Area

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters[a]
X700-02G	Monitors the interior of the QII VOC plume	Annual	V1-A, R2-B, M2-B
X700-03G	Monitors potential groundwater movement towards the X-701B area	Annual	V1-A
X701-26G	Monitors the eastern margin of the QII VOC plume and potential groundwater movement towards the X-701B area	Annual	V1-A, R2-B
X701-27G	Monitors potential groundwater movement towards the X-701B area	Annual	V1-A
X701-69G	Monitors east of the former X-701C Neutralization Pit and potential groundwater movement towards the X-701B area	Annual	V1-A, R2-B
X705-02G	Monitors the western interior of the QII VOC plume	Annual	V1-A, R2-B, M2-B
X705-03G	Monitors the western margin of the QII VOC plume[b]	Annual	V1-A
X705-04G	Monitors the northwestern corner of QII VOC plume	Annual	V1-A
X720-01G	Monitors the southeastern interior of the QII VOC plume and the former X-720 Neutralization Pit	Annual	V1-A, R2-B, IX-B
X720-08G	Monitors the southeastern plume perimeter	Annual	V1-A, R2-B
X701-28GA	Monitors upgradient[b] north of the QII VOC plume	Biennial / odd	V1-B
X701-45G	Monitors the southern margin of QII VOC plume	Biennial / odd	V1-B
X701-68G	Monitors within the QII VOC plume northwest of the former X-701C Neutralization Pit	Biennial / odd	V1-B, R2-B
X701-70G	Monitors within the QII VOC plume southwest of the former X-701C Neutralization Pit	Biennial / odd	V1-B, R2-B
X701-117GA	Monitors within the QII VOC plume west of the former X-701C Neutralization Pit	Biennial / odd	V1-B, M2-B
X705-01GA	Monitors the western interior of the QII VOC plume	Biennial / odd	V1-B, R1-B, M2-B
X705-06G	Monitors the northern margin of the QII VOC plume	Biennial / odd	V1-B
X705-07G	Monitors the northern interior of the QII VOC plume	Biennial / odd	V1-B, R2-B, M2-B
X705-08G	Monitors upgradient[b] south of QII VOC plume	Biennial / odd	V1-B
X705-10B	Monitors the Berea beneath the QII VOC plume and the former X-701C Neutralization Pit	Biennial / odd	V1-B

[a]Table 1 defines the parameter suites (M2, R1, R2, V1, and IX). Parameter suites are followed by a letter that indicates the monitoring frequency. A = annual; B = biennial.
[b]The Quadrant II Groundwater Investigative Area Plume is being drawn inward to the X-700 and X-705 building sumps; therefore, wells outside of the plume are considered upgradient.

Table B-2. Integrated monitoring at the X-701B Holding Pond

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters
LBC-PZ03G	Monitors X-701B VOC plume near downgradient (eastern) margin	Semiannual	V1-S, R2-A
LBC-PZ06G	Monitors outside of X-701B VOC plume near Little Beaver Creek	Semiannual	V1-S, R2-A
X230J7-01GA	Monitors south of X-230J7 and along north margin of X-701B VOC plume	Semiannual	V1-S, WQ1-S, R2-A
X230J7-02GA	Monitors south of X-230J7 and along north margin of X-701B VOC plume	Semiannual	V1-S, WQ1-S, R2-A
X230J7-03GA	Monitors south of X-230J7 and along north margin of X-701B VOC plume	Semiannual	V1-S, WQ1-S, R1-A
X701-01G	Monitors TCE plume south of X-744G	Semiannual	V1-S, M2-S, R2-A
X701-15G	Monitors downgradient of the X-237 groundwater collection system	Semiannual	V1-S, R2-A
X701-16G	Monitors downgradient of north end of the X-237 groundwater collection system	Semiannual	V1-S, R2-A
X701-19G	Monitors outside of the southern margin of the X-701B plume	Semiannual	V1-S, R2-A
X701-20G	Monitors interior of X-701B VOC plume along plume axis	Semiannual	V1-S, WQ1-S, M2-S, R1-S
X701-21G	Monitors northern interior of X-701B VOC plume	Semiannual	V1-S, WQ1-S, R2-A
X701-24G	Monitors downgradient of the X-237 groundwater collection system, along original plume axis	Semiannual	V1-S, WQ1-S, R1-A
X701-25G	Monitors outside of the northern margin of X-701B plume	Semiannual	V1-S, R2-A
X701-30G	Monitors isolated TCE hit south of X-744G	Semiannual	V1-S, M2-S, R2-A
X701-127G	Monitors interior of X-701B VOC plume along plume axis and downgradient of oxidant injection area	Semiannual	V1-S, WQ1-S, M2-S, R1-S
X701-128G	Monitors inside plume perimeter	Semiannual	V1-S, WQ1-S, R1-A
X744G-01G	Monitors southwest of X-744G	Semiannual	V1-S, M2-S
X744G-02G	Monitors near southwest corner of X-744G	Semiannual	V1-S, M2-S
X744G-03G	Monitors south of X-744G	Semiannual	V1-S, M2-S

Table B-2. Integrated monitoring at the X-701B Holding Pond (continued)

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters
X230J7-04GA	Monitors north of X-230J7	Annual	V1-A, R2-A
X701-18G	Monitors downgradient/sidegradient of X-701B VOC plume	Annual	V1-A, R2-A
X701-23G	Monitors outside of the southern margin of X-701B plume	Annual	V1-A, R2-A
X701-31G	Monitors south (downgradient) of X-744G	Annual	V1-A, R2-A
X701-48G	Monitors east of Little Beaver Creek	Annual	V1-A, R2-A
X701-58B	Monitors Berea near northern edge of the X-237 groundwater collection system	Annual	V1-A, R2-A
X701-61B	Monitors Berea near the X-237 groundwater collection system	Annual	V1-A, R2-A

[a]Table 1 defines the parameter suites (V1, WQ1, M2, R1, and R2). Parameter suites are followed by a letter that indicates the monitoring frequency. S = semiannual; A = annual.

Table B-3. Integrated monitoring at the X-633 Pumphouse/Cooling Towers Area

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters
X633-07G	Monitors near X-633-2C Cooling Tower basin	Semiannual	M3-S
X633-PZ04G	Monitors west of X-633-2C Cooling Tower basin	Semiannual	M3-S

[a]Table 1 defines the parameter suite (M3). The parameter suite is followed by a letter that indicates the monitoring frequency. S = semiannual.

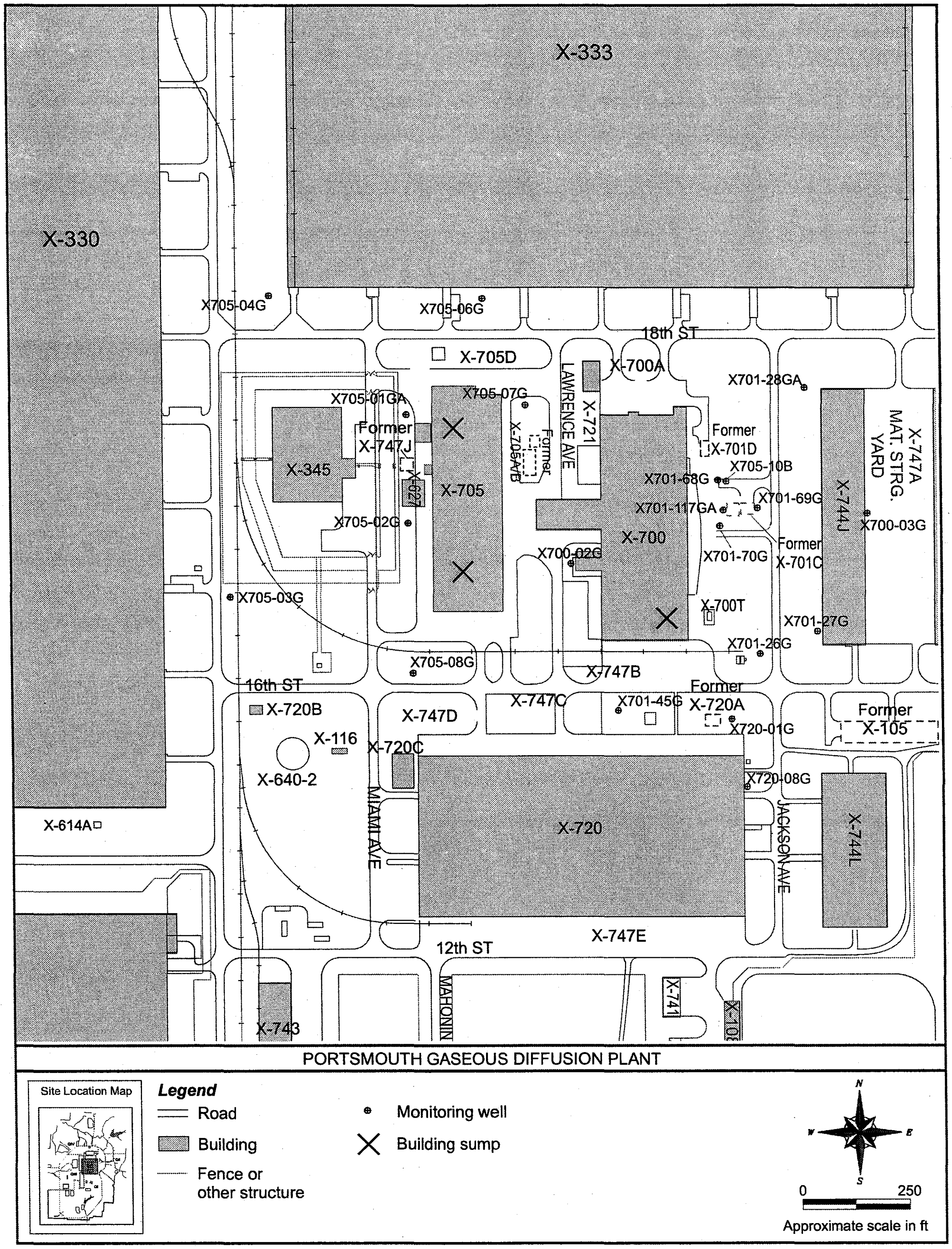

Figure B-1. Integrated monitoring wells Quadrant II Groundwater Investigative Area.

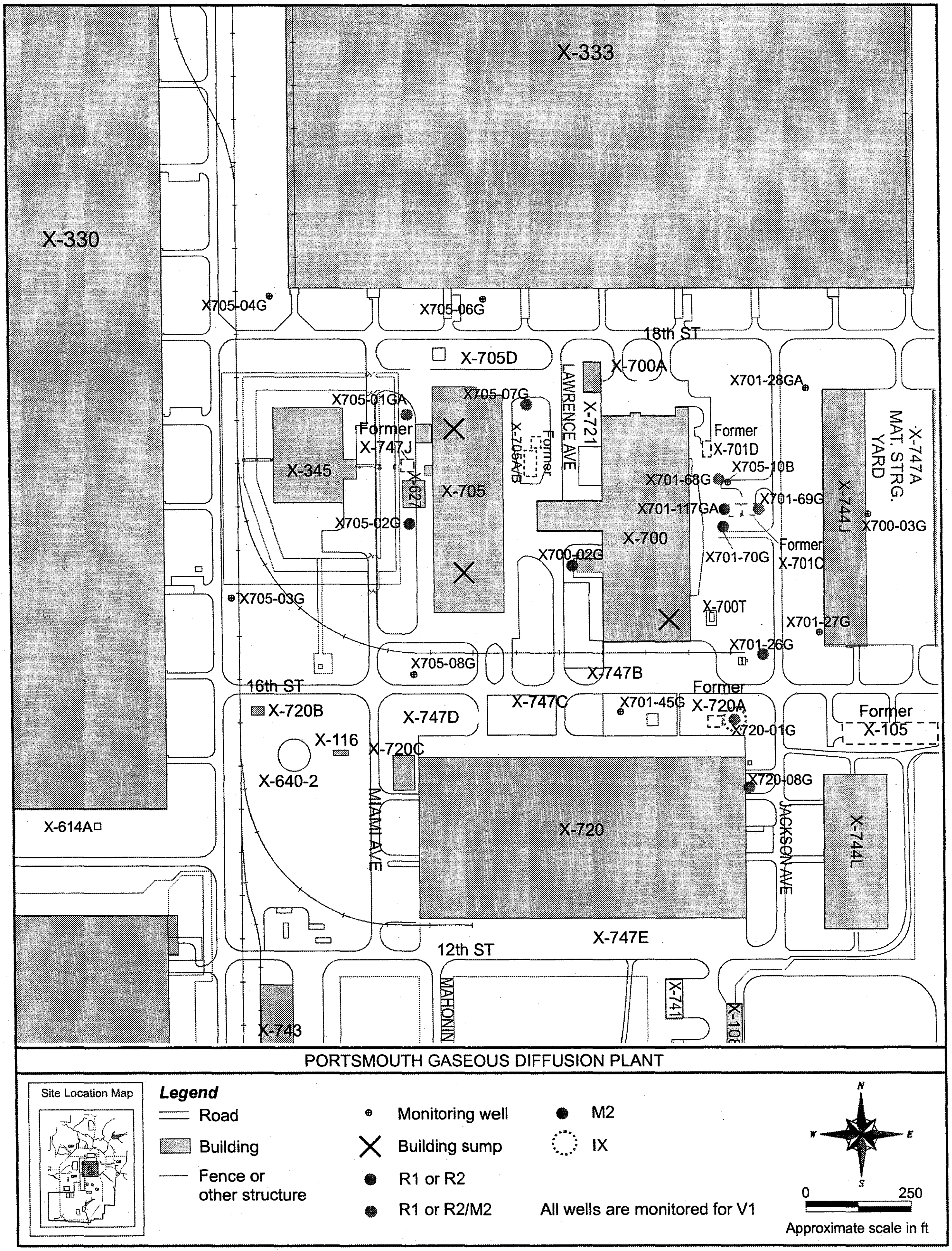

Figure B-2. Integrated monitoring parameter suites Quadrant II Groundwater Investigative Area.

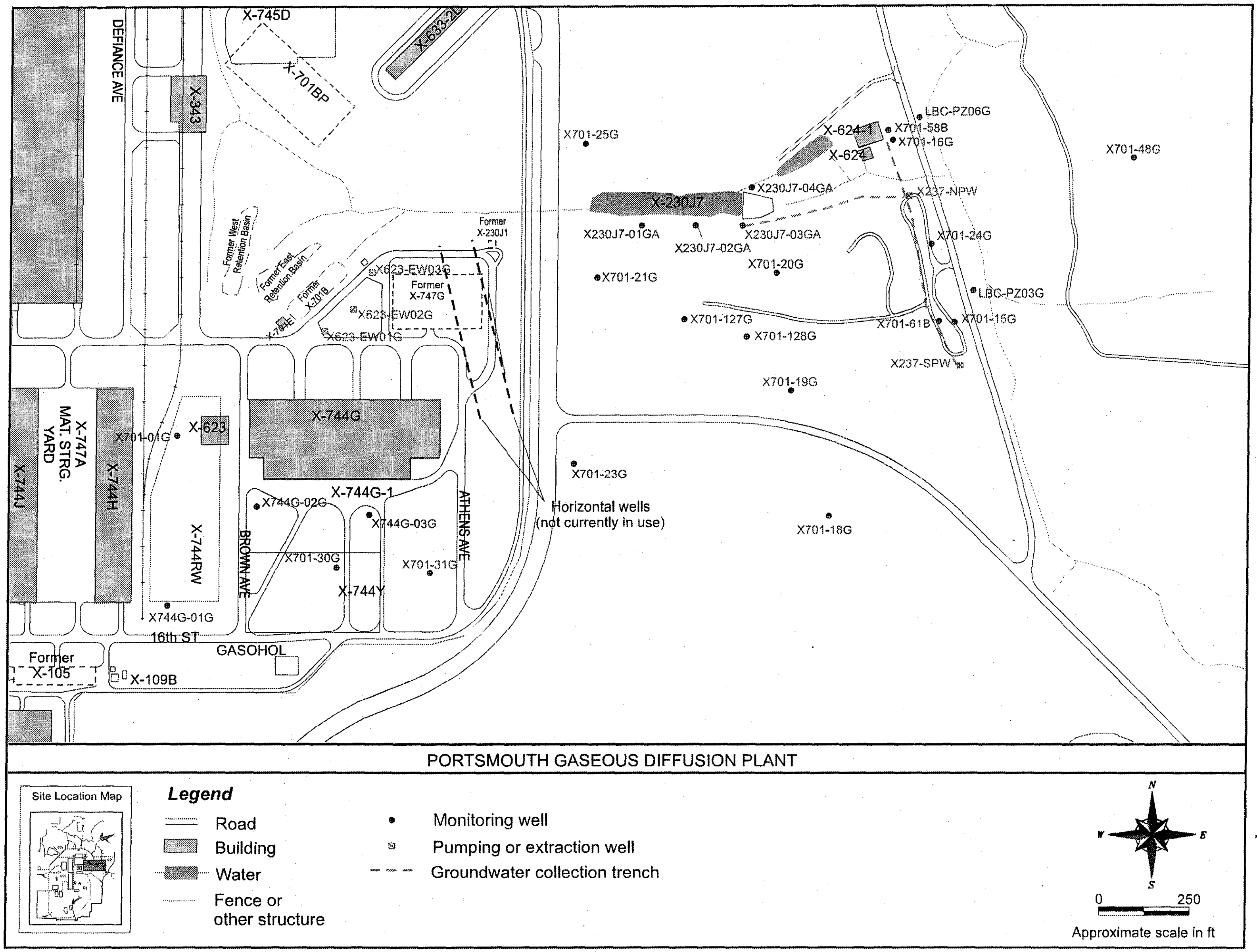

Figure B-3. Integrated monitoring wells X-701B Holding Pond.

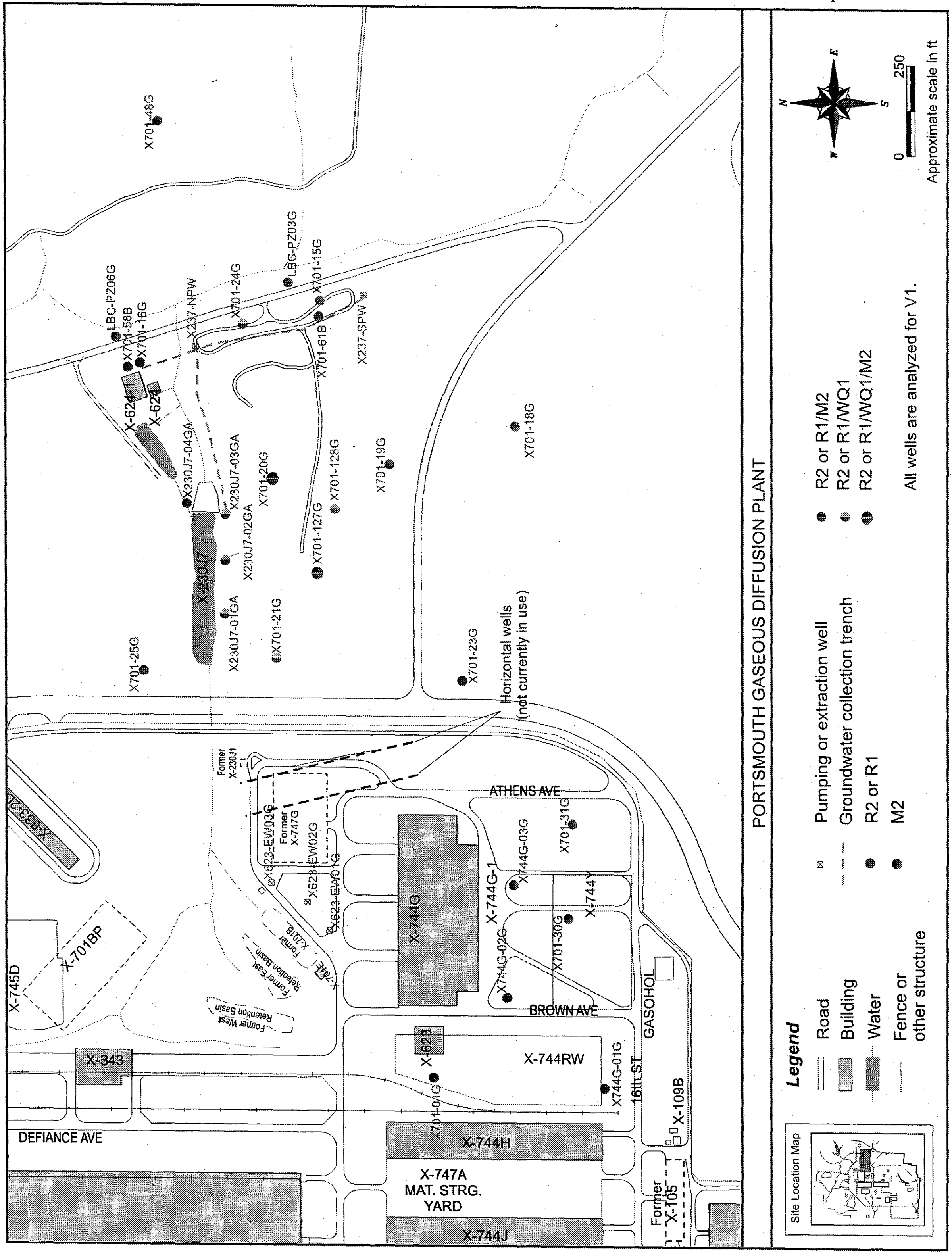

Figure B-4. Integrated monitoring parameter suites X-701B Holding Pond.

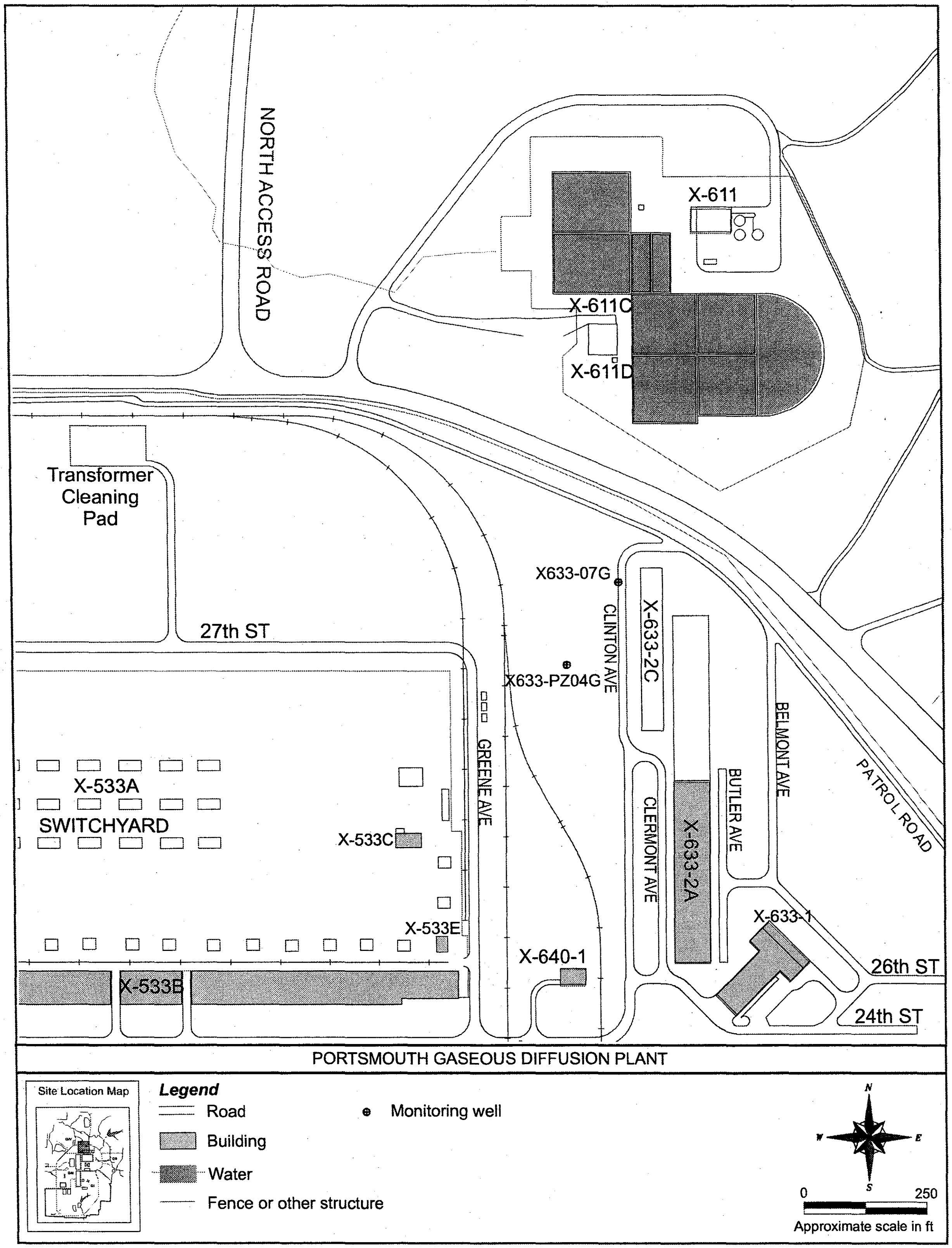

Figure B-5. Integrated monitoring wells X-633 Pumphouse/Cooling Towers Area.

APPENDIX C

QUADRANT III SUMMARY TABLES AND FIGURES

TABLES

FIGURES

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Table C-1. Integrated monitoring at the X-616 Chromium Sludge Surface Impoundments

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters[a]
X616-02G	Monitors upgradient to the eastern boundary of X-616	Annual	V1-A, M2-B
X616-05G	Monitors to the northeast, down/side-gradient to X-616	Annual	V1-A, M2-A
X616-09G	Monitors downgradient to western boundary of X-616	Annual	V1-A, M2-B
X616-16G	Monitors downgradient to the southwest boundary of X-616	Annual	V1-A, M2-B
X616-20B	Monitors downgradient to the southwest boundary of X-616	Annual	V1-A, M2-B
X616-25G	Monitors downgradient southwest of X-616	Annual	V1-A, M2-A
X616-28B	Monitors to the southeast, up/side-gradient to X-616	Annual	V1-A, M2-B
X616-10G	Monitors to the southeast, up/side-gradient to X-616	Biennial / odd	V1-B, M2-B
X616-13G	Monitors downgradient to western boundary of X-616	Biennial / odd	V1-B, M2-B
X616-14G	Monitors downgradient to the northwest boundary of X-616	Biennial / odd	V1-B, M2-B
X616-17G	Monitors to the northeast, upgradient to X-616	Biennial / odd	V1-B, M2-B
X616-19B	Monitors northern downgradient boundary of X-616	Biennial / odd	V1-B, M2-B
X616-21G	Monitors downgradient to the northwest of X-616	Biennial / odd	V1-B, M2-B
X616-22G	Monitors downgradient to the west of X-616	Biennial / odd	V1-B, M2-B
X616-24B	Monitors downgradient to the west of X-616	Biennial / odd	V1-B, M2-B
X616-26G	Monitors to the southeast, up/side-gradient to X-616	Biennial / odd	V1-B, M2-B

[a]Table 1 defines the parameter suites (V1 and M2). Parameter suites are followed by a letter that indicates the monitoring frequency. A = annual; B = biennial.

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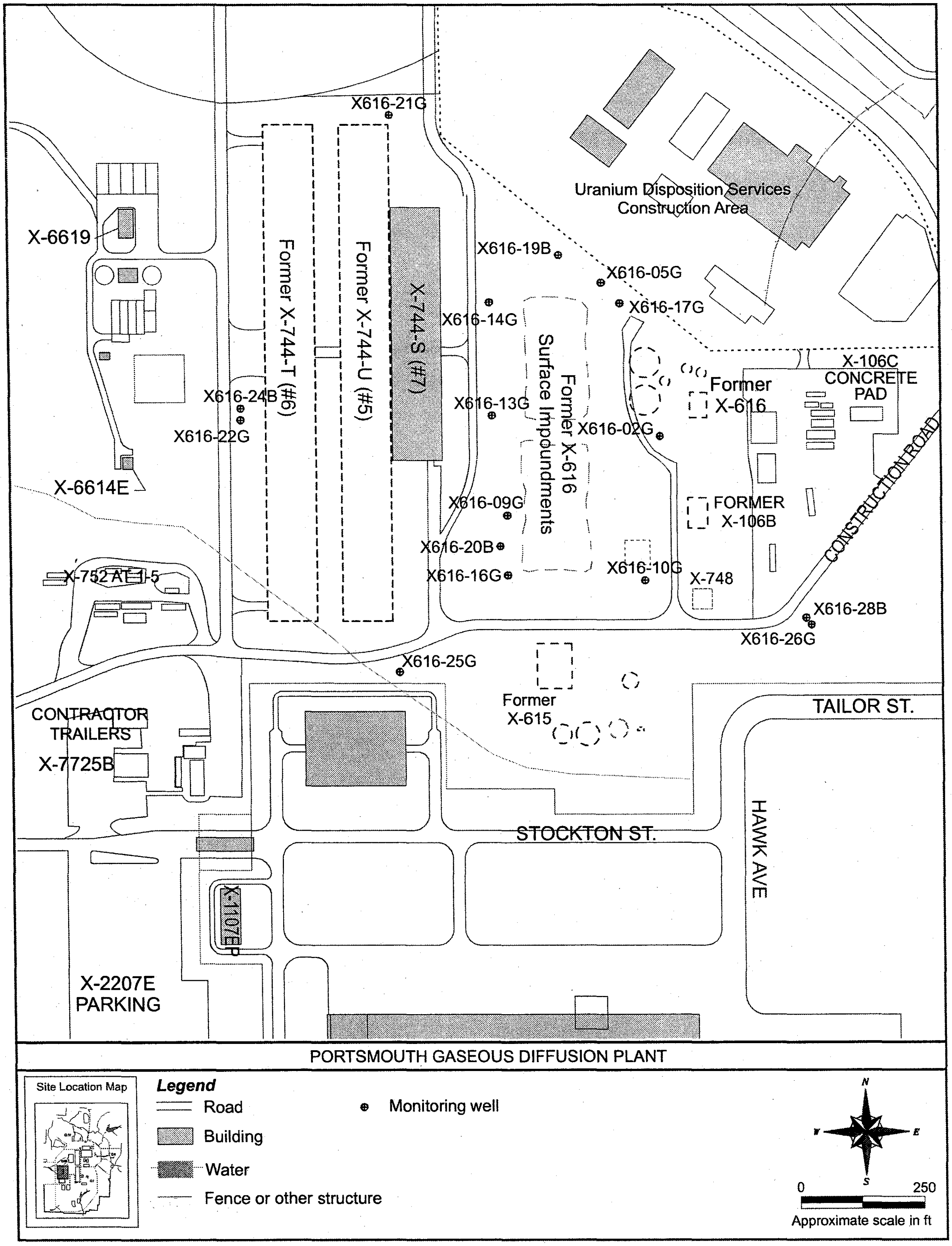

Figure C-1. Integrated monitoring wells X-616 Chromium Sludge Surface Impoundments.

APPENDIX D

QUADRANT IV SUMMARY TABLES AND FIGURES

TABLES

FIGURES

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Table D-1. Integrated monitoring at the X-611A Former Lime Sludge Lagoons

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters[a]
F-07G	Monitors unconsolidated material upgradient of X-611A	Semiannual	M4-S
F-08B	Monitors Berea upgradient of X-611A	Semiannual	M4-S
X611-01B	Monitors Berea downgradient of X-611A	Semiannual	M4-S
X611-02BA	Monitors Berea downgradient of X-611A	Semiannual	M4-S
X611-03G	Monitors unconsolidated material downgradient of X-611A	Semiannual	M4-S
X611-04BA	Monitors Berea downgradient of X-611A	Semiannual	M4-S
Wells X611-02BA, X611-03G and X611-04BA will be sampled for total PCBs in 2012 to support the five-year review for this area due in 2013 and will be sampled for total PCBs every five years thereafter.			

[a]Table 1 defines the parameter suite (M4). The parameter suite is followed by a letter that indicates the monitoring frequency. S = semiannual.

Table D-2. Integrated monitoring at the X-735 Landfills

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters[a]
X735-01GA	Monitors east and upgradient of X-735	Semiannual	LF1-S, LF3-S, LF2-A, R2-B
X735-02GA	Monitors north and downgradient of X-735	Semiannual	LF1-S, LF3-S, LF2-A, R2-B
X735-03GA	Monitors west and downgradient of X-735	Semiannual	LF1-S, LF3-S, LF2-A, R2-B
X735-04GA	Monitors west and downgradient of X-735	Semiannual	LF1-S, LF3-S, LF2-A, R2-B
X735-05GA	Monitors southwest and downgradient of X-735	Semiannual	LF1-S, LF3-S, LF2-A, R2-B
X735-06GAA	Monitors south and downgradient of X-735	Semiannual	LF1-S, LF3-S, LF2-A, R2-B
X735-13GA	Monitors east and upgradient of X-735	Semiannual	LF1-S, LF3-S, LF2-A, R2-B
X735-16B	Monitors Berea sandstone east and upgradient of X-735	Semiannual	LF1-S, LF3-S, LF2-A, R2-B
X735-17B	Monitors Berea sandstone north and downgradient of X-735	Semiannual	LF1-S, LF3-S, LF2-A, R2-B
X735-18B	Monitors Berea sandstone west and downgradient of X-735	Semiannual	LF1-S, LF3-S, LF2-A, R2-B
X735-19G	Monitors within the buffer zone between the northern and southern portions of X-735	Semiannual	LF1-S, LF3-S, LF2-A, R2-B
X735-20B	Monitors Berea sandstone within the buffer zone between the northern and southern portions of X-735	Semiannual	LF1-S, LF3-S, LF2-A, R2-B
X735-21G	Monitors west and downgradient of X-735	Semiannual	LF1-S, LF3-S, LF2-A, R2-B
X737-05B	Monitors east and upgradient of X-735	Semiannual	LF1-S, LF3-S, LF2-A, R2-B
X737-06G	Monitors east and upgradient of X-735	Semiannual	LF1-S, LF3-S, LF2-A, R2-B
X737-07B	Monitors east and upgradient of X-735	Semiannual	LF1-S, LF3-S, LF2-A, R2-B
X737-08B	Monitors east and upgradient of X-735	Semiannual	LF1-S, LF3-S, LF2-A, R2-B
X737-09G	Monitors east and upgradient of X-735	Semiannual	LF1-S, LF3-S, LF2-A, R2-B

Table D-2. Integrated monitoring at the X-735 Landfills (continued)

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters[a]
X735-03G	Former assessment monitoring well west and downgradient of X-735	Every 3 years	LF1-3, LF2-3, LF3-3, R2-3
X735-04G	Former assessment monitoring well west and downgradient of X-735	Every 3 years	LF1-3, LF2-3, LF3-3, R2-3
X735-05G	Former assessment monitoring well west and downgradient of X-735	Every 3 years	LF1-3, LF2-3, LF3-3, R2-3
X735-12G	Former assessment monitoring well west and downgradient of X-735	Every 3 years	LF1-3, LF2-3, LF3-3, R2-3

[a]Table 1 defines the parameter suites (LF1, LF2, LF3, and R2). Parameter suites are followed by a letter that indicates the monitoring frequency. S = semiannual; A = annual; B = biennial; 3 = every 3 years beginning in 2008.

Table D-3. Integrated monitoring at the X-734 Landfills

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters[a]
RSY-02B	Monitors Berea upgradient of X-734 Landfills	Semiannual	V1-S, M2-B, LF5-A, R1-B
X734-01G	Monitors unconsolidated material northwest and downgradient of X-734	Semiannual	V1-S, M2-A, LF5-A, R1-B
X734-02B	Monitors Bedford Shale northeast and downgradient of X-734	Semiannual	V1-S, M2-B, LF5-A, R1-B
X734-03G	Monitors unconsolidated material northeast and downgradient of X-734	Semiannual	V1-S, M2-A, LF5-A, R1-B
X734-04G	Monitors unconsolidated material east and downgradient of X-734	Semiannual	V1-S, M2-B, LF5-A, R1-B
X734-05B	Monitors Bedford Shale east and downgradient of X-734A	Semiannual	V1-S, M2-B, LF5-A, R1-B
X734-06G	Monitors unconsolidated material east and downgradient of X-734A	Semiannual	V1-S, M2-A, LF5-A, R1-B
X734-10G	Monitors Gallia east and downgradient of X-734B	Semiannual	V1-S, M2-A, LF5-A, R1-B
X734-14G	Monitors Gallia upgradient of X-734/X-734A	Semiannual	V1-S, M2-B, LF5-A, R1-B
X734-15G	Monitors Gallia southwest and upgradient of X-734/X-734A	Semiannual	V1-S, M2-A, LF5-A, R1-B
X734-16G	Monitors unconsolidated material west of X-734/X-734A	Semiannual	V1-S, M2-A, LF5-A, R1-B
X734-18G	Monitors unconsolidated material west of X-734	Semiannual	V1-S, M2-A, LF5-A, R1-B
X734-20G	Monitors Gallia northeast and downgradient of X-734B	Semiannual	V1-S, M2-A, LF5-A, R1-B
X734-22G	Monitors Gallia west and upgradient of X-734B	Semiannual	V1-S, M2-B, LF5-A, R1-B
X734-23G	Monitors Gallia east and downgradient of X-734B	Semiannual	V1-S, M2-A, LF5-A, R1-B

[a]Table 1 defines the parameter suites (V1, M2, LF5, and R1). Parameter suites are followed by a letter that indicates the monitoring frequency. S = semiannual; A = annual; B = biennial.

Table D-4. Integrated monitoring at the X-533 Switchyard Area

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters[a]
F-03G	Monitors downgradient (north) of transformer cleaning pad	Semiannual	M5-S
X533-03G	Monitors near northwest corner of X-533A Switchyard	Semiannual	M5-S
TCP-01G	Monitors adjacent to transformer cleaning pad	Semiannual	M5-S

[a]Table 1 defines the parameter suite (M5). The parameter suite is followed by a letter that indicates the monitoring frequency. S = semiannual.

Table D-5. Integrated monitoring at the former X-344C Hydrogen Fluoride Storage Building

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters[a]
X344C-01G	Monitors upgradient (south) of the former X-344C building	Annual	V1-A

[a]Table 1 defines the parameter suite (V1). The parameter suite is followed by a letter that indicates the monitoring frequency. A = Annual. Per agreement with Ohio EPA, the well will be monitored for three years beginning in 2010 and ending in 2012.

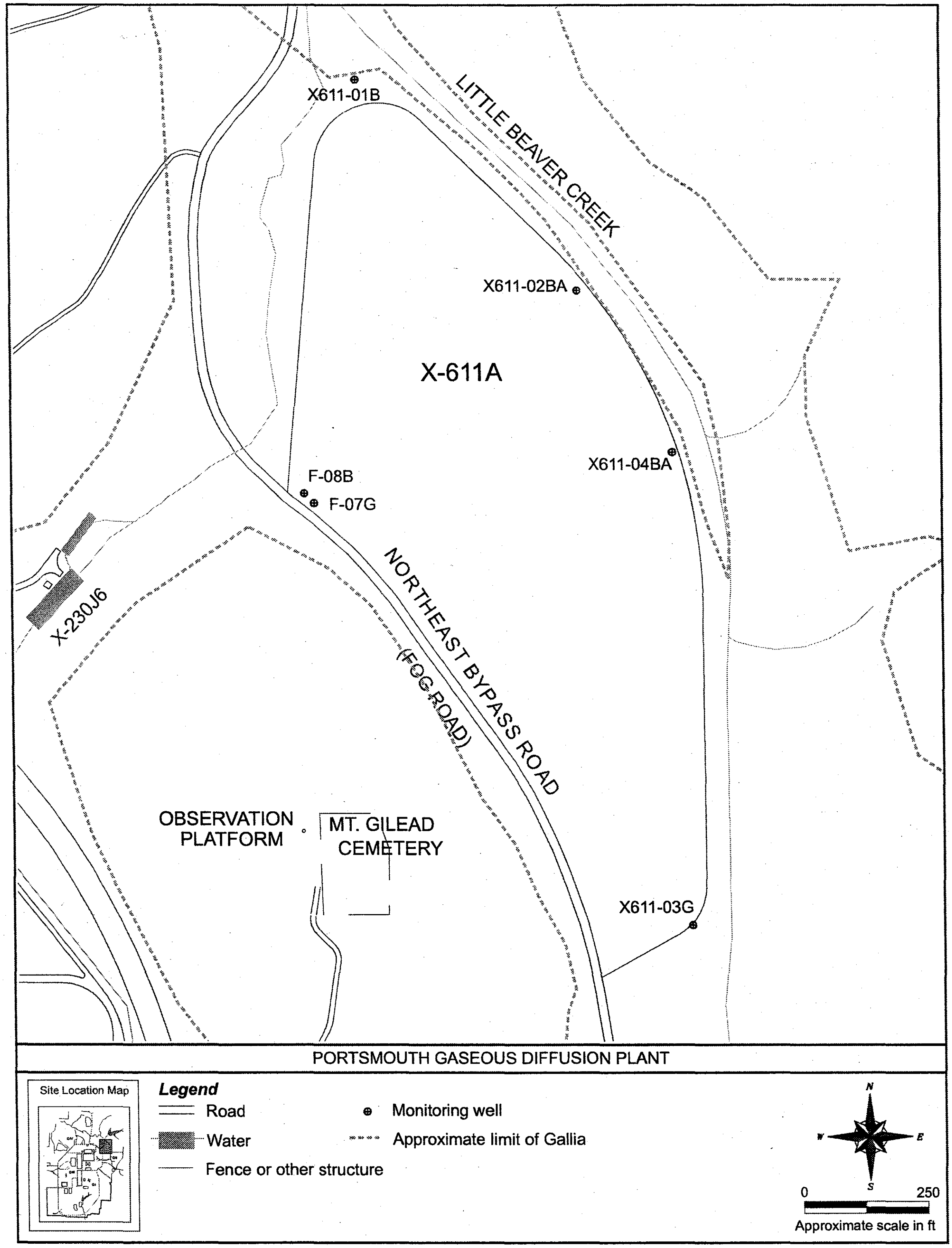

Figure D-1. Integrated monitoring wells X-611A Former Lime Sludge Lagoons.

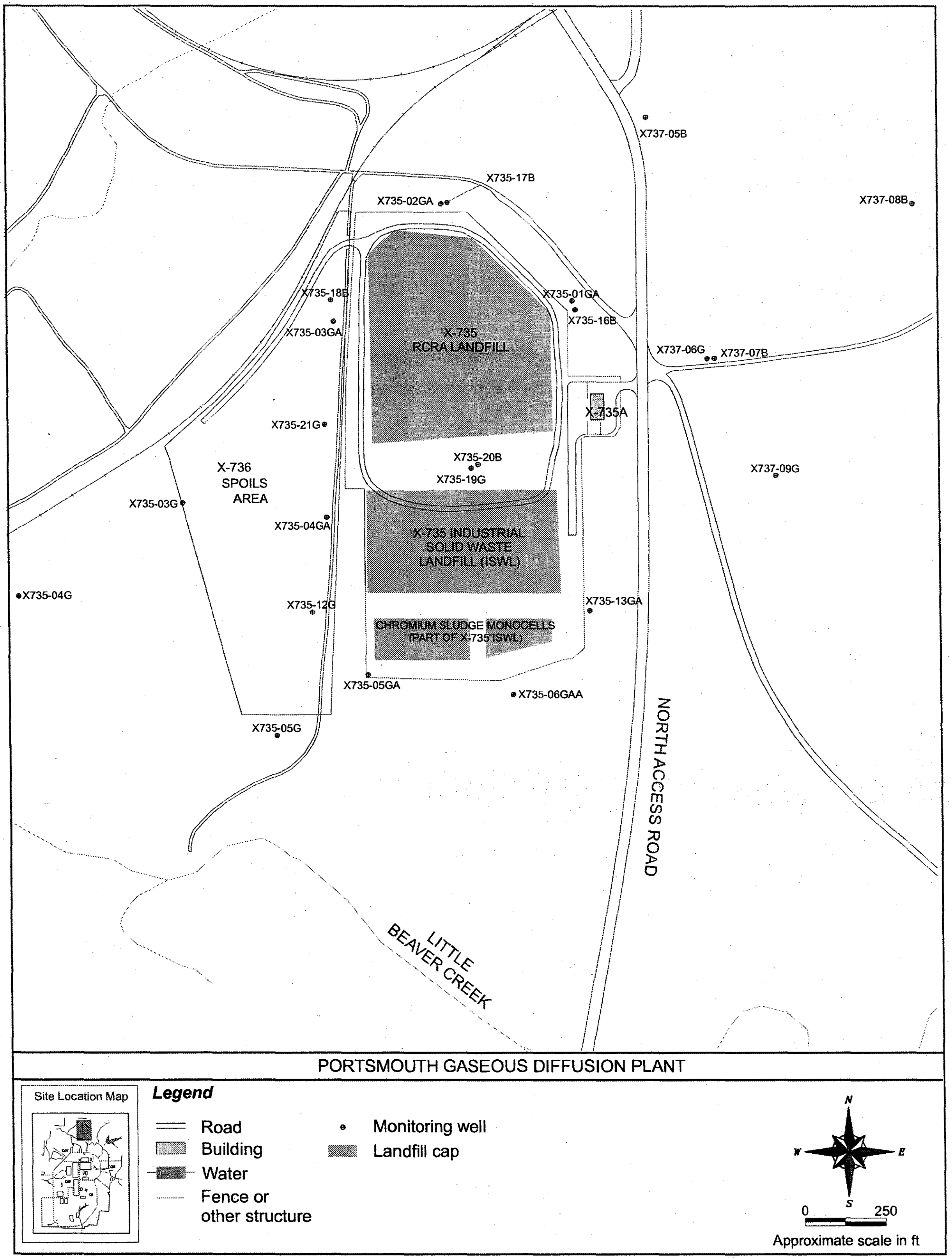

Figure D-2. Integrated monitoring wells X-735 Landfills.

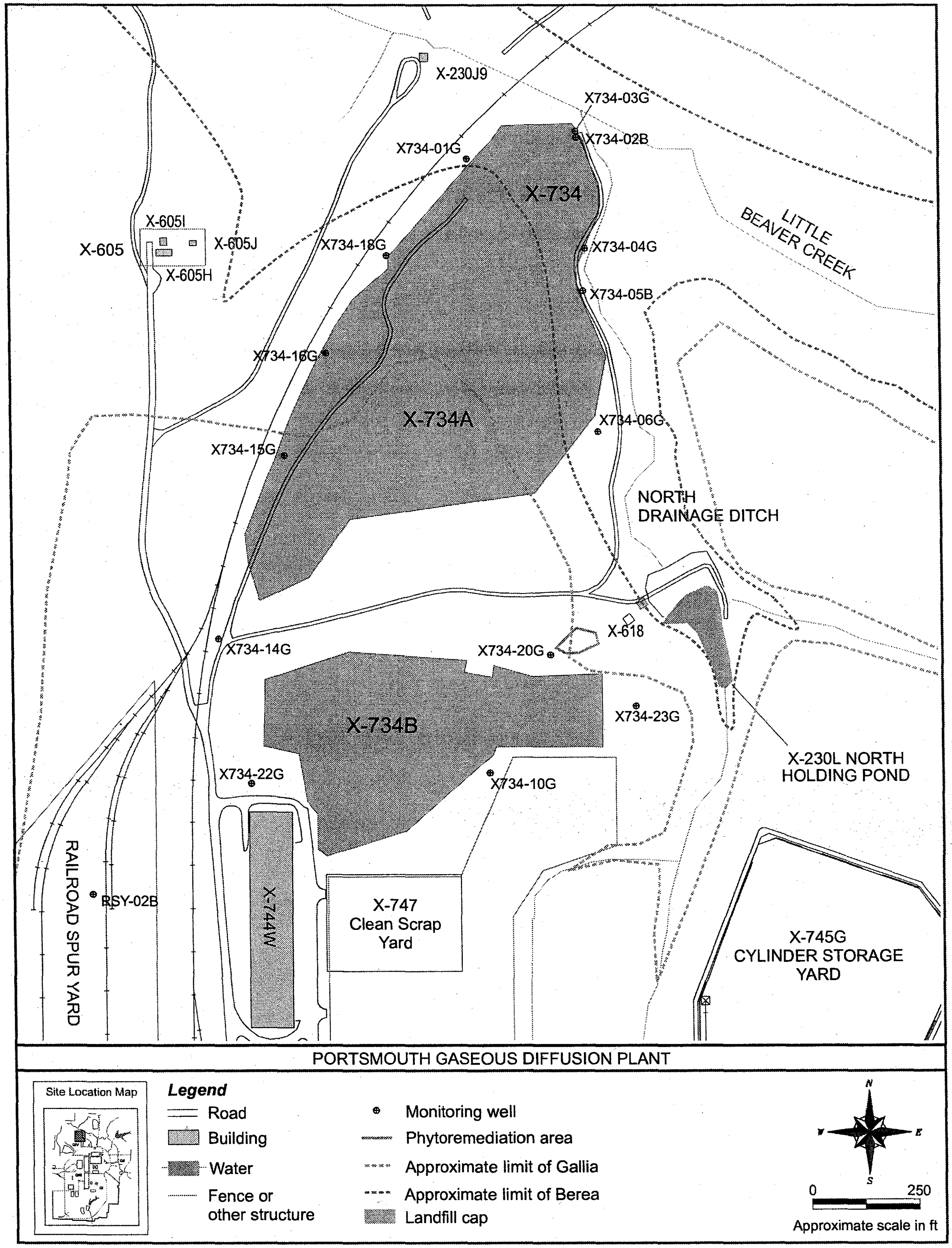

Figure D-3. Integrated monitoring wells X-734 Landfills.

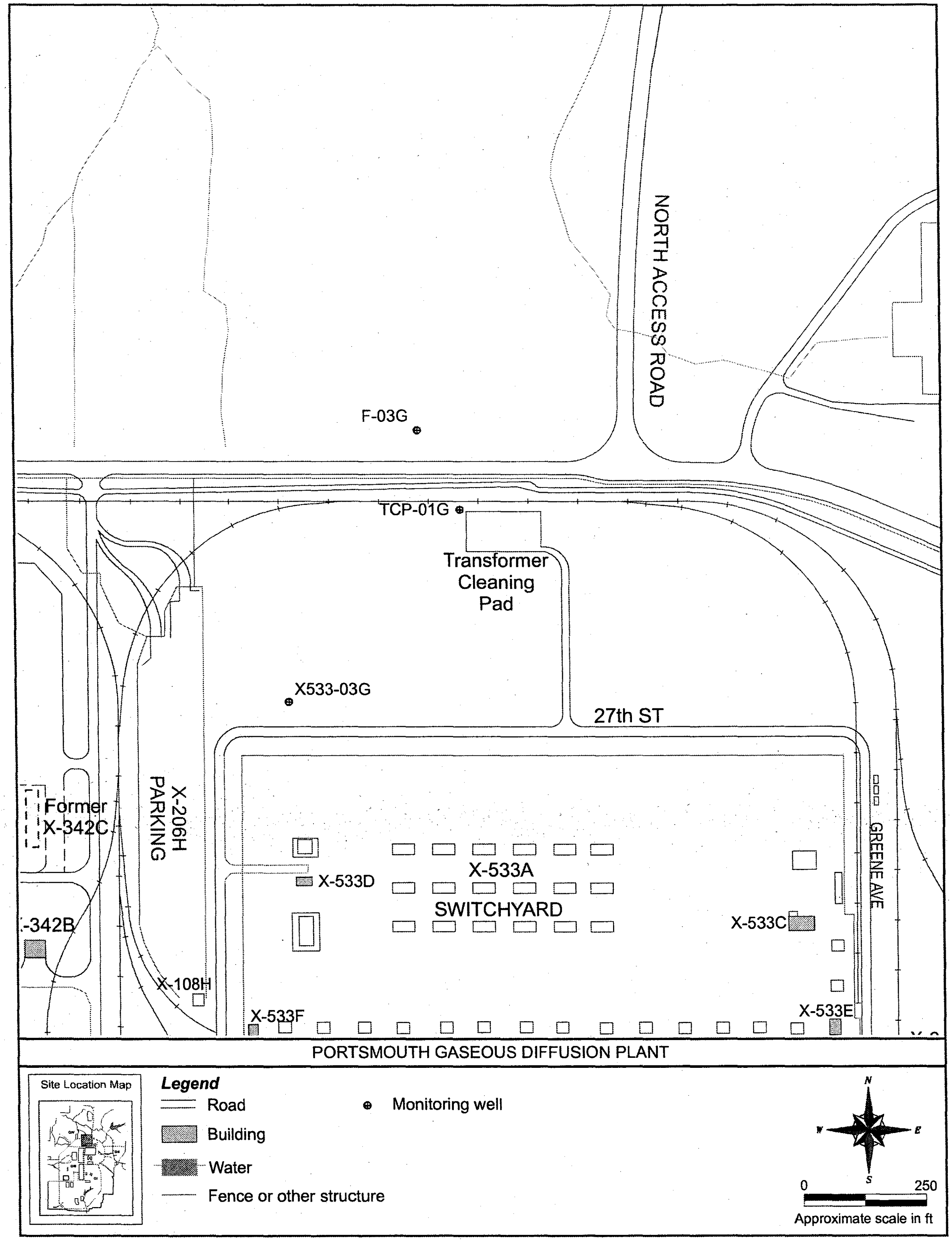

Figure D-4. Integrated monitoring wells X-533 Switchyard Area.

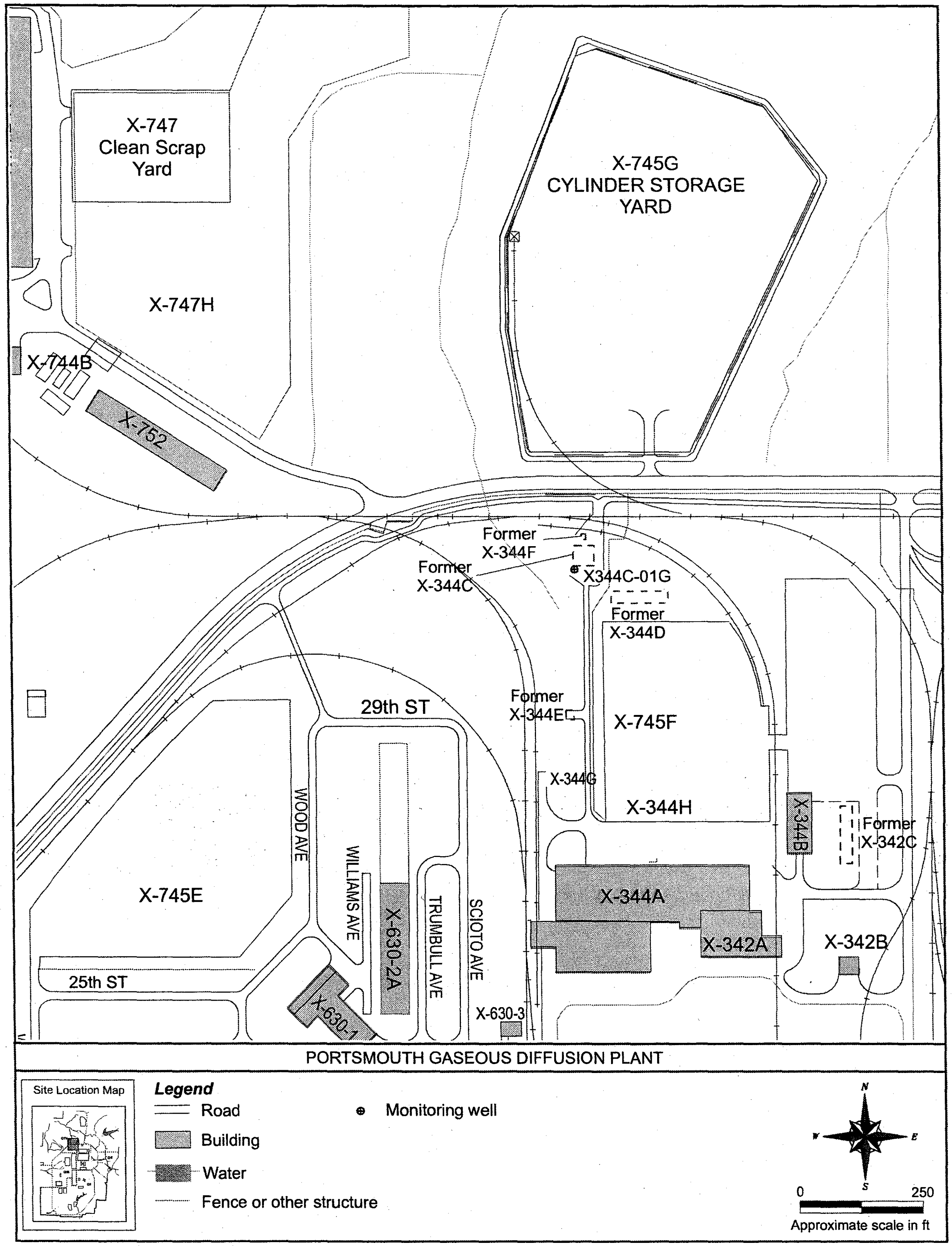

Figure D-5. Integrated monitoring wells former X-344C Hydrogen Fluoride Storage Building.

APPENDIX E

SURFACE WATER AND WATER SUPPLY MONITORING SUMMARY TABLES

TABLES

FIGURE

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Table E-1. Integrated surface water monitoring summary

Location ID	IGWMP sample frequency	IGWMP parameters[a]
BRC-SW01	Quarterly	V1-Q, R1-S, R2-S[b]
BRC-SW02	Quarterly	V1-Q, R1-S, R2-S[b]
BRC-SW05	Quarterly	V1-Q, R1-S, R2-S[b]
EDD-SW01	Quarterly	V1-Q, R1-S, R2-S[b]
LBC-SW01	Quarterly	V1-Q, R1-S, R2-S[b]
LBC-SW02	Quarterly	V1-Q, R1-S, R2-S[b]
LBC-SW03	Quarterly	V1-Q, R1-S, R2-S[b]
LBC-SW04	Quarterly	V1-Q, R1-S, R2-S[b]
NHP-SW01	Quarterly	V1-Q, R1-S, R2-S[b]
UND-SW01	Quarterly	V1-Q, R1-S, R2-S[b]
UND-SW02	Quarterly	V1-Q, R1-S, R2-S[b]
WDD-SW01	Quarterly	V1-Q, R1-S, R2-S[b]
WDD-SW02	Quarterly	V1-Q, R1-S, R2-S[b]
WDD-SW03	Quarterly	V1-Q, R1-S, R2-S[b]

[a]Table 1 defines the parameter suites (V1, R1, and R2). Parameter suites are followed by a letter that indicates the monitoring frequency. S = semiannual; Q = quarterly.
[b]Samples will be analyzed for radionuclides on a quarterly basis. R1 parameters will be analyzed semiannually, and remaining quarterly samples will be analyzed for R2 parameters.

Table E-2. Water supply monitoring summary

Location ID	Location	IGWMP sample frequency	IGWMP parameters[a]
RES-004	64 Bailey Chapel Road (old well)	Semiannual	V1-S, R1-S
RES-005	64 Bailey Chapel Road (new well)	Semiannual	V1-S, R1-S
RES-012	PORTS plant water supply	Semiannual	V1-S, R1-S
RES-014	884 Wakefield Mound Road	Semiannual	V1-S, R1-S
RES-015	22060 State Route 124	Semiannual	V1-S, R1-S
RES-016	4744 Wakefield Mound Road	Semiannual	V1-S, R1-S
RES-017	2156 Big Run Road	Semiannual	V1-S, R1-S

[a]Table 1 defines the parameter suites (V1 and R1). Parameter suites are followed by a letter that indicates the monitoring frequency. S = semiannual.

Missing numbers represent sites no longer in the program.

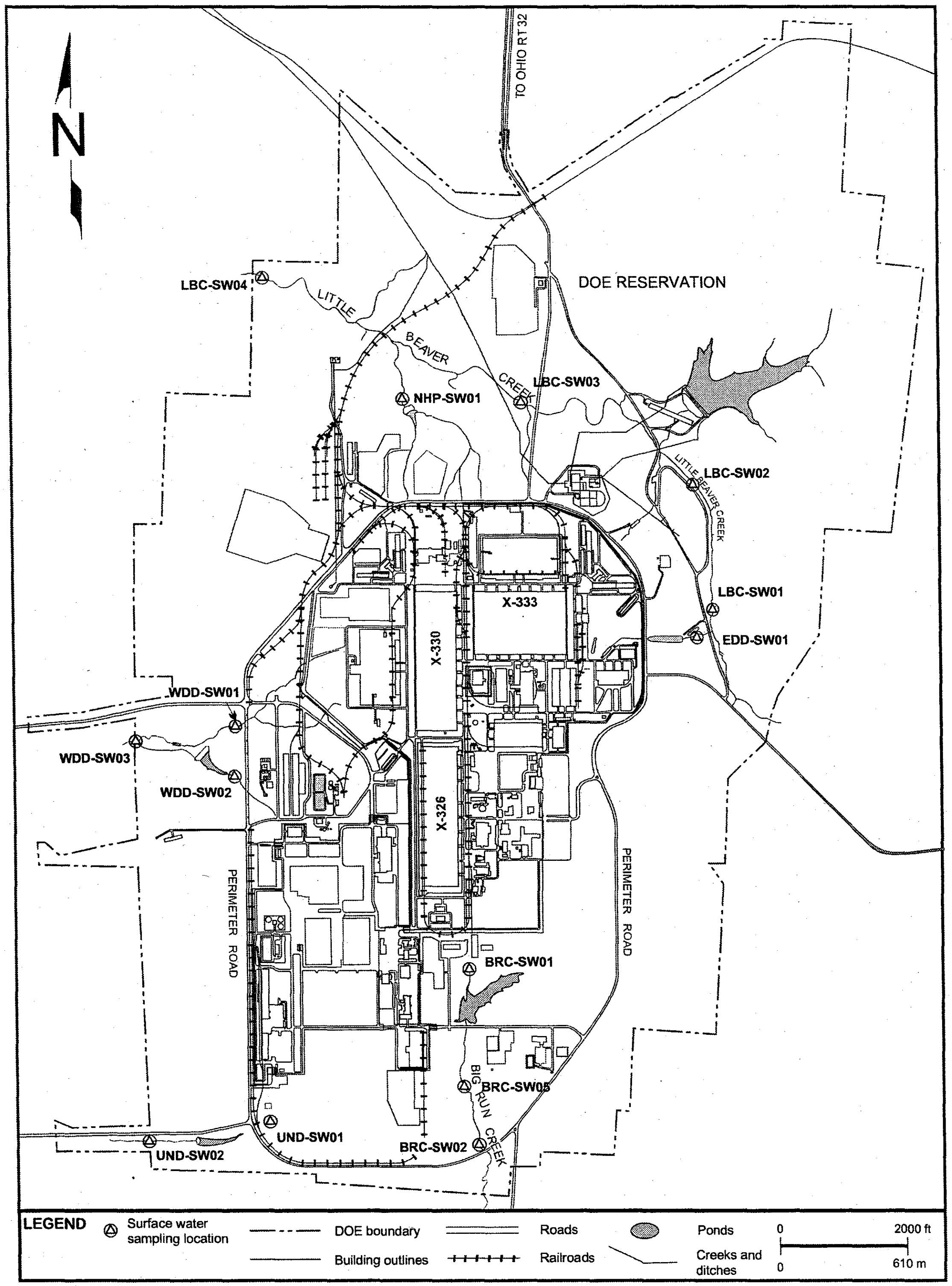

Figure E-1. Integrated surface water monitoring points.

APPENDIX F

EVALUATION PROCEDURES FOR THE X-749A CLASSIFIED MATERIALS DISPOSAL FACILITY AND X-735 LANDFILLS

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CONTENTS

ACRONYMS

CUSUM	cumulative summation
EPA	Environmental Protection Agency
h	decision internal value
OAC	Ohio Administrative Code
SCL	Shewart control limit

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F.1. INTRODUCTION

Statistical evaluation of certain parameters is part of the monitoring programs for the X-749A Classified Materials Disposal Facility (part of the Quadrant I Groundwater Investigative Area) and the X-735 Landfills (Quadrant IV) at the U.S. Department of Energy's Portsmouth Gaseous Diffusion Plant. This appendix provides the statistical evaluation procedures applicable to wells that are part of the monitoring programs for the X-749A and X-735 Landfills. The X-749A Classified Materials Disposal Facility is currently in detection monitoring. The X-735 Gallia wells are currently evaluated under a corrective measures monitoring program and the X-735 Berea wells are evaluated under a detection monitoring program.

The statistical evaluation procedures provided herein are based on guidelines provided by the American Society of Testing and Materials (1998), Gibbons (1994), and Gibbons (1999). Figure F-1 provides a flow chart of the statistical evaluation approach for detection monitoring. Figure F-2 provides a flow chart of the evaluation approach for corrective measures monitoring. Because it is desirable to minimize false positive errors and the effects of spatial variability, an intra-well statistical analysis is used for monitoring at the X-749A Classified Materials Disposal Facility and the X-735 Landfills. Under the intra-well approach, historical compliance well data is used to determine baseline conditions for each compliance well to compare with future monitoring results at these wells. The background well data is used to evaluate suspected trends and their influence on compliance well data to ensure that any increasing trends found in compliance wells are due to actual releases or impacts and are not due to overall increasing trends in background data at the groundwater monitoring area.

The first step is to determine the appropriate type of intra-well statistical comparison method to use. The preferred method is Alternative 1 (intra-well control charts). This method is used in cases where the baseline data contain less than 50% nondetects (i.e., less than half of the results are reported below the analytical reporting limit), in which case one-half the reporting limit will be used in calculating the control limits. In cases where greater than 50% nondetects are present, Alternative 2 (intra-well prediction limits) is used.

The following information is provided herein:

- Detection monitoring wells and indicator parameters for X-749A
- Detection monitoring wells (background and compliance wells) and indicator parameters for X-735
- Corrective measures monitoring wells and parameters for X-735
- Concentration limits applicable to X-735 corrective measures monitoring wells
- Methodology for Alternative 1 – Intra-well control charts
- Methodology for Alternative 2 – Intra-well prediction limits
- References

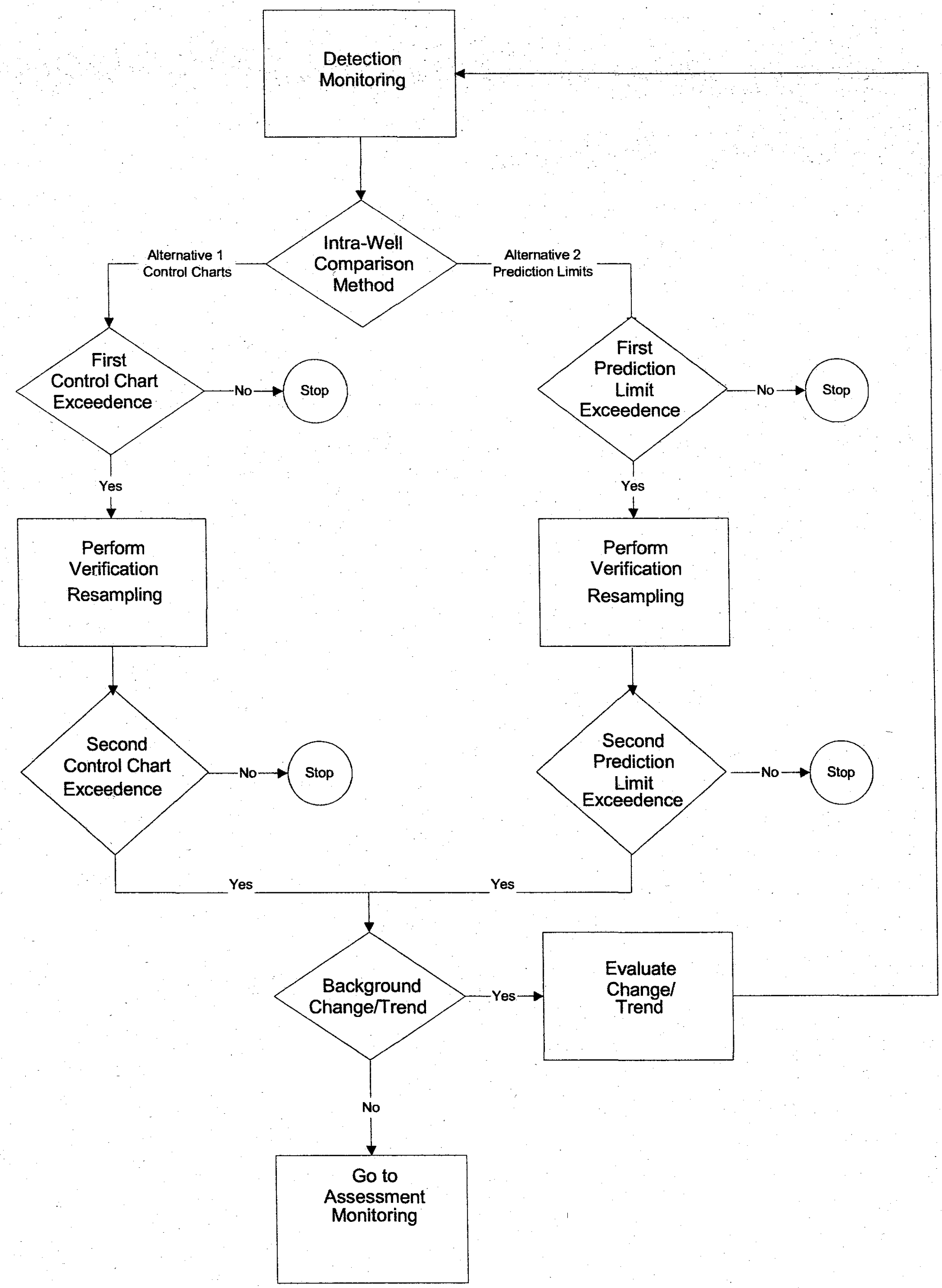

Figure F-1. Statistical evaluation approach for detection monitoring.

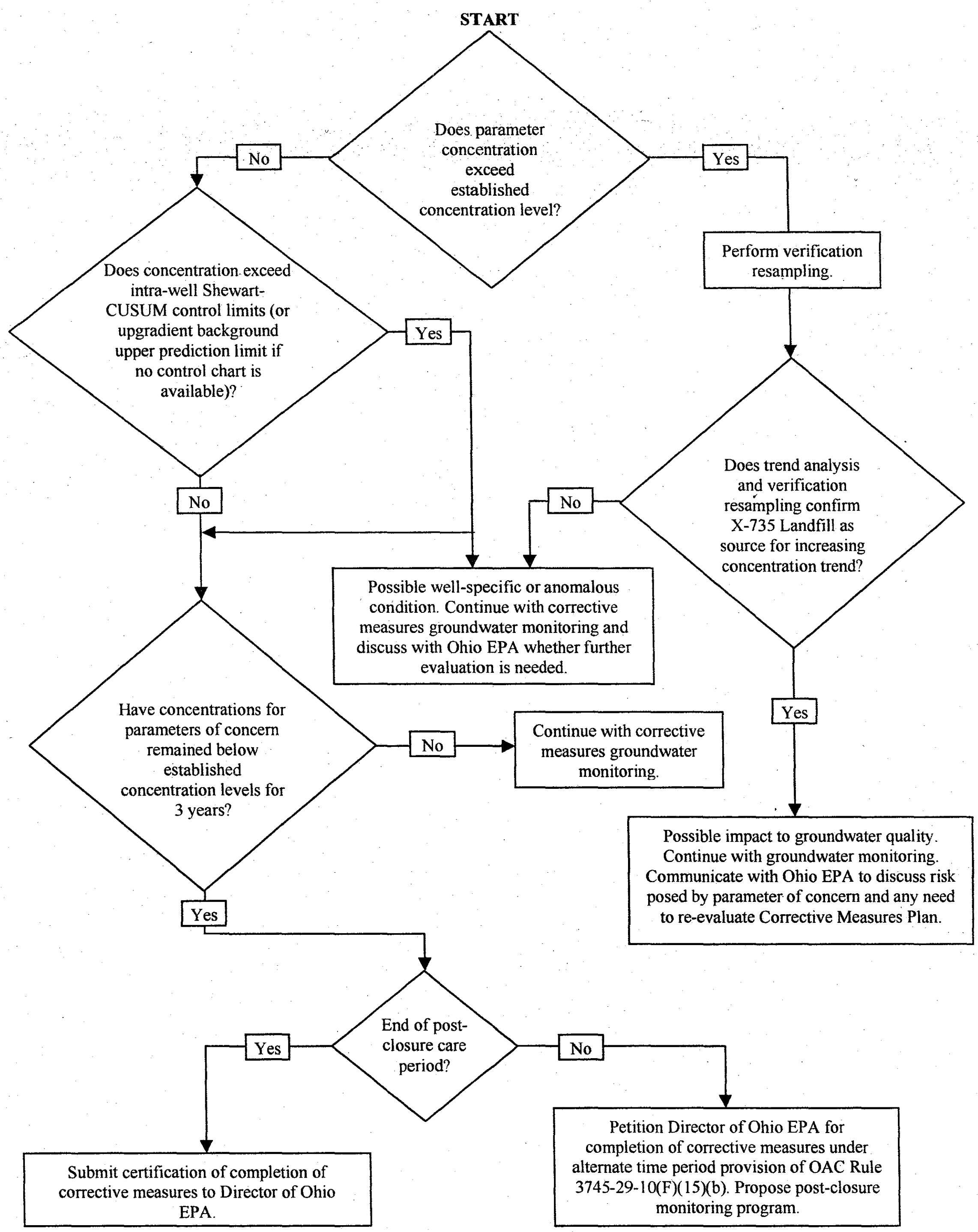

Figure F-2. Corrective measures monitoring decision logic diagram.

F.2 X-749A CLASSIFIED MATERIALS DISPOSAL FACILITY

Table F-1 lists the wells that comprise the detection monitoring program for the X-749A Classified Materials Disposal Facility. Because of remedial actions in progress at the Quadrant I Groundwater Investigative Area, groundwater flows in the vicinity of the X-749A Classified Materials Disposal Facility can fluctuate from southeast to southwest. Therefore, background (upgradient) wells and compliance (downgradient) wells at the X-749A can also change. Detection monitoring wells will be sampled as described in Appendix A, Table A-2.

Table F-1. Detection monitoring wells and parameters for the X-749A Classified Materials Disposal Facility

Compliance/background wells		Parameters
X749A-02G[a]	X749A-03G[b]	Alkalinity, Total
X749A-04G[a]	X749A-07G[c]	Chloride
X749A-12G[a]	X749A-14G[a]	Dissolved Solids, Total
X749A-16G[a]	X749A-17G[a]	Sodium
X749A-18G[a]	X749A-19G[a]	Sulfate

[a]Upgradient or downgradient well based on groundwater flow direction.
[b]Downgradient well
[c]Upgradient well

F.3. X-735 LANDFILLS

Table F-2 lists the background (upgradient) wells, compliance (downgradient) wells, and indicator parameters used for the detection monitoring program for Berea wells at the X-735 Landfills.

Table F-2. Background wells, compliance wells, and indicator parameters for the detection monitoring program at the X-735 Landfills

Background wells	Compliance wells	Indicator parameters	
X735-16B	X735-17B	Alkalinity, Total	Chloride
X737-05B	X735-18B	Dissolved Solids, Total	Sodium
X737-07B		Sulfate	
X737-08B			

Table F-3 lists the wells that comprise the corrective measures monitoring program for the X-735 Landfills. Monitoring wells that are part of the corrective measures monitoring program will also be sampled as described in Appendix D, Table D-2.

Table F-3. Corrective measures monitoring wells and parameters for the X-735 Landfills

Background wells	Compliance wells	Parameters
X735-01GA	X735-02GA	Alkalinity, Total
X735-13GA	X735-03GA	Chloride
X737-06G	X735-04GA	Dissolved Solids, Total
X737-09G	X735-05GA	Sodium
	X735-06GAA	Sulfate
	X735-21G	Cobalt
	X735-03G[a]	Mercury
	X735-04G[a]	Nickel
	X735-05G[a]	
	X735-12G[a]	

[a]Former X-735 assessment monitoring well to be sampled once every three years beginning in 2008.

Groundwater samples will continue to be collected at wells X735-19G and X735-20B; however, these wells are not listed in the tables above because they are located in the buffer zone between the northern and southern portions of the landfill. Therefore, a statistical exceedence in any indicator parameter or corrective measures monitoring parameter at these wells does not correspond with a release from the overall landfill unit.

In support of the *Corrective Measures Plan for the X-735 Landfill* approved by Ohio EPA in March 2008, analytical results for the corrective measures monitoring parameters are evaluated as summarized in Figure F-2. Table F-4 provides the concentration limits for the monitoring parameters of concern in the downgradient X-735 wells. Analytical results from each sampling event are compared to these concentration limits. If the concentration limits are not exceeded, statistical evaluations are completed on an annual basis to determine whether statistically significant increases in parameters of concern have occurred in the downgradient wells.

Table F-4. Concentration limits applicable to downgradient X-735 wells

Parameter	Limit
Alkalinity, Total	434 mg/L
Chloride	250 mg/L
Cobalt	153 µg/L
Mercury	2 µg/L
Nickel	100 µg/L
Sodium	250 mg/L
Sulfate	500 mg/L
Dissolved Solids, Total	500 mg/L

F.4. ALTERNATIVE 1 – INTRA-WELL CONTROL CHARTS

Intra-well Shewart-CUSUM (cumulative summation) control charts are constructed using historical baseline data for each compliance well. Initially, eight samples representing the previous eight sampling rounds were used to represent the baseline. Control charts are constructed showing two control limits calculated using the baseline compliance well data. The Shewart control limit (SCL) is sensitive to rapid increases in compliance well concentrations, while the decision internal value (*h*) threshold, or limit, is sensitive to gradual concentration increases.

The CUSUM control chart is designed to indicate a "long-term" trend or accumulation above baseline and is used as an internal indicator for the early detection of gradual concentration increases at a well, but shall <u>not</u> be used to determine a statistically significant change requiring notification under OAC 3745-29-10(D)(7)(b). The Shewart control chart is designed to indicate a "short-term" or immediate spike in the concentration of an indicator parameter in a compliance well and shall be used to determine whether a statistically significant change has occurred requiring notification to Ohio EPA under OAC 3745-29-10(D)(7)(b).

<u>*Control Limits*</u>. The SCL and *h* limits used for the control charts are based on the goal of attaining a site-wide 5% false positive rate while maintaining at least a 20% false negative rate (or 80% statistical power). Gibbons (1999) provides tables used to establish appropriate thresholds. In addition, verification resampling is incorporated into the control chart scheme if necessary to achieve the 5%/20% goal. An additional parameter (k) is used in calculating the CUSUM for future compliance well data, which are then compared to the *h* threshold. Selection of the k value (commonly selected to be approximately one-half the size of an important displacement, D) in conjunction with the *h* threshold is such that together they allow a displacement of two standard deviations (above baseline) to be detected quickly (i.e., between sampling rounds).

<u>*Verification Resampling*</u>. For control charts, verification resampling is particularly important to identify outliers that may be due to transcription, sampling, or analytical error and/or natural variation in groundwater quality. Verification resampling is limited to cases where the original sample causes an exceedence. In accordance with OAC 3745-29-10(D)(7)(b), the Ohio EPA will be notified of a statistically significant change (increase) in the concentration of an indicator parameter (i.e., SCL control limit exceedence) within 75 days of withdrawing the sample from a possible affected well in detection monitoring. As allowed by OAC 3745-29-10(D)(7)(c), one or two (if necessary) rounds of verification resampling may then be conducted, and the results and/or other information reported to Ohio EPA within 105 days from the determination that a significant increase has occurred. Since the effect of an identified outlier will impact the CUSUM portion of the control chart for subsequent sampling rounds, the outlier shall be replaced (if appropriate) by the compliant resample. If approval to continue detection monitoring is not obtained from Ohio EPA during this period, an assessment monitoring program shall be initiated.

<u>*Updating Baseline Data*</u>. Baseline data are updated in groups of four or more statistically independent samples. These data are added to the original pooled historical compliance well data used for calculating the baseline. The SCL and *h* limits are then recalculated for comparisons with subsequent samples.

<u>*Background Trend Analysis*</u>. Periodically, the upgradient (background) well data may be tested for trends to ensure that apparent trends in compliance well data (shown on the control charts) are due to actual trends and not due to trends in background well concentrations. A trend analysis using the Mann-Kendall test may be conducted when a control chart exceedence occurs. If increasing trends in background are

identified, the compliance well data may be de-trended using the procedure detailed in Gibbons (1994), and the control charts adjusted accordingly.

F.5. ALTERNATIVE 2 – INTRA-WELL PREDICTION LIMITS

Nonparametric or Poisson prediction limits are calculated in cases where the percentage of nondetects exceeds 50%. In these cases, the pooled historical compliance well data (and possibly background well data) is used to calculate the prediction limits. Pooling of the historical compliance well data is necessary to obtain sufficient numbers of baseline/background data to attain a site-wide false positive rate of approximately 5% ($\alpha^* \sim 0.05$) using an individual test false positive rate of approximately 1% ($\alpha \sim 0.01$). These performance standards are consistent with OAC 3745-29-10(C)(7)(a-f) and Federal regulations promulgated by U.S. EPA and codified in Title 40 of the *Code of Federal Regulations* Part 264, Subpart F, which are designed to provide an adequate balance between the site-wide and individual test false positive rates. To achieve these performance standards using the prediction limit approach, it is necessary to incorporate verification resampling into the sampling strategy. Without verification resampling, an impracticably large number of baseline/background samples are necessary to achieve these same performance standards.

<u>Initial Screening</u>. Initial prediction limits, as shown in Figure F-1, will be calculated based on the assumption of no verification resampling. Regardless of whether an exceedence of the prediction limit occurs for any parameter/compliance well, detection monitoring continues with the next round of sampling. However, if an exceedence does occur for any parameter/compliance well, then the next round of sampling serves as the first round of verification resampling for that parameter/well. In accordance with OAC 3745-29-10(D)(7)(b), Ohio EPA will be notified of a statistically significant change (increase) in the concentration of an indicator parameter within 75 days of withdrawing the sample from a possible affected well in detection monitoring.

<u>Verification Resampling</u>. When verification resampling is necessary to confirm an indicated release or impact, the data collected from the next round(s) of sampling from the affected well for the parameter causing the exceedence serves as the verification resample(s). As stated above, the goal of the verification resampling strategy is to ensure a balance between the site-wide and individual test false positive rates. Therefore, verification resampling will continue until this balance is achieved. Given the number of pooled historical compliance well data, it is estimated that no more than two verification resamples will be necessary. As allowed by OAC 3745-29-10(D)(7)(c), one or two (if necessary) rounds of verification resampling will then be conducted, and the results reported to Ohio EPA within 105 days from the determination that a significant increase has occurred. If approval to continue detection monitoring is not obtained from Ohio EPA during this period, an assessment monitoring program will be initiated. Confirmation of an exceedence will require that both resamples exceed the prediction limit.

<u>Updating Baseline Data</u>. Baseline data are updated in groups of four or more statistically independent samples. These data are added to the original pooled historical compliance well data used for calculating the initial prediction limit. The upper prediction limit is then recalculated for comparisons with subsequent samples.

<u>Background Trend Analysis</u>. As with the control chart approach, the upgradient (background) well data may be evaluated when prediction limit exceedences occur to ensure that apparent prediction limit

exceedences in compliance well data are due to actual exceedences and not due to changes in background well concentrations. If required, the evaluation will include trend analysis using the Mann-Kendall test. If changes in background are identified, including increasing trends in background, the background data may be added to the pooled historical compliance well data for purposes of calculating the prediction limits. This is necessary to minimize false positives due to background changes over time.

F.6. REFERENCES

American Society for Testing and Materials 1998. *Standard Guide for Developing Appropriate Statistical Approaches for Groundwater Detection Monitoring Programs*, (Method D6312-98).

Gibbons, R.D. 1994. *Statistical Methods for Groundwater Monitoring*, John Wiley & Sons, Inc.

Gibbons, R.D. 1999. "Use of Combined Shewart-CUSUM Control Charts for Ground Water Monitoring Applications", *Ground Water*, V. 37, No. 5, p. 682.

APPENDIX G

OHIO ADMINISTRATIVE CODE (OAC) 3745-29-10 GROUNDWATER MONITORING PROGRAM FOR AN INDUSTRIAL SOLID WASTE LANDFILL FACILITY

(JUNE 1, 1994)

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Equation (2) $T = D/AK$ where:

T = Time (seconds)

D = Thickness of geologic stratum (cm)

K = Hydraulic conductivity of geologic stratum (cm/sec)

A = Constant determined by type of geologic stratum where:

A = 2.0 for clay

A = 2.5 for silt

A = 3.5 for sand or gravel

A = 5.0 for fractured bedrock

A = The inverse of the porosity of the non-fractured bedrock material

Procedure:

(1) Calculate T for each geologic stratum that is to be present between the uppermost aquifer system and the base of the recompacted soil liner using equation (2).

(2) The values for T calculated in procedure (1) shall be summed to yield T for the entire section between the uppermost aquifer system and the base of the recompacted soil liner.

(3) Subtract T from 7.9×10^8 seconds to get N (seconds).

(4) Insert N into equation (1) to determine required liner thickness.

3745-29-10 Ground water monitoring program for an industrial solid waste landfill facility.

(A) Applicability.

(1) General applicability. In accordance with the schedule in paragraphs (A)(2) and (A)(3) of this rule, the owner or operator of an industrial solid waste landfill facility shall implement a "ground water monitoring program" capable of determining the impact of the facility on the quality of ground water occurring within the uppermost aquifer system and all significant zones of saturation above the uppermost aquifer system underlying the industrial solid waste landfill facility. The "ground water monitoring program" has the following elements:

(a) A "ground water detection monitoring program" which includes, but is not limited to,

(i) A "ground water detection monitoring plan" in accordance with paragraphs (B) to (D) of this rule; and

(ii) A monitoring system in accordance with paragraph (B) of this rule; and

(iii) Sampling and analysis procedures, including an appropriate statistical method, in accordance with paragraph (C) of this rule; and

(iv) Detection monitoring procedures, including monitoring frequency and a parameter list, in accordance with paragraph (D) of this rule.

(b) A "ground water quality assessment monitoring program" when the owner or operator determines that a release of leachate or leachate-derived constituents into the ground water has occurred. A "ground water quality assessment monitoring program" includes, but is not limited to,

(i) A "ground water quality assessment plan" in accordance with paragraphs (E)(3) and (E)(4) of this rule; and

(ii) Determinations of rate, extent, and concentration of leachate and leachate-derived constituents detected in the ground water in accordance with paragraph (E)(5) of this rule; and

(iii) Submission of a "ground water quality assessment report;" and

(iv) Where applicable, the requirements of paragraphs (B) to (D) of this rule.

(c) A "corrective measures program" when the owner or operator determines, pursuant to paragraph (E)(4) of this rule, that leachate or leachate-derived constituents from the facility have entered the ground water. A "corrective measures program" includes, but is not limited to,

(i) A "corrective measures plan" in accordance with paragraphs (F)(2) and (F)(3) of this rule; and

(ii) Proposed concentration levels in accordance with paragraph (F)(7) of this rule; and

(iii) Selection and implementation of a corrective measure in accordance with paragraph (F)(10) of this rule; and

(iv) Where applicable, the requirements of paragraphs (B) to (D) of this rule.

(2) Schedule for implementation of detection monitoring. The owner or operator of the following industrial solid waste landfill facilities shall implement a ground water monitoring program in accordance with this rule:

(a) New industrial solid waste landfill facilities shall implement a ground water monitoring program in accordance with the schedules contained in the approved permit to install;

(b) All lateral and vertical expansions of industrial solid waste landfill facilities shall implement a ground water monitoring program in accordance with the approved permit to install;

(c) All industrial solid waste landfill facilities undergoing closure, according to rule 3745-29-11 of the Administrative Code, shall implement a ground water monitoring program in accordance with the approved closure plan;

(d) All facilities which are, or will be, subject to paragraph (L) of rule 3745-29-11 of the Administrative Code shall implement a ground water monitoring program no later than September 30, 1991; and

(e) All facilities to which both of the following apply:

(i) The facility was a sanitary landfill facility which was deemed to be an industrial solid waste landfill facility in accordance with rules 3745-27-04 and 3745-29-02 of the Administrative Code; and

(ii) The owner or operator was implementing or was required to implement a ground water monitoring program in accordance with rule 3745-27-10 of the Administrative Code as of the date the sanitary landfill facility was deemed to be an industrial waste landfill facility. The owner or operator shall revise a previously approved ground water monitoring program in accordance with the requirements of this rule, submit a copy of the revised program to the director, and implement the revised program no later than October 9, 1994. The Ohio EPA may review, approve, and/or require revisions to plans submitted in accordance with this paragraph.

(3) Implementation of "ground water quality assessment monitoring program" and "corrective measures program."

The owner or operator shall implement a "ground water quality assessment monitoring program" and/or a "corrective measures program" when required by paragraph (E) or (F) of this rule to implement these programs. Implementation shall be in accordance with the timeframes specified in paragraphs (E) and (F) of this rule.

(4) For the purposes of this rule, the ground water monitoring program, which includes the detection monitoring program, and where required, the assessment monitoring and corrective measures programs, is implemented upon the commencement of sampling of ground water monitoring wells in accordance with paragraph (D), (E), or (F) of this rule.

(B) Ground water monitoring system.

(1) The ground water monitoring system, for detection monitoring, assessment monitoring, or corrective measures, shall consist of a sufficient number of wells, installed at appropriate locations and depths, to yield ground water samples from both the uppermost aquifer system and any significant zones of saturation that exist above the uppermost aquifer system that:

(a) Represent the quality of the background ground water that has not been affected by past or present operations at the industrial solid waste landfill facility; and

(b) Represent the quality of the ground water passing directly downgradient of the limits of solid waste placement.

(2) Where the uppermost aquifer system exists more than one hundred fifty feet beneath the recompacted clay liner of the industrial solid waste landfill facility, the ground water monitoring system shall consist of a sufficient number of wells, installed at appropriate locations and depths, to yield ground water samples from an adequate number of significant zones of saturation, in accordance with paragraphs (B)(1)(a) and (B)(1)(b) of this rule, to ensure detection of any contaminant release from the facility.

(3) All monitoring wells shall be designed, installed, and developed in a manner that allows the collection of ground water samples that are representative of ground water quality in the geologic unit being monitored. At a minimum:

(a) Monitoring wells shall be cased in a manner that maintains the integrity of the monitoring well boreholes; and

(b) The annular space (i.e., the space between the borehole and the well casing) above the sampling depth shall be sealed to prevent the contamination of the samples and the ground water; and

(c) The casing shall be screened or perforated and surrounded by sand or gravel in such a way that allows:

(i) For the minimization of the passage of formation materials into the well; and

(ii) For the monitoring of discrete portions of the uppermost aquifer system or any significant zones of saturation above the uppermost aquifer system; and

(d) The design, installation, development, and abandonment of any monitoring wells, piezometers, and other measurement, sampling, and analytical devices shall be documented in the plans for detection monitoring, assessment monitoring and/or corrective measures; and

(e) The monitoring wells, piezometers, and other measurement, sampling, and analytical devices shall be operated and maintained to perform to design specifications throughout the life of the monitoring program.

(4) The number, spacing, and depth of ground water monitoring wells shall be:

(a) Based on site specific hydrogeologic information including that information listed in paragraphs (C)(2)(a) to (C)(2)(f) of rule 3745-29-06 of the Administrative Code; and

(b) Capable of detecting a release from the industrial solid waste landfill facility to the ground water at the closest practicable location to the limits of solid waste placement.

(5) The owner or operator shall, at least annually, evaluate the ground water surface elevation data obtained in accordance with paragraph (C)(3) of this rule to determine whether the requirements of paragraph (B) of this rule for locating the monitoring wells continue to be satisfied. The results of this evaluation, including potentiometric maps for every geologic unit monitored, shall be included in the report required in accordance with paragraph (M) of rule 3745-29-19 of the Administrative Code. If the evaluation shows that paragraph (B) of this rule is no longer satisfied, the owner or operator shall immediately revise the number, location, and/or depth of the monitoring wells to bring the ground water monitoring system into compliance with this requirement.

(C) Ground water sampling, analysis, and statistical methods.

(1) General requirements. The ground water monitoring program shall include consistent sampling and analysis procedures and statistical methods that are protective of human health and the environment and that are designed to ensure monitoring results that provide an accurate representation of ground water quality at the background and downgradient wells installed in accordance with paragraph (B), (E), or (F) of this rule. The following shall be included in the "ground water detection monitoring plan," "ground water quality assessment monitoring plan," and "corrective measures plan."

(a) A written sampling and analysis plan which documents the sampling and analysis procedures employed in the "ground water detection monitoring program," the "ground water quality assessment monitoring program," and the "corrective measures program;"

(b) The statistical method selected by the owner or operator shall be in accordance with paragraphs (C)(6) and (C)(7) of this rule; and

(c) The statistical determination of a significant increase in a monitoring parameter shall be in accordance with paragraph (C)(8) of this rule; and

(d) The number of samples collected shall be in accordance with paragraph (C)(9) of this rule; and

(e) Submission of ground water and statistical analysis shall be in accordance with paragraph (C)(10) of this rule.

(2) A sampling and analysis plan shall, at a minimum, include a detailed description of the equipment, procedures, and techniques to be used for:

(a) Measurement of ground water elevations; and

(b) Detection of immiscible layers; and

(c) Collection of ground water samples, including:

(i) Well evacuation; and

(ii) Sample withdrawal; and

(iii) Sample containers and handling; and

(iv) Sample preservation; and

(d) Performance of field analysis, including:

(i) Procedures and forms for recording raw data and the exact location, time, and facility-specific conditions associated with the data acquisition; and

(ii) Calibration of field devices; and

(e) Decontamination of equipment; and

(f) Analysis of ground water samples; and

(g) Chain of custody control, including:

(i) Standardized field tracking reporting forms to record sample custody in the field prior to and during shipment; and

(ii) Sample labels containing all information necessary for effective sample tracking; and

(h) Field and laboratory quality assurance and quality control, including:

(i) Collection of replicate samples; and

(ii) Submission of field-bias blanks; and

(iii) Potential interferences.

(3) Measurement of ground water elevations. Ground water elevations shall be measured in all wells prior to any purging and sampling. The owner or operator shall determine, for the uppermost aquifer system and for all significant zones of saturation monitored, the direction of ground water flow each time ground water elevation measurements are performed. Ground water elevations in wells monitoring the same area or portion of area of an industrial solid waste landfill facility shall be measured within a period of time short enough to avoid temporal variations in ground water flow which could preclude an ac-

curate determination of ground water flow rate and direction. The owner or operator shall annually evaluate the ground water elevation data collected pursuant to this paragraph in accordance with paragraph (B)(5) of this rule.

(4) The owner or operator establish background ground water quality, unless the exception in paragraph (C)(5) of this rule applies, by analyzing ground water samples collected from hydraulically upgradient wells(s) for each of the monitoring parameters or constituents required in the ground water monitoring program.

(5) Background ground water quality at an industrial solid waste landfill facility may be based on sampling of wells that are not hydraulically upgradient where:

(a) Hydrogeologic conditions do not allow the owner or operator to determine which wells are upgradient; and

(b) Sampling of other wells will provide an indication of background ground water quality that is as representative or more representative than that provided by upgradient wells.

(6) Statistical methods. The owner or operator shall specify one of the following statistical methods to be used in evaluating ground water monitoring data. The statistical method chosen shall be conducted separately for each of the parameters required to be statistically evaluated in paragraph (D)(4) of this rule. The statistical method specified shall ensure protection of human health and the environment and shall comply with the performance standards outlined in paragraph (C)(7) of this rule. The statistical method specified shall be selected from the following:

(a) A parametric analysis of variance ("ANOVA") followed by multiple comparisons procedures to identify statistically significant evidence of contamination. This shall include estimation and testing of the contrasts between each monitoring well's mean and the background mean levels for each constituent; or

(b) An analysis of variance ("ANOVA") based on ranks followed by multiple comparisons procedures to identify statistically significant evidence of contamination. This shall include estimation and testing of the contrasts between each monitoring well's median and the background median levels for each constituent; or

(c) A tolerance or prediction interval procedure in which an interval for each constituent is established from the distribution of the background data, and the level of each constituent in each monitoring well is compared to the upper tolerance or prediction limit; or

(d) A control chart approach that gives control limits for each constituent; or

(e) Another statistical test method submitted by the owner or operator and approved by the director or his authorized representative.

(7) Performance standards for statistical methods. Any statistical method chosen in accordance with paragraph (C)(6) of this rule shall comply with the following performance standards as appropriate:

(a) The statistical method used to evaluate ground water monitoring data shall be appropriate for the distribution of chemical parameters or leachate and leachate-derived constituents. If the distribution of the chemical parameters or leachate and leachate-derived constituents is shown by the owner or operator to be inappropriate for a normal theory test, then the data should be transformed or a distribution free theory test should be used. If the distributions for the constituents differ, more than one statistical method may be needed; and

(b) If an individual well comparison procedure is used to compare an individual monitoring well constituent concentration with background constituent concentrations or a ground water concentration level, the test shall be conducted at a type I error level not less than 0.01 for each testing period. If multiple comparisons procedures are used, the type I experimentwise error rate for each testing period shall be not less than 0.05; however, the type I error rate of not less than 0.01 for individual monitoring well comparisons shall be maintained. This performance standard does not apply for tolerance intervals, prediction intervals, or control charts; or

(c) If a control chart approach is used to evaluate ground water monitoring data, the specific type of control chart and its associated parameter values shall be protective of human health and the environment. The parameters shall be determined after considering the number of samples in the background data base, the date distribution, and the range of the concentration values for each constituent; or

(d) If a tolerance interval or a prediction interval is used to evaluate ground water monitoring data, the levels of confidence, and for tolerance intervals, the percentage of the population that the interval must contain, shall be protective of human health and the environment. These parameters shall be determined after considering the number of samples in the background data base, the data distribution, and the range of the concentration values for each constituent of concern; and

(e) The statistical method shall account for data below the limit of detection with one or more statistical procedures that ensure protection of human health and the environment. Any practical quantification limit (PQL) used in the statistical method shall be the lowest concentration level that can be reliably achieved within the specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility; and

(f) If necessary, the statistical method shall include procedures to control or correct for seasonal and spatial variability as well as temporal correlation in the data.

(8) Determination of significant increase. The owner or operator shall determine whether or not there is a statistically significant increase (or decrease in the case of pH) from background values for each parameter or constituent required in the ground water monitoring program. The owner or operator shall make this determination each time he assesses ground water quality. To determine whether a statistically-significant increase or decrease has occurred, the owner or operator shall compare the ground water quality of each parameter or constituent at each downgradient ground water monitoring well to the background value of that parameter or constituent according to the statistical procedures specified in paragraphs (C)(6) and (C)(7) of this rule.

(9) Sample number. The number of samples collected to establish ground water quality data shall be consistent with the appropriate statistical procedures determined pursuant to paragraphs (C)(6) and (C)(7) of this rule. The sampling procedures shall be those specified under paragraph (D) of this rule for detection monitoring, paragraph (E) of this rule for assessment monitoring, and paragraph (F) of this rule for corrective measures.

(10) Submission of results. All ground water elevation, sample analysis and statistical analysis results generated in accordance with paragraphs (B), (C), (D), (E) and (F) of this rule shall be submitted to the director or his authorized representative not later than seventy-five days after sampling the well. All ground water data and an accompanying text shall be submitted to the director or his authorized representative in a form specified by the director or his authorized representative.

(D) Ground water detection monitoring program.

(1) Monitoring parameters. The owner or operator shall determine the concentration or value of the parameters listed in appendix I in ground water in accordance with paragraph (D) of this rule.

(2) Alternate monitoring parameter list. The owner or operator of an industrial solid waste landfill facility may propose, in writing, that an alternative list of appendix I monitoring parameters be used to meet the requirements of paragraph (D)(5) to (D)(8) of this rule. The director may approve the alternative list of appendix I monitoring parameters if the removed parameters are not reasonably expected to be in or derived from the waste contained or deposited in the industrial solid waste landfill facility. Upon approval by the director or his authorized representative, the owner or operator may use the alternative list. The owner or operator shall, at a minimum, consider the following factors in proposing an alternative inorganic parameter list:

(a) Which of the parameters specified in appendix I of this rule shall be deleted from the parameters required to be monitored in paragraph (D)(5) of this rule; and

(b) The types, quantities, and concentrations of constituents in wastes managed at the industrial solid waste landfill facility; and

(c) The concentrations of the appendix I constituents in the leachate from the relevant areas of the industrial solid waste landfill facility; and

(d) Any other relevant information that the director or his authorized representative deems necessary.

(3) Alternate inorganic parameter list. The owner or operator of an industrial solid waste landfill facility may propose, in writing, that an alternative list of inorganic indicator parameters be used to meet the requirements of paragraph (D)(5) of this rule in lieu of some or all of the inorganic parameters listed in appendix I of this rule. The director may approve the alternative inorganic indicator parameters if the alternative list will provide a reliable indication of inorganic releases from the industrial solid waste landfill facility to the ground water. Upon approval by the director or his authorized representative, the owner or operator may use the alternative list. The owner or operator shall, at a minimum, consider the following factors in proposing an alternative inorganic parameter list:

(a) The types, quantities, and concentrations of constituents in wastes managed at the industrial solid waste landfill facility;

(b) The mobility, stability, and persistence of waste constituents or their reaction products in the unsaturated zone beneath the industrial solid waste landfill facility;

(c) The deductibility of the indicator parameters, waste constituents, and their reaction products in the ground water; and

(d) The concentrations or values and coefficients of variation of monitoring parameters or constituents in the background ground water quality.

(4) Alternative parameters for low-yield wells not screened in the uppermost aquifer system. The owner or operator may propose in writing, that an alternative list of any of the appendix I monitoring parameters be used to meet the requirements of paragraph (D)(5)(c) of this rule for those monitoring wells not screened in the uppermost aquifer system that cannot produce enough water within a twenty-four hour period to allow for the analysis of the required parameters. The list of the appendix I monitoring parameters to be deleted shall be submitted by the owner or operator and approved by the director or his authorized representative prior to use by the owner or operator. Upon approval by the director or his authorized representative, the owner or operator may use the alternative parameter list. The owner or operator shall, at a minimum, consider the following factors in proposing an alternative list for low-yield wells not screened in the uppermost aquifer:

(a) Whether the monitoring well is constructed in accordance with paragraph (B)(3) of this rule; and

(b) Whether the well screen is properly placed across the significant zone of saturation in order to maximize yield; and

(c) A calculation of the maximum sustainable yield of the significant zone of saturation; and

(d) Field data demonstrating the time necessary for the well to recover completely after purging; and

(e) The amount of water needed to analyze for all required parameters. This should include a discussion of which parameters will be deleted and the amount of water needed to analyze for these deleted parameters as well as the listing of the parameters which will be analyzed for in the samples and how much water is required to analyze for these parameters.

(5) Monitoring parameters, frequency, location. The owner or operator shall monitor all wells in the ground water monitoring well system, during the active life of the facility (including final closure) and the post-closure care period, in accordance with the following:

(a) During the initial one hundred and eighty days after implementing the ground water detection monitoring program (the first semiannual sampling event), a minimum of four independent samples shall be collected from each monitoring well (background and downgradient) included in the ground water monitoring system in the ground water detection monitoring program and analyzed for parameters 64, 65, 70, 71, and 73 in appendix I of this rule, or the alternative parameter list approved in accordance with paragraphs (D)(2), (D)(3) and/or (D)(4) of this rule. The owner or operator of an industrial solid waste landfill facility with an existing ground water monitoring system, may use existing data with the approval of the director or his authorized representative in lieu of the first semiannual sampling event; and

(b) During subsequent semiannual sampling events, at least one sample from each monitoring well (background and downgradient) included in the ground water monitoring system in the ground water detection monitoring program must be collected and analyzed for the parameters specified in paragraph (D)(5) of this rule; and

(c) Beginning with receiving the results from the second semiannual monitoring event and semiannually thereafter, by statistically analyzing the results from all wells included in the ground water monitoring system designated in the ground water detection monitoring program for the parameters specified in paragraph (D)(5)(a) of this rule; and

(d) All monitoring wells included in the ground water monitoring system designated in the ground water detection monitoring program shall be monitored for constituents in appendix I of this rule or the alternative parameter list approved in accordance with paragraphs (D)(2), (D)(3) and/or (D)(4) of this rule at least annually during the active life of the industrial solid waste landfill facility (including final closure) and during the post-closure care period. If the owner or operator can demonstrate that waste containing the volatile organic constituents listed in appendix I of this rule has not and will not be deposited in the industrial solid waste landfill facility, then the volatile organic constituents listed in appendix I of this rule need only be sampled during the initial sampling event; and

(e) All samples collected from all monitoring wells included in the ground water monitoring system designated in the ground water monitoring program shall be field analyzed for parameters 67, 68, and 69 listed in appendix I of this rule whenever the owner or operator withdraws a sample from a monitoring well.

(6) Alternative sampling and statistical analysis frequency. During the active life (including final closure) of an industrial solid waste landfill facility and the post-closure care period, the owner or operator may propose, in writing, an alternative frequency for ground water sampling and/or statistical analysis required by paragraph (D)(5) of this rule. The director or his authorized representative may approve a proposed alternative frequency provided the alternative frequency sampling and/or analysis frequency is not less than annual. Upon approval by the director or his authorized representative, the owner or operator may use the alternative sampling/analysis frequency. The owner or operator shall, at a minimum, consider the following factors in proposing an alternative sampling and/or analysis frequency:

(a) Lithology of the aquifer system and all stratigraphic units above the uppermost aquifer system;

(b) Hydraulic conductivity of the uppermost aquifer system and all stratigraphic units above the uppermost aquifer system;

(c) Ground water flow rates for the uppermost aquifer system and all zones of saturation above the uppermost aquifer system;

(d) Minimum distance between the upgradient edge of the limits of waste placement of the industrial solid waste landfill facility and the downgradient monitoring well system; and

(e) Resource value of the uppermost aquifer system.

(7) Determination of statistically significant change in detection monitoring parameters.

(a) The owner or operator shall comply with paragraph (D)(7)(b) of this rule, if the owner or operator determines, according to the statistical procedures specified in paragraphs (C)(6) and (C)(7) of this rule, for parameters 64, 65, 70, 71, and 73 of appendix I of this rule or the alternate parameter list approved in accordance with paragraphs (D)(2) (D)(3), and/or (D)(4) of this rule in samples for all monitoring wells in the ground water monitoring system.

(b) The owner or operator shall notify the director of a statistically significant change not later than seventy-five days after withdrawing a sample from the well, that upon analysis demonstrates a statistically significant change. The notification must indicate which parameters have shown a statistically significant change from background levels; and

(c) The owner or operator may demonstrate that a source other than the industrial solid waste landfill facility caused the contamination or that the statistically significant increase resulted from error in the sampling, analysis, statistical evaluation, or natural variation in ground water quality. A report documenting this demonstration must be submitted to and approved by the director or his authorized representative. If the owner or operator does not obtain approval to continue detection monitoring within one hundred and five days from the determination that a significant increase has occurred, the owner or operator shall initiate an assessment monitoring program as required by paragraph (E) of this rule; and

(E) Ground water quality assessment monitoring program.

(1) General requirements. Unless the director approves the report submitted in accordance with paragraph (D)(7)(c) of this rule, the owner or operator shall implement a "ground water quality assessment monitoring program" capable of determining the concentration, rate, and extent of migration of leachate or leachate-derived constituent(s) in the ground water upon determining a significant change in accordance with paragraph (D)(7) of this rule. The owner or operator shall implement the "ground water quality assessment monitoring program" in accordance with the "ground water quality assessment plan" and the requirements of this rule.

(2) Submission of ground water quality assessment plan. Within one hundred and five days of notifying the director of a significant change in accordance with paragraph (D)(7)(b) of this rule, the owner or operator shall submit to the director, a "ground water quality assessment plan" for implementing the a "ground water quality assessment monitoring program" at the industrial solid waste landfill facility.

(3) Ground water quality assessment plan elements. The plan to be submitted in accordance with paragraph (E)(2) of this rule shall include, at a minimum, detailed descriptions of the following:

(a) Hydrogeologic conditions at the industrial solid waste landfill facility; and

(b) The detection monitoring program implemented by the industrial solid waste landfill facility, including:

(i) The number, location, depth, and construction of detection monitoring wells with documentation; and

(ii) A summary of detection monitoring ground water analytical data with written documentation of the results; and

(iii) A summary of statistical analyses applied to the data; and

(c) The investigatory approach to be followed during the assessment, including but not limited to:

(i) The proposed number, location, depth, installation method, and construction of assessment monitoring wells; and

(ii) The proposed method(s) for gathering additional hydrogeologic information; and

(iii) The planned use of supporting methodology (i.e., soil gas or geophysical surveys); and

(d) The techniques, procedures, and analytical equipment to be used for ground water sampling during the assessment, including but not limited to:

(i) Measurement of ground water elevations; and

(ii) Detection of immiscible layers; and

(iii) Collection of ground water samples, including:

(*a*) Well evacuation; and

(*b*) Sample withdrawal; and

(*c*) Sample containers and handling; and

(*d*) Sample preservation; and

(iv) Performance of field analysis, including:

(*a*) Procedures and forms for recording data and the exact location, time, and facility-specific conditions associated with the data acquisition; and

(*b*) Calibration of field devices; and

(v) Decontamination of equipment; and

(vi) Methods for ground water sample analysis for all leachate or leachate-derived constituents, including all constituents listed in appendix II of this rule; and

(vii) Chain of custody control including:

(*a*) Standardized field tracking reporting forms to record sample custody in the field prior to and during shipment; and

(*b*) Preprepared sample labels containing all information necessary for effective sample tracking; and

(viii) Field and laboratory quality assurance and quality control including:

(*a*) Collection of replicate samples; and

(*b*) Submission of field-bias blanks; and

(*c*) Potential interferences; and

(d) Data evaluation procedures, including but not limited to:

(i) Planned use of statistical data evaluation; and

(ii) Planned use of computer models; and

(iii) Planned use of previously gathered information; and

(iv) Criteria which will be utilized to determine if additional assessment activities are warranted; and

(f) A schedule of implementation which incorporates the requirements specified in paragraph (E)(4) of this rule.

(g) Provisions installing additional wells, as necessary, for determining the nature and extent of any release of leachate or leachate-derived constituents; and

(h) Provisions for installing at least one additional monitoring well at the facility boundary in the direction of contaminate migration and resampling this well according to the provisions of paragraph (E)(4) of this rule.

(4) Assessment monitoring schedule, frequency, and parameters.

(a) Within one hundred and five days of notifying the director of a significant change in accordance with paragraph (D)(7) of this rule, the owner or operator shall:

(i) Sample the affected well(s) and background wells and analyze the samples for all leachate or leachate-derived constituents, including all constituents listed in appendix I and appendix II of this rule; and

(ii) Within seventy-five days of commencing the sampling required in paragraph (E)(4)(a)(i) of this rule, sample all monitoring wells not sampled under paragraph (E)(4)(a)(i) of this rule. These samples shall be analyzed for those leachate or leachate-derived constituents found to be above background levels in the affected monitoring wells sampled under paragraph (E)(4)(a)(i) of this rule.

(b) The owner or operator shall sample all monitoring wells in the ground water quality assessment program:

(i) At least semiannually for

(*a*) All parameters in appendix I of this rule or the alternative parameter list approved under paragraph (D)(2), (D)(3), or (D)(4) of this rule; and

(*b*) All the constituents reported to the director in accordance with paragraph (E)(4)(c) of this rule; and

(ii) At least annually for

(*a*) All parameters in appendix II of this rule; or

(*b*) The remaining appendix II parameters if the director has deleted appendix II parameters in accordance with paragraph (E)(4)(e) of this rule.

(c) Within seventy-five days of sampling the ground water monitoring wells in accordance with paragraph (E)(4)(a) of this rule and after all subsequent samplings, the owner or operator shall place a notice in the operating record identifying all constituents that have been detected. The owner or operator shall send a copy of this notice to the appropriate Ohio EPA district office and the approved health department.

[Comment: Paragraph (C)(10) of this rule requires all ground water analysis and statistical analysis results to be submitted to the director within seventy-five days after sampling a monitoring well.]

(d) Within one hundred and eighty days of implementing the ground water quality assessment program, the owner or operator shall collect additional statistically independent samples (a minimum of four) from any background well that does not have at least four independent analysis results of each leachate or leachate-derived constituents detected in the monitoring well(s), demonstrating a statistically significant increase, to provide sufficient analysis results to statistically compare the downgradient ground water quality assessment program wells to the background wells for that parameter.

(e) Upon the written request of the owner or operator, the director may delete any of the appendix II monitoring parameters for an industrial solid waste landfill facility if the owner or operator can show that the deleted constituents are not reasonably expected to be in or derived from the waste contained in the facility.

(f) Ground water monitoring wells not included in the assessment monitoring program shall be monitored in accordance with paragraphs (B), (C), and (D) of this rule.

(5) First determination of rate, extent, and concentration. The owner or operator shall implement the "ground water quality assessment plan" which satisfies the requirements of paragraphs (E)(2), (E)(3), and (E)(4) of this rule and, at a minimum, determine:

(a) The rate and extent of migration of the leachate or leachate-derived constituents in the ground water; and

(b) The concentrations of the leachate or leachate-derived constituents in the ground water.

(6) Ground water assessment report. The owner or operator shall make a first determination according to paragraph (E)(5) of this rule within the time frame specified in the submitted "ground water quality assessment plan." The owner or operator shall submit to the director a written "ground water quality assessment report" containing an assessment of the ground water quality including all data generated as part of the implementation of the "ground water quality assessment plan."

(7) Reinstatement of detection monitoring.

(a) If the owner or operator determines that the concentrations of all leachate and leachate-derived constituents are shown to be at or below background values, using the statistical procedures described in paragraph (C)(6) of this rule for two consecutive sampling events, then the owner or operator shall request, in writing, that the director approve reinstatement of the detection monitoring program described in paragraphs (C) and (D) of this rule.

(b) The owner or operator may demonstrate that a source other than the industrial solid waste landfill facility caused the contamination, or that the statistically significant change resulted from error in sampling, analysis, statistical evaluation, or natural variation in ground water quality. A report documenting this demonstration must be submitted to the director and request that the director approve reinstatement of the detection monitoring program described in paragraphs (C) and (D) of this rule.

(c) Until the director approves reinstatement of the detection monitoring program, the owner or operator shall comply with paragraphs (E)(8) and (F) of this rule.

(8) Semiannual determination of rate, extent, and concentration. If the owner or operator determines, based on the first determination made according to paragraph (E)(5) of this rule, that leachate or leachate-derived constituents from the facility have entered the ground water, then the owner or operator shall continue to make the determination required in accordance with paragraph (E)(5) of this rule on a semiannual basis until released from this obligation by the director or unless an alternate time interval is established by the director. The owner or operator shall submit documentation of the semiannual

determination of rate, extent, and concentration with the reports required to be submitted in accordance with paragraph (E)(10) of this rule.

(9) Quarterly assessment activities report. The owner or operator shall submit, upon implementation of the "ground water quality assessment plan" submitted under paragraph (E)(1) of this rule, a report on the activities being conducted at the facility as part of implementation of the "ground water quality assessment plan." This report shall be submitted quarterly and contain the following:

(a) A narrative description of all assessment activities that have occurred since the previous report; and

(b) All data generated as part of the assessment program since the previous report.

(F) Corrective measures program.

(1) General requirements. Unless the director reinstates the detection monitoring program in accordance with paragraph (E)(7) of this rule, upon determining in accordance with paragraph (E) of this rule that leachate or leachate-derived constituents have been detected in the ground water the owner or operator shall implement a "corrective measures program" capable of evaluating all practicable ground water remediation procedures, attaining the concentration level for leachate or leachate-derived constituents detected in the ground water, controlling the source of the release, and eliminating further releases. The owner or operator shall implement the "corrective measures program" in accordance with the "corrective measures plan" and the requirements of this rule.

(2) Submission of corrective measures plan. Within one hundred and eighty days of making a first determination in accordance with paragraph (E)(5) of this rule, the owner or operator shall submit a corrective measures plan to the director. The "corrective measures plan" shall evaluate all practicable remediation procedures which are available for remediating any contamination discovered during the "ground water quality assessment monitoring program." The evaluated remediation procedures shall, at a minimum:

(a) Be protective of human health and the environment; and

(b) Attain the proposed ground water concentration levels specified in accordance with paragraph (F)(7) of this rule; and

(c) Control the source(s) of releases to reduce or eliminate, to the maximum extent practicable, further releases of leachate or leachate-derived constituents into the environment; and

(d) Comply with standards for management of wastes as specified in paragraph (F)(13) of this rule.

(3) The owner or operator shall evaluate each proposed remediation procedure within the corrective measures plan. This evaluation shall, at a minimum, consider:

(a) Any potential remediation procedure, which shall be assessed for the long-term and short-term effectiveness and the protection it affords. This shall include the degree of certainty that the remediation procedure will prove successful. Factors to be considered include:

(i) Magnitude of reduction of existing risks; and

(ii) Magnitude of residual risks in terms of likelihood of further releases due to waste remaining following implementation of a remediation procedure; and

(iii) The type and degree of long-term management required, including monitoring, operation, and maintenance; and

(iv) Short-term risks that may affect the community, workers, or the environment during implementation of such a remediation procedure, including potential threats to human health and the environment associated with excavation, transportation, redisposal, or containment; and

(v) Potential for human and environmental receptor exposure to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, redisposal, or containment; and

(vi) Long-term reliability of the engineering and institutional controls; and

(vii) Potential need for replacement of the remediation procedure; and

(viii) Time until full protection is achieved; and

(b) The effectiveness of the remediation procedure in controlling the source in order to reduce further releases, including:

(i) The extent to which containment practices will reduce further releases; and

(ii) The extent to which treatment technologies may be used; and

(c) The need to coordinate with, and obtain necessary approvals and permits from, other agencies; and

(d) The available capacity and location of needed treatment, storage, and disposal services; and

(e) The ease or difficulty of implementing a potential remedy(s) based on consideration of the following types of factors:

(i) Degree of difficulty associated with constructing the technologies;

(ii) Expected operation reliability of the technologies; and

(iii) Availability of necessary equipment and specialists; and

(f) The degree to which community concerns are addressed by a potential corrective measure;

(g) The performance, reliability, ease of implementation, and potential impacts of the potential remediation procedures, including safety impacts, cross-media impacts, and control of exposure to any residual contamination; and

(h) A schedule for initiating and completing each remediation procedure discussed in the plan. In establishing this schedule, the owner or operator shall consider:

(i) The extent and nature of any contamination; and

(ii) The practical capability of remedial technologies to achieve compliance with ground water concentration levels established in accordance with paragraph (F)(6) of this rule and other objectives of the remediation procedure; and

(iii) The availability of treatment or disposal capacity for wastes managed during implementation of the remediation procedure; and

(iv) The desirability of utilizing technologies that are not currently available, but which may offer significant advantages over currently available technologies in terms of protection, reliability, safety, or the ability to achieve remedial objectives; and

(v) Potential risks to human health and the environment from contaminant exposure prior to completion of the remediation procedure; and

(vi) Practicable capability of the owner or operator; and

(vii) Other relevant factors; and

(i) Resource value of the aquifer system, including:

(i) Current and future uses; and

(ii) Proximity and withdrawal rate of users; and

(iii) Ground water quantity and quality; and

(iv) The potential damage to wildlife, crops, vegetation, and physical structures resulting from exposure to waste constituents; and

(v) The hydrogeologic characteristics of the facility and surrounding area; and

(vi) Ground water removal and treatment costs; and

(vii) The cost and availability of alternate water supplies.

(j) Practical capability of the owner or operator; and

(k) Other relevant factors.

(4) [Reserved]

(5) The director or his authorized representative may require the owner or operator to evaluate, as part of the corrective measures study, one or more specific potential remediation procedure(s).

(6) Interim corrective measures. If, at any time during the assessment described in paragraphs (E) and (F) of this rule, the director determines that the facility threatens human health or the environment, the director may require the owner or operator to implement the following measures:

(a) Notify all persons, via certified mail, who own the land or reside on the land that directly overlies or lies adjacent to any part of the plume of contamination; and

(b) Take any interim measures deemed necessary by the director to ensure the protection of human health and the environment. Interim measures should, to the extent practicable, be consistent with the objectives of and contribute to the performance of any remediation procedure that may be required pursuant to paragraphs (F)(1), (F)(2), (F)(3), and (F)(7) of this rule. The following factors may be considered by the director in determining whether interim measures are necessary:

(i) The amount of time required to develop and implement a final remediation procedure; and

(ii) Actual or potential exposure of nearby populations or environmental receptors to leachate or leachate-derived constituents; and

(iii) Actual or potential contamination of drinking water supplies or sensitive ecosystems;

(iv) Any further degradation of the ground water that may occur if remedial action is not initiated expeditiously; and

(v) Weather conditions that may cause leachate or leachate-derived constituents to migrate or be released; and

(vi) Risks of fire, explosion, or potential for exposure to leachate or leachate-derived constituents as a result of an accident or failure of a container or handling system; and

(vii) Other situations that threaten human health and the environment.

(7) Concentration levels for contaminants. The corrective measures plan shall propose a concentration level for each leachate or lea-

chate-derived constituent which has been detected in the ground water at a statistically significant level. These shall be established as follows:

(a) The proposed concentration levels in the ground water shall be protective of human health and the environment; and

(b) Unless an alternate level is deemed necessary to protect environmental receptors, then:

(i) For constituents for which a maximum contaminant level has been promulgated under section 1412 of the federal Safe Drinking Water Act (40 Code of Federal Regulations Part 141), the maximum contaminant level for that constituent;

(ii) For constituents for which maximum contaminant levels have not been promulgated, the background concentration for the constituent from wells in accordance paragraphs (C)(4) and (C)(5) of this rule; and

(iii) If the owner or operator can demonstrate to the director that a leachate or leachate-derived constituent is already present in the ground water at a background level, then the proposed concentration levels shall not be set below background levels unless the director determines that cleanup to levels below background levels is necessary to protect human health and the environment and such cleanup is in connection with an area-wide remedial action under other authorities.

(c) In establishing the proposed concentration levels that meet the requirements of paragraph (F)(7)(b) of this rule, the permittee shall consider the following:

(i) Multiple contaminants in the ground water; and

(ii) Exposure threat to sensitive environmental receptors; and

(iii) Other site-specific exposure or potential exposure to ground water; and

(iv) The reliability, effectiveness, practicability, and other relevant factors of the remediation procedure; and

(d) The director or his authorized representative may establish an alternative ground water protection standard for constituents for which maximum contaminant levels have not been established. These ground water protection standards shall be appropriate health based levels that satisfy the following criteria:

(i) The level is derived in a manner consistent with federal guidelines for assessing the health risks of environmental pollutants;

(ii) The level is based on scientifically valid studies conducted in accordance with the federal Toxic Substance Control Act good laboratory practice standards (40 Code of Federal Regulations Part 792) or equivalent standards;

(iii) For known or suspected carcinogens, the proposed concentration levels shall be established at concentration levels below those that represent a cumulative (due to lifetime exposure) excess upper-bound lifetime cancer risk to an individual within the 1×10^{-4} to 1×10^{-6} range; and

(iv) For systematic toxicants, the proposed concentration levels shall be reduced to levels to which the human population (including sensitive subgroups) could be exposed on a daily basis without appreciable risk of deleterious effects during a lifetime. For the purposes of this rule, "systematic toxicants" include toxic chemicals that cause effects other than cancer or mutation.

(8) Determination that remediation is not necessary. The director may determine that remediation of a release of leachate or leachate-derived constituents from the industrial solid waste landfill facility is not necessary if the owner or operator demonstrates the following:

(a) The ground water is additionally contaminated by substances that have originated from a source other than the industrial solid waste landfill facility and those substances are present in concentrations such that cleanup of the release from the industrial solid waste landfill facility would provide no significant reduction in risk to actual or potential receptors; or

(b) The constituent(s) is present in ground water that,

(i) Is not currently or reasonably expected to be a source of drinking water; and

(ii) Is not hydraulically connected with waters to which the leachate or leachate-derived constituent(s) are migrating or are likely to migrate in a concentration(s) that would exceed the ground water concentration levels established under paragraph (F)(6) of this rule; or

(c) Remediation of release(s) is technically impractical; or

(d) Remediation results in unacceptable cross-media impacts.

(9) A determination by the director pursuant to paragraph (F)(8) of this rule shall not affect the director's authority to require the owner or operator to undertake source control measures or other measures that may be necessary to eliminate or minimize further releases to ground water, to prevent exposure to ground water, or to remediate ground water to concentrations that are technically practicable and significantly reduce threats to human health and the environment.

(10) Selection of corrective measure. The director shall select from the corrective measures plan, or designate according to paragraph (F)(6) of this rule, the corrective measure which best meets the criteria listed in paragraphs (F)(2), (F)(3), and (F)(7) of this rule. The owner or operator shall implement the corrective measure designated by the director in accordance with the schedule of implementation selected by the director.

(11) Determination that corrective measure is not technically practicable. The director may determine, based on information developed by the owner or operator after implementation of the remediation procedure has begun, or from other information, that compliance with the requirements(s) for the remediation procedure selected under paragraph (F)(10) of this rule is not technically practicable. In making such a determination, the director shall consider:

(a) The owner's or operator's efforts to achieve compliance with the requirement(s); and

(b) Whether other currently available or new methods or techniques could practicably achieve compliance with the requirements.

(12) Alternative measures. If the director determines that compliance with a remediation procedure requirement is not technically practicable, then the director may require that the owner or operator:

(a) Implement alternate measures to control human or environmental receptor exposure to residual contamination, as necessary, to protect human health and the environment; and

(b) Implement alternate measures for control of the sources of contamination, or for removal or decontamination of equipment, units, devices, or structures required to implement the remediation procedure(s), that are:

(i) Technically practicable; and

(ii) Consistent with the overall objective of the remediation procedure.

(13) All solid wastes that are managed pursuant to a remediation procedure required under paragraph (F)(9) of this rule, or an interim measure required under paragraph (F)(6) of this rule, shall be managed in a manner:

(a) That is protective of human health and the environment; and

(b) That complies with applicable laws and regulations.

(14) Quarterly corrective measures activities report. The owner or operator shall submit, upon implementation of the remediation procedure chosen under paragraph (F)(9) of this rule, a report of the activities being conducted at the facility as part of implementation of the corrective measures program. This report shall be submitted quarterly and contain:

(a) A narrative description of all remedial activities that have occurred since the previous report; and

(b) All data generated as part of the remedial activities at the facility.

(15) Completion of corrective measures. The corrective measures selected pursuant to paragraph (F)(10) of this rule shall be considered complete when:

(a) The owner or operator complies with the ground water protection standards established under paragraph (F)(7) of this rule at all points within the plume of contamination that lie beyond the limits of waste placement; and

(b) Compliance with the ground water protection standards established under paragraph (F)(7) of this rule has been achieved by demonstrating semiannually via ground water monitoring that the contamination has not exceeded the ground water protection standard(s) for a period of three years or until the end of the post-closure care period, whichever is longer, using the statistical procedures and performance standards in paragraphs (C)(6) and (C)(7) of this rule. The director may specify an alternative length of time during which the owner or operator shall demonstrate that the contamination has not exceeded the ground water protection standard(s) taking into account the following considerations:

(i) Extent and concentration of the contamination;

(ii) Behavior characteristics of the contamination in the ground water;

(iii) Accuracy of monitoring or modeling techniques, including any seasonal, meteorological, or other environmental variabilities that may affect the accuracy; and

(iv) Characteristics of the ground water; and

(c) All actions required to complete the corrective measure have been satisfied.

(16) Certification corrective measures completed. Upon completion of the corrective measure, the owner or operator shall certify within fourteen days to the director that the corrective measure has been completed in compliance with paragraph (F)(15) of this rule. The certification shall be signed by the owner or operator and a qualified ground water scientist.

(Effective June 1, 1994)

Appendix I

Compound[1]	CAS RN[2]
1) Antimony	See Note 3
2) Arsenic	See Note 3
3) Barium	See Note 3
4) Beryllium	See Note 3
5) Cadmium	See Note 3
6) Chromium	See Note 3
7) Cobalt	See Note 3
8) Copper	See Note 3
9) Lead	See Note 3
10) Nickel	See Note 3
11) Selenium	See Note 3
12) Silver	See Note 3
13) Thallium	See Note 3
14) Vanadium	See Note 3
15) Zinc	See Note 3
16) Acetone	67-64-1
17) Acrylonitrile	107-13-1
18) Benzene	71-43-2
19) Bromocholoromethane	74-97-5
20) Bromodichloromethane	75-27-4
21) Bromoform; Tribromomethane	75-25-2
22) Carbon disulfide	75-15-0
23) Carbon tetrachloride	56-23-5
24) Chlorobenzene	108-90-7
25) Chloroethane; Ethyl Chloride	75-00-3
26) Chloroform; Trichloromethane	67-66-3
27) Dibromochloromethane; Chlorodibromomethane	124-48-1
28) 1,2-Dibromo-3-chloropropane; DBDP	96-12-8
29) 1,2-Dibromomethane; Ethylene dibromide; EDB	106-93-4
30) o-Dichlorobenzene; 1,2-Dichlorobenzene	95-50-1
31) p-Dichlorobenzene; 1,4-Dichlorobenzene	106-46-7
32) trans-1,4-Dichloro-2-butene	110-57-6
33) 1,1-Dichloroethane; Ethylidene chloride	75-34-3
34) 1,2-Dichloroethane; Ethylidene dichloride	107-06-2
35) 1,1-Dichloroethylene; 1,1-Dichloroethane; Vinylidene chloride	75-35-4
36) cis-1,2-Dichloroethylene; cis-1,2-Dichloro-ethene	156-59-2
37) trans-1,2-Dichloroethylene; trans-1,2-Dichloro-ethene	156-60-5
38) 1,2-Dichloropropane; Propylene dichloride	78-87-5
39) cis-1,3-Dichloropropene	10061-01-5
40) trans-1,3-Dichloropropene	10061-02-6
41) Ethylbenzene	100-41-4
42) 2-Hexanone (Methyl butyl ketone)	591-78-6
43) Methyl bromide; Bromomethane	74-83-9
44) Methyl chloride; Chloromethane	74-87-3
45) Methylene bromide; Dibromomethane	74-95-3
46) Methylene chloride; Dichloromethane	75-09-2
47) Methyl ethyl ketone; MEK; 2-Butanone	78-93-3
48) Methyl iodine; Idomethane	74-88-4
49) 4-Methyl-2-pentanone; Methyl isobutyl ketone	108-10-1
50) Styrene	100-42-5

Compound[1]	CAS RN[2]
51) 1,1,1,2-Tetrachloroethane	630-20-6
52) 1,1,2,2-Tetrachloroethane	79-34-5
53) Tetrachloroethylene; Tetrachloroethene; Perchloroethylene	127-18-4
54) Toluene	108-88-3
55) 1,1,1-Trichloroethane; Methylchloroform	71-55-6
56) 1,1,2-Trichloroethane	79-00-5
57) Trichloroethylene; Trichloroethene	79-01-6
58) Trichloroflouromethane; CFC-11	75-69-4
59) 1,2,3-Trichloropropane	96-18-4
60) Vinyl acetate	108-05-4
61) Vinyl chloride	75-01-4
62) Xylenes	See Note 4
63) Ammonia	
64) Chloride	
65) Sodium	
66) Chemical oxygen demand	
67) Temperature	
68) pH	
69) Specific conductance	
70) Total dissolved solids	
71) Total alkalinity	
72) Nitrate-nitrite	
73) Sulfate	
74) Magnesium	
75) Calcium	
76) Potassium	
77) Turbidity	
78) Iron	
79) Manganese	

Note 1. Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

Note 2. Chemical Abstract Service registry number.

Note 3. Analysis for these compounds shall be representative of the quality background ground water that has not been affected by past or present operations at the industrial waste landfill facility and representative of the quality of ground water passing directly downgradient of the limits of solid waste placement.

Note 4. Xylene (total): This entry includes o-Xylene (CAS RN 96-47-6), m-Xylene (CAS RN 108-38-3), p-Xylene (CAS RN 106-42-3), and unspecified Xylenes (Dimethylbenzenes) (CAS RN 1330-20-7).

Appendix II

Compound[1]	**CAS RN**[2]
1) Acenaphthene; 1,2-Dihydroacenaphthylene	83-32-9
2) Acenaphthylene	208-96-8
3) Acetone; 2-Propanone	67-64-1
4) Anthracene	120-12-7
5) Antimony	see note 3
6) Arsenic	see note 3
7) Barium	see note 3
8) Benzene	71-43-2
9) Benzo[a]pyrene	50-32-8
10) Beryllium	see note 3
11) alpha-BHC; 1,2,3,4,5,6-Hexachlorocyclohexane, (1*a*,2*a*,3*b*,4*a*,5*b*,6*B*)	319-84-6[4]
12) beta-BHC; 1,2,3,4,5,6-Hexachlorocyclohexane, (1*a*,2*b*,3*a*,4*b*,5*a*,6*b*)	319-85-7[4]
13) delta-BHC; 1,2,3,4,5,6-Hexachlorocyclohexane, (1*a*,2*a*,3*a*,4*b*,5*a*,6*b*)	319-86-8[4]
14) gamma-BHC; Lindane; 1,2,3,4,5,6-Hexachlorocyclohexane, (1*a*,2*a*,3*B*,4*a*,5*a*,6*B*)	58-89-9[4]
15) bis(2-Chloroethyl) ether; Dichloroethyl ether; 1,1'-oxybis[2-Chloroethane]	111-44-4
16) bis-(2-Chloro-1-methylethyl) ether; 2,2'-Dichloro diisopropyl ether; DCIP; 2,2'-oxybis[1-Chloro propane]	see note 5
17) bis(2-Ethylhexyl) phthalate; 1,2-Benzenedicarboxylic acid, bis(2-Ethylhexyl) ester	117-81-7
18) Bromodichloromethane; Dibromochloromethane	75-27-4
19) Bromoform; Tribromomethane	75-25-2
20) Butyl benzyl phthalate; Benzyl Butyl Phthalate; 1,2-Benzenedicarboxylic acid, butyl phenylmethyl ester	85-68-7
21) Cadmium	see note 3
22) Carbon disulfide	75-15-0
23) Carbon tetrachloride; Tetrachloromethane	56-23-5
24) Chlordane; 1,2,4,5,6,8,8-octochloro-2,3,3a,4,7,7a-hexahydro-4,7-Methano-1H-indene	see note 6
25) Chlorobenzene	108-90-7
26) p-Chloro-m-cresol; 4-Chloro-3-methylphenol	59-50-7
27) Chloroethane; Ethyl chloride	75-00-3
28) Chloroform; Trichloromethane	67-66-3
29) 2-Chlorophenol	95-57-8
30) Chromium	Total
31) Chrysene	218-01-9
32) Cobalt	Total
33) Copper	Total
34) m-Cresol; 3-methylphenol	108-39-4
35) o-Cresol; 2-methylphenol	95-48-7
36) p-Cresol; 4-methylphenol	106-44-5
37) Cyanide	57-12-5
38) 2,4-D; 2,4-Dichlorophenoxyacetic acid	94-75-7
39) 4,4'-DDD; 1,1'-(2,2-Dichloroethylidene)bis [4-chlorobenzene]	72-54-8
40) 4,4'-DDE; 1,1'-(2,2-Dichloroethyenylidene)bis [4-chlorobenzene]	72-55-9

Compound[1]	CAS RN[2]
41) 4,4'-DDT; 1,1'-(2,2,2-Trichloroethylidene)bis [4-chlorobenzene]	50-29-3
42) Dibromocholormethane; Chlorodibromomethane	124-48-1
43) Di-n-butyl phthalate; 1,2-Benzenedicarboxylic acid dibutyl ester	84-74-2
44) o-Dichlorobenzene; 1,2-Dichlorobenzene	95-50-1
45) m-Dichlorobenzene; 1,3-Dichlorobenzene	541-73-1
46) p-Dichlorobenzene; 1,4-Dichlorobenzene	106-46-7
47) Dichlorodifluoromethane; CFC 12	75-71-8
48) 1,1-Dichloroethane; Ethylidene chloride	75-34-3
49) 1,2-Dichloroethane; Ethylene dichloride	107-06-2
50) 1,1-Dichloroethylene; 1,1-Dichloroethene; Vinylidene chloride	75-35-4
51) trans-1,2-Dichloroethylene; trans-1,2-Dichloro ethene	156-60-5
52) 2,4-Dichlorophenol	120-83-2
53) 1,2-Dichloropropane; Propylene dichloride	78-87-5
54) Dieldrin; 3,4,5,6,9,9-Hexachloro-1a,2,2a,3,6,6a, 7,7a-octahydro-2,7:3,6-dimethanonaphthalene [2,3-b]oxirene, (la*a*,2*b*,2a*a*,3*B*,6*B*,6a*a*,7*B*,7a*a*)	60-57-1[4]
55) Diethyl phthalate; 1,2-Benzenedicarboxylic acid, diethyl ester	84-66-2
56) 2,4-Dimethylphenol; m-Xylenol	105-67-9
57) Dimethyl phthalate; 1,2-Benzenedicarboxylic acid, Dimethyl ester	131-11-3
58) 4,6-Dinitro-o-cresol; 4,6-Dinitro-2-methylphenol; 2-methyl-4,6-dinitrophenol	534-52-1
59) Di-n-octyl phthalate; 1,2-Benzenedicarboxylic acid, Dioctyl ester	117-84-0
60) Endosulfan I; 6,7,8,9,10,10-Hexachloro-1,5,5a,6,9, 9a-hexahydro-6,9-methano-2,4,3-benzodioxa thiepin, 3-oxide	959-98-8
61) Endosulfan II; 6,7,8,9,10,10-Hexachloro-1,5,5a,6,9, 9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin, 3-oxide (3*a*,5a*a*,6*b*,9*b*,9a*a*)	33213-65-9[4]
62) Endrin; 3,4,5,6,9,9,-Hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-2,7:3,6-dimethanonaphth[2,3-b]oxirene, (la*a*,2*B*,2a*B*,3*a*,6*a*,6a*B*,7*B*,7a*a*)	72-20-8[4]
63) Ethylbenzene	100-41-4
64) Flouranthene	206-44-0
65) Flourene; 9H-Flourene	86-73-7
66) Heptachlor; 1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-methano-1H-indene	76-44-8
67) Heptachlor epoxide; 2,3,4,5,6,7,7-Heptachloro-1a,1b, 5,5a,6,6a-hexahydro-2,5-methano-2H-indeno [1,2-b]oxirene, (1a*a*,1b*B*,2*a*,5*a*,5a*B*,6*B*,6a*a*)	1024-57-3[4]
68) Hexachlorobenzene	118-74-1
69) Hexachlorobutadiene; 1,1,2,3,4,4-Hexachloro-1,3-butadiene	87-68-3
70) Hexachlorocyclopentadiene; 1,2,3,4,5,5-Hexachloro-1,3-cyclopentadiene	77-47-4
71) Hexachloroethane	67-72-1
72) 2-Hexanone; Methyl butyl ketone	591-78-6
73) Lead	Total

Compound[1]	CAS RN[2]
74) Mercury	Total
75) Methoxychlor; 1,1'-(2,2,2-Trichloroethylidene) bis [4-methoxybenzene]	72-43-5
76) Methyl chloride; Chloromethane	74-87-3
77) Methyl ethyl ketone; MEK; 2-Butanone	78-93-3
78) 4-Methyl-2-pentanone; Methyl isobutyl ketone	108-10-1
79) Methylene chloride; Dichloromethane	75-09-2
80) Naphthalene	91-20-3
81) Nickel	see note 3
82) Nitrobenzene	98-95-3
83) o-Nitrophenol; 2-Nitrophenol	88-75-5
84) p-Nitrophenol; 4-Nitrophenol	100-02-7
85) N-Nitrosodiphenylamine; N-nitroso-N-phenyl benzenamine	86-30-6
86) Pentachlorophenol	87-86-5
87) Phenanthrene	85-01-8
88) Phenol	108-95-2
89) Polychlorinated biphenyls; PCBs; Aroclors; 1,1'-Biphenyl, chloro derivatives	see note 7
90) Pyrene	129-00-0
91) Selenium	see note 3
92) Silver	see note 3
93) Silvex; 2,4,5-TP; 2-(2,4,5-Trichlorophenoxy)Propanoic acid	93-72-1
94) Styrene; Ethenylbenzene	100-42-5
95) Sulfide	18496-25-8
96) 1,1,2,2-Tetrachloroethane	79-34-5
97) Tetrachloroethylene; Tetrachloroethene; Perchloroethylene	127-18-4
98) Thallium	see note 3
99) Tin	see note 3
100) Toluene; Methylbenzene	108-88-3
101) Toxaphene	see note 8
102) 1,2,4-Trichlorobenzene	120-82-1
103) 1,1,1-Trichloroethane; Methylchloroform	71-55-6
104) 1,1,2-Trichloroethane	79-00-5
105) Trichloroethylene; Trichloroethene	79-01-6
106) Trichlorofluoromethane; CFC-11	75-69-4
107) 2,4,6-Trichlorophenol	88-06-2
108) Vanadium	see note 3
109) Vinyl acetate; Acetic acid, Ethenyl ester	108-05-4
110) Vinyl chloride; Chloroethene	75-01-4
111) Xylene (Total); Dimethylbenzene	see note 9
112) Zinc	see note 3

Note 1: Common names are those widely used in government regulation, scientific publications, and commerce; synonyms exist for many chemicals.

Note 2: Chemical Abstract Service registry number. Where "Total" is entered, all species in ground water that contain this element are included.

Note 3: Analysis for these compounds shall be representative of the quality background ground water that has not been affected by past or present operations at the industrial waste landfill facility and representative of the quality of ground water passing directly downgradient of the limits of solid waste placement.

Note 4: When numbers and letters appear in this form at the end of a chemical name, i.e.

(1*a*,4*a*,4a*B*,5*a*,8*a*,8a*B*), the following applies: "a" = small case "a"; "*a*" (italic) = alpha; "b" = small case "b"; and "*B*" (italic) = beta.

Note 5: CAS No. 108-60-1. This substance is often called bis(2-Chloroisopropyl) ether, the name Chemical Abstracts Service applies to its commercial isomer, Propane, 2,2"-oxybis[2-chloro- (CAS RN 39638-32-9).

Note 6: Chlordane: This entry includes alpha-chlordane (CAS RN 5103-71-9), beta-chlordane (CAS RN 5103-74-2), gamma-chlordane (CAS RN 5566-34-7), and constituents of chlordane (CAN RN 54-74-9 and CAS RN 12789-03-06).

Note 7: Polychlorinated biphenols (CAS RN 1336-36-3); This category contains congener chemicals, including constituents of Aroclor 1016 (CAS RN 12674-11-2), Aroclor 1221 (CAS RN 11104-28-2), Aroclor 1232 (CAS RN 11141-16-5), Aroclor 1242 (CAS RN 53469-21-9), Aroclor 1248 (CAS RN 12672-29-6), Aroclor 1254 (CAS RN 11097-69-1), and Aroclor 1260 (CAS RN 11096-82-5).

Note 8: Toxaphene: This entry includes congener chemicals contained in technical toxaphene (CAS RN 8001-35-2, i.e., chlorinated camphene.

Note 9: Xylene (total): This entry includes o-xylene (CAS RN 96-47-6), m-xylene (CAS RN 108-38-3), p-xylene (CAS RN 106-42-3), and unspecified xylenes (dimethylbenzenes) (CAS RN 1330-20-7).

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ATTACHMENT C

INTEGRATED SURVEILLANCE AND MAINTENANCE PLAN FOR THE PORTSMOUTH GASEOUS DIFFUSSION PLANT, PIKETON, OHIO

Environmental
Protection Agency
John R. Kasich, **Governor**
Mary Taylor, **Lt. Governor**
Scott J. Nally, **Director**

RECEIVED
JUN 29 2011
AH

June 27, 2011

US DOE-PORTS
PIKE COUNTY
DERR CORRESPONDENCE

Joel Bradburne, Site Lead
Portsmouth/Paducah Project Office
US Department of Energy
Post Office Box 700
Piketon, Ohio 45661

Kristi Wiehle, Site Coordinator
Portsmouth/Paducah Project Office
US Department of Energy
Post Office Box 700
Piketon, Ohio 45661

RE: US DOE Request for Approval of the Revised Integrated Surveillance and Maintenance Plan

Dear Mr. Bradburne and Ms. Wiehle:

Ohio EPA is in receipt of the revised Integrated Surveillance and Maintenance (S&M) Plan for the Portsmouth Gaseous diffusion Plant, submitted to this office on June 16, 2011 via e-mail. The purpose of the plan is twofold: 1) to incorporate post-closure operations and maintenance for closed hazardous and solid waste land disposal units, and 2) provide S&M plans for areas where corrective measures have been implemented as part of the Resource Conservation and Recovery Act (RCRA) Corrective Action Program. The plan provides for a systematic approach for the continued long-term maintenance of each unit addressed.

The revised plan incorporates changes made pertaining to the X-749/120 Ground Water Plume corrective action maintenance activities. The phytoremedial maintenance actions were removed from the plan in response to Ohio EPA comments on the "First Five Year Review for the X-749/120 Ground Water Plume". As noted in your correspondence, Ohio EPA and US DOE will be discussing the current surveillance, operation, and maintenance activities performed on the extraction system in the X-749/120 Ground Water Plume area as well as other potential modifications and updates to the plan.

Southeast District Office
2195 Front Street
Logan, OH 43138-8637

740 | 385 8501
740 | 385 6490 (fax)
www.epa.ohio.gov

US DOE has revised the S&M Plan in accordance with the May 26, 2011 Ohio EPA correspondence. The revised S&M Plan is approved in accordance with the requirements of the Ohio Consent Decree and the Director's Final Findings and Orders for Integration.

If you have any questions regarding this correspondence, please do not hesitate to contact me at 740-380-5289 or maria.galanti@epa.ohio.gov.

Sincerely,

M. Galanti

Maria Galanti
Site Coordinator
Division of Environmental Response and Revitalization

MG/jg

cc: Dennis Carr, FPB, LLC
Vincent Adams, Site Director, PPPO-PORTS
William Murphie, Manager, Portsmouth/Paducah Project Office

Department of Energy

Portsmouth/Paducah Project Office
1017 Majestic Drive, Suite 200
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(859) 219-4000

JUN 15 2011

PPPO-03-1225395-11

Ms. Maria Galanti
Ohio Environmental Protection Agency
Southeast District Office
2195 Front Street
Logan, Ohio 43138

Mr. Harry Sarvis
Manager, Compliance Assurance Section
Ohio Environmental Protection Agency
50 West Town Street, Suite 700
Columbus, Ohio 43215

Dear Madam and Sir:

INTEGRATED SURVEILLANCE AND MAINTENANCE PLAN FOR THE PORTSMOUTH GASEOUS DIFFUSION PLANT, PIKETON, OHIO (DOE/PPPO/03-0084&D2)

Reference: Letter from M. Galanti to J. Bradburne and K. Wiehle, "The First Five-Year Review for the X-749/120 Ground Water Plume – Ohio EPA Response to U.S. DOE Correspondence," dated May 26, 2011

Enclosed for your approval is the revised *Integrated Surveillance and Maintenance Plan (ISMP) for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE/PPPO/03-0084&D2). In accordance with the requirements of the Ohio Consent Decree and the Director's Final Findings and Orders for Integration, the Ohio Environmental Protection Agency (Ohio EPA) approved the Department of Energy's (DOE) request for removal of the surveillance and maintenance (S&M) requirements for the X-749/X-120 Phytoremediation Area in correspondence dated May 26, 2011. The enclosed document has been revised to remove the S&M requirements for the X-749/X-120 Phytoremediation Area.

In the same correspondence, Ohio EPA stated that DOE must maintain the extraction wells and provide Ohio EPA with an S&M plan for the components of the extraction system. Per our discussions, DOE proposes a meeting with Ohio EPA to discuss the surveillance, operation, and maintenance activities that are performed on the extraction system in lieu of submitting a separate S&M plan for the extraction system at this time.

In the near future, DOE would also like to meet with Ohio EPA and discuss additional updates to the ISMP. A redline version of the proposed updates is available upon request to aid in your review.

If you have any questions, please contact Kristi Wiehle of my staff at (740) 897-5020.

Sincerely,

Joel B. Bradburne
Portsmouth Site Lead
Portsmouth/Paducah Project Office

Enclosure:
Integrated Surveillance and Maintenance Plan (DOE/PPPO/03-0084&D2)

cc w/enclosure:
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Administrative Records
PPPO Records, LEX

Integrated Surveillance and Maintenance Plan for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio

U.S. Department of Energy
DOE/PPPO/03-0084&D2

June 2011

By
FBP LLC, a Joint Venture Under Contract DE-AC30-10CC40017

FBP-ER-GEN-RPT-0020, Revision 1

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Integrated Surveillance and Maintenance Plan for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio

U.S. Department of Energy
DOE/PPPO/03-0084&D2

June 2011

By
FBP LLC, a Joint Venture Under Contract DE-AC30-10CC40017

FBP-ER-GEN-RPT-0020, Revision 1

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CONTENTS

TABLES

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ACRONYMS

CMI	corrective measures implementation
DOE	U.S. Department of Energy
HDPE	high density polyethylene
IGWMP	*Integrated Groundwater Monitoring Plan*
ISMP	*Integrated Surveillance and Maintenance Plan*
MSDS	material safety data sheet
OAC	Ohio Administrative Code
Ohio EPA	Ohio Environmental Protection Agency
PK Landfill	X-749B Peter Kiewit Landfill
PORTS	Portsmouth Gaseous Diffusion Plant
PPE	personal protective equipment
RCRA	Resource Conservation and Recovery Act
S&M	surveillance and maintenance
SWMU	solid waste management unit
TCE	trichloroethene
VOC	volatile organic compound

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1. GENERAL INFORMATION

1.1 SITE DESCRIPTION

The Portsmouth Gaseous Diffusion Plant (PORTS) is located near Piketon, Ohio, in the south-central portion of the state. The principal process at the PORTS facility was the separation of uranium isotopes through gaseous diffusion. The active or industrialized portion of the plant site encompasses approximately 1000 acres of the 3777-acre site.

The U.S. Department of Energy (DOE) manages the environmental restoration and waste management activities at PORTS in compliance with all applicable state and federal regulations. The fundamental objective of this program is to ensure that risks posed to the environment and to human health and safety due to radioactive, hazardous, and mixed wastes are either eliminated or reduced to levels deemed safe by the regulatory agencies.

A number of solid and/or hazardous waste management units are present at PORTS. Environmental restoration (i.e. remediation) of many of these areas is being completed under requirements of the Resource Conservation and Recovery Act (RCRA). Several landfills have been closed under requirements for landfills used to dispose of hazardous waste, solid waste, or construction and demolition debris. Other solid waste management units (SWMUs) at PORTS have been addressed under RCRA Corrective Action Program requirements. Implementation of corrective measures has been completed at a number of these SWMUs.

1.2 PURPOSE OF PLAN

This document, the *Integrated Surveillance and Maintenance Plan* (ISMP), has been prepared at the request of the Ohio Environmental Protection Agency (Ohio EPA) to incorporate (1) post-closure operations and maintenance for closed hazardous and solid waste land disposal units, and (2) surveillance and maintenance (S&M) plans for areas where corrective measures have been implemented as part of the RCRA Corrective Action Program.

Operation, inspection, and/or maintenance procedures for the units addressed in this document are required by the 1989 U.S. EPA Administrative Consent Order (amended 1997), the 1999 Ohio EPA Director's Final Findings and Orders, and/or decision documents for the specific units included in this plan. This document includes inspection, operation, and maintenance requirements for each unit that requires an S&M plan.

This plan provides a systematic approach for the continued long-term maintenance of each unit addressed. The information contained in this S&M plan is based on manufacturer recommendations, industry standards (when no manufacturer recommendations are available), or EPA standards. Routine groundwater monitoring may be required at the units included in this plan. Groundwater monitoring requirements are provided in the latest revision of the *Integrated Groundwater Monitoring Plan* (IGWMP) (DOE 2010a).

1.3 REVISIONS TO PLAN

When necessary to reflect actual conditions, the procedures presented or referenced in this plan will be revised to reflect any improvements or changes to the system components, or changes in the Ohio EPA standards affecting or governing the S&M of the selected remedy. Each revision to this document will be submitted to the Ohio EPA for review and approval.

1.3.1 X-740 Groundwater Area

As noted in previous correspondence and during meetings with Ohio EPA, the initial remedy selected for the X-740 Groundwater Area (phytoremediation) was not performing in accordance with the requirements of the Quadrant III Decision Document (Ohio EPA 1999). DOE moved forward with in-situ chemical oxidation in 2008, which was also not effective due to the limited Gallia.

In 2009, DOE completed a remedial technology evaluation to identify potential remedial methods that may be viable for the X-740 Area. Based on this evaluation and subsequent recommendations provided by the DOE Office of Groundwater and Soil Remediation (EM-32) in 2010, DOE and Ohio EPA agreed to conduct an in-situ enhanced anaerobic bioremediation (EAB) pilot study at the X-740 Area. In December 2010, DOE initiated EAB injections in accordance with the Ohio EPA-approved *Work Plan for the X-740 Groundwater Enhanced Anaerobic Bioremediation Pilot Study at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2010b). Quarterly sampling will be conducted for eighteen months, which began in May 2011 to monitor the effectiveness of the EAB pilot study.

1.3.2 X-749/X-120 Phytoremediation Area

The *First Five-Year Review for the X-749/X-120 Groundwater Plume at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE 2011), concluded that the phytoremediation remedy for the X-749/X-120 groundwater plume was not as successful as anticipated. In May 2011 Ohio EPA agreed that the X-749/X-120 Phytoremediation Area no longer needed to be maintained and approved DOE's request to remove the surveillance and maintenance requirements for the X-749/X-120 Phytoremediation Area.

DOE continues to operate and maintain the extraction wells installed within the X-749/X-120 plume area to reduce trichloroethene (TCE) concentrations in groundwater and prevent further migration of the plume. The final remedy for the X-749/X-120 Groundwater Plume Area will be determined once additional data is collected and evaluated.

1.4 EMERGENCY, HEALTH, AND SAFETY CONSIDERATIONS

A general site-wide accident prevention plan, *PORTS Corrective Measure Implementation Program Safety and Health Accident Prevention Plan* (DOE 1995), has been developed by DOE to address all corrective measures implementation (CMI) work activities performed at PORTS. All work is performed in accordance with the DOE Integrated Safety Management System/Environmental Management System.

Additional health and safety considerations may apply to work completed at individual units, such as measures to prevent or minimize dangers associated with animals (such as wasps, spiders, and snakes) and application of herbicides or pesticides. Personnel who apply herbicides and/or fertilizers will review the material safety data sheet (MSDS) and be trained (and certified, as necessary) in safe work practices. Personal protective equipment listed in the MSDS will be worn by personnel applying herbicides and/or fertilizer. If applicable, additional health and safety measures are discussed in the sections for specific units.

1.5 RECORD KEEPING

All inspections, sampling, and monitoring activities performed under the requirements of this plan are documented. These records are maintained and controlled by the PORTS Surveillance and Maintenance Program or the Groundwater Protection Program in a manner that prevents loss, damage, or other detrimental conditions and can be obtained from PORTS Document Management Center. Inspection reports contain the following (as applicable):

- the date, time, and results of the inspection,
- the location of inspection,
- information related to any non-conformance,
- evidence of completion and verification of inspection, and
- identification of person(s) performing inspection.

All corrective maintenance or repairs are performed in accordance with manufacturer's recommendations and procedures approved by the PORTS Surveillance and Maintenance Program or Groundwater Protection Program. Actions taken in response to non-conformances are documented on the inspection report and may contain the following information (as appropriate):

- the scope and purpose of repair,
- the date(s) when the repair was performed,
- location of repair,
- planned actions and schedule to address item
- Work Order number initiated for repair work,
- information related to any non-conformance, and
- date item was closed and initials of personnel who closed the item.

Any continuing non-conformances are noted in subsequent inspections. The records listed above are maintained for a minimum of five years.

Inspections and sampling of groundwater monitoring wells are completed in accordance with the IGWMP.

1.6 REPORTING

A written summary of S&M inspections completed in the previous calendar quarter is submitted to the Southeast District Office of the Ohio EPA no later than April 15, July 15, October 15, and January 15 (not including inspections of groundwater monitoring wells completed in accordance with the IGWMP). The inspection summary details the results of the inspections and lists a schedule of actions (if any) to be taken. Copies of the S&M inspection form(s) for each unit are submitted with the written summary.

Results of environmental groundwater sampling are completed and recorded in accordance with the IGWMP.

The table below provides a summary of upcoming five year reviews for remediation effectiveness.

Quadrant I	
X-749/120 Area Groundwater Plume	06/30/2016
X-749B Peter Kiewit Landfill	09/30/2013
Five-Unit Area, X-231A Cap, and X-231B Cap (Quadrant I Groundwater Investigative Area)	09/30/2013
Quadrant IV	
X-611A Prairie	06/30/2013
X-734 Landfills	12/31/2013

2. X-611A PRAIRIE

2.1 INTRODUCTION

This section describes the recommended S&M procedures for the X-611A Former Lime Sludge Lagoons (1) soil and vegetative cover system, (2) surface water control system, (3) groundwater monitoring system, and (4) miscellaneous systems including the lagoon's perimeter embankments. The S&M procedures are based on the information and data contained in the EPA's decision document; the certified-for-construction specifications and construction drawings for the X-611A CMI; and *Guidelines for the Development of Tallgrass Prairie Vegetation at the X-611A Lime Sludge Lagoons in Piketon, Ohio* (Knoop 1996).

The X-611A Former Lime Sludge Lagoons consist of three unlined sludge retention lagoons constructed in 1954. The lagoons were constructed in a low-lying area that included the Little Beaver Creek channel. As a result, approximately 1,500 feet of Little Beaver Creek was relocated to a new channel just east of the current lagoon locations. In general, the lagoon depths increase from west to east as the preconstruction topography elevation decreases. Maximum lagoon depth ranges from approximately 14 feet in the north lagoon to 12 feet in the south lagoon.

The X-611A Lime Sludge Lagoons received waste lime sludge from the X-611 Water Treatment Plant from 1954 to 1960. The sludge consisted primarily of white, saturated lime sludge. Sparse, grassy vegetation became established in the western portions of all three lagoons. The eastern portions of all three lagoons contained surface water with a maximum depth of approximately 8 feet.

The *Decision Document for the X-611A Solid Waste Management Unit* (Ohio EPA 1996a) specified the selected remedy to be used to achieve the remedial goals. This selected remedy required the following actions:

- Placement of a minimum of 2-ft-thick sloped soil cover over the north and middle lagoons with the soil cover contoured to divert surface water away from the north and middle lagoons.
- Placement of a minimum 2-ft-thick soil cover over the south lagoon with shallow water expected to pond on the surface of the lagoon.
- Placement of material to facilitate the deposition of soil on the sludge and enhance sludge stability (if required).
- Development of a prairie habitat on the soil cover placed over the north, middle, and south lagoons. Prairie vegetation that grows in wetter areas may be cultivated in portions of the south lagoons to accommodate the shallow accumulation of water expected on the lagoon surface.
- Construction of a soil berm outside the northern boundary of the north lagoon to facilitate shallow accumulation of water in this low-lying area.
- Groundwater monitoring to ensure that no contaminants of concern are migrating to the groundwater.

2.2 DESCRIPTION OF SYSTEM COMPONENTS

2.2.1 Soil and Vegetative Cover System

The soil/vegetative cover system constructed at the X-611A Former Lime Sludge Lagoons consists of a minimum 2-ft-thick soil layer designed to support a prairie vegetation ground cover and a reinforcement geotextile fabric used to aid in the construction of the soil layer over the sludge. By placing a soil cover on the lagoons, exposure pathways for a number of modeled receptors have been eliminated or reduced.

Installation of the soil and vegetative cover system consisted of clearing the site, installing the geotextile over the lime sludge, and placement of the soil layer. Soil layer placement utilized special earthwork techniques and equipment to minimize sludge waves and over-tensioning of the underlying geotextile fabric.

Elevated embankments were previously installed at the northwestern, northern, eastern, and southern portions of the lagoons during the initial 1954 construction. Unconsolidated material removed from the lagoon areas was used to form the lagoon's embankments. These embankments were maintained as part of the CMI remedy as the sludge retaining mechanism. A seep was previously observed from an area near the bottom of the middle lagoon embankment. The seep was sampled and characterized, and no contaminants of concern were detected. Although the seep flow either has been stopped or minimized by removal of standing surface water from the lagoon during the CMI, a layer of large rock was installed during CMI construction at the seep location to minimize future embankment erosion if the seep continues.

2.2.2 Surface Water Control System

The soil layer was graded and contoured to drain precipitation falling on the middle and north lagoons in a north-northwest direction. The collected drainage is routed down a concrete chute to an existing drainage channel, where it merges with surface water drainage from other areas. The combined surface drainage discharges to Little Beaver Creek at the northern end of the X-611A site.

Surface drainage from the south lagoon collects in a low area before discharging through a rock spillway channel and gabion level spreader. The level spreader creates a wide, low-velocity flow to designated wetlands at the southern end of the X-611A site.

2.2.3 Groundwater Monitoring System

Groundwater monitoring at the X-611A Prairie is performed in accordance with the IGWMP.

2.2.4 Miscellaneous Systems

Various miscellaneous items are required to support the X-611A CMI. These items are maintenance of adjacent areas, site access, and deed monuments.

2.3 NORMAL OPERATIONS AND PREVENTIVE MAINTENANCE

The X-611A remedial and monitoring systems are properly maintained to assure the CMI's ability to contain and isolate contaminants of concern from the environment. Processes that could damage the cover include erosion due to surface runoff, physical disturbances, and settlement. Damage to the X-611A site is repaired and the cause investigated, if necessary, so that future need for additional repair can be minimized.

Normal maintenance includes the inspection and repairs, as needed, of system components at prescribed intervals for the purpose of preventing abnormal operating conditions. Also included are detecting, repairing, and reporting defects that could lead to system component damage or breakdown. These requirements are summarized in the following sections and in Table 2.1. An inspection checklist is used during the quarterly and annual inspections listed in Table 2.1. Attachment 2.A at the end of this section provides an example of this inspection checklist. Any occurrences of deficiencies noted by the inspections are recorded during the inspection and corrected in accordance with Sect. 2.4, Potential Operating Problems.

2.3.1 Soil and Vegetative Cover System

The following parts of the X-611A soil/vegetative cover system are routinely inspected during preventive maintenance activities:

- prairie flora vegetation cover,
- soil layer,
- embankment side slopes,
- erosion control rock blankets, and
- surface drainage systems (rock or concrete drainage channels).

No system preventive or corrective maintenance is listed for the geotextile. The underlying geotextile was used to achieve a support surface of sufficient strength to place the soil layer.

The prairie is burned once every three to five years (starting in 2006), either in the spring or fall, depending on when weather conditions are conducive to burning. Burning stimulates prairie plant growth and discourages cool-season domestic grasses and woody invaders, thus tipping the balance in favor of the prairie species.

A separate burn plan for the X-611A Prairie describes the procedures required to conduct a safe and controlled burn of the X-611A prairie vegetation. The burn plan will be reviewed by the PORTS surveillance and maintenance contractor prior to burning and updated, if required, to meet changing field conditions.

The existing lagoon embankments are currently vegetated. Areas associated with the X-611A site that are not seeded with the prairie flora vegetative mixture are mowed as needed.

In addition to the above pre-established maintenance requirements, the prairie flora and existing embankment vegetation are visually inspected for the presence of stressed vegetation and small shrubs or deeply rooted wooded plant growth. As needed, any woody plant growth will be removed or sprayed with herbicide that only targets woody plants.

Table 2.1. X-611A Prairie maintenance program

System Component	Preventive Maintenance Activity	Preventive Maintenance Frequency	Corrective Maintenance Activity	Corrective Maintenance Frequency
Prairie flora	Burning*	Every 3-5 years[a]	Vegetation reseeding and watering	As needed
Vegetative ground cover	Visual inspection	Quarterly	Brush removal	As needed
			Burrowing animal removal	As needed
Soil layer	Visual inspection	Quarterly	Erosion repair	As needed
			Major settlement/subsidence repair	As needed
Embankment side slopes	Visual inspection	Quarterly	Erosion/seepage repair	As needed
	Mowing	Prior to burning and as needed	Subsidence/depression repair	As needed
			Burrowing animal removal	As needed
Erosion control rock blanket	Visual inspection	Quarterly	Erosion/seepage repair	As needed
			Subsidence/depression repair	As needed
Surface water control system	Visual inspection	Quarterly	Drainage channel repair/cleaning	As needed
			Drainage pipe repair/cleaning	As needed
			Drainage channel rock lining repair	As needed
			North depression structure repair	As needed
			South lagoon pond/level spreader repair	As needed
Groundwater monitoring wells	Visual inspection	In accordance with the IGWMP	Repaint well	As needed
			Repair or replace concrete pad	As needed
			Replace casing hinge	As needed
			Other repairs	As needed
Deed monuments	Visual inspection	Annually	Repair/replace	As needed

[a] Areas that are not seeded with prairie flora vegetation will be mowed on an as-needed basis.
*Mowing may be conducted if burning cannot be completed.

The soil layer is visually inspected for the presence of conditions that could lead to a breakdown of the layer's integrity or the engineered system. If a breakdown in the integrity of the remedial alternative is detected, DOE will notify the Ohio EPA of the incident and actions taken to correct the situation. Conditions that could affect the CMI integrity include items that could expose or threaten to expose the surface of the lime sludge or items that could impact the 2-foot minimum soil cover requirement. The potential problems to be observed during the visual inspections include:

- burrowing animals,
- erosion and
- major settlement and subsidence.

Some settlement and subsidence of the surface of the lagoons is anticipated and will be tolerated as long as no deterioration of the soil cover occurs, and the surface of the lagoons does not become exposed.

The rock erosion control blanket at the middle lagoon eastern embankment and side slopes of the other lagoon embankments is inspected quarterly. Potential problems to be observed include ponding of water (possibly due to subsidence), craters, erosion, seepage, and the presence of burrowing animals. Settlement monitoring consists of visual inspections for subsidence, depressions, or ponding.

2.3.2 Surface Water Control System

The surface water controlling systems are inspected routinely, and the drainage system should be free of excessive soil, silt, and debris. Potential problems to be observed include debris, soil and silt blockage in drains, broken or collapsed drain pipes, drainage channel erosion, washing out of rock channel protection (dumped rock fill), sloughing of side slopes within ponded areas (i.e., the north depression structure and the south lagoon), or the lack of positive drainage (in areas not engineered for standing water). Items to be inspected include:

- surface drainage channels (rock and/or concrete),
- 60-inch corrugated pipe,
- rock channel protection,
- north depression structure,
- south lagoon exit channel and level spreader, and
- south lagoon ponded area.

2.3.3 Groundwater Monitoring System

Groundwater monitoring wells are inspected in accordance with the IGWMP.

2.3.4 Miscellaneous Systems

Vehicular access roads to the site, gate barriers, and deed monuments are inspected to ensure that these items are serving their intended purpose (see Table 2.1). Fog Road or other suitable vehicular access to the site and all on-site gravel accesses are visually inspected to ensure that the access remains passable and that adjacent vegetation has not detrimentally encroached onto or above the access road. Potential problems to be observed include low-hanging tree limbs and gaps in the roadbed material.

Deed monuments are inspected to ensure that physical damage has not occurred due to erosion, settlement, or tampering and vandalism; and that they are readable.

2.4 POTENTIAL OPERATING PROBLEMS

Maintenance tasks or repairs are performed as described in this section to correct deficiencies or operating problems detected during preventive maintenance activities. Materials used in maintenance activities are equivalent to or better than those originally specified for the initial construction.

2.4.1 Soil and Vegetative Cover System

Corrective maintenance activities that may need to be performed on the soil and vegetation system and the embankment slopes are as follows:

- removal/relocation of burrowing animals,
- prairie flora vegetation reseeding and weed/brush removal,
- soil layer repair, and
- embankment slope reseeding or repair.

Burrowing animals are removed or relocated to other portions of the DOE reservation. Any burrows that remain are backfilled with soil to the maximum extent possible.

The prairie flora vegetation may require reseeding if there is a dieback of the vegetation or if repair of settlement/subsidence becomes necessary. The section below contains information for reseeding the prairie flora vegetation, if necessary.

The soil layer and the side slopes of the embankments may need to be reconstructed if damage occurs due to erosion, substantial settlement, or sloughing (in the south lagoon area where ponded water exists). If soil layer reconstruction is required, care will be utilized to ensure that a sufficient bearing capacity exists to support the construction equipment that is used to make the repair. Use of low pressure equipment that exerts a ground pressure of no more than five pounds per square inch will be required. Erosion control matting and/or rock protection (dumped rock fill) may be required on the perimeter embankments prone to surface and seepage erosion.

Reseeding The following species of grasses and forbs (prairie wildflower) will be used for reseeding activities based on whether reseeding is required for a wet or drier mesic area:

Wet Areas (South Section)

Grasses

- Blue Joint Grass
- Big Bluestem Grass
- Prairie Cord Grass
- Indian Grass

Forbs

- New England Aster
- Spike Blazingstar
- Pale Lobelia
- Wild Bergamot
- Gray-headed Coneflower
- Black-eyed Susan
- Ohio Spiderwort
- Downy Phlox
- Prairie Dock
- Stiff Goldenrod
- Shooting Star
- Common Mountain Mint
- Rattlesnake Master

Drier Mesic Areas (Middle and North Sections)

Grasses

- Big Bluestem Grass
- Little Bluestem Grass
- Prairie Dropseed Grass
- Indian Grass

Forbs

- New England Aster
- Purple Coneflower
- Wild Bergemot
- Gray-headed Coneflower
- Black-eyed Susan
- Ohio Spiderwort
- Downy Phlox:
- Round-headed Bush Clover
- Stiff Goldenrod
- Prairie Dock
- Compass Plant
- Prairie Blazing-star
- Flowering Spurge
- Shooting Star
- Hoary Puccoon
- Butterfly Milkweed
- Tall Coreopsis

The recommended mix ratio for grass and forb seeds used for reseeding is:

Drier Area	Wet Area
4 lb. Little Bluestem Grass	2 lb. Big Bluestem Grass
2 lb. Big Bluestem Grass	2 lb. Indian Grass
2 lb. Indian Grass	0.5 lb. Prairie Cord Grass
0.5 lb. Prairie Dropseed Grass	0.5 lb Blue Joint Grass
8 lb. forbs mix	8 lb. forbs mix

- Grass and forb seeds must be mixed thoroughly prior to planting.
- Do not sow immediately following rain, when ground is too dry, or during windy periods.
- Apply seed mixture evenly at a rate of 2 pounds per 1000 square feet.
- The prairie seed will be mixed in a larger volume of inert material such as sawdust, vermiculite, or sand that has been slightly damped. Spot seeding may be performed by hand broadcasting over the seed bed and then covering the seeded area with ¼ to ½ inches of soil.
- The newly seeded area will receive a light covering of clean straw

An acceptable stand of grass is defined using the following parameters:

- No bare spots larger than three feet square.
- No more than 10% of total area with bare spots larger than one square feet, and
- No more than 15% of total area with bare spots larger than six inches square.

2.4.2 Surface Water Control System

The surface water control system may require repair because of damage caused by erosion. Stone or erosion-control matting may be installed in drainage channels prone to erosion. Rock/concrete channel protection that may be washed out by heavy precipitation events will require replacement.

After silt is cleaned from the drainage structures (i.e., ditches, the north depression structure, and the south level spreader) following the initial construction, silt cleaning is only anticipated at the south level spreader to ensure that a non-concentrated flow is being discharged to the low-lying areas. The gabion baskets at this location are also repaired on an as-needed basis. Other areas (such as the north depressions area and the ponded area in the south lagoon) should develop into an ecosystem where cleaning maintenance is unnecessary. A small accumulation of silt within the drainage ditches on the prairie will be tolerated; such accumulation will create a meandering effect that will aid in ecosystem enhancement. Any blockage that causes a sufficient surface water backup to flow over the perimeter embankments at a non-engineered location will be removed.

If sloughing occurs within the engineered ponded area of the former south lagoon and the condition exposes or threatens to expose the surface of the lagoons, it will be repaired as soon as possible. Ponded areas will be drained to facilitate repairs. Repairs will be accomplished by using best management practices and site procedures that comply with local, state, and federal discharge regulations. Activities may include passing water through silt fences to discharge on grassy areas, or passing water through existing storm water controls (i.e., rip rap, gabions, and settling basins) prior to reaching a receiving stream. The discharge rate of the water will be controlled to minimize silt discharge.

Silt removed during the S&M period will be air-dried, if required, and deposited on the DOE reservation for fill or utilized to make on-site erosion repairs.

2.4.3 Groundwater Monitoring System

Monitoring wells are repainted when the paint has deteriorated such that the well labels have become illegible. The concrete pad may need to be repaired or reinstalled. The well-casing hinge is checked and replaced if necessary. Other repairs may be required if a well has been damaged.

2.4.4 Miscellaneous Systems

Vehicular access routes may require maintenance to keep the access clear of encroaching vegetation and maintain a level surface that is free of ruts and potholes. Deed monuments may require repair or replacement due to erosion, settlement, or tampering and vandalism. Replacement is performed by or under the direction of a registered land surveyor in the State of Ohio.

2.5 GROUNDWATER MONITORING

Routine groundwater monitoring for the X-611A is performed in accordance with the IGWMP.

2.6 ALTERNATIVE S&M ACTIVITIES

The constructed remedy provides protection of human health and the environment by eliminating the relevant exposure pathways. The constructed remedy will be effective in the long term by containing the sludge and isolating it from the environment. Design calculations on the stability of the embankments, under static and seismic loading from the retained sludge and proposed soil covering, determined that the embankments had a safety factor twice the minimum factor of safety for stability. The existing maintenance plan requires uncomplicated nontechnical operating and maintenance procedures that will provide long-term maintenance for the corrective measures required in the *Decision Document for the X-611A Solid Waste Management Unit* (Ohio EPA 1996a); therefore, there is no need for an alternative S&M plan for the X-611A SWMU.

2.7 EMERGENCY, HEALTH, AND SAFETY CONSIDERATIONS

Health and safety considerations specific to the X-611A include hazards associated with controlled burning to maintain the prairie vegetation. Burning activities will be conducted in accordance with the health and safety requirements outlined in the X-611A burn plan (DOE 2002).

2.8 S&M EQUIPMENT AND INFORMATION

Equipment required for S&M includes mowers, material for sampling of the groundwater monitoring wells, and materials for controlled burning of the prairie grasses. These types of equipment are already owned and used at PORTS for similar types of projects. The manufacturers' and vendors' product literature, certificates, and installation instructions for the various materials used in the CMI construction project that may be required during the corrective maintenance activities are identified below:

- product data and recommended installation instructions on erosion control matting,
- gabion baskets recommended installation instructions,

- lagoon reinforcement geotextile specification (used for subsurface separation/reinforcement underneath the lagoon soil separation layer. It is not anticipated that this type of geotextile will be needed for repairs),
- rock-lined channel geotextile (used for separation and filtration underneath the dumped rockfill placed in drainage channels and for seepage erosion blanket),
- roadway geotextile (used for subsurface separation and reinforcement underneath roadways), and
- herbicide recommended application instructions and the material safety data sheet.

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ATTACHMENT 2.A

INSPECTION FORM
FOR X-611A

X-611A PRAIRIE
Surveillance and Maintenance
Quarterly and Annual Inspection Check Sheet (Sheet 1 of 2)

Inspected By: Signature	**Date Inspection Performed:**
Reviewed By: Signature	**Time Inspection Performed:**

SECTION A

INSPECTION ITEMS			
YES	NO	N/A[1]	**Unit Access Roads**
			1) Unit access roads are passable. **(Annual Inspection)**
YES	NO	N/A[1]	**Prairie Flora Vegetative Cover and Soil Layer**
			2) Cover is free of bare spots (areas lacking cover).
			3) Cover is free of woody plants.
			4) Cover is free of burrowing animals.
			5) Soil layer is free of evidence of erosion.
YES	NO	N/A[1]	**Embankment Side Slopes**
			6) Side slopes are free of erosion damage.
			7) Side slopes are free of seeps.
			8) Side slopes are free of woody plants.
			9) Side slopes are free of low spots or signs of subsidence.
			10) Side slopes are free of burrowing animals.
YES	NO	N/A[1]	**Erosion Control Rock Blanket**
			11) Rock blanket is free of burrowing animals.
			12) Rock blankets are free of evidence of erosion and/or seeps.
YES	NO	N/A[1]	**Surface Drainage System**
			13) Drainage channels and culverts are free of obstructions and erosion.
			14) Side slopes of ponded areas are free of evidence of sloughing.
			15) South lagoon ponded area exit channel and level spreader is free of damage.
YES	NO	N/A[1]	**Deed Monument (Benchmark) Integrity**
			16) Benchmarks are readable, free of physical damage, and free of evidence of tampering. **(Annual inspection)**

X-611A PRAIRIE
Surveillance and Maintenance
Quarterly and Annual Inspection Check Sheet (Sheet 2 of 2)

SECTION A (Continued)
INSPECTION ITEMS
[1] IF " NA" IS CHECKED LIST REASON:

SECTION B

ITEM #	COMMENTS/OBSERVATIONS	ACTION TAKEN/NATURE OF REPAIRS	CLOSED INITIALS/DATE

3. X-616 CHROMIUM SLUDGE SURFACE IMPOUNDMENTS

3.1 INTRODUCTION

This section describes the post-closure operations and maintenance for the X-616 Chromium Sludge Surface Impoundments. The X-616 Chromium Sludge Surface Impoundments consist of two unlined surface impoundments used from 1976 to 1985 for storage of sludge generated by the treatment of recirculating cooling water blowdown from the PORTS process cooling system. A hexavalent chromium-based corrosion inhibitor was used in the cooling water system. Chromium in the blowdown was reduced to trivalent chromium at the X-616 Liquid Effluent Control Facility by adding sulfur dioxide to the water, which produced sulfurous acid. The resulting chromium hydroxide sludge was then precipitated in a clarifier by pH adjustment with slaked lime and a polymer coagulant. The sludge was then pumped to the X-616 Chromium Sludge Surface Impoundments for storage.

From February to May 1987, treated process effluent from the X-700 Chemical Cleaning Facility was diverted to the X-616 Liquid Effluent Control Facility via the X-701C Neutralization Pit to reduce the high concentration of suspended solids discharged from the X-701B Holding Pond. In addition, chlorinated organic solvents were discovered in the X-700 Chemical Cleaning Facility basement sump that discharged to the X-701C Neutralization Pit.

The X-616 Chromium Sludge Surface Impoundments were initially identified as a hazardous waste management unit requiring closure in December of 1986. As part of the closure, the chromium sludge and surrounding soil were removed from the sludge impoundments and placed in special cells in the X-735 Landfills. Soil from the impoundment berms and additional fill was used to bring the area to grade and the area was seeded to provide a vegetative cover.

3.2 MAINTENANCE REQUIREMENTS

Maintenance requirements are applicable to the entire 30-year post-closure period. Equipment necessary for the maintenance program includes riding mowers and push mowers, weed-eaters, backhoes, grading machines, seeders, shovels, picks, and any other equipment appropriate for the nature of the work involved to protect the integrity of the cover.

The following items are included as part of the post-closure maintenance plan for the final cover of the X-616 Chromium Sludge Surface Impoundments:

- *Mowing and Fertilization*: The cover is mowed at least annually to prevent the establishment of woody plants. If needed, the cap will be fertilized. Any areas larger than 100 sq ft lacking vegetation are reseeded, fertilized, and watered as needed to maintain adequate cover.

- *Erosion Damage Repair*: Corrective maintenance is required if inspection reveals any condition that threatens the integrity of the unit, such as soil loss, surface displacements, surface cracks, irregularities, or vegetative overgrowth or damage. Eroded areas may require removal of the affected loose soil followed by replacement, re-compaction, reseeding, fertilization, and regrading or raking to the original contour. These activities are accomplished using hand tools or a small backhoe.

- *Settlement, Subsidence, or Displacement*: Subsided or settled areas requiring repair are investigated by qualified personnel to determine the cause of the displacement. If appropriate, suitable soil cover material is placed on the affected areas. These activities are accomplished with the aid of a small backhoe and hand tools.

- *Survey/Bench Marks*: Survey marks locating the perimeter of the area are inspected to ensure that physical damage has not occurred due to erosion, settlement, or tampering and vandalism; and that they are readable. Any damaged or improperly located survey mark is repaired and/or resurveyed.

- *Rodent and Insect Control*: DOE has existing programs at PORTS to control rodents and insects. With proper use of these procedures, minimal maintenance activities are required. If the cover is damaged by rodents or insects, the damage is repaired with the use of appropriate hand tools or, if necessary, a small backhoe. The area is regraded and reseeded. Special attention is given to these areas in future inspections to ensure they are not continual problems.

- *Contingency Plans*: In the event of a storm or severe event such as a riot or tornado, the area is inspected as soon as possible after the event, and in no case more than 12 hours after the event. If significant damage has been caused by the event, then the inspector will contact the emergency coordinator who will activate an emergency response team.

- *Corrective Maintenance Activities*: Corrective maintenance activities are conducted any time the integrity of the containment and monitoring systems are disturbed and subsequently discovered by PORTS inspectors.

3.3 QUARTERLY INSPECTION

Inspections are conducted quarterly. Inspections are walking inspections with observations recorded on an inspection form, an example of which is included in Attachment 3.A at the end of this section. The inspection sheet lists items to be inspected and potential problems. A new form is completed for each inspection. Completed inspection forms are maintained as described in Sect. 1.5.

Specific inspection items include cover conditions (erosion damage, vegetative cover condition, rodent and/or insect damage, settlement, subsidence, displacement) and survey mark integrity. Groundwater monitoring wells at the unit are inspected in accordance with the IGWMP (DOE 2010a).

The X-616 Chromium Sludge Surface Impoundments are not subject to casual foot or vehicular traffic and are isolated from major activities at the site. Consequently, the potential is low for damage to the physical structures, such as the monitoring wells and survey marks. Quarterly inspections are considered sufficient to monitor the condition of the units. Deficiencies are corrected as soon as possible. Upon correction of the deficient item(s), the inspection log is updated to indicate any actions taken.

3.4 GROUNDWATER MONITORING

Groundwater monitoring at the X-616 Chromium Sludge Surface Impoundments is performed in accordance with the IGWMP.

ATTACHMENT 3.A

INSPECTION FORM
FOR X-616 CHROMIUM SLUDGE SURFACE IMPOUNDMENTS

X-616 CHROMIUM SLUDGE SURFACE IMPOUNDMENTS
Surveillance and Maintenance
Quarterly Inspection Check Sheet (Sheet 1 of 2)

Inspected By: Signature	**Date Inspection Performed:**
Reviewed By: Signature	**Time Inspection Performed:**

SECTION A

INSPECTED ITEMS

YES	NO	N/A[1]	Condition of Closure Cap
			1) Cap is free of woody vegetation.
			2) Cap is free of areas of dead vegetation.
			3) Cap is free of woody plants.
			4) Cap is free of burrowing animals.
			5) Cap is free of erosion damage.
			6) Cap is free of evidence of settlement, subsidence, or displacement.
YES	**NO**	**N/A[1]**	**Benchmark Integrity**
			7) Benchmarks are readable, free of physical damage, and free of evidence of tampering. **(Annual Inspection)**

[1]**IF "N/A" IS CHECKED LIST REASON:**

X-616 CHROMIUM SLUDGE SURFACE IMPOUNDMENTS
Surveillance and Maintenance
Quarterly Inspection Check Sheet (Sheet 2 of 2)

SECTION B

ITEM #	COMMENTS/OBSERVATIONS	ACTION TAKEN/NATURE OF REPAIRS	CLOSED INITIALS/DATE

4. X-734 LANDFILLS

4.1 INTRODUCTION

The X-734 Landfills are in the northwestern portion of the site, just north of the X-744W Surplus and Salvage Warehouse and the X-747H Northwest Surplus and Scrap Yard. The X-734 Landfills consists of three former landfills: (1) the X-734 Old Sanitary Landfill, (2) the X-734A Construction Spoils Landfill, and (3) the X-734B Old Construction Spoils Landfill.

The X-734 Old Sanitary Landfill encompasses approximately 3.8 acres. Personnel interviews and review of historic aerial photographs revealed that solid waste and debris were deposited in the landfill, compacted by a bulldozer, and covered with fill material and coal ash from the PORTS X-600 Steam Plant. The process was repeated as additional solid waste and debris were deposited. As of 1985 wastes were no longer placed in this landfill, and the surface of the landfill was vegetated.

The X-734A Construction Spoils Landfill has a surface area of approximately 3.5 acres and is adjacent to the southern boundary of the X-734 Old Sanitary Landfill. Waste disposed at the X-734A included construction spoils, trees, railroad ties, broken concrete, stumps, roots, brush, ash, and other wastes from clearing and grubbing operations. The X-734A no longer accepts waste and was covered with soil and vegetation.

The X-734B Old Construction Spoils Landfill is located south of the X-734A and has a surface area of approximately 5.14 acres. Waste disposed at the X-734B Landfill included construction spoils, trees, railroad ties, broken concrete, stumps, roots, brush, and other wastes from clearing and grubbing operations. The X-734B Landfill is no longer in use and was covered with soil and vegetation. The southwest boundary of the unit overlaps a portion of the X-744W leach field area.

A dirt access road and buffer zone separate the northern boundary of the X-734B from the X-734 and the X-734A. As part of the CMI closure and because of the differences in the cover systems used on the areas north and south of the road, the X-734B has been designated as the X-734 South Landfill. The total area north of the access road (i.e., the X-734 and the X-734A areas) is designated as the X-734 North Landfill. The surface area of this combined cover system is approximately 11.43 acres.

An engineered soil cap was placed over the X-734 South Landfill that meets Ohio EPA requirements for construction and demolition debris landfills [Ohio Administrative Code (OAC) 3745-400]. Additionally, hybrid poplar trees were planted just north of the X-734 South Landfill for the purpose of conducting phytoremediation of contaminated groundwater. It is not anticipated that this landfill will generate gases due to the degradation of waste; therefore, a gas venting system was not required.

A multimedia cap meeting the requirements of RCRA Subtitle D (OAC 3745-29) has been placed over the X-734 North Landfill. An interceptor trench has been installed on the southern edge of the limits of waste to collect shallow groundwater. A surface water drainage system was also installed that includes vegetation lined drainage channels and riprap surface drainage channels. It is not anticipated that this landfill will generate gases due to the degradation of waste; therefore, a gas venting system was not required.

4.2 DESCRIPTION OF SYSTEM COMPONENTS

The maintenance program for the X-734 Landfills (North and South) falls into two categories: (1) normal operations and preventive maintenance, which is the inspection and upkeep of system components at prescribed intervals for the purpose of preventing abnormal operating conditions, or detecting and reporting defects that could lead to damage, and (2) corrective maintenance, or maintenance tasks or repairs performed to correct deficiencies or problems detected during normal S&M activities.

4.2.1 Systems at the X-734 South Landfill

Containment for the X-734 South Landfill is an engineered soil cap and hybrid poplar trees. These trees were planted for the purpose of phytoremediation of contaminated groundwater.

An engineered soil cap was placed over the X-734 South Landfill that meets Ohio EPA requirements for construction and demolition debris landfills (OAC 3745-400). The cap consists of a compacted cohesive soil layer and a vegetative layer to prevent erosion. To construct the cap, initial grading and placement of compacted soil fill material to attain proper grade for drainage were required. The landfill area was shaped to establish minimum slopes of 5% and maximum slopes not to exceed 25%, except for slopes outside the limits of waste, which were two-to-one slopes. The lower layer was 18-inch compacted soil, and the top layer is a minimum of 6-inch-thick established vegetation. Additionally, a riprap ditch was installed to control surface water runoff on the eastern portion of the cap. Finally, gates and fencing were installed to restrict access to the capped area. This landfill is not anticipated to generate gases due to the degradation of waste; therefore, a gas venting system is not required.

Institutional controls that consist of site deed restrictions to restrict access to prevent disturbance of the capped area have been implemented to ensure the integrity of the remedial action.

Hybrid poplar trees were planted in the area adjacent to and north of the X-734 South Landfill in accordance with the following requirements:

- The hybrid poplar trees are male clones selected for resistance to local diseases and parasites and are expected to withstand anticipated weather conditions for southern Ohio.
- Two-foot-diameter borings were utilized to aid in the planting and mixing of the soil additives (amendments). The borings extend to a depth of approximately 6 feet.
- Soil amendments consisting of sand, lime, and peat moss (based upon agronomic laboratory sample results) were mixed with the excavated soils around each tree to aid in tree growth.
- For safety reasons, trees were not planted within 20 feet of overhead power lines or within 10 feet of roadways.

4.2.2 Systems at the X-734 North Landfill

Containment for the X-734 North Landfill is a multimedia cap that covers the X-734 Old Sanitary Landfill and the X-734A Construction Spoils Landfill.

A multimedia cap that meets the requirements of RCRA Subtitle D (OAC 3745-29) was placed over the X-734 North Landfill. The cap consists of a compacted soil subgrade, a 1-foot-thick soil engineered fill, a geosynthetic clay liner, a 40-mil flexible membrane liner, a geonet geotextile drainage layer with perimeter drainage pipes, and a 30-inch-thick combined frost protection/vegetative layer, which consists of 24 inches of compacted soil followed by a 6-inch nutrient-enriched layer for vegetative growth.

An interceptor trench was installed on the southern edge of the limits of waste to collect shallow groundwater. This trench, approximately 815 feet long, was included as part of the landfill cap construction and follows the southern perimeter of the capped area from the extreme southwest corner of the cap to the rock-lined drainage ditch on the east side, where it daylights and discharges. The trench depth varies but was excavated at least 3 inches into the underlying bedrock formation. The trench is nominally 24-inches-wide and contains a 6-inch-diameter, high density polyethylene (HDPE) slotted drainage pipe at the trench invert, covered with not less than 24 inches of No. 57 stone. No limestone was used. A layer of non-woven geotextile fabric specified to be at least 4 ounces per yard surrounds the pipe and stone. The trench was back-filled with compacted soil to existing grade after the pipe system was installed.

A surface water drainage system was installed that does not significantly change rainfall runoff from what was occurring prior to cap installation. The majority of the cap is drained by a runoff control swale constructed through the middle portion of the capped area. This vegetation-lined drainage swale discharges on the eastern side of the cap into the rock-lined drainage ditch. An additional vegetation-lined drainage swale was excavated south of the cap and interceptor trench and provides runoff control of the southern edge of the cap and the area in between the cap and the east-west gravel road that provides access to the X-230L North Holding Pond. The rock-lined drainage ditch mentioned previously collects water from the two swales as well as the interceptor trench. This ditch directs the water to the North Drainage Ditch through a culvert under the northern landfill access road.

A gas venting system was not required as part of this capping system. The landfill is not expected to generate any significant amounts of waste degradation gases.

Monitoring of groundwater will confirm that the containment is sufficiently protective of human health and environment. The X-734 Landfills groundwater monitoring system is described in the IGWMP (DOE 2010a), including the sampling locations, frequency of monitoring, parameters to be monitored, and data evaluation and reporting.

4.3 NORMAL OPERATIONS AND PREVENTIVE MAINTENANCE

4.3.1 General

Remedial and monitoring systems at the X-734 Landfills must be properly maintained to contain and isolate contaminants of concern from the environment. Processes that could damage the X-734 CMI systems include soil erosion, sedimentation, physical disturbances, settlement, exposure to weather, and predation of the poplar trees by deer or insects. Any discovered damage to the X-734 Landfills is repaired promptly and the cause investigated, if necessary, so that future needs for additional repairs can be minimized.

Preventive maintenance includes inspection and repairs of system components at prescribed intervals for the purpose of preventing abnormal operating conditions. Also included is detecting, repairing, and reporting of defects that could lead to system component damage or breakdown. Table 4.1 lists the system components subject to preventive and corrective maintenance. Attachment 4.A at the end of this section provides an example of the form used for inspections at the X-734 Landfills.

4.3.2 Soil and Vegetative Cover Systems

4.3.2.1 X-734 South Landfill

The following parts of the X-734 South Landfill soil and vegetative cap system are visually inspected quarterly (see Table 4.1):

- vegetation,
- earthen embankment side slopes, and
- phytoremediation trees.

Potential problems to be observed during visual inspections include, but are not limited to:

- burrowing animals,
- soil erosion, and
- settlement and subsidence.

4.3.2.2 X-734 North Landfill

The following parts of the X-734 North Landfill cap system are inspected quarterly during preventive maintenance activities (see Table 4.1):

- vegetation,
- soil layer, and
- earthen embankment side slopes.

Weed or brush removal (mowing) is performed as necessary to control deeply rooted plant growth. The X-734 North Landfill cap system is fertilized as necessary.

The cap system is visually inspected for the presence of small shrubs or deeply rooted plant growth. The side slope embankments and adjacent areas are inspected for the presence of conditions that could lead to a breakdown of the cap's integrity. Conditions that could affect the system's integrity include items that threaten to expose the surface of the underlying landfill cap section, impact the minimum soil cover requirements, or prevent positive surface drainage. Potential problems include:

- burrowing animals,
- soil erosion, and
- settlement and subsidence

4.3.3 Surface Drainage System

The surface drainage of both X-734 Landfill caps is inspected quarterly for excessive soil, silt, and debris (see Table 4.1). Potential problems include debris, erosion, sedimentation, blocked drainage pipes, washing out of rock channel protection, sloughing of drainage channel side slopes, and the lack of positive drainage. Items to be inspected include:

- vegetation-lined surface drainage channels,
- storm drainage discharge points, and
- riprap-lined channels.

Table 4.1. X-734 Landfills maintenance program

System Component	Preventive Maintenance Activity	Preventive Maintenance Frequency	Corrective Maintenance Activity	Corrective Maintenance Frequency
Soil and vegetative cover system	Mowing Fertilization Visual inspection	As needed As needed Quarterly	Vegetation reseeding and watering Fertilization Weed or brush removal Erosion repair Subsidence and depression repair Burrowing animal removal Embankment side slope repair	As needed As needed As needed As needed As needed As needed As needed
Surface drainage system	Visual inspection	Quarterly	Drainage channel cleaning and repair Drainage pipe cleaning and repair	As needed As needed
Cap drainage system	Visual inspection	Quarterly	Cap drain cleaning and repair	As needed
Groundwater monitoring wells	Visual inspection	Per the IGWMP	Repaint well Replace casing hinge Repair or replace concrete pad	As needed As needed As needed
Earthen embankment side slope	Visual inspection	Annually	Erosion repair	As needed
Perimeter fence	Visual inspection	Annually	Fence repair or replacement	As needed
Gates	Visual inspection	Annually	Gate repair or replacement	As needed
Deed monuments	Visual inspection	Annually	Monument repair or replacement	As needed
Trees	Visual inspection	Monthly (during the growing season) Quarterly (during dormant season	Replacement of dead trees as necessary	Annually*
Trees (insect infestation)	Visual inspection	Quarterly	Spraying or other appropriate control techniques	As needed

*Excluding summer and winter

The outlet of the groundwater interceptor trench at the X-734 North Landfill is inspected quarterly. Potential problems that may be observed include accumulation of debris and/or sedimentation, blocked drainage pipe, the lack of drainage, and damage to the wire screen or to the end of the pipe.

4.3.4 Cap Drainage System

The cap drainage system discharge point at the X-734 North Landfill is inspected quarterly (see Table 4.1). Potential problems that may be observed include accumulation of debris and/or sedimentation, blocked drainage pipe, the lack of positive drainage, and damage to the wire screen or to the end of the pipes.

4.3.5 Groundwater Monitoring System

The X-734 monitoring wells are inspected in accordance with the IGWMP.

4.3.6 Miscellaneous Systems

Perimeter fence, gate, and deed monuments are inspected annually to insure that these items are serving their intended purpose (see Table 4.1). All site access corridors are visually inspected annually to insure that the access remains passable and in good condition. Perimeter fencing is inspected annually to insure that it remains in good condition and is structurally sound. Deed monuments are inspected annually to ensure that physical damage has not occurred due to erosion, settlement, or tampering and vandalism; and that they are readable. The hybrid poplar trees planted to the northeast of X-734 South Landfill are inspected quarterly to determine their condition and if insect infestation has occurred.

4.4 CORRECTIVE MAINTENANCE

4.4.1 General

Maintenance tasks or repairs are performed as described in this section to correct deficiencies or operating problems detected during maintenance activities. Materials used in maintenance activities are equivalent to, or better than, those originally specified for the initial construction.

4.4.2 Soil and Vegetative Cover System

Corrective maintenance activities that may become necessary for the soil and vegetative cover system are as follows:

- reseeding grass and vegetation,
- removing weed or brush,
- removing (or relocating) burrowing animals,
- repairing instances of vegetative layer subsidence or settlement,
- repairing embankment side slope, and
- repairing geosynthetic cap system.

Reseeding is necessary if there is insufficient grass on the landfill cap, or if repairs due to settlement or subsidence become necessary. Weed or brush removal is required at the X-734 North Landfill to prevent deeply rooted plant growth from becoming established and jeopardizing the integrity of the liner system.

Burrowing animals at the X-734 North Landfill are removed or relocated. Any burrows that remain are backfilled with soil to a maximum extent possible and measures are taken to discourage the return of similar types of burrowing animals.

The X-734 South Landfill soil layer and side slopes of the embankments may need to be reconstructed if damage occurs due to erosion, substantial settlement, or sloughing. If reconstruction is required, like material will be used. The capping system may also need reconstruction if damage occurs from differential settlement due to waste subsidence. Erosion control matting or dumped rock fill may be required on any perimeter embankments prone to surface erosion.

The X-734 North Landfill soil layer and side slopes of the embankments may need to be reconstructed if damage occurs due to erosion, substantial settlement, or sloughing. If reconstruction is required, care will be used to replace each layer, as needed, with like material and to install each layer as specified for the original installation. The capping system may also need reconstruction if damage occurs from differential settlement due to waste subsidence. Subsidence depressions will be remediated below the level of the barrier system as necessary. If soil layer reconstruction is required, adequate care will be taken to ensure that a sufficient bearing capacity exists to support the construction equipment used to make the repair and to prevent damage to the geosynthetic materials underneath. Erosion control matting or dumped rock fill may be required on any perimeter embankments prone to surface erosion.

4.4.3 Surface Drainage System

The surface drainage system may require repair because of damage caused by erosion. Stone or temporary erosion control matting or other appropriate material will be installed in drainage channels prone to continued erosion. Drainage channels damaged by heavy precipitation events will be repaired. Sediment deposits in the dumped rock channel that could contribute to the influx of sedimentation into the North Drainage Ditch or Little Beaver Creek will be removed from the channel as necessary.

Repairs to the groundwater interceptor trench gravity drainage system at the X-734 North Landfill may be required if the outlet pipe becomes blocked (through siltation) or damaged. Cleaning and purification may be employed to remove silt and bacterial growth.

4.4.4 Cap Drainage System

The cap drainage system at the X-734 North Landfill may require repair if the outlet pipes are blocked or damaged. Other repairs may be needed if there is evidence of poor or inadequate drainage within the landfill cap soil.

4.4.5 Groundwater Monitoring System

Monitoring wells are repainted when the paint has deteriorated such that the well labels are illegible. The concrete pad is inspected and repaired or reinstalled as required. The well-casing hinge and locks are checked and replaced if necessary. Other repairs may be required if a well has been damaged.

4.4.6 Miscellaneous Systems

Perimeter fences and gates may need repair due to physical damage or settlement. Gate hardware may need to be replaced due to normal wear and tear. Vehicular access routes may require repair or maintenance to keep the access clear of encroaching vegetation. Deed monuments may require repair or replacement due to erosion, settlement, or vandalism. Deed monuments are replaced by, or under the direction of, a land surveyor registered in the State of Ohio. Excessive insect infestation detected before severe damage occurs is addressed using standard control techniques appropriate to the species involved. These controls usually involve application of an appropriate insecticide by spraying or some other technique.

4.5 GROUNDWATER AND SURFACE WATER MONITORING

Surface water downgradient of the North Holding Pond and groundwater at the X-734 Landfills is monitored in accordance with the IGWMP. Results are reported in accordance with the IGWMP.

4.6 ALTERNATIVE S&M ACTIVITIES

The constructed remedy provides for the protection of human health and the environment by eliminating the relevant exposure pathways. Design calculations on the stability of the embankment determined that the embankments have acceptable factors of safety approved by the Ohio EPA. The maintenance plan requires uncomplicated nontechnical S&M procedures that will provide long-term protection of the corrective measures. No alternative S&M activities are required.

ATTACHMENT 4.A

INSPECTION FORM
FOR X-734 LANDFILLS

X-734 LANDFILLS
Surveillance and Maintenance Inspection Check Sheet (Sheet 1 of 2)
Inspection Frequency: Quarterly (1^{st} and 4^{th} Quarters)
Monthly (2^{nd} and 3^{rd} Quarters)

Inspected By: Signature	**Date Inspection Performed:**
Reviewed By: Signature	**Time Inspection Performed:**

SECTION A

			INSPECTED ITEMS
YES	**NO**	**N/A**[1]	**Unit Access Roads, Barriers, and Gates**
			1) Fence and gates are free of damage. **(Annual inspection)**
			2) Unit Access roads are passable. **(Annual inspection)**
YES	**NO**	**N/A**[1]	**Condition of Closure Cap/Slopes/Drainage System**
			3) Cap does not require mowing.
			4) Cap is free of areas of dead vegetation.
			5) Cap Cover is free of woody plants.
			6) Cap is free of ponded water.
			7) Cap is free of burrowing animals.
			8) Cap is free of erosion damage.
			9) Cap is free of evidence of settlement, subsidence, or displacement.
			10) Drainage channels are free of obstructions.
			11) All surface water run-off controls (rip-rap lined channels, etc.) are free of erosion or storm damage.
			12) Groundwater interceptor trench outlet pipes are free of damage and debris (X-734 North Landfill only).
YES	**NO**	**N/A**[1]	**Condition of Hybrid Poplar Trees:**
			13) Trees are free of disease, fungi, insects (not in need of spraying).
			14) There are no severely damaged or dead trees (need for replanting).
YES	**NO**	**N/A**[1]	**Cap Drainage System**
			15) Cap outlet pipes are free of blockage and damage.
			16) Mesh screening on cap drains is installed and free of damage.
YES	**NO**	**N/A**[1]	**Benchmark Integrity**
			17) Benchmarks are readable, free of physical damage, and free of evidence of tampering. **(Annual inspection)**

X-734 LANDFILLS
Surveillance and Maintenance Inspection Check Sheet (Sheet 2 of 2)
Inspection Frequency: Quarterly

SECTION A (Continued)
INSPECTED ITEMS
[1] IF "N/A" IS CHECKED LIST REASON:

SECTION B

ITEM #	COMMENTS/OBSERVATIONS	ACTION TAKEN/NATURE OF REPAIRS	CLOSED INITIALS/DATE

5. X-735 LANDFILL (NORTHERN PORTION)

5.1 INTRODUCTION

This section describes the post-closure operations and maintenance for the X-735 Landfill (Northern Portion). This landfill is part of the X-735 Landfills, which include the X-735 Landfill (Northern Portion), and the X-735 Industrial Solid Waste Landfill (Southern Portion). Section 6 provides the post-closure operations and maintenance for the X-735 Industrial Solid Waste Landfill (Southern Portion).

Initially, a total of 17.9 acres at the X-735 Landfills was approved by the Ohio EPA and Pike County Department of Health for landfill disposal of conventional solid wastes. The landfill began operation in 1981. During operation of the landfill, PORTS investigations indicated that approximately 12,000 pounds of wipe rags contaminated with solvents had inadvertently been disposed in the northern portion of the landfill. Historical data indicated that the wipe rags contaminated with solvents most likely contained methyl ethyl ketone, which was considered a hazardous waste. The contaminated rags were immediately removed from the solid waste stream by instituting new management controls to isolate contaminated rags as hazardous waste.

Waste disposal in the northern area ended in December 1991 and Ohio EPA determined that the area required closure as a RCRA hazardous waste landfill. Consequently, this unit of the sanitary landfill was identified as the X-735 Landfill (Northern Portion). A buffer zone was left unexcavated to provide space for groundwater monitoring wells and a space between the northern portion and the remaining southern portion, the X-735 Industrial Solid Waste Landfill.

5.2 MAINTENANCE REQUIREMENTS

5.2.1 Leachate Inspections

Leachate monitoring during the post-closure care period consists of quarterly visual inspections of the cap system and exposed slopes for surface outbreaks of leachate. If leachate is observed during the inspection (or any other time) on the surface of a landfill, repair on the leachate outbreak will begin immediately, and the leachate will be contained and managed in accordance with applicable regulations.

A leachate collection system is in place for the closed chromium sludge monocells located south of the solid waste portion of the X-735 Landfills. This system is part of the X-735 Industrial Solid Waste Landfill and is discussed in Sect. 6.

5.2.2 Explosive Gas Extraction System

Gas vents are inspected for proper operation and any damages on a quarterly basis. Any necessary repairs or replacements are performed. Operation of the gas venting systems must be sufficient to eliminate the buildup of gas beneath the cap.

5.2.3 Cap System

The final cover and support systems for the X-735 Landfill (Northern Portion) was designed to resist erosion and settlement, prevent infiltration, and promote run-off. Both preventive and corrective maintenance of the cover and support systems will allow the unit to continue to meet these requirements. The inspection form (see example in Attachment 5.A at the end of this section) contains the areas of inspection for preventive and corrective maintenance under the maintenance plan. All operations described herein will be in operation for the entire 30-year post-closure period.

Equipment necessary for the maintenance program includes riding mowers and push mowers, weed-eaters, backhoes, grading machines, seeders, shovels, picks, and any other equipment appropriate for the nature of the work involved to protect the integrity of the cover.

5.2.4 Final Cover

The following items are included as part of the post-closure maintenance plan for the final cover of the X-735 Landfill (Northern Portion):

- *Mowing and Fertilization*: The cover is mowed as necessary utilizing riding lawn mowers and push mowers during growing seasons and fertilized as needed in the spring. Large plants are pulled from the cover by hand or with the aid of hand tools to prevent root penetration in the drainage layer. Any areas lacking vegetation are reseeded, fertilized, and watered as needed to maintain adequate cover.

- *Run-On and Run-Off Control Structures*: Routine maintenance is conducted on run-on/run-off structures to ensure that these structures continue to function as designed. Damaged areas are repaired utilizing the equipment necessary to complete the repair.

- *Erosion Damage Repair*: Corrective maintenance is required if inspection reveals any condition that threatens the integrity of the unit, such as soil loss, surface displacements, surface cracks, irregularities, or vegetative overgrowth or damage. Eroded areas may require removal of the affected loose soil followed by replacement, re-compaction, reseeding, fertilization, and regrading or raking to the original contour. These activities are accomplished using hand tools or a small backhoe.

- *Settlement, Subsidence, or Displacement*: Subsided or settled areas requiring repair are investigated by qualified personnel to determine the cause of the displacement. If appropriate, suitable soil cover material is placed on the affected areas. If investigations reveal that a malfunction of the cover has caused the displacement (e.g., line failure, drainage layer failure), the defective items are repaired or replaced, and the cover is regraded. These activities are accomplished with the aid of a small backhoe and hand tools.

- *Channels or Culverts*: Drainage structures are kept free of excessive vegetation. Excessive siltation due to erosion is removed when noted and the area restored.

- *Survey/Benchmarks*: Survey marks locating perimeter of the landfill are inspected annually to ensure that physical damage has not occurred due to erosion, settlement, or tampering and vandalism; and that they are readable. Any damaged or improperly located survey mark is repaired and/or resurveyed.

- *Rodent and Insect Control*: DOE has existing programs at PORTS to control rodents and insects. With proper use of these procedures, minimal maintenance activities are required. If the cover is damaged by rodents or insects, the damage is repaired with the use of appropriate hand tools or, if necessary, a small backhoe. The area is regraded and reseeded. Special attention is given to these areas in future inspections to ensure they are not continual problems.

- *Contingency Plans*: In the event of a storm or severe event such as a riot or tornado, the landfill is inspected as soon as possible after the event, and in no case more than 12 hours after the event. If significant damage has been caused by the event, then the inspector will contact the emergency coordinator who will activate an emergency response team. Items to be considered include repair to the synthetic liner, replacement of the liner, and restoration of the entire or significant portions of the cap.

- *Corrective Maintenance Activities*: Corrective maintenance activities are conducted any time the integrity of the containment and monitoring systems are disturbed and subsequently discovered by PORTS inspectors.

5.2.5 Security Systems

During routine quarterly inspections, all deficiencies in the security system are noted and corrected as soon as possible.

5.3 QUARTERLY INSPECTION

Inspections are conducted quarterly. Inspections are walking inspections with observations recorded on an inspection form, an example of which is included in Attachment 5.A at the end of this section. The inspection sheet lists items to be inspected and potential problems. A new form is completed for each inspection. Completed inspection forms are maintained as described in Sect. 1.5.

Specific inspection items include security control devices (barriers and gates), engineered cap (erosion damage, surface cracks, vegetative cover condition, rodent and/or insect damage), gas ventilation systems, run-on/run-off control devices, survey mark integrity, and cover conditions (drainage system, settlement, subsidence, displacement). Groundwater monitoring wells at the X-735 Landfills are inspected in accordance with the IGWMP (DOE 2010a).

The X-735 Landfills are not subject to casual foot or vehicular traffic and are isolated from major activities at the site. Consequently, the potential is low for damage to the physical structures, such as the vent system, monitoring wells, and survey marks. Material components used for the multilayer cap consist of natural materials, a synthetic liner, a geotextile fabric, and a vegetative layer and have an extended service life. Quarterly inspections are considered sufficient to monitor the condition of the units. Deficiencies, with the exception of leachate outbreaks, are corrected as soon as possible. Leachate outbreaks are handled immediately as described in Sect. 5.2.1. Upon correction of the deficient item(s), the inspection log is updated to indicate any actions taken.

5.4 GROUNDWATER MONITORING

Groundwater monitoring at the X-735 Landfills is performed in accordance with the IGWMP.

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ATTACHMENT 5.A

INSPECTION FORM
FOR X-735 LANDFILL (NORTHERN PORTION)

X-735 LANDFILL (Northern Portion)
Surveillance and Maintenance
Quarterly Inspection Check Sheet (Sheet 1 of 2)

Inspected By: Signature	**Date Inspection Performed:**
Reviewed By: Signature	**Time Inspection Performed:**

SECTION A

ITEMS INSPECTED			
YES	NO	N/A[1]	**Unit Access Roads, Barriers and Gates**
			1) Fences and gates are free of damage. **(Annual Inspection)**
			2) Unit access roads are passable. **(Annual Inspection)**
YES	NO	N/A[1]	**Condition of Closure Cap /Slopes/Drainage System**
			3) Cap does not require mowing.
			4) Cap is free of areas of dead vegetation.
			5) Cap is free of woody plants.
			6) Cap is free of ponded water.
			7) Cap is free of burrowing animals.
			8) Cap is free of erosion damage.
			9) Cap is free of evidence of settlement, subsidence, or displacement.
			10) Drainage channels are free of obstructions.
			11) All surface water run-off controls (rip-rap lined channels, etc.) are free of erosion or storm damage.
YES	NO	N/A[1]	**Leachate Monitoring**
			12) Cap system is free of leachate outbreaks.
			13) Exposed side slopes are free of leachate outbreaks.
			14) Drainage ditch(s) is free of leachate outbreaks.
YES	NO	N/A[1]	**Gas Vent System**
			15) Vents are free of damage.
YES	NO	N/A[1]	**Benchmark Integrity**
			16) Benchmarks are readable, free of physical damage, and free of evidence of tampering **(Annual Inspection)**

IF "N/A" IS CHECKED LIST REASON:

X-735 LANDFILL (Northern Portion)
Surveillance and Maintenance
Quarterly Inspection Check Sheet (Sheet 2 of 2)

SECTION B			
ITEM #	COMMENTS/OBSERVATIONS	ACTION TAKEN/NATURE OF REPAIRS	CLOSED INITIALS/DATE

6. X-735 INDUSTRIAL SOLID WASTE LANDFILL (SOUTHERN PORTION)

6.1 INTRODUCTION

This section describes the post-closure operations and maintenance for the X-735 Industrial Solid Waste Landfill (Southern Portion). This landfill is part of the X-735 Landfills, which include the X-735 Landfill (Northern Portion), and the X-735 Industrial Solid Waste Landfill (Southern Portion). The X-735 Industrial Solid Waste Landfill includes the industrial solid waste cells, asbestos disposal cells, and the closed chromium sludge monocells A and B. The chromium sludge monocells contain a portion of the chromium sludge generated during the closure of the X-616 Chromium Sludge Surface Impoundments. Sect. 5 provides the post-closure operations and maintenance for the X-735 Landfill (Northern Portion).

Initially, a total of 17.9 acres at the X-735 Landfills was approved by the Ohio EPA and Pike County Department of Health for landfill disposal of conventional solid wastes. The landfill began operation in 1981. During operation of the landfill, PORTS investigations indicated that approximately 12,000 pounds of wipe rags contaminated with solvents had inadvertently been disposed in the northern portion of the landfill. Historical data indicated that the wipe rags contaminated with solvents most likely contained methyl ethyl ketone, which was considered a hazardous waste. The contaminated rags were immediately removed from the solid waste stream by instituting new management controls to isolate contaminated rags as hazardous waste.

A buffer zone was left unexcavated to provide space for groundwater monitoring wells and a space between the northern portion and the remaining southern portion, the X-735 Industrial Solid Waste Landfill. The X-735 Industrial Solid Waste Landfill, not including the chromium sludge monocells, encompasses a total area of approximately 4.1 acres. Operation of the X-735 Industrial Solid Waste Landfill ceased in 1997, and this portion of the landfill was capped in 1998.

6.2 MAINTENANCE REQUIREMENTS

6.2.1 Leachate Management System

A leachate collection system is in place for the closed chromium sludge monocells located south of the solid waste portion of the X-735 Landfills. Each of the two monocells has a single collection sump that is equipped with a sensor that will signal when the leachate in the sump reaches one foot deep. The leachate will then be sampled and analyzed, pumped out of the sump, and disposed in accordance with applicable regulations and/or permits.

Leachate monitoring during the post-closure care period includes quarterly visual inspections of the cap system and exposed slopes for surface outbreaks of leachate. If leachate is observed during the inspection (or any other time) on the surface of a landfill, repair on the leachate outbreak will begin immediately, and the leachate will be contained and managed in accordance with applicable regulations.

6.2.2 Surface Water Management System

The surface water from the final caps is directed through rip rap lined ditches. The ditches are regularly inspected and maintained during the post-closure period.

6.2.3 Cap System

The final cover and support systems for the X-735 Landfill (Southern Portion) was designed to resist erosion and settlement, prevent infiltration, and promote run-off. Both preventive and corrective maintenance of the cover and support systems will allow the unit to continue to meet these requirements. The inspection form, an example of which is included in Attachment 6.A at the end of this section, contains the areas of inspection for preventive and corrective maintenance under the maintenance plan. All operations described herein will be in operation for the entire 30-year post-closure period.

Equipment necessary for the maintenance program includes riding mowers and push mowers, weed-eaters, backhoes, grading machines, seeders, shovels, picks, and any other equipment appropriate for the nature of the work involved and to protect the integrity of the cover.

6.2.4 Final Cover

The following items are included as part of the post-closure maintenance plan for the final cover of the X-735 Landfill (Southern Portion):

- *Mowing and Fertilization*: The cover is mowed as necessary utilizing riding lawn mowers and push mowers during growing seasons and fertilized as needed in the spring. Large plants are pulled from the cover by hand or with the aid of hand tools to prevent root penetration in the drainage layer. Any areas lacking vegetation are reseeded, fertilized, and watered as needed to maintain adequate cover.

- *Run-On and Run-Off Control Structures*: Routine maintenance is conducted on run-on/run-off structures to ensure that these structures continue to function as designed. Damaged areas are repaired utilizing the equipment necessary to complete the repair.

- *Erosion Damage Repair*: Corrective maintenance is required if inspection reveals any condition that threatens the integrity of the unit, such as soil loss, surface displacements, surface cracks, irregularities, or vegetative overgrowth or damage. Eroded areas may require removal of the affected loose soil followed by replacement, re-compaction, reseeding, fertilization, and regrading or raking to the original contour. These activities are accomplished using hand tools or a small backhoe.

- *Settlement, Subsidence, or Displacement*: Subsided or settled areas requiring repair are investigated by qualified personnel to determine the cause of the displacement. If appropriate, suitable soil cover material is placed on the affected areas. If investigations reveal that a malfunction of the cover has caused the displacement (e.g., line failure, drainage layer failure), the defective items are repaired or replaced, and the cover is regraded. These activities are accomplished with the aid of a small backhoe and hand tools.

- *Channels or Culverts*: Drainage structures are kept free of excessive vegetation. Excessive siltation due to erosion is removed when noted and the area restored.

- *Survey/Benchmarks*: Survey marks locating the asbestos cells and perimeter of the landfill are inspected annually to ensure that physical damage has not occurred due to erosion, settlement, or tampering and vandalism; and that they are readable. Any damaged or improperly located survey mark is repaired and/or resurveyed.

- *Rodent and Insect Control*: DOE has existing programs at PORTS to control rodents and insects. With proper use of these procedures, minimal maintenance activities are required. If the cover is damaged by rodents or insects, the damage is repaired with the use of appropriate hand tools or, if necessary, a small backhoe. The area is regraded and reseeded. Special attention is given to these areas in future inspections to ensure they are not continual problems.

- *Contingency Plans*: In the event of a storm or severe event such as a riot or tornado, the landfill is inspected as soon as possible after the event, and in no case more than 12 hours after the event. If significant damage has been caused by the event, then the inspector will contact the emergency coordinator who will activate an emergency response team. Items to be considered include repair to the synthetic liner, replacement of the liner, and restoration of the entire or significant portions of the cap.

- *Corrective Maintenance Activities*: Corrective maintenance activities are conducted any time the integrity of the containment and monitoring systems are disturbed and subsequently discovered by PORTS inspectors.

6.2.5 Security Systems

During security patrols by PORTS Security or routine quarterly inspections, all deficiencies in the security system are noted and corrected as soon as possible.

6.3 QUARTERLY INSPECTION

Inspections are conducted quarterly. Inspections are walking inspections with observations recorded on an inspection form, an example of which is included in Attachment 6.A at the end of this section. The inspection sheet lists items to be inspected and potential problems. A new form is completed for each inspection. Completed inspection forms are maintained as described in Sect. 1.5.

Specific inspection items include security control devices (barriers and gates), engineered cap (erosion damage, surface cracks, vegetative cover condition, rodent and/or insect damage), run-on/run-off control devices, survey mark integrity, and cover conditions (drainage system, settlement, subsidence, displacement). Groundwater monitoring wells at the X-735 Landfills are inspected in accordance with the IGWMP (DOE 2010a).

The X-735 Landfills are not subject to casual foot or vehicular traffic and are isolated from major activities at the site. Consequently, the potential is low for damage to the physical structures, such as the vent system, monitoring wells, and survey marks. Material components used for the multilayer cap consist of natural materials, a synthetic liner, a geotextile fabric, and a vegetative layer and have an extended service life. Quarterly inspections are considered sufficient to monitor the condition of the units. Deficiencies, with the exception of leachate outbreaks, are corrected as soon as possible. Leachate outbreaks are handled immediately as described in Sect. 6.2.1. Upon correction of the deficient item(s), the inspection log is updated to indicate any actions taken.

6.4 GROUNDWATER MONITORING

Groundwater monitoring at the X-735 Landfills is performed in accordance with the IGWMP.

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ATTACHMENT 6.A

INSPECTION FORM
FOR X-735 INDUSTRIAL SOLID WASTE LANDFILL
(SOUTHERN PORTION)

X-735 INDUSTRIAL SOLID WASTE LANDFILL (Southern Portion)
Surveillance and Maintenance
Quarterly Inspection Check Sheet (Sheet 1 of 2)

Inspected By: Signature	**Date Inspection Performed:**
Reviewed By: Signature	**Time Inspection Performed:**

SECTION A

			ITEMS INSPECTED
YES	**NO**	**N/A[1]**	**Unit Access Roads, Barriers, and Gates**
			1) Fences and gates are free of damage. **(Annual Inspection)**
			2) Unit access roads are passable. **(Annual Inspection)**
YES	**NO**	**N/A[1]**	**Condition of Closure Cap/Slopes/Drainage System**
			3) Cap does not require mowing.
			4) Cap is free of areas of dead vegetation.
			5) Cap is free of woody plants.
			6) Cap is free of ponded water.
			7) Cap is free of burrowing animals.
			8) Cap is free of erosion damage.
			9) Cap is free of evidence of settlement, subsidence, or displacement.
			10) Drainage channels are free of obstructions.
			11) All surface water run-off controls (rip-rap lined channels, etc.) are free of erosion or storm damage.
YES	**NO**	**N/A[1]**	**Leachate Management System**
			12) Cap system is free of leachate outbreaks.
			13) Exposed side slopes are free of leachate outbreaks.
			14) Drainage ditch(s) is free of leachate outbreaks.
			15) Leachate collection system at the X-735 monocells is operating properly.
YES	**NO**	**N/A[1]**	**Benchmark Integrity**
			16) Benchmarks are readable, free of physical damage, and free of evidence of tampering. **(Annual Inspection)**

[1] **IF "N/A" IS CHECKED LIST REASON:**

X-735 INDUSTRIAL SOLID WASTE LANDFILL (Southern Portion)
Surveillance and Maintenance
Quarterly Inspection Check Sheet (Sheet 2 of 2)

SECTION B			
ITEM #	COMMENTS/OBSERVATIONS	ACTION TAKEN/NATURE OF REPAIRS	CLOSED INITIALS/DATE

7. X-749 CONTAMINATED MATERIALS DISPOSAL FACILITY

7.1 INTRODUCTION

This section describes the post-closure operations and maintenance for the X-749 Contaminated Materials Disposal Facility (both northern and southern portions). The X-749 Contaminated Materials Disposal Facility is a landfill located in the south-central section of the PORTS reservation. The landfill covers approximately 7.5 acres and was built in an area of highest elevation within the southern half of PORTS. The landfill operated from 1955 to 1990, during which time buried wastes were generally contained in metal drums or other containers that were compatible with the waste.

The northern portion (approximately 200,000 square ft) contains waste contaminated with industrial solvents, waste oils from plant compressors and pumps, sludges that were classified as hazardous, and low-level radioactive materials. The southern portion (approximately 130,000 square ft) contains non-hazardous, low-level radioactive scrap materials.

Closure of both portions of the X-749 landfill in 1994 included installation of (1) a multimedia cap, (2) a slurry wall along the north side and northwest corner of X-749 which was extended in 2002 to include the east and south sides, and (3) subsurface groundwater drains on the southwest corner, including three groundwater extraction wells within the groundwater drain.

7.2 MAINTENANCE REQUIREMENTS

7.2.1 Leachate Inspections

Leachate monitoring during the post-closure care period consists of quarterly visual inspections of the cap system and exposed slopes for surface outbreaks of leachate. If leachate is observed during the inspection (or any other time) on the surface of a landfill, repair on the leachate outbreak will begin immediately, and the leachate will be contained and managed in accordance with applicable regulations.

7.2.2 Surface Water Management System

Surface water controls collect run-off from the landfill. Surface water from the cap is directed into rip rap lined drainage channels. The channels are regularly inspected and maintained during the post-closure period.

7.2.3 Explosive Gas Extraction System

Gas vents are inspected for proper operation and any damages on a quarterly basis. Any necessary repairs or replacements will be performed. Operation of the gas venting systems must be sufficient to eliminate the buildup of gas beneath the cap.

7.2.4 Cap System

The final cover and support systems for the X-749 Contaminated Materials Disposal Facility were designed to resist erosion and settlement, prevent infiltration, and promote run-off. Both preventive and corrective maintenance of the cover and support systems will allow the unit to continue to meet these requirements. The inspection form, an example of which is included in Attachment 7.A at the end of this section, contains the areas of inspection for preventive and corrective maintenance under the maintenance plan. All operations described herein will be in operation for the entire 30-year post-closure period.

Equipment necessary for the maintenance program includes riding mowers and push mowers, weed-eaters, backhoes, grading machines, seeders, shovels, picks, and any other equipment appropriate for the nature of the work involved to protect the integrity of the cover.

7.2.5 Final Cover

The following items are included as part of the post-closure maintenance plan for the final cover of the X-749 Contaminated Materials Disposal Facility:

- *Mowing and Fertilization*: The cover is mowed as necessary utilizing riding lawn mowers and push mowers during growing seasons and fertilized as needed. Large plants are pulled from the cover by hand or with the aid of hand tools to prevent root penetration in the drainage layer. Any areas lacking vegetation are reseeded, fertilized, and watered as needed to maintain adequate cover.

- *Run-On and Run-Off Control Structures*: Routine maintenance is conducted on run-on/run-off structures to ensure that these structures continue to function as designed. Damaged areas are repaired utilizing the equipment necessary to complete the repair.

- *Erosion Damage Repair*: Corrective maintenance is required if inspection reveals any condition that threatens the integrity of the unit, such as soil loss, surface displacements, surface cracks, irregularities, or vegetative overgrowth or damage. Eroded areas may require removal of the affected loose soil followed by replacement, re-compaction, reseeding, fertilization, and regrading or raking to the original contour. These activities are accomplished using hand tools or a small backhoe.

- *Settlement, Subsidence, or Displacement*: Subsided or settled areas requiring repair are investigated by qualified personnel to determine the cause of the displacement. If appropriate, suitable soil cover material is placed on the affected areas. If investigations reveal that a malfunction of the cover has caused the displacement (e.g., line failure, drainage layer failure), the defective items are repaired or replaced, and the cover is regraded. These activities are accomplished with the aid of a small backhoe and hand tools.

- *Channels or Culverts*: Drainage structures are kept free of excessive vegetation. Excessive siltation due to erosion is removed when noted and the area restored.

- *Survey/Bench Marks*: Survey marks locating the perimeter of the landfill are inspected annually to ensure that physical damage has not occurred due to erosion, settlement, or tampering and vandalism; and that they are readable. Any damaged or improperly located survey mark is repaired and/or resurveyed.

- *Rodent and Insect Control*: DOE has existing programs at PORTS to control rodents and insects. With proper use of these procedures, minimal maintenance activities are required. If the cover is damaged by rodents or insects, the damage is repaired with the use of appropriate hand tools or, if necessary, a small backhoe. The area is regraded and reseeded. Special attention is given to these areas in future inspections to ensure they are not continual problems.

- *Contingency Plans*: In the event of a storm or severe event such as a riot or tornado, the landfill is inspected as soon as possible after the event, and in no case more than 12 hours after the event. If significant damage has been caused by the event, then the inspector will contact the emergency coordinator who will activate an emergency response team. Items to be considered include repair to the synthetic liner, replacement of the liner, and restoration of the entire or significant portions of the cap.

- *Corrective Maintenance Activities*: Corrective maintenance activities are conducted any time the integrity of the containment and monitoring systems are disturbed and subsequently discovered by PORTS inspectors.

7.2.6 Groundwater Drain System

The subsurface groundwater drain system is inspected routinely to ensure that surface water infiltration is minimized. Potential problems that may be observed include settlement or cracking of surface soils, biological growth, lack of extraction well pump operation, or inoperable leak detection system.

7.2.7 Security Systems

During patrols by PORTS Security or routine quarterly inspections, all deficiencies in the security system are noted and corrected as soon as possible.

7.3 QUARTERLY INSPECTION

Inspections are conducted quarterly. Inspections are walking inspections with observations recorded on an inspection form, an example of which is included in Attachment 7.A at the end of this section. The inspection sheet lists items to be inspected and potential problems. A new form is completed for each inspection. Completed inspection forms are maintained as described in Sect. 1.5.

Specific inspection items include security control devices (barriers and gates), engineered cap (erosion damage, surface cracks, vegetative cover condition, rodent and/or insect damage), gas ventilation systems, run-on/run-off control devices, survey mark integrity, cover conditions (drainage system, settlement, subsidence, displacement), and groundwater drainage system. Groundwater monitoring wells at the X-749 Contaminated Materials Disposal Facility are inspected in accordance with the IGWMP (DOE 2010a).

The X-749 Contaminated Materials Disposal Facility is not subject to casual foot or vehicular traffic and is isolated from major activities at the site. Consequently, the potential is low for damage to the physical structures, such as the vent system, monitoring wells, and survey marks. Material components used for the multilayer cap consist of natural materials, a synthetic liner, a geotextile fabric, and a vegetative layer and have an extended service life. Quarterly inspections are considered sufficient to monitor the condition of the units. Deficiencies, with the exception of leachate outbreaks, are corrected as soon as possible. Leachate outbreaks are handled immediately as described in Sect. 7.2.1. Upon correction of the deficient item(s), the inspection log is updated to indicate any actions taken.

7.4 GROUNDWATER MONITORING

Groundwater monitoring at the X-749 Contaminated Materials Disposal Facility is performed in accordance with the IGWMP.

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ATTACHMENT 7.A

INSPECTION FORM
FOR X-749 CONTAMINATED MATERIALS
DISPOSAL FACILITY

X-749 CONTAMINATED MATERIALS DISPOSAL FACILITY
Surveillance and Maintenance
Quarterly Inspection Check Sheet (Sheet 2 of 2)

SECTION B			
ITEM #	COMMENTS/OBSERVATIONS	ACTION TAKEN/NATURE OF REPAIRS	CLOSED INITIALS/DATE

X-749 CONTAMINATED MATERIALS DISPOSAL FACILITY
Surveillance and Maintenance
Quarterly Inspection Check Sheet (Sheet 1 of 2)

Inspected By: Signature	**Date Inspection Performed:**
Reviewed By: Signature	**Time Inspection Performed:**

			SECTION A
			INSPECTED ITEMS
YES	**NO**	**N/A[1]**	**Unit Access Roads, Barriers, and Gates**
			1) Fences and gates are free of damage. **(Annual Inspection)**
			2) Unit access roads are passable **(Annual Inspection)**
YES	**NO**	**N/A[1]**	**Condition of Closure Cap/Slopes/Drainage System**
			3) Cap does not require mowing.
			4) Cap is free of areas of dead vegetation.
			5) Cap is free of woody plants.
			6) Cap is free of ponded water.
			7) Cap is free of burrowing animals.
			8) Cap is free of erosion damage.
			9) Cap is free of evidence of settlement, subsidence, or displacement.
			10) Drainage channels are free of obstructions.
			11) All surface water run-off controls (rip-rap lined channels, etc.) are free of erosion or storm damage.
YES	**NO**	**N/A[1]**	**Leachate Monitoring**
			12) Cap system is free of leachate outbreaks.
			13) Exposed side slopes are free of leachate outbreaks.
			14) Drainage ditch(s) is free of leachate outbreaks.
			15) Leachate collection pump is operating properly.
YES	**NO**	**N/A[1]**	**Gas Vent System**
			16) Vents are free of damage.
YES	**NO**	**N/A[1]**	**Benchmark Integrity**
			17) Benchmarks are readable, free of physical damage, and free of evidence of tampering. **(Annual Inspection)**
YES	**NO**	**N/A[1]**	**Groundwater Drain System**
			18) Drain trench area surface soils are free of settlement or damage

[1] **IF "N/A" IS CHECKED LIST REASON:**

8. X-749A CLASSIFIED MATERIALS DISPOSAL FACILITY

8.1 INTRODUCTION

This section describes the post-closure operations and maintenance for the X-749A Classified Materials Disposal Facility. The X-749A Classified Materials Disposal Facility is a 6-acre unit located just south of the plant's main administration building (X-100 Building), and immediately east and northeast of the X-600 Steam Plant and X-231B, respectively. The facility was operational from 1953 to 1988 as a landfill for the disposal of wastes whose nature was classified or whose content might include classified information. Available records indicate that the contents of the landfill include aluminum dross (slag), security ashes, barrier scrap, tube sheets, seal parts, floor sweepings (lube oil and sawdust that may contain PCBs, asbestos, and radionuclides), and parts from a nickel powder processing plant that may contain nickel carbonyl. Available records indicate that contents underwent decontamination, as necessary, before disposal in the unit.

Waste materials disposed of in the landfill are classified under the Atomic Energy Act. Security regulations require that any classified waste placed in a trench must be covered by at least 4 ft of soil or an equivalent barrier to visual or physical access within the same day. A description of the other types of materials disposed includes magnetic media (computer tapes, floppy disks, etc.) that contained or might have contained classified information, classified documents (both as shredded material and ashes from burned documents), decontaminated machine parts whose nature (function, design, etc.) or materials of construction were classified, and process equipment from a metal working plant that manufactured machine parts for PORTS. Active use of the landfill ceased in 1988 and the landfill was capped in 1993-1994.

8.2 MAINTENANCE REQUIREMENTS

8.2.1 Leachate Inspections

Leachate monitoring during the post-closure care period consists of quarterly visual inspections of the cap system and exposed slopes for surface outbreaks of leachate. If leachate is observed during the inspection (or any other time) on the surface of a landfill, repair on the leachate outbreak will begin immediately, and the leachate will be contained and managed in accordance with applicable regulations.

8.2.2 Surface Water Management System

Surface water controls collect run-off from the landfill. Surface water from the cap is directed into channels. The channels are regularly inspected and maintained during the post-closure period.

8.2.3 Cap System

The final cover and support systems for the X-749A Classified Materials Disposal Facility were designed to resist erosion and settlement, prevent infiltration, and promote run-off. Both preventive and corrective maintenance of the cover and support systems will allow the unit to continue to meet these requirements. The inspection form, an example of which is included in Attachment 8.A at the end of this section, contains the areas of inspection for preventive and corrective maintenance under the maintenance plan. All operations described herein will be in operation for the entire 30-year post-closure period.

Equipment necessary for the maintenance program includes riding mowers and push mowers, weed-eaters, backhoes, grading machines, seeders, shovels, picks, and any other equipment appropriate for the nature of the work involved to protect the integrity of the cover.

8.2.4 Final Cover

The following items are included as part of the post-closure maintenance plan for the final cover of the X-749A Classified Materials Disposal Facility:

- *Mowing and Fertilization*: The cover is mowed as necessary utilizing riding lawn mowers and push mowers during growing seasons and fertilized as needed in the spring. Large plants are pulled from the cover by hand or with the aid of hand tools to prevent root penetration in the drainage layer. Any areas lacking vegetation are reseeded, fertilized, and watered as needed to maintain adequate cover.

- *Run-On and Run-Off Control Structures*: Routine maintenance is conducted on run-on/run-off structures to ensure that these structures continue to function as designed. Damaged areas are repaired utilizing the equipment necessary to complete the repair.

- *Erosion Damage Repair*: Corrective maintenance is required if inspection reveals any condition that threatens the integrity of the unit, such as soil loss, surface displacements, surface cracks, irregularities, or vegetative overgrowth or damage. Eroded areas may require removal of the affected loose soil followed by replacement, re-compaction, reseeding, fertilization, and regrading or raking to the original contour. These activities are accomplished using hand tools or a small backhoe.

- *Settlement, Subsidence, or Displacement*: Subsided or settled areas requiring repair are investigated by qualified personnel to determine the cause of the displacement. If appropriate, suitable soil cover material is placed on the affected areas. If investigations reveal that a malfunction of the cover has caused the displacement (e.g., line failure, drainage layer failure), the defective items are repaired or replaced, and the cover is regraded. These activities are accomplished with the aid of a small backhoe and hand tools.

- *Channels or Culverts*: Drainage structures are kept free of excessive vegetation. Excessive siltation due to erosion is removed when noted and the area restored.

- *Survey/Bench Marks*: Survey marks locating the perimeter of the landfill are inspected annually to ensure that physical damage has not occurred due to erosion, settlement, or tampering and vandalism; and that they are readable. Any damaged or improperly located survey mark is repaired and/or resurveyed.

- *Rodent and Insect Control*: DOE has existing programs at PORTS to control rodents and insects. With proper use of these procedures, minimal maintenance activities are required. If the cover is damaged by rodents or insects, the damage is repaired with the use of appropriate hand tools or, if necessary, a small backhoe. The area is regraded and reseeded. Special attention is given to these areas in future inspections to ensure they are not continual problems.

- *Contingency Plans*: In the event of a storm or severe event such as a riot or tornado, the landfill is inspected as soon as possible after the event, and in no case more than 12 hours after the event. If significant damage has been caused by the event, then the inspector will contact the emergency coordinator who will activate an emergency response team. Items to be considered include repair and/or restoration of the entire or significant portions of the cap.

- *Corrective Maintenance Activities*: Corrective maintenance activities are conducted any time the integrity of the containment and monitoring systems are disturbed and subsequently discovered by PORTS inspectors.

8.3 QUARTERLY INSPECTION

Inspections are conducted quarterly. Inspections are walking inspections with observations recorded on an inspection form, an example of which is included in Attachment 8.A at the end of this section. The inspection sheet lists items to be inspected and potential problems. A new form is completed for each inspection. Completed inspection forms are maintained as described in Sect. 1.5.

Specific inspection items include the cap (erosion damage, surface cracks, vegetative cover condition, rodent and/or insect damage), run-on/run-off control devices, survey mark integrity, and cover conditions (drainage system, settlement, subsidence, displacement). Groundwater monitoring wells at the X-749A Classified Materials Disposal Facility are inspected in accordance with the IGWMP (DOE 2010a).

The X-749A Classified Materials Disposal Facility is not subject to casual foot or vehicular traffic and is isolated from major activities at the site. Consequently, the potential is low for damage to the physical structures, such as the monitoring wells and survey marks. Material components used for the cap have an extended service life. Quarterly inspections are considered sufficient to monitor the condition of the units. Deficiencies, with the exception of leachate outbreaks, are corrected as soon as possible. Leachate outbreaks are handled immediately as described in Sect. 8.2.1. Upon correction of the deficient item(s), the inspection log is updated to indicate any actions taken.

8.4 GROUNDWATER MONITORING

Groundwater monitoring at the X-749A Classified Materials Disposal Facility is performed in accordance with the IGWMP.

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ATTACHMENT 8.A

FOR X-749A CLASSIFIED MATERIALS
DISPOSAL FACILITY

X-749A CLASSIFIED MATERIALS DISPOSAL FACILITY
Surveillance and Maintenance
Quarterly Inspection Check Sheet (Sheet 1 of 2)

Inspected By: Signature				**Date Inspection Performed:**
Reviewed By: Signature				**Time Inspection Performed:**
SECTION A				
INSPECTED ITEMS				
YES	**NO**	**N/A[1]**	**Condition of Closure Cap/Slopes/Drainage System**	
			1) Cap does not require mowing.	
			2) Cap is free of areas of dead vegetation.	
			3) Cap is free of woody plants.	
			4) Cap is free of ponded water.	
			5) Cap is free of burrowing animals.	
			6) Cap is free of erosion damage.	
			7) Cap is free of evidence of settlement, subsidence, or displacement.	
			8) Drainage channel is free of obstructions.	
			9) All surface water run-off controls (rip-rap lined channels, etc.) are free of erosion or storm damage.	
YES	**NO**	**N/A[1]**	**Leachate Monitoring**	
			10) Cap system is free of leachate outbreaks.	
			11) Exposed side slopes are free of leachate outbreaks.	
			12) Drainage channel is free of leachate outbreaks	
YES	**NO**	**N/A[1]**	**Benchmark Integrity**	
			13) Benchmarks are readable, free of physical damage, and free of evidence of tampering. **(Annual Inspection)**	

[1] **IF "N/A" IS CHECKED LIST REASON:**

X-749A CLASSIFIED MATERIALS DISPOSAL FACILITY
Surveillance and Maintenance
Quarterly Inspection Check Sheet (Sheet 2 of 2)

SECTION B

ITEM #	COMMENTS/OBSERVATIONS	ACTION TAKEN/NATURE OF REPAIRS	CLOSED INITIALS/DATE

9. X-749B PETER KIEWIT LANDFILL

9.1 INTRODUCTION

This section describes the recommended S&M procedures for the X-749B Peter Kiewit Landfill (PK Landfill) (1) soil and vegetative cover system, (2) surface water control system, (3) perimeter embankments, (4) seep collection system, and (5) groundwater monitoring system. The S&M Plan is based on the information and data contained in the Ohio EPA's decision document and the certified-for-construction specifications and construction drawings for the PK Landfill CMI.

The PK Landfill is located on the southern portion of the DOE reservation and is situated along the west side of Big Run Creek approximately 2000 feet east of the XT-847 Gaseous Centrifuge Enrichment Plant construction warehouse and northeast of the X-749 Contaminated Materials Disposal Facility. The PK Landfill was used from approximately 1953 until 1968. During plant construction, the landfill was used as a salvage yard, burn pit, and trash disposal area. After plant construction, the landfill was used as a sanitary landfill. It has been estimated that the maximum fill thickness in the central portion of PK Landfill is approximately 15 feet.

The *Decision Document for the Peter Kiewit Landfill* (Ohio EPA 1996b) specified the selected remedy to be used to achieve the remedial goals. This selected remedy required the following actions:

- continued operation of seep collection system on the east side of the landfill,
- capping the landfill to contain wastes and reduce water infiltration with a cap that meets the requirements of RCRA, Subtitle D,
- using vertical barriers (slurry wall) as necessary to minimize lateral migration of contaminants (subsequent evaluations have determined that a barrier wall is not necessary, as documented in the most recent 5-year review [DOE 2008]), and
- environmental monitoring to ensure that the final remedial action is protective of human health and the environment.

9.2 DESCRIPTION OF SYSTEM COMPONENTS

The capping system constructed for PK Landfill consists of several materials in layers that effectively isolate the landfill from exposure to the environment. By placing a capping system on top of PK Landfill, the risk of contaminant exposure is greatly reduced. Surface water run-on and run-off is prevented from contacting the landfilled materials. In particular, placement of a barrier over the landfill minimizes the generation of leachate because the amount of water percolating vertically downward through the capped area is virtually eliminated. The system components that require inspection and maintenance are briefly described in this section.

- *Soil and vegetative cover system*: The soil and vegetative cover system constructed at the PK Landfill consists of a soil layer (minimum 23 feet thick) designed for frost protection of the underlying cap system and a topsoil layer (minimum 6 inches thick) designed to support vegetation.

- *Rock toe embankment system*: A rock toe embankment was constructed along the eastern edge of the landfill boundary to allow the capping system to cover the landfill boundary limits and minimize encroachment upon the flood plain of Big Run Creek. The rock toe embankment consists of dumped rock fill, coarse aggregate, and geotextile.

- *Surface drainage system*: The surface drainage channels are lined either with temporary erosion control matting or with riprap and geotextile. The surface drainage channels are designed for flow capacity and velocity from a 25-year peak precipitation event. Riprap and a protective geotextile are installed at ditch locations with higher flow velocities and potential for soil erosion.

- *Cap drainage system*: The cap drainage system consists of HDPE piping. The slotted 6-inch pipe is approximately 2500 feet long and extends around the landfill cap boundary. The cap drainage system has 11 outlets, and each solid pipe outlet is approximately 25 feet long. The solid pipe has an end cap/screen attached to the end to prevent small animals from entering the cap drainage system and possibly causing damage or blockage.

- *PK Landfill collection system*: A seep collection system was constructed in November 1994 to collect water seeping from the east perimeter of the PK Landfill. In October 1997, a second collection system was constructed on the southeastern boundary to intercept contaminated water migrating to surface waters and eventually toward Big Run Creek from the southern portion of the PK Landfill. Both collection systems include a gravity collection system and a double-contained force main that travel along three sides of the landfill cap boundary. The gravity collection system consists of approximately 1200 feet of perforated pipe and seven concrete manholes along the eastern perimeter. The force main system includes a pumping station at the southeast corner of the project site. The force main has three access ports along the southern boundary before connecting to the X-749 groundwater collection system that delivers the collected water to the X-622 Groundwater Treatment Facility.

- *PK Landfill monitoring system*: Monitoring of groundwater, the collection trench system, and surface water will confirm that the containment and treatment of leachate are sufficiently protective of human health and the environment. Monitoring requirements for these systems, including sampling locations, frequency of monitoring, parameters, and reporting requirements are provided in the IGWMP.

- *Miscellaneous systems*: Miscellaneous systems at the PK Landfill include (1) sanitary sewer manhole, (2) stormwater pipe line, (3) gravel access roads, (4) perimeter security fence and gates, and (5) deed monuments. There is one sanitary sewer manhole at the northwest corner of the landfill cap that serves the XT-847 warehouse. A 36-inch stormwater pipe is buried beneath the PK Landfill southern toe to convey stormwater runoff from X-749 landfill to Big Run Creek. There are two gravel access roads: one at the north side, and another at the west side of the landfill. The project site is enclosed by a woven wire security fence with three gates. There are 14 deed monuments at the perimeter of the PK Landfill. The monuments are constructed of aluminum and encased in concrete to be relatively flush with the ground.

9.3 NORMAL OPERATIONS AND PREVENTIVE MAINTENANCE

Remedial and monitoring systems at the PK Landfill must be properly maintained to contain and isolate contaminants of concern from the environment. Processes which could damage the landfill cap system include soil erosion, sedimentation, physical disturbances, settlement, and exposure to weather.

Any discovered damage to the PK Landfill will be repaired promptly and the cause investigated, if necessary, so that future needs for additional repairs can be minimized.

Normal maintenance includes inspection and repairs of system components at prescribed intervals for the purpose of preventing abnormal operating conditions. Also included in the category of normal maintenance are detecting, repairing, and reporting defects that could lead to system component damage or breakdown. These requirements are summarized in Table 9.1. The operation, maintenance, and inspections of the trench pumps and drainage system are conducted in accordance with the operating procedures for the X-622 Groundwater Treatment Facility. Attachment 9.A provides an example of the inspection form used for assessment of the systems at the PK Landfill.

9.3.1 Soil and Vegetative Cover System

Soil amendments (fertilizer and lime) are added as needed, if on-site observations show stressed vegetation or poor growth.

The following parts of the PK Landfill soil and vegetative cover system are routinely inspected during preventive maintenance activities (see Table 9.1):

- grass and vegetation,
- soil layer, and
- earthen embankment side slopes.

The landfill cover is mowed at least twice a year to control weeds. Additional mowing is performed as needed to prevent weeds from becoming overly tall or dense.

The soil and vegetation cover is routinely visually inspected for the presence of stressed vegetation and small shrubs or deeply rooted woody plant growth. The soil layer is visually inspected for the presence of conditions that could lead to a breakdown of the layer's integrity or the engineered system. The side slope embankments and adjacent areas are inspected in accordance with Table 9.1. Conditions that could affect the CMI integrity include items that threaten to expose the surface of the underlying landfill cap section, impact the minimum soil cover requirement, or prevent positive surface drainage as engineered on the design drawings. The potential problems to be observed during visual inspections include:

- burrowing animals,
- erosion or cracks, and
- settlement and subsidence.

9.3.2 Rock Toe Embankment System

The rock toe embankment is inspected in accordance with Table 9.1 to ensure that the stability of the landfill cap is maintained. Potential problems that may be observed include debris and sedimentation, washing out of rock material, sloughing of side slopes, or the presence of standing water.

9.3.3 Surface Drainage System

The surface drainage system is inspected in accordance with Table 9.1. The drainage system should be free of excessive soil, silt, and debris. Potential problems that may be observed include debris, erosion, sedimentation, blocked drainage pipes, washing out of rock channel protection, sloughing of drainage channel side slopes, and the lack of positive drainage. Items to be inspected include:

- grass surface drainage channels,
- riprap surface drainage channels,
- storm drainage outfalls at the west side of the project site,
- the 24-in. diameter corrugated metal pipe underneath the gravel access road, and
- the 36-in. diameter corrugated polyethylene pipe underneath the southern cap toe.

Table 9.1. PK Landfill maintenance program

System Component	Preventive Maintenance Activity	Preventive Maintenance Frequency	Corrective Maintenance Activity	Corrective Maintenance Frequency
Grass and vegetation	Mowing Amendments Visual inspection	As needed[a] As needed Quarterly	Vegetation reseeding and watering Brush removal	As needed As needed
Soil and vegetative cover system	Visual inspection	Quarterly	Erosion repair Subsidence and depression repair Burrowing animal removal Embankment side slope repair Geosynthetic cap repair	As needed As needed As needed As needed As needed
Rock toe embankment	Visual inspection	Quarterly	Subsidence and depression repair Burrowing animal removal	As needed As needed
Surface drainage system	Visual inspection Sampling	Quarterly Per the IGWMP	Drainage channel cleaning and repair Drainage pipe cleaning and repair	As needed As needed
Cap drainage system	Visual inspection	Quarterly	Cap drain cleaning and repair Screen mesh replacement	As needed As needed
Seep collection system	Visual inspection Sampling Test Hi Level Alarm Clean out system	Quarterly Per the IGWMP Annually As needed	Manhole repair Cleanout repair Repair High Level Alarm Remove silt/bacteria Pump repair	As needed As needed As needed As needed As needed
Groundwater monitoring wells	Visual inspection	Per the IGWMP	Repaint well Replace casing hinge Other repairs	As needed As needed As needed
Sanitary sewer manhole	Visual inspection	Annually	Manhole repair	As needed
Gravel access roads	Visual inspection	Annually	Road repair	As needed
Perimeter fence	Visual inspection	Annually	Fence repair or replacement	As needed
Gates	Visual inspection	Annually	Gate repair or replacement	As needed
Deed monuments	Visual inspection	Annually	Monument repair or replacement	As needed

[a]At a minimum, 2 times/year.

9.3.4 Cap Drainage System

The cap drainage system is inspected in accordance with Table 9.1. Potential problems that may be observed include debris, sedimentation, blocked drainage pipes, the lack of positive drainage, and damage to the wire screen or to the end of pipes.

9.3.5 Seep Collection System

The seep collection system is inspected routinely to ensure that surface water infiltration is minimized. Potential problems that may be observed include settlement or cracking of manhole or cleanout structures, debris or sedimentation within manholes or in collected seep water, biological growth, lack of pump operation, inoperable leak detection system, or the presence of animal life and tree root intrusion to collection system.

9.3.6 Groundwater Monitoring System

Monitoring wells are inspected in accordance with the IGWMP.

9.3.7 Miscellaneous Systems

Vehicular access roads to the site, perimeter fence, gate barriers, and deed monuments are inspected annually in accordance with Table 9.1 to ensure that these items are serving their intended purpose. Vehicular access to the site and all on-site access corridors are visually inspected to ensure that the access remains passable and in good condition. Perimeter fences are inspected to ensure that it remains in good condition and structurally sound. Survey marks locating the perimeter of the landfill are inspected annually to ensure that physical damage has not occurred due to erosion, settlement, or tampering and vandalism; and that they are readable.

9.4 CORRECTIVE MAINTENANCE

Maintenance tasks or repairs are performed as described in this section to correct deficiencies or operating problems detected during preventive maintenance activities. Materials used in all maintenance activities are equivalent to or better than those originally specified for the initial construction.

9.4.1 Soil and Vegetative Cover System

Corrective maintenance activities that may become necessary for the soil and vegetative cover systems are as follows:

- grass and vegetation reseeding,
- amendments,
- weed or brush removal,
- removing or relocating burrowing animals,
- vegetative layer repair for instances of subsidence or settlement,
- embankment side slope repair, and
- geosynthetic cap repair.

Reseeding may be necessary if there is insufficient grass on the landfill cap, for whatever reason, or if repairs due to settlement or subsidence become necessary. Weed or brush removal is required to prevent plants with long roots from becoming established on the landfill cap.

Burrowing animals are removed or relocated to other portions of the DOE reservation. Any burrows that remain are backfilled with soil to the maximum extent possible, and measures are taken to discourage the return of similar types of burrowing animals.

The soil layer and the side slopes of the embankments may need to be reconstructed if damage occurs due to erosion, substantial settlement, or sloughing. If reconstruction is required, care will be used to replace each layer, as needed, with like materials and to install each layer as specified for the original installation. The capping system may also need to be reconstructed if damage occurs as the result of differential settlement due to waste subsidence. Subsidence depressions will be remediated below the level of the barrier system (i.e., geomembrane) to avoid long-term acceleration of the subsidence due to roof ponding (where ponding water causes the roof on the cap to deflect, thus allowing more water to pond, and so on). Subsidence remediation requires removing a portion of the cover system (including the geomembrane by peeling back) and backfilling the depression with specified original layers to the specified grade. The geomembrane must then be replaced to the manufacturer's recommendations such that the capping system's integrity is restored to the original specifications. Where soil layer reconstruction is required, adequate care will be taken to ensure that a sufficient bearing capacity exists to support the construction equipment used to make the repair and to prevent damage to the geosynthetic materials underneath. Erosion control matting or dumped rock fills may be required on any perimeter embankments prone to surface erosion.

9.4.2 Rock Toe Embankment System

Corrective maintenance activities that may become necessary for the rock toe embankment system are as follows:

- repair for subsidence or settlement, and
- removing or relocating burrowing animals.

Burrowing animals are removed or relocated to other portions of the DOE reservation. Any burrows that remain are backfilled with dumped rock fills to the maximum extent possible, and measures are taken to discourage the return of similar types of burrowing animals.

9.4.3 Surface Drainage System

The surface drainage system may require repair because of damage caused by erosion. Stone or temporary erosion control matting or other appropriate material will be installed in drainage channels prone to erosion. Dumped rock fill channel protection that is dislodged by heavy precipitation events will require replacement. Silt removed during the S&M period will be air-dried, if required, and deposited on the DOE reservation for fill or utilized to make on-site erosion repairs.

9.4.4 Cap Drainage System

The cap drainage system may require repair if the outlet pipes are blocked or damaged. Other repairs may be needed if there is evidence of poor or inadequate drainage within the landfill cap soil.

9.4.5 Seep Collection System

Repairs to the concrete manholes may be necessary due to subsidence or settlement. Debris or silt will be removed from the manhole inverts if necessary. Needed repairs to the gravity drain portions of the system may be evident by comparing the flows in each manhole. The system may need to be cleaned and purified to remove silt and bacterial growth.

9.4.6 Groundwater Monitoring System

Monitoring wells are repainted when the paint has deteriorated such that the well labels have become illegible. The concrete pad is inspected and repaired or reinstalled as required. The well-casing hinge is checked and replaced if necessary. Other repairs may be required if a well has been damaged.

9.4.7 Miscellaneous Systems

Perimeter fences and gates may need repair due to physical damage or settlement. Gate hardware may need to be replaced due to normal wear and tear. The vehicular access routes may require repair or maintenance to keep the access clear of encroaching vegetation and maintain a passable surface that is free of ruts and potholes. The deed monuments may require repair or replacement due to erosion, settlement, or vandalism. Deed monuments are replaced by, or under the direction of, a land surveyor registered in the State of Ohio.

9.5 ROUTINE MONITORING

The IGWMP provides monitoring and reporting requirements for the following systems at the PK Landfill:

- surface water contaminants at Big Run Creek,
- leachate samples and flow measurements at manholes in the seep collection system, and
- routine groundwater monitoring.

9.6 ALTERNATIVE S&M ACTIVITIES

Upon completion, the constructed remedy provides protection of human health and the environment by eliminating the relevant exposure pathways. The constructed remedy will be effective in the long term by preventing or containing the seeps and isolating them from the environment. Design calculations on the stability of the embankments, under static and seismic loading, determined that the embankments have acceptable factors of safety, based on discussions with the Ohio EPA.

The only alternative to the S&M procedures for the PK Landfill is an alternative plan for the seep collection systems. In case of power loss, pump failure, and/or force main piping system disruption, the leachate from the collection system will be removed by portable self-powered pumps. These pumps will be used to pump the leachate from the collection basin to portable tanks for transport to the appropriate permitted treatment facility. This alternative plan will continue until the seep collection system has been restored to original operating conditions.

9.7 EMERGENCY, HEALTH, AND SAFETY CONSIDERATIONS

Specific permits are required for working in potentially hazardous environments. Lock out/tag out requirements must be met when working where electrical hazards are present. There are electric lines located aboveground and underground; electric lines and electrical equipment must always be treated carefully. Confined space permits are necessary to enter manholes. Welding permits may be necessary for some types of repairs.

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ATTACHMENT 9.A

INSPECTION FORM
FOR X-749B PETER KIEWIT LANDFILL

X-749B PETER KIEWIT LANDFILL
Surveillance and Maintenance
Quarterly and Annual Inspection Check Sheet (Sheet 1 of 2)

Inspected By: Signature				**Date Inspection Performed:**
Reviewed By: Signature				**Time Inspection Performed:**

SECTION A

ITEMS INSPECTED

YES	NO	N/A[1]	Unit Access Roads, Barriers, and Gates
			1) Fences and gates are free of damage. **(Annual inspection)**
			2) Unit access roads are passable. **(Annual Inspection)**
YES	**NO**	**N/A[1]**	**Condition of Closure Cap and Rock Toe Embankment**
			3) Cap does not require mowing.
			4) Cap is free of areas of dead vegetation.
			5) Cap is free of woody plants.
			6) Cap is free of ponded water.
			7) Cap is free of burrowing animals.
			8) Cap is free of erosion damage.
			9) Cap is free of evidence of settlement, subsidence, or displacement.
			10) Drainage channels are free of obstructions.
			11) All surface water run-off controls (rip-rap lined channels, etc.) are free of erosion or storm damage.
YES	**NO**	**N/A[1]**	**Sanitary Sewer Manhole**
			12) Manhole is free of damage. **(Annual Inspection)**
YES	**NO**	**N/A[1]**	**Cap Drainage System**
			13) Cap outlet pipes are free of blockage and damage.
			14) End cap screening on cap drains is securely installed and free of damage.
YES	**NO**	**N/A[1]**	**Benchmark Integrity**
			15) Benchmarks are readable, free of physical damage, and free of evidence of tampering. **(Annual inspection)**
YES	**NO**	**N/A[1]**	**Seep Collection System**
			16) Manholes are free of damage.

X-749B PETER KIEWIT LANDFILL
Surveillance and Maintenance
Quarterly and Annual Inspection Check Sheet (Sheet 2 of 2)

SECTION A (Continued)

INSPECTED ITEMS

[1] IF N/A IS CHECKED LIST REASON:

SECTION B

ITEM #	COMMENTS/OBSERVATIONS	ACTION TAKEN/NATURE OF REPAIRS	CLOSED INITIALS/DATE

10. X-231A OIL BIODEGRADATION PLOT

10.1 INTRODUCTION

The X-231A Oil Biodegradation Plot is located in the central portion of Quadrant I, immediately east of the X-626 Recirculating Cold Water building and Cooling Tower, and just south of the X-600A Coal Pile Yard. The X-231A is approximately 2.46 acres in size. Waste materials were disposed of at the Oil Biodegradation Plot during the 1974 to 1976 period, and included solvent-contaminated radioactive waste oil, oil-soaked fuller's earth and trichloroethylene. A nitrile liner was installed in 1987. Construction activities for a permanent engineered cap, required by the Ohio EPA, were completed in September 2000.

Ohio EPA's preferred remedial alternative for the X-231A Oil Biodegradation Plot is a multimedia cap. The cap, together with the installed cap drainage system, berms and ditches, directs surface water from and around the cap and into the drainage ditch that flows to the X-230K South Holding Pond. Although the cap is not required to meet the design requirements of a RCRA Subtitle C or D cap, it does limit surface water infiltration, thereby preventing or limiting contaminants from leaching to groundwater.

This section describes the post-closure operations and maintenance for the X-231A Oil Biodegradation Plot located at the Portsmouth Gaseous Diffusion Plant, Quadrant I, Piketon, Ohio. The designated agent for DOE shall perform this work.

10.2 MAINTENANCE REQUIREMENTS

10.2.1 Leachate Inspections

Not applicable.

10.2.2 Surface Water Management System

Surface water controls collect run-off from the cap. Surface water from the cap is directed into engineered drainage channels. The channels are regularly inspected and maintained during the post-closure period.

10.2.3 Cap System

The final cover and support systems for the X-231A Oil Biodegradation Plot were designed to resist erosion and settlement, prevent infiltration, and promote run-off. The cap drainage system consists of geonet composite and HDPE piping intended to collect any surface water that may migrate through the frost protection layer. The 4-inch corrugated HDPE perforated pipe is approximately 1,500 feet long and extends around the Oil Biodegradation Plot cap boundary. The cap drainage system has eight outlets, which consist of 4-inch corrugated HDPE solid pipe. The HDPE solid pipe has an end cap screen to prevent small animals from entering the cap drainage system and possibly causing damage or blockage.

Both preventive and corrective maintenance of the cover and support systems will allow the unit to continue to meet the performance requirements. The inspection form, an example of which is included in Attachment 10.A at the end of this section, contains the areas of inspection for preventive and corrective maintenance under the maintenance plan. All operations described herein will be performed for the entire 30-year post-closure period.

Equipment necessary for the maintenance program includes riding mowers and push mowers, weed-eaters, backhoes, grading machines, seeders, shovels, picks, and any other equipment appropriate for the nature of the work involved and the need to protect the integrity of the cover.

10.2.4 Final Cover

The following items are included as part of the post-closure maintenance plan for the final cover of the X-231A Oil Biodegradation Plot.

- *Mowing and Fertilizing*: The cover is mowed as necessary utilizing riding lawn mowers and push mowers during growing seasons, and fertilized as needed in the spring. Large plants are pulled from the cover by hand or with the aid of hand tools to prevent root penetration in the drainage layer. Any areas lacking vegetation are reseeded, fertilized, and watered as needed to maintain adequate cover.

- *Erosion Damage Repair*: Corrective maintenance is required if inspection reveals any condition that threatens the integrity of the unit, such as soil loss, surface displacements, surface cracks, irregularities, or vegetative overgrowth or damage. Eroded areas may require removal of the affected loose soil followed by replacement, re-compaction, reseeding, fertilization, and regrading or raking to the original contour. These activities are accomplished using hand tools or a small backhoe.

- *Settlement, Subsidence, or Displacement*: Subsided or settled areas that require repair will be investigated by qualified personnel to determine the cause of the displacement. If appropriate, suitable soil cover material is placed on the affected areas. If investigations reveal that a malfunction of the cover has caused the displacement (e.g., liner failure, drainage layer failure), the defective items are repaired or replaced, and the cover is regraded. These activities are accomplished with the aid of a small backhoe and hand tools.

- *Channels or Culverts*: Drainage structures are kept free of excessive vegetation. Excessive siltation due to erosion is removed when noted and the area restored. Screened drainage pipe discharges are kept clear and intact.

- *Survey/Bench Marks*: Survey marks locating the perimeter of the landfill are inspected annually to ensure that physical damage has not occurred due to erosion, settlement, or tampering and vandalism; and that they are readable. Any damaged or improperly located survey mark is repaired and/or resurveyed.

- *Rodent and Insect Control*: DOE has existing programs at PORTS to control rodents and insects. With proper use of these procedures, minimal maintenance activities are required. If rodents or insects damage the cover, the damage is repaired with the use of appropriate hand tools or, if necessary, a small backhoe. The area is regraded and reseeded. Special attention is given to these areas in future inspections to ensure they are not continual problems.

- *Contingency Plans*: In the event of a storm or severe event such as a tornado, the landfill is inspected as soon as possible after the event, and in no case more than 12 hours after the event. If significant damage has been caused by the event, then the inspector will contact the emergency coordinator who will activate an emergency response team. Items to be considered include repair or replacement of the synthetic liner and restoration of any damaged area(s).

- *Corrective Maintenance Activities*: Corrective maintenance activities are conducted any time the integrity of the containment and monitoring systems are disturbed and subsequently discovered by PORTS inspectors.

10.2.5 Security Systems

Security fencing requirements for the X-231A Oil Biodegradation Plot are met by the PORTS security fencing system.

10.3 QUARTERLY INSPECTION

Inspections are conducted quarterly. Inspections are walking inspections with observations recorded on an inspection form, an example of which is included in Attachment 10.A at the end of this section. The inspection sheet lists items to be inspected and potential problems. A new form is completed for each inspection. Completed inspections forms are maintained in accordance with Section 1.5.

Specific inspection items include the engineered cap (erosion damage, vegetative cover condition, rodent and/or insect damage), below cap drainage system, survey mark integrity, and cover conditions (drainage system, settlement, subsidence, displacement). Groundwater monitoring wells at the X-231A Oil Biodegradation Plot are inspected in accordance with the IGWMP.

The X-231A Oil Biodegradation Plot is not subject to casual foot or vehicular traffic and is isolated from major activities at the site. Consequently, the potential is low for damage to the physical structures, such as the drainage system, monitoring wells, and survey marks. Material components used for the multilayer cap consist of natural materials, a synthetic liner, a geotextile fabric, and a vegetative layer and have an extended service life. Quarterly inspections are considered sufficient to monitor the condition of the units. Deficiencies are corrected as soon as possible. Leachate outbreaks are not anticipated due to the below grade configuration of the Oil Biodegradation Plot. Upon correction of the deficient item(s), the inspection log is updated to indicate any actions taken.

10.4 GROUNDWATER MONITORING

Groundwater monitoring at the X-231A Oil Biodegradation Plot is performed in accordance with the IGWMP.

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ATTACHMENT 10.A

INSPECTION FORM
FOR X-231A OIL BIODEGRADATION PLOT

X-231A OIL BIODEGRADATION PLOT
Surveillance and Maintenance
Quarterly and Annual Inspection Check Sheet (Sheet 1 of 2)

Inspected By: Signature	**Date Inspection Performed:**
Reviewed By: Signature	**Time Inspection Performed:**

SECTION A

ITEMS INSPECTED			
YES	**NO**	**N/A[1]**	**Condition of Closure Cap/Slopes/Drainage System**
			1) Cap does not require mowing.
			2) Cap is free of areas of dead vegetation.
			3) Cap is free of woody plants.
			4) Cap is free of ponded water.
			5) Cap is free of burrowing animals.
			6) Cap is free of erosion damage.
			7) Cap is free of evidence of settlement, subsidence, or displacement.
YES	**NO**	**N/A[1]**	**Cap Drainage System**
			8) Cap outlet pipes are free of blockage and damage.
			9) Mesh screening on cap drains is securely installed and free of damage.
YES	**NO**	**N/A[1]**	**Benchmark Integrity**
			10) Benchmarks are readable, free of physical damage, and free of evidence of tampering. **(Annual Inspection)**

[1]IF "N/A" IS CHECKED LIST REASON:

X-231A OIL BIODEGRADATION PLOT
Surveillance and Maintenance
Quarterly and Annual Inspection Check Sheet (Sheet 2 of 2

SECTION B

ITEM #	COMMENTS/OBSERVATIONS	ACTION TAKEN/NATURE OF REPAIRS	CLOSED INITIALS/DATE

11. X-231B OIL BIODEGRADATION PLOT

11.1 INTRODUCTION

The X-231B Oil Biodegradation Plot is located south of the X-326 Process Building. This plot is closely bordered by plant roads on the north and east, and is approximately 1.31 acres. There are several underground utilities directly beneath or in the immediate vicinity of the landfill. The waste oils were disposed of at the landfill at a rate of 2,000 to 3,500 gallons per year from 1976 to 1983. These waste oils were contaminated with chlorinated solvents, metals, radionuclides, and PCBs. A temporary clay cap and a nitrile liner were installed at X-231B site in 1987, but they no longer exist due to the soil remediation work that took place later. Construction activities for the permanent engineered cap, required by the Ohio EPA, were completed in October 2000.

Ohio EPA's preferred remedial alternative for the X-231B Oil Biodegradation Plot is a multimedia cap. This cap is engineered such that it meets the RCRA substantive requirements as noted in OAC 3745-67-80. The Ohio EPA Quadrant I Decision Document stipulates that completion of all remedial activities associated with this unit (i.e. X-231B) meet the substantive requirements of RCRA as noted in the Ohio EPA's March 1999 Director's Final Findings & Orders for integration, Section VI, Paragraph 2. The cap, together with the installed cap drainage system, directs surface water around the cap and into the drainage ditch that flows to the X-230K South Holding Pond. The cap meets the RCRA substantive requirements of OAC 3745-67-80.

This section describes the post-closure operations and maintenance for the X-231B Oil Biodegradation Plot located in Quadrant I. The designated agent for DOE shall perform this work.

11.2 MAINTENANCE REQUIREMENTS

11.2.1 Leachate Inspections

Not Applicable

11.2.2 Surface Water Management System

Surface water controls collect run-off from the cap. Surface water from the cap is directed into rip-rap lined drainage channels. The channels are regularly inspected and maintained during the post-closure period.

11.2.3 Cap System

The final cover and support systems for the X-231B Oil Biodegradation Plot was designed to resist erosion and settlement, prevent infiltration, and promote run-off. Both preventive and corrective maintenance of the cover and support systems will allow the unit to continue to meet these requirements. The cap drainage system consists of geonet composite, which is designed to collect infiltration water from the surface. This infiltration water drains into the perimeter aggregate toe drain constructed with AASHTO No 57 stone. The water discharges into the surrounding ground via aggregate lined perimeter toe drains. No additional piping or channels are involved.

The inspection form, an example of which is included in Attachment 11.A at the end of this section, contains the areas of inspection for preventive and corrective maintenance under the maintenance plan. All operations described herein will be performed for the entire 30-year post-closure period.

Equipment necessary for the maintenance program includes riding mowers and push mowers, weed-eaters, backhoes, grading machines, seeders, shovels, picks, and any other equipment appropriate for the nature of the work involved and the need to protect the integrity of the cover.

11.2.4 Final Cover

The following items are included as part of the post-closure maintenance plan for the final cover of the X-231B Oil Biodegradation Plot.

- *Mowing and Fertilizing*: The cover is mowed as necessary utilizing riding lawn mowers and push mowers during growing seasons, and is fertilized as needed in the spring. Large plants are pulled from the cover by hand or with the aid of hand tools to prevent root penetration in the drainage layer. Any areas lacking vegetation are reseeded, fertilized, and watered as needed to maintain adequate cover.

- *Run-On and Run-Off Control Structures*: Routine maintenance is conducted on run-on/run-off structures to ensure that these structures continue to function as designed. Damaged areas are repaired utilizing the equipment necessary to complete the repair.

- *Erosion Damage Repair*: Corrective maintenance is required if inspection reveals any condition that threatens the integrity of the unit, such as soil loss, surface displacements, surface cracks, irregularities, or vegetative overgrowth or damage. Eroded areas may require removal of the affected loose soil followed by replacement, re-compaction, reseeding, fertilization, and regrading or raking to the original contour. These activities are accomplished using hand tools or a small backhoe.

- *Settlement, Subsidence, or Displacement*: Subsided or settled areas that require repair will be investigated by qualified personnel to determine the cause of the displacement. If appropriate, suitable soil cover material is placed on the affected areas. If investigations reveal that a malfunction of the cover has caused the displacement (e.g., liner failure, drainage layer failure), the defective items are repaired or replaced, and the cover is regraded. These activities are accomplished with the aid of a small backhoe and hand tools.

- *Channels or Culverts*: Drainage structures are kept free of excessive vegetation. Excessive siltation due to erosion is removed when noted and the area restored.

- *Survey/Bench Marks:* Survey marks locating the perimeter of the landfill are inspected annually to ensure that physical damage has not occurred due to erosion, settlement, or tampering and vandalism; and that they are readable. Any damaged or improperly located survey mark is repaired and/or resurveyed.

- *Rodent and Insect Control*: DOE has existing programs at PORTS to control rodents and insects. With proper use of these procedures, minimal maintenance activities are required. If rodents or insects damage the cover, the damage is repaired with the use of appropriate hand tools or, if necessary, a small backhoe. The area is regraded and reseeded. Special attention is given to these areas in future inspections to ensure they are not continual problems.

- *Contingency Plans*: In the event of a storm or severe event such as a tornado, the landfill is inspected as soon as possible after the event, and in no case more than 12 hours after the event. If significant damage has been caused by the event, then the inspector will contact the emergency coordinator who will activate an emergency response team. Items to be considered include repair to the synthetic liner, replacement of the liner, restoration of the entire or significant portions of the cap, and any damage or impact to USEC utilities that pass beneath the cap.

In the event that a utility line passing under the cap failed, the line would be isolated. The line will be rerouted around the cap and the section of failed line filled with concrete or grout, sealed at the ends and abandoned in place. An evaluation on the structural integrity of the cap will be performed and needed actions implemented to address any damage. The need for development and implementation of a special ground water monitoring plan to determine if contaminates have migrated outside the boundary of the cap will be evaluated.

- *Corrective Maintenance Activities*: Corrective maintenance activities are conducted any time the integrity of the containment and monitoring systems are disturbed and subsequently discovered by PORTS inspectors.

11.2.5 Security Systems

During routine quarterly inspections, all deficiencies in the security system are noted and corrected as soon as possible. A security fence was installed as part of the original design, but security fencing requirements for the X-231B Oil Biodegradation Plot are met by the PORTS security fencing system. Therefore, the fence surrounding the X-231B Oil Biodegradation Plot does not have to be maintained.

11.3 QUARTERLY INSPECTION

Inspections are conducted quarterly. Inspections are walking inspections with observations recorded on an inspection form, an example of which is included in Attachment 11.A at the end of this section. The inspection sheet lists items to be inspected and potential problems. A new form is completed for each inspection. Completed inspections forms are maintained in accordance with Section 1.5.

Specific inspection items include security control devices (barriers and gates), engineered cap (erosion damage, surface cracks, vegetative cover condition, rodent and/or insect damage), run-on/run-off control devices, survey mark integrity, and cover conditions (drainage system, settlement, subsidence, displacement). Groundwater monitoring wells at the X-231B Oil Biodegradation Plot is inspected in accordance with the IGWMP.

The X-231B Oil Biodegradation Plot is not subject to casual foot or vehicular traffic and is isolated from major activities at the site. Consequently, the potential is low for damage to the physical structures, such as the cap drainage system, monitoring wells, and survey marks. Material components used for the multilayer cap consist of natural materials, a synthetic liner, a geotextile fabric, and a vegetative layer and have an extended service life. Quarterly inspections are considered sufficient to monitor the condition of the units. Deficiencies are corrected as soon as possible. Leachate outbreaks are not anticipated due to the below grade configuration of the Oil Biodegradation Plot. Upon correction of the deficient item(s), the inspection log is updated to indicate any actions taken.

11.4 GROUNDWATER MONITORING

Groundwater monitoring at the X-231B Oil Biodegradation Plot is performed in accordance with the IGWMP.

ATTACHMENT 11.A

INSPECTION FORM
FOR X-231B OIL BIODEGRADATION PLOT

X-231B OIL BIODEGRADATION PLOT
Surveillance and Maintenance
Quarterly and Annual Inspection Check Sheet (Sheet 1 of 2)

Inspected By: Signature	**Date Inspection Performed:**
Reviewed By: Signature	**Time Inspection Performed:**

SECTION A

ITEMS INSPECTED

YES	NO	N/A[1]	Unit Access Roads, Barriers, and Gates
			1) Fences and gates are free of damage.
			2) Unit access roads are passable.
YES	**NO**	**N/A[1]**	**Condition of Closure /Slopes/Drainage System**
			3) Cap does not require mowing.
			4) Cap is free of areas of dead vegetation.
			5) Cap is free of woody plants.
			6) Cap is free of ponded water.
			7) Cap is free of burrowing animals.
			8) Cap is free of erosion damage.
			9) Cap is free of evidence of settlement, subsidence, or displacement.
YES	**NO**	**N/A[1]**	**Benchmark Integrity**
			10) Benchmarks are readable, free of physical damage, and free of evidence of tampering. **(Annual Inspection)**

[1]IF "N/A" IS CHECKED LIST REASON:

X-231B OIL BIODEGRADATION PLOT
Surveillance and Maintenance
Quarterly and Annual Inspection Check Sheet (Sheet 2 of 2)

SECTION B			
ITEM #	COMMENTS/OBSERVATIONS	ACTION TAKEN/NATURE OF REPAIRS	CLOSED INITIALS/DATE

12. REFERENCES

DOE 1995. *Portsmouth Gaseous Diffusion Plant Corrective Measure Implementation Program Safety and Health Accident Prevention Plan.* (Incorporated in the *Corrective Measures Implementation Program Plan [Generic Plan]*, DOE/OR/11-1344&D3, May 1999, Bechtel Jacobs Company, Piketon, OH).

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DOE 2001. *Quadrant I Corrective Measures Implementation Program Plan for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/OR/11-3072&D2, Bechtel Jacobs Company, Piketon, Ohio.

DOE 2008. *Second Five-Year Review for the X-749B Peter Kiewit Landfill at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0053&D1, LATA/Parallax Portsmouth, LLC, Piketon, OH.

DOE 2010a (or latest revision). *Integrated Groundwater Monitoring Plan for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0032&D4, LATA/Parallax Portsmouth, LLC, Piketon, OH.

DOE 2010b. *Work Plan for the X-740 Groundwater Enhanced Anaerobic Bioremediation Pilot Study at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0154&D2, LATA/Parallax Portsmouth, LLC, Piketon, OH.

DOE 2011. *First Five-Year Review for the X-749/X-120 Groundwater Plume at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0187V1&D1, LATA/Parallax Portsmouth, LLC, Piketon, OH.

Galanti, M. April 24, 2008. Ohio EPA, Division of Emergency and Remedial Response, Logan, OH, letter to W. Murphie, Department of Energy, Portsmouth/Paducah Project Office, Lexington, KY.

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Knoop, 1996. *Guidelines for the Development of Tallgrass Prairie Vegetation at the X-611A Lime Sludge Lagoons in Piketon, Ohio.*

Ohio EPA 1996a. *The Decision Document for the X-611A Solid Waste Management Unit, U.S. DOE – PORTS Site, June 1996.* Ohio Environmental Protection Agency, Division of Emergency and Remedial Response, Columbus, Ohio.

Ohio EPA 1996b. *Decision Document Peter Kiewit Landfill, U.S. DOE Portsmouth, Pike County, Ohio, May 1996.* Ohio Environmental Protection Agency, Division of Emergency and Remedial Response, Columbus, Ohio.

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