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

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

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EQ Midwest, Inc.
contributed to the preparation of this document and should not be considered an eligible contractor for its review.

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ACRONYMS

BRC	Big Run Creek
CAS	Cleanup Alternatives Study
CMI	Corrective Measures Implementation
CMP	*Comprehensive Monitoring Plan for the X-749 and Peter Kiewit Landfills Area*s (DOE/OR/11-3124&D1)
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	Groundwater Quality Assessment
LBC	Little Beaver Creek
LNAPL	light non-aqueous phase liquid
IGWMP	Integrated Groundwater Monitoring Plan
IRM	Interim Remedial Measure
ISWL	Industrial Solid Waste Landfill
NHP	North Holding Pond
NPDES	National Pollutant Discharge Elimination System
O&M	operation and maintenance
OAC	Ohio Administrative Code
PCB	polychlorinated biphenyl
PEMS	Project Environmental Measurements System
PK	Peter Kiewit
PORTS	Portsmouth Gaseous Diffusion Plant
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
ROD	Record of Decision
SWL	static water level
SWMU	solid waste management unit
TCE	trichloroethene
TOC	total organic carbon
TOX	total organic halogens
UND	Unnamed Southwest Drainage Ditch
VOA	volatile organic analyses
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 hydrogeology of the PORTS site is characterized in terms of lithology, hydraulic conductivity, and overall groundwater contaminant distributions. PORTS is in the process of designing and implementing groundwater corrective actions.

Groundwater monitoring has been conducted in response to regulatory requirements of the Ohio Administrative Code (OAC), closure documents, an Administrative Consent Order between DOE and the U.S. Environmental Protection Agency (EPA), and a Consent Decree between the DOE and the Ohio EPA, as well as DOE Orders. A primary remedial component for the site's corrective actions will be groundwater monitoring. DOE Order 5400.5, *Radiation Protection of the Public and the Environment,* requires radiological monitoring. These radiological monitoring requirements are included in the Integrated Groundwater Monitoring Plan (IGWMP) so that all groundwater monitoring and surface water monitoring requirements (with the exception of the National Pollutant Discharge Elimination System [NPDES] permit) are captured in a single plan.

This 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, this 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.

1.1 OVERVIEW OF APPROACH

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." Economies of scale are established 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 Fig. 1. All changes to the IGWMP require Ohio EPA approval.

This IGWMP is organized into two large-scale divisions: Sects. 1 through 3 comprise the introduction, background, history, and the regulatory and technical considerations for changes to the groundwater monitoring program at PORTS; Sects. 4 through 7 contain the revised groundwater monitoring programs for each of the quadrants at PORTS.

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2. HISTORY OF GROUNDWATER MONITORING AT PORTS

The pre-integrated groundwater monitoring program at PORTS was conducted in accordance with the OAC, an Administrative Consent Order (Consent Order) between DOE and the U.S. EPA, and a Consent Decree between the DOE and the Ohio EPA. 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
- Decision Document for the Peter Kiewit Landfill

The Ground-Water Quality Assessment (GWQA) 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 was conducted in the vicinity of these four units since 1989. The assessment monitoring program for X-616 facility had been 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, detection monitoring is performed at units where there has been no statistically significant exceedance 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 is characterized during an assessment monitoring program. The assessment monitoring is performed on a quarterly basis under an approved groundwater quality assessment. The assessment monitoring program is 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, semi-annual 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 have been 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.

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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 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 judgement. 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 Areas of Concern

The process of developing an integrated groundwater monitoring program at PORTS began by selecting or designating relatively large-scale contamination areas called groundwater Areas of Concern. Areas of Concerns 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 Areas of Concern 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 Areas of Concern on the basis of areas previously identified in three documents, or series of documents: the 1988 GWQA (DOE 1989), the four quadrant RFIs (DOE 1996a through d), and the Background Sampling Investigation Report (DOE 1996e). The GWQA was discussed in Sect. 2. The RFIs delineated additional areas of groundwater concern associated with predominantly VOC contamination. Additionally, areas were noted as containing potential sources of groundwater contamination. Fig. 2 shows the groundwater Areas of Concern 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 slurry 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 up-gradient 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 Areas of Concern 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 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) and technetium-99, 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 Area of Concern.

- *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) are 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 short-term monitoring activities that are highly focused on specific groundwater problems. Specific special studies may be proposed by the Ohio EPA or by DOE, but are only formally incorporated into the IGWMP based on Ohio EPA approval. Specific special studies currently approved by the Ohio EPA are discussed in Sect. 9.

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 Sect. 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 are not currently associated with a contaminant plume. Therefore, the monitoring programs for these two units, the X-749A Classified Materials Disposal Facility and the X-735 Industrial Solid Waste Landfill, are detection monitoring programs under OAC 3745-29-10. The detection 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 after each sampling event at the X-749A and the X-735 and are described in Sect. 4.2.4 and Sect. 7.2.4, respectively.

If the statistical evaluation performed for either unit indicates a statistically significant increase for two consecutive semiannual statistical determination periods, DOE will notify the Ohio EPA no later than fifteen days after receiving the second period's statistical results that indicate a statistically significant change. The notification will identify the wells and parameters that have shown a statistically significant change in accordance with OAC 3745-30-08(D), except as otherwise approved by the Ohio EPA.

As described in OAC 3745-30-08(D)(9), DOE may choose to demonstrate that a source other than the X-749A or X-735 landfill facilities 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. This demonstration may take the form of a special study as described in Sect. 3.2. A report documenting this demonstration will be submitted to the Ohio EPA and may include a request to continue the detection monitoring program. If DOE can not successfully show that the identified contamination was not caused by the landfill, DOE will initiate an assessment monitoring program in accordance with OAC 3745-30-08(E), except for modifications otherwise approved by the Ohio EPA.

3.3.2 Assessment and Corrective Measures Reporting

Although the X-749A and X-735 landfill facilities are in a detection monitoring phase, the DOE will follow, if and where monitoring results make applicable, the OAC rules 3745-30-08(E) for assessment monitoring and reporting requirements, and OAC rules 3745-30-08(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 on an annual basis 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 detection monitoring programs at the X-749A or the X-735 landfill facilities. A description of the finding 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, depth-to-water results, 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 quarterly depth-to-water survey results 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 Areas of Concern 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 Sects. 4.1 and 4.2, respectively.

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

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 Area of Concern. Sect. 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 Storage Yard (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 Sect. 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 7.5 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 feet 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 feet 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 document Ground-Water Quality Assessment of Four RCRA Units for the Portsmouth Gaseous Diffusion Plant, which was approved by the Ohio EPA in 1989. 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 1994 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 slurry 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 slurry 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 DOE's NPDES permit.

The leading edge of the contaminated groundwater plume emanating from X-749 is approaching the southern boundary of the PORTS reservation. In 1995, an interim measure subsurface diversion wall was completed across a portion of the facility's southern boundary. The diversion wall, which extends from the surface into the Sunbury Shale, is designed to inhibit migration of the plume off plant property.

In 2001, Ohio EPA issued the decision document for Quadrant I, which identified the selected remedial measures for X-749 unit. 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 addition, phytoremediation is being used to control groundwater flow and remove VOCs in the southern and eastern portions of the X-749 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 transmits (by gravity drainage) contaminated groundwater to the X-625 Groundwater Treatment Facility. In July 2003, the X-625 Groundwater Treatment Facility ceased operating and was placed on stand-by, based on the limited amount of groundwater that can be treated at the facility. Use of the horizontal well and treatment facility will be re-evaluated within two years.

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 feet 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 feet 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 requires sampling of the groundwater collection system on a quarterly basis. Operational samples may also be collected during periods of high and low flow.

In accordance with the provisions of various regulatory requirements, the final Record of Decision/Statement of Basis (ROD) for the PK Landfill was issued by the Ohio EPA in July 1996, and the U.S. EPA in May 1997. The ROD 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."
- "The use of vertical barriers (slurry wall) as necessary to minimize lateral migration of contaminants. Future evaluation of the leachate volumes flowing to the seep collection system will determine the need for a vertical subsurface barrier..."
- "Environmental monitoring to ensure that the final remedial action is protective."

The RCRA Subtitle D landfill cap designed for the PK Landfill does not include the installation of a vertical barrier. At the end of a five year monitoring program, DOE and Ohio EPA will determine whether the Subtitle D cap remedy is effective, whether contaminants have migrated beyond the control of the Corrective Measures Implementation (CMI) remedy, and whether groundwater is flowing into the PK Landfill buried waste. The decision for a CMI subsurface barrier will consider whether this subsurface barrier would potentially jeopardize any current or future quadrant-wide groundwater remedy.

Five Gallia wells and one Berea well were abandoned as part of the PK Landfill cap project, and eight additional monitoring wells were installed. Two of the newly installed wells were installed in the Gallia, the remaining wells were either installed in the Berea, or in both the Gallia and the Berea. Those wells installed in both the Gallia and the Berea carry a Berea designation (e.g. PK-17B, PK-20B, and PK-21B).

In April 1997, contaminated seeps were noted in the tributary to Big Run Creek on the south side of the PK Landfill. Because the groundwater flow in the PK Landfill area is from the northwest to southeast and 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 the area, it is believed that these seeps are the result of the groundwater plume associated with the X-749 facility intersecting the ground surface at this location, although data is not available to show that waste buried within the PK Landfill are not contributing to the seeps.

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

4.1.2 Regulatory Considerations for Optimizing Groundwater Monitoring

Regulatory requirements for the X-120/X-749/PK Landfill Area are summarized in the following section. As noted previously, the X-749 landfill 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 exist. Specifically, two parameters (simazine and trifluralin), were included in the southern portion closure plan, but not in the northern portion closure plan. Also, the southern portion closure plan stipulates quarterly monitoring, while the northern portion specifies semi-annual monitoring.

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 have been added to the original monitoring system as part of the 1989 PORTS GWQA, to support the 1993 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 are monitored for a different list of parameters.

The PK Landfill lies within or is adjacent to the X-120 and X-749 contaminant plumes and is considered part of the X-120/X-749/PK Landfill Area of Concern. To optimize the groundwater monitoring program in this area, a monitoring program was developed to accomplish the objects 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 are specified in the Operation and Maintenance Plan for the PK Landfill 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 are 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.

The criteria for frequency and parameter selection are also identified in Appendix A, Table A-1. A known VOC groundwater contaminant plume emanates from X-749. Routine groundwater monitoring has occurred for X-749 since 1990. VOCs and technetium-99 are typically detected in the X-749/X-120 plume; therefore, VOCs and technetium-99 will be monitored more frequently than other parameters at this area.

Following the 1988-1989 GWQA, nineteen wells were selected for quarterly assessment monitoring at X-749, beginning in 1990. Ten other wells have been added to this list since 1990. Two wells, X749-04G and X749-06G, were added in 1991 and 1992, respectively, to better monitor the effects of the slurry wall and french drain near the north and west portions of the landfill. Well X749-32G was added in the third quarter of 1991 as required by the closure plans for the North and South portions of X-749 (two other wells required by the closure plan, X749-26G and X749-36G, were already included in the nineteen quarterly assessment wells). Two wells, X749-51B and X749-54B, which were screened in the Berea Sandstone were added in the second quarter of 1992 to better monitor the Berea. Five wells, X749-PZ02G, X749-PZ03G, X749-PZ04G, X749-PZ05G, and X120-08G were added in 1993, following their installation during the X-749 IRM groundwater investigation. These five wells provided more thorough coverage of the south and west margins of the X-749/X-120 plume.

The twenty-nine wells at X-749 were sampled quarterly until the third quarter of 1995, when the sampling frequency was changed to semiannual, as was indicated by the closure plan for the northern portion. However, three wells, X749-26G, X749-32G, and X749-36G, continued to be sampled quarterly according to the closure plan for the southern portion. Wells were generally sampled by bailer until late 1996. Since December 1996, wells generally have been sampled by low-flow techniques using bladder pumps. This low-flow technique is recommended by Ohio EPA and allows for more representative low-turbidity groundwater samples (high sample turbidities are believed to contribute to sporadic detections of metals or radionuclides).

Analytical parameters for X-749 wells typically include VOCs, physical parameters, radiological parameters, metals, and inorganics. The specific list of VOCs have varied from year to year; however, the primary plume VOCs have always been included in the list (32 VOCs are included). The radiological parameters have always included technetium-99 and total uranium. However, historical data indicates that only technetium-99 has been a consistent plume constituent (since technetium-99 is a beta emitter, gross beta results generally mimic technetium-99 results). Physical parameters have typically included temperature, pH, and specific conductance. Recent changes in sampling method have also allowed measurements of the physical parameters turbidity and dissolved oxygen. Hazardous metals parameters have 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. However, sporadic elevations of these metals have been detected in samples with high turbidity. Low-flow low-turbidity sampling techniques have provided more consistent metals results. 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.

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 non-detect or below drinking water standards.

Locations of integrated wells are shown in Fig. A-1, integrated monitoring frequencies are presented in Fig. A-2, and integrated monitoring parameter suites are presented in Fig. A-3.

4.1.3.1 X-749 Contaminated Materials Disposal Facility

The X-749 is a landfill (source) with a groundwater contaminant plume for which a number of remedial actions have been performed including a cap, slurry walls, leachate collection system, and a groundwater diversion wall. Therefore, source monitoring, plume monitoring, and remedial action effectiveness monitoring are all conducted at X-749.

Source monitoring is performed to detect changes in contaminant concentrations emanating from the X-749 Landfill. Sampling of selected wells near the source on a biennial basis for the additional parameters contained in the Appendix to OAC rule 3745-54-98 is also conducted to determine if all hazardous constituents that may be present are identified. The wells and location relative to groundwater flow for the integrated groundwater source monitoring at X-749 are presented in the following table. All integrated wells, parameters and frequencies for this Area of Concern are presented in Appendix A, Table A-1.

X-749 source monitoring

Well	Location	Well	Location
X749-04G[a]	upgradient	X749-08G	downgradient
X749-06G[a]	downgradient	X749-09GA	downgradient
X749-07G[a]	downgradient	X749-10GA	downgradient

[a]Well listed for more than one purpose.

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 wells and location relative to groundwater flow for the integrated groundwater plume monitoring at X-749 are presented in the following table.

X-749 plume monitoring

Well	Location	Well	Location
PK-10G[a]	outside plume perimeter	X749-50B	below plume center, Berea
STSW-101G	inside plume perimeter	X749-51B	outside plume, Berea
STSW-102G	inside plume perimeter	X749-54B	outside plume, Berea
X749-04G[a]	plume center	X749-60B	below plume, Berea
X749-06G[a]	plume center	X749-64B	below plume, Berea
X749-07G[a]	plume center	X749-67G	inside plume perimeter
X749-13G	inside plume perimeter	X749-68G	outside plume perimeter
X749-14B	outside plume, Berea	X749-96G	outside plume perimeter
X749-20G[a]	plume center	X749-97G	outside plume perimeter
X749-21G	outside plume perimeter	X749-98G	outside plume perimeter
X749-23G	outside plume perimeter	X749-99M	outside plume perimeter
X749-24G	outside plume perimeter	X749-100M	outside plume perimeter
X749-25G	inside plume perimeter	X749-101M	outside plume perimeter
X749-26G	plume center	X749-WPW	inside plume perimeter
X749-35G	plume center	X749-PZ02G	outside plume perimeter
X749-36G	plume center	X749-PZ03G	outside plume perimeter
X749-37G	inside plume perimeter	X749-PZ04G	inside plume perimeter
X749-44G	outside plume perimeter	X749-PZ05G	outside plume perimeter
X749-45G	outside plume perimeter	X749-PZ06G	outside plume perimeter

[a]Well listed for more than one purpose.

The X-749 wells screened in the Berea sandstone have historically been monitored at the same frequency as Gallia wells at this unit. 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 which 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, all Berea wells associated with X-749 will be sampled annually.

Each of the wells used for remedial action effectiveness monitoring at X-749 is also used for plume monitoring at this unit. The monitoring frequency and parameters for these wells can be found in Appendix A. Wells that monitor the effectiveness of cap, slurry walls, and groundwater interceptor trench for the X-749 Landfill include X749-04G, X749-06G, X749-07G, X749-08G, X749-09GA, and X749-10GA. Wells that monitor the effectiveness of the X-749 diversion wall include X749-PZ04G, X749-45G, X749-PZ03G, X749-PZ05G, and X749-44G. Because the X-749 plume is close to the reservation boundary, the wells near the diversion wall must be monitored frequently to determine whether the plume is beginning to migrate around the wall. Wells X749-PZ03G, X749-PZ04G, and X749-PZ05G are adjacent to the diversion wall and will be monitored quarterly. Wells X749-44G and X749-45G will be monitored semiannually. Six additional monitoring wells (X749-96G, X749-97G, X749-98G, X749-99M, X749-100M, and X749-101M) were installed south of the X-749 IRM subsurface barrier during calendar year 2000 to provide exit pathway monitoring. These wells are included in Appendix A, Table A-1.

4.1.3.2 X-120 Old Training Facility

At X-120, no source of groundwater contamination has been identified, therefore source monitoring will not be conducted for this unit. However, a known groundwater contaminant plume exists for X-120, so plume monitoring will be performed. Also, a remedial action/technology demonstration (horizontal well) was implemented for this unit, so remedial action effectiveness monitoring will be performed.

Plume monitoring at X-120 is performed to determine the extent and concentration of the X-120 plume. Although the X-749 and X-120 plumes co-mingle, and the monitoring program is designed to integrate both, the integrated plume monitoring for these units is presented separately. The wells and location relative to groundwater flow for the integrated groundwater plume monitoring at X-120 are presented in the following table. All integrated wells, parameters and frequencies for this Area of Concern are presented in Appendix A, Table A-1.

X-120 plume monitoring

Well	Location	Well	Location
F-27G	outside plume perimeter	X120-10G	outside plume perimeter
F-28B	outside plume perimeter	X120-11G[a]	inside plume perimeter
PK-09G	inside plume perimeter	X749-40G	outside plume perimeter
X120-03G	upgradient	X749-41G[a]	plume center
X120-05G[a]	plume center	X749-42G[a]	inside plume perimeter
X120-06B[a]	Below plume center, Berea	X749-57G	upgradient
X120-08G[a]	inside plume perimeter	X749-63B	outside plume perimeter
X120-09G	outside plume perimeter	X749-PZ08G	upgradient

[a]Well listed for more than one purpose.

Wells with a biennial sampling frequency were not routinely monitored prior to the IGWMP. These wells will be monitored every two years to verify that the X-120 plume is properly delineated.

In 1996, the X-120 horizontal well was installed along the axis of the X-120 groundwater plume. Prior to the IGWMP, X120-08G was the only monitored well that was useful for determining the effectiveness of the horizontal well. The wells and location relative to groundwater flow for the integrated groundwater remedial action effectiveness monitoring at X-120 are presented in the following table. All integrated wells, parameters and frequencies for this Area of Concern are presented in Appendix A, Table A-1.

X-120 remedial action effectiveness monitoring

Well	Location	Well	Location
X120-05G[a]	near horizontal well	X120-11G[a]	near horizontal well
X120-06B	below horizontal well, Berea	X749-41G[a]	near horizontal well
X120-08G[a]	near horizontal well	X749-42G[a]	near horizontal well

[a]Well listed for more than one purpose.

4.1.3.3 PK Landfill

The wells and location relative to groundwater flow for the integrated groundwater source monitoring at the PK Landfill are presented in the table below.

PK Landfill source monitoring

Well	Location	Well	Location
PK-10G[a]	upgradient	PK-PL6A[a]	sump for southern PK (east lobe of X-749) collection system
PK-11G	upgradient	X749-20G[a]	upgradient of PK downgradient of X-749
PK-PL6[a]	sump for northern PK collection system	X749-35G	side-gradient to PK downgradient of X-749

[a]Well listed for more than one purpose.

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. The wells and location relative to groundwater flow for monitoring the effectiveness of this remedial action at the PK Landfill are presented in the following table.

PK Landfill remedial action effectiveness monitoring

Well	Location	Well	Location
PK-14G	downgradient	PK-19B	downgradient
PK-15B	downgradient	PK-20B	downgradient
PK-16G	downgradient	PK-21B	downgradient
PK-17B	downgradient	PK-PL6[a]	sump for northern PK collection system
PK-18B	downgradient	PK-PL6A[a]	sump for southern PK collection system

[a]Well listed for more than one purpose.

In 1998, six wells (PK-02G, PK-06G, PK-12G, PK-13G, X749-12G, and X749-BG7G) within the proposed construction area were plugged and abandoned. However, eight new monitoring wells (PK-14G, PK-15B, PK-16G, PK-17B, PK-18B, PK-19B, PK-20B, and PK-21B) were installed as part of the X-749B CMI and X-749/120 Interim Action. Monitoring of water quality and contaminant migration will be evaluated annually. In the area near Big Run Creek where the Sunbury is absent, the Berea is hydraulically connected to the Gallia/colluvium. Therefore, the Berea wells in this area (PK-15B, PK-17B, PK-18B, PK-19B, PK-20B, and PK-21B) will be monitored more frequently. The monitoring activities will be evaluated to confirm that the containment and/or treatment of source materials are sufficiently protective of human health and the environment. If the results from the surface water, groundwater and collection trench indicates that the selected monitoring network is inadequate, the system will then be modified. If any contaminants of concern are not detected during the first four quarters of monitoring, the analyte will be subjected to a review by DOE and the Ohio EPA for removal from the list of parameters in the designated suite.

4.1.4 Evaluations and Reporting

Pre-integrated regulatory requirements concerning data evaluations and data reporting include the assessment and annual reporting of the concentration, rate of migration, and extent of the contaminated groundwater plume associated with the X-749 facility. 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.

4.1.5 Additional Evaluation and Reporting for Remedial Measures at the X-749/X-120/PK Landfill

In 2003, DOE developed the *Comprehensive Monitoring Plan for the X-749 and Peter Kiewit Landfill Areas for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (CMP) (DOE/OR/11-3124&D1). The CMP describes 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 are needed.

The CMP requires quarterly water quality monitoring for groundwater contaminants in selected current X-749 and PK Landfill IGWMP monitoring wells and nine non-IGWMP wells. Appendix A, Table A-1 lists the monitoring parameters for each well. The following table lists all the quarterly monitoring wells that are part of the CMP (both current IGWMP wells and wells that have been added to the IGWMP in this revision) and the sampling frequency for these wells prior to initiation of the CMP.

CMP monitoring wells

Well	Sampling frequency in 2002[a]	Well	Sampling frequency in 2002[a]
MH GW-4	Not sampled	X749-10GA	Semiannual
MH GW-5	Not sampled	X749-20G	Annual
PK-09G	Biennial	X749-21G	Semiannual
PK-10G	Semiannual	X749-23G	Semiannual
PK-11G	Semiannual	X749-24G	Semiannual
PK-14G	Semiannual	X749-25G	Semiannual
PK-16G	Semiannual	X749-35G	Annual
PK-17B	Semiannual	X749-54B	Semiannual
PK-19B	Semiannual	X749-BG6G	Not sampled
PK-20B	Semiannual	X749-BG9G	Not sampled
PK-21B	Semiannual	X749-PZ09G	Not sampled
X749-04G	Annual	X749-PZ10G	Not sampled
X749-07G	Semiannual	X749-PZ11G	Not sampled
X749-08G	Semiannual	X749-PZ13G	Not sampled
X749-09GA	Semiannual	X749-PZ14G	Not sampled

[a]Prior to initiation of the CMP

In addition, samples of surface water and sediment will be collected quarterly from locations in Big Run Creek that are opposite the manholes in the PK groundwater collection system included in the CMP (MH GW-4 and MH GW-5). Appendix E lists the monitoring parameters for these surface water sampling locations (BRC-SW03 and BRC-SW04). Sediment samples from these locations, identified as BRC-SD03 and BRC-SD04, will be analyzed for the same parameters as the surface water samples (parameter suite B-98, see Table 1) with the exception of alkalinity (pH will be substituted for alkalinity).

Data will be collected under the CMP for approximately two years. After data evaluation, wells and surface water/sediment monitoring locations may be removed from the IGWMP and monitoring frequencies may return to frequencies used prior to implementation of the CMP. Data collected by the CMP will be summarized in the annual Groundwater Monitoring Report provided to Ohio EPA.

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 Area of Concern. Sect. 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 Figs. A-4 through A-6.

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 Sect. 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 Sect. 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 Sect. 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.

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 facility 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 facility was not operated as a RCRA regulated land treatment unit.

The X-231B facility 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 GWQA document which was approved by the Ohio EPA in 1989. 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 unit 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&Os 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.

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 facility and the X-231B, respectively. The location of this facility is shown in Appendix A, Fig. A-4.

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 feet 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 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 feet deep and filled with eight feet of waste materials. The remaining six feet 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. DFF&Os 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 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 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 those 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. Following the Quadrant I Groundwater Investigative Area CMI, remedial action effectiveness monitoring will be incorporated into the IGWMP.

4.2.2.2 X-749A Classified Materials Disposal Facility

When the X-749A was closed, regulatory requirements governing groundwater monitoring at the unit were found in the approved closure plan for the facility and the solid waste regulations (OAC 3745-27-10) promulgated in 1990. 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.

After the requirements of the closure plan had been in effect, the Ohio EPA promulgated new solid waste regulations in 1994 which 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 unit consistent with the monitoring program of the other solid waste unit at PORTS (X-735 Landfill, Sect.

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 in 1997 and 2000-2001. In 1997, pH was shown to be anomalously low in well X749A-02G. However, 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 Sects. 4.2.3.2 and 4.2.4).

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. 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.

The criteria for frequency and parameter selection are also identified in Appendix A, Table A-2. As stated in Sect. 4.2.1.1, a known VOC groundwater contaminant plume exists within the Quadrant I Groundwater Investigative Area. Also, technetium-99 has been detected in a number of wells in this area. Groundwater has been routinely monitored in portions of this area since 1990. Historically, the aerial extent of the plume has changed very little over time. Contaminant concentrations have fluctuated in wells within the plumes, although some trends have become apparent (e.g., concentrations have decreased near the extraction wells south of X-231B). Also, the routinely monitored wells that were initially below detection limits for plume constituents have remained below detection (except for occasional data anomalies). In other PORTS plumes, where wells have gone from below- to above-detection for plume contaminants, VOCs and, occasionally, technetium-99 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 and technetium-99 will be monitored more frequently than other parameters at this area.

Following the 1988-1989 GWQA, twelve wells were selected for quarterly assessment monitoring at X-231B, beginning in 1990. Seven other wells have been added to this list since 1990. Three wells, X231B-02G, X231B-03G and X231B-06G, were selected in 1991 to better monitor the perimeter of X-231B. Four wells, X231B-01G, X231B-05G, X231B-08G, and X231B-12G were added in the fourth quarter of 1996, as required by the X-231B Consolidated Closure Plan. Two of these wells, X231B-01G and X231B-05G provided little additional information, and they have been dropped from the list contained herein.

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 low-flow techniques using bladder pumps. This low-flow technique is recommended by Ohio EPA and allows for more representative low-turbidity groundwater samples (high sample turbidities are believed to contribute to sporadic detections of metals or radionuclides).

Analytical parameters for the Quadrant I Groundwater Investigative Area wells typically include VOCs, physical parameters, radiological parameters, metals, and inorganics. The specific list of VOCs have varied from year to year; however, the primary plume VOCs have always been included in the list (32 VOCs are included). The radiological parameters have always included technetium-99 and total uranium. However, historical data indicates that only technetium-99 has consistently been a plume constituent because technetium-99 is a beta emitter and gross beta results generally mimic technetium-99 results. Physical parameters have typically included temperature, pH, and specific conductance. Recent sampling events have included measurements of the physical parameters turbidity and dissolved oxygen.

Hazardous metals parameters have typically included barium, lead, and nickel, and more recently have also included 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. However, sporadic elevations of these metals have been detected in samples with high turbidity. Low-flow low-turbidity sampling techniques are being used to provide more consistent metals results. 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. Recently, other parameters monitored at this unit have included nitrates, total organic carbon (TOC), total organic halogens (TOX), and fluoride, per the X-231B Consolidated Closure Plan. With the exception of wells surrounding X-749A, no RCRA metals have been included in the IGWMP for the Quadrant I Groundwater Investigative Area/X-749A Area as routine long-term monitoring parameters.

The integrated monitoring network for the Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility is presented in a series of figures contained in Appendix A. The locations of integrated wells are shown in Fig. A-4, monitoring frequencies are presented in Fig. A-5, and integrated monitoring parameters are presented in Fig. A-6.

4.2.3.1 Quadrant I Groundwater Investigative Area

The Quadrant I Groundwater Investigative Area consists of several potential sources for groundwater contamination. It also 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 rule 3745-54-98 is also conducted to determine if all hazardous constituents that may be present are identified. Source monitoring for X-749A is presented separately in Sect. 4.2.3.2 of the IGWMP. The wells and location relative to groundwater flow for source monitoring at the Quadrant I Groundwater Investigative Area are presented in the following table. All integrated wells, parameters and frequencies for this Area of Concern are presented in Appendix A, Table A-2.

Quadrant I Groundwater Investigative Area source monitoring

Well	Location	Well	Location
X231A-01G[a]	downgradient	X231B-03G[a]	downgradient
X231A-04G[a]	upgradient	X231B-04G[a]	upgradient
X231B-02G[a]	upgradient	X231B-06G[a]	downgradient

[a]Well listed for more than one purpose.

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. Therefore, only source monitoring and not plume monitoring will be performed at X-749A as outlined in Sect. 4.2.3.2. The plume monitoring wells and location relative to groundwater flow or the contaminant plume at the Quadrant I Groundwater Investigative Area are presented in the following table.

Quadrant I Groundwater Investigative Area plume monitoring

Well	Location	Well	Location
X230K-11G	downgradient	X231B-24B	below plume center, Berea
X230K-14G	inside plume perimeter	X231B-27G	outside plume perimeter
X230K-15G	inside plume perimeter	X231B-28G	outside plume perimeter
X231A-01G[a]	inside plume perimeter	X231B-29G	inside plume perimeter
X231A-04G[a]	plume center	X231B-32B	below plume, Berea
X231B-02G[a]	plume center	X231B-36G	inside plume perimeter
X231B-03G[a]	plume center	X231B-37G	inside plume perimeter
X231B-04G[a]	plume center	X231B-38G	outside plume perimeter
X231B-06G[a]	plume center	X231B-39G	outside plume perimeter
X231B-07G	inside plume perimeter	X710-01G	upgradient
X231B-08G	plume center	X749A-01G[a]	inside plume perimeter
X231B-11G	inside plume perimeter	X749A-03G[a]	outside plume perimeter
X231B-12G	plume center	X749A-12G[a]	outside plume perimeter
X231B-14G	inside plume perimeter	X626-07G	inside plume perimeter
X231B-15G[a]	inside plume perimeter	X760-02G	upgradient
X231B-16G	outside plume perimeter	X760-03G	plume center
X231B-19G	outside plume perimeter	X760-07G	inside plume perimeter

Quadrant I Groundwater Investigative Area plume monitoring (continued)

Well	Location	Well	Location
X231B-20G	inside plume perimeter	X770-MW17G	inside plume perimeter
X231B-23G[a]	plume center	X326-09G	northwest plume perimeter
X231B-33B	outside plume, Berea	X326-10G	northwest plume perimeter
X231B-34B	outside plume, Berea		

[a]Well listed for more than one purpose.

The X-231B wells screened in the Berea sandstone have historically been monitored at the same frequency as Gallia wells at this unit. The Quadrant I Groundwater Investigative Area 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 this area, thus limiting 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, so 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 Quadrant I Groundwater Investigative Area Plume will be sampled annually.

Each of the wells used for remedial action effectiveness monitoring at X-231B is also used for plume monitoring at this unit. The monitoring frequency and parameters for these wells can be found in Appendix A, Table A-2. Locations of the extraction wells installed in this area are included on Fig. 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. Another well, X749A-12G, was selected in 1995 to better monitor groundwater upgradient of the unit. One well, F-17G, was deleted from the monitoring program in 1996 because it was not specifically required by the X-749A Closure Plan, and because adjacent wells were already monitored.

Although the eastern margin of the Quadrant I Groundwater Investigative Area coincides with the western margin of X-749A, there is no VOC plume identified as being associated with X-749A. Therefore, only source monitoring will be performed at X-749A. The wells and location relative to groundwater flow for the integrated groundwater source monitoring at X-749A are presented in the following table. All integrated wells, parameters and frequencies for this Area of Concern are presented in Appendix A, Table A-2. It should be noted that other wells exist in the X-749A area, but are not included in the IGWMP. These wells will not be abandoned, but will be maintained in the event they are needed for future potential assessment monitoring purposes.

X-749A source monitoring

Well	Location	Well	Location
X749A-01G[a]	upgradient	X749A-07G	upgradient
X749A-02G	downgradient	X749A-12G	upgradient
X749A-03G[a]	downgradient	X749A-13GA	upgradient
X749A-04G	downgradient	X749A-14G	downgradient
X749A-05G	downgradient	X749A-16G	downgradient

[a]Well listed for more than one purpose.

The monitoring program for the X-749A included herein closely resembles the pre-integrated monitoring program established for the X-749A, however, the specific parameters monitored at the facility have changed due to the differences between the sanitary landfill regulations and the industrial solid waste regulations.

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 G.

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5. QUADRANT II

Two groundwater Areas of Concern 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 Sects. 5.1 and 5.2, respectively.

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 Area of Concern. Sect. 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, and in Figs. B-1 through B-3.

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 Sect. 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 1996).

The X-701C Neutralization Pit is 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 TCE- and TCA-contaminated rinse water resulting from metal cleaning operations. Wastes were released on a batch basis to the X-701C Pit, where lime was added to neutralize the pH. When the X-701C 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 facility directly to the X-701C Pit and then discharged to a temporary carbon treatment system located inside the X-700 Facility.

The soil and groundwater in the vicinity of the X-701C facility 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 to the present. The detection monitoring plan is not typical because of the size of X-701C and its location in an existing contaminated groundwater plume. Detection monitoring at X-701C uses the three existing wells installed into the Gallia sand (X701-68G, X701-69G, and X701-70G). These wells surround X-701C; however, they are not adequate to monitor the entire Quadrant II Groundwater Investigative Area plume.

Due to the nature of the wastewaters discharged to the X-701C 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 DFF&Os 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&Os 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. In a letter dated January 21, 1997, the Ohio EPA recommended that the X-701C be kept intact at this time. In March 1999, Ohio EPA issued DFF&Os that integrated the X-701C unit into the RCRA corrective action process. Closure of this unit was completed by September 2001.

5.1.2 Regulatory Considerations for Optimizing Groundwater Monitoring

Although routine groundwater monitoring has been conducted at three X-701C groundwater monitoring wells, no approved closure plan exists for the X-701C Pit. 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 is considered a detection monitoring program. Alternatives for groundwater remediation in the vicinity of X-701C will be evaluated in the Quadrant II Cleanup Alternatives Study/Corrective Measures Study (CAS/CMS).

Therefore, changes to the monitoring program in this IGWMP include converting from a detection monitoring program at the X-701C to an assessment monitoring program for the Quadrant II Groundwater Investigative Area. This conversion will enable monitoring of the rate of migration, extent, and concentration of the entire Quadrant II Groundwater Investigative Area plume. This conversion is 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.

The criteria for frequency and parameter selection are also identified in Appendix B, Table B-1. As stated in Sect. 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 has been performed at three wells surrounding X-701C (X701-68G, X701-69G, and X701-70G) since 1993. Because this unit is located within a known VOC plume, detection monitoring has been somewhat inconclusive, although higher VOC concentrations have always been found in well X701-69G, which is 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-622T Groundwater Treatment Facility. Synoptic water level measurements in the area have shown that groundwater flow in the Quadrant II Groundwater Investigative Area is toward these sumps, which are in the interior of the plume. Therefore, it is believed that the plume will not expand, but rather it will continue to be drawn toward the sumps.

The following table lists TCE concentrations for several sampling events at a number of the wells within the plume. This data indicates that TCE concentrations at a number of plume wells have dropped over time. Therefore, wells within the plume will be monitored annually to assess plume concentrations, whereas wells outside of the plume will be monitored biennially to help verify the plume delineation.

TCE concentrations at specific wells within the Quadrant II Groundwater Investigative Area plume

Well number	TCE concentrations in μg/L (ppb)		
	QII Phase I RFI (90-91)	QII Phase II RFI (10/93-1/94)	X-705A sampling event (1/97)
X705-01G	1100	300	NA
X705-02G	16	ND	NA
X705-06G	150	ND	NA
X705-07G	1300	470	100
X720-01G	23000	3700	NA

ND = Not detected. NA = Not analyzed/sampled.

The three detection monitoring wells for X-701C (X701-68G, X701-69G, and X701-70G) were initially sampled quarterly, were sampled semiannually until implementation of the IGWMP, and are now sampled annually. These wells were sampled by bailer through 1996. Since January 1997, these wells have been sampled by a low-flow technique using bladder pumps. This low-flow technique is recommended by Ohio EPA and allows for more representative low-turbidity groundwater samples (high sample turbidities are believed to contribute to sporadic detections of metals or radionuclides).

Analytical parameters for the X-701C wells previously sampled have included organics, physical parameters, radiological parameters, metals, and inorganics. Organics have generally included TOX, TOC, phenolics, and VOCs. The specific list of VOCs has varied from year to year; however, the primary plume VOCs have always been included in the list. The radiological parameters have always included technetium-99 and total uranium. Physical parameters have typically included temperature, pH, and specific conductance. Recent sampling events have also included measurements of the physical parameters turbidity and dissolved oxygen. Other routinely monitored parameters at this unit have 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 have 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 have not been 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 have been 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 *Report of Findings Special Study for Metals and Radiological Parameters in Groundwater for the Portsmouth Gaseous Diffusion Plan,* DOE/OR/11-3029&D3.)

The integrated monitoring network for the Quadrant II Groundwater Investigative Area is presented in a series of figures contained in Appendix B. Locations of integrated wells are shown in Fig. B-1, integrated monitoring frequencies are presented in Fig. B-2, and integrated monitoring parameters are presented in Fig. B-3.

The Quadrant II Groundwater Investigative Area consists of several potential sources for groundwater contamination. However, because the potentiometric surface indicates that the plume is migrating inward (toward the X-700 and X-705 building sumps), emphasis will be placed on annually assessing the plume (plume monitoring) rather than monitoring specific sources. As with all monitoring in the IGWMP, if conditions change, then monitoring may be modified per discussions with Ohio EPA.

Plume monitoring at the Quadrant II Groundwater Investigative Area is performed to determine the extent and concentration of the contamination. Sampling of a selected well near the X-701C unit on a biennial basis for the additional parameters contained in the Appendix to OAC rule 3745-54-98 is also conducted to determine if all hazardous constituents that may be present are identified. The wells and location relative to groundwater flow for plume monitoring at the Quadrant II Groundwater Investigative Area are presented in the following table. All integrated wells, parameters and frequencies for this Area of Concern are presented in Appendix B, Table B-1.

Quadrant II Groundwater Investigative Area plume monitoring

Well	Location	Well	Location
PRCL-01G	upgradient	X705-01GA	inside plume perimeter
X700-02G	plume center	X705-02G	inside plume perimeter
X701-26G	upgradient	X705-03G	at plume perimeter
X701-27G	upgradient	X705-04G	at plume perimeter
X701-28GA	upgradient	X705-05B	beneath plume perimeter, Berea
X701-29G	upgradient	X705-06G	at plume perimeter
X701-45G	inside plume perimeter	X705-07G	plume center
X701-46G	upgradient	X705-08G	outside plume perimeter
X701-68G	inside plume perimeter	X705-09B	beneath plume perimeter, Berea
X701-69G	inside plume perimeter	X705-10B	below plume, Berea

Quadrant II Groundwater Investigative Area plume monitoring (continued)

Well	Location	Well	Location
X701-70G	inside plume perimeter	X720-07G	upgradient
X701-117GA	inside plume perimeter	X720-08G	plume perimeter
X720-01G	plume center		

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. However, 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. Therefore, the Berea wells selected for the Quadrant II Groundwater Investigative Area Plume will be sampled biennially. As with all monitoring in the IGWMP, if conditions change (e.g., contaminants are detected in Berea wells, or water levels indicate changes in groundwater flow), then monitoring may be modified per discussions with Ohio EPA.

The building sumps at X-700 and X-705 have served to effectively remove contaminated groundwater from this area; however, to date no other groundwater remedial actions have occurred for this area. Therefore, remedial action effectiveness monitoring will be performed at the time a remedial action is performed at the Quadrant II Groundwater Investigative Area.

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 include 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 are 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 will no longer be 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 Area of Concern. Sect. 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; 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. Additional historical information specific to the X-701B groundwater monitoring wells and analytical results is presented in Sect. 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 Groundwater 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 remains 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 has also been 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 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 ponds 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 southeast 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 the development of DFF&Os that would address the 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. The collection of soil samples from beneath the pond was also mandated in the August 1995 letter. These activities were completed, and no further work has been undertaken at the X-701B Holding Pond.

5.2.1.2 X-230J7 Holding Pond

The X-230J7 Unit 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 is currently 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 Sect. 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 is included in the closure plan for the X-230J7 Holding Pond, the plan has not been approved, and routine monitoring in the area has been 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 have been 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.

The criteria for frequency and parameter selection are also identified in Appendix B, Table B-2. As stated in Sect. 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 1988-1989 GWQA. Historically, the contaminant concentrations in wells within the plumes have changed very little over time, except for concentrations in wells beyond the groundwater interceptor trench (the X-237 Groundwater Collection System) and a well near the highest concentration gradient within the plume. As long as DNAPL exists within the X-701B plume, VOC concentrations are likely to remain very high (> 100,000 ppb) near the center of the plume. Contaminant concentrations in wells beyond the trench have decreased since the trench was installed. One mid-plume well, X701-21G, near a high concentration gradient has shown significant fluctuations in TCE concentrations. Also, wells that were initially below detection limits for plume constituents have remained below detection. In other PORTS plumes, where wells have gone from below-to above-detection for plume contaminants, VOCs and technetium-99 are typically first detected at the same time, which indicates that these constituents are migrating at the leading edge of the plume. No such correlation has been noted for metals or any other parameters at this unit. Therefore, VOCs and technetium-99 will be monitored more frequently than other parameters at this area.

Following the 1988-1989 GWQA, 21 wells were selected for quarterly assessment monitoring at X-701B, beginning in 1990. Seven other wells have been added to this list since 1990. One mid-plume well, X701-08G, was added in 1990 to replace another mid-plume well, X701-09G, which, after being struck by equipment, was feared to be damaged. The integrity of well X701-09G was later determined to be sound, and both wells X701-08G and X701-09G were retained on the list of routinely monitored wells because they each help monitor along the plume axis. Three wells, X701-02G, X701-05G and X701-06G, were selected in 1991 to better monitor the upgradient (western) portion of the X-701B plume. Three wells, X701-11G, X701-12G, and X701-13G were added in the third quarter of 1996, as required by the X-701B Consolidated Closure Plan.

Of the 28 wells previously monitored routinely for this unit, three (X701-11G, X701-32G, and X701-49G) have not been included for IGWMP monitoring. Well X701-11G provided information obtained from other monitored wells. Well X701-49G was often dry and was too far east and north of the plume to warrant continued monitoring, and well X701-32G was too far east and south of the plume to warrant continued monitoring.

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. This low-flow technique is recommended by Ohio EPA and allows for more representative low-turbidity groundwater samples (high sample turbidities are believed to contribute to sporadic detections of metals or radionuclides).

Analytical parameters for the X-701B wells typically include VOCs, physical parameters, radiological parameters, metals, and inorganics. The specific list of VOCs has varied from year to year; however, the primary plume VOCs have always been included in the list. The radiological parameters have always included technetium-99 and total uranium. Physical parameters have typically included temperature, pH, and specific conductance. Recent sampling events have included measurements of the physical parameters turbidity and dissolved oxygen.

Hazardous metals parameters have typically included cadmium, chromium, lead, and nickel. These metals are not believed to be associated with the VOC plume at X-701B because a number of mid-plume wells have shown no detections for these metals. However, sporadic elevated concentrations of these metals have been detected in samples with high turbidity. Low-flow sampling techniques are expected to provide more consistent metals results. 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.

The integrated monitoring network for the X-701B Area is presented in a series of figures contained in Appendix B. The locations of integrated wells are shown in Fig. B-4, integrated monitoring frequencies are presented in Fig. B-5, and integrated monitoring parameters are presented in Fig. B-6.

5.2.3.1 X-701B Holding Pond

Source monitoring is performed to detect changes in contaminant concentrations emanating from X-701B. The wells and location relative to groundwater flow for source monitoring at the X-701B Holding Pond Area are presented in the following table. All integrated wells, parameters and frequencies for this Area of Concern are presented in Appendix B, Table B-2.

X-701B Holding Pond Area source monitoring

Well	Location	Well	Location
X701-05G[a]	upgradient	X701-14G[a]	downgradient
X701-12G[a]	downgradient	X701-BW4G[a]	downgradient
X701-13G[a]	downgradient		

[a]Well listed for more than one purpose.

Plume monitoring at the X-701B Holding Pond Area is performed to determine the extent and concentration of the existing contamination. The wells and location relative to the plume boundaries for plume monitoring at the X-701B Holding Pond Area are presented in the following table.

X-701B Holding Pond Area plume monitoring

Well	Location	Well	Location
X230J7-01GA	inside plume perimeter	X701-18G	downgradient/sidegradient
X230J7-02GA	inside plume perimeter	X701-19G	outside plume perimeter
X230J7-03GA	inside plume perimeter	X701-20G	plume center
X230J7-04GA	downgradient	X701-21G	outside plume perimeter
LBC-PZ03	inside plume perimeter	X701-23G	outside plume perimeter
LBC-PZ06	outside plume perimeter	X701-24G[a]	downgradient of interceptor trench
X700-03G	west of X-701B plume perimeter	X701-25G	outside plume perimeter
X701-01G	X-744G area	X701-30G	monitors isolated TCE hit south of X-744G
X701-02G	inside plume perimeter	X701-31G	downgradient of isolated TCE hit south of X-744G
X701-05G[a]	inside plume perimeter	X701-38G	outside plume perimeter
X701-06G	inside plume perimeter	X701-48G	outside plume perimeter
X701-08G	plume center	X701-50B	below plume, in Berea
X701-09G	plume center	X701-58B	outside plume, in Berea
X701-10G	plume center	X701-61B	outside plume, in Berea
X701-12G[a]	inside plume perimeter	X701-80G	plume center
X701-13G[a]	plume center	X701-127G	inside plume perimeter
X701-14G[a]	plume center	X701-128G	inside plume perimeter
X701-15G[a]	downgradient of interceptor trench	X701-BW1G	upgradient
X701-16G[a]	downgradient of interceptor trench		

X-701B Holding Pond Area plume monitoring (continued)

Well	Location	Well	Location
X701-66G	plume center	X744G-01G	X-744G area
X701-74G	plume center	X744G-02G	X-744G area
X701-78G	plume center	X744G-03G	X-744G area
X701-BW2G	plume center	X701-BW4G[a]	outside plume perimeter

[a]Well listed for more than one purpose.

The X-701B wells screened in the Berea sandstone have historically been monitored at the same frequency as Gallia wells at this unit. The X-701B VOC 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 this area, thus limiting the downward migration potential of groundwater from the Gallia into the Berea. Berea wells, including Berea wells that underlie the center of 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 will be sampled annually.

A number of remedial actions and technology demonstrations have occurred for the X-701B plume. However, remedial action effectiveness monitoring will occur only for the X-237 Groundwater Collection System (interceptor trench). This trench is used to prevent plume contaminants from migrating into Little Beaver Creek. Prior to the trench installation the X-701B plume discharged into Little Beaver Creek, and although residual plume contaminants still exist between the trench and Little Beaver Creek, the concentrations have fallen significantly since the trench was installed. Therefore, this area will continue to be monitored to help evaluate whether the trench is functioning properly. The monitoring wells that measure the effectiveness of the interceptor trench are X701-15G, X701-16G, and X701-24G. Each of these wells used for remedial action effectiveness monitoring at X-701B is also used for plume monitoring at this unit. The monitoring frequency and parameters for these wells can be found in Appendix B, Table B-2.

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 will be 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. Three of these wells, X230J7-01GA, X230J7-02GA, and X230J7-03GA, are located south of X-230J7 and within the X-701B plume. These wells will be monitored annually as part of the X-701B plume assessment. One well (X230J7-04GA) is located north of X-230J7 and outside of the X-701B plume. This well will also be sampled annually.

5.2.4 Evaluations and Reporting

Pre-integrated data evaluations and data reporting for the X-701B Holding Pond Area include 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 are 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.

6. QUADRANT III

Two groundwater Areas of Concern 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 Sects. 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 Area of Concern. Sect. 6.1 concludes with discussions regarding regulatory evaluations and reporting for the X-616 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 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 surface impoundments were initially identified as a hazardous waste unit requiring closure in December of 1986. A closure plan was subsequently prepared and submitted to the Ohio EPA and the U.S. EPA in June of 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 sludge impoundments and placed in special cells in the X-735 landfill.

The X-616 facility was 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 is potentially due to releases from the X-616 unit. Ohio EPA also mandated a modification to the closure plan and the development and submittal of a post-closure plan for the X-616 unit which includes 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 surface impoundments, 22 groundwater monitoring wells were sampled. Some VOCs were found in isolated wells at concentrations below 10 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 surface impoundments through calendar year 1993. This unit was certified closed in 1993, and has been monitored semi-annually under an approved post closure plan since 1994. 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 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

The criteria for frequency and parameter selection are identified in Appendix C, Table C-1. As stated in Sect. 6.1.1, there is no known groundwater contaminant plume emanating from the X-616 surface impoundments, however, 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 surface impoundments has occurred since 1990 for metals and since 1991 for VOCs. Since 1991, none of the historically clean wells have become contaminated. Also, no other wells have been added to this monitoring network since 1991.

Wells were typically sampled by bailer until late 1996. Since December 1996, wells generally have been sampled by low-flow techniques using bladder pumps. This low-flow technique allows for more representative low-turbidity groundwater samples. High sample turbidities are believed to contribute to sporadic detections of metals, gross alpha, or gross beta.

Analytical parameters for X-616 wells include VOCs, physical parameters, radiological parameters, metals, and inorganics. The specific list of VOCs have varied from year to year; however, the few VOCs which were constituents of concern for X-616 surface impoundments have always been included in the list. The radiological parameters have included technetium-99 and total uranium. Physical parameters have included temperature, pH, and specific conductance. Recent changes in sampling methods have also allowed measurements of the physical parameters of turbidity and dissolved oxygen. 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.

While VOCs are not a major concern in the X-616 Area, VOCs (primarily TCE) have been detected in four wells (X616-09G, X616-16G, X616-20B, and X616-28B) out of the wells routinely sampled for this unit. Three of these wells (X616-09G, X616-16G, and X616-20B) are grouped near the southwest corner of X-616. The VOC concentration typically exceeds 10 ppb in only one of the wells (X616-20B) and the VOCs are only slightly above detection limits in the other wells. No VOC plume emanates from X-616 surface impoundments because VOCs are not detected in wells downgradient from these wells. Also, VOC concentrations in each of these four wells have generally dropped over time. Because the VOCs have shown no migration in over six years of routine sampling and are detected in low concentrations (typically less than 10 ppb), if at all, PORTS will reduce the sampling frequency at these four wells from semiannually to annually. One other well (X616-02G), which was only sampled during the RFI, also had a TCE concentration above 10 ppb. This well, which is upgradient of X-616 surface impoundments and which has not been sampled since 1992, will also be sampled annually.

It is believed that natural attenuation will cause VOC concentrations to continue to decrease in these five wells. Historical monitoring results of groundwater for this unit indicate that annual sampling should be sufficient to monitor such attenuation. The remainder of the routinely monitored wells will be sampled biennially for selected natural attenuation parameters to verify that groundwater conditions at the unit have not changed.

Analysis is performed for the hazardous metals barium, cadmium, chromium, lead, manganese, and nickel. Historically, well X616-05G is the only well with chromium concentrations which consistently exceed the drinking water standard (100 ppb). However, sporadic elevations of these metals have been detected in samples with high turbidity. These metals are not believed to occur as a plume at X-616 surface impoundments because the metals are not consistently detected; they are seldom in any spatial pattern resembling a plume; they do not correspond to wells which have VOC contamination; and the dissolved (filtered metals) are generally much lower than the total (unfiltered) metals. Low-flow, low-turbidity sampling techniques will provide more consistent metals results. Special metals studies at other units throughout the site will help determine whether high background concentrations of metals occur in groundwater at PORTS. The results of such studies may lead to future modifications of metals sampling at this unit.

Results of the GWQA and routine assessment monitoring have 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 the proposed 3790 pCi/L standard. These results are believed to be analytical anomalies. No technetium-99 has been detected at any well at this unit since the first quarter of 1994. Technetium-99 will continue to be included as an analytical parameter each time a well is routinely sampled at the X-616 surface impoundments.

The integrated monitoring network for the X-616 surface impoundments is presented in a series of figures contained in Appendix C. The locations of integrated wells are shown in Fig. C-1, integrated monitoring frequencies are presented in Fig. C-2, and integrated monitoring parameters are presented in Fig. C-3.

The wells and location relative to groundwater flow for the integrated groundwater monitoring at the X-616 surface impoundments are presented in the following table. All integrated wells, parameters and frequencies for this Area of Concern are presented in Appendix C, Table C-1.

X-616 source monitoring

Well	Location	Well	Location
X616-02G	upgradient	X616-19B	downgradient
X616-05G	downgradient/side-gradient	X616-20B	downgradient
X616-09G	downgradient	X616-21G	downgradient
X616-10G	upgradient/side-gradient	X616-22G	downgradient
X616-13G	downgradient	X616-24B	downgradient
X616-14G	downgradient	X616-25G	downgradient
X616-16G	downgradient	X616-26G	upgradient/side-gradient
X616-17G	upgradient	X616-28B	upgradient/side-gradient

6.1.4 Evaluations and Reporting

Pre-integrated regulatory requirements concerning data evaluations and data reporting include the assessment of the concentration, rate of migration, and extent of groundwater contaminants associated with the X-616 surface impoundments. Verification and validation of the laboratory analytical data are also required because hazardous constituents associated with the X-616 surface impoundments have been 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 Area of Concern continues to be an assessment monitoring program, the data will continue to 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 Area of Concern. Sect. 6.2 concludes with discussions regarding regulatory evaluations and reporting for the X-740 Area of Concern.

6.2.1 Background and History

The X-740 Waste Oil Handling Facility is 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 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 volatile organic compound (VOC) groundwater plume extends approximately 700 feet west of the X-740 Building. The X-740 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 consists of a diked concrete pad, a roof, corrugated steel siding on three sides and a plastic windbreak on the fourth side. The unit is approximately 120 feet by 50 feet. 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 of 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, submitted in April 1998, presented alternatives for remediation of the contaminated groundwater in the vicinity of X-740. In May 1999, Ohio EPA finalized the Quadrant III Decision Document identifying phytoremediation as the preferred remedy for cleanup of groundwater at X-740.

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 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 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 X-740 facility. Results from previous sampling events have shown that the X-740 facility is not likely the source for this contamination. However, sampling of a selected well near the X-740 on a biennial basis for the additional parameters contained in the Appendix to OAC rule 3745-54-98 is also conducted to determine if all hazardous constituents that may be present are identified. 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 integrated monitoring network to be used is presented in Appendix C, Figs. C-4 through C-6.

The wells and their locations relative to groundwater flow for the groundwater plume monitoring at the X-740 Area are presented in the following table. All wells, analytical parameters, and sampling frequencies for this Area of Concern are presented in Appendix C, Table C-2.

X-740 plume monitoring

Well	Location	Well	Location
X740-01G	south of plume perimeter	X740-09B	plume center
X740-02G	inside plume perimeter	X740-10G	plume center
X740-03G	plume center	X740-11G	inside plume perimeter
X740-04G	inside plume perimeter	X740-12B	downgradient of plume
X740-05G	upgradient of plume	X740-PZ10G	inside plume perimeter
X740-06G	downgradient of plume	X740-PZ12G	inside plume perimeter
X740-07B	downgradient of plume	X740-PZ14G	inside plume perimeter
X740-08G	inside plume perimeter	X740-PZ17G	inside plume perimeter

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 expected to be detectable in both Gallia and Berea wells. However, because the hydraulic conductivity is higher in the Gallia than in the Berea, the plume will migrate more quickly in the Gallia.

Per Ohio EPA comments to the Quadrant III RFI, two wells have been installed to help adequately delineate the western margin of the X-740 plume. These wells (X740-11G in the Gallia and X740-12B in the Berea) have been installed west of the midplume wells X740-03G and X740-09B, respectively (see Fig. C-4). Four additional Gallia wells were installed during construction of the CMI to assist in the evaluation of the effectiveness of the CMI in remediating the groundwater contamination.

6.2.4 Evaluations and Reporting

To monitor the cumulative effect of the trees on the Minford, Gallia, and Berea groundwater elevations, water levels will be monitored at the following well locations (see Appendix C, Fig. C-7):

X740-01G	X740-06G	X740-11G	X740-PZ04M	X740-PZ09M	X740-PZ14G	F-13G
X740-02G	X740-07B	X740-12B	X740-PZ05M	X740-PZ10G	X740-PZ15M	F-14B
X740-03G	X740-08G	X740-PW01M	X740-PZ06M	X740-PZ11M	X740-PZ16M	
X740-04G	X740-09B	X740-PW02M	X740-PZ07M	X740-PZ12G	X740-PZ17G	
X740-05G	X740-10G	X740-PZ03M	X740-PZ08M	X740-PZ13M		

These wells will be monitored according to the following schedule:

1. The water levels for all 31 wells were measured quarterly from the second quarter 1999 to the first quarter 2000. Water level measurements were recorded for 12 wells in the second quarter 2000 (X740-01G, X740-02G, X740-03G, X740-04G, X740-05G, X740-06G, X740-07B, X740-08G, X740-09B, X740-10G, X740-11G, and X740-12B) and 16 wells in the third quarter 2000 (the 12 wells listed previously plus X740-PZ10G, X740-PZ12G, X740-14G, and X740-17G). Beginning in the fourth quarter 2000, water levels will be measured at least quarterly in all 31 X-740 monitoring wells and piezometers. The data from the eight quarterly sampling events (second quarter 1999 through first quarter 2001) should be representative of water levels prior to extensive root development.

2. Beginning in April 2001, water levels from all X-740 monitoring wells and piezometers will be recorded monthly during the growing season (from April through September). Additionally, post- and pre-growing season measurements will be collected during the fourth quarter and first quarter routine synoptic water level measurement events, respectively. These protocols will provide eight water level measurements from each well annually.

3. Beginning in July 2001, groundwater elevations will also be measured hourly from four wells (X740-03G, X740-PZ03M, X740-PZ16M, and X740-PZ17G) for 30 days (preferably consecutive) during the growing season each year for five years. These data are to be used to produce hydrographs to determine the relationship between water levels and the daily cycle of water use by the trees.

The water level data will be used to determine the Gallia potentiometric surface. Minford and Berea data will be used to help determine vertical gradients between the units. Results will be presented annually in the Groundwater Monitoring Report. The hourly water level data will be corrected for barometric changes as needed and plotted in a hydrograph showing water level fluctuations over time.

As part of the pre-integrated monitoring program, data from the X-740 area was not routinely evaluated. To determine the effectiveness of the CMI on the VOC contaminant plume in the Gallia and

Berea, analytical monitoring will be conducted at the integrated wells, the frequencies, and the parameters presented in Appendix C, Table C-2.

Data collected for the integrated monitoring program developed for the X-740 area will be evaluated to update the Gallia TCE plume configuration and will be presented as an annualized TCE plume map in the annual Groundwater Monitoring Report. Verification and validation of the laboratory analytical data will be completed. All available data will be presented 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 Areas of Concern 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 Sects. 7.1, 7.2, and 7.3, respectively.

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 Area of Concern. Sect. 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 Fig. D-1.

7.1.1 Background and History

The X-611A site 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 lagoons, approximately 1,500 ft of Little Beaver Creek was relocated to a new channel just east of the lagoons. The lagoons are 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 lagoons. In general, lagoon depths range between 12 and 14 feet, and depths generally increase from west to east.

Between 1954 and 1960, the X-611A 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 were disconnected.

Sludge in the X-611A lagoons consists 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 includes 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 and U.S. EPA issued a Decision Document for the X-611A SWMU which 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 foot-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, the Ohio EPA approved the CMI in September 1997.

7.1.2 Regulatory Considerations for Optimizing Groundwater Monitoring

Regulatory requirements for groundwater monitoring are included in the Operation and Maintenance (O&M) Plan (August 1997) developed as part of the corrective action for the X-611A. Since the requirements of the O&M 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.

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 Area, is presented in Appendix D, Table D-1. As part of the pre-integrated monitoring program, this unit is monitored semi-annually at six wells for the metals beryllium and chromium as well as PCBs, specifically Arochlor-1242 and Arochlor-1248. The only change to the integrated monitoring program for this unit is that PCBs will no longer be monitored.

Historically, PCBs have not been detected in PORTS groundwater, except when dissolved in DNAPL such as at X-701B. The PCB concentrations in the DNAPL at X-701B are often greater than 500 ppm, yet PCBs are not detected in the surrounding groundwater. For example, the DNAPL removed from an extraction well (X236-1 at X-701B) 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 will not include PCBs for this unit.

Only source monitoring is performed for X-611A. The locations of integrated wells are shown in Fig. D-1. The wells and location relative to groundwater flow for the integrated groundwater monitoring at the X-611A lagoons are presented in the following table. All integrated wells and locations relative to groundwater flow for this Area of Concern are presented in the following table. The selected parameters and sampling frequencies are presented in Appendix D, Table D-1.

X-611A source monitoring

Well	Location	Well	Location
F-07G	upgradient	X611-02B	downgradient
F-08B	upgradient	X611-03G	downgradient
X611-01B	downgradient	X611-04B	downgradient

7.1.4 Evaluations and Reporting

Pre-integrated regulatory requirements directed by the Operations and Maintenance (O&M) Plan concerning data evaluations and data reporting include annual evaluations completed to determine if the contaminants of concern are impacting the surrounding groundwater. Verification and validation of the laboratory analytical data are also completed. If concentrations above the established maximum contaminant levels are detected, the Ohio EPA will be notified.

Because an integrated approach to groundwater monitoring has been developed in this document, a IGWMP Report will be completed for the entire PORTS site, including the X-611A Area of Concern, and will be 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 Area of Concern. Sect. 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, and in Figs. D-2 through D-4.

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 Sect. 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 ground water 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 landfill, and issued DFF&Os 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 landfill 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. 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.

In 2000, an assessment monitoring program was initiated at the X-735 Landfills 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 Sects. 7.2.3 and 7.2.4).

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

The integrated monitoring program for the X-735 Landfills Area of Concern, including all wells, monitoring frequency and parameter selection are presented in Appendix D, Table D-2. The criteria for frequency and parameter selection are also identified. The Sunbury shale is absent in the X-735 Area, so the Berea is monitored at the same frequency as the Gallia in this area.

Isolated detections for metals and other miscellaneous parameters have also been identified in a number of wells in the X-735 Area. Typically, high metal concentrations have been attributed to turbid samples. Wells were typically sampled by bailer until late 1996, however, since December 1996, wells generally have been sampled by low-flow techniques using bladder pumps. This low-flow technique allows for more representative low-turbidity groundwater samples. High sample turbidities are believed to contribute to sporadic detections of metals, gross alpha, or gross beta.

Analytical parameters for X-735 have historically included VOCs, physical parameters, radiological parameters, and inorganics including metals. The specific list of parameters have varied from year to year; depending on the regulatory status of this area (see Sect. 7.2.1). Physical parameters have included temperature, pH, and specific conductance. Recent changes in sampling methods have also allowed measurements of the physical parameters of turbidity and dissolved oxygen. 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.

The integrated monitoring network for the X-735 Landfills is presented in a series of figures contained in Appendix D. The locations of integrated wells are shown in Fig. D-2, integrated monitoring frequencies are presented in Fig. D-3, and integrated monitoring parameters are presented in Fig. D-4. The wells and locations relative to groundwater flow for the integrated groundwater monitoring at the X-735 Landfills are presented in the following table. Monitoring frequencies and parameters are presented in Appendix D, Table D-2.

X-735 source monitoring

Well	Location	Well	Location
X735-01GA	upgradient	X735-18B	downgradient
X735-02GA	downgradient/sidegradient	X735-19G	buffer zone[a]
X735-03GA	downgradient	X735-20B	buffer zone[a]
X735-04GA	downgradient	X735-21G	downgradient
X735-05GA	downgradient	X737-05B	upgradient
X735-06GAA	downgradient	X737-06G	upgradient
X735-13GA	upgradient	X737-07B	upgradient
X735-16B	upgradient	X737-08B	upgradient
X735-17B	downgradient/sidegradient	X737-09G	upgradient

[a]Buffer zone separates the X-735 RCRA Landfill (northern portion of X-735) and the X-735 Industrial Solid Waste Landfill (southern portion of X-735), see Appendix D, Fig. D-2.

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 G.

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 Area of Concern. Sect. 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. Figures showing the well locations, sampling frequencies, and parameters are also presented in Appendix D.

7.3.1 Background and History

The X-734 Landfills Area of Concern consists of three landfill units; the X-734 Old Sanitary Landfill, the X-734A Construction Spoils Landfill, and the X-734B Old Construction Spoils Landfill. The X-734 Old Sanitary Landfill has a total area of approximately 3.4 acres, the X-734A Construction Spoils Landfill has a total area of approximately 7.6 acres, and the X-734B Old Construction Spoils Landfill has a total area of approximately 2.6 acres. Waste disposal activities at the sanitary landfill was discontinued in 1981 when the X-735 Landfill began operations. Waste disposal operations at the X-734 construction spoils landfill 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 GCEP contractors, 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 mg/kg.

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

7.3.2 Regulatory Considerations for Optimizing Groundwater Monitoring

The X-734 Sanitary Landfill was closed in accordance with the solid waste regulations in effect at that time, and no groundwater monitoring of the unit was required. However, the X-734 Landfill has been closed as part of the remedial actions required for Quadrant IV. Therefore, remedial action effectiveness monitoring has been added to the IGWMP for the X-734 Landfills Area, to commence the second quarter after approval of the certification report for the unit.

7.3.3 Technical Considerations for Optimizing Groundwater Monitoring

Groundwater monitoring was not routinely performed at this unit. 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 is also unavailable and future remedial alternatives for the X-734 are undecided.

The data collected to date at 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 Berea sandstone/Bedford shale have shown various hydrocarbon constituents; however, these constituents are believed to be naturally occurring. The Berea is known to produce hydrocarbons in certain areas, and these constituents are similar to those found in other deep Berea wells across the PORTS site. Neither technetium-99 nor uranium were detected in the groundwater at this unit during the RFI.

Only source monitoring is performed for X-734. The locations of integrated wells are shown in Appendix D, Fig. D-5. The wells and location relative to groundwater flow for the integrated groundwater monitoring at the X-734 landfills are presented in the following table. All integrated wells and locations relative to groundwater flow for this Area of Concern are presented in the following table. The selected parameters and sampling frequencies are presented in Appendix D, Table D-1, Fig. D-6, and Fig. D-7.

X-734 source monitoring

Well	Location	Well	Location
RSY-02B	upgradient	X734-14G	upgradient
X734-01G	downgradient	X734-15G	upgradient
X734-02B	downgradient	X734-16G	downgradient
X734-03G	downgradient	X734-18G	downgradient
X734-04G	downgradient	X734-20G	downgradient
X734-05B	downgradient	X734-21B	downgradient
X734-06G	downgradient	X734-22G	upgradient
X734-10G	downgradient		

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 Area of Concern, 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 the DOE NPDES Permit. 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 the Department of Energy, and the *Offsite Residential Drinking Water Quality Monitoring Plan* dated April 1989 and approved by the Ohio EPA on May 10, 1989. The monitoring program described in the following section is a revision to the monitoring plan developed in 1989. The methods for collecting samples are described in Sect. 10 and in the procedures included in Appendix F.

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-1, 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 Sect. 3.2, special short-term evaluations can be triggered by additional data needs, physical changes at an Area of Concern (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, but are only formally incorporated into the IGWMP based on Ohio EPA approval.

The following sections describe those special studies that have been conducted or are planned at PORTS.

9.1 COMPLETED SPECIAL STUDIES

Several special studies have been conducted since implementation of the IGWMP on April 1, 1999. A special study for metals and radiological parameters, *Report of Findings, Special Study for Metals and Radiological Parameters in Groundwater for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, (DOE/OR/11-3029&D3), investigated ten Areas of Concern as identified by DOE and Ohio EPA to evaluate potential metals and radiological groundwater contamination. 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, 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 were selected for additional metals monitoring. Monitoring requirements for the selected metals have been incorporated into the tables and figures presented in Appendices A through D for the particular Areas of Concern. 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 Manganese 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 incorporated into the appropriate IGWMP wells in Quadrants I and II. Results of the Radiological Verification Sampling conducted in calendar year 2000 indicate that the rate and extent of radiological contaminants at PORTS have been adequately defined by previous studies.

9.2 CURRENT SPECIAL STUDIES

The *Comprehensive Monitoring Plan for the X-749 and Peter Kiewit Landfill Areas for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (DOE/OR/11-3124&D1) describes additional data to be collected to evaluate the performance of the barrier walls installed at the X-749 Landfill and groundwater collection systems installed for the PK Landfill and X-749 Landfill. Water quality monitoring requirements of this plan are included in the IGWMP (see Sect. 4.1.5, Additional Evaluation and Reporting for Remedial Measures at the X-749/X-120/PK Landfill).

The following special studies were conducted or being planned during 2003. Based on the results of these studies, changes may be made to the IGWMP in the future, as warranted.

- In Quadrant I, the *Conceptual Work Plan for Groundwater Monitoring at the X-749 South Barrier Wall Area at the Portsmouth Gaseous Diffusion Plant Piketon, Ohio* (BJC/PORTS-452) was developed to collect additional data in the vicinity of the south barrier wall at the X-749/X-120 groundwater plume.

- In Quadrant I, DOE is developing a program to monitor the performance of the X-749 Phytoremediation Area. The program will include installing new wells in selected trenches, and monitoring new and existing wells in native soil. Water levels and groundwater quality will be monitored.

- In Quadrant I, DOE will install two groundwater monitoring wells in the vicinity of the X-746 building based on the findings of the report *Investigation of Potential Additional Solid Waste Management Units for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio.* The wells will be installed southwest and northeast of the X-746 building and sampled for radionuclides and VOCs.

- In Quadrant II, additional wells were installed in 2003 in the X-701B Holding Pond Area to provide additional data for selection and implementation of remedial actions for this area.

- In Quadrant IV, DOE prepared a work plan to investigate VOC contamination at the X-734 Landfills, specifically in the vicinity of well X734-21B.

10. SAMPLING AND ANALYSIS

The following sections describe the procedures and techniques for obtaining information associated with groundwater samples collected at PORTS. Sects. 10.1 through 10.4 describe sample collection activities, Sect. 10.5 discusses analytical procedures, and Sect. 10.6 contains information on sample quality assurance and quality control (QA/QC). Sect. 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 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. To the extent possible, field personnel will use the same techniques and types of equipment to keep the data collection process uniform. These procedures are reviewed and revised (if necessary) on a routine basis. Revised procedures will be incorporated into this document as appropriate. The current version of the applicable procedures are included in Appendix F. 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. 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. Water level measurements are described in detail in the procedures contained in Appendix F.

The SWLs are also collected quarterly from predetermined wells (groundwater wells and piezometers) to generate groundwater flow maps for the Gallia and the Berea formations. To obtain accurate data on groundwater flow, the SWLs are collected in the shortest reasonable time. To the extent possible, water levels in a given area are collected in a single day. Site-wide, the water level snapshots are typically completed within three days. The quarterly SWLs typically are not initiated within 48 hours after a major precipitation event.

10.1.2 Detection of Immiscible Layers

Before purging and sample collection, wells that have historically exhibited high concentrations (≥100 ppm) of an organic constituent are often inspected for the presence of light nonaqueous-phase liquids (LNAPLs) 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 dense non-aqueous phase liquid 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 feet 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. The methods used for purging monitoring wells are described in Appendix F.

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 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 call 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. Specific procedures for calibration and operation of instruments are included in Appendix F.

Other analyses performed in the field 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, dedicated/disposable Teflon and/or stainless steel bailers, or utilizing other methods as approved by the Ohio EPA (see Appendix F). 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. The procedures contained in Appendix F further discuss residential well sampling.

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. The type of sample container used for a given parameter may be changed as laboratory requirements are revised. Sample containers are purchased as "certified clean" from a laboratory supplier. Bottle lot numbers and certification records shall be maintained. Table 2 lists the appropriate sample container for each analytical parameter.

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 $4^{\circ}C \pm 2^{\circ}C$. The pH of samples may be reduced to <2 by the addition of acid to the sample containers or increased by adding a base to a $pH > 12$. Table 2 lists preservation requirements for each analytical parameter, as well as specified holding times.

10.2.3 Sample Handling

Samples for volatile organic analysis 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 chain-of-custody (COC) record is used. A sample data and chain-of-custody record 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 Sample Data and COC program include sample labels, field records, and chain-of-custody records for analysis. Examples of completed Sample Data and COC Record can be found in Appendix F.

If samples are shipped off-site, a signed or initialed custody seal may be 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. Examples of these forms are included in Appendix F. 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 (Sect. 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. A discussion concerning the labeling of QA/QC samples is contained in the procedures located in Appendix F.

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-mL volatile organic analyses (VOA) vials of deionized ultra-filtered (DIUF) water (or water that meets or exceeds the standards for DIUF water) that are filled in the field laboratory, transported to the sampling site, and returned to the 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 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. Initially, these samples were collected at a rate of one per case of 12 bailers. However, five years of rinseate samples have shown no 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. Typically, only one or two lots of bailers are used per quarter. Therefore, only one rinseate blank is now collected per quarter. The lot number of the bailer used for each well 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 per well field. 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 well field. 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. A duplicate is collected for each residential sample, while other field duplicates are collected at one per ten sampling locations per well field. 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 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*, (SW-846, most recent edition) and/or *Methods for Chemical Analysis of Water and Waste* (EPA-600/4-032, most recent edition). Methods and procedures are applied to organic and inorganic constituents.

10.7 DATA MANAGEMENT PLAN

A comprehensive Data Management Plan has 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 will be collected by field personnel and recorded on applicable sampling logs. Field data will be reviewed by the sampling team supervisor for completeness; the field data will be maintained in a data base file. At a minimum, field parameters will include pH, temperature, specific conductance, groundwater elevations, well depth (when appropriate), and organic and radiation meter readings. Data entered into the Field Database are the stabilized pH, temperature, and specific conductance. Data generated during the groundwater monitoring program will be collected by field personnel and recorded on applicable sampling logs. In addition, the field database tracks QC samples (identified in Sect. 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 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 QC samples associated with each sample from the field is conducted. Field data will be examined for acceptance and development of required field documentation, which includes 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 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 Quality Assurance Project Plan provides a more thorough discussion of the data validation and verification process. At a minimum, the following items are evaluated for data validation:

- 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 procedure included in Appendix F. 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.

- *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 feet by 3 feet 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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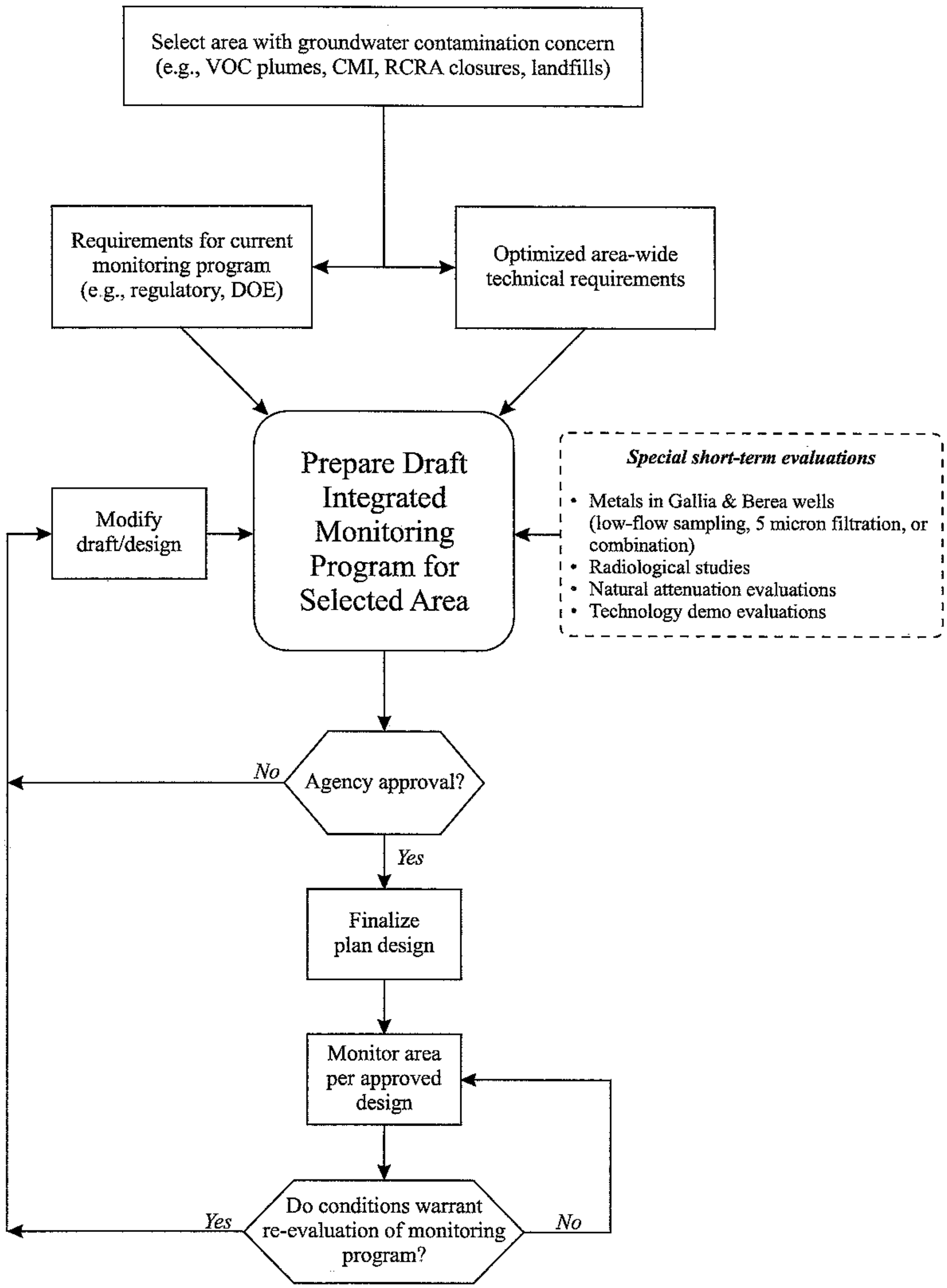

Fig. 1. Process flow for the PORTS Integrated Groundwater Monitoring Plan.

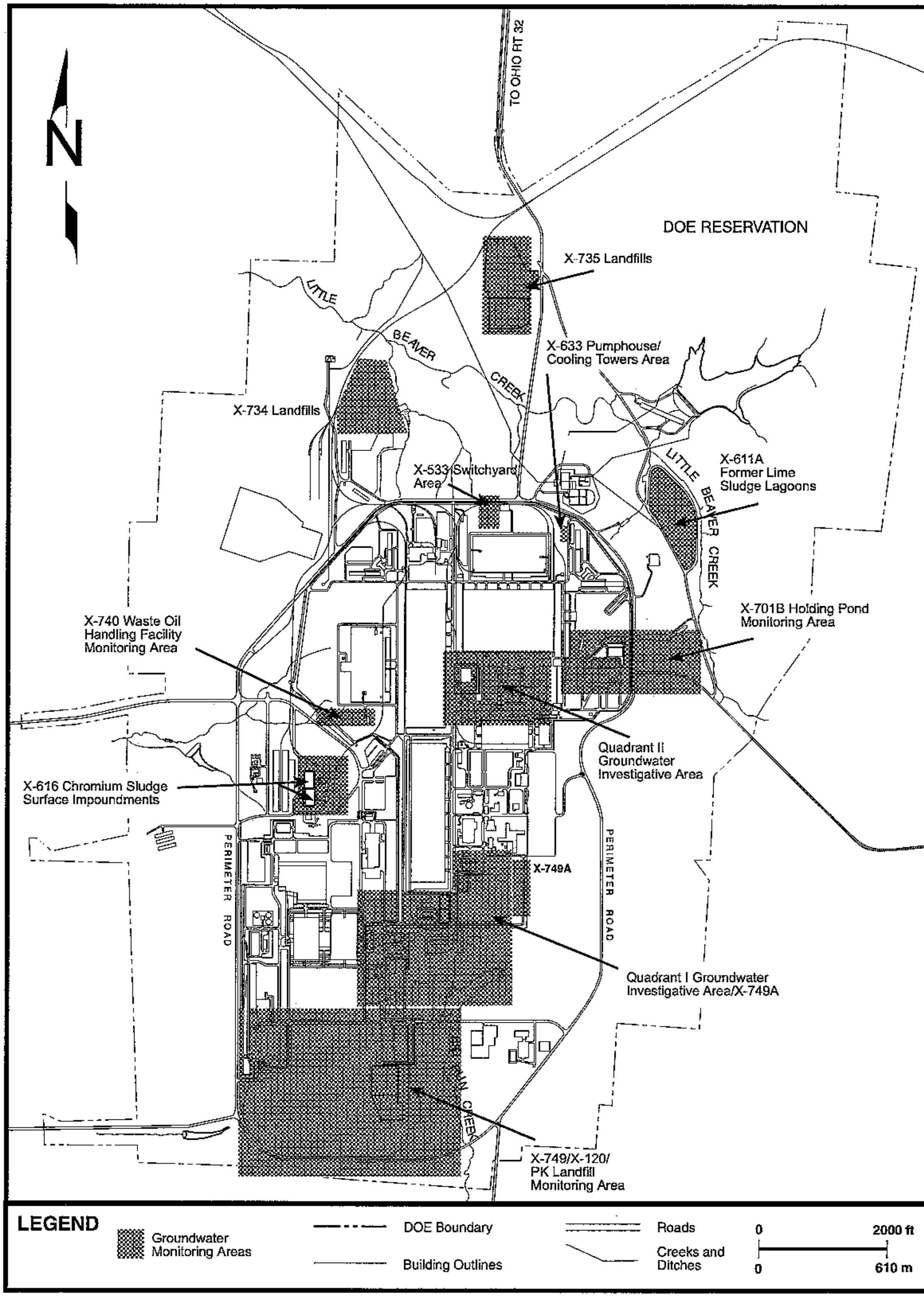

Fig. 2. Groundwater areas of concern.

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

Parameter set	Analyte	Method number[a]
A-98	Volatile organic compounds[b] Technetium-99 Total uranium Isotopic uranium Transuranic isotopes[d]	8260
B-98	Volatile organic compounds[b] Technetium-99 Total uranium Isotopic uranium Transuranic isotopes[d] Alkalinity Chloride Sulfate Total metals: Ca, Fe, K, Mg, Na	8260 310.1 or 2320B 300 300 6010 or 6020
C-98	Volatile organic compounds[b] Technetium-99 Total uranium Isotopic uranium Transuranic isotopes[d] Alkalinity Chloride Sulfate Total metals: Ba, Ca, Cd, Cr, Fe, K, Mg, Mn, Na, Pb, Ni, Sb, Tl	8260 310.1 or 2320B 300 300 6010 or 6020
D-98	Volatile organic compounds[b] Technetium-99 Total uranium Isotopic uranium Transuranic isotopes[d] Alkalinity Chloride Sulfate Total metals: As, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Na, Ni, Pb, Se, V, Zn	8260 310.1 or 2320B 300 300 6010 or 6020

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

Parameter set	Analyte	Method number[a]
E-98	Chloride Sulfate Alkalinity Total dissolved solids Total metals: Na Technetium-99 Total uranium Isotopic uranium Transuranic isotopes[d]	300 300 310.1 or 2320B 160.1 6010 or 6020
F-00	Volatile organic compounds[b] Total metals: Cd, Ni	8260 6010 or 6020
G-98	Total metals: Be, Cr	6010 or 6020
H-98	Volatile organic compounds[c] Technetium-99 Total uranium Isotopic uranium Transuranic isotopes[d] Alkalinity Chloride Sulfate Total metals: Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, Tl, V, Zn Ammonia Chemical oxygen demand Total dissolved solids Nitrite/nitrate	8260 310.1 or 2320B 300 300 6010 or 6020 350.2 410.1 160.1 353.2
I-98	Appendix to OAC rule 3745-54-98 (Appendix IX) Technetium-99 Total uranium Isotopic uranium Transuranic isotopes[d]	Various
J-00	Alkalinity Chloride Sulfate Total metals: Cd, Cr, Co, Pb, Mn, Ni, Tl	310.1 or 2320B 300 300 6010 or 6020
K-00	Alkalinity Chloride Sulfate Total metals: Fe, K, Mg, Mn, Na	310.1 or 2320B 300 300 6010 or 6020

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

Parameter set	Analyte		Method number[a]
L-00	Total metals:	Cd, Co, Ni	6010 or 6020
M-00	Total metals:	Cr	6010 or 6020
N-00	Alkalinity Chloride Sulfate Total metals:	 Cd, Co, Cr, Fe, K, Mg, Mn, Na, Ni, Pb, Tl	310.1 or 2320B 300 300 6010 or 6020
O-01	Manganese		6010 or 6020

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

[a]Samples shall be 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.

[b]Acetone, benzene, bromodichloromethane, bromoform (tribromomethane), carbon disulfide, carbon tetrachloride, chlorobenzene, chloroethane (ethyl chloride), chloroform (trichloromethane), dibromochloromethane (chlorodibromomethane), o-dichlorobenzene (1,2-dichlorobenzene), p-dichlorobenzene (1,4-dichlorobenzene), 1,1-dichloroethane (ethylidene chloride), 1,2-dichloroethane (ethylidene dichloride), 1,1-dichloroethylene (1,1-dichloroethene, vinylidene chloride), cis-1,2-dichloroethylene (cis-1,2-dichloroethene), trans-1,2-dichloroethylene (trans-1,2-dichloroethene), ethylbenzene, methyl bromide (bromomethane), methyl chloride (chloromethane), methylene chloride (dichloromethane), methyl ethyl ketone (MEK, 2-butanone), 4-methyl-2-pentanone (methyl isobutyl ketone), 1,1,2,2-tetrachloroethane, tetrachloroethylene (tetrachloroethene, perchloroethylene), toluene, 1,1,1-trichloroethane (methylchloroform), 1,1,2-trichloroethane, trichlorethylene (trichloroethene), trichlorofluoromethane (CFC-11), vinyl chloride, and xylenes.

[c]VOCs listed under footnote b above plus the following: acrylonitrile, bromochloromethane, 1,2-dibromo-3-chloropropane (DBCP), 1,2-dibromoethene (ethylene dibromide, EDB), trans-1,4-dichloro-2-butene, 1,2-dichloropropane (propylene dichloride), cis-1,3-dichloropropene, trans-1,3-dichloropropene, 2-hexanone (methyl butyl ketone), methylene bromide (dibromomethane), methyl iodide (iodomethane), styrene, 1,1,1,2-tetrachloroethane, 1,2,3-trichloropropane, and vinyl acetate.

[d]Americium-241, neptunium-237, plutonium-238, and plutonium 239/240.

Table 2. Sample containers, preservatives, and holding times

Parameter	Container	Preservative	Holding time
Volatile organic compounds	Two 40 ml amber glass, septum lid	HCl ($pH < 2$), 2°C-6°C	14 days
Technetium-99	1 L plastic	HNO_3 ($pH < 2$)	180 days
Total uranium/ isotopic uranium	1 L plastic	HNO_3 ($pH < 2$)	180 days
Transuranic isotopes	1L plastic	HNO_3 ($pH < 2$)	180 days
Alkalinity	250 ml plastic	NP, 2°C-6°C	14 days
Chloride, sulfate	250 ml plastic	NP, 2°C-6°C	28 days
Total metals	250 ml plastic	HNO_3 ($pH < 2$)	180 days
Total dissolved solids	250 ml plastic	NP, 2°C-6°C	7 days
Ammonia	250 ml plastic	10% H_2SO_4, 2°C-6°C, $pH < 2$ & > 1	28 days
Chemical oxygen demand	250 ml plastic	10% H_2SO_4, $pH < 2$	28 days
Nitrate, nitrite	250 ml plastic	NP, 2°C-6°C	48 hours

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
MH GW-4	Monitors PK groundwater collection system for CMP two-year evaluation	Quarterly	B-98
MH GW-5	Monitors PK groundwater collection system for CMP two-year evaluation	Quarterly	B-98
PK-09G	Monitors eastern perimeter of X-120 plume and provides data for CMP two-year evaluation	Quarterly	B-98
PK-10G	Monitors northern upgradient boundary of X-120 plume and west perimeter of PK Landfill and provides data for CMP two-year evaluation	Quarterly	D-98, B-98[a]
PK-11G	Monitors upgradient of boundary of PK Landfill and provides data for CMP two-year evaluation	Quarterly	D-98, B-98[a]
PK-14G	Monitors downgradient of the PK collection system and provides data for CMP two-year evaluation	Quarterly	D-98, B-98[a]
PK-16G	Monitors downgradient of the PK collection system and provides data for CMP two-year evaluation	Quarterly	D-98, B-98[a]
PK-17B	Monitors downgradient of the X-749 IRM collection system and provides data for CMP two-year evaluation	Quarterly	D-98, B-98[a]
PK-19B	Monitors downgradient of the X-749 IRM collection system and provides data for CMP two-year evaluation	Quarterly	D-98, B-98[a]
PK-20B	Monitors downgradient of the X-749 IRM collection system and provides data for CMP two-year evaluation	Quarterly	D-98, B-98[a]
PK-21B	Monitors downgradient of the X-749 IRM collection system and provides data for CMP two-year evaluation	Quarterly	D-98, B-98[a]
PK-PL6	Monitors sump of groundwater collection trench for northern portion of the PK Landfill	Quarterly	D-98
PK-PL6A	Monitors sump of groundwater collection trench for southern portion of the PK Landfill and east lobe of X-749 plume	Quarterly	D-98
X749-04G	Monitors north perimeter of X-749 Landfill and provides data for CMP two-year evaluation	Quarterly	B-98
X749-07G	Monitors west perimeter of X-749 Landfill, middle of plume, X-749 trench/cap, and provides data for CMP two-year evaluation	Quarterly	B-98[b]
X749-08G	Monitors south perimeter of X-749 Landfill, X-749 trench/cap, and provides data for CMP two-year evaluation	Quarterly	B-98[b]
X749-09GA	Monitors east perimeter of X-749 Landfill, X-749 cap, and provides data for CMP two-year evaluation	Quarterly	B-98
X749-10GA	Monitors east perimeter of X-749 Landfill, X-749 cap, and provides data for CMP two-year evaluation	Quarterly	B-98[b]
X749-20G	Monitors east lobe of X-749 plume, PK Landfill perimeter, and provides data for CMP two-year evaluation	Quarterly	B-98
X749-21G	Monitors middle of east lobe of plume and provides data for CMP two-year evaluation	Quarterly	B-98
X749-23G	Monitors outside margin of east lobe of X-749 plume and provides data for CMP two-year evaluation	Quarterly	B-98

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

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters
X749-24G	Monitors margin of east lobe of plume and provides data for CMP two-year evaluation	Quarterly	B-98
X749-25G	Monitors southeast portion of X-749 plume and provides data for CMP two-year evaluation	Quarterly	B-98
X749-35G	Monitors east lobe of X-749 plume, PK Landfill perimeter, and provides data for CMP two-year evaluation	Quarterly	B-98
X749-54B	Monitors Berea south of PK Landfill and provides data for CMP two-year evaluation	Quarterly	B-98
X749-96G	Monitors DOE property boundary	Quarterly	B-98
X749-97G	Monitors DOE property boundary	Quarterly	B-98
X749-98G	Monitors DOE property boundary	Quarterly	B-98
X749-99M	Monitors DOE property boundary	Quarterly	B-98
X749-100M	Monitors DOE property boundary	Quarterly	B-98
X749-101M	Monitors DOE property boundary	Quarterly	B-98
X749-BG6G	Monitors east of X-749 Landfill to provide data for CMP two-year evaluation	Quarterly	B-98
X749-BG9G	Monitors southeast corner of X-749 Landfill to provide data for CMP two-year evaluation	Quarterly	B-98
X749-PZ03G	Monitors potential groundwater movement around south slurry wall	Quarterly	A-98, B-98[c]
X749-PZ04G	Monitors potential groundwater movement around south slurry wall	Quarterly	A-98, B-98[c]
X749-PZ05G	Monitors potential groundwater movement around south slurry wall	Quarterly	A-98, B-98[c]
X749-PZ09G	Monitors eastern boundary of X-749 Landfill to provide data for CMP two-year evaluation	Quarterly	B-98
X749-PZ10G	Monitors east of X-749 Landfill to provide data for CMP two-year evaluation	Quarterly	B-98
X749-PZ11G	Monitors eastern boundary of X-749 Landfill to provide data for CMP two-year evaluation	Quarterly	B-98
X749-PZ13G	Monitors southern boundary of X-749 Landfill to provide data for CMP two-year evaluation	Quarterly	B-98
X749-PZ14G	Monitors southern boundary of X-749 Landfill to provide data for CMP two-year evaluation	Quarterly	B-98

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

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters
PK-15B	Monitors downgradient of the PK collection system	Semiannual	D-98
PK-18B	Monitors downgradient of the PK collection system	Semiannual	D-98
STSW-101G	Monitors southern portion of X-749 plume	Semiannual	A-98, B-98[c]
STSW-102G	Monitors southern portion of X-749 plume	Semiannual	A-98, B-98[c]
X120-05G	Monitors horizontal well; provides data on effectiveness of technical demonstration	Semiannual	A-98, B-98[c]
X120-08G	Monitors horizontal well; provides data on effectiveness of technical demonstration	Semiannual	A-98, B-98[c]
X120-11G	Monitors horizontal well; provides data on effectiveness of technical demonstration	Semiannual	A-98, B-98[c]
X749-06G	Monitors west perimeter of X-749 Landfill; within middle of plume; provides monitoring of trench/cap	Semiannual	A-98, B-98[c]
X749-13G	Monitors southeast front of X-749 plume	Semiannual	A-98, B-98[c]
X749-37G	Monitors west perimeter of plume	Semiannual	A-98, B-98[c]
X749-41G	Monitors horizontal well; monitors effectiveness of technical demo.	Semiannual	A-98, B-98[c]
X749-42G	Monitors horizontal well; monitors effectiveness of technical demo.	Semiannual	A-98, B-98[c]
X749-44G	Monitors west edge of retention wall; provides exit pathway monitoring	Semiannual	A-98, B-98[c]
X749-45G	Monitors center of wall; provides exit pathway monitoring	Semiannual	A-98, B-98[c]
X749-67G	Monitors southern portion of X-749 plume	Semiannual	A-98, B-98[c]
X749-PZ02G	Monitors margin of east lobe; outside X-749 plume	Semiannual	A-98, B-98[c]
X749-WPW	Previously X749-PL, monitors west trench effluent (if effluent is present); monitors effectiveness of trench	Semiannual	A-98, B-98[c]
X749-14B	Monitors Berea near Big Run Creek	Annual	B-98
X749-26G	Monitors middle of X-749 plume; required originally by X-749 closure	Annual	B-98
X749-36G	Monitors middle of X-749 plume; required originally by X-749 closure	Annual	B-98

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

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters
X749-50B	Monitors Berea below center of plume	Annual	B-98
X749-51B	Monitors Berea east of X-749 Landfill	Annual	B-98
X749-60B	Monitors Berea at southwest perimeter of plume	Annual	B-98
X749-63B	Monitors Berea at depth; monitors perimeter; provides exit pathway monitoring	Annual	B-98
X749-64B	Monitors Berea at depth; monitors perimeter; provides exit pathway monitoring	Annual	B-98
X749-68G	Downgradient well for southeast boundary of plume; provides exit pathway monitoring	Annual	B-98
X749-PZ06G	Replaces X749-43G; monitors southwest outer perimeter of X-749 plume	Annual	B-98
F-27G	Monitors Gallia downgradient of the X-120 plume	Biennial / odd	B-98
F-28B	Monitors Berea downgradient of the X-120 plume	Biennial / odd	B-98
X120-03G	Monitors northern upgradient margin of X-749 plume perimeter; well is outside plume	Biennial / odd	B-98
X120-06B	Monitors Berea beneath X-120 plume	Biennial / odd	B-98
X120-09G	Monitors horizontal well; provides data on groundwater outside of southern margin of X-120 plume	Biennial / odd	B-98
X120-10G	Monitors outside and south of X-120 plume margins; generally south and upgradient of X-120 plume	Biennial / odd	B-98
X749-40G	Monitors outside plume perimeter; upgradient well	Biennial / odd	B-98
X749-57G	Monitors northwest margin of plume; outside plume	Biennial / odd	B-98
X749-PZ08G	Monitors outside plume margins; generally upgradient	Biennial / odd	B-98

Parameter suites are defined in Table 1.
[a]Samples for D-98 parameters will be collected semiannually. Additional sampling during each year will be for B-98 parameters only
[b]Well will also be monitored for the additional parameters specified in the Appendix to OAC 3745-54-98 on a biennial basis.
[c]Samples for B-98 parameters will be collected annually Additional sampling during each year will be for A-98 parameters only

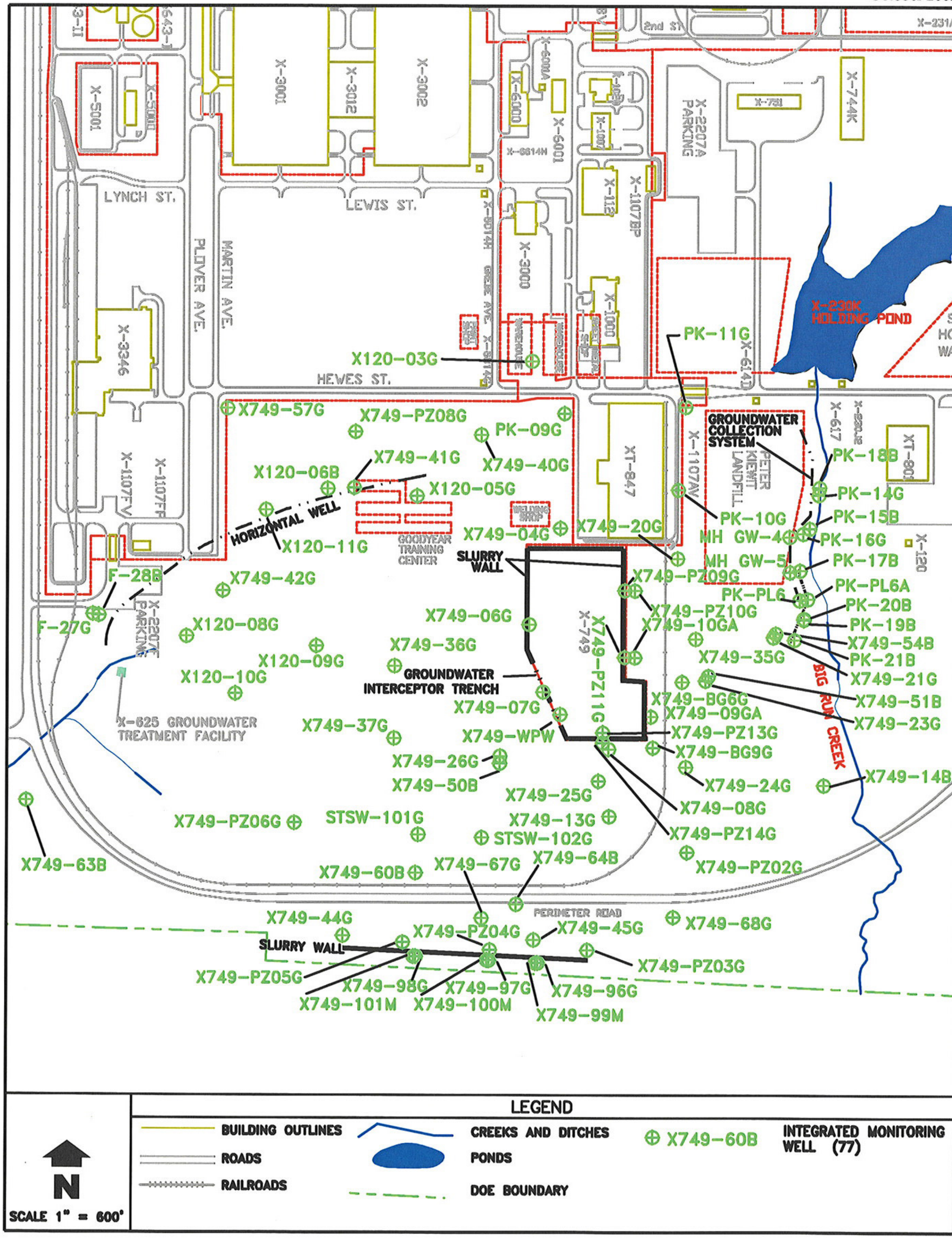

Fig. A-1. Integrated monitoring wells X-749/X-120/PK Landfill.

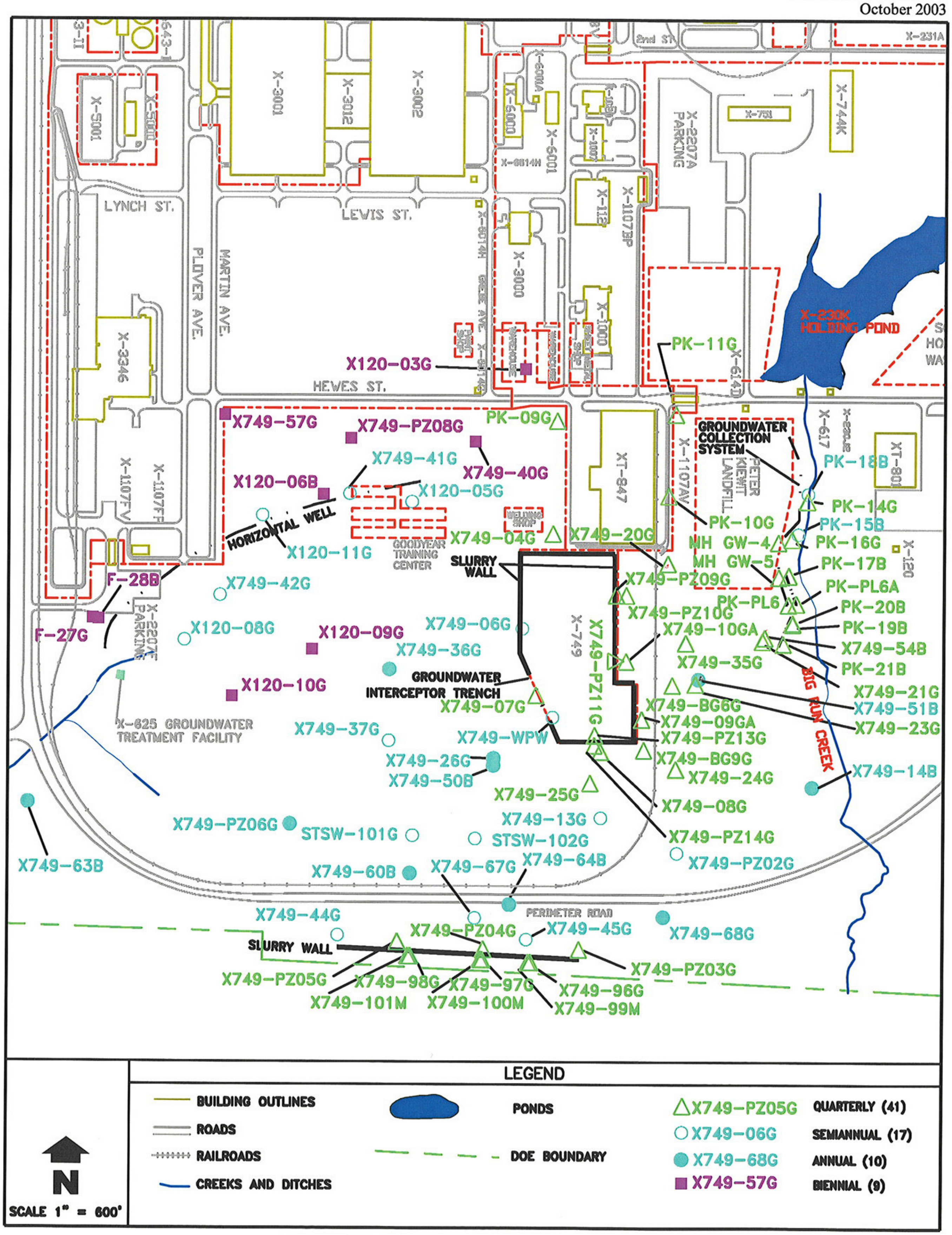

Fig. A-2. Integrated monitoring frequencies X-749/X-120/PK Landfill.

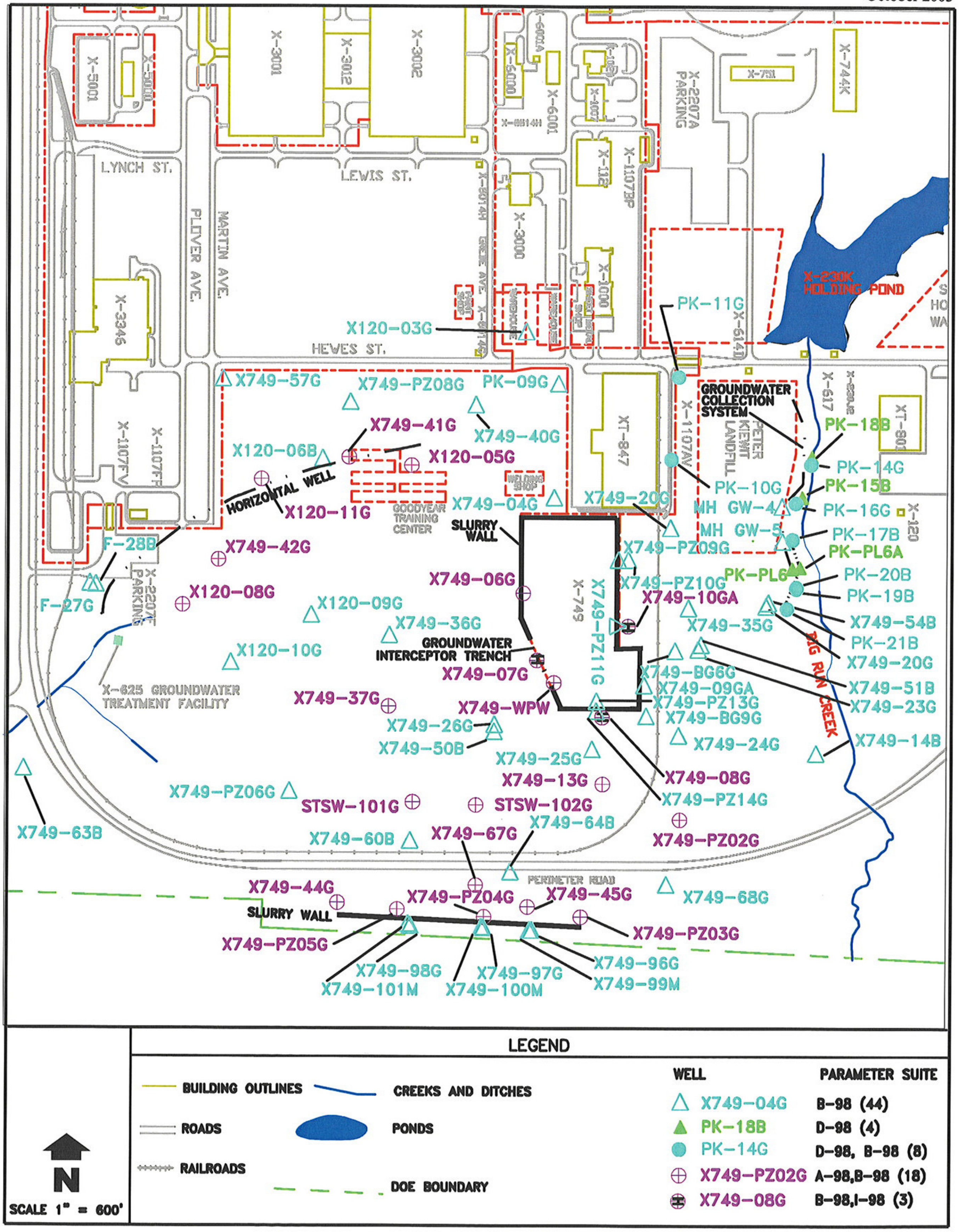

Fig. A-3. Integrated monitoring parameter suites X-749/X-120/PK Landfill.

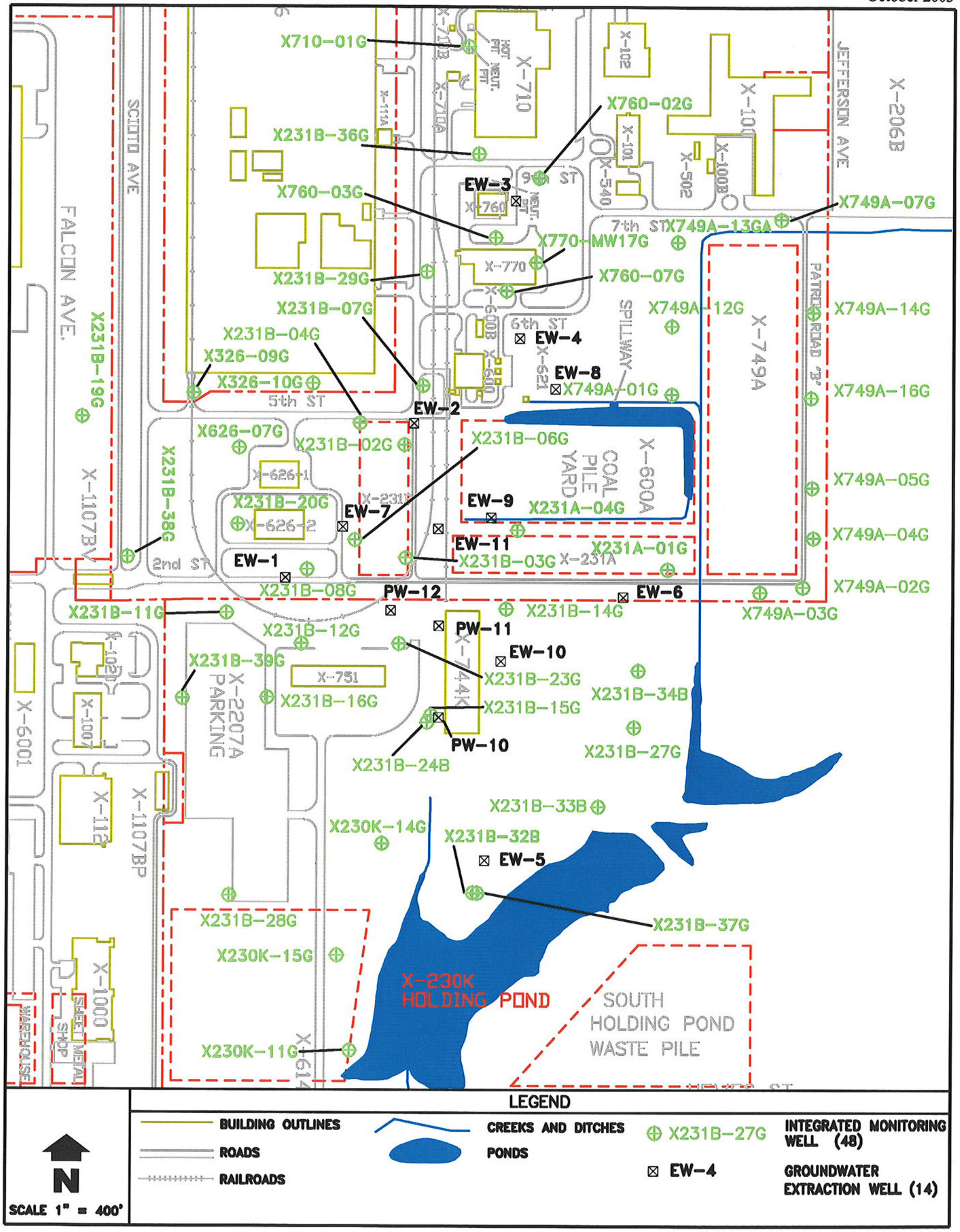

Fig. A-4. Integrated monitoring wells Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility.

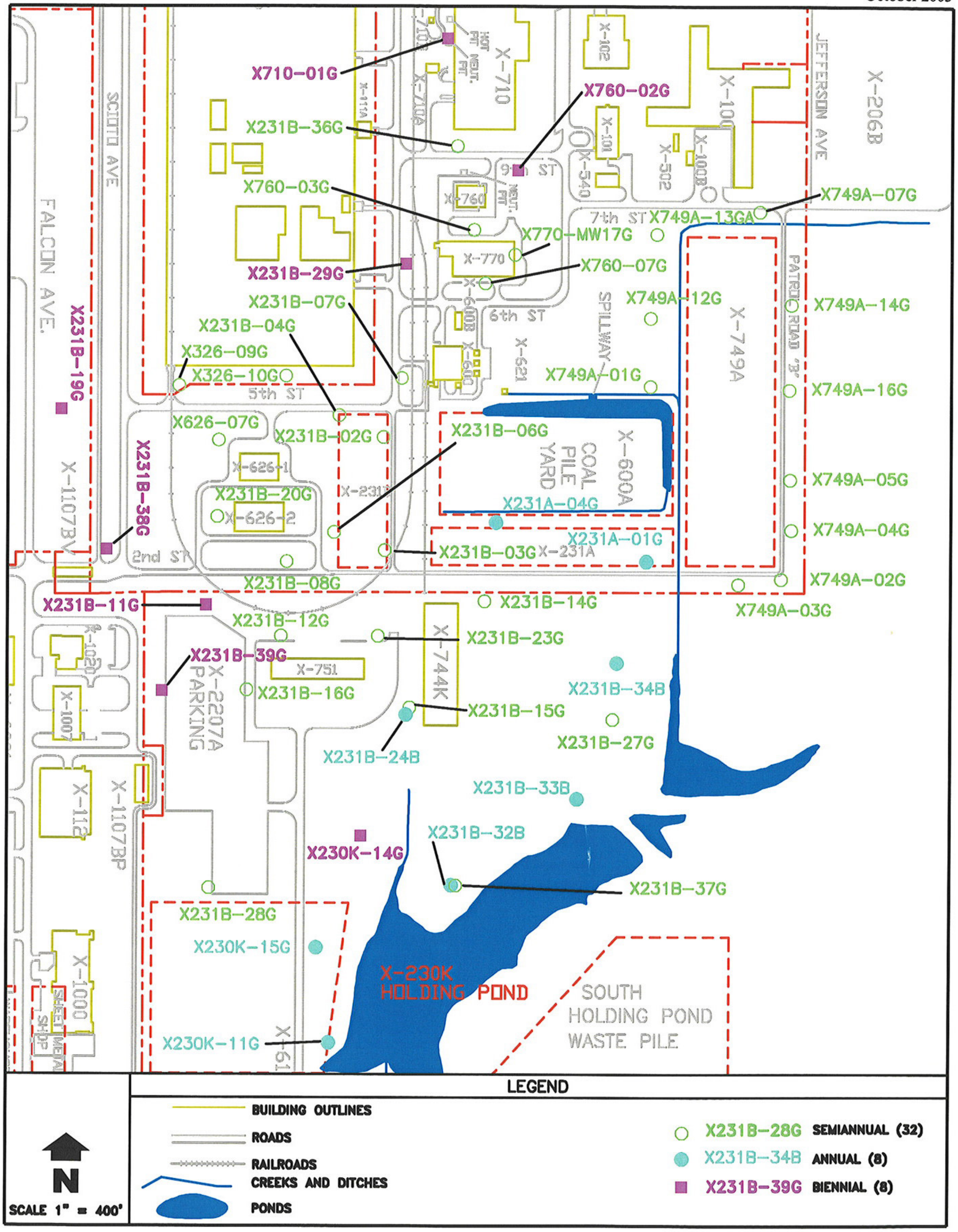

Fig. A-5. Integrated monitoring frequencies Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility.

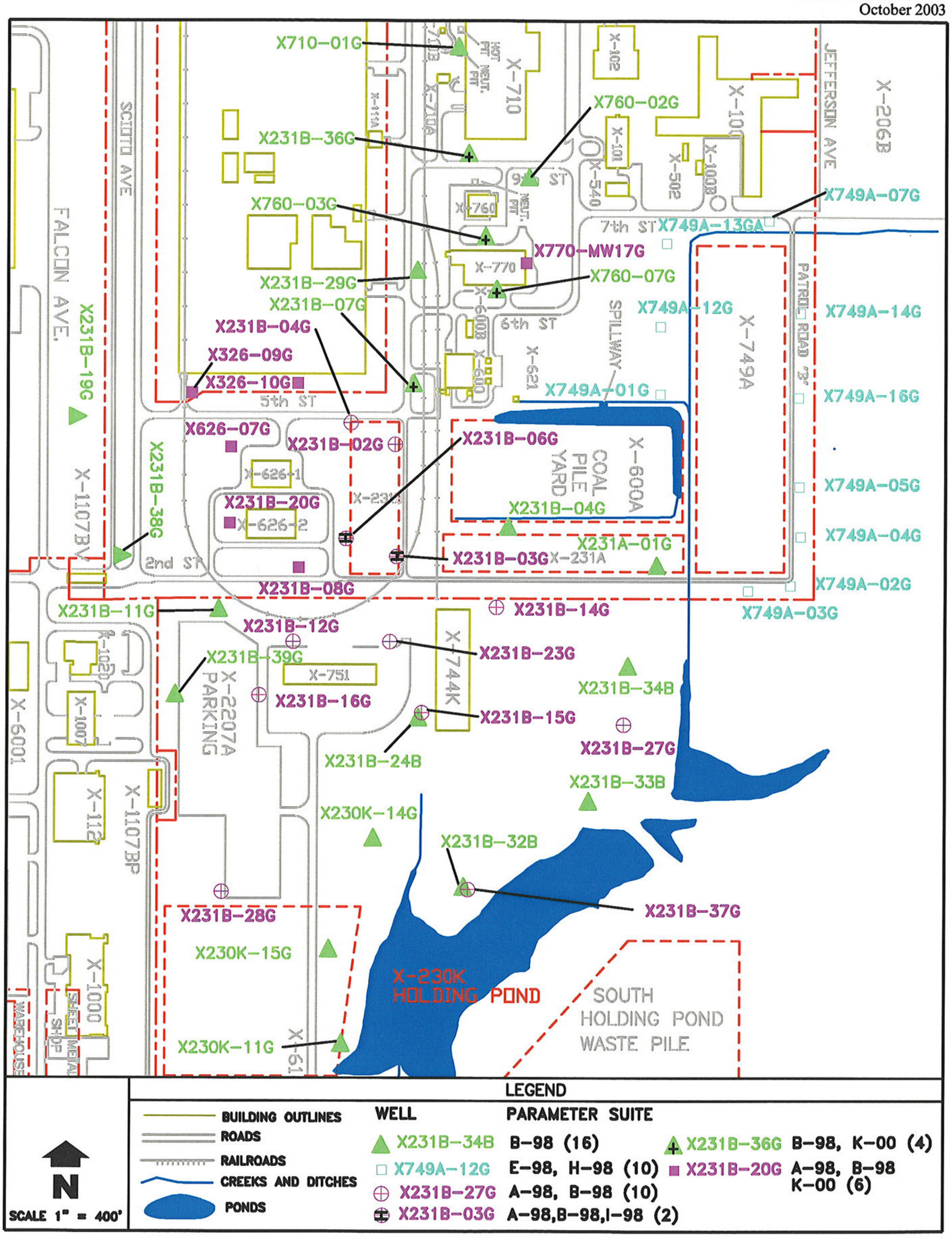

Fig. A-6. Integrated monitoring parameter suites Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility.

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
X700-02G	Monitors the interior of the QII VOC plume	Annual	B-98
X701-45G	Monitors within southern margin of QII VOC plume	Annual	B-98
X701-68G	Monitors within the QII VOC plume, northwest and typically downgradient of X-701C	Annual	B-98
X701-69G	Monitors within the QII VOC plume, east and typically upgradient of X-701C	Annual	B-98
X701-70G	Monitors within the QII VOC plume, southwest and typically downgradient of X-701C	Annual	B-98
X701-117GA	Monitors within the QII VOC plume, west and downgradient of X-701C	Annual	B-98[a]
X705-01GA	Monitors western interior of the QII VOC plume	Annual	B-98
X705-07G	Monitors northern interior of the QII VOC plume	Annual	B-98
X720-01G	Monitors southeastern interior of the QII VOC plume	Annual	B-98
X720-08G	Monitors plume perimeter	Annual	B-98
PRCL-01G	Monitors upgradient[b] north of QII VOC plume	Biennial / odd	B-98
X701-26G	Monitors upgradient[b] east of QII VOC plume	Biennial / odd	B-98
X701-27G	Monitors upgradient[b] east of QII VOC plume	Biennial / odd	B-98
X701-28GA	Monitors upgradient[b] north of QII VOC plume	Biennial / odd	B-98
X701-29G	Monitors upgradient[b] north of QII VOC plume	Biennial / odd	B-98
X701-46G	Monitors east of QII VOC plume	Biennial / odd	B-98
X705-02G	Monitors upgradient[b] west of QII VOC plume	Biennial / odd	B-98
X705-03G	Monitors western margin of QII VOC plume[b]	Biennial / odd	B-98
X705-04G	Monitors western margin of QII VOC plume[b]	Biennial / odd	B-98
X705-05B	Monitors Berea beneath the northwest margin of the QII VOC plume	Biennial / odd	B-98
X705-06G	Monitors upgradient[b] north of QII VOC plume	Biennial / odd	B-98
X705-08G	Monitors upgradient[b] south of QII VOC plume	Biennial / odd	B-98

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

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters
X705-09B	Monitors Berea beneath the southwest margin of the QII VOC plume	Biennial / odd	B-98
X705-10B	Monitors Berea beneath the eastern interior of the QII VOC plume	Biennial / odd	B-98
X720-07G	Monitors upgradient[b] south of QII VOC plume	Biennial / odd	B-98

Parameter suites are defined in Table 1.
[a]Well will also be monitored for the additional parameters specified in the Appendix to OAC 3745-54-98 on a biennial basis.
[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. Water levels will be collected quarterly to verify gradient positions.

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

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters
LBC-PZ03	Monitors X-701B VOC plume near downgradient (eastern) margin	Semiannual	A-98, B-98[a]
LBC-PZ06	Monitors outside of X-701B VOC plume near Little Beaver Creek	Semiannual	A-98, B-98[a]
X230J7-01GA	Monitors south of X-230J7 and along north margin of X-701B VOC plume	Semiannual	B-98, O-01[b]
X230J7-02GA	Monitors south of X-230J7 and along north margin of X-701B VOC plume	Semiannual	B-98, O-01[b]
X230J7-03GA	Monitors south of X-230J7 and along north margin of X-701B VOC plume	Semiannual	B-98, O-01[b]
X700-03G	Monitors between X-701B and Quadrant II Groundwater Investigative Area and metals west of X-744G	Semiannual	B-98, N-00[b]
X701-01G	Monitors TCE plume south of X-744G	Semiannual	B-98, F-00[c]
X701-02G	Monitors X-701B VOC plume near upgradient (western) margin	Semiannual	A-98, B-98[a]
X701-05G	Monitors within western margin of X-701B VOC plume	Semiannual	A-98, B-98[a]
X701-06G	Monitors western interior of X-701B VOC plume	Semiannual	A-98, B-98[a]
X701-09G	Monitors interior of X-701B VOC plume along plume axis	Semiannual	B-98, N-00[b]
X701-10G	Monitors southern interior of X-701B VOC plume	Semiannual	A-98, B-98[a]
X701-12G	Monitors within the X-701B plume, at the eastern margin of X-701B Holding Pond	Semiannual	A-98, B-98[a]
X701-13G	Monitors within the X-701B plume, at the eastern margin of X-701B Holding Pond	Semiannual	A-98, B-98[a, d]
X701-14G	Monitors interior of X-701B VOC plume along plume axis	Semiannual	B-98, J-00[b, d]
X701-15G	Monitors downgradient of the X-237 groundwater collection system	Semiannual	A-98, B-98[a]
X701-16G	Monitors downgradient of north end of the X-237 groundwater collection system	Semiannual	A-98, B-98[a]
X701-19G	Monitors outside of the southern margin of the X-701B plume	Semiannual	A-98, B-98[a]
X701-20G	Monitors interior of X-701B VOC plume along plume axis	Semiannual	B-98, O-01[b]
X701-21G	Monitors northern interior of X-701B VOC plume	Semiannual	A-98, B-98 O-01[a, b]
X701-24G	Monitors downgradient of the X-237 groundwater collection system, along original plume axis	Semiannual	A-98, B-98[a]
X701-25G	Monitors outside of the northern margin of X-701B plume	Semiannual	A-98, B-98[a]

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

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters
X701-30G	Monitors isolated TCE hit south of X-744G	Semiannual	B-98, F-00[c]
X701-66G	Monitors adjacent to X-701B	Semiannual	J-00
X701-74G	Monitors between horizontal wells	Semiannual	K-00
X701-78G	Monitors upgradient (west) of horizontal wells	Semiannual	K-00
X701-80G	Monitors downgradient (northeast) of horizontal wells	Semiannual	K-00
X701-127G	Monitors inside plume perimeter	Semiannual	A-98, B-98[a]
X701-128G	Monitors inside plume perimeter	Semiannual	A-98, B-98[a]
X701-BW2G	Monitors within western margin of X-701B VOC plume	Semiannual	B-98, N-00[b]
X701-BW4G	Monitors outside of the X-701B plume, at the northern margin of X-701B Holding Pond	Semiannual	A-98, B-98[a]
X744G-01G	Monitors southwest of X-744G	Semiannual	F-00
X744G-02G	Monitors near southwest corner of X-744G	Semiannual	F-00
X744G-03G	Monitors south of X-744G	Semiannual	F-00
X230J7-04GA	Monitors north of X-230J7	Annual	B-98
X701-08G	Monitors interior of X-701B VOC plume along plume axis	Annual	B-98
X701-18G	Monitors downgradient/sidegradient of X-701B VOC plume	Annual	B-98
X701-23G	Monitors outside of the southern margin of X-701B plume	Annual	B-98
X701-38G	Monitors upgradient and outside of X-701B VOC plume	Annual	B-98
X701-48G	Monitors east of Little Beaver Creek	Annual	B-98
X701-50B	Monitors Berea beneath southern interior of X-701B VOC plume	Annual	B-98
X701-58B	Monitors Berea near northern edge of the X-237 groundwater collection system	Annual	B-98
X701-61B	Monitors Berea near the X-237 groundwater collection system	Annual	B-98

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

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters
X701-BW1G	Monitors upgradient and outside of X-701B VOC plume	Annual	B-98
X701-31G	Monitors downgradient of isolated TCE hit south of X-744G	Biennial / odd	B-98

Parameter suites are defined in Table 1

Additional parameters specified in the Appendix to OAC 3745-54-98 are not included for the X-230J7 wells.

[a]Samples for B-98 parameters will be collected annually. Additional sampling during a given year will be for A-98 parameters only.

[b]Samples for J-00, N-00, or O-01 parameters will be collected semiannually Additional sampling for B-98 parameters will be performed annually.

[c]Samples for F-00 parameters will be collected semiannually Additional sampling for B-98 parameters will be performed on a biennial basis.

[d]Well will also be monitored for the additional parameters specified in the Appendix to OAC 3745-54-98 on a biennial basis.

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	M-00
X633-PZ04G	Monitors west of X-633-2C Cooling Tower basin	Semiannual	M-00

Parameter suites are defined in Table 1

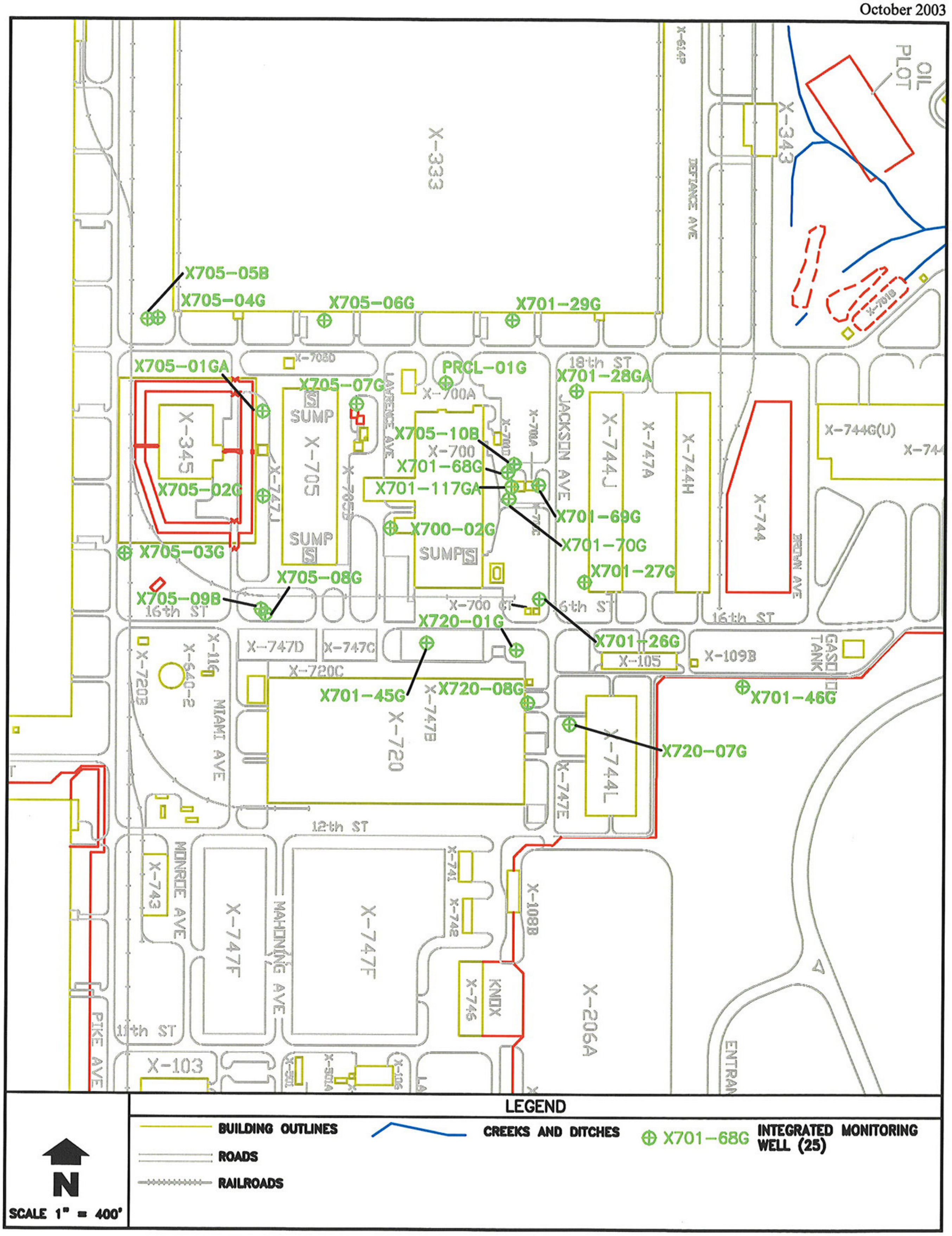

Fig. B-1. Integrated monitoring wells Quadrant II Groundwater Investigative Area.

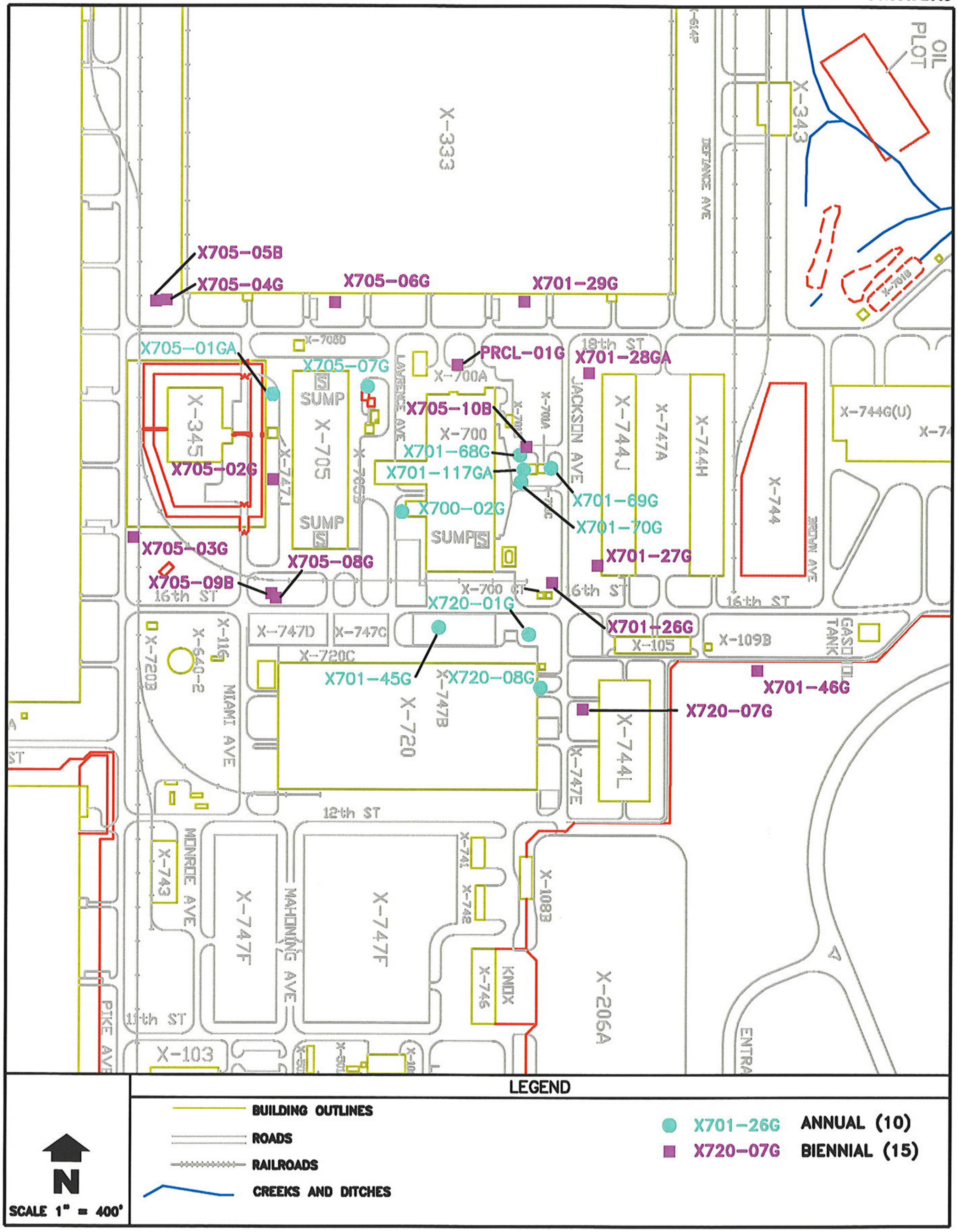

Fig. B-2. Integrated monitoring frequencies Quadrant II Groundwater Investigative Area.

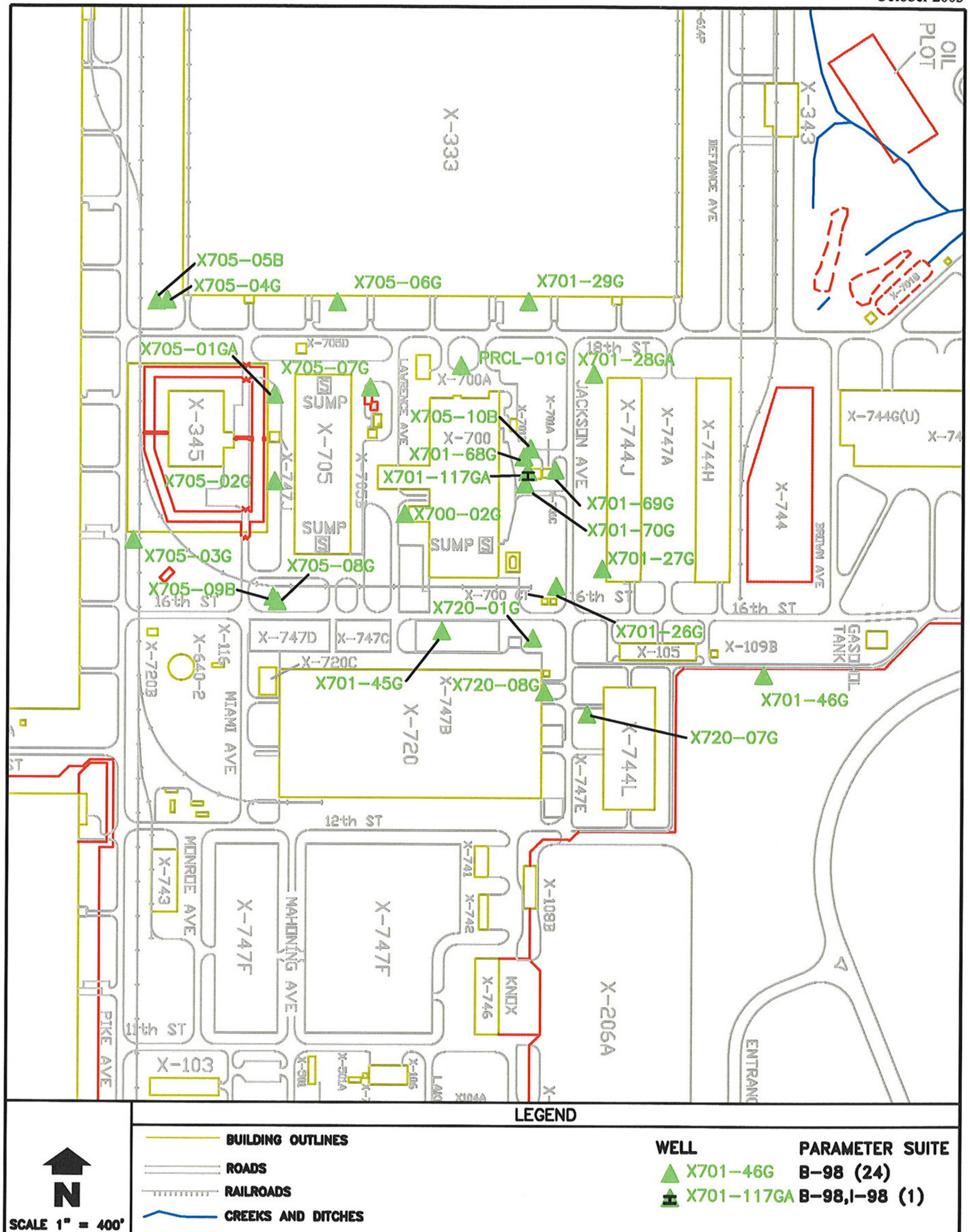

Fig. B-3. Integrated monitoring parameter suites Quadrant II Groundwater Investigative Area.

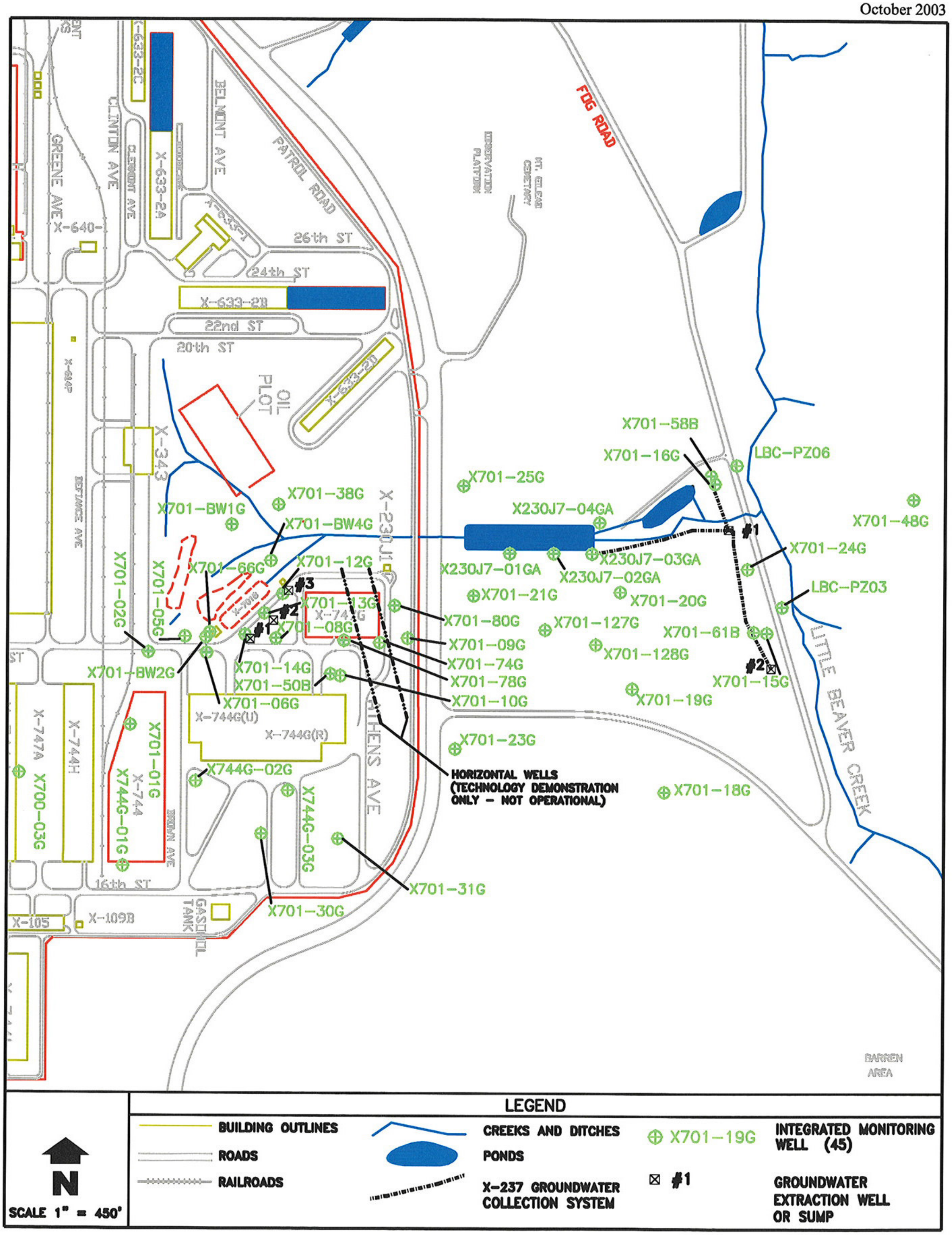

Fig. B-4. Integrated monitoring wells X-701B Holding Pond.

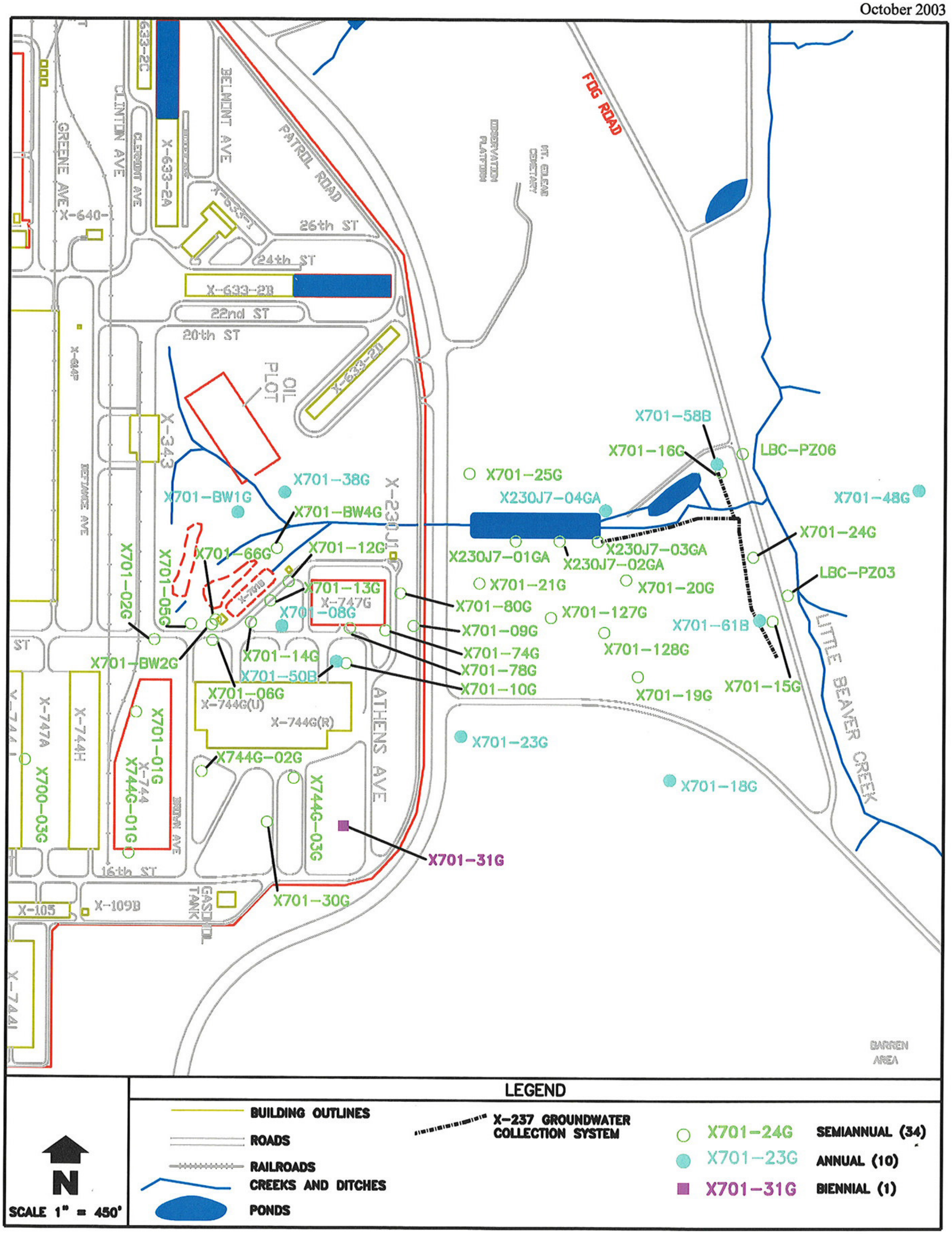

Fig. B-5. Integrated monitoring frequencies X-701B Holding Pond.

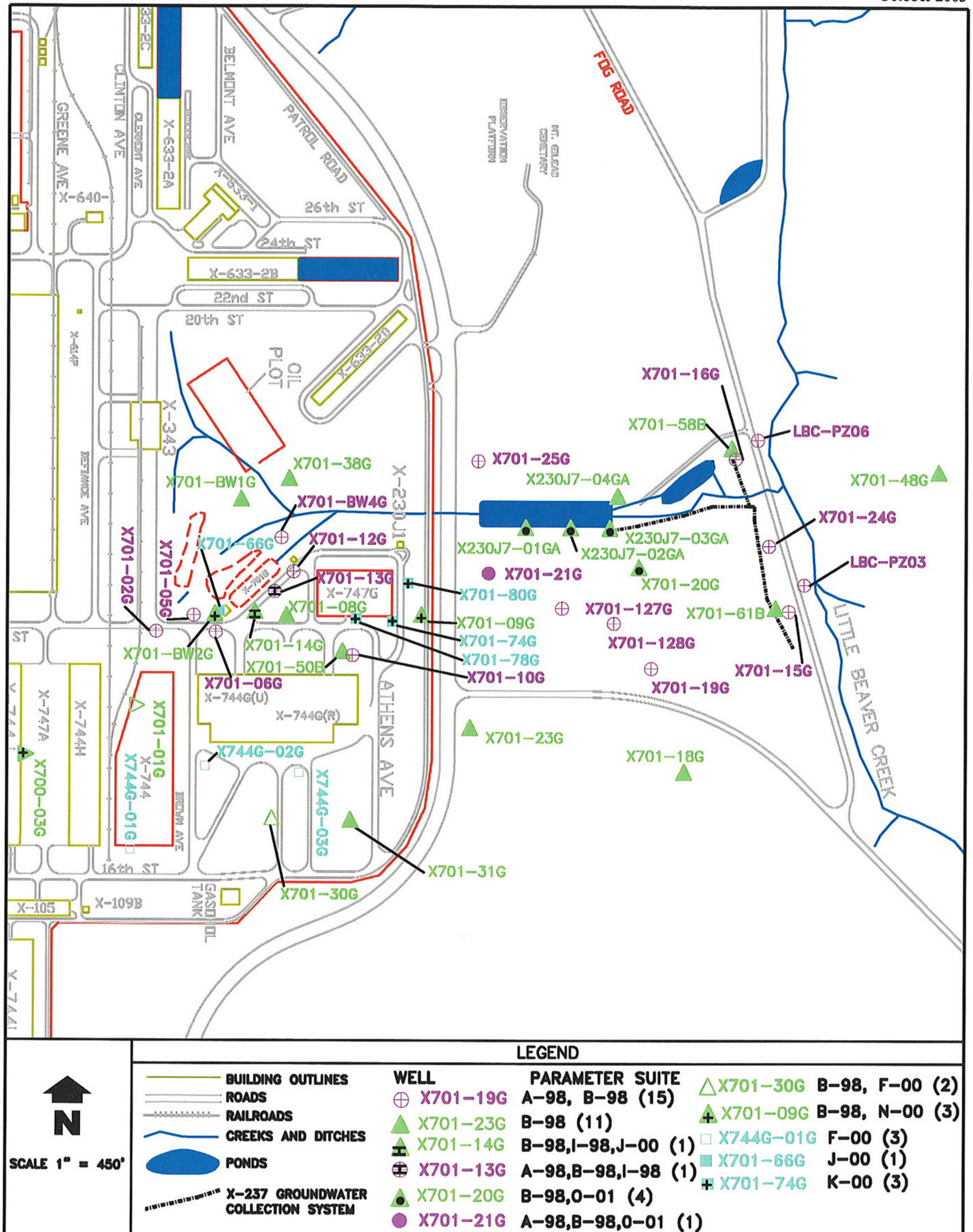

Fig. B-6. Integrated monitoring parameter suites X-701B Holding Pond.

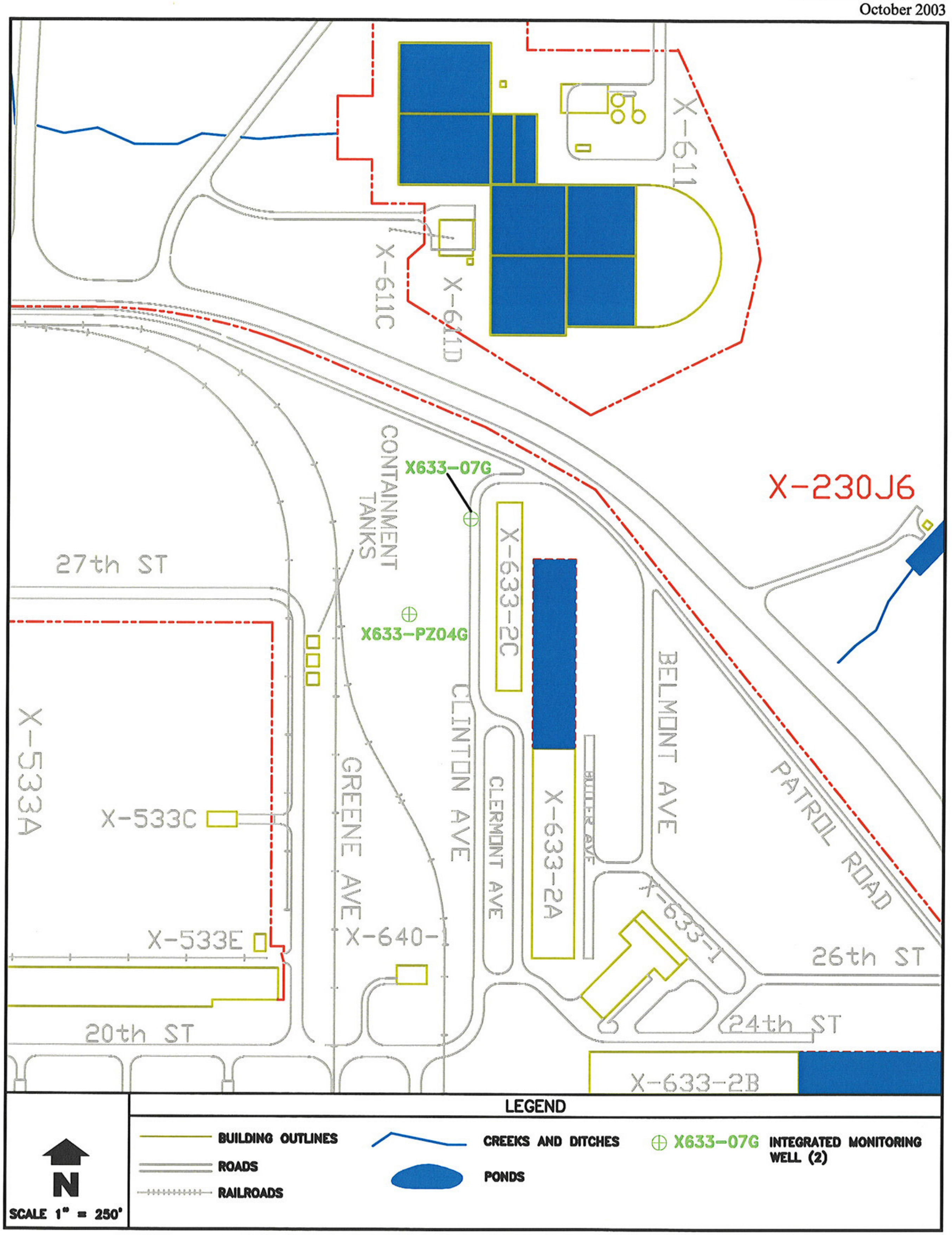

Fig. B-7. Integrated monitoring wells X-633 Pumphouse/Cooling Towers Area.

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
X616-02G	Monitors upgradient to the eastern boundary of X-616	Annual	C-98
X616-05G	Monitors to the northeast, down/side-gradient to X-616	Annual	C-98
X616-09G	Monitors downgradient to western boundary of X-616	Annual	C-98
X616-16G	Monitors downgradient to the southwest boundary of X-616	Annual	C-98
X616-20B	Monitors downgradient to the southwest boundary of X-616	Annual	C-98
X616-25G	Monitors downgradient southwest of X-616	Annual	C-98
X616-28B	Monitors to the southeast, up/side-gradient to X-616	Annual	C-98
X616-10G	Monitors to the southeast, up/side-gradient to X-616	Biennial / odd	C-98
X616-13G	Monitors downgradient to western boundary of X-616	Biennial / odd	C-98
X616-14G	Monitors downgradient to the northwest boundary of X-616	Biennial / odd	C-98
X616-17G	Monitors to the northeast, upgradient to X-616	Biennial / odd	C-98
X616-19B	Monitors northern downgradient boundary of X-616	Biennial / odd	C-98
X616-21G	Monitors downgradient to the northwest of X-616	Biennial / odd	C-98
X616-22G	Monitors downgradient to the west of X-616	Biennial / odd	C-98
X616-24B	Monitors downgradient to the west of X-616	Biennial / odd	C-98
X616-26G	Monitors to the southeast, up/side-gradient to X-616	Biennial / odd	C-98

Parameter suites are defined in Table 1.
Additional parameters specified in the Appendix to OAC 3745-54-98 are not included.

Table C-2. Integrated monitoring at the X-740 Waste Oil Handling Facility

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters
X740-03G	Monitors near middle of X-740 VOC plume	Semiannual	B-98[a]
X740-09B	Monitors Berea near middle of X-740 VOC plume	Semiannual	B-98
X740-10G	Monitors inside south-central portion of X-740 VOC plume	Semiannual	B-98
X740-11G	Monitors Gallia at southwestern margin of X-740 VOC plume	Semiannual	B-98
X740-12B	Monitors Berea downgradient southwest of X-740 VOC plume	Semiannual	B-98
X740-PZ10G	Monitors Gallia inside north-central portion of X-740 VOC plume	Semiannual	B-98
X740-PZ12G	Monitors Gallia inside west-central portion of X-740 VOC plume	Semiannual	B-98
X740-PZ14G	Monitors Gallia inside southern margin of X-740 VOC plume	Semiannual	B-98
X740-PZ17G	Monitors Gallia inside northwest margin of X-740 VOC plume	Semiannual	B-98
X740-01G	Monitors south of the southern margin of X-740 VOC plume	Annual	B-98
X740-04G	Monitors just inside northeast margin of X-740 VOC plume	Annual	B-98
X740-08G	Monitors just inside southeast margin of X-740 VOC plume	Annual	B-98
X740-02G	Monitors just inside east margin of X-740 VOC plume	Biennial / odd	B-98
X740-05G	Monitors upgradient of X-740 VOC plume	Biennial / odd	B-98
X740-06G	Monitors downgradient northwest of X-740 VOC plume	Biennial / odd	B-98
X740-07B	Monitors Berea downgradient northwest of X-740 VOC plume	Biennial / odd	B-98

Parameter suites are defined in Table 1.
[a]Well will also be monitored for the additional parameters specified in the Appendix to OAC 3745-54-98 on a biennial basis.

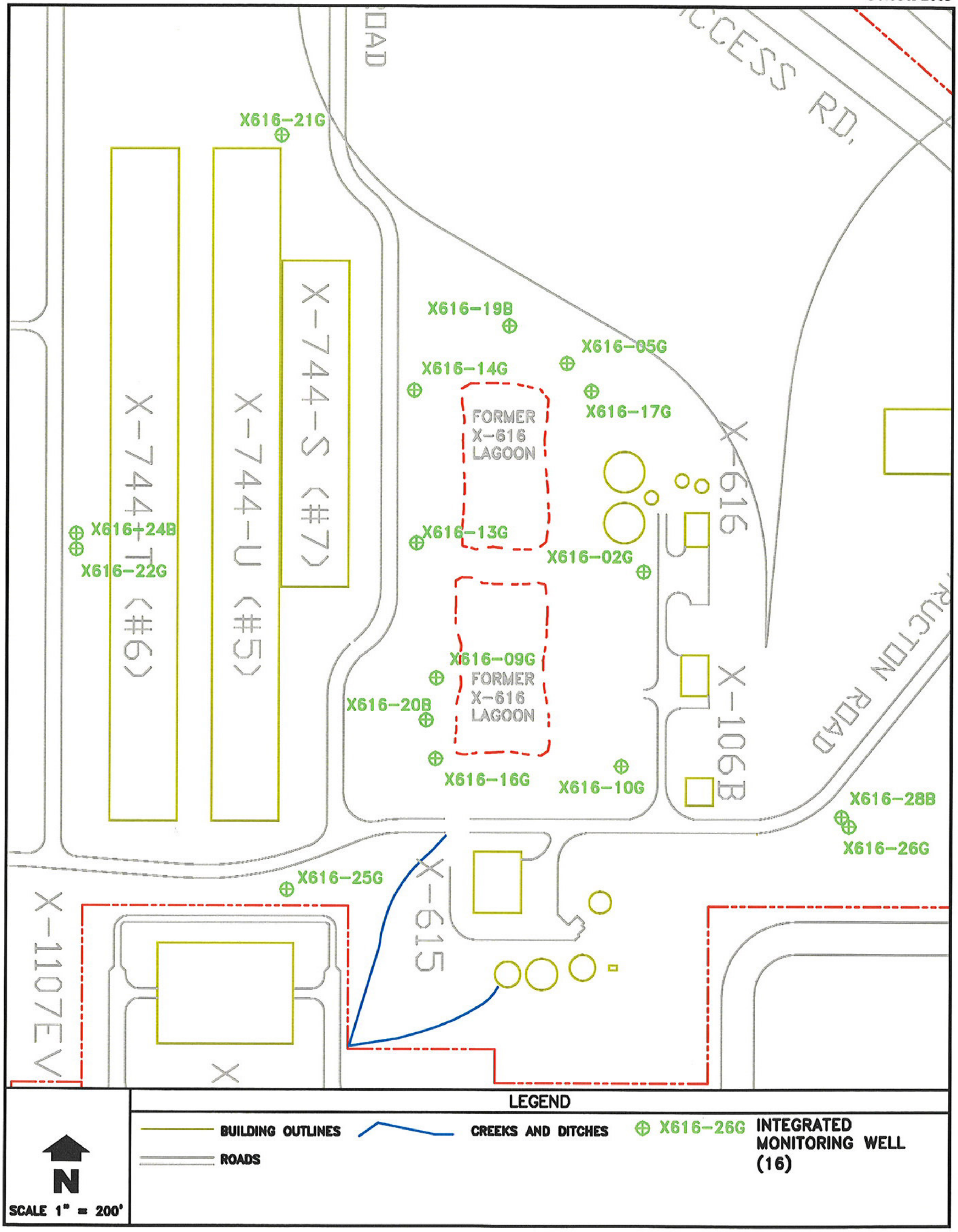

Fig. C-1. Integrated monitoring wells X-616 Chromium Sludge Surface Impoundments.

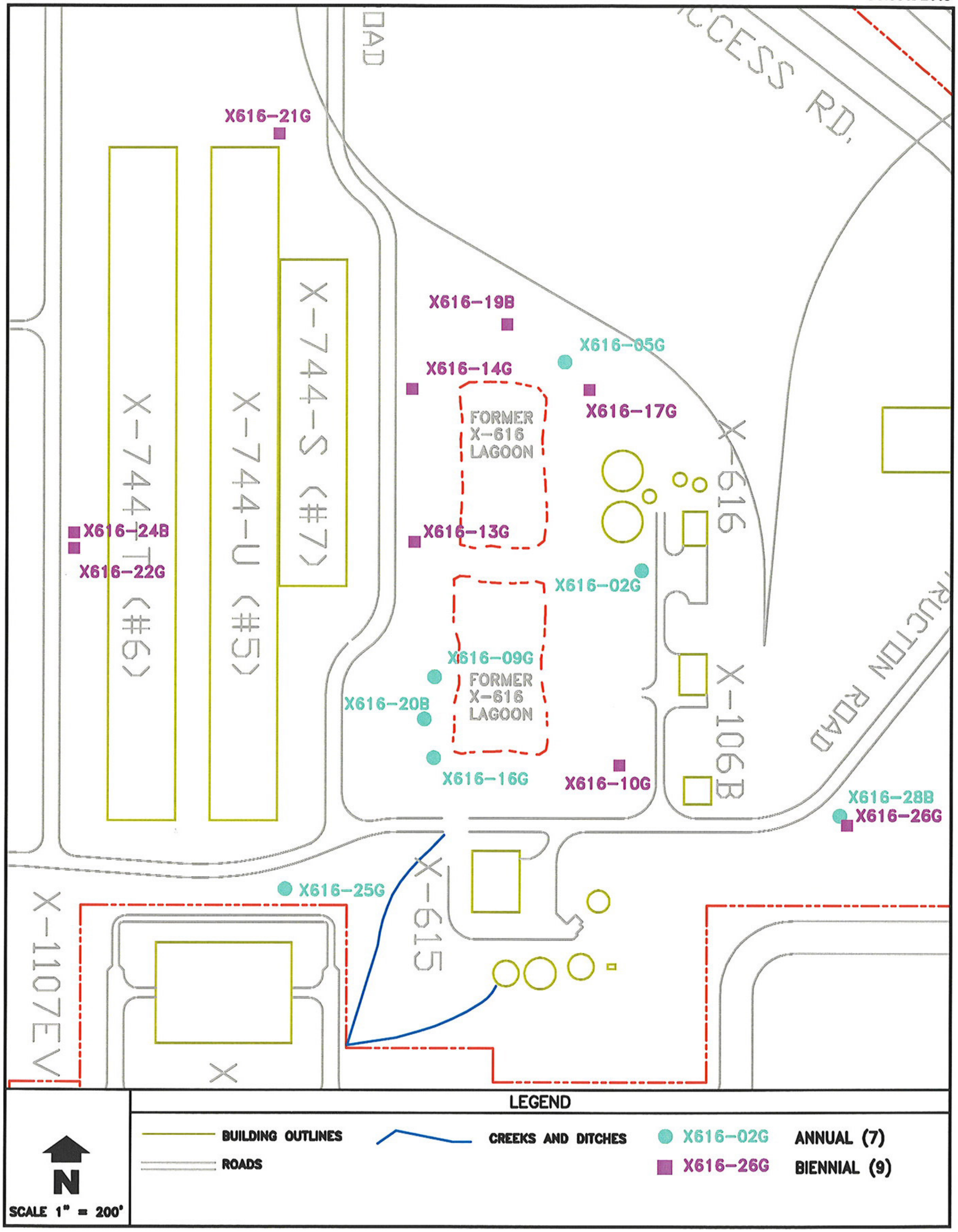

Fig. C-2. Integrated monitoring frequencies X-616 Chromium Sludge Surface Impoundments.

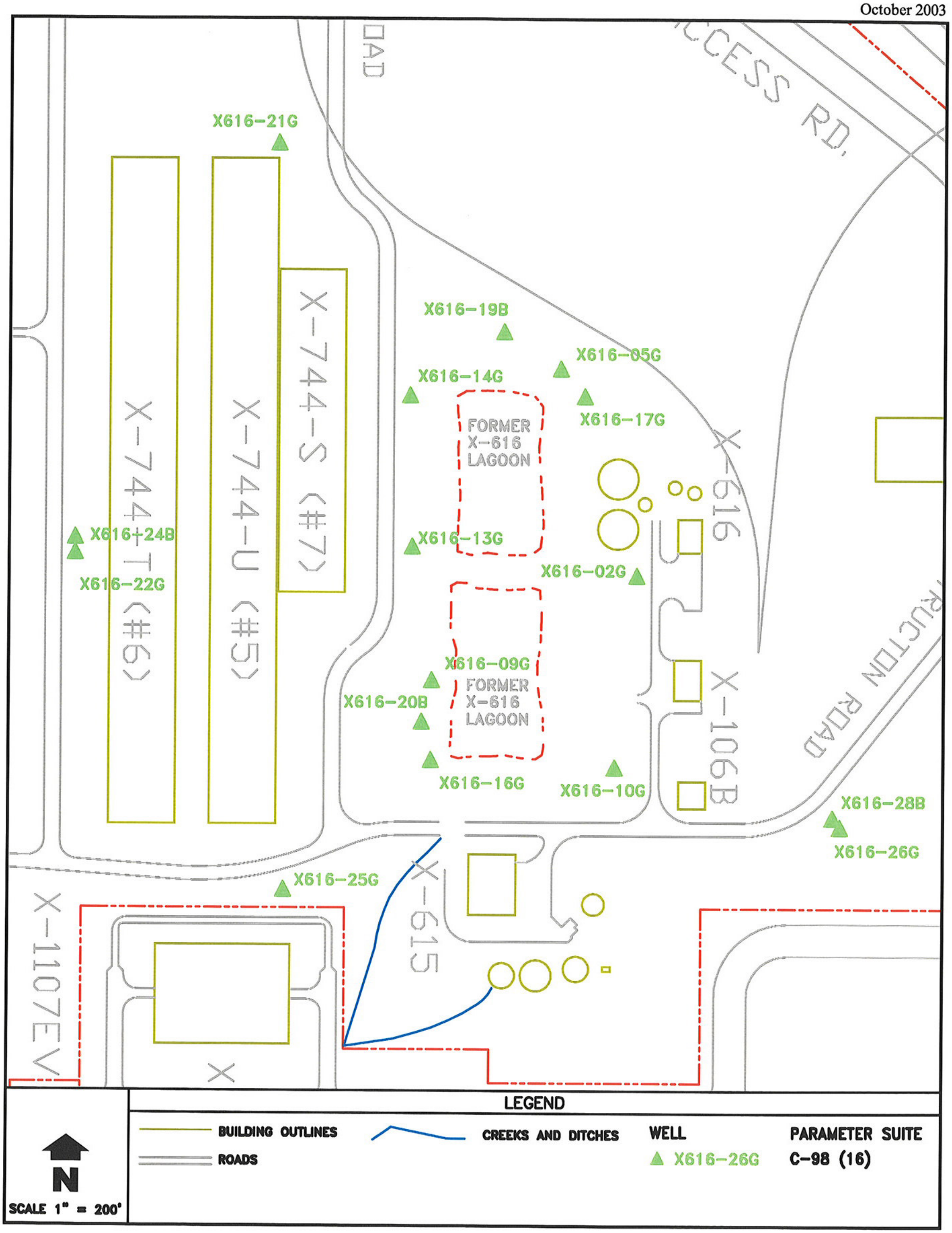

Fig. C-3. Integrated monitoring parameter suites X-616 Chromium Sludge Surface Impoundments.

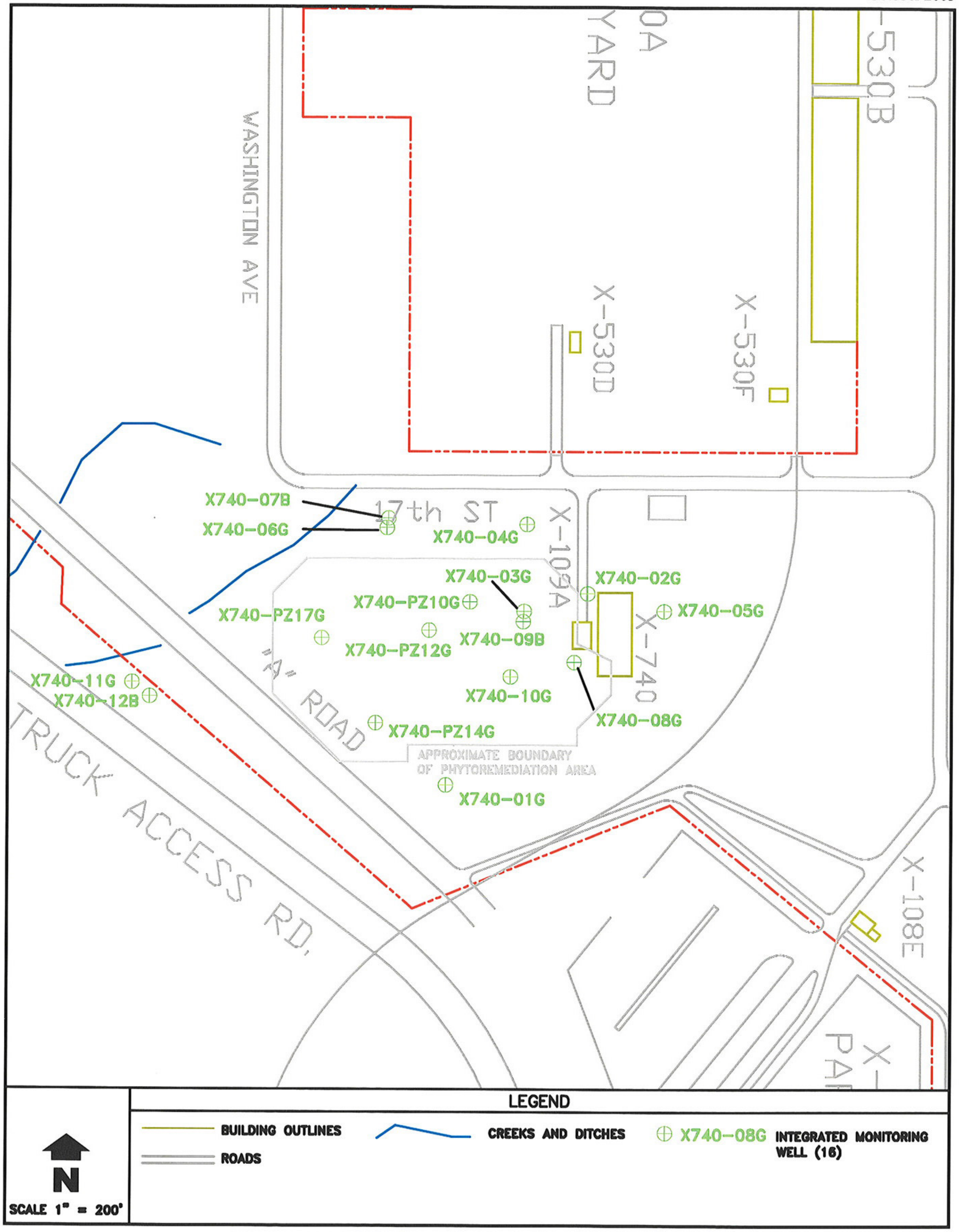

Fig. C-4. Integrated monitoring wells X-740 Waste Oil Handling Facility.

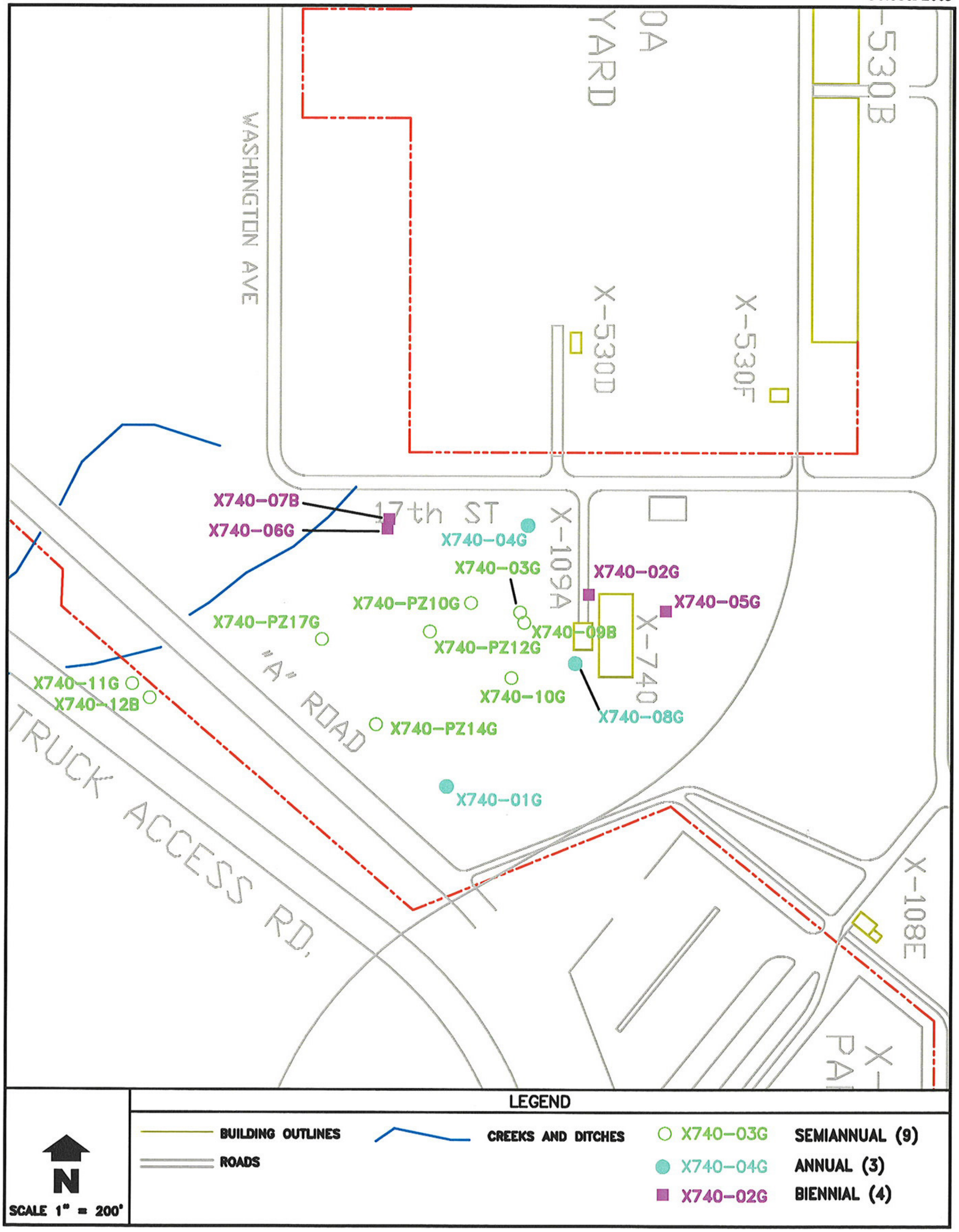

Fig. C-5. Integrated monitoring frequencies X-740 Waste Oil Handling Facility.

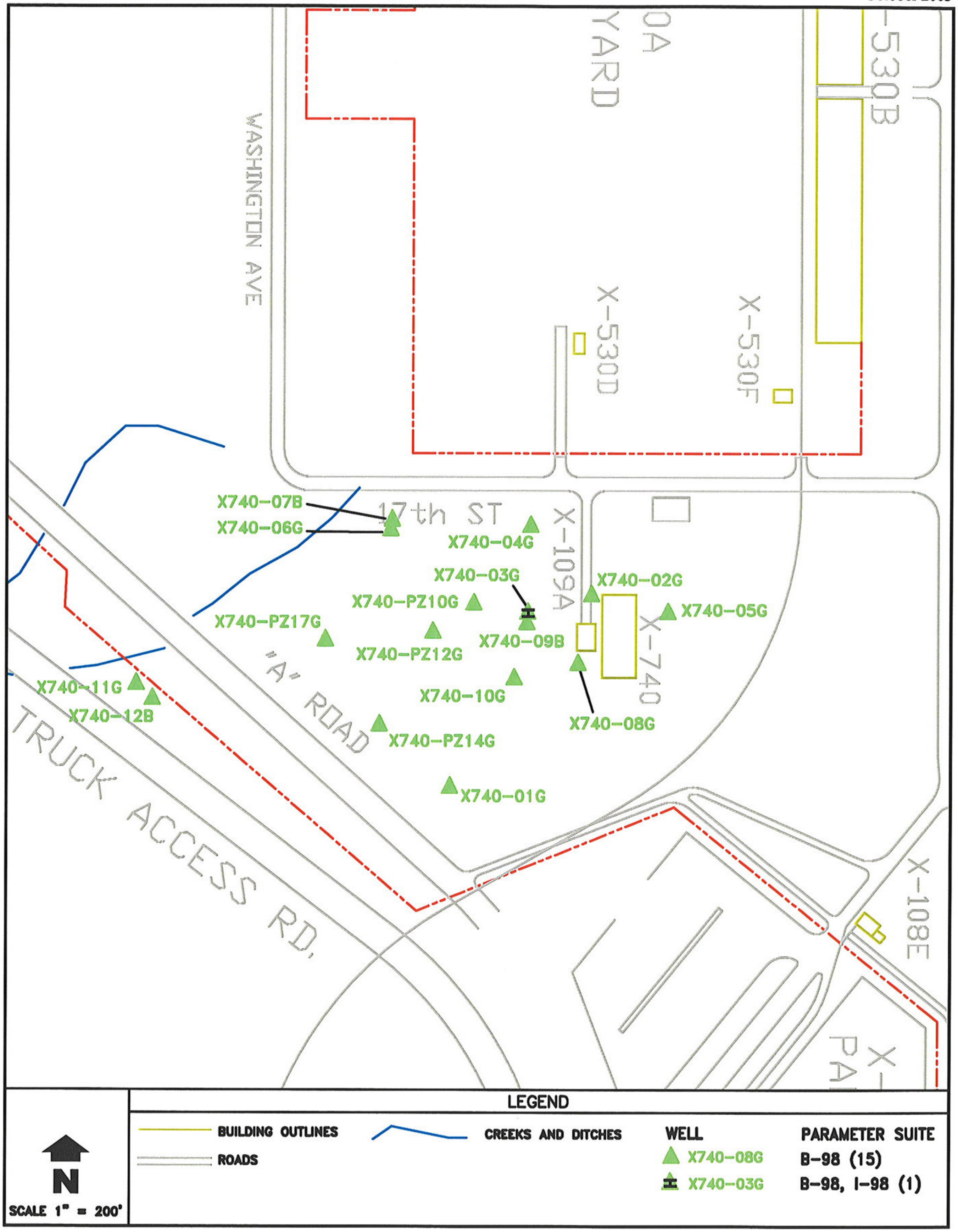

Fig. C-6. Integrated monitoring parameter suites X-740 Waste Oil Handling Facility.

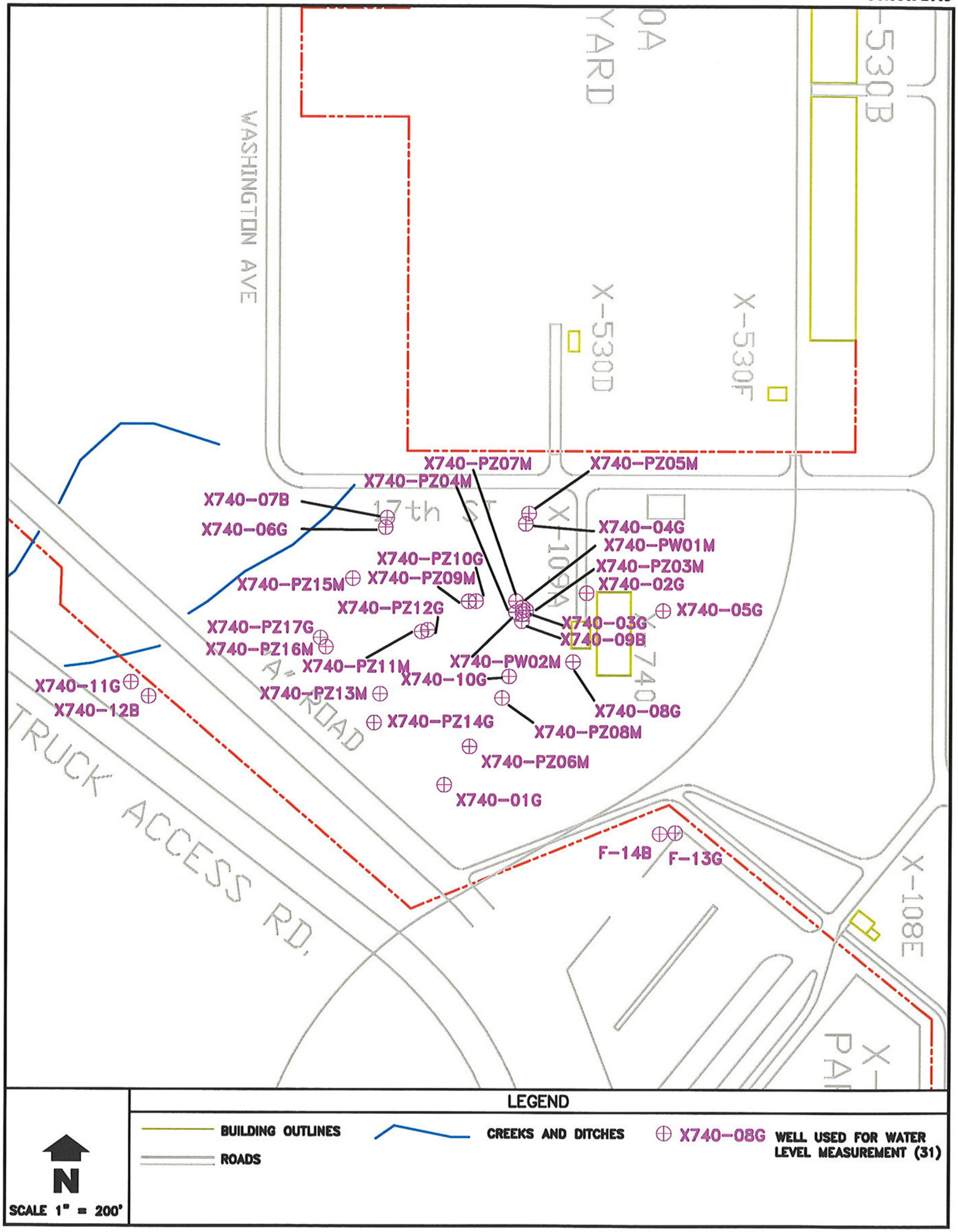

Fig. C-7. Wells used for water level measurements X-740 Waste Oil Handling Facility.

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
F-07G	Monitors unconsolidated material upgradient of X-611A	Semiannual	G-98
F-08B	Monitors Berea upgradient of X-611A	Semiannual	G-98
X611-01B	Monitors Berea downgradient of X-611A	Semiannual	G-98
X611-02B	Monitors Berea downgradient of X-611A	Semiannual	G-98
X611-03G	Monitors unconsolidated material downgradient of X-611A	Semiannual	G-98
X611-04B	Monitors Berea downgradient of X-611A	Semiannual	G-98

Parameter suites are defined in Table 1

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

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters
X735-01GA	Monitors east and upgradient of X-735	Semiannual	E-98, H-98[a, b]
X735-02GA	Monitors north and downgradient of X-735	Semiannual	E-98, H-98[a]
X735-03GA	Monitors west and downgradient of X-735	Semiannual	E-98, H-98[a]
X735-04GA	Monitors west and downgradient of X-735	Semiannual	E-98, H-98[a]
X735-05GA	Monitors southwest and downgradient of X-735	Semiannual	E-98, H-98[a]
X735-06GAA	Monitors south and downgradient of X-735	Semiannual	E-98, H-98[a, b]
X735-13GA	Monitors east and upgradient of X-735	Semiannual	E-98, H-98[a, b]
X735-16B	Monitors Berea sandstone east and upgradient of X-735	Semiannual	E-98, H-98[a, b]
X735-17B	Monitors Berea sandstone north and downgradient of X-735	Semiannual	E-98, H-98[a]
X735-18B	Monitors Berea sandstone west and downgradient of X-735	Semiannual	E-98, H-98[a]
X735-19G	Monitors within the buffer zone between the northern and southern portions of X-735	Semiannual	E-98, H-98[a]
X735-20B	Monitors Berea sandstone within the buffer zone between the northern and southern portions of X-735	Semiannual	E-98, H-98[a]
X735-21G	Monitors west and downgradient of X-735	Semiannual	E-98, H-98[a]
X737-05B	Monitors east and upgradient of X-735	Semiannual	E-98, H-98[a, b]
X737-06G	Monitors east and upgradient of X-735	Semiannual	E-98, H-98[a, b]
X737-07B	Monitors east and upgradient of X-735	Semiannual	E-98, H-98[a, b]
X737-08B	Monitors east and upgradient of X-735	Semiannual	E-98, H-98[a, b]
X737-09G	Monitors east and upgradient of X-735	Semiannual	E-98, H-98[a, b]

Parameter suites are defined in Table 1.
[a]Samples for H-98 parameters will be collected annually. Additional sampling during a given year will be for the E-98 parameters only
[b]Wells are also sampled for cobalt when samples for E-98 parameters are collected.

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

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters
RSY-02B	Monitors Berea upgradient of X-734 Landfills	Semiannual	H-98
X734-01G	Monitors northwest and downgradient of X-734	Semiannual	H-98
X734-02B	Monitors Berea northeast and downgradient of X-734	Semiannual	H-98
X734-03G	Monitors northeast and downgradient of X-734	Semiannual	H-98
X734-04G	Monitors east and downgradient of X-734	Semiannual	H-98
X734-05B	Monitors Berea east and downgradient of X-734A	Semiannual	H-98
X734-06G	Monitors east and downgradient of X-734A	Semiannual	H-98
X734-10G	Monitors east and downgradient of X-734B	Semiannual	H-98
X734-14G	Monitors upgradient of X-734 Landfills	Semiannual	H-98
X734-15G	Monitors southwest and upgradient of X-734/X-734A	Semiannual	H-98
X734-16G	Monitors west of X-734/X-734A	Semiannual	H-98
X734-18G	Monitors west of X-734	Semiannual	H-98
X734-20G	Monitors northeast and downgradient of X-734B	Semiannual	H-98
X734-21B	Monitors Berea northeast and downgradient of X-734B	Semiannual	H-98
X734-22G	Monitors west and upgradient of X-734B	Semiannual	H-98

Parameter suites are defined in Table 1

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

Well ID	Location/purpose	IGWMP sample frequency	IGWMP parameters
F-03G	Monitors downgradient (north) of transformer cleaning pad	Semiannual	L-00
X533-03G	Monitors near northwest corner of X-533A Switchyard	Semiannual	L-00
TCP-01G	Monitors adjacent to transformer cleaning pad	Semiannual	L-00

Parameter suites are defined in Table 1

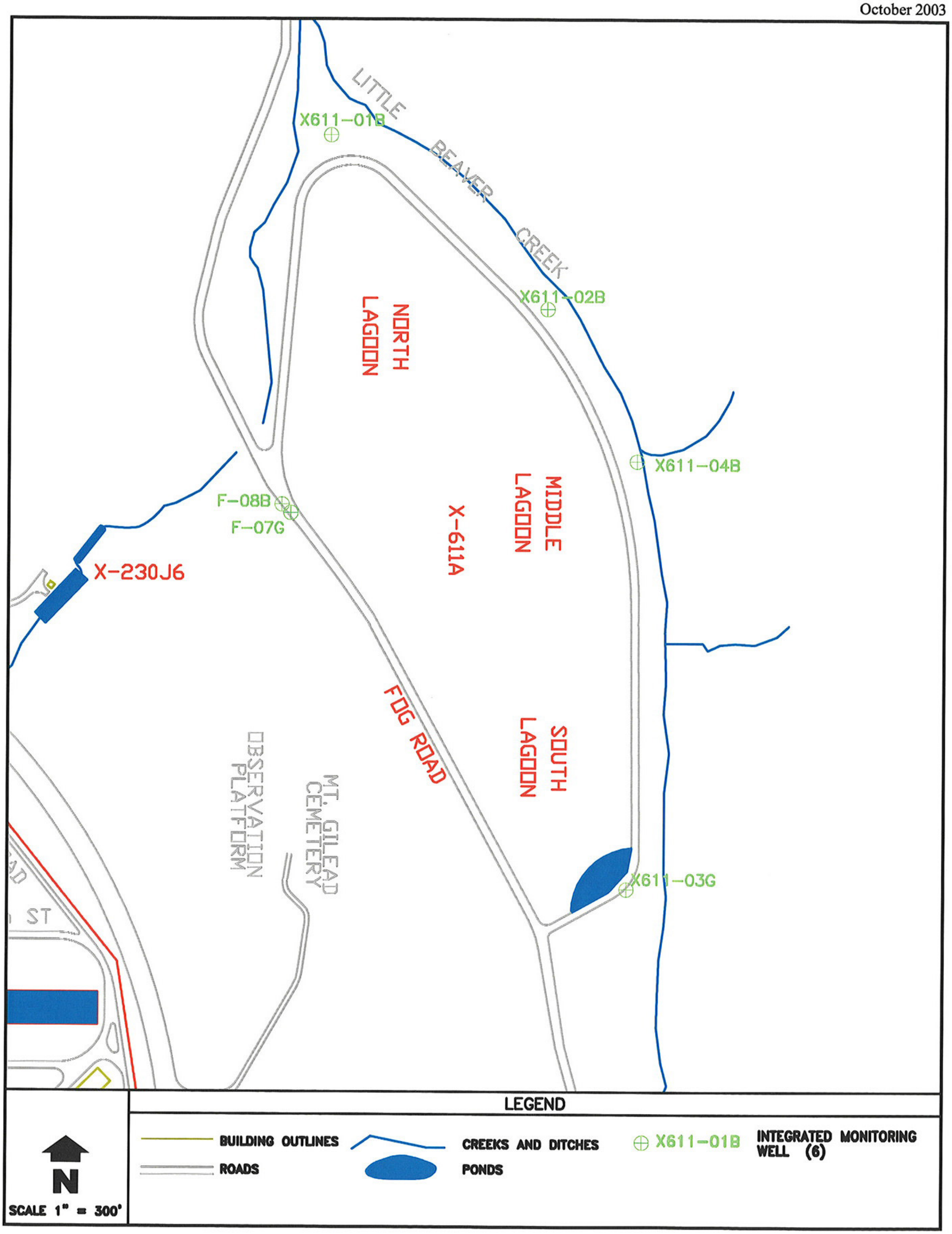

Fig. D-1. Integrated monitoring wells X-611A Former Lime Sludge Lagoons.

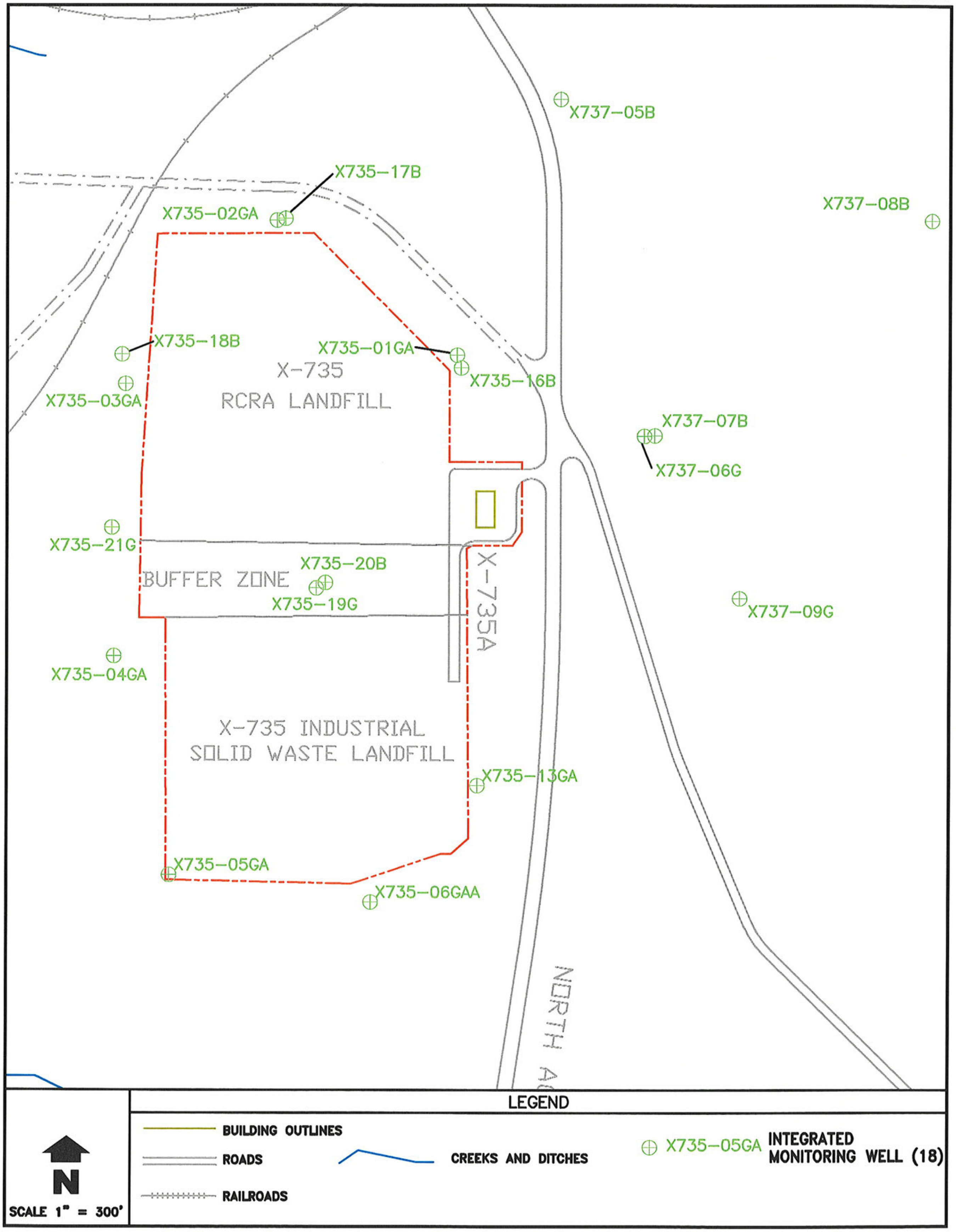

Fig. D-2. Integrated monitoring wells X-735 Landfills.

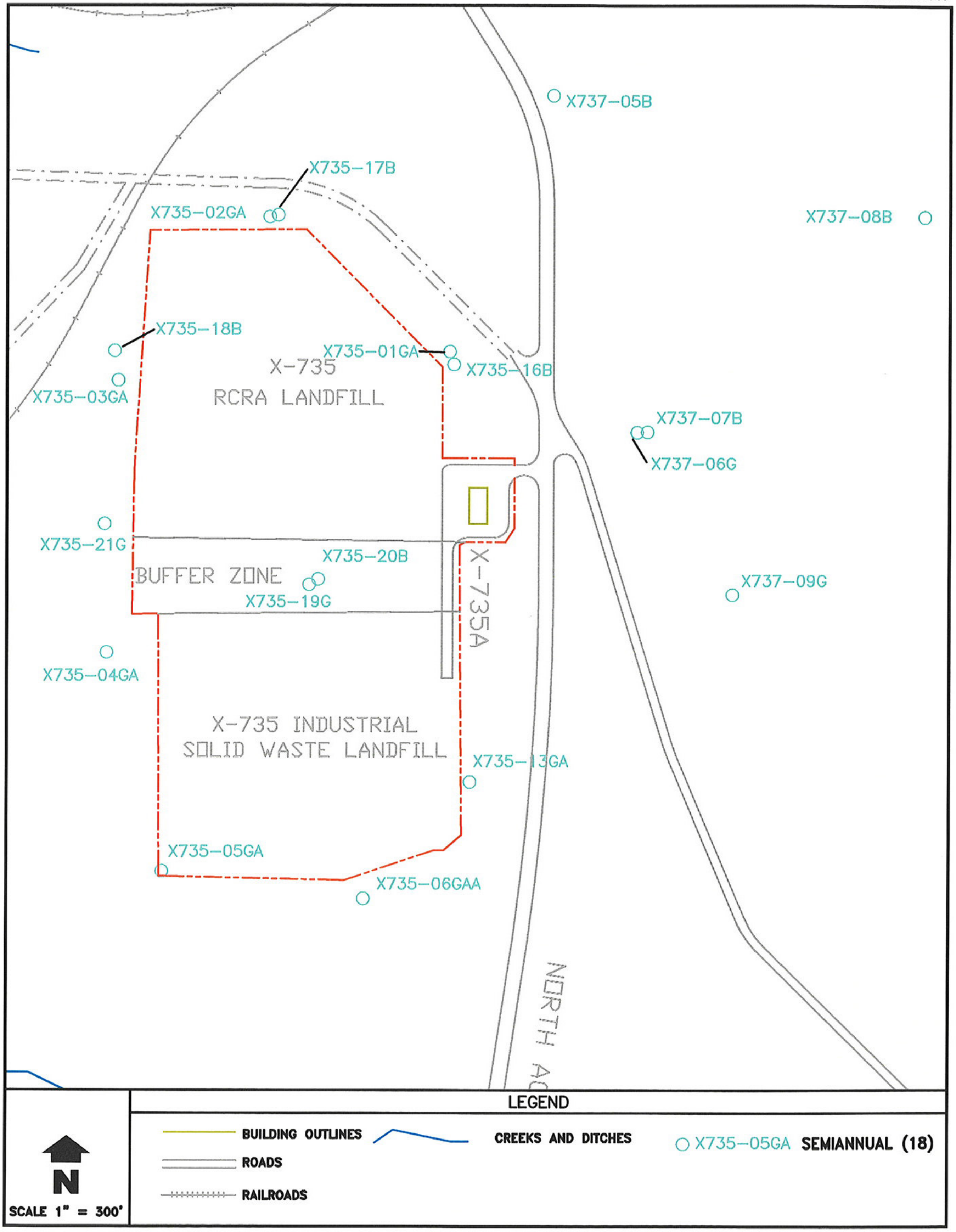

Fig. D-3. Integrated monitoring frequencies X-735 Landfills.

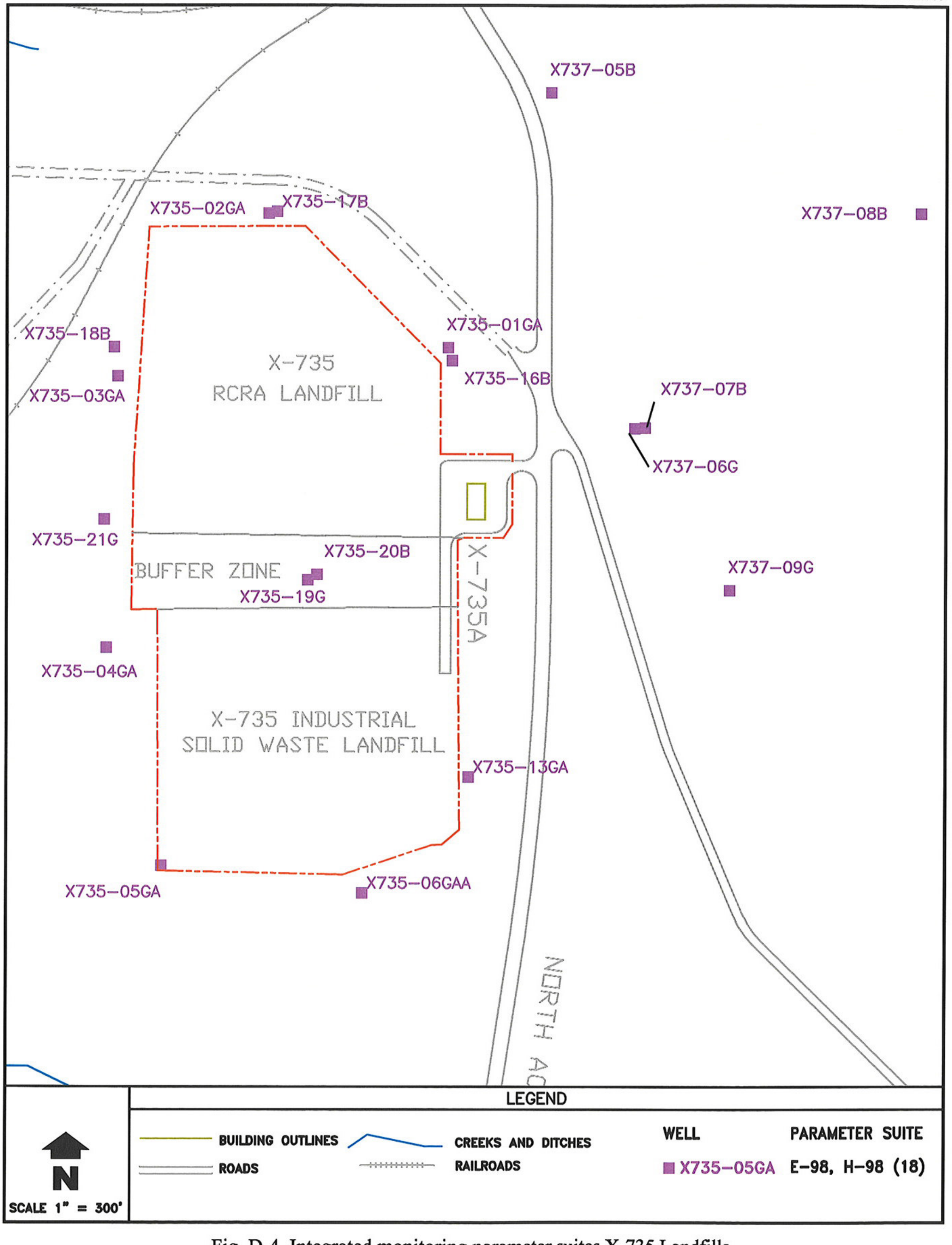

Fig. D-4. Integrated monitoring parameter suites X-735 Landfills.

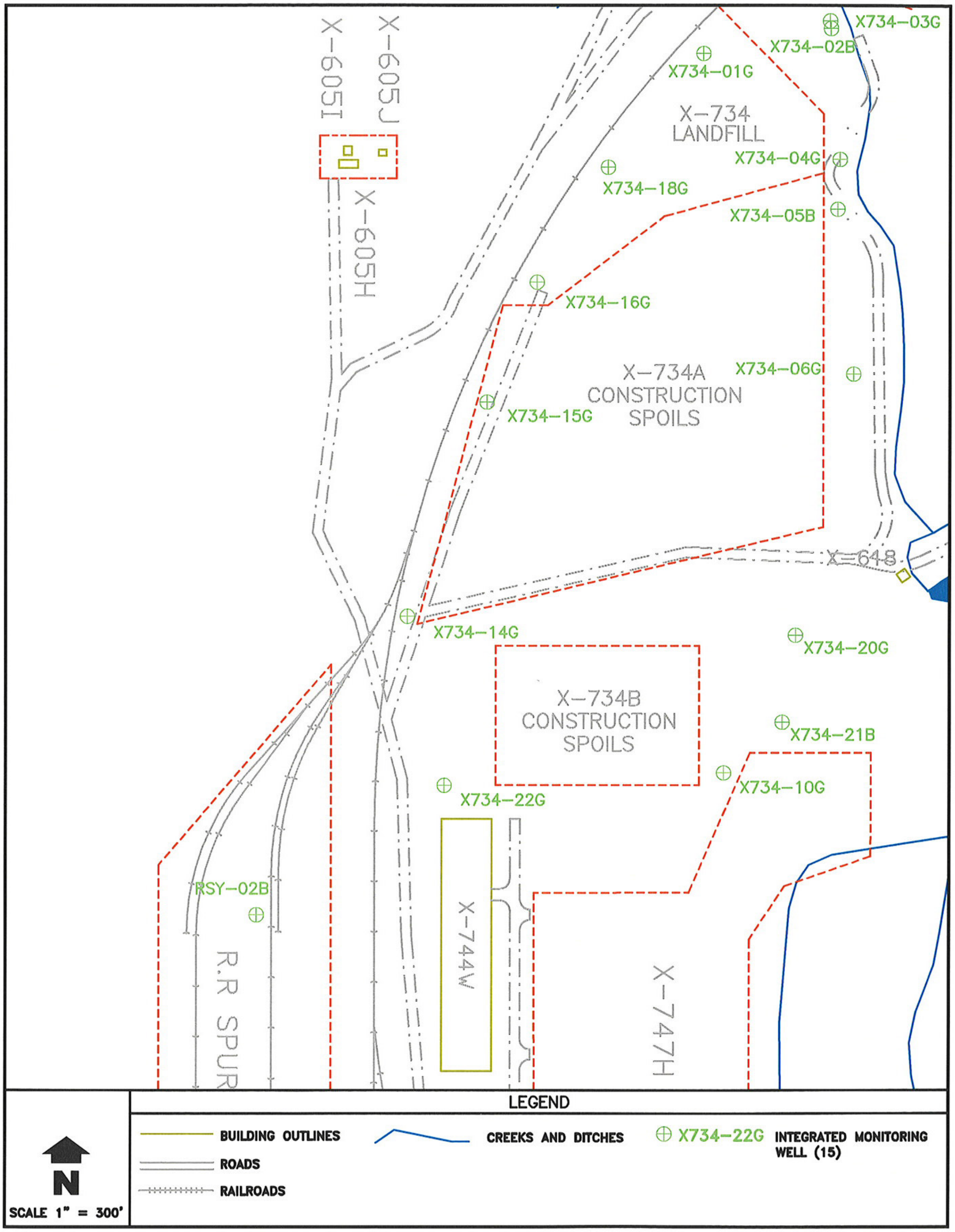

Fig. D-5. Integrated monitoring wells X-734 Landfills.

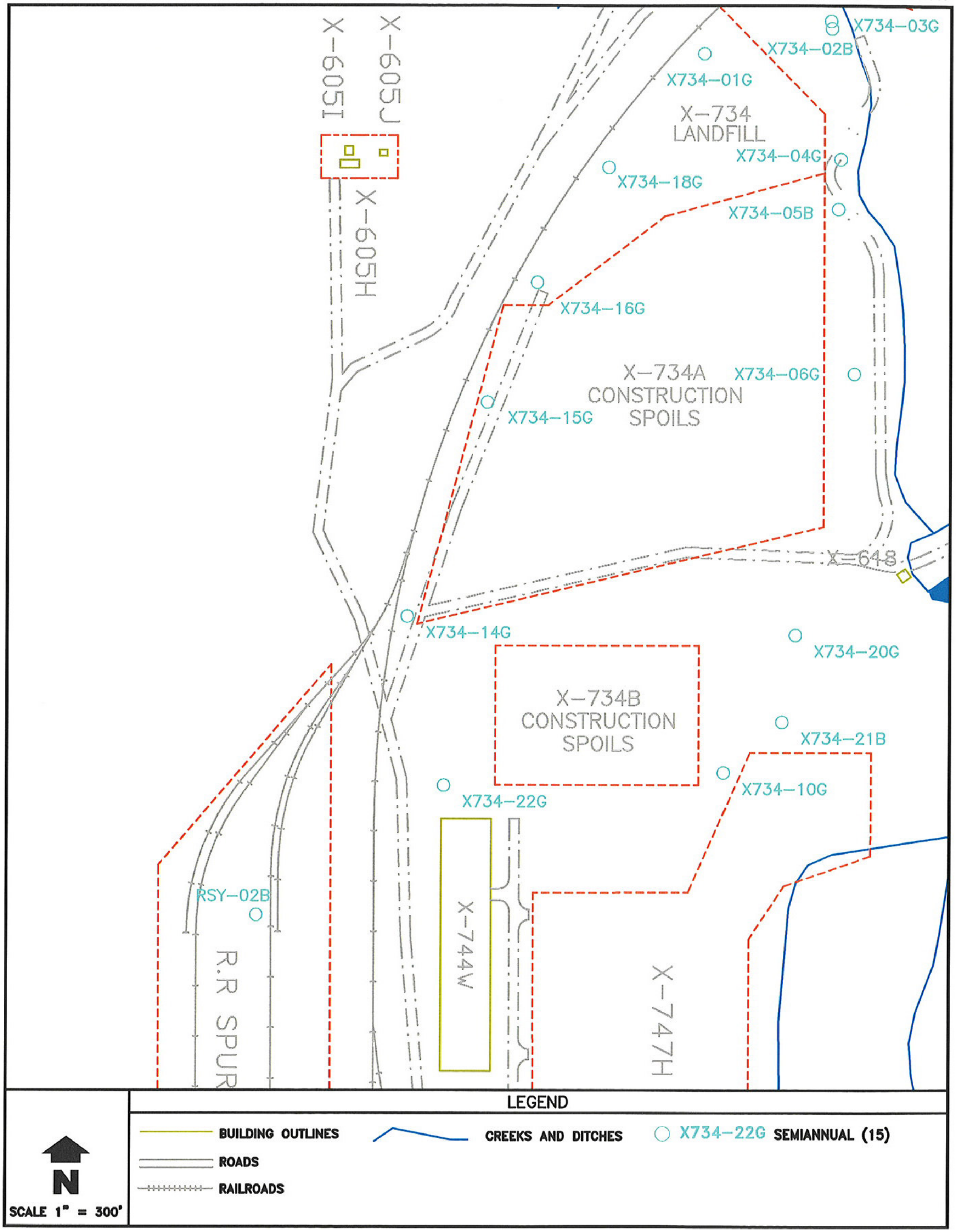

Fig. D-6. Integrated monitoring frequencies X-734 Landfills.

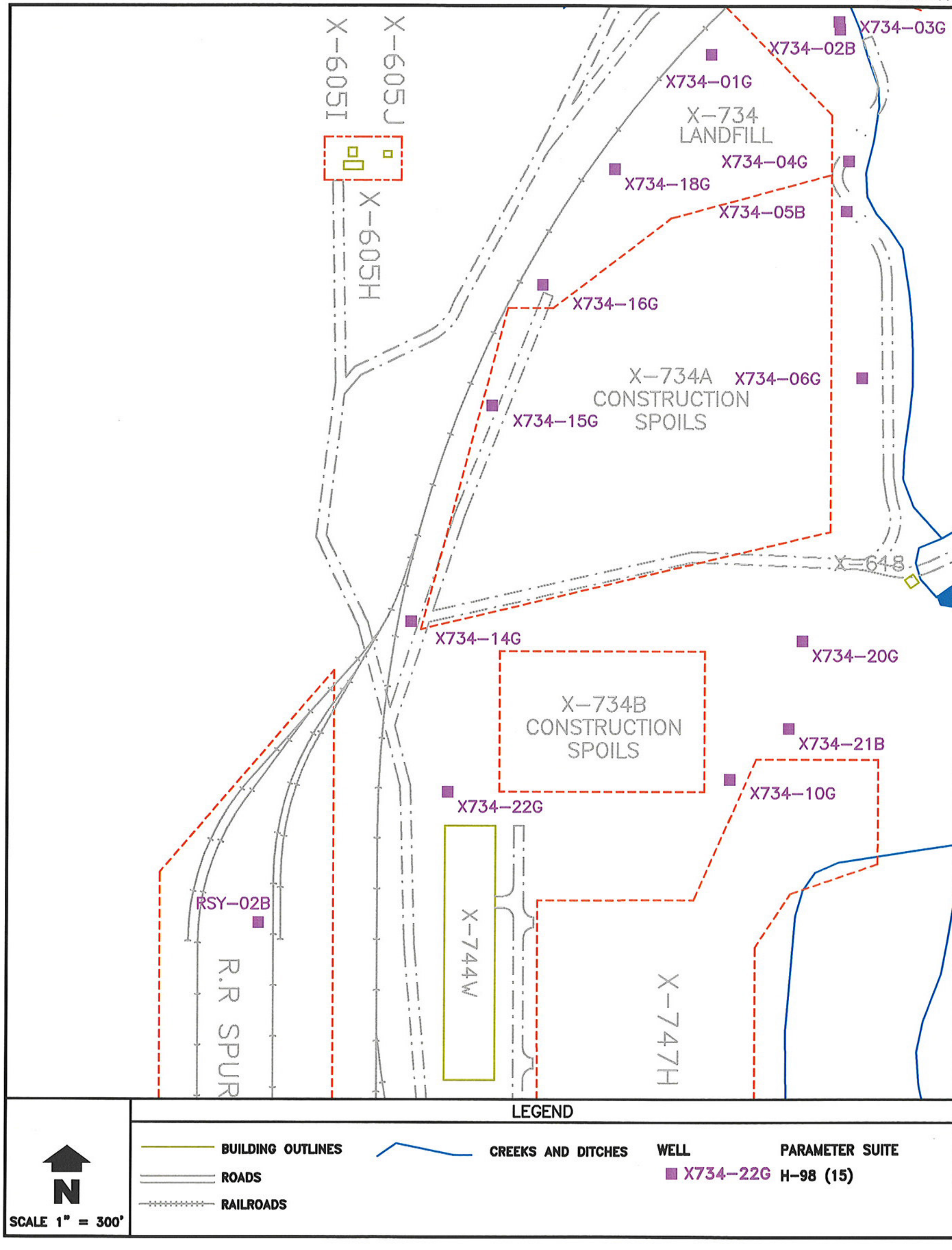

Fig. D-7. Integrated monitoring parameter suites X-734 Landfills.

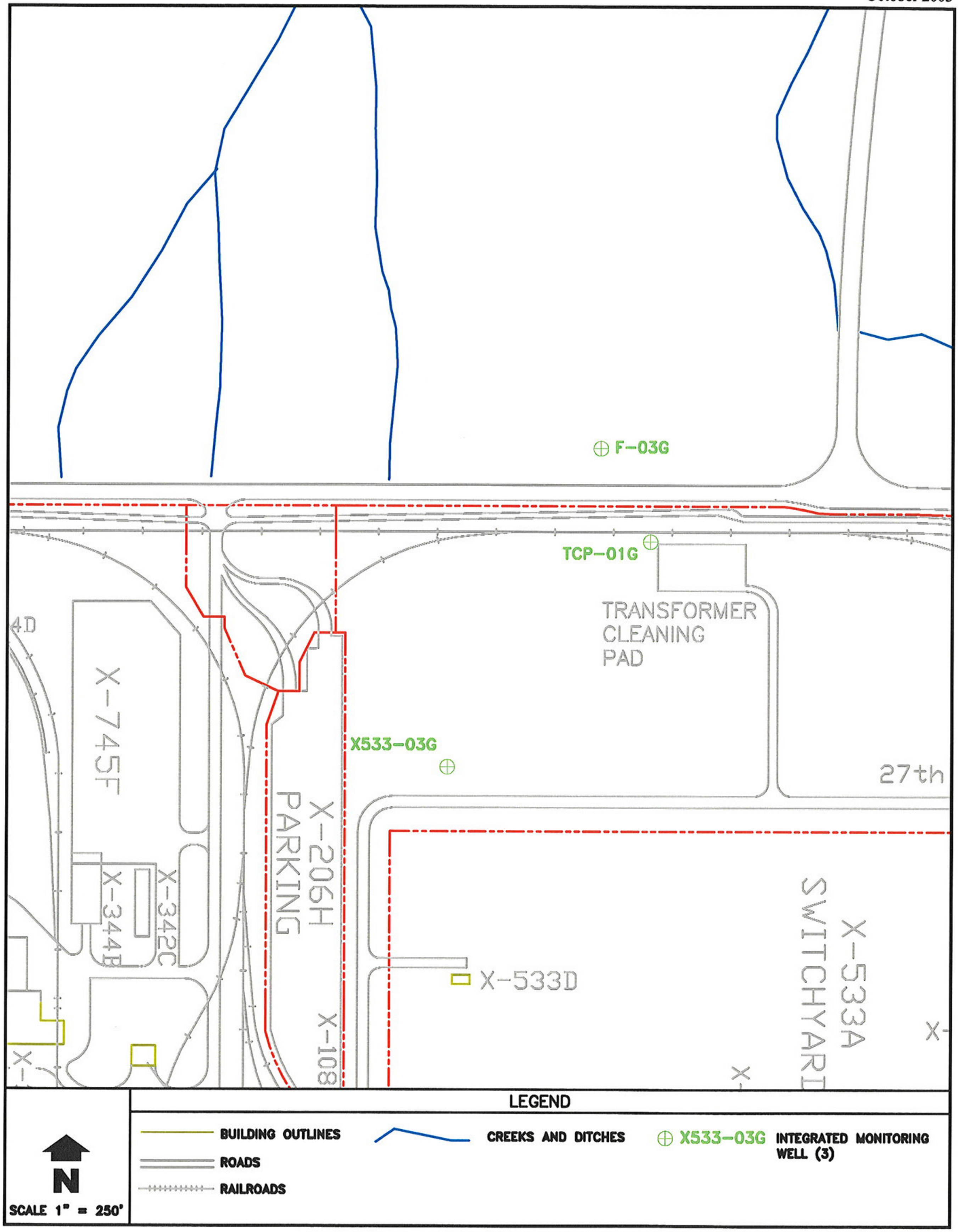

Fig. D-8. Integrated monitoring wells X-533 Switchyard Area.

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
BRC-SW01	Quarterly	B-98
BRC-SW02	Quarterly	B-98
BRC-SW03	Quarterly (CMP monitoring only)	B-98
BRC-SW04	Quarterly (CMP monitoring only)	B-98
EDD-SW01	Quarterly	B-98
LBC-SW01	Quarterly	B-98
LBC-SW02	Quarterly	B-98
LBC-SW03	Quarterly	B-98
LBC-SW04	Quarterly	B-98
NHP-SW01	Quarterly	B-98
UND-SW01	Quarterly	B-98
UND-SW02	Quarterly	B-98
WDD-SW01	Quarterly	B-98
WDD-SW02	Quarterly	B-98
WDD-SW03	Quarterly	B-98

Parameter suites are defined in Table 1

Table E-2. Water supply monitoring summary

Location ID	Location	IGWMP sample frequency	IGWMP parameters
RES-002	4564 U.S. Route 23 South	Semiannual	B-98
RES-004	64 Bailey Chapel Road (old well)	Semiannual	B-98
RES-005	64 Bailey Chapel Road (new well)	Semiannual	B-98
RES-010	6756 St. Rt. 104	Semiannual	B-98
RES-012	PORTS plant water supply	Semiannual	B-98
RES-014	884 Wakefield Mound Road	Semiannual	B-98
RES-015	22060 State Route 124	Semiannual	B-98
RES-016	4744 Wakefield Mound Road	Semiannual	B-98

Parameter suites are defined in Table 1.
Missing numbers represent sites no longer in the program.

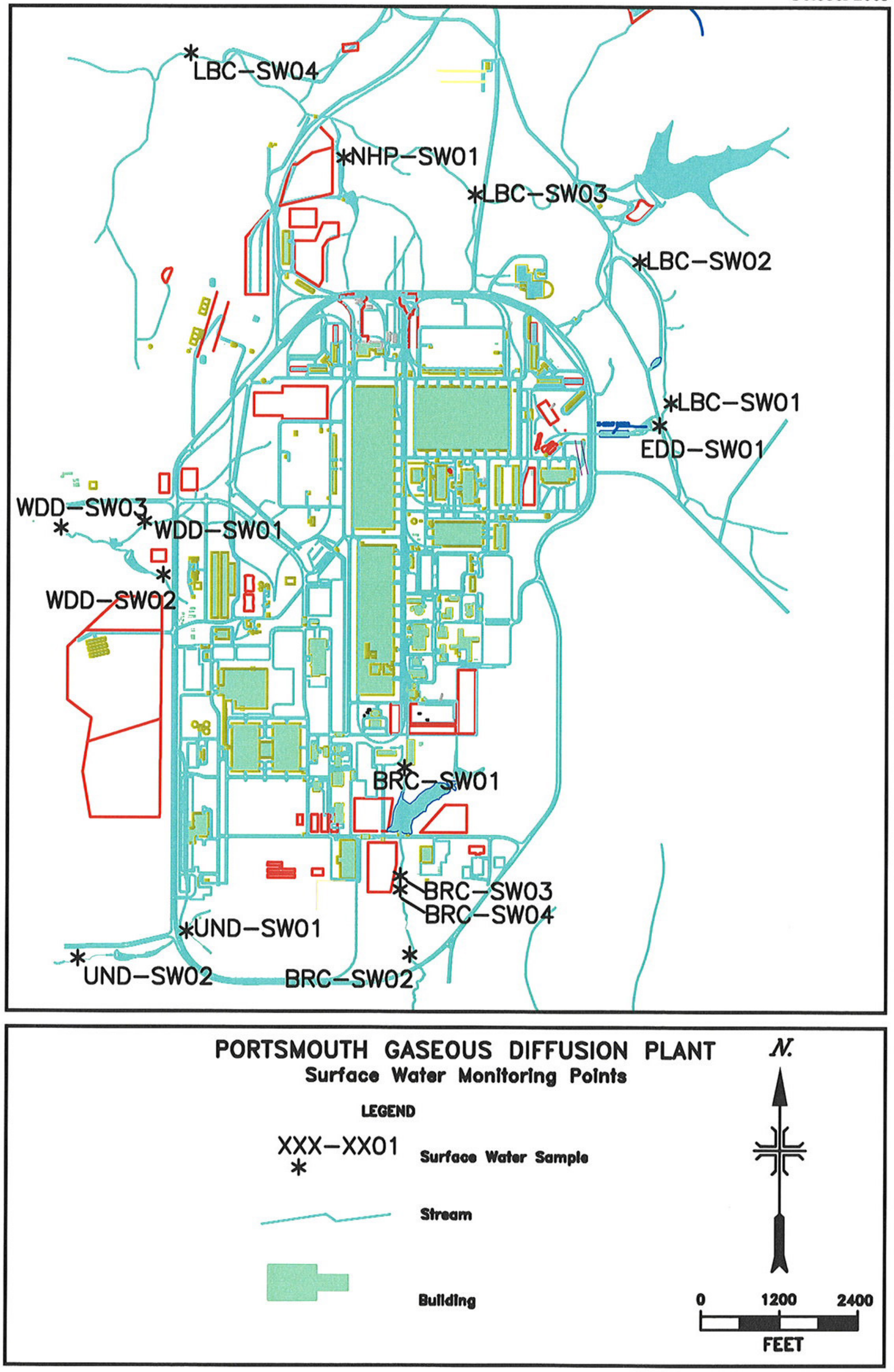

Fig. E-1. Integrated surface water monitoring points.

APPENDIX F

PROCEDURES

Procedure Number	Title	Date	Revision
PORTS GWS 004	Collection of Groundwater Samples	09/16/03	1
PORTS GWS 005	Monitoring Well and Piezometer Inspection	05/23/00	0
PORTS GWS 006	Decontamination of Sampling Equipment	05/23/00	0
PORTS GWS 007	Conducting Field Measurements	01/19/01	0
PORTS GWS 008	Residential Water Supply Sampling	12/27/01	1

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Prepared: Wendy Stewart

Technical Review: Marc Sheridan

Issued: [signature] 11/10/03
Signature/date

Approved: [signature] 11/10/03
Signature/date

1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to define the techniques and the requirements for collecting groundwater samples.

2.0 BACKGROUND

2.1 Definitions

AC- Alternating current

Bladder Pump-An air-activated, positive-displacement pump consisting of a bladder inside a stainless steel or plastic housing.

Buffer Solution-A chemical standard to verify the accuracy of an instrument such as a pH meter.

Casing-A section of the well consisting of a solid (typically joined) pipe that extends from the top of the well screen to the top of the well. The casing helps prevent possible surface contaminants from entering the well.

Chain of Custody (COC)-Method for documenting the history and possession of a sample from the time of its collection through analysis.

Conductivity Meter-An instrument for the measurement of specific conductance in liquids.

Conventional Purging-Purging a well to remove stagnant water by removing at least 3 to 5 well volumes of water from the well until the remaining water is representative of the formation water, or purging the well "dry" and then sampling after the parameters have stabilized or after the well has gone "dry".

Decontaminated Container or Equipment-Container or equipment that has been decontaminated in accordance with PORTS GWS 006 "Decontamination of Sampling Equipment".

Dedicated Equipment-Equipment that is reserved for use in only one monitoring well and is normally left in place.

DNAPL-Dense, Non-Aqueous Phase Liquid

DOE-Department of Energy

EPA-Environmental Protection Agency

Equipment Rinseate Blank-Sample of deionized, ultra-filtered water that has been passed through and over sampling equipment that has been decontaminated. The samples are analyzed for the same analytes as the regular groundwater sample. An equipment rinseate is collected to verify that decontamination is effective by detecting potential cross contamination.

Field Blank-A sample of deionized, ultra-filtered water that has been collected (bottled and preserved) in the field. The samples are analyzed for the same analytes as the regular groundwater sample. A field blank is collected to determine if field conditions have adversely affected sample collection at a given location and for a given collection method.

Field Parameters-Groundwater is typically analyzed for pH, specific conductance, temperature, dissolved oxygen, and turbidity while in the field; each measurement (parameter) is used to determine if the water quality has stabilized and is representative of the formation water

Field Replicate-An additional set of samples (same analytes) collected from the same sampling point. Field Replicate samples are used for quality control purposes.

GFCI-Ground Fault Circuit Interrupter

IGWMP-Portsmouth Gaseous Diffusion Plant "Integrated Groundwater Monitoring Plan"

Headspace-The space above the sample and below the container lid in a sample container.

LNAPL-Light, Non-Aqueous Phase Liquid

mL-milliliter

Micro purge (slow flow/low volume purging)-Pumping a well from the well screen at a flow rate below the recharge capacity of the formation. The specific rate of pumping is generally aquifer dependant, but typically does not exceed one liter per minute (or equivalently, 0.26 gallons per minute). By purging at low flow rates, only ground water that enters through the well screen is purged from the well. Because stagnant water located above the pump intake in the well casing is not drawn into the pump, the casing volume would not have to be purged from the well prior to sampling.

µS/cm-MicroSiemens per centimeter; the unit of measurement of specific conductance.

NAPL-Non-Aqueous Phase Liquid

NTU-Nephelometric Turbidity Unit; the unit of measurement for turbidity.

PCB-Polychlorinated Biphenyl

Peristaltic Pump-A portable pump that applies a moving, rolling external force along a silicon tube to form a vacuum inside the tube to pump fluids

pH-A measure of the acidity or basicity of a solution; the negative logarithm of the hydrogen ion concentration expressed in gram moles per liter. Its values are given in standard units (S.U.), where a value of 7 S.U. represents a neutral solution. A value less than 7 S.U. indicates an acidic solution, while a value greater than 7 S.U. indicates a basic solution. pH values range from 1 to 14.

pH meter-An instrument for the measurement of the acidity or basicity of a solution.

PID-Photoionization Detector

PORTS-Portsmouth Gaseous Diffusion Plant

PPE-Personal Protective Equipment

ppm-Parts Per Million (μg/L)

Pre-cleaned Container-Sample containers cleaned by the analytical laboratory or vendor according to specified protocols prior to shipment to PORTS.

QC-Quality Control

Radiation Meter-An instrument for the detection of alpha, beta, and/or gamma radiation.

RCRA-Resource Conservation and Recovery Act

RFD-Request For Disposal

Specific Conductance-Measure of a material's ability to conduct electric current, the reciprocal of resistivity; it reflects the ion content of a solution.

S.U.-Standard Unit; the unit of measurement for pH.

Standardization-Comparison of measurement devices against reference standards of known and documented intensity, concentration, length, etc., to detect and quantify inaccuracies or maintain calibration.

SVOC-Semi-volatile Organic Compound

Tap water-Potable water obtained from the PORTS water supply.

TOC-Total Organic Carbon

TOX-Total Organic Halogen

Trip blank-Samples consisting of 40-mL volatile organic analysis (VOA) vials of deionized, ultra-filtered water that are filled in the sample container preparation work space (field laboratory), taken with the sample containers to the sampling location, placed in the same transportation containers (usually coolers) as groundwater samples to be analyzed for VOCs, and transported with the groundwater samples to the sample analysis laboratory. Trip blanks are QC samples used to help detect cross-contamination of samples.

Turbidity-A measure of the relative clarity of water. It is measured in nephelometric turbidity units (NTUs). Lack of clarity is caused by the presence of suspended particles (such as clay, silt, particulate organic or inorganic matter, and/or dissolved organic matter).

VOA-Volatile Organic Analysis

VOC-Volatile Organic Compound

VOX-Volatile Organic Halogen

2.2 Discussion

This procedure provides protocols to:

1. Prepare to sample groundwater monitoring wells/piezometers, including requirements for notification, documentation, and equipment/sample container preparation.
2. Collect samples from groundwater monitoring wells/piezometers that are representative of the formation water and are suitable for various specified chemical and radiological analysis.

2.3 Associated Procedures

- PORTS GWS 006 "Decontamination of Sampling Equipment"
- PORTS GWS 007 "Conducting Field Measurements"

2.4 Associated Activity Hazard Analyses

- Air Compressor
- Bladder Pump
- Generator
- Groundwater Sampling
- Loading and Unloading Equipment
- Motor Vehicle
- Ready Flow Pump
- Sampling Preservation
- Site Setup

3.0 RESPONSIBILITIES

Site Manager – The Site Manager (or designated alternate) is responsible for ensuring that sampling efforts are conducted in accordance with this procedure and any other SOPs pertaining to specific media sampling.

Field Team Leader – The Field Team Leader is responsible for ensuring that field personnel collect groundwater samples in accordance with this and other relevant procedures.

Field Personnel – The Field Personnel are responsible for understanding and following this procedure.

4.0 REQUIRED EQUIPMENT

All or part of the equipment listed may be required at any specific site depending on the plans for that site:

Decontamination Supplies

- Brushes
- Buckets, pans, or tubs
- Liquid waste containers
- Plastic wrap
- Deionized, ultra-filtered water
- Laboratory grade detergent (Liquinox™)
- Squeeze bottles

Forms

- Chain-of-Custody

- Well Sampling Log Sheet

Instruments
- Conductivity
- pH meter
- PID
- Radiation meter
- Thermometer (2) °C
- Turbidity meter
- Dissolved Oxygen meter
- Water Level Indicator

Miscellaneous
- Crescent wrench
- Hammer
- Large screw driver
- Paper towels
- Waterproof Pens
- Plastic bags
- Radio

Personal Protective Equipment
- Shoe covers (as necessary)
- Eye protection including side shields
- Gloves – nitrile or latex (powder free)
- Laboratory apron or coat

Sampling Equipment
- Peristaltic Pump
- Bladder pump supplies
  - Hoses
  - Plastic tubing
  - Controller
  - Air pressure supply
- Bailer
- Rope

Sampling Supplies
- Containers as required by analysis for sampling location
- Cooler with ice packs
- Bottle labels

Standardization Media
- Certified pH 4 buffer solution
- Certified pH 7 buffer solution
- Certified pH 10 buffer solution
- Certified Conductivity Standard Solution

Waste Management Supplies
- Bung wrench

- Liquid waste containers
- Funnel
- Labels: Hazardous and Non-regulated waste labels
- Plastic bags

5.0 PROCEDURES

5.1 Preparation

The steps listed below shall be followed when preparing for sample collection:

1. The Statement of Work or Sampling and Analysis Plan must be reviewed by the Environmental Sampler prior to starting work.
2. All non-dedicated sampling equipment must be decontaminated in accordance with PORTS GWS 006.
3. Historical data for the sampling location (if available) should be in hand.
4. Sampling shall be coordinated with the analytical laboratory. The laboratory must agree to accept and analyze the samples within specified holding times in advance of sampling.

5.1.1 Sampling Well Location

1. Record all appropriate information in the following steps on the Well Sampling Log. An example of a Well Sampling Log is provided in Appendix A.
2. Identify well(s) to be sampled.
3. Obtain well construction information including well depth and diameter, if available.
4. Obtain historical well information, if available, including:
   - Water levels
   - Temperature
   - pH
   - Specific Conductance measurements
   - Flow recharge information
   - Analytical data
   - Turbidity
   - Amount of purge water generated
   - Status of solid and liquid waste generated (hazardous or non-hazardous)
   - Presence or suspected presence of a non-aqueous phase liquid (NAPL) layer

5.1.2 Waste Management

1. Identify how purge water, excess sample water, and other wastes are to be managed by consulting the approved generator's Waste Management Plan.
2. Obtain containers, labels, and other supplies, as appropriate.

5.1.3 Field Quality Control Samples

1. Identify required field quality control (QC) samples and record this information on the Field Log sheet.

5.1.4 Sample Container Preparation

1. Select appropriate containers as specified by the analytical method, lab agreement, or laboratory manager.
2. If sample preservation is required, then, wear the following protective clothing:

- A protective laboratory apron or coat
- Eye protection with side shields
- Nitrile surgical gloves; butyl, natural rubber, neoprene rubber, polyethylene, polyvinyl chloride, Teflon™, or 4H™ gloves may also be worn.

3. Gather required acids and bases, dropper or acid dispenser, neutralizing material, and sample containers and place them in the fume hood in X-7725.
4. Ensure that emergency eyewash is available near the X-7725 fume hood.
5. Add preservatives to the sample containers in the X-7725 fume hood.
6. Tightly secure the sample lid. If the container has a septum lid, then ensure that the septum is on the bottle squarely and the lid is secured to prevent leakage.
7. Using a paper towel, wipe any preservative from the outside of the sample containers.
8. Disperse neutralizing material on any spilled preservative.
9. Affix sample labels or tags to sample containers prior to filling the container.
10. Fill in labels with black indelible ink, and include the following information:
    - Unique field study or sampling activity name and /or number
    - Unique sample number
    - Sample location or appropriate identification as given in the sampling program
    - Sampling date
    - Sampling time (optional)
    - Sample preservation used
    - Analyses to be preformed

    (When PEMS labels are used, only the date and samplers' initials are required.)

5.1.5 Equipment Preparation

1. Prepare sample coolers (add ice or "blue ice" as required).
2. Standardize field parameter measuring equipment in accordance with PORTS GWS 007 "Conducting Field Measurements".
3. Verify that all necessary supplies and equipment are available in sufficient quantities.
4. Obtain vehicle(s), load equipment and supplies, and proceed to sampling location.

5.1.6 Field Preparation

1. Record the following well location information on the Well Sampling Log:
    - Well location number
    - Date
    - Time
    - Weather
    - Other activities taking place in the vicinity of the well that might affect the sample
    - Background radiological and photoionization detector (PID) readings at well location
    - Radiological and PID reading around the well head
    - Any other pertinent well-specific information
2. Place plastic sheeting (or other protective material) near well and work area, if necessary. Plastic sheeting is only necessary for well purging with a bailer (or other non-dedicated purge methods) or if conditions warrant it for cleanliness (i.e. it is NOT required when only water level measurements are to be taken)
3. Unlock and open the well.
4. Take and record radiological and PID readings in the breathing zone. If the PID reading is greater than 10 parts per million (ppm), then contact the Health and Safety Officer It may be necessary to don a full-face respirator fitted with organic cartridges.
5. Take and record radiological and PID readings in the well casing.

6. Record the condition of the well on the Well Sampling Log.

5.2 Measurement of Water Levels and Other Parameters

The following general steps shall be followed when measuring the water level and other parameters:

5.2.1 Water Level Measurement

1. Don clean protective gloves, and eye protection with side shields.
2. Locate the reference mark, if visible, at the top of the well's inner casing. In wells containing dedicated bladder pumps, the reference mark has been covered over. If no reference mark can be found, then use the north side of the inner casing as a reference mark. If the reference mark has been covered over, then use the lower edge (underside) of the hole in the well cap as the reference mark.
3. Make sure the cap is flush on TOP of the casing. Care should be taken to avoid scraping the cord and probe on the side of the well.
4. Using historical water level for the well as a guide, lower the probe into the well.
5. Obtain the water level measurement in accordance with manufacturer's instructions for the instrument.
6. Repeat the water level measurement until it is constant.
7. Record the measurement on the Well Sampling Log to the nearest 0.01 foot.

5.2.2 NAPL Layer Detection

1. Follow steps 1 through 3 in 5.2.1 Water Level Measurement.
2. Using the historical well data as a guide to determine the approximate location of the NAPL Layer, lower the probe into the well.
3. Detect the NAPL layer in accordance with manufacturer's instructions for the instrument.
4. Repeat the measurement until it is constant.
5. Record the measurement in the Well Sampling Log.

5.2.3 NAPL Layer Detection Using a Transparent Bailer

1. Don PPE including gloves and eye protection with side shields.
2. Remove bailer from the protective covering, ensuring that it does not touch the ground unless covered by a plastic sheet.
3. Attach sufficient stainless steel or Teflon™ leader and cord to the bailer. Use previous data on well depth to estimate the amount of leader and cord needed.
4. When detecting DNAPL, slowly lower the bailer to the bottom of the well. When detecting LNAPL, slowly lower bailer 1 foot past the air/liquid interface.
5. Slowly raise the bailer from the well.
6. Visually inspect the liquid in the bailer for the presence of a separate phase.
7. Record results on the Well Sampling Log.
8. Manage the liquid in accordance with the approved generator's Waste Management Plan.

5.2.4 Measurement of Well Depth

1. If historical data is not available and the well does not contain a dedicated bladder pump, then measure the total well depth.
2. Locate the reference mark, if visible, at the top of the well's inner casing. If a reference mark cannot be found, then use the north side of the inner casing as a reference mark.
3. Lower the probe into the well.
4. Continue lowering the probe until the bottom of the well is reached as indicated by a slacking of the probe cord.

5. Raise the probe cord until there is no longer any slack.
6. Gently "feel" the bottom of the well by slowly raising and lowering the probe.
7. Hold the cord at the reference mark and note the measurement to the nearest 0.01-foot. Repeat three times for consistency.
8. Record the measurement in the Well Sampling Log.

5.3 Calculation of the Volume of Well Water to be Purged (Conventional Purging)

The following general steps shall be followed when calculating the volume of water to be purged from a well before sampling:

1. Obtain the water level measurement.
2. Determine the height of the water column in the well using the previously obtained well depth. The height of the water column equals the Total Well Depth minus the Depth to Water.
3. Calculate the gallons of water in the well casing or section of telescoping well casing in one of the two following ways:
   a.) $7.481(\pi r^2 h)$ = gallons of water in the well, where
   - $\pi = 3.142$
   - r = radius of the well pipe in feet
   - h = height of the water column (ft.)
   - 7.481 = gallons per cubic ft. of water

   b.) If the well casing diameter is a common size, then one of the following formulas can be used, where h = height of the water column in the well (ft.)
   - 2 inch diameter well: 0.16 gal/ft x h ft. = gallons of water in the well
   - 4 inch diameter well: 0.65 gal/ft x h ft. = gallons of water in the well
   - 6 inch diameter well: 1.47 gal/ft x h ft. = gallons of water in the well
   - 8 inch diameter well: 2.61 gal/ft x h ft. = gallons of water in the well
4. Record purge volume calculations in the Well Sampling Log.

5.4 Purging the Well

The following general steps shall be followed when purging the well:

5.4.1 pH Meter Standardization

1. Record the date the pH meter was standardized on the Well Sampling Log.
2. If the pH meter has not been standardized within 4 hours of sampling, then re-standardize it in accordance with PORTS GWS 007 "Conducting Field Measurements".
3. If the pH meter has not been standardized within 2 hours of sampling, then check the standardization.
4. Measure the pH using the certified pH 7 buffer solution.
5. If the pH reading is not within 0.1 S.U. (6.9 to 7.1), then re-standardize the meter in accordance with PORTS GWS 007 "Conducting Field Measurements".

5.4.2 Well Purging Definitions

1. Field parameters (temperature, pH, specific conductivity, dissolved oxygen, and turbidity) are considered stabilized when, during two consecutive measurements, the following is true:
   - The difference between the temperatures for two measurements is within 1°Celsius.
   - The difference between the pH of two measurements is within 0.2 S.U.
   - The difference between two measurements for specific conductivity is either within 50 microSiemens per centimeter (µS/cm) when the specific conductivity is less than or equal to 500 µS/cm, or within 10% when the specific conductivity is greater than 500 µS/cm.

- There are no stability criteria for turbidity or dissolved oxygen.

2. A well is considered "dry" when the following is true:
   - The bailer (standard size bailer - approximately 1 66 inches outside diameter and less than five feet in length) is less than half full when it is raised from the bottom of the well;
   - Less than 200 mL of water is discharged from the bladder pump in one cycle with at least a 9-second refill time and enough pressure to empty the bladder.

5.4.3 Conventional Purging with Pump

The steps listed below apply to wells without dedicated pumps but can be used for wells with dedicated bladder pumps that can not achieve "no draw-down".

1 Establish a power supply – usually a portable gas-driven generator. If a gas-driven generator or compressor is used, then, place it at least 15 feet from the well and, if possible, downwind.
2. Verify that a ground fault circuit interrupter (GFCI) is part of, or a separate GFCI is connected to, the power cord if an electric pump or compressor is being used.
3 Start the generator, and run the power cord or airline to the well.
4. Carefully remove the pump and hose assembly from protective covering if a non-dedicated pump is being used.
5. Ensure the assembly does not touch the ground unless covered by a plastic sheet.
6. Plug the pump into the controller.
7. Plug the controller into the power cord or air supply.
8. Attach the sample line (discharge tubing) to the pump
9 Place the discharge end of the sample line in the receptacle specified for the management of well wastewater.
10 If a non-dedicated pump is being used, slowly lower the pump into the well to approximately 3 feet below the water level. Dropping the pump into the well will disturb the water column and should be avoided.
11 Ensure the rope, cord, or hose does not touch the ground unless it is covered by a plastic sheet.
12. For field parameter measurement, pump the water into a container or a flow-through cell that is decontaminated or visually clean.
13. Pump remaining water into a properly labeled liquid waste container or other comparable container.
14. Check the water with a radiation meter and a PID and record results on the Well Sampling Log if well has not been sampled before or if historical data is not known.
15. Measure field parameters of the water in accordance with PORTS GWS 007 "Conducting Field Measurements", and record results on the Well Sampling Log.
16. Continue pumping water from the well.
17. Place water in the liquid waste container.
18. Keep a cumulative measurement of the amount of water purged. For each well volume, measure field parameters, check water with a radiation meter and PID, and record results on the Well Sampling Log.
19 When at least three well volumes of water have been removed and the field parameters have stabilized or the well is declared "dry", then discontinue purging. If the well is declared "dry", then record it on the "Well Sampling Log".

5.4.4 Conventional Purging with a Bailer

1 Remove the bailer from the protective covering, ensuring that it does not touch the ground unless covered by a plastic sheet.
2. Don appropriate PPE.
3 Attach sufficient stainless steel or Teflon™ (normally decontaminated reusable Teflon™-coated stainless steel) leader and new nylon cord to the bailer to allow it to reach the bottom of the well. Use

previous well data to determine the approximate amount of leader and cord required. Dropping the bailer into the well will disturb the water column and should be avoided.

4. Slowly lower the bailer into the well casing.
5. When the bailer is filled, then slowly raise the bailer being careful that the rope does not touch the ground unless it is covered by a plastic sheet.
6. For field parameter measurement, pour the water into a container or a flow-through cell that is decontaminated or visually clean.
7. Pour any remaining water into a liquid waste container.
8. Check the water with a radiation meter and a PID and record results on the Well Sampling Log.
9. Measure field parameters of the water in accordance with PORTS GWS 007 "Conducting Field Measurements" and record results on the Well Sampling Log.
10. Continue bailing water from the well.
11. Place the water in a liquid waste container.
12. Keep a cumulative measurement of the amount of water bailed.
13. For each well volume, measure field parameters, check water with a radiation meter and PID, and record results on the Well Sampling Log.
14. When at least three well volumes of water have been removed and the field parameters have stabilized or the well is declared "dry" discontinue purging. If the well is declared "dry", then record it on the Well Sampling Log.

5.4.5 Micro Purging with a Bladder Pump

1. Perform micro purging (slow flow/low volume purging) with a bladder pump.
2. Establish a power supply for the air compressor, if needed. If a single unit, portable, gas-driven air compressor is used, then place it at least 15 feet from the well and, if possible, downwind.
3. Connect the air lines from the regulated, compressed gas source to the control box. Bottled compressed gas can also be used as a source.
4. Attach the sample line to the pump.
5. Place the discharge end of the sample line in the receptacle specified for the management of well wastewater.
6. Don appropriate PPE.
7. Start the air compressor.
8. Start the airflow and adjust the flow rate by turning the throttle knob located on the bladder pump control box.
9. For field parameter measurement, pump the water into a container or a flow-through cell that is decontaminated or visually clean.
10. Pump remaining water into a liquid waste container.
11. Check the water with a radiation meter and a PID and record results on the Well Sampling Log.
12. Measure field parameters of the water in accordance with PORTS GWS 007 "Conducting Field Measurements", and record results on the Well Sampling Log.
13. Adjust the discharge and refill control knobs to control the discharge and refill cycle rate of the bladder. Equal length discharge and refill cycles are generally desirable, but individual well conditions may dictate otherwise.
14. Adjust the flow rate so that there is no draw down in the well.
15. Determine lack of draw down by using a water level meter in the well to monitor the water level. No draw down is defined as draw down of less than 1.0 foot from original depth to water. If no draw down cannot be achieved, then follow the steps outlined in Section 5.4.3.
16. When the pump is adjusted so that no draw down is maintained, then, for field parameter measurement, pump the water into a container or a flow-through cell that is decontaminated or visually clean.
17. Continue to pump remaining water into a liquid waste container
18. Check the water with a radiation meter and a PID and record results on the Well Sampling Log.

19. Measure field parameters of the water in accordance with PORTS GWS 007 "Conducting Field Measurements", and record results on the Well Sampling Log.
20. Continue pumping water from the well.
21. Place the water in a liquid waste container.
22. Keep a cumulative measurement of the amount of water pumped.
23. After approximately two pump and line volumes, measure field parameters, check water with a radiation meter and PID, and record results on the Well Sampling Log.
24. Measure field parameters, check water with a radiation meter and PID, and record results of the Well Sampling Log every 10 minutes.
25. When at least three sets of field parameter measurements (in addition to the initial set of measurements) have been taken, and the field parameters have stabilized, then samples may be collected. Do not shut the pump off.
26. Collect samples at the same flow rate or lower. If necessary, the flow rate may be reduced for collection of samples to be analyzed for VOCs.

5.5 Groundwater Sample Collection

1. - When the well has been purged by conventional methods, then organic samples shall be collected within 4 hours of the well being purged or declared dry. Inorganic samples shall be collected within 24 hours of the well being purged or declared dry.
   - If, within 4 hours of the well being declared dry, the well has not recharged with sufficient volume to collect organic samples, then collect all samples (organic and inorganic) within 24 hours in the order specified in step 2 until all samples are collected or no additional samples can be obtained because the well has gone dry.
   - If the well was micro purged, then samples must be collected immediately after parameters have stabilized.
2. Collect samples for laboratory analysis based on the laboratory Statement of Work and in the following order:
   - Volatile organic compounds (VOCs)
   - Volatile organic halogens (VOXs)
   - Total organic carbon (TOC)
   - Total organic halogen (TOX)
   - Polychlorinated biphenyls (PCBs)
   - Semi-volatile organic compounds (SVOCs)
   - Total metals
   - Phenolics
   - Cyanide
   - Sulfate and chloride
   - Turbidity
   - Nitrate, nitrite, or ammonia
   - Radionuclides
   - Dissolved metals (filtered)
3. **If collecting samples with a bailer:**
   - Remove the bailer from its protective covering; attach a sufficient length of stainless steel or Teflon™ leader and cord to the bailer. Use previous well data to determine the length of leader and cord required (If a bailer was used to purge the well, then that bailer, leader wire and cord can be used to sample).
   - Slowly lower bailer into the well. Care should be taken to avoid scraping the bailer and cord on the side of the well casing. Dropping the bailer in the well will disturb the water column and should be avoided.
   - When the bailer has filled (to the extent possible), then slowly raise the bailer from the well.

- Fill the sample containers as described in step 4.

If collecting samples with bladder pump:

- If sampling with a bladder pump, then collect the sample at the same rate used for purging or slower.
- Detach the flow through cell (if applicable).
- From the discharge tube of the bladder pump, fill the sample containers as described in step 4

4. Fill sample containers by the following method:
   - Remove sample container cap.
   - Pour or allow water to run slowly down the inside of the sample container, being careful to avoid splashing the sample.
   - If sample container contains a chemical preservative, then do not allow the container to overflow, except for zero headspace samples.
   - Fill containers to 80% capacity, leaving adequate air space in all containers (Except zero headspace containers), to allow for expansion.
   - If zero headspace is required, then fill the container slowly until it is "overfull" (having a meniscus at top of container), then carefully cap the container.
   - Invert the sample container to verify that there are no air bubbles. The presence of air bubbles indicates that there is not zero headspace.
   - If air bubbles are present, then add more sample to the container.
   - Place samples in the ice chest or another container, as appropriate. Remove and dispose of surgical gloves before collecting samples at the next location in order to prevent cross contamination of samples.

5.6 Field Filtering Samples

5.6.1 Field Filtering Samples Using a Peristaltic Pump

1. Ensure an AC power source is available in the field or that the peristaltic pump internal battery is fully charged.
2. Cut clean, unused silicon tubing to the proper length with stainless steel scissors and insert it into the peristaltic pump.
3. Attach the filter to the tubing and, by turning the pump ON, verify that the discharge direction is toward the filter.
4. Place the inlet end of the tubing into the pre-cleaned container of unpreserved sample.
5. Place the outlet end of the filter into a waste container.
6. Turn ON the peristaltic pump and pump approximately 100 mL of unpreserved sample through the filter into the waste container.
7. Move the outlet tube from the waste container into the preserved sample container to collect the filtered sample.
8. Continue pumping unpreserved sample, and once the necessary sample containers are filled, turn OFF the peristaltic pump.
9. Dispose of the water in the waste container and any excess sample water in the appropriate liquid waste container.
10. Remove and dispose of the silicon tubing and filter.

5.6.2 Field Filtering Samples Using a Bladder Pump

1. Place an adapter on the filter
2. Verify that connections are correct by locating the flow arrow on the side of the filter that indicates flow direction.
3. Connect the adapter/filter assembly to the bladder pump's discharge tube.

4. Point the outlet end of the filter into a waste container.
5. Pump approximately 100 mL of water through the filter into the waste container.
6. Move the outlet end of the filter toward the sample container to collect the filtered sample.
7. Continue pumping until all filtered samples are collected.
8. Disconnect adapter and decontaminate in accordance with PORTS GWS 006 "Decontamination of Sampling Equipment".
9. Remove and dispose of the filter in accordance with the approved generator's Waste Management Plan.
10. Manage the water in the waste container and any excess sample water in accordance with the approved generator's Waste Management Plan.

5.7 Sample Preservation Verification

Sample preservation verification may be completed at any time prior to delivery of the samples to the laboratory. If the sampling location is routinely sampled and only standard amounts of preservative have been historically required, then preservation does not normally need verification. The receiving laboratory or the project/program manager can require that sample preservation be verified.

1. Determine if sample preservation needs to be verified. Preservation verification of samples to be analyzed for VOCs or SVOCs is not required.
2. If preservation verification is required, then check pH of samples to be analyzed for non-VOC analytes by pouring a small amount of sample over a pH test strip.
3. If samples have been incorrectly preserved, then discard the samples and re-sample the groundwater location.
4. Manage any waste generated in accordance with the approved generator's Waste Management Plan.

5.8 Document Completion

1. Complete the Well Sampling Log.
2. Complete the Chain-of-Custody (COC) form.

5.9 Site Cleanup

1. Close and lock the well.
2. Verify that all sampling waste is managed in accordance with the approved generator's Waste Management Plan.

5.10 Samples and Associated Documents Delivery

1. Deliver samples to the appropriate receiving area as soon as possible after sampling has been completed unless the receiver is unable to receive them.
2. If the receiver is unable to receive the samples on the sampling day, then refrigerate them overnight in a locked sampler's preparation room and deliver them to the receiving area the next morning.
3. Retain a copy of the receiver-signed COC form.
4. Deliver copies of the sampling logs and COC forms for sampled location as directed by the project/program manager.

6.0 RESTRICTIONS/LIMITATIONS

Peristaltic pumps are generally not capable of lifting water distances greater than 20 to 25 feet above the normal hydrostatic level. Peristaltic pumps must not be used when samples are collected for volatile organics, oil and grease, pH, dissolved gases, residual chlorine, or for other characteristics that may change rapidly.

Failure to use personal protective equipment (PPE) could result in worker exposure to hazardous constituents or radioactive contamination. Contaminants present at the sampling locations are to be determined from historical records, if available. The expected contaminants determine the type of PPE to be worn.

The use of bailers to purge monitoring wells should be minimized because the plunger effect created by raising and lowering the bailer into the well can result in continual development or over-development of the well Bailers should be used only when use of a pump is not practical.

For micro purging (slow flow/low volume sampling), the pump must have an adjustable flow rate in the range of 0.2 to 2.0 liters per minute. Bladder pumps must be installed in the well for at least 24 hours before purging can begin.

7.0 REFERENCES

Ohio Environmental Protection Agency 1995. *Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring*

APPENDIX A
WELL SAMPLING LOG
(EXAMPLE ONLY)

WELL SAMPLING LOG

Date:____________ Team:__ Well #:____________

Samplers: ____________ Data Loggers: ____________

____________ ____________

____________ Other Personnel: ____________

____________ ____________

____

TIME	DESCRIPTION OF ACTIVITIES
	Field instruments calibrated, if required; calibration data recorded (see calib. logs for more information): Instrument — Meter #: — Date Calibrated: pH: ________ ________ Conductivity: ________ ________ PID: (OVM HNU,Other:_____): ________ ________ Turbidimeter: ________ ________ Radioactivity: ________ ________ Dissolved Oxygen: ________ ________
__	Arrival at well; condition of well exterior: ____________ Rad — PID Background readings: ______cpm ______ppm Readings around well: ______cpm ______ppm Activities at well site : ____________ Weather conditions: ____________
__	Well area prepared for sampling: _ Plastic sheeting placed around well: _ Purge water containers/decon supplies in place: _ Bailer or pump prepared: _ Sample bottles/vials labeled: _ Preservatives added to appropriate vials/bottles: _ Sampling personnel suit up in appropriate PPE: ( ) modified Level D ( ) PE Tyveks/Nitrile
__	Well is opened; condition inside:____________ Readings: Rad — PID In breathing zone: ______cpm ______ppm In protective casing: ______cpm ______ppm
__	Well depth measurements/ volume computations for conventional purge: M-scope I.D. #: ________ Measuring point (MP): ________ Total sounded depth of well below MP ( ) Historical ( ) Measured ________ Depth to water below MP (DTW): ________ Water column (WC) in well: ________ Casing diameter: ______ Gallons/foot (GPF) = ________ Gallons in well (GW) = WC x GPF = ________ Gallons to be pumped/bailed prior to sampling (GW x 3) = ________

(Revised 10/01)

Well casing volumes: gal/ft: 2" = 0.16 4" = 0.65 6" = 1.47 8" = 2.61

Remarks:

TIME	DESCRIPTION OF ACTIVITIES
	Purging begins; method: ( ) Dedicated Bladder Pump ( ) Teflon Bailer ( ) micro purge ( ) conventional purge
	Field Meas.:

	Vol (Gal.)	Temp (°C)	pH	Cond (uS)	Turb (NTU)	Rad (cpm)	PID (ppm)	D.O.	DTW	Flow (mL/min.)
Initial:										
1st:										
2nd:										
3rd:										
If necessary: 4th:										
5th:										
If purged to dryness, final parameters after sampling: After samples:										
_ Historical field parameter values:										

	Color:	Odor:	Clarity:
Initial			
1st:			
2nd:			
3rd:			

Actual volume (in gallons) purged: ____________

Sampling begins; method: ( ) Dedicated Bladder Pump ( ) Teflon Bailer

Parameter Suite(s) (A,B,etc.): ______________ other: ______________

Chain-of-custody form number(s): ____________________

Color: ____________ Odor: ____________ Clarity: ____________

Activities at or near well during sampling: ______________________

QA samples (collect if necessary):

Type	Where Collected:	Reference Numbers:
Field Replicate		
Trip Blank:		
Field Blank:		
Other:		

___ Sampling completed

___ Well secured and locked

Remarks:

(revised 10/01/)

Bottle Lot #'s:

40 mL amber gl.: ______________ 250 mL pl: ______________

125 mL pl: ______________ 1L pl: ______________

Other____________ : ____________ ____________ : ____________

Signature: (of all team members; samplers/data loggers) ______________________ Date: ________

Reviewed by: ______________________ ________

MONITORING WELL AND PIEZOMETER INSPECTION

Prepared: Wendy J Brunton Technical Review: Del R. Baird

Issued: Del R Baird / 10/11/00 Approved: Del R Baird / 10/11/00

Signature/Date Signature/Date

1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to define requirements for inspecting monitoring wells and piezometers at the Portsmouth Gaseous Diffusion Plant (PORTS).

2.0 BACKGROUND

2.1 Definitions

None

2.2 Discussion

This procedure provides instructions and guidance for the well and piezometer inspection program at the Portsmouth Gaseous Diffusion Plant (PORTS). This procedure applies to all monitoring wells and piezometers used in the support of PORTS Environmental Management and Enrichment Facilities Operations. This procedure is applicable to all personnel who are responsible for the inspection of monitoring wells and piezometers at PORTS.

3.0 RESPONSIBILITIES

Site Manager – The Site Manager is responsible for ensuring that field personnel are trained in the use of this and related SOPs and the required equipment.

Field Team Leader – The Field Team Leader (FTL) is responsible for ensuring that inspectors are familiar with the necessary criteria that constitute a satisfactory inspection. During the inspections, the FTL must ensure that discrepancies are noted so that corrective action measures may be performed.

Inspection Personnel – The inspection personnel need to understand the necessary criteria that constitute a satisfactory inspection.

4.0 REQUIRED EQUIPMENT

All or part of the equipment listed may be required at any specific site, depending on the plan(s) for that site.

- Monitoring well and piezometer inspection list
- Keys
- Inspection Report Form

5.0 PROCEDURES

The following steps must be taken when inspecting monitoring wells or piezometers. Ensure that each component will remain in good working order until the next inspection:

1. *Locked* – Ensure that the monitoring well/piezometer is locked and the lock appears to be in good working order.

2. *Exterior Hinge/Hasp or Locking Cap* – Ensure the hinge and hasp (where appropriate) appear to be in good working order.
3. *Interior cap* – Ensure an interior cap is present and in place. If a bladder pump has been installed, an interior cap is not necessary. If an expandable cap is present, make sure it is tight enough so that it cannot be pulled off.
4. *Outer casing* – Ensure the casing is not cracked, dented, bent, crimped or severely rusted and appears firmly imbedded in the cement pad. The identification should be legible.
5. *Gravel* – Ensure the void between the inner casing and the outer casing is filled with gravel to a level above the weep hole. The gravel is only required if the outer casing diameter is greater than 2 times the diameter of the inner casing.
6. *Cement Pad* – Ensure the pad has no cracks or chips, is tapered away from the outer casing and at least slightly above ground level. There should be no evidence of frost heaving.
7. *Weep Hole* – Ensure 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.
8. Record any discrepancies on the inspection report (see Appendix A) and notify the Bechtel Jacobs Company Subcontractor Technical Representative of any significant problems.

6.0 RESTRICTIONS/LIMITATIONS

None

7.0 REFERENCES

Bechtel Jacobs Company LLC Procedure Number – EM&EF/PO-ER-P2008 "Monitoring Well and Piezometer Inspection Program"

APPENDIX A

INSPECTION REPORT FORM

Well #	Quad	Locked		Hinge/Hasp Ok		Grout to Land Surface		Cap OK		Outer Casing OK		Gravel Present		Cement Pad OK		Weep Holes Present		Date	Initials	Comments
		Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N			
BSIA1-01G	BG																			
BSIA1-02B	BG																			
BSIA1-02G	BG																			
BSIA1-03G	BG																			
BSIA1-04B	BG																			
BSIA1-04G	BG																			
BSIA1-05G	BG																			
BSIA1-06B	BG																			
BSIA1-06G	BG																			
BSIA1-07B	BG																			
BSIA1-07G	BG																			
BSIA1-08G	BG																			
BSIA2-01B	BG																			
BSIA2-01G	BG																			
BSIA2-04B	BG																			
BSIA2-05B	BG																			
BSIA2-06B	BG																			
BSIA2-07B	BG																			
F-15G	1																			
F-16B	1																			
F-17G	1																			
F-18B	1																			
F-19G	1																			
F-20B	1																			
F-23G	1																			
F-24B	1																			
F-25G	1																			
F-26B	1																			
F-27G	1																			

DECONTAMINATION OF SAMPLING EQUIPMENT

Prepared: Wendy L Brunton
Technical Review: Del R. Baird
Issued: Del R. Baird /10/11/00
Signature/Date
Approved: Del R. Baird /10/11/00
Signature/Date

1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to define requirements for decontamination of reusable environmental sampling equipment.

2.0 BACKGROUND

2.1 Definitions/Acronyms

Tap Water – Potable water obtained from the facility water supply

2.2 Discussion

This procedure provides protocols for decontaminating reusable environmental sampling equipment to prevent cross contamination of samples and environmental media by chemical or radioactive constituents so that:

- Both the media being sampled and the samples collected are not contaminated, and
- The samples collected are representative of the media being sampled.

3.0 RESPONSIBILITIES

Site Manager – The Site Manager is responsible for ensuring that field personnel are trained in the use of this and related SOPs and the required equipment.

Field Team Leader – The Field Team Leader (FTL) is responsible for ensuring that decontamination efforts are conducted in accordance with this procedure and any other SOPs pertaining to decontamination.

4.0 REQUIRED EQUIPMENT

All or part of the equipment listed may be required at any specific site, depending on the plan(s) for that site.

- Brushes
- Buckets, pans, or tubs
- Tap water
- Plastic wrap
- Deionized, ultra-filtered water
- Laboratory-grade detergent
- Squeeze bottles
- Paper towels
- Plastic bags (various sizes)
- Eye protection with side shields
- Gloves (nitrile, butyl, natural rubber, etc.)

- Liquid waste receptacle

5.0 PROCEDURES

5.1 Method for Decontamination of Portable Pumps

The following steps must be taken when decontaminating Portable Pumps:

1. Prepare a solution of tap water and laboratory-grade detergent such as Liquinox™ or equivalent.
2. Don appropriate gloves (butyl, natural rubber, neoprene rubber, polyethylene, polyvinyl chloride, Teflon™, or 4H™ gloves) and safety glasses.
3. Immerse the pump and hoses in the cleaning solution.
4. Clean all exterior surfaces using a brush, if necessary. All particulate matter and/or surface film must be removed from the exterior of the pump.
5. Rinse all exterior surfaces thoroughly with tap water.
6. Rinse all exterior surfaces thoroughly with deionized, ultra-filtered water.
7. Prepare a second cleaning solution of tap water and laboratory-grade detergent to decontaminate the inside of the pump.
8. Pump approximately three pump/hose volumes of cleaning solution through the pump and hoses directly to a liquid waste receptacle.
9. Pump clean tap water through the pump and hoses directly to a liquid waste receptacle. Continue pumping until the cleaning detergent residue is rinsed from the pump and hoses.
10. Pump approximately one pump/hose volume of deionized, ultra-filtered water through the pump and hoses directly to a liquid waste receptacle.
11. Place the pump and hoses in clean plastic to prevent contamination during storage or transit.
12. Dispose of decontamination water in accordance with the generator's Waste Management Plan.

5.2 Method for Decontamination of Miscellaneous Equipment

The following steps must be followed when decontaminating miscellaneous types of equipment (such as water level indicator, spoons, bowls, augers, back savers, etc.).

1. Prepare a solution of tap water and laboratory-grade detergent such as Liquinox™ or equivalent.
2. Don appropriate gloves (butyl, natural rubber, neoprene rubber, polyethylene, polyvinyl chloride, Teflon™, or 4H™ gloves) and safety glasses.
3. Immerse the equipment in the cleaning solution, if practical.
4. Clean all exterior surfaces using a brush, if necessary. All particulate matter or surface film must be removed.
5. Rinse thoroughly with tap water.
6. Rinse thoroughly with deionized, ultra-filtered water.
7. Place the equipment in clean plastic or aluminum foil to prevent contamination during storage or transit.
8. Dispose of decontamination water in accordance with the generator's Waste Management Plan.

6.0 RESTRICTIONS/LIMITATIONS

Failure to use personal protective equipment when decontaminating equipment could result in worker exposure to chemical or radioactive constituents.

7.0 REFERENCES

Bechtel Jacobs Company LLC Technical Procedure - PO-ER-T2029 "Decontamination of Sampling Equipment"

Prepared: Wendy L Brunton
Technical Review: Del R. Baird
Issued: Del R. Baird 1/22/01
Signature/date
Approved: Del R. Baird 1/22/01
Signature/date

1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to define the techniques and the requirements for conducting field measurements.

2.0 BACKGROUND

2.1 Definitions/Acronyms

Buffer Solution – A chemical standard used to verify the accuracy of an instrument such as a pH meter.

Conductivity Meter – An instrument for measuring the specific conductance of liquids.

Decontaminated Container or Equipment – Container or equipment that has been decontaminated in accordance with PORTS GWS 006 "Decontamination of Sampling Equipment".

DOE – Department of Energy

EPA – Environmental Protection Agency

NTU-Nephelometric Turbidity Unit; the unit of measurement for turbidity

mS/cm – milliSiemens; unit of measurement for specific conductance

µS/cm – microSiemens; unit of measurement for specific conductance

pH-A measure of the acidity or basicity of a solution; the negative logarithm of the hydrogen ion concentration expressed in gram moles per liter. Its values are given in standard units (S.U.), where a value of 7 S.U. represents a neutral solution. A value less than 7 S.U. indicates an acidic solution, while a value greater than 7 S.U. indicates a basic solution. pH values range from 1 to 14.

pH Meter – An instrument for measuring the acidity or basicity of a solution.

PID – Photoionization detector

PORTS – Portsmouth Gaseous Diffusion Plant

Precleaned Container – Sample containers cleaned by the analytical laboratory or vendor according to specified protocols prior to shipment to PORTS.

Radiation Meter – An instrument for the detection of alpha, beta, and /or gamma radiation.

RCRA – Resource Conservation and Recovery Act

S.U. – Standard Unit

Specific Conductance – Measure of a material's ability to conduct electric current, the reciprocal of resistivity. It reflects the ion content of a solution.

Standard or Standard Solution – A solution (commonly certified) of known value used for the calibration of instruments.

Standardization – Comparison of measurement devices against reference standards of known and documented intensity, concentration, length, etc., to detect and quantify inaccuracies.

Turbidimeter- An instrument for measuring the turbidity of a solution.

Turbidity-A measure of the relative clarity of water. It is measured in nephelometric turbidity units (NTUs). Lack of clarity is caused by the presence of suspended particles (such as clay, silt, particulate organic or inorganic matter, and/or dissolved organic matter).

2.2 Discussion

This procedure provides instructions to standardize, maintain, and use instruments that measure field parameters of environmental media.

Environmental Samplers must complete Radiological Worker II training prior to using radiation-measuring instruments.

3.0 RESPONSIBILITIES

Site Manager – The Site Manager is responsible for ensuring that field personnel are trained in the use of this and related SOPs and the required equipment.

Field Team Leader – The Field Team Leader (FTL) is responsible for ensuring that field-measuring efforts are conducted in accordance with this and other relevant procedures.

Field Sampling Personnel – The Field Sampling Personnel are responsible for understanding and performing the field-measuring procedure properly.

4.0 REQUIRED EQUIPMENT

All or part of the equipment listed may be required at any specific site, depending on the plan(s) for that site.

Decontamination Supplies

- Squeeze bottle(s)
- Deionized, ultra-filtered water
- Lint-free tissue

Instruments

- Conductivity Meter
- pH meter
- Photoionization detector (PID)

- Radiation meter
- Thermometers (2)
- Dissolved Oxygen Meter
- Turbidimeter

Standardization Media

- pH buffer solutions certified by the supplier
- Standard conductivity solution certified by supplier
- Standard gas certified by the supplier
- NTU standard solutions certified by supplier

Miscellaneous

- Paper towels
- Pens (black, indelible ink ballpoint and black, indelible, waterproof markers)
- Plastic bags (large and small)
- Radio

5.0 PROCEDURES

Decontaminated or precleaned containers may be used for water collected to measure field parameters or a flow-through cell may be used.

5.1 Temperature Measuring Instruments

5.1.1 Preparation

Temperature measurements may be made with any calibrated thermometer or thermistor with an analog or digital read-out device.

1. Verify that the thermistor included with the pH probe has been checked on a semiannual basis to ensure that it meets the manufacturer's temperature specifications.
2. Verify that the calibrations of the thermometers and thermistors are current.
3. Inspect the thermometer before each field trip to ensure that there are no cracks in the glass or air spaces or bubbles in the mercury, if applicable.

5.1.2 Measuring Temperature

1. Insert thermometer or thermistor in situ when possible, or in a grab sample.
2. Swirl the thermometer or thermistor in the sample, and read the temperature when the readout stabilizes.
3. If the instrument is analog, then read the temperature to the nearest 1.0° Celsius. If the instrument is digital, then read the temperature to the nearest 0.1° Celsius.
4. Record the temperature on the appropriate log.

5.2 pH Measuring Instruments

5.2.1 Preparation

1. Clean the probe, if necessary, by removing coating of oily material or particulate matter (that can impair sensor response) by gently blotting with a lint-free tissue and then rinsing with Deionized, ultra-filtered water.

2 Check meter for mechanical and electrical failures, weak batteries, and cracked sensors.

5.2.2 Standardizing the Meter

1. Calibrate the pH meter according to manufacturer's procedures.

5.2.3 Measuring pH

1. Remove the wetting cap from the pH probe.
2. Rinse the probe thoroughly with deionized, ultra-filtered water and remove excess water from it.
3. Carefully pour a water sample into a precleaned or decontaminated container or pump through a flow-through cell.
4. Turn the meter ON and place the pH probe in the water sample.
5. Allow the measurement to stabilize.
6. Read and record the sample pH measurement in the appropriate sampling log.
7. Repeat steps 1 through 6 as needed at each sampling point.
8. When pH has been measured for all samples at the sampling point, then remove probe from sample and rinse with deionized ultrafiltered water.
9. Place the wetting cap on the end of the probe.

5.3 Conductivity Measuring Instruments

5.3.1 Preparation

1. Clean the probe, if necessary, by removing coatings of oily material or particulate matter by gently blotting with a lint-free tissue and then rinsing with deionized, ultra-filtered water.
2. Check meter for mechanical and electrical failures, weak batteries, and cracked sensors.

5.3.2 Standardizing the Meter

1. Calibrate the conductivity meter according to manufacturer's procedure.

5.3.3 Measuring Conductivity

1. Carefully pour a water sample into a precleaned or decontaminated container or pump through a flow-through cell.
2. Rinse the probe thoroughly with deionized, ultra-filtered water and remove excess water from it.
3. Turn the meter ON and place the conductivity probe in the water sample.
4. Allow the measurement to stabilize. The measurement will be displayed in milliSiemens (mS/cm) or microSiemens (μS/cm). Normally recorded in microSiemens (μS/cm).
5. Read and record the sample conductivity measurement in the appropriate sampling log.
6. Repeat steps 1 through 5 as needed at each sampling point.
7. When conductivity has been measured for all samples at a sampling point, then remove the probe from the sample.
8. Rinse the probe thoroughly with deionized, ultra-filtered water and remove excess water from it.

5.4 Radiation Measuring Instruments

1. Use radiation measuring instruments in accordance with Radiological Worker II Training.

5.5 Organic Vapors Measuring Instruments

5.5.1 Preparation

1. Check meter for mechanical and electrical failures and weak batteries.

5.5.2 Standardizing the Meter

1. Calibrate the meter according to the manufacturer's procedure.

5.5.3 Measuring Organic Vapors

1 Turn the instrument on and ensure that it is operating.
2 Place the probe in the area to be measured and record the reading in ppm.
Note: Do not pull water or other liquids into the probe.

5.6 Dissolved Oxygen Measuring Instruments

5.6.1 Preparation

1. Ensure that the membrane is intact and not ruptured.
2. Check for poor connections and weak or dead batteries.

5.6.2 Standardizing the Meter

1 Calibrate the meter according to the manufacturer's procedure.

5.6.3 Measuring Dissolved Oxygen

1. Place the probe in a flow through cell and pump sample water through the cell.
2 Record reading in mg/L (ppm).
Note: Measuring dissolved oxygen in an open container does not produce a stable reading and should be avoided if possible.

5.7 Turbidity Measuring Instruments

5.7.1 Preparation

1. Check for weak or dead batteries.

5.7.2 Standardizing the Meter

1. Calibrate the meter according to the manufacturer's procedure

5.7.3 Measuring Turbidity

1 Collect a sample of water in a precleaned or decontaminated container. Fill the glass sample cell of the turbidimeter to the line, and place the cap on the glass cell.
2. Wipe the cell with a clean cloth to remove water spots and fingerprints.
3 Turn the turbidimeter ON
4 Place the sample cell into the cell compartment so the diamond orientation mark aligns with the raised mark in the front of the cell compartment. Close the cover
5 Press READ Record the reading to the nearest 0 1 NTU.

6.0 RESTRICTIONS/LIMITATIONS

Glass thermometers in the field must be transported in a protective case to prevent leakage.

7.0 REFERENCES

Bechtel Jacobs Company Technical Procedure – PO-ER-T2028 "Conducting Field Measurements"

Prepared: Wendy Brunton   Technical Review: D R Baird

Issued: D R. Baird 1/2/02   Approved: D R. Baird 1/2/02
Signature/date   Signature/date

1.0 OBJECTIVE

The objectives of this standard operating procedure (SOP) are:

1. Prepare to sample residential water supplies, including requirements for notification, documentation, and equipment/sample container preparation, and
2. Collect samples from residential water supplies that are representative of the water supply and are suitable for various specified chemical and radiological analysis.

2.0 BACKGROUND

2.1 Definitions/Acronyms

AC - Alternating Current

Buffer Solution – A chemical standard used to verify the accuracy of an instrument such as a pH meter

Chain-of-Custody – Method for documenting the history and possession of a sample from the time of its collection through its analysis

cm – Centimeter

COC – Chain-of-Custody

Conductivity Meter – An instrument for the measurement of specific conductance in liquids

Decontaminated Container – A container that has been decontaminated in accordance with PORTS GWS 006 "Decontamination of Sampling Equipment"

DOE – Department of Energy

Duplicate Sample – A second set of samples collected from one sampling point for quality control purposes. Duplicate samples are analyzed for the same parameters as the first sample

EPA – Environmental Protection Agency

Equipment Rinseate – Sample of deionized, ultra-filtered water that has been passed through and over sampling equipment that has been decontaminated. It is analyzed for all parameters that the residential water supply sample is analyzed for, to verify that the decontamination was effective

Field Blank – A sample of deionized, ultra-filtered water that has been sampled (bottled and preserved) in the field. It is analyzed for all parameters that the residential water supply sample is analyzed for, to check on sample collection methods and to determine if field conditions have adversely affected sample collection at a given location

Field Parameters – pH, specific conductance, temperature, and turbidity. They are measured to determine whether or not the water quality has stabilized and is representative of the water supply

Headspace – The space above the sample and below the container lid in a sample container

mL – milliliter

µS/cm – MicroSiemens per centimeter; the unit of measurement of specific conductivity

Non-dedicated Sampling Equipment – Equipment used at more than a single sampling location

NTU – Nephelometric turbidity unit; the unit of measurement for turbidity

PCB – Polychlorinated biphenyl

pH – A measure of the acidity or alkalinity of a solution; the logarithm of the reciprocal of the hydrogen ion concentration expressed in gram moles per liter. Its values are given in standard units (S.U.), where a value of 7 S.U. represents a neutral solution. A value less than 7 S.U. indicates an acidic solution, while a value greater than 7 S.U. indicates an alkaline solution

pH meter – An instrument for the measurement of the acidity or alkalinity of a solution

PORTS – Portsmouth Gaseous Diffusion Plant

Pre-cleaned Container – Sample containers cleaned by the analytical laboratory or vendor according to specified protocols prior to shipment to PORTS

QC – Quality Control

RCRA – Resource Conservation and Recovery Act

Rinseate Blank – A sample of deionized, ultra-filtered water that is used for decontamination. It is usually obtained in a laboratory setting

Specific Conductance – Measure of a material's ability to conduct electric current, the reciprocal of resistivity

Standardization – Comparison of measurement devices against reference standards of known and documented intensity, concentration, length, etc., to detect and quantify inaccuracies

S.U. – Standard Unit; the unit of measurement for pH

SVOC – Semi-volatile organic compound

Tap Water – Potable water obtained form the PORTS water supply

TOC – Total organic carbon

TOX – Total organic halogen

Trip Blank – Samples consisting of 40-mL volatile organic analysis (VOA) vials of deionized, ultra-filtered water that are filled in the sample container preparation work space (field laboratory), taken with the sample containers to the sampling location, placed in the same transportation containers (usually coolers) as residential water supply samples to be analyzed for VOCs, and transported with the residential water supply samples to the sample analysis laboratory. Trip blanks are QC samples used to help detect cross-contamination of samples

Turbidity – A measure of the clarity of water. It is measured in nephelometric turbidity units (NTUs). Lack of clarity is caused by the presence of suspended matter such as clay, silt, finely divided organic and inorganic matter, and soluble, colored organic compounds

VOA – Volatile organic analysis

VOC – Volatile organic compound

VOX – Volatile organic halogen

3.0 RESPONSIBILITIES

Site Manager – The Site Manager is responsible for ensuring that sampling efforts are conducted in accordance with this procedure and any other SOPs pertaining to specific media sampling.

Field Team Leader – The Field Team Leader is responsible for ensuring that field personnel collect samples in accordance with this and other relevant procedures.

4.0 REQUIRED EQUIPMENT

Decontamination Supplies
- Brushes
- Buckets, pans, or tubs
- Carboys with tap water
- Plastic wrap
- Deionized, ultra-filtered water
- Laboratory grade detergent (Liquinox™)
- Squeeze bottles

Forms
- Chain-of-Custody
- Residential Water Supply Sampling Log

Instruments
- Conductivity meter
- pH meter
- Thermometer °C (Celsius)
- Turbidity meter

Miscellaneous
- Masking tape
- Paper cups
- Paper towels
- Pens
- Plastic bags (large and small)
- Radio

Personal Protective Equipment
- Eye protection including side shields
- Gloves
- Laboratory apron or coat

Sampling Equipment
- Dipper
- Peristaltic pump
- Pump supplies:
  Filters
  Hose
  Plastic tubing

Sampling Supplies
- Clipboard
- Containers
- Cooler with ice packs
- Dipper
- Labels

Standardization Media
- Certified pH 4 buffer solution
- Certified pH 7 buffer solution
- Certified pH 10 buffer solution
- Certified Conductivity Standard Solution

5.0 PROCEDURES

5.1 Prerequisites

1. The Environmental Sampler prior to starting work must review the Statement of Work or Sampling and Analysis Plan. If non-routine conditions are identified during the review, then the Safety and Health officer must be contacted to evaluate the conditions prior to sampling.
2. Standardized instruments must be used for all sampling activities. Instruments must be standardized in accordance with PORTS GWS 007 "Conducting Field Measurements"
3. Historical data for the residential water supply sampling locations, if it exists, must be available for reference.
4. Sampling must be coordinated with the analytical laboratory The laboratory must agree to accept and analyze the samples within specified holding times in advance of sampling.
5. Sampling events must be agreed upon with the homeowner IN ADVANCE of sampling.
6. Ohio Environmental Protection Agency (EPA) must be notified of the sampling event by letter or verbally at least 7 days in advance.

5.2 Sampling Preparation

Record all appropriate information in the following steps on the Residential Water Supply Sampling Log.

5.2.1 Residential Water Supply Location

1. Verify sampling date and time with the residential water supply owner. If the owner cannot be reached, report to the Subcontract Technical Representative (STR).

2. Initiate a residential Water Supply Sampling Log for each residential water supply location to be sampled.
3. Initiate filling in Chain-of-Custody (COC) forms

5.2.2 Waste Management

1. Identify how waste is to be managed by consulting the approved Generator's Waste Management Plan.
2. Obtain containers, labels, and other supplies, as appropriate.

5.2.3 Location-Specific Requirements

1. Identify any location-specific requirements and sample parameter suites as provided in the PORTS Integrated Groundwater Management Plan. The Project/Program Manager may also direct specific requirements for particular locations, specific times of year, special sampling occasions, or other project-specific or programmatic needs.

5.2.4 Field Quality Control Samples

1. Identify required field Quality Control (QC) samples and record this information in the Field Log. Required QC samples are identified in the IGWMP or by the program/project manager.

5.2.5 Sample Container Preparation

1. Select appropriate containers as specified by the analytical method, lab agreement, or laboratory manager
2. If sample preservation is required, then wear the following protective clothing:
   - Eye protection with side shields
   - Nitrile gloves
3. Gather required acids and bases, dropper or acid dispenser, and sample containers
4. Ensure that an emergency eyewash is available
5. Add preservatives to the sample containers
6. Affix sample labels or tags (as appropriate) to sample containers prior to, or at the time of, sampling. To the extent practicable, labels are to be affixed prior to filling the container.
7. Fill in the labels with black indelible ink, and include the following information:
   - Unique field study or sampling activity name and /or number (The project designation may be eliminated from the label and documented in the Residential Water Supply Sampling Log, if necessary, to protect sensitive data or to transmit blind QC samples)
   - Unique sample number
   - Sample location or appropriate identification as given in the sampling program (The project sampling location may be included in the sample number or may be eliminated from the label and documented in the Residential Water Supply Sampling Log, if necessary, to protect sensitive data or to transmit blind QC samples)
   - Sampling date
   - Sampling time (optional)
   - Analyses to be performed
   - Comment and special precautions as needed (not required on all sample labels)

5.2.6 Equipment Preparation

1. Prepare sample coolers. Add ice or "blue ice" as required
2. Standardize field parameter measuring equipment in accordance with the appropriate procedure

3 Verify that all necessary supplies and equipment are available in sufficient quantities
4 Obtain vehicles, load equipment and supplies, and proceed to sampling location

5.3 Work Area Preparation

1. Arrive at the residential water supply location at the agreed-upon time
2. Record the following residential water supply information on the Residential Water Supply Sampling Log:
   - Name of samplers
   - Location
   - Date and time
   - Weather
   - Source of water (well, cistern, etc.)
   - Specific location of the tap where sample is collected
   - Whether the residence has a water treatment or purification system, and if a system is present, is the point of sample collection before the water is treated
   - The type of treatment system (if present)
   - Other conditions or activities taking place near the point of sample collection
   - Any other pertinent residential water-supply-specific information
3. Record date of standardization of pH meter on the Residential Water Supply Sampling Log; If pH meter has not been standardized within 4 hours of sampling, then re-standardize the meter in accordance with PORTS GWS 007 "Conducting Field Measurements"
4. If the pH meter has not been standardized with 2 hours of sampling, then check the standardization
   - Measure the pH of the pH 7 buffer solution
   - If the pH reading is not within 0.1 S.U., then re-standardize the meter in accordance with PORTS GWS 007 "Conducting Field Measurements"
5. If an aerator is present on the faucet, then remove it

5.4 Purging Residential Water Supply

1. Don surgical gloves
2. Open the faucet fully, allowing a free flow of water
3. Collect a sample of water in a decontaminated container for field parameter measurement
4. Measure pH, temperature, specific conductance, and turbidity of the water initially and at 2-minute intervals
5. When during two consecutive measurements the following is true, then the field parameters are considered stabilized, the water supply is considered purged, and samples can be collected:
   - The difference between the temperature for two sample measurements is within 1°C
   - The difference between the pH measurements for two samples is within 0.2 S.U.
   - The difference between the specific conductivity measurements for two samples is either: 1) within 50 microSiemens per centimeter when the specific conductivity is less than or equal to 500 microSiemens per centimeter, or 2) within 10% when the specific conductivity is greater than 500 microSiemens per centimeter
   - There is no stability criterion for turbidity
6. If values of the pH, temperature, and specific conductance have not stabilized after 5 2-minute intervals, then document and initiate sampling

5.5 Collection of Residential Water Supply Samples

5.5.1 Obtaining Water Samples

1. Don surgical gloves, and safety glasses
2. Collect samples for laboratory analysis based on the laboratory Statement of Work and in the following order:
   - Volatile organic compounds (VOC)
   - Volatile organic halogens (VOX)
   - Total organic carbon (TOC)
   - Total organic halogens (TOX)
   - Polychlorinated biphenyls (PCB)
   - Semi-volatile organic compounds (SVOC)
   - Total metals (unfiltered)
   - Phenolics
   - Cyanide
   - Sulfate and chloride
   - Turbidity
   - Nitrate, nitrite, or ammonia
   - Radionuclides
   - Dissolved metals (filtered)
3. Fill sample container
4. Fill containers to 80% capacity, leaving adequate air space in all containers. When sampling for Volatile Organic Compounds, there must be zero headspace in each container.
5. Place samples in the ice chest or another container, as appropriate.

5.5.2 Sample Preservation Verification

1. If the sampling location is routinely sampled and only standard amounts of preservative have been historically required, then preservation does not normally need verification. The receiving laboratory or the project/program manager can require that sample preservation be verified
2. If preservation verification is required, then check pH of samples to be analyzed for non-VOC analytes by pouring a small amount of sample over a pH test strip

5.5.3 Document Completion

1. Complete filling out the residential water supply sampling log
2. Complete filling out the field COC form

5.5.4 Site Cleanup

1. Verify that all sampling waste is managed in accordance with the approved Waste Management Plan

5.6 Samples and Associated Document Delivery

1. Deliver samples to the appropriate receiving area as soon as possible after sampling has been completed
2. If the receiver is unable to receive the samples on the sampling day, then refrigerate them overnight in a locked room and deliver them to the receiving area as soon as possible
3. Retain a copy of the receiver-signed COC form

6.0 RESTRICTIONS/LIMITATIONS

When grab sampling for VOC analysis or for analysis of any other compounds that may be degraded by aeration, it is necessary to minimize sample disturbance and, hence, analyte loss. The representativeness of this sample, however, is difficult to determine because the collected sample represents a single point, is not homogenized, and has been disturbed.

Only pre-cleaned sample containers may be used for the collection of samples other than those collected for the measurement of field parameters. All sampling equipment must be constructed of materials that will not influence the analysis of the sample. Use the historical sampling point if at all possible. Do not sample from hoses or similar equipment. The sample should be taken from a point located before any treatment or filtering system.

7.0 REFERENCES

Bechtel Jacobs Procedure – PO-ER-T2027 "Residential Water Supply Sampling"

APPENDIX G

STATISTICAL 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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G.1. INTRODUCTION

Statistical evaluation of certain parameters is part of the detection 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. 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). Fig. G.1 provides a flow chart of the statistical evaluation approach for detection monitoring. Because it is desirable to minimize false positive errors and the effects of spatial variability, an intra-well statistical analysis is used for detection 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 detection 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:

- Monitoring wells (background and compliance wells) and indicator parameters for X-749A
- Monitoring wells (background and compliance wells) and indicator parameters for X-735
- Methodology for Alternative 1 – Intra-well control charts
- Methodology for Alternative 2 – Intra-well prediction limits
- References

G.2. MONITORING WELLS AND STATISTICAL PARAMETERS FOR THE X-749A CLASSIFIED MATERIALS DISPOSAL FACILITY

The background (upgradient) wells, compliance (downgradient) wells, and indicator parameters used for the groundwater detection monitoring program at the X-749A Classified Materials Disposal Facility are summarized in the following table.

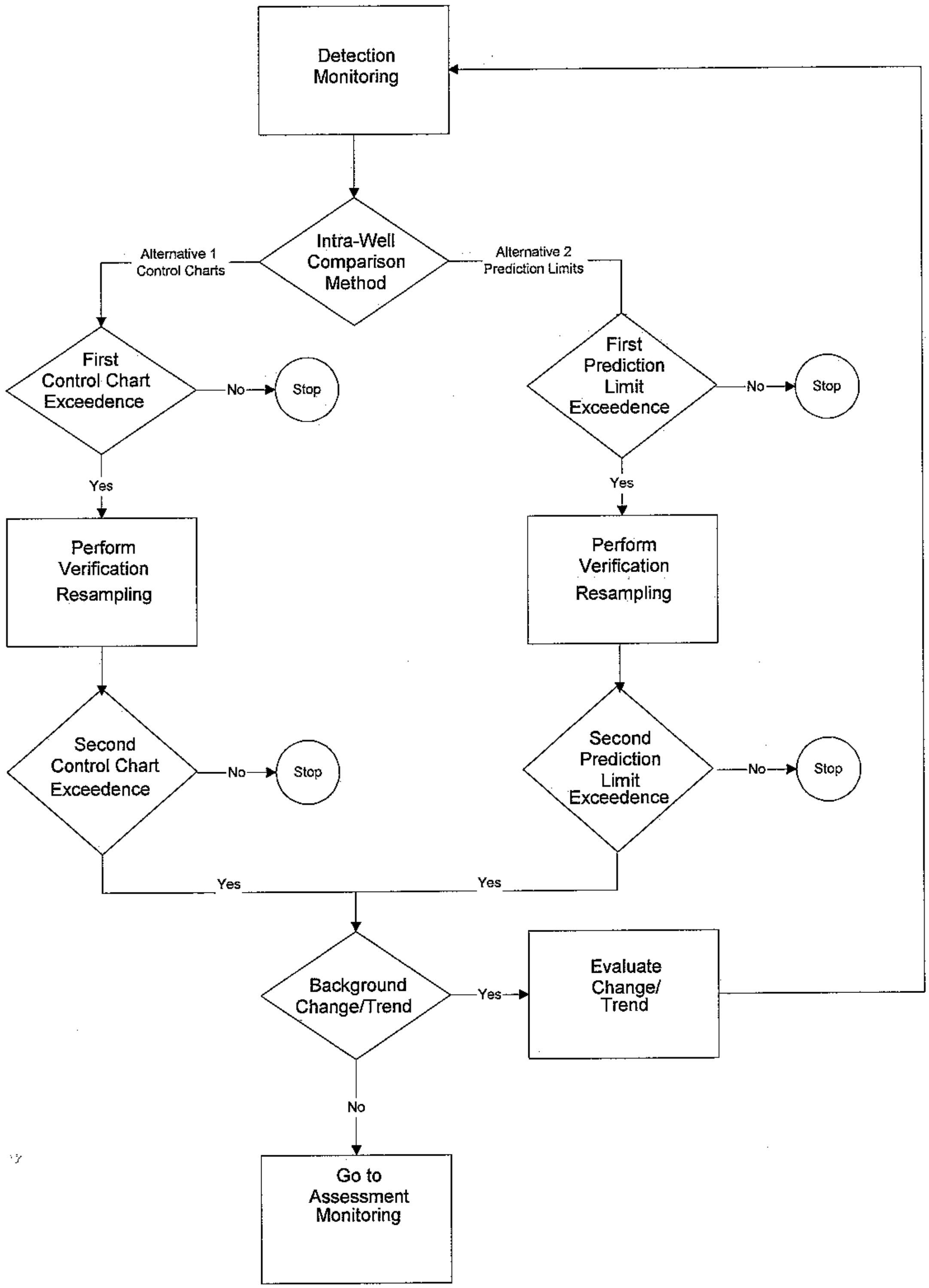

Fig G.1. Statistical evaluation approach for detection monitoring.

Table G.1. Background wells, compliance wells, and indicator parameters for the detection monitoring program at the X-749A Classified Materials Disposal Facility

Background wells	Compliance wells	Indicator parameters
X749A-01G	X749A-02G	Alkalinity, Total
X749A-07G	X749A-03G	Chloride
X749A-12G	X749A-04G	Dissolved Solids, Total
X749A-13GA	X749A-05G	Sodium
	X749A-14G	Sulfate
	X749A-16G	

G.3. MONITORING WELLS AND STATISTICAL PARAMETERS FOR THE X-735 LANDFILLS

The background (upgradient) wells, compliance (downgradient) wells, and indicator parameters used for the groundwater detection monitoring program at the X-735 Landfills are summarized in the following table.

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

Background wells	Compliance wells	Indicator parameters
X735-01GA	X735-02GA	Alkalinity, Total
X735-13GA	X735-03GA	Chloride
X735-16B	X735-04GA	Dissolved Solids, Total
X737-05B	X735-05GA	Sodium
X737-06G	X735-06GAA	Sulfate
X737-07B	X735-17B	Cobalt[a]
X737-08B	X735-18B	
X737-09G	X735-21G	

[a]Cobalt is statistically evaluated only at well X735-06GAA because cobalt was detected in this well during previous assessment monitoring at concentrations slightly exceeding the (statistical) upper prediction limit.

Groundwater samples will continue to be collected at wells X735-19G and X735-20B; however, these wells are not listed in the table above because they are no longer considered compliance wells subject to statistical evaluation. The wells are located in the buffer zone between the northern and southern portions of the landfill; therefore, a statistical exceedence in any indicator parameter at these wells does not correspond with a release from the overall landfill unit.

G.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. If either or both of these limits are exceeded by subsequent compliance well samples, an out-of-control condition (i.e., release or impact) is indicated. 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.

Control Limits. 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). In accordance with Ohio Administrative Code (OAC) 3745-30-08(D)(8), the Ohio Environmental Protection Agency (EPA) will be notified when, for two consecutive semiannual statistical determination periods, there has been a statistically significant change (increase) in the concentration of an indicator parameter at any compliance well. This notification will be made no later than fifteen days after receiving the second period's statistical/analytical results.

Verification Resampling. 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. Since the effect of an identified outlier will impact the CUSUM portion of the control chart for subsequent sampling rounds, the outlier must be replaced by the resample. Verification resampling is limited to cases where the original sample causes an exceedence. The next semiannual sample collected from a compliance well after an initial determination is made that a statistically significant change (increase) has occurred will be considered the verification resample. If the results for this sample do not demonstrate a statistically significant change for the affected indicator parameter, the resample results will replace the results from the prior semiannual sampling round (outlier) in the control chart and detection monitoring will continue at the unit. If the resample shows a second consecutive statistically significant change for the affected parameter, additional sampling will be conducted in accordance with OAC 3745-30-08(D)(10-13) and (E) until Ohio EPA approves reinstatement of the detection monitoring program.

Updating Baseline Data. After eight rounds of compliance well sampling and no exceedences, the baseline data is updated by adding these eight rounds of data to the original eight historical samples used to calculate the baseline. The SCL and h limits will then be recalculated for comparisons with subsequent samples.

Background Trend Analysis. Periodically, the upgradient (background) well data is 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. Trend analysis is conducted using the Mann-Kendall test 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.

G.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 3745-30-08(C)(6)(a-h) 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.

Initial Screening. Initial prediction limits, as shown in Fig. G.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.

Verification Resampling. When verification resampling is necessary to confirm an indicated release or impact, the data collected from the next round(s) of semiannual 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. Confirmation of an exceedence will require that both resamples exceed the prediction limit. In accordance with OAC 3745-30-08(D)(8), the Ohio EPA will be notified when, for two consecutive semiannual statistical determination periods, there has been a statistically significant change (increase) in the concentration of an indicator parameter at any compliance well. If the resample shows a second consecutive statistically significant change for the affected parameter, additional sampling will be conducted in accordance with OAC 3745-30-08(D)(10-13) and (E) until Ohio EPA approves reinstatement of the detection monitoring program.

Updating Baseline Data. After eight rounds of compliance well sampling and no exceedences, the baseline data is updated by adding these eight rounds of data 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.

Background Trend Analysis. As with the control chart approach, the upgradient (background) well data is 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.

G.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.

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