Attachment A

Operations and Maintenance Master Plan for Aquifer Restoration and Wastewater Treatment

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Abbreviations

ARWWT	Aquifer Restoration and Wastewater Treatment
AWWT	Advanced Wastewater Treatment Facility
CAWWT	Converted Advanced Wastewater Treatment Facility
D&D	decontamination and demolition
DOE	U.S. Department of Energy
EM	Office of Environmental Management
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
FFCA	Federal Facilities Compliance Agreement
FRL	final remediation level
ft	foot/feet
gpm	gallons per minute
HMI	human-machine interface
IEMP	Integrated Environmental Monitoring Plan
lb/yr	pounds per year
LM	Office of Legacy Management
LMICP	Legacy Management and Institutional Controls Plan
LMS	Legacy Management Support
LTS	leachate transmission system
µg/L	micrograms per liter
NPDES	National Pollutant Discharge Elimination System
OAC	*Ohio Administrative Code*
Ohio EPA	Ohio Environmental Protection Agency
OMMP	Operations and Maintenance Master Plan
OSDF	On-Site Disposal Facility
OU	Operable Unit
PLC	programmable logic controller
PLS	permanent lift station
ppb	parts per billion
RA	Remedial Action
ROD	Record of Decision
RW	recovery well

SSOD	storm sewer outfall ditch
SWRB	storm water retention basin
VFD	variable-frequency drive
WSA	Waste Storage Area

1.0 Introduction

This document is the Operations and Maintenance Master Plan (OMMP) for Aquifer Restoration and Wastewater Treatment (ARWWT) at the U.S. Department of Energy's (DOE's) Fernald Preserve. The OMMP is a formal remedial design deliverable, originally prepared to fulfill Task 2 of the *Remedial Design Work Plan for the Remedial Actions at OU5* (DOE 1996a). It was first issued in November 1997. The OMMP has undergone several revisions and became part of the *Comprehensive Legacy Management and Institutional Controls Plan* (LMICP) in January 2006.

1.1 Scope of ARWWT and Objectives of the OMMP

The scope of ARWWT includes the operation and maintenance of the site's groundwater and the On-Site Disposal Facility's (OSDF's) leachate management facilities.

The fundamental objectives of the OMMP are to guide and coordinate the extraction, collection, conveyance, treatment, and discharge of all groundwater and leachate during the post-closure period. Compliance with discharge limits includes a plan of the commitments, performance goals, operating schedule, treated water flow rates, direct discharge flow rates, and other operating priorities. This plan also provides the approach for the management of treatment residuals (e.g., backwash basin sediments, spent resins/filtration media) that are byproducts of the Fernald Preserve's wastewater treatment processes.

The OMMP serves as a comprehensive statement of management policy to ensure that planned modes of operation and maintenance for ARWWT are consistent with regulatory requirements and satisfy the Fernald Preserve's remedy performance commitments for groundwater restoration and wastewater treatment. The plan establishes the decision logic and priorities for the major flow and water treatment decisions needed to maintain compliance with the Fernald Preserve's National Pollutant Discharge Elimination System (NPDES) permit and Record of Decision (ROD)-based surface water discharge limits. The plan also provides the overall management philosophy and decision parameters to implement the day-to-day flow routing, critical-component maintenance, and treatment priority decisions. It is not intended to provide detailed, specific operating or maintenance procedures for ARWWT. The plan also serves to inform the U.S. Environmental Protection Agency (EPA) and the Ohio Environmental Protection Agency (Ohio EPA) of the planned operational approaches and strategies that are intended to meet the regulatory agreements made during the Operable Unit 5 (OU5) remedial investigation/feasibility study (DOE 1995a, DOE 1995b) process and documented in the OU5 decision documents: the *Record of Decision for Remedial Actions at OU5* (DOE 1996b), the *Explanation of Significant Differences for Operable Unit 5* (DOE 2001b), and the *Remedial Design Fact Sheet for Operable Unit 5 Wastewater Treatment Updates* (DOE 2004).

The plan provides the basis for development of more-detailed internal operating procedure documents (e.g., standard operating procedures, preventive maintenance plans) that are required for execution of work at the Fernald Preserve. The existing detailed procedural documents that govern the performance of water-related operations and maintenance activities at the Fernald Preserve are expected to be updated (revised, combined, or eliminated) as required to conform to the general strategies, guidelines, and decision parameters defined in this plan.

1.2 Basis and Need

The need for the OMMP arose in the mid-1990s, as DOE and regulators realized that the various water and wastewater flows that originate from Fernald Site remediation activities were in direct competition with one another for treatment resources. The wastewater treatment capacities at the Fernald Site had to be prioritized so that (1) discharge limits could be maintained, (2) a range of flow conditions at various time intervals could be accommodated, and (3) the detrimental effects of exceptional operating circumstances could be effectively managed. The need for treatment (and the accompanying hierarchy of treatment priorities) has varied over the span of the site remedy as new projects came on line, other projects were completed, and aquifer restoration activities progressed.

During development of the OU5 ROD (DOE 1996b), it was recognized that the monthly average concentration discharge limit for total uranium (established at 20 parts per billion [ppb] in the OU5 ROD and revised to 30 ppb in the Explanation of Significant Differences [ESD] for Operable Unit 5 [DOE 2001b]) could probably be met under average operating conditions, but that maintaining the limit may not be achievable during periods of exceptional operating conditions. It was further recognized that the application of the discharge limit was not considered as a required component of the remedy to ensure protectiveness, but rather as an appropriate performance-based objective that appeared reasonably attainable through the application of an appropriate level of water treatment. It was recognized that the performance-based discharge limit must be able to accommodate exceptional operating conditions expected to occur over the duration of the remedy. Two exceptional operating conditions were actually cited in the OU5 ROD; it would permit relief allowances from the total uranium monthly average concentration discharge limit, when necessary, for (1) storm water bypasses during high-precipitation events and (2) periodic reductions in treatment plant operating capacity that are necessary to accommodate scheduled maintenance activities. Since storm water treatment is no longer required (other than a portion of the Converted Advanced Wastewater Treatment facility [CAWWT] footprint), storm water bypasses are no longer required.

At the time the ROD was signed, it was recognized that the OMMP would define the operating philosophy for (1) the extraction/re-injection and treatment systems, (2) the establishment of operational constraints and conditions for given systems, and (3) the establishment of the process for reporting and instituting corrective measures to address exceedances of discharge limits. The OMMP also contains detailed information about the manner in which exceptional operating conditions are to be accommodated and reported in the demonstration of discharge limit compliance.

The OMMP will be modified during the course of the remedy to accommodate changes to the treatment and well field systems or the retirement of individual restoration modules from service, once area-specific cleanup levels are achieved. The plan is intended to serve as a living guidance document to instruct operations staff in implementing required adjustments to the system over time and to ensure that the most recent instructions regarding treatment priorities and flow-routing decisions are available to system operators. Proper notifications for reporting maintenance shutdowns of the system, and the reporting and application of corrective measures to address exceedances of discharge limits, are also identified in the OMMP.

Prior to site closure in 2006, water treatment flows were primarily reduced to groundwater and leachate from the OSDF. Elimination of remediation wastewater, impacted storm water, and sanitary sewer wastewater provided an opportunity to reduce the size of the water treatment facility remaining to service the aquifer restoration and leachate treatment after site closure. Reducing the size of the treatment facility prior to site closure in 2006 reduced the amount of impacted materials that may need future offsite disposal.

Between October 2003 and March 2004, DOE conducted a series of meetings with public stakeholders, EPA, and the Fernald Citizens Advisory Board to identify a more cost-effective water treatment facility that would serve as a long-term replacement for the existing Advanced Wastewater Treatment (AWWT) facility. The interactions led to support for a plan to carve down the AWWT facility to permit the 1,800-gallons-per-minute (gpm) Phase III expansion system to remain as the long-term groundwater treatment facility. The 1,800-gpm CAWWT provided a 1,200-gpm capacity for groundwater and about 600 gpm of storm water capacity (including carbon treatment) to handle the last remaining storm water and remediation wastewater flows prior to site closure. Upon site closure in 2006, the need to treat storm water and wastewater flows ceased. Therefore, at site closure the CAWWT provided a dedicated long-term groundwater treatment capacity of up to 1,800 gpm.

In addition to the decrease in the size of the water treatment facility, operational approaches to the aquifer remedy were reevaluated and resulted in the elimination of well-based groundwater re-injection, since it was determined that this was not a cost-effective approach to aquifer restoration at Fernald. This OMMP reflects the aquifer restoration design provided in the *Waste Storage Area (Phase II) Design Report* (DOE 2005) and updated in the *Operational Design Adjustments-I WSA Phase I Groundwater Remediation Design, Fernald Preserve* (DOE 2014).

As predicted, each year the percentage of groundwater treatment needed to achieve uranium discharge limits decreased. As of the spring of 2011 the CAWWT was being operated on an as-needed basis. In 2011, DOE, EPA, and Ohio EPA agreed to proceed with reducing the treatment capacity from approximately 1,800 gpm down to 500–600 gpm. In 2012, the throughput treatment capacity of the CAWWT was safely reduced from 1,800 gpm down to 500–600 gpm by isolating trains 1 and 2 in place to serve as spare parts for treatment train 3.

Following the implementation of operational changes to the aquifer remediation system in 2014, a condition assessment of the CAWWT was conducted. The CAWWT condition assessment, issued in March 2015 (Whitman, Requardt & Associates, LLP 2015), concluded that many components of the CAWWT were past their design life and in need of replacement. Additionally, the treatment capacity of 500–600 gpm was significantly more than needed and groundwater modeling predictions based on the 2014 operational design predicted that this higher treatment capacity would not be needed in the future. Discussions were completed in the spring and summer of 2015 with regulators and stakeholders to help ensure a common understanding of the issues related to wastewater treatment at the site. DOE, EPA, Ohio EPA, and members of the community all reached agreement on replacing the 500 to 600 gpm system with a 50 gpm system that could be expanded in the future if deemed necessary.

Decontamination and demolition (D&D) of the 500 to 600 gpm system was completed at the end of 2016. Construction of the 50 gpm system began in September 2017 and was completed in April 2018.

1.3 Relationship to Other Documents

The OMMP functions in tandem with several other major ARWWT design documents and support plans, such as Attachment D, *Integrated Environmental Monitoring Plan* (IEMP); various aquifer restoration module design packages; the *Remedial Action* [RA] *Work Plan for Aquifer Restoration at Operable Unit 5* (DOE 1997a); and the *Fernald Groundwater Certification Plan* (DOE 2006).

The environmental monitoring and reporting activities conducted in support of aquifer restoration performance decisions are specified in the IEMP. Information obtained through the IEMP will be used to (1) appraise groundwater restoration progress, (2) assess the need for changing groundwater extraction flow rates, and (3) assess the durations of groundwater extraction activities over the life of the remedy.

The initial design flow rates, planned installation sequence, detailed design basis, and overall restoration strategy for the aquifer restoration modules that constitute the groundwater remedy were developed in the *Baseline Remedial Strategy Report, Remedial Design for Aquifer Restoration* (DOE 1997b). The overall restoration strategy has been modified as a result of information gained from the ongoing remedy performance/operations monitoring and pre-design monitoring conducted in support of the Waste Storage Area (WSA) (Phases I and II) Modules and the South Field Extraction System (Phase II) Module.

The Remedial Action Work Plan (submitted to EPA and Ohio EPA as Task 10 of the OU5 Remedial Design Work Plan) conveyed the enforceable RA construction schedule for the initial restoration modules brought online in 1998 (the Re-injection Demonstration Module, the South Field Extraction System Module, and the South Plume Optimization Module). It also contained the planning-level RA construction schedule for the remaining modules to be brought online in later years. With the completion and startup of the Waste Storage Area Phase I Module in 2002 and the South Field Phase II Module in 2003, all the schedules specified in the RA Work Plan have been met.

The *Fernald Groundwater Certification Plan* (DOE 2006) defines a programmatic strategy for certifying the completion of the aquifer remedy. The Certification Plan establishes the processes that will be used to achieve groundwater restoration and conduct certification. The preferred outcome is to certify that the OU5 ROD groundwater remediation goals have been achieved using the pump-and-treat remediation system that is currently operating at the site. The plan also covers other potential contingencies and exit scenarios. Any change to the operation of the aquifer remedy system needed to achieve certification will be controlled through the OMMP.

The OMMP has functioned in tandem with several other remedial design or design support plans prepared by other project organizations outside ARWWT. All the other site remediation projects have been completed; therefore, there is no longer a need to interface with other projects, as only a small flow of leachate from the OSDF and groundwater remains to be treated.

1.4 Plan Organization

The plan is generally organized around the wastewater streams. The sections and their contents are as follows:

Section 1.0 Introduction: Presents an overview of the plan, its objectives, its relationship to other documents, and its organization.

Section 2.0 Summary of Regulatory Drivers and Commitments: Discusses the applicable or relevant and appropriate requirements compliance crosswalk and provides a summary of the other commitments and guidelines that the OU5 ROD has activated for ARWWT.

Section 3.0 Descriptions of Major ARWWT Components: Identifies the major collection, conveyance, and treatment components that constitute the Fernald Preserve's system for managing groundwater and leachate, the treatment capacities that are available, and a schedule of major ARWWT activities throughout the aquifer restoration process.

Section 4.0 Projected Flows: Provides an estimate of flow generation rates and durations for groundwater and leachate.

Section 5.0 Operations Plan: Establishes the operations philosophy, treatment priorities and hierarchy, treatment operational decisions, well field operational objectives and decisions, maintenance priorities, controlling documentation, and the management and flow of operations information to successfully operate the groundwater and leachate transmission systems to achieve regulatory requirements and commitments.

Section 6.0 Operations Performance Monitoring and Maintenance: Addresses the general methods, guidelines, and practices used in managing equipment operation and maintenance; discusses some of the dedicated organizational resources and management systems that will help to ensure that ROD requirements are met; describes the key parameters used to monitor the performance of the groundwater and wastewater facilities; and describes the principal features and maintenance needs of the overall operation.

Section 7.0 Organizational Roles, Responsibilities, and Communications: Presents the organizational roles and responsibilities with respect to implementation of this OMMP; also presents the communications protocol for coordinating with EPA and Ohio EPA.

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2.0 Summary of Regulatory Drivers and Commitments

Regulatory drivers and commitments, as they pertain to the successful operation of the treatment system and associated groundwater extraction systems, involve source water treatment requirements and the specific effluent limits that need to be met. (Other regulatory requirements, legal agreements, and agency commitments apply to the site as a whole, and those may apply to the treatment process. However, these general Fernald Preserve drivers and commitments are not discussed further in this section.)

2.1 Discharge Limits

The required effluent limits for this discharge are governed by the OU5 ROD for the uranium component of the discharge and by the NPDES permit (Permit No. 1IO00004*ID) for the non-uranium parameters. This permit became effective on March 1, 2015, and expires on February 29, 2020. Requirements from the new permit are incorporated into the LMICP.

Up until 2011, the discharges from the Fernald Preserve to the Great Miami River were primarily associated with the groundwater remedy involving the treated effluent (primarily groundwater) from the CAWWT and extracted groundwater that is discharged without treatment. Small volumes of other wastewater sources (Section 2.2) were blended into the treatment stream as needed. The combined effluent from the CAWWT was discharged to the Great Miami River through the Parshall Flume Building, which is the final monitoring point before effluent reaches the Great Miami River.

Since 2011, groundwater has not needed to be routinely treated to meet discharge limits, resulting in rightsizing the treatment system to a 50 gpm system. With no need to routinely treat groundwater and a smaller 50 gpm system, treatment mainly addresses the other wastewater sources (Section 2.2). The other wastewater streams are first sent to the backwash basin. Wastewater from the backwash basin is mixed with groundwater and is routed to the 50 gpm system. The ratio of water from the backwash basin to groundwater is variable depending on the concentration of suspended sediments in the basin and concentration of anions in the water.

2.1.1 OU5 ROD

The OU5 ROD states that treatment will be applied to all discharges to the Great Miami River, to the extent necessary, to limit the total mass of uranium discharged through the Fernald Preserve outfall to the Great Miami River to no more than 600 pounds per year (lb/yr). This mass-based discharge limit became effective upon the issuance of the OU5 ROD (DOE 1996b). Additionally, the necessary treatment will be applied to limit the concentration of total uranium in the blended effluent to the Great Miami River to no greater than 30 ppb. The 30 ppb discharge limit for uranium is based on a monthly flow-weighted average concentration. This limit became effective December 1, 2001, based on the *Explanation of Significant Differences for Operable Unit 5* (DOE 2001b), which replaced the original 20 ppb standard that applied to the Fernald site beginning January 1, 1998.

The OU5 ROD stipulates specific circumstances that necessitate relief from the concentration limit. Relief can be requested for maintenance activities. EPA approval must be obtained in advance by notification of these planned maintenance periods. The notification must be accompanied by a request for the uranium concentrations in the discharge not to be considered in the monthly averaging performed to demonstrate compliance with the 30 ppb total uranium discharge limit. Uranium contained in these bypass events will only be counted in the annually discharged mass, not in the monthly average concentration calculations.

2.1.2 NPDES Permit

Under the Clean Water Act, as amended, the Fernald Preserve is governed by NPDES regulations that require the control of discharges of nonradiological pollutants to waters of the State of Ohio. The NPDES permit, issued by the State of Ohio, specifies discharge and sample locations, sampling and reporting schedules, and discharge limits. The Fernald Preserve submits monthly reports on NPDES activities to Ohio EPA. The Fernald Preserve's current NPDES permit, No. 1IO00004*ID, became effective on March 1, 2015, and expires on February 29, 2020. Requirements from this permit are incorporated into the LMICP.

2.2 Source Water Treatment Requirements

Three sources of wastewater have specific management requirements: groundwater, OSDF leachate, and storm water.

2.2.1 Groundwater

Since 2011, the aquifer remedy has been able to achieve uranium discharge limits (i.e., average monthly concentration of less than 30 micrograms per liter [µg/L] and 600 pounds annually) established in the OU5 ROD (DOE 1996b) without routine groundwater treatment.

2.2.2 Storm Water

With the exception of stormwater that falls on the concrete pad at the CAWWT, it is not expected that any storm water will require treatment, since soil remediation and certification has been completed. Storm water that falls on the CAWWT concrete tank pad is collected in a sump, pumped to the backwash basin, and sent to treatment.

2.2.3 OSDF Leachate

Ohio Administrative Code (OAC) 3745-27-19, "Operational Criteria for a Sanitary Landfill Facility," requires the treatment of leachate. Leachate from the OSDF is a minimal flow. Leachate will be treated through the CAWWT prior to discharge to the Great Miami River until the CAWWT is no longer needed. Leachate is pumped to the CAWWT backwash basin first and then for treatment through the 50 gpm treatment system. Prior to the cessation of CAWWT operations, currently planned for late 2035, DOE will have proposed and negotiated the future management of leachate with EPA and Ohio EPA.

3.0 Descriptions of Major ARWWT Components

This section describes the major operating system components required to accomplish aquifer remedy commitments and goals. The site conveyance and treatment system components for managing the major wastewater streams are identified, as are treatment capacities. This section also describes key linkages between the components. Figure 1 depicts the facilities as well as groundwater wells on a projected view of the site. Figure 2 provides a timeline of major activities that have occurred and those that are projected to occur throughout the aquifer restoration process.

3.1 Groundwater Component

Remediation of the Great Miami Aquifer is divided into area-specific groundwater restoration modules. These modules were specified in the following documents:

- Remedial Design/Remedial Action work plans for OU5
- *Baseline Remedial Strategy Report, Remedial Design for Aquifer Restoration*
- *Design for the Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas* (DOE 2001a)
- *Design for Remediation of the Great Miami Aquifer South Field (Phase II) Module* (DOE 2002)
- *Waste Storage Area (Phase II) Design Report* (DOE 2005)

During 2003, new information became available (refer to the *Comprehensive Groundwater Strategy Report* [Fluor Fernald Inc. 2003]) that allowed for more refined groundwater modeling predictions of when aquifer restoration would be completed. The updated modeling predictions and groundwater remedy performance monitoring data both indicated that the aquifer restoration time frame would likely be extended beyond the dates previously predicted. The updated modeling also indicated that the use of groundwater re-injection via wells did not significantly reduce the time required to remediate the aquifer.

In 2005, EPA approved the *Fernald Groundwater Certification Plan* (DOE 2006), a programmatic strategy for certifying the completion of the aquifer remedy. The Certification Plan established the processes that will be used to achieve groundwater restoration and conduct certification of the aquifer remedy. The Certification Plan relies on the IEMP and the OMMP for implementation of that process.

In 2014, the ongoing pump-and-treat groundwater remediation was optimized as presented in the *Operational Design Adjustments-1, WSA Phase-II Groundwater Remediation Design, Fernald Preserve* (DOE 2014). The changes were implemented because model-predicted cleanup times were extended when updated uranium analytical data were input into the model. Operational changes were made in an attempt to speed up the cleanup of some areas of the aquifer (DOE 2014). The new cleanup times are reflected in Figure 2. As shown in Figure 2, pump-and-treat activities are predicted to be necessary until 2035. Note that the groundwater remedy is concentration-based and will continue until the cleanup goals specified in the OU5 ROD are achieved.

3.1.1 Current Groundwater Restoration Modules

Three groundwater restoration modules are currently in operation:

- South Plume
- South Field (Phases I and II)
- Waste Storage Area (Phases I and II)

Figure 3 shows the approximate area of each of these modules and associated wells. Subsections 3.1.1.1–3.1.1.3 provide descriptions of each of the modules.

3.1.1.1 South Plume Module

Five extraction wells were installed in 1993 at the leading edge of the off-property South Plume, as part of the South Plume removal action, to gain an early start on groundwater restoration. The South Plume removal action well system began pumping in August 1993. The primary intent of the original five-well system was to prevent further off-property migration of contamination within the groundwater plume. It was determined that one of the wells (RW-5) was not providing any additional benefit and was turned off in 1993. The other four wells have been operating since 1993. Two additional extraction wells came online in August 1998 for the active restoration of the central portion of the off-property plume. These two new wells, known as the South Plume Optimization Module, have now been incorporated into the South Plume Module for remedy performance tracking and reporting. Figure 3 shows the locations of the wells, and Table 1 provides the operating status of the South Plume Module.

As of 2018, the South Plume wells have been operating for over 25 years. Well RW-4 can no longer yield sufficient water to maintain the design set point of 200 gpm. To maintain the water level above the pump intake, during 2018 the pumping rate for the well was lowered several times. A concrete plug installed in 2011 in the bottom of the well to address a hole in the screen limits pump placement. The pump can no longer be lowered to maintain the water level above the pump intake. A modeling assessment was conducted to determine if model predicted cleanup times or capture of the remaining uranium plume would be impacted if well RW-4 was turned off. The model indicated that there would be no impact to model predicted cleanup times or capture of the remaining plume if the well was turned off in 2018 and the rest of the well field remained operating at design pumping rates. Modeling results were discussed with EPA and Ohio EPA in July 2018 during the quarterly regulator meeting. Consensus agreement was reached that the pumping rate in well RW-4 could be lowered to 100 gpm and that the well will continue to be operated until failure. Continued operation of well RW-4 at a 100 gpm set point is a conservative approach that provides for modeling uncertainties associated with pumping remedies.

3.1.1.2 South Field Module

The South Field Module was installed in two phases. South Field Extraction System Phase I Module includes 10 extraction wells. In 1996, as part of an EPA-approved early-start initiative, the 10 extraction wells were installed on Fernald Site property near the south field/storm sewer outfall ditch (SSOD). These wells are removing groundwater contamination in an on-property area of the southern uranium plume.

Figure 1. ARWWT Facilities Locations Map

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Aquifer Restoration			Wastewater Treatment
		1952	Sewage Treatment Plant (STP)
		1986	Bio-surge Lagoon/High Nitrate Tank (BSL/HNT)
		1988	Storm Water Retention Basin (SWRB)
		1992	Interim Advanced Wastewater Treatment (IAWWT) Facility
South Plume Extraction Wells	1993		
		1994	South Plume Interim Treatment (SPIT) Facility
		1995	Advanced Wastewater Treatment Facility (AWWT) Phases I/II
		1996	Slurry Dewatering Facility (SDF)
Injection Demonstration Module, South Plume Optimization Module, South Field Extraction Module (Phase I)	1998	1998	AWWT Resin Regeneration System, New STP Operational, AWWT Expansion
		1999	Bio-surge Lagoon (BSL) Pump and Piping Modifications/Sludge Removal System
Waste Storage Area Module (Phase I)	2002		
South Field Extraction Module (Phase II)	2003		
Shut Down Well-based Re-injection	2004	2004	Shut Down AWWT Expansion for Conversion to CAWWT – 9/04
		2005	Reroute of Leachate and Waste Storage Area Storm Water to SWRB – 3/05 BSL is Shut Down for decommissioning and demolition (D&D) and Excavation – 3/05 Begin Full-Scale Operation of CAWWT – 3/05 Shut Down SDF and Sewage Treatment Plant for D&D and Excavation – 3/05 Shut Down AWWT Phases I & II for Selective D&D and Excavation – 3-4/05 Shut Down SPIT/IAWWT for D&D and Excavation – 7/05 Reroute Waste Storage Area Storm Water to CAWWT – 10/05 Shut Down West SWRB for D&D and Excavation – 10/05
Waste Storage Area Module (Phase II) Pilot Plant Replacement Well Storm Sewer Outfall Ditch Infiltration	2006	2006	Shut Down East SWRB for D&D and Excavation – 2/06 Reroute of OSDF Leachate/Storm Water Directly to CAWWT – 2/06 CAWWT Backwash Basin Operational – 2/06 OSDF Capped Sufficiently Such that OSDF Storm Water Can Be Routed to Free Release – 2006
		----	Transfer of Site from the DOE Office of Environmental Management (EM) to the DOE Office of Legacy Management (LM).
		2011	Limited Groundwater Treatment to Meet Discharge Limits
		2012	Throughput Capacity of CAWWT Safely Reduced from 1,800 gpm Down to Approximately 500–600 gpm
		2015	CAWWT Conditions Assessment and Decision to Replace System
		2016	Completed Initial D&D of Eight of Ten CAWWT Treatment Vessels
		2018	Completed Construction and Startup of New 50 gpm CAWWT Treatment System
South Plume and Southern Portion of the South Field Module – Stop Pump-and-Treat Operations[a]	2022		
South Plume Module – Certified Clean[b]	2025		
Northern Portion of South Field Module – Stop Pump-and-Treat Operations[a] South Field Module Certified Clean[b]	2030 2033		
South Field Module – Remove Infrastructure South Plume Module – Remove Infrastructure	2034		
Waste Storage Area – Stop Pump-and-Treat Operations[a]	2035		
Waste Storage Area Certified Clean[b]	2038		
Waste Storage Area – Remove Infrastructure	2039		
Long-Term Monitoring Ends	2044		

[a] Stop pump-and-treat operations' dates are based on modeling predictions reported in *Operational Design Adjustments -1 WSA Phase-II Groundwater Remediation Design Fernald Preserve* (DOE 2014), and dates reflect implementation beginning in 2014. The groundwater remedy is concentration-based and will continue until OU5 ROD-specified cleanup goals are achieved.
[b] Certified clean dates assume best case (3.25 years).

Figure 2. Aquifer Restoration and Wastewater Treatment Timeline

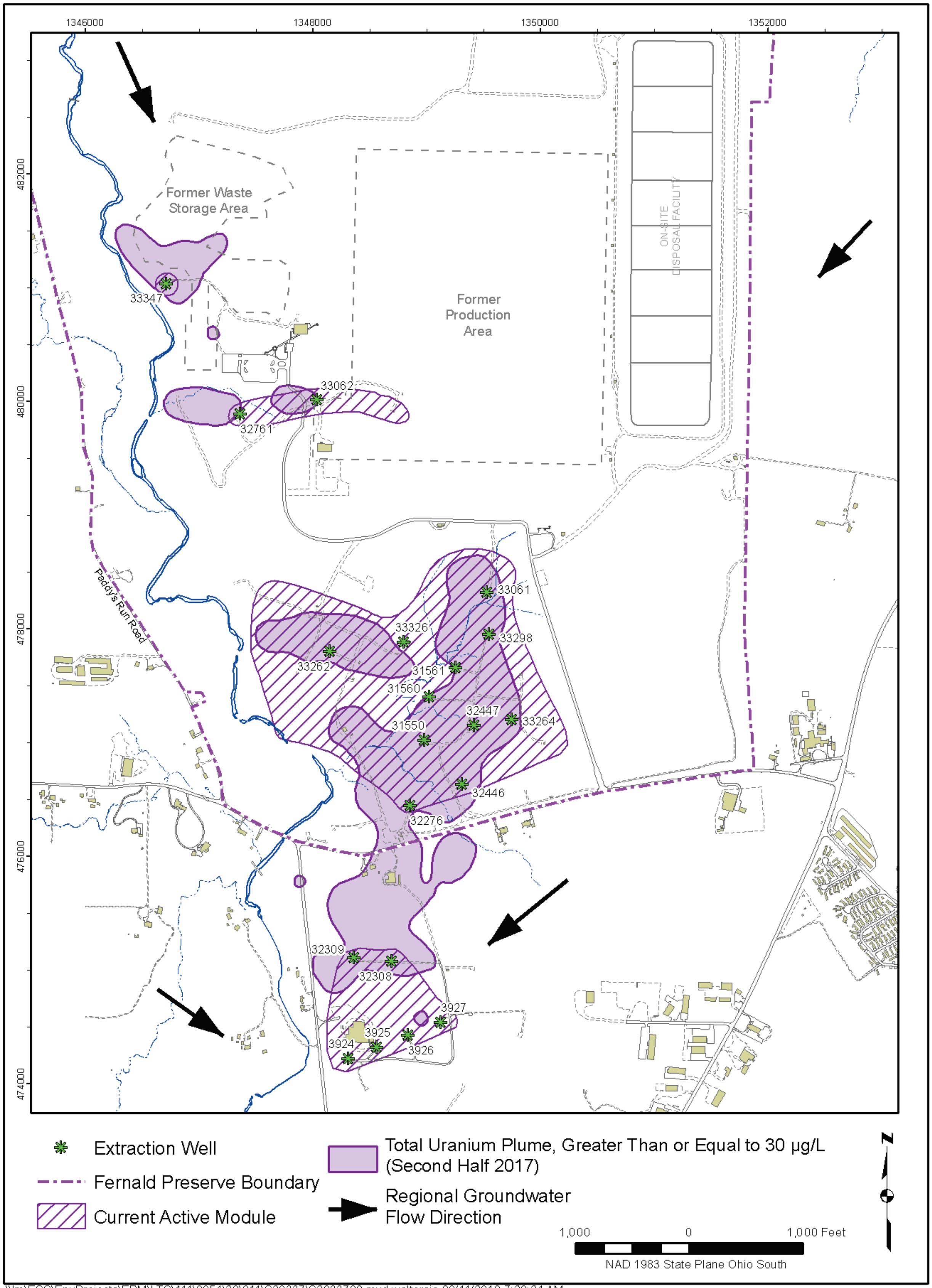

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Figure 3. Extraction Wells for the Groundwater Remedy

Table 1. Well Field Operating Status

Module	Operations Identification	Database Identification	Date of Initial Operation	Current Status	Notes
South Plume	RW-1	3924	08/27/93	Active	
South Plume	RW-2	3925	08/27/93	Active	
South Plume	RW-3	3926	08/27/93	Active	
South Plume	RW-4	3927	08/27/93	Active	
South Plume	RW-5	3928	08/27/93	Inactive	Turned off 9/11/94, not needed
South Plume	RW-6	32308	08/09/98	Active	
South Plume	RW-7	32309	08/09/98	Active	
South Field	EW-13	31565	07/13/98	Inactive	Turned off 5/22/01
South Field	EW-14	31564	07/13/98	Inactive	Turned off 12/19/01
South Field	EW-15	31566	07/13/98	Inactive	Turned off 8/7/98, replaced by EW-15A
South Field	EW-15A	33262	07/26/03	Active	
South Field	EW-16	31563	07/13/98	Inactive	Turned off 12/19/02, converted to IW-16
South Field	EW-17	31567	07/13/98	Inactive	Turned off 9/6/05, replaced by EW-17A
South Field	EW-17A	33326	09/13/05	Active	
South Field	EW-18	31550	07/13/98	Active	
South Field	EW-19	31560	07/13/98	Active	
South Field	EW-20	31561	07/13/98	Active	
South Field	EW-21	31562	07/13/98	Inactive	Turned off 3/13/03, replaced by EW-21A
South Field	EW-21A	33298	07/29/03	Active	
South Field	EW-22	32276	07/13/98	Active	
South Field	EW-23	32447	02/02/00	Active	
South Field	EW-24	32446	02/02/00	Active	
South Field	EW-25	33061	05/07/02	Active	
South Field	EW-30	33264	07/25/03	Active	
South Field	EW-31	33265	07/25/03	Inactive	Turned off 4/14/14
South Field	EW-32	33266	07/25/03	Inactive	Turned off 4/14/14
Waste Storage Area	EW-26	32761	05/08/02	Active	
Waste Storage Area	EW-27	33062	05/08/02	Active	
Waste Storage Area	EW-28	33063	05/08/02	Inactive	Turned off 7/01/05, plugged and abandoned
Waste Storage Area	EW-28a	33334	06/29/06	Inactive	Turned off 4/14/14
Waste Storage Area	EW-33	33330		Inactive	Never installed, location moved
Waste Storage Area	EW-33A	33347	10/05/06	Active	
Re-injection	IW-8	22107	09/02/98	Inactive	Turned off 12/31/01
Re-injection	IW-8A	33253	11/07/02	Inactive	Turned off 9/25/04
Re-injection	IW-9	22108	09/02/98	Inactive	Turned off 3/01/02
Re-injection	IW-9A	33254	11/07/02	Inactive	Turned off 9/25/04
Re-injection	IW-10	22109	09/02/98	Inactive	Turned off 9/25/04
Re-injection	IW-10A	33255	05/22/03	Inactive	Turned off 9/25/04
Re-injection	IW-11	22240	09/02/98	Inactive	Turned off 9/25/04
Re-injection	IW-12	22111	09/02/98	Inactive	Turned off 9/25/04
Re-injection	IW-16	31563	07/27/03	Inactive	Turned off 9/25/04
Re-injection	IW-29	33263	07/27/03	Inactive	Turned off 9/25/04
Re-injection	Inj. Pond	NA	07/27/03	Inactive	Turned off 9/25/04

Since the installation of the 10 original extraction wells of the South Field Extraction Phase I Module, and prior to 2014, three new extraction wells were added to the module, three of the original wells were shut down, and one of the original wells was converted to a re-injection well. The three extraction wells that were shut down are all located in the upgradient area of the plume where total uranium concentrations in the Great Miami Aquifer are now below the final remediation level (FRL). An additional consideration in removing two of these three wells was to accommodate soil remedial activities near the wells.

The three new wells added to the South Field Phase I Module were installed at locations where total uranium concentrations were considerably above the groundwater FRL, in the eastern, downgradient portion of the South Field plume. Two of the three new wells were installed in late 1999 and began pumping in February 2000. The third well was installed in 2001 and became operational in 2002.

Phase II components of the South Field became operational in 2003. The components included:

- Four additional extraction wells, one in the southern waste unit area and three along the eastern edge of the on-property portion of the southern uranium plume.
- One additional re-injection well in the southern waste unit area. All re-injection wells have been removed from service.
- A converted extraction well, which was converted into a re-injection well. All re-injection wells have been removed from service.
- An injection pond, which was located in the western portion of the Southern Waste Units Excavations. The injection pond was removed from service along with all re-injection wells.

Operational changes were implemented in the South Field in 2014 in an effort to accelerate the predicted cleanup of the southern half of the South Field. Two extraction wells in the South Field were turned off and the pumping budget was reallocated to other areas of the South Field where the uranium concentration remained above the cleanup FRL.

Table 1 provides the operational status of the currently configured South Field Extraction System Module (Phase I and Phase II components) with 2014 operational changes.

3.1.1.3 Waste Storage Area Module

The Waste Storage Area Module was designed and installed in two phases. The Waste Storage Area Extraction System targets contaminants in the Great Miami Aquifer underlying the former Waste Storage Area (OU1 and OU4). Figure 3 shows the geographical location of the area. The *Design for the Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas* (DOE 2001a) defines the Phase I design. Phase I addresses the plume of contamination defined in the vicinity of the Pilot Plant Drainage Ditch. The *Waste Storage Area (Phase II) Design Report* (DOE 2005) defines the Phase II design. Phase II addresses the plume of contamination defined in the vicinity of the former Waste Pit Area.

Phase I of the Waste Storage Area Module consists of one 12-inch diameter well and two 16-inch-diameter extraction wells complete with submersible pumps with variable-frequency drives (VFDs), well houses, electrical power, instrumentation and controls, fiber optic communications, and dual discharge headers (one for treatment and one for direct discharge).

Operation of this phase of the module began on May 8, 2002. The easternmost well in the Phase I design (extraction well [EW] 33063 or EW-28) was taken out of service, then plugged and abandoned in July 2004 to make way for soil remediation activities. The well was replaced in 2005 and was brought online in 2006 prior to the site's transition from the DOE Office of Environmental Management (EM) to the DOE Office of Legacy Management (LM).

The *Design for the Remediation of the Great Miami Aquifer in the Waste Storage Area and Plant 6 Areas* (DOE 2001a) concluded that uranium concentrations in the Great Miami Aquifer beneath Plant 6 had naturally attenuated to concentrations below 20 ppb. While the data indicated that no extraction wells and infrastructure were needed for the former Plant 6 Area, monitoring of the area will continue until aquifer restoration certification is completed and approved by EPA and Ohio EPA.

Phase II of the Waste Storage Area Module consists of one 16-inch-diameter well with a submersible pump, a VFD, a well house, electrical power, instrumentation and controls, fiber optic communications, and a dual-discharge header.

Operational changes were implemented in the Waste Storage Area Module in 2014 (DOE 2014) in an area where the uranium concentration was below the FRL. One extraction well in the Waste Storage Area was turned off, and the pumping budget was reallocated to areas of the south field where the uranium concentration remained above the cleanup FRL.

3.1.2 Groundwater Collection and Conveyance

An extensive system of collection and conveyance piping was installed for the remediation of the Great Miami Aquifer. These piping systems were specified in the various module-specific design documents. Figure 4 provides an overview of the current wellfield piping.

As described in Section 2.2.1, the piping network that conveys on-property extracted groundwater from the individual extraction wells has double headers, one connected to the main line to treatment and the other to the main discharge line as shown in Figure 4. The double headers allow for treatment/bypass decisions to be made on an individual-well basis for the on-property wells.

This design feature is not applicable to the off-property South Plume Module, which was largely in place prior to the design of the on-property piping network. Since individual well bypass/treatment lines are not available on the South Plume wells, treatment/bypass decisions for the six wells in this system are made on the basis of uranium concentration in the combined flow from all of the wells. Routing decisions for these wells need to be made on a modular basis, as indicated in Figure 4.

Since groundwater treatment is no longer routinely needed to meet discharge limits and the treatment system has a 50 gpm capacity, very little groundwater is routed to treatment. Groundwater is blended with water from the backwash basin to facilitate the treatment of water from the backwash basin.

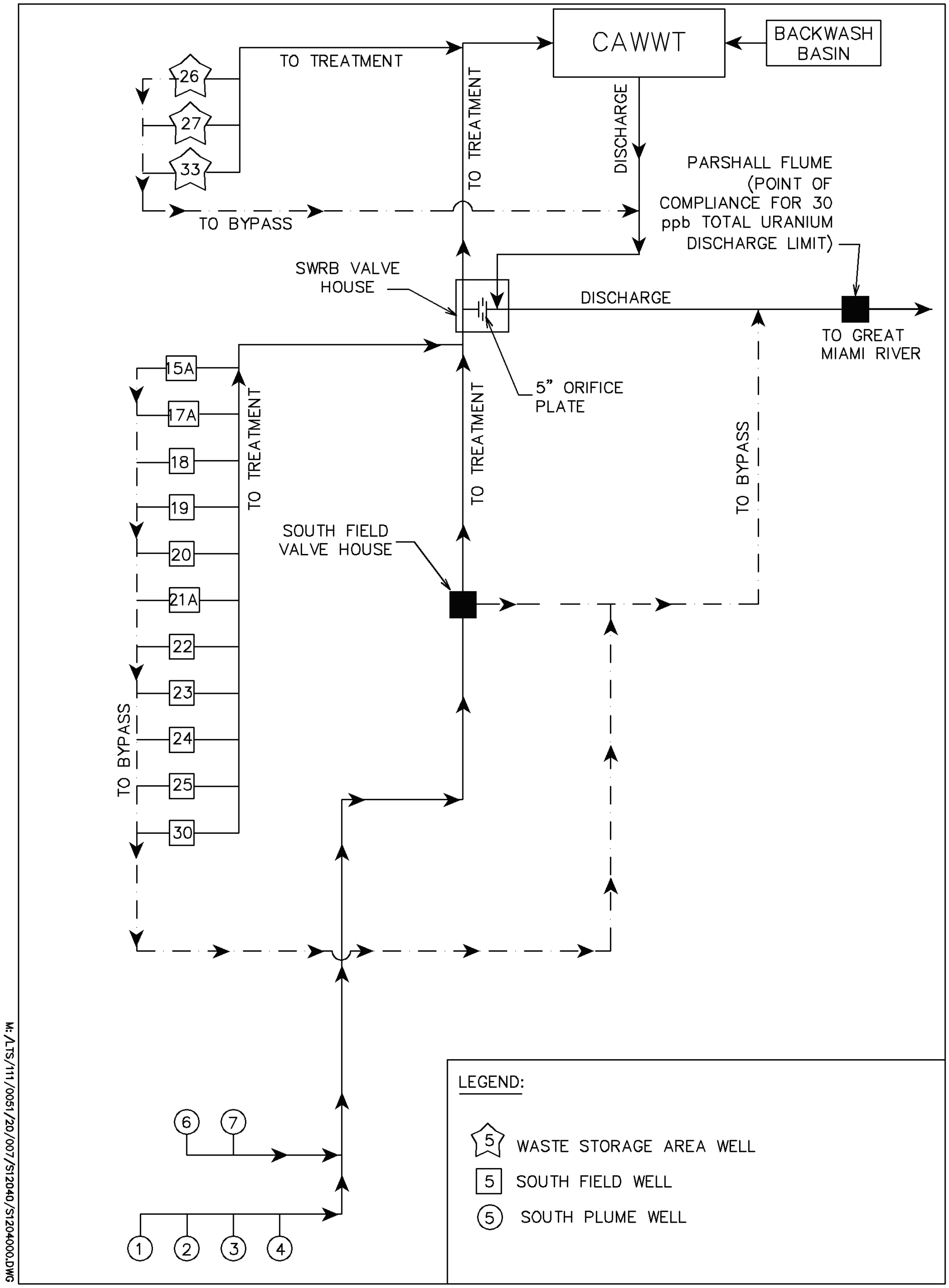

Figure 4. Current Groundwater Remediation/Treatment Schematic

3.1.3 Great Miami Aquifer Remedy Performance Monitoring

Section 3 of the IEMP provides for the routine remedy performance monitoring of the Great Miami Aquifer. Details of how the remedy performance data are being evaluated and the associated decision-making process are located in Section 3.7 of the IEMP. Figure 5 illustrates the groundwater certification process for the aquifer remedy. As illustrated in Figure 5 remedy performance monitoring is being conducted to assess the efficiency of mass removal and to gauge performance in meeting remediation objectives. If it is determined that aquifer restoration program expectations (as identified in the IEMP) are not being met, the design and operation of the aquifer restoration system will be evaluated to determine if a change needs to be implemented. A change to the operation of the aquifer restoration system would be implemented by a modification to this OMMP. A groundwater monitoring change, if found to be necessary, would be implemented through the IEMP review and approval process. If additional characterization data are needed (e.g., to determine the nature of a newly detected FRL exceedance), a modification to the IEMP would be implemented, or a new sampling plan would be prepared, depending on the anticipated size of the activity.

If a new extraction well is put into operation, additional monitoring wells may be installed to help monitor the performance of the new wells. New extraction wells are also monitored for uranium concentration on a frequent basis just after startup. The sitewide groundwater data collected via the IEMP are used to assess the performance of the sitewide groundwater remedy. Any data, derived from additional monitoring wells and/or new extraction well uranium monitoring, would be integrated with the IEMP groundwater monitoring such that area-wide interpretations could be made. Changes to the scope of the routine monitoring identified in the IEMP may be necessary based on the results of sampling conducted in the new monitoring and extraction wells. These changes would be accommodated as necessary through the prescribed IEMP review process.

Details of the annual reporting of groundwater remedy performance are also provided in the IEMP, Section 3.7. The reporting subsection provides the specific information to be reported in the comprehensive Site Environmental Report.

3.2 Other Site Wastewater Sources

Because treatment for groundwater on a routine basis is no longer needed to meet discharge limits, other site wastewater sources comprise the main portion of the water being sent to the 50 gpm system. Other wastewater sources include leachate from the OSDF, small amounts of wastewater from the extraction well rehabilitation, wastewater from the CAWWT laboratory, investigation-derived water from sampling, and a small amount of storm water from portions of the CAWWT footprint that will be collected and treated as necessary.

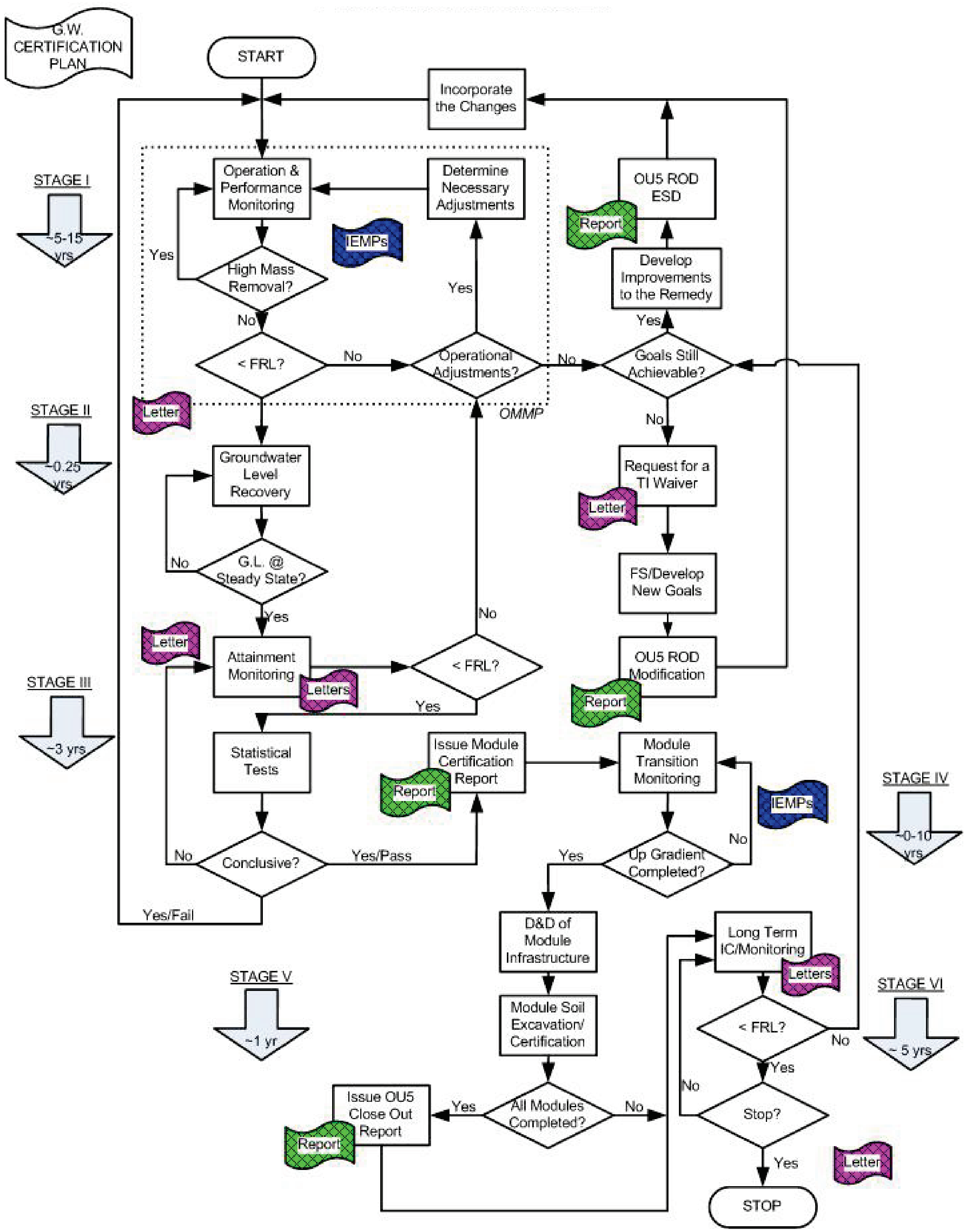

Figure 5. Groundwater Certification Process and Stages

3.3 Treatment System

As noted in Section 1.0, with site closure in 2006, several water treatment flows were eliminated (remediation and sanitary wastewater) or greatly reduced (storm water runoff) from the scope of the treatment operation. The elimination or reduction of these flow streams provided an opportunity to reduce the size of the water treatment facility that remained to service the aquifer restoration after site closure. The various facility shutdown dates are provided in Figure 2.

As noted in Section 1.0, the AWWT expansion system was "converted" to the long-term groundwater treatment facility called the CAWWT. The CAWWT provides a dedicated long-term groundwater treatment capacity for the Fernald Preserve. The original capacity of the CAWWT was up to 1,800 gpm.

As predicted, each year the percentage of groundwater treatment needed to achieve uranium discharge limits decreased. As of the spring of 2011, the CAWWT was being operated intermittently on an as-needed basis. In 2011, DOE, EPA, and Ohio EPA agreed to proceed with reducing the treatment capacity from approximately 1,800 gpm down to 500–600 gpm. In 2012, the throughput treatment capacity of the CAWWT was safely reduced from 1,800 gpm down to 500–600 gpm by isolating trains 1 and 2 in place to serve as spare parts for treatment train 3.

Following the implementation of operational changes to the aquifer remediation system in 2014, a condition assessment of the CAWWT was conducted. The CAWWT condition assessment, issued in March 2015 (Whitman, Requardt & Associates, LLP 2015), concluded that many components of the CAWWT were past their design life and in need of replacement. Additionally, the treatment capacity of 500 to 600 gpm was significantly more than needed and groundwater modeling predictions based on the new operational design predict that this higher treatment capacity would not be needed in the future. Discussions were completed in the spring and summer of 2015 with regulators and stakeholders to help ensure a common understanding of the issues related to wastewater treatment at the site. DOE, EPA, Ohio EPA, and the community all reached agreement on replacing the 500 to 600 gpm system with a new 50 gpm system within the footprint of the existing system that could be expanded in the future, if deemed necessary.

D&D of the 500 to 600 gpm system was completed in 2016. In April 2018, the 50 gpm system became operational. The 50 gpm system consists of multimedia filters and ion-exchange vessels that can be operated one at a time or in parallel. The system is used to treat water stored in the backwash basin. Water from the backwash basin is mixed with groundwater and sent to the 50 gpm treatment system. Water is blended to reduce potential plugging of the treatment system from suspended solids in the basin and to dilute the seasonally high anion concentrations in the water from the backwash basin. The anion concentrations in the backwash basin are higher in the summer when wastewater resulting from the summer well rehabilitation is discharged to the backwash basin. High anion concentrations cause reduced treatment efficiency by stripping uranium from the ion-exchange treatment resin. This small flow rate (50 gpm) of treated effluent is combined with untreated groundwater and discharged to the Great Miami River. The CAWWT process flow diagram is provided in Figure 6.

Figure 7 shows the percent treated and average monthly uranium discharge concentrations versus time from January 2004 through 2017. As shown in Figure 7, the aquifer remedy achieves the uranium discharge limits (i.e., average monthly concentration of less than 30 µg/L, and 600 pounds annually) established in the OU5 ROD, without routine groundwater treatment.

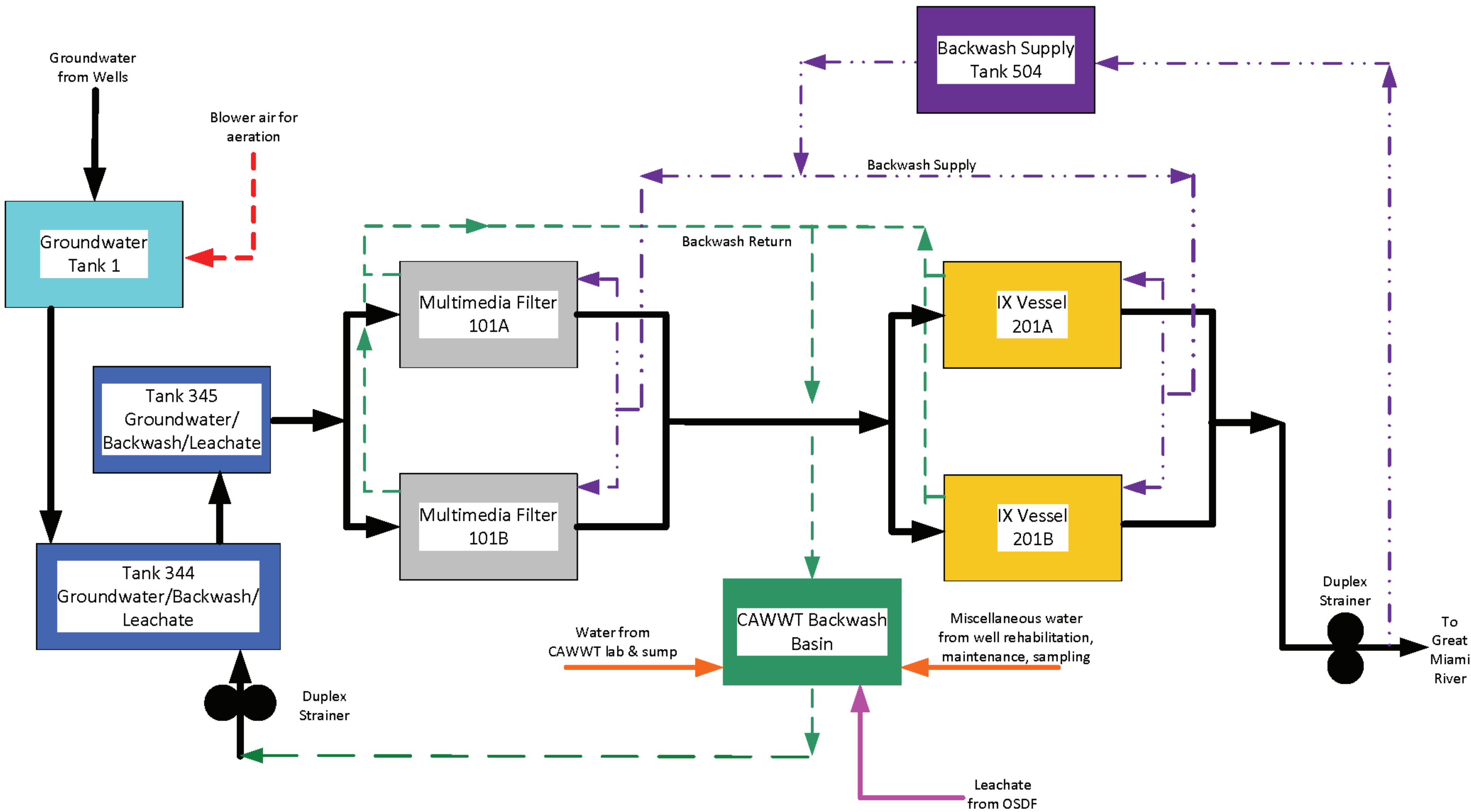

Figure 6. CAWWT Process Flow Diagram

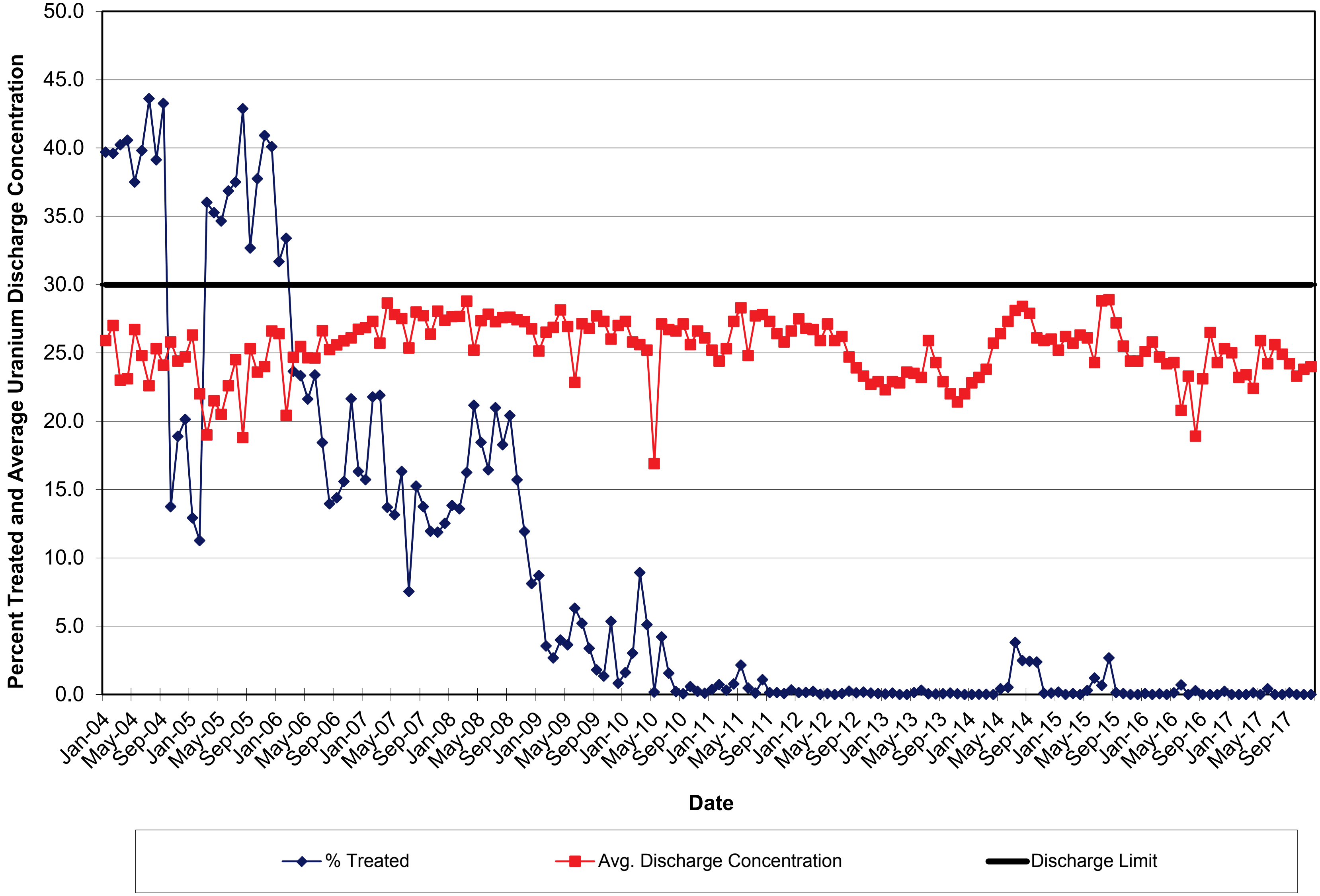

Figure 7. Percent Treated and Average Monthly Uranium Discharge Concentration versus Time (January 2004 through December 2017)

3.4 Ancillary Facilities

A number of facilities support the operation of aquifer restoration and the treatment system. These facilities include groundwater flow routing facilities, wastewater collection and transfer facilities, and discharge monitoring facilities.

3.4.1 Great Miami Aquifer

No specific headworks exist for groundwater. However, because this flow can be adjusted by regulating the extraction wells, the aquifer itself serves as the headworks for groundwater.

3.4.2 CAWWT Backwash Basin

The CAWWT includes a backwash basin. This basin is an aboveground, lined basin measuring 100 feet (ft) × 100 ft × 6 ft deep. It was installed December 2005 through January 2006 and became operational the week of January 30, 2006. The basin was designed to contain the last remaining impacted storm water prior to site closure and to serve as the facility to contain backwash water from the CAWWT multimedia filters and ion-exchange vessels for the duration of CAWWT operations, as well as leachate from the OSDF. The basin has an approximate working capacity of up to 400,000 gallons to allow for a minimum of 6 inches of freeboard at all times. The basin contains a baffle to separate the influent from the effluent and allow any solids backwashed from the filters and ion-exchange vessels to settle prior to discharge back into the CAWWT treatment system.

3.4.3 Storm Water Retention Basin Valve House

The storm water retention basin (SWRB) Valve House contains pipes that direct groundwater flow to the CAWWT for treatment. This facility also serves as the point of convergence for the effluent from the treatment system prior to discharge through the Fernald Preserve outfall pipeline. Changing the 500 to 600 gpm treatment system to a 50 gpm system required replacing the large pressure-regulating valve in the SWRB Valve House with a 5-inch orifice plate (Figure 4). The small orifice plate is necessary at a 50 gpm flow rate to place backpressure on the groundwater pipe and force flow to CAWWT for treatment. The orifice plate is a necessary piece of the system that allows for control of water flow to CAWWT for treatment.

3.4.4 South Field Valve House

As part of the South Field Extraction System Phase I construction, a new South Field Valve House was constructed, upstream of the SWRB Valve House. The primary purpose of this valve house is to receive the combined South Plume Recovery System groundwater. It directs all or portions of the combined flow toward treatment or toward untreated discharge prior to its being combined with other groundwater flows.

3.4.5 Parshall Flume

Downstream of the SWRB Valve House, the combined flows pass through the Parshall Flume and an associated outfall monitoring station for Fernald Preserve discharge flow measurement and monitoring.

3.4.6 OSDF Leachate Transmission System Permanent Lift Station

Leachate from the OSDF drains by gravity to the valve houses located on the west side of each cell. From the valve houses, the leachate is routed to the leachate transmission system (LTS) permanent lift station (PLS). When sufficient leachate collects in the PLS, it is pumped to the backwash basin at the CAWWT for treatment.

3.5 Current Performance

The performance of the ARWWT systems measured against the overriding goal of meeting OU5 ROD discharge standards relative to uranium as well as NPDES effluent limits has been satisfactory. The uranium mass loading limit of 600 lb/yr has been met every year since the requirement became effective in January 1998. As depicted in Figure 8, the monthly average concentration has been met every month since January 1998 with the exception of 5 months. The Fernald Preserve has been in compliance with NPDES effluent limits well in excess of 99 percent of the time since January 1995, the date the AWWT Phases I and II were placed into service.

3.6 Current and Planned Discharge Monitoring

Currently, discharge monitoring is completed under two sampling programs. Conventional pollutants are monitored under the NPDES permit. Monitoring for uranium occurs under the OU5 ROD and the *Federal Facilities Compliance Agreement* (FFCA) (EPA 1986). These two programs have been incorporated into the IEMP sampling program as described in Section 4 of the IEMP. These monitoring programs are described briefly in the Subsections 3.6.1 and 3.6.2.

In the 2017 Site Environmental Report (DOE 2018a), justification to eliminate radium-228 monitoring at PF4001was provided in Appendix B, Section B.1.5. The proposed elimination was based on the fact that the surface water FRL of 47 pCi/L had never been exceeded at the location since radium-228 monitoring began in 1997.

3.6.1 NPDES Monitoring

Five locations are monitored under the current NPDES permit. Three of the locations relate to permitted Fernald Preserve wastewater/storm water discharge outfalls to State of Ohio waters (biowetlands overflow, Parshall Flume, SSOD), and two relate to upstream and downstream monitoring (relative to the Fernald Preserve outfall line) of the Great Miami River. The permit (Ohio EPA Permit No. 1IO00004*ID) is administered by Ohio EPA and granted to DOE at the Fernald Preserve. The effluent pollutant limitations, monitoring requirements, and reporting requirements are specified in the permit for each of the five monitored locations. The current NPDES permit became effective on March 1, 2015, and expires on February 29, 2020.

3.6.2 Uranium Monitoring

The Fernald Preserve conducts a surface water sampling and analytical program for liquid effluent and uncontrolled storm water runoff from the site. Details of this program are provided in Section 4 of the IEMP.

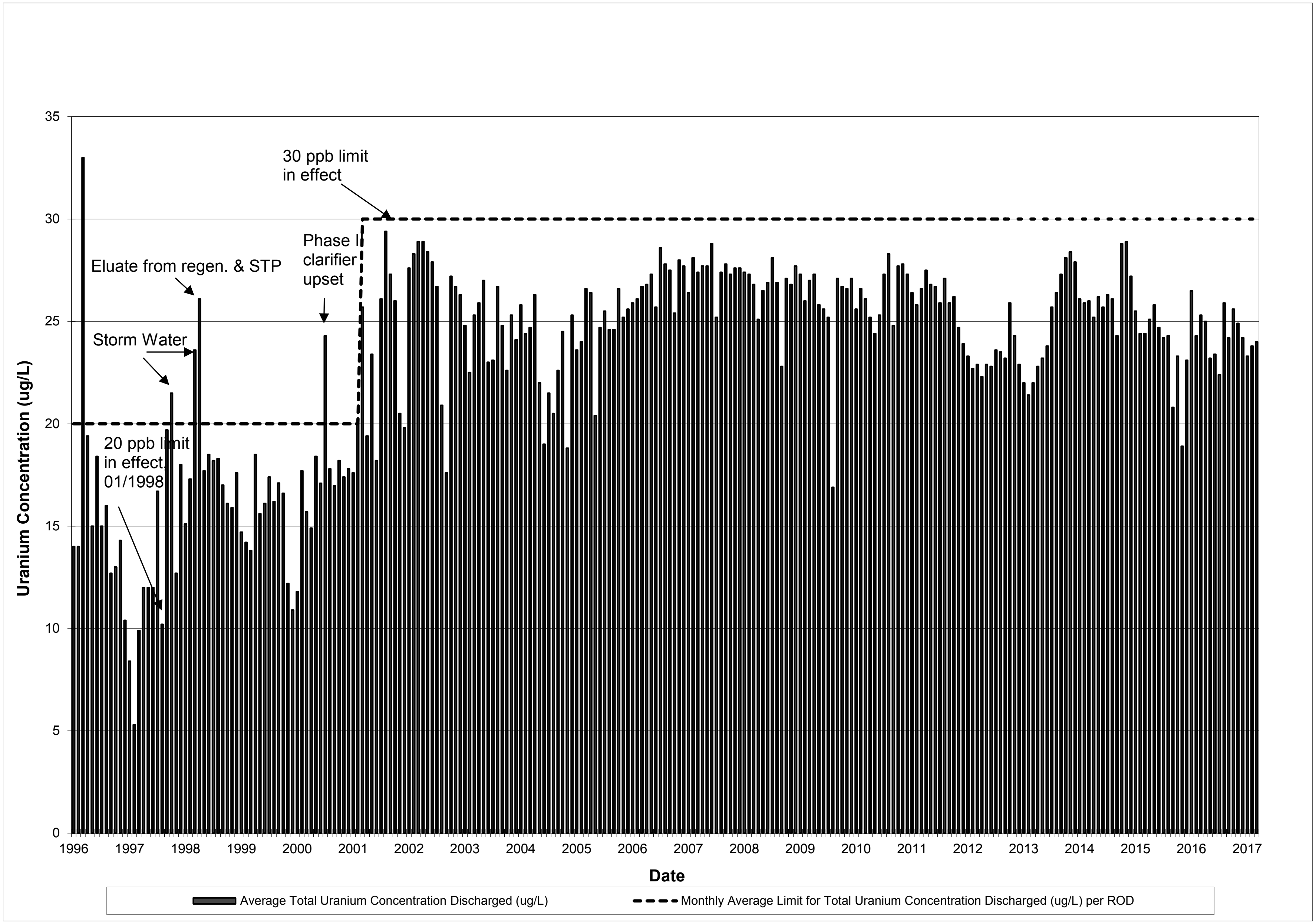

Figure 8. Monthly Average Uranium Concentration in the Effluent to the Great Miami River (through December 2017)

The daily total uranium analysis of the site effluent to the Great Miami River is used to track compliance with OU5 ROD established limits. The Fernald Preserve is obligated to limit the total mass of uranium discharged through the outfall line to the Great Miami River to 600 lb/yr while not exceeding a monthly average of 30 ppb.

This daily effluent uranium analysis is also used to demonstrate compliance with the monthly average uranium concentration of 30 ppb uranium in the site discharge to the river. The original requirement for compliance with a monthly average concentration became effective on January 1, 1998, as established in the OU5 ROD. The OU5 ROD established this concentration at 20 ppb uranium, which was the compliance standard from January 1998 through November 2001. The monthly average concentration limit changed from 20 ppb to 30 ppb beginning December 1, 2001, as a result of EPA approval of the *Explanation of Significant Differences* [ESD] *for Operable Unit 5* in November 2001 (DOE 2001b). This OU5 ESD changed the total uranium groundwater FRL from 20 ppb to 30 ppb and established the new monthly average concentration discharge standard. The 600 lb/yr limit was unaffected by this ESD and remains in effect.

The monthly average uranium concentration is calculated by multiplying each daily flow by the uranium concentration of the flow-weighted composite sample for that day. The sum of the values obtained by multiplying the flow times by the concentration is then divided by the sum of the flows for the month. The result is a flow-weighted average monthly uranium concentration. The daily flow-weighted concentrations are then multiplied by 8.35 lb/gallon to obtain the daily pounds of uranium discharged. The sum of the daily masses for the year is used to compare against the 600 lb/yr limit.

If the monthly average uranium concentration exceeds the 30 ppb limit, the exceedance will be reported to the agencies, and a course of action will be determined. Depending on the reason for the exceedances, corrective actions would be taken.

If corrective measures are deemed necessary, the situation will be outlined to EPA and Ohio EPA to reach consensus regarding what action (if any) is required.

3.6.3 IEMP Surface Water and Treated Effluent Monitoring Program

Significant portions of the current and past programs (NPDES and FFCA) have been incorporated into the IEMP. Section 4 of the IEMP describes these two programs in more detail and also how these two programs have been integrated into the IEMP surface water and treated effluent sampling program. Section 4 of the IEMP also provides the regulatory drivers and actions for additional monitoring. This additional monitoring is performed as a supplement to monitor surface water and treated effluent for potential site impacts to various receptors during aquifer remediation. In addition to identifying the sampling program requirements, the IEMP provides a comprehensive data evaluation and associated decision-making and reporting strategy for surface water and treated effluent.

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4.0 Projected Flows

This section addresses the latest understanding of flows for groundwater and OSDF leachate.

4.1 Groundwater

Extracted groundwater is the primary wastewater flow. Groundwater extraction rates can be controlled. Groundwater flows are defined such that discharge limits at the Parshall Flume, and capture of the 30 µg/L uranium plume, are achieved. The objective is to pump as aggressively as possible without exceeding discharge limits. The individual groundwater remediation modules that currently constitute the aquifer remedy are presented in Section 3.1. Figure 3 depicts the locations of current operating extraction wells. Table 2 provides the target extraction rate schedule for each of the wells currently operating. The combined modeled target pumping rate is approximately 4,975 gpm.

Throughout the duration of groundwater remediation, the pumping rates may be modified within system design and operational constraints, as necessary. These rate modifications will be made to maintain, to the degree possible, the aquifer restoration objectives outlined in the remedy design. An operational rate of 10 percent over the modeled pumping rates is being targeted to provide for anticipated and unanticipated downtime.

For pulse pumping operations, the selected rate and duration of pumping will assure that capture of the 30 µg/L uranium plume is maintained and that 24-hour volumes planned for removal under the current model design are achieved. For example, a 110 gpm well pumping for 24 hours a day will remove 158,400 gallons in 24 hours. Selection of a pulse pumping rate and time will also be based on removing a minimum of 158,400 gallons in a 24-hour time period. Pulse pumping operation instructions will be issued and documented through the use of standard operating procedures.

4.2 OSDF Leachate

In 2006, the year the OSDF was completed, 7.6 million gallons of leachate were collected. In 2017, 93,316 gallons of leachate were collected, a reduction of over 98%. This flow stream is expected to continue to decline since the facility was completely capped in late 2006. The leachate collects in the PLS sump and from there is pumped to the CAWWT backwash basin for treatment.

4.3 Other Flows

Other flows include wastewater from extraction well rehabilitation, wastewater from the CAWWT laboratory, investigation-derived waste water from sampling, and a small amount of storm water from portions of the CAWWT footprint. In 2017, these other flows amounted to approximately 166,000 gallons.

Table 2. Target Extraction Rate Schedule

System ID	Location	Operations ID	Database ID	Target Extraction Rates 2014 to 2022[a] (gpm)	Target Extraction Rates 2022 to 2030[a] (gpm)	Target Extraction Rates 2030 to End[a] (gpm)
I	Waste Pits	EW-26	32761	300	500	500
I	Waste Pits	EW-27	33062	200	300	300
I	Waste Pits	EW-33A	33347	300	300	300
	System Totals	**Pumped**		**800**	**1,100**	**1,100**
II	South Field	EW-15A	33262	300	400	0
II	South Field	EW-17	31567	175	175	0
II	South Field	EW-18	31550	100	0	0
II	South Field	EW-19	31560	100	300	0
II	South Field	EW-20	31561	200	400	0
II	South Field	EW-21A	33298	300	400	0
II	South Field	EW-22	32276	300	0	0
II	South Field	EW-23	32447	500	0	0
II	South Field	EW-24	32446	400	0	0
II	South Field	EW-25	33061	100	300	0
II	South Field	EW-30	33264	400	0	0
	System Totals	**Pumped**		**2,875**	**1,975**	**0**
IV	South Plume	RW-1	3924	200	0	0
IV	South Plume	RW-2	3925	200	0	0
IV	South Plume	RW-3	3926	200	0	0
IV	South Plume	RW-4	3927	100[b]	0	0
IV	South Plume	RW-6	32308	300	0	0
IV	South Plume	RW-7	32309	300	0	0
	System Totals	**Pumped**		**1,300**	**0**	**0**
	Total Extraction			**4,975**	**3,075**	**1,100**

[a] Predicted completion dates reflect implementation of Operational Adjustments in 2014.

[b] The target extraction rate in well RW-4 was lowered in 2018 because it was determined that lowering the pumping rate would not impact predicted cleanup rates or plume capture.

5.0 Operations Plan

This section contains the operations philosophy, treatment priorities, hierarchy of decisions, management and flow of operations information, and management of treatment residuals necessary to successfully operate the groundwater extraction and treatment systems to achieve regulatory requirements and commitments.

5.1 Wastewater Treatment Operations Philosophy

The primary goals of wastewater treatment operations and maintenance are to meet effluent discharge requirements and provide for leachate treatment. Until 2011, treatment capacity was needed to treat groundwater to meet system pumping rates, but since 2011, routine groundwater treatment to meet discharge limits has not been required. In 2018, to address current and ongoing treatment needs, which mostly center around other wastewater sources (Section 4.0), a new 50 gpm treatment system became operational.

Other regulatory discharge requirements, such as NPDES, must also be met. Sampling under the NPDES permit and the IEMP is performed to verify that requirements and effluent limits for discharges to the Great Miami River are met. Influent streams to treatment and effluent streams from treatment as well as other process control sampling around specific unit operations (e.g., ion exchangers) are conducted for uranium and other appropriate constituents as necessary to provide information needed to document compliance.

5.2 CAWWT Operation

As discussed in Section 3.3, a 50 gpm treatment system began operating in April 2018. The effluent from this system and bypassed (untreated) groundwater combine in the site discharge line to form the Fernald Preserve's regulated discharge to the Great Miami River.

Since 2011, groundwater has not needed to be routinely treated in order to meet discharge limits, resulting in rightsizing the treatment system to a 50 gpm system. With no need to routinely treat groundwater, and a smaller 50 gpm system, treatment mainly addresses the other wastewater sources (e.g., backwash from the treatment system, water from the CAWWT sump, water from well rehabilitations, and OSDF leachate).

These other wastewater sources are first sent to the backwash basin. Wastewater from the backwash basin is mixed with groundwater and sent to the 50 gpm system. Blending with groundwater occurs to dilute anion concentrations in the water from the backwash basin. High anion concentrations have been shown to reduce the life of the resin and even strip uranium off the ion-exchange treatment resin. The 50 gpm system effluent is combined with untreated groundwater and discharged through the Parshall Flume.

Water from the CAWWT backwash basin is pumped to the CAWWT at a flow rate adequate to ensure that the basin level does not exceed 5.5 ft so that a minimum of 6 inches of freeboard is maintained at all times.

Operators are onsite 365 days per year. The operators are responsible for ensuring that treatment and monitoring equipment is operated, maintained, and repaired so that the necessary treatment throughput is achieved. Operations and maintenance are performed in accordance with all appropriate standard operating procedures, standards, and specifications. Additionally, process engineering support personnel are on call to provide assistance in problem solving.

5.3 Groundwater Treatment

The CAWWT provides up to 50 gpm treatment capacity for wastewater from the backwash basin blended with groundwater. Most groundwater, therefore, is directed to the bypass header and does not go to treatment. The set points at which the wells are pumped are typically set to approximately 10 percent more than the groundwater remedy target set point to account for downtime.

5.3.1 Groundwater Treatment Prioritization versus Bypassing

The need for groundwater treatment prioritization was eliminated once discharge limits could be met without routine treatment. Historically, when groundwater needed to be routinely treated to meet discharge limits, groundwater well discharges were prioritized in order of uranium concentration; the highest uranium concentration wells were routed to treatment until the treatment capacity necessary to meet the site's uranium discharge limit was utilized. Remaining well discharges were bypassed around treatment to the Parshall Flume. As shown schematically in Figure 4, treatment/bypass decisions for the Southfield and Waste Storage Area extraction wells were made on a well-by-well basis.

With installation of the 50 gpm treatment system in April 2018, a 5-inch orifice plate was installed in the SWRB Valve House to increase the backpressure on all the wells being fed through the treatment header. This results in most groundwater flow bypassing treatment. A very small volume of groundwater (less than 50 gpm) is routed to treatment. Operating the system in this manner reduces the energy consumed by the well motors (by reducing back pressure on the pumps) and extends the operating life of the well pumps.

5.4 Well Field Operational Objectives

Several objectives must be considered when well field operational decisions are made. These objectives are listed in Table 3 along with the anticipated actions required to achieve each objective. Decisions that affect well field operations are communicated to EPA and Ohio EPA in the IEMP reports. Changes in groundwater restoration well pumping set points are transmitted to shift supervisors by the Site Operations Manager, after consultation with the Aquifer Restoration Lead.

In addition to the objectives listed in Table 3, the well field is shutdown each year for approximately one month to allow water levels in the aquifer to rebound. The shutdown is planned to take place in the late spring and early summer to correspond with seasonal water level highs in the aquifer. The objective of the shutdown is to allow water levels to reach uranium sorbed to aquifer sediments in the unsaturated portion of the aquifer beneath former source areas. Uranium contamination bound to aquifer sediments in the unsaturated portion of the Great Miami Aquifer has been identified under some former source areas at the site. Uranium bound to unsaturated aquifer sediments will remain bound unless water levels rise and saturate the sediments, allowing the uranium to dissolve into the groundwater.

Table 3. Well Field Operational Objectives

Objectives	Actions Required
Operate individual wells within constraints imposed by system design and equipment. Key constraints include: • Pumping equipment is limited to a range of flows that will dictate the flexibility of extraction rates for individual wells. • Hydraulic capacity of the piping limits extraction rates. • Average entrance velocity of water moving into the screen should not exceed 0.1 ft per second.	Operate well pumps and motors according to manufacturer recommendations. Operate extraction well systems within design constraints.
Perform necessary equipment and well maintenance in accordance with established schedules.	According to OMMP, Section 6.0.
Maintain compliance with the discharge limits of 30 µg/L monthly average uranium concentration and 600 lb/yr for the combined site water discharged to the Great Miami River.	Monitor discharge concentrations. Modify well set points as necessary to maintain compliance with discharge limits. Evaluate well set points. Use flow-weighted average-concentration calculations to predict how changes to set points will affect discharge concentrations. Compare predictions with actual measurements to evaluate if and how predictions can be improved. Maintain well set points to the degree possible.
Minimize impact to the Paddys Run Road Site plume.	Pumping from well 3924 (RW-1) should not exceed 300 gpm. Pumping from well 3925 (RW-2) should not exceed 300 gpm (if well 3924 is pumping) and 400 gpm (if well 3924 is not pumping). Pumping from well 3926 (RW-3) should not exceed 500 gpm if either well 3924 or well 3925 is not pumping. If the actual capture zone differs significantly from that defined via previous modeling, it may be determined that the pumping rates noted above require modification to maintain this objective. Required modifications will be made based on additional modeling projections and verified based on field data.

Table 3 (continued). Well Field Operational Objectives

Objectives	Actions Required
Maintain capture of the 30 µg/L uranium plume along the southern administrative boundary.	The following pumping rates for each South Plume well provides for the capture (within system constraints) of the uranium plume along the administrative boundary: well 3924 at 200 gpm well 3925 at 200 gpm well 3926 at 200 gpm well 3927 at 100 gpm Adjust the pumping rates of the remaining operable wells in the South Plume module to maintain capture along the administrative boundary when (1) any single South Plume Module well outage for 1 week or more occurs or (2) multiple well outages occur for 3 days or more. If the actual capture zone differs significantly from that defined via previous modeling, it may be determined that the pumping rates noted above require modification to maintain this objective. Required modifications will be made based on additional modeling projections and verified based on field data.
Maintain hydraulic capture of the remaining portions of the 30 µg/L uranium plume (within areas of active modules).	Establish pumping rates based on model predictions of required pumping rates to maintain a desired area of capture. Determine the actual area of capture created when the wells are operating at the modeled rates based on groundwater elevation contour maps derived from field measurements. Adjust pumping rates within system design and operational constraints, if warranted, when the actual area of capture is not consistent with the modeled area of capture. This will be done in an effort to establish an area of capture consistent with the desired area of capture, as modeled.
Minimize duration of cleanup time for off-property portion of the 30 µg/L uranium plume.	Give priority as follows: (1) off-property wells have priority over on-property wells for maintaining operation at the design set points. (2) South Field Wells EW-18, EW-22, EW-23, EW-24, and EW-30 have priority over other on-property wells for maintaining operation at the design set points. Maximize pumping rates within the following constraints and considerations: system design and equipment, hydraulic capacity of the piping, regulatory limits, interaction with other modules, and remedy performance.
Minimize duration of cleanup time for on-property portions of the uranium plume.	Maximize pumping rates within the following constraints and considerations: system design and equipment, hydraulic capacity of the piping, regulatory limits, interaction with other modules.
Minimize migration of on-property portion of the plume to off-property areas.	Balance pumping from the South Field Extraction System Module and South Plume Module such that the stagnation zone is at or south of Willey Road.
Minimize drawdown in off-property areas.	Do not exceed 110 percent of the set points defined in Table 2, with the exception of “Minimizing the impact to the Paddys Run Road Site Plume” Objective.

Water levels will be measured at key locations (by hand and downhole transducer/data logger) before, during, and after the shutdown to record the resulting water level change. The uranium concentration in the pumped groundwater immediately after the wells are restarted will be compared to pre-shutdown concentrations to determine the amount of concentration rebound that occurred. Shutdown times are subject to change.

The well field downtime period will also be used to conduct well field and water treatment system maintenance.

The well field can be nonoperational for 1,080 days based on a uranium retardation factor of 12 without exceeding the southern extent of the capture of the South Plume Module. This retardation factor is documented on Table F.7.2 of the OU5 Feasibility Study Report (DOE 1995b). The uranium plume is located such that groundwater moves toward the plume from all sides except the south, providing a degree of containment. Groundwater migrates away from the site to the south through the Paddys Run Outlet. Section 3.6.2.1 of the OU5 Remedial Investigation Report (DOE 1995a) presents time of travel calculations for the Paddys Run Outlet under non-pumping conditions. The horizontal seepage velocity for the Paddys Run Outlet is calculated as 2.75 feet per day. Capture zone interpretations presented in past Site Environmental Reports indicate that the southern extent of capture of the South Plume module is approximately 250 feet south of the recovery wells. The latest interpretation is provided as Figure A.3-4 of the 2016 Site Environmental Report (DOE 2017). This indicates that groundwater in this area (moving by advection only) would need approximately 90 days to travel the 250 feet from the wells to the southern edge of capture of the well system. It should also be noted that, if a retardation factor of 12 for the migration of uranium in the subsurface is also taken into consideration, uranium contamination would need approximately 1,080 days to travel the 250-foot distance.

5.5 Operational Maintenance Priorities

Maintaining the treatment facilities online includes ensuring that all equipment is operating properly, that adequate personnel are assigned to operate the treatment systems safely, and that the site effluent requirements at the Parshall Flume are met. Following is a list of operational maintenance priorities in their order of importance:

1. Keep the Parshall Flume discharge point and sampling system operating. If the discharge monitoring system were to become nonoperational, discharge monitoring samples of effluent to the river from the Fernald Preserve would have to be collected manually or the CAWWT treatment system and all extraction wells would be shut down until the sampling system is operational. The sampling system must be operational so that accurate reports of uranium and NPDES contaminant levels can be made.
2. Pumping of off-property wells has priority over on-property wells.
3. Keep South Plume recovery wells 1 through 3 operating at target set points.
4. South Field wells EW-18, EW-22, EW-23, EW-24, and EW-30 have priority over other on-property wells for maintaining operation of design set points.
5. Keep all extraction wells operating at the design set points.

Section 6.0 provides more-specific details of managing equipment operation and maintenance.

5.6 Operations Controlling Documents

Operations at the wastewater treatment facilities are controlled directly by standard operating procedures.

Section 6.1.2 provides a more extensive discussion of standard operating procedures. Standard operating procedures implement the requirements of this plan. The OMMP is not intended to replace standard operating procedures.

5.7 Management and Flow of Operations Information

Water samples are taken from the in service ion-exchange vessel on a regular basis to ensure that uranium is still being removed by the resin. Project personnel review the results of sample analysis as necessary to evaluate system performance and determine if either of the treatment system ion-exchange vessels needs to be removed from service for resin replacement.

The project issues monthly operations reports that summarize flow rates and flow totals as well as uranium concentrations from the CAWWT and the wells. Information on required well pumping rates is communicated from the Site Operations Manager to the operations personnel as specified in the *Wastewater Treatment Outside Systems Procedure for the Fernald Preserve, Fernald, Ohio* (DOE 2018b).

5.8 Management of Treatment Residuals

Treatment residuals consist of exhausted ion-exchange resin, used filter media from the multimedia filters, and sediment in the backwash basin. These materials will ultimately be disposed of offsite at a licensed disposal facility. They will be transported using a subcontractor qualified to transport radioactive materials. Unused tanks at the CAWWT may be used for interim storage of spent resin and filter media until the CAWWT is decommissioned. Sediments in the backwash basin may be removed and disposed prior to decommissioning CAWWT if they are adversely impacting system operation.

6.0 Operations Performance Monitoring and Maintenance

This section describes the general methods, guidelines, and practices used in managing equipment operation and maintenance and presents planned maintenance and monitoring requirements for the groundwater restoration wells to support successful long-term operation of the groundwater restoration system.

Managing equipment operation and maintenance in the context of this document includes not only routine control panel monitoring and repair work, but also the preventive, predictive, and proactive actions used to maximize equipment operating efficiency and capacities. This section presents some of the management systems that will help to ensure that the OU5 ROD requirements continue to be met, describes the key parameters used to monitor performance of the groundwater and wastewater facilities, and describes the principal features and maintenance needs of the overall operation.

The treatment system and restoration well system performance parameters and maintenance requirements have unique differences. The treatment system is designed and built with redundant features and equipment to reduce potential downtime (e.g., installed spare pumps). Those features are not economically practical for the well systems. The equipment in the treatment systems has more easily discernible indicators of equipment condition and is more easily accessed for monitoring by operating personnel walk-through than the underground well system. The methods used to measure the equipment condition and the specific measurable goals for the two systems also are different.

The activities described in this section also provide the basis for routine maintenance of the system and for monitoring the system performance to determine if more extensive maintenance activities are required. Regularly scheduled maintenance minimizes system downtime. Continuous operation of the well system, within practical limitations, is required to maintain groundwater restoration objectives at the Fernald Preserve.

This plan describes monitoring and maintenance activities and their frequencies, based on current projections. The need for and frequency of these activities may change based on future experience gained through the operation, maintenance, and monitoring of the extraction wells that are currently operating. Parameter monitoring frequency may change as well. This plan will be revised as necessary during the life of the groundwater restoration process.

6.1 Management Systems

6.1.1 Maintenance and Support

A qualified subcontractor under the direction of Legacy Management Support (LMS) personnel will provide maintenance for the well field. Preventive maintenance will be performed on the schedule recommended by the equipment manufacturer.

The technical staff at the Fernald Preserve directly supports facility operation and maintenance. The technical staff members work together to resolve issues and improve operations. They also provide troubleshooting and technical assistance to the operations personnel.

The facilities consist of standard high-capacity filter-packed water wells and conventional water and wastewater treatment unit processes that are typical for the industry. The equipment is expected to continue to have good reliability and has well-documented maintenance guidelines. Routine maintenance practices, as documented by the original equipment manufacturer's maintenance manuals, have been used to provide the basis for maintenance procedures and practices. Maintenance feedback and component manufacturer suggestions have been used to develop a spare parts list and stock inventories of the most frequently used parts. The availability of spare parts will assist in minimizing downtimes associated with all maintenance activities.

6.1.2 Operations

Operating personnel play an important role in maximizing equipment operating efficiency and capacity. One significant duty of the facility operating personnel is to identify and report existing and potential future equipment problems. Operating personnel perform routine scheduled checks, inspections, and walk-throughs of the facilities and systems. Operating personnel maintain a shift logbook that documents activities and specific actions taken during each shift. The logbooks are kept as a historical record of operational activities. Logbooks and roundsheets are periodically reviewed as additional assurance that the systems are being operated effectively.

6.1.2.1 Process Control

Facilities are staffed by operating personnel daily. The operating personnel at CAWWT monitor the process using a computerized control system located in the control room. The control system receives input from process meters (e.g., tank level and process flow meters) and from devices that indicate equipment status (e.g., valve position limit switches and motor VFD). The control system outputs control signals to regulate the process (e.g., control valve positioning and motor speed control). The control system uses desktop-style computer equipment (monitors, keyboards, and pointing devices) to provide a graphic human-machine interface (HMI) for the process monitoring and control. The control system HMI includes various process graphics screens that depict portions of the treatment system in piping and instrumentation diagram format and provide real-time process measurements and information. The control system has process alert and alarm management and a historical database of all operating personnel input and process alert/alarms. The operating personnel at CAWWT also access process and equipment information by making "walking rounds" of all equipment in the process.

6.1.2.2 Standard Operating Procedures

Each operation is performed in accordance with approved standard operating procedures that are developed by the technical staff with the assistance of operations personnel. The standard operating procedures are reviewed periodically and revised as necessary for the safe and consistent operation of treatment processes.

Standard operating procedures provide step-by-step instructions for performing wastewater treatment operations activities. They also contain safety and health precautions that employees must follow while performing the steps in the procedure. The procedures are written from the perspective of the operating personnel who will be performing the steps.

Standard operating procedures also contain instructions as to when management must be notified of nonroutine operating conditions or events and to whom in management these conditions must be reported. Standard operating procedures include such activities as:

- Calibration of water quality meters.
- IEMP surface water sampling.
- NPDES sampling.
- Daily operations at the Parshall Flume.
- Enhanced permanent LTS operation.
- CAWWT system operations.
- Monitoring recovery and extraction wells.
- Measuring soluble uranium by kinetic phosphorescence analyzer.

6.1.2.3 Training

A training and qualification program is in place to ensure that all operating personnel involved in treating wastewater are qualified and competent for their positions. The goal of the training and qualification program is to prepare personnel for the operations team and to continually improve the team’s knowledge and capabilities.

6.2 Restoration Well Performance Monitoring and Maintenance

This section describes the key performance monitoring and maintenance guidelines for the groundwater restoration well systems. To complete the aquifer restoration within the model-predicted time frames, a high level of on-stream time at the modeled pumping rates is needed for each well. Actual target pumping rates are set at around 110 percent of the modeled target pumping rates to provide for downtime. Some well downtime is expected and can be accommodated. However, lengthy outages can adversely impact model predictions. A well maintenance program is being implemented to address this issue. More frequent component preventive maintenance checks along with periodic formal performance testing and well and pump cleaning were identified and included as major program elements to improve well operating efficiency.

6.2.1 Well Descriptions

This section provides a general description of the extraction wells that constitute the active groundwater restoration modules. The active modules are the South Plume, South Field, and the Waste Storage Area.

6.2.1.1 South Plume Extraction Wells

The South Plume Module includes six wells that are used to pump groundwater from the off-property portion of the Great Miami Aquifer plume to the Fernald Preserve's South Field Valve House. In the valve house, piping is provided that allows flow from the following South Plume wells to be routed either to treatment or to the Great Miami River:

Extraction Well ID	Common Well ID	Formal Site Well ID
EW-1	RW-1	3924
EW-2	RW-2	3925
EW-3	RW-3	3926
EW-4	RW-4	3927
EW-6	RW-6	32308
EW-7	RW-7	32309

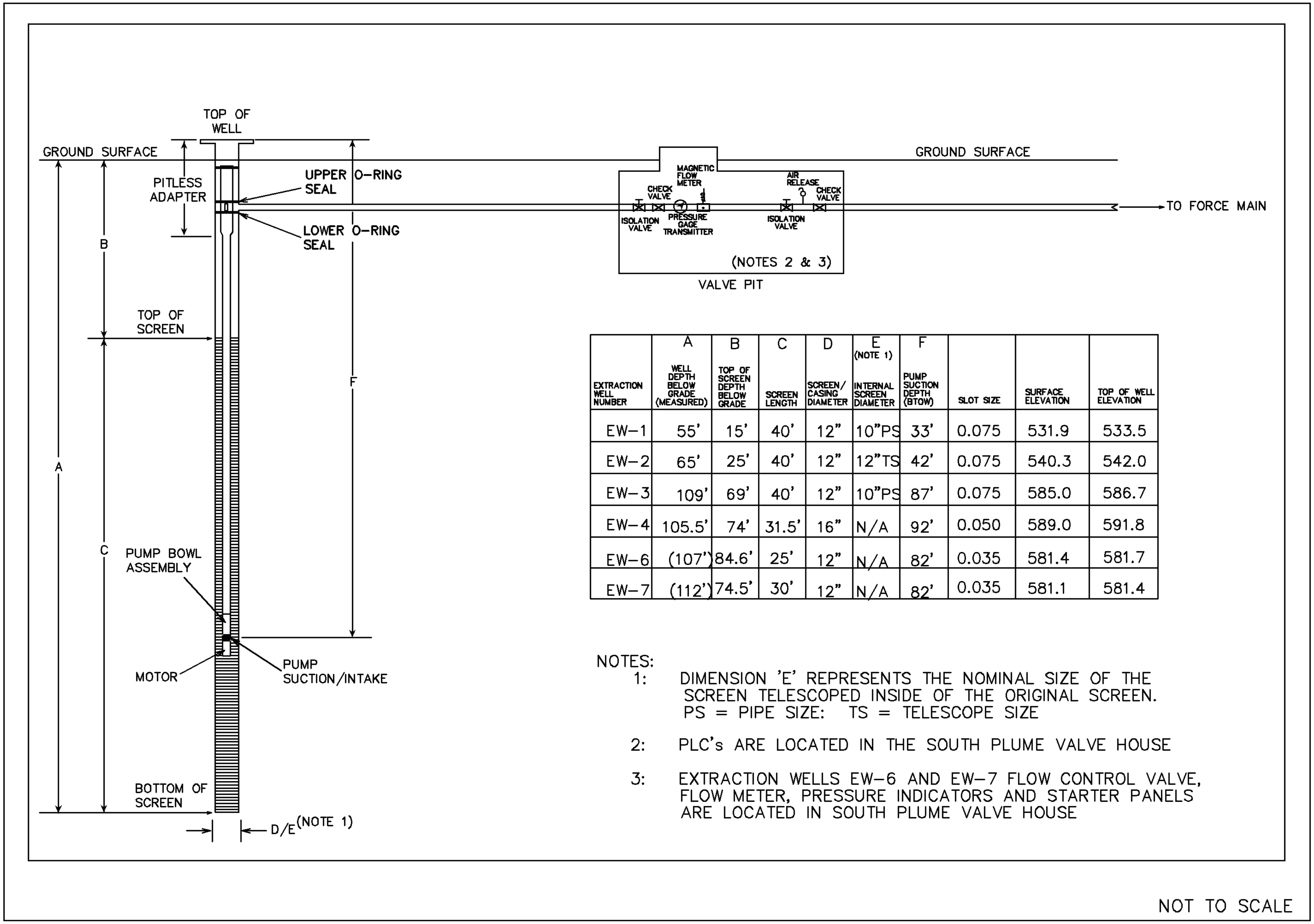
Each of the South Plume extraction wells contains a submersible pump/motor assembly and has a pitless-type adapter near the ground surface that transitions the vertical pump discharge piping to the underground force main. The underground force main from wells RW-1, RW-2, RW-3, and RW-4 passes through individual underground valve pits. These valve pits contain several components of the individual well's control system. Wells RW-6 and RW-7 do not use underground valve pits to contain any control system components. All control components for these two wells are located in the South Plume Valve House.

The flow control system for one of the six South Plume wells is controlled by a flow-control loop consisting of a magnetic flow meter, programmable logic controller (PLC), and a VFD.

Each South Plume extraction well is equipped with isolation valves, check valves, an air release, and a pressure-indicating transmitter. The pressure-indicating transmitters are tied to process interlocks that will shut the pumps down if high or low pressures are maintained for extended periods, indicating a closed valve or catastrophic system leak, respectively. This interlock is intended to protect the pump/motor assemblies from damage due to closed discharge valves or to shut down the pumps if no system backpressure is sensed. Critical control components are protected by lightning/surge arresters to help prevent damage to the control system during electrical storms.

Routine water level monitoring within the well is performed during regularly scheduled performance monitoring or more frequently if required.

Installation details of the South Plume extraction wells are shown in Figure 9.



EXTRACTION WELL NUMBER	A WELL DEPTH BELOW GRADE (MEASURED)	B TOP OF SCREEN DEPTH BELOW GRADE	C SCREEN LENGTH	D SCREEN/ CASING DIAMETER	E (NOTE 1) INTERNAL SCREEN DIAMETER	F PUMP SUCTION DEPTH (BTOW)	SLOT SIZE	SURFACE ELEVATION	TOP OF WELL ELEVATION
EW–1	55'	15'	40'	12"	10"PS	33'	0.075	531.9	533.5
EW–2	65'	25'	40'	12"	12"TS	42'	0.075	540.3	542.0
EW–3	109'	69'	40'	12"	10"PS	87'	0.075	585.0	586.7
EW–4	105.5'	74'	31.5'	16"	N/A	92'	0.050	589.0	591.8
EW–6	(107')	84.6'	25'	12"	N/A	82'	0.035	581.4	581.7
EW–7	(112')	74.5'	30'	12"	N/A	82'	0.035	581.1	581.4

NOTES:

1: DIMENSION 'E' REPRESENTS THE NOMINAL SIZE OF THE SCREEN TELESCOPED INSIDE OF THE ORIGINAL SCREEN. PS = PIPE SIZE: TS = TELESCOPE SIZE

2: PLC's ARE LOCATED IN THE SOUTH PLUME VALVE HOUSE

3: EXTRACTION WELLS EW–6 AND EW–7 FLOW CONTROL VALVE, FLOW METER, PRESSURE INDICATORS AND STARTER PANELS ARE LOCATED IN SOUTH PLUME VALVE HOUSE

Figure 9. South Plume Module Extraction Well Installation Details

6.2.1.2 *South Field and Waste Storage Area Extraction Wells*

The South Field and Waste Storage Area Modules include 11 and 3 wells, respectively, which are used to pump groundwater from the Great Miami Aquifer to the Fernald Preserve water treatment facilities or to the Great Miami River if treatment is not required to achieve uranium discharge limits. These wells are as follows:

Extraction Well ID	Common Well ID	Formal Site Well ID
EW-15A[a]	EW-15A	33262
EW-17A[a]	EW-17A	31567
EW-18[a]	EW-18	31550
EW-19[a]	EW-19	31560
EW-20[a]	EW-20	31561
EW-21A[a]	EW-21A	31562
EW-22[a]	EW-22	32276
EW-23[a]	EW-23	32447
EW-24[a]	EW-24	32446
EW-25[a]	EW-25	33061
EW-30[a]	EW-30	33264
EW-26[b]	EW-26	32761
EW-27[b]	EW-27	33062
EW-33A[b]	EW-33A	33347

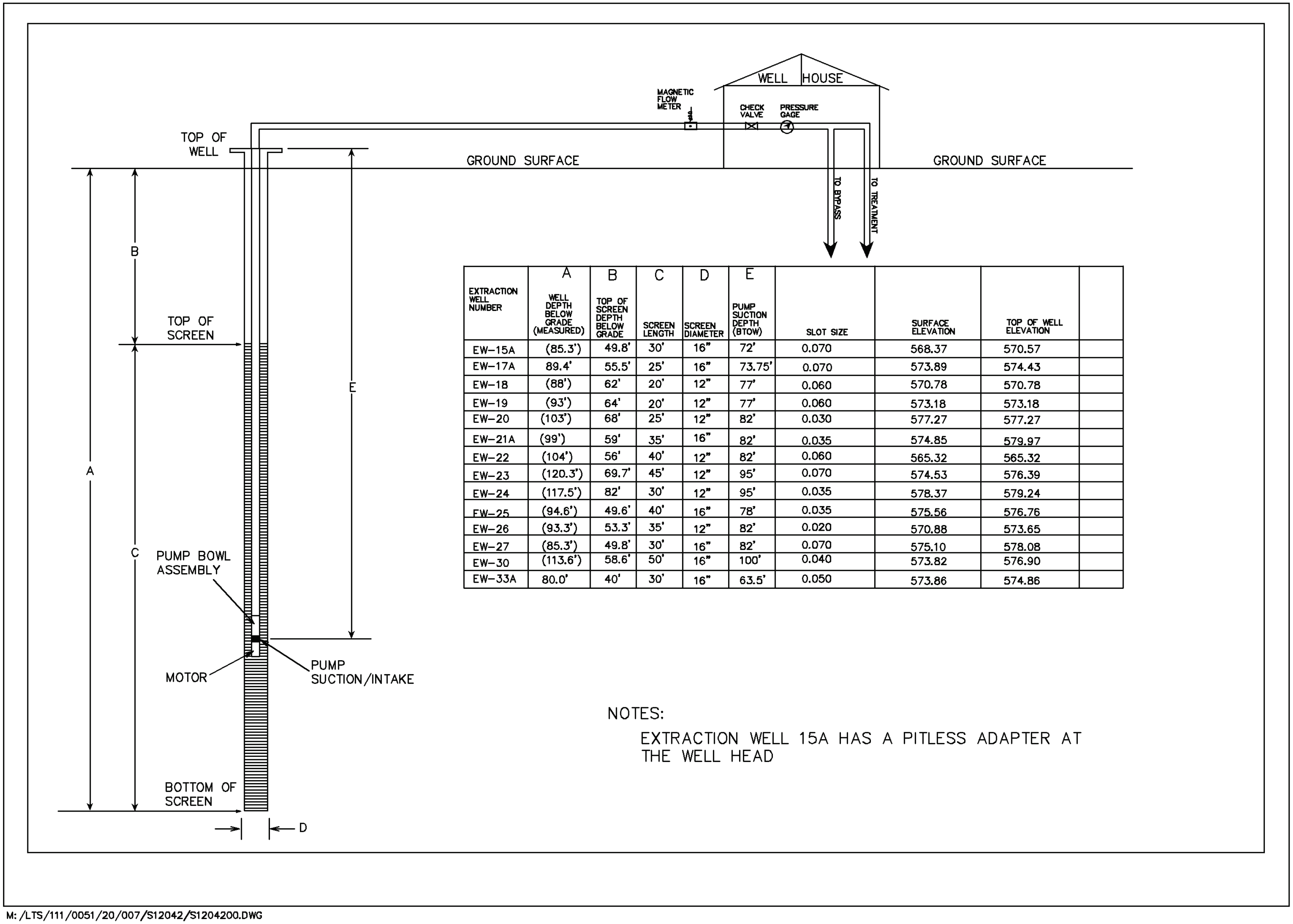
[a] Extraction well is in the South Field Module.
[b] Extraction well is in the Waste Storage Area Module.

Each of the 11 South Field and 3 Waste Storage Area extraction wells is of similar design with the exception of the well depth, screen length, and screen slot size. Each contains a submersible pump/motor assembly. Groundwater is pumped from the below-grade pump to the wellhead at the ground surface via the vertical discharge piping. At the wellhead, this piping is routed horizontally through a magnetic flow meter and into the individual well houses. All of the individual well control components are located at these well houses.

The flow control system for each of the 14 extraction wells is identical; flow is controlled by a flow-control loop consisting of a magnetic flow meter, a PLC, and a VFD. The desired flow rate set point for each extraction well is entered into the PLC at the individual well houses. This value is compared continuously to the actual flow rate measured by the magnetic flow meter. When required, the PLC adjusts the pump motor speed via the VFD to maintain the desired flow. Pump “Start” and “Stop” can be controlled by the PLC and can also be controlled at the VFD.

In addition, each extraction well is equipped with isolation valves, check valves, an air release, and a pressure-indicating transmitter. Routine water level monitoring within the well is performed during regularly scheduled performance monitoring and more frequently if required.

Installation details of the South Field extraction wells and Waste Storage Area wells are shown in Figure 10.



EXTRACTION WELL NUMBER	A WELL DEPTH BELOW GRADE (MEASURED)	B TOP OF SCREEN DEPTH BELOW GRADE	C SCREEN LENGTH	D SCREEN DIAMETER	E PUMP SUCTION DEPTH (BTOW)	SLOT SIZE	SURFACE ELEVATION	TOP OF WELL ELEVATION	
EW-15A	(85.3')	49.8'	30'	16"	72'	0.070	568.37	570.57	
EW-17A	89.4'	55.5'	25'	16"	73.75'	0.070	573.89	574.43	
EW-18	(88')	62'	20'	12"	77'	0.060	570.78	570.78	
EW-19	(93')	64'	20'	12"	77'	0.060	573.18	573.18	
EW-20	(103')	68'	25'	12"	82'	0.030	577.27	577.27	
EW-21A	(99')	59'	35'	16"	82'	0.035	574.85	579.97	
EW-22	(104')	56'	40'	12"	82'	0.060	565.32	565.32	
EW-23	(120.3')	69.7'	45'	12"	95'	0.070	574.53	576.39	
EW-24	(117.5')	82'	30'	12"	95'	0.035	578.37	579.24	
EW-25	(94.6')	49.6'	40'	16"	78'	0.035	575.56	576.76	
EW-26	(93.3')	53.3'	35'	12"	82'	0.020	570.88	573.65	
EW-27	(85.3')	49.8'	30'	16"	82'	0.070	575.10	578.08	
EW-30	(113.6')	58.6'	50'	16"	100'	0.040	573.82	576.90	
EW-33A	80.0'	40'	30'	16"	63.5'	0.050	573.86	574.86	

Figure 10. South Field Module and Waste Storage Area Extraction Well Installation Details

6.2.2 Factors Affecting System Operation

The original five extraction wells of the South Plume groundwater restoration module began operating in August 1993 as part of the OU5 South Plume Removal Action. In the intervening time, valuable operational experience and knowledge was gained that is being used to optimize long-term operation of extraction wells sitewide. This experience has resulted in identification of factors affecting operation life and efficiency, some of which were unknown at the start of pumping operations. These factors have either already been addressed or are incorporated into planned maintenance.

To better understand the factors affecting large-scale groundwater pumping operations, Moody's of Dayton, a water well maintenance and installation contractor, was consulted. Moody's has served the water well industry throughout the Great Miami Aquifer for more than 30 years and has extensive experience maintaining large-capacity wells for a number of major water supply systems. Frequencies for routine maintenance and monitoring activities were selected using recommendations from their evaluation of the South Plume extraction well system and their experience working with systems of similar magnitude in the regional aquifer. Well maintenance protocol was further refined in 2008 and 2014 based on additional consultation with Smith-Comeskey Groundwater Science LLC.

Several factors affect the performance of the extraction wells. In addition, a number of other specific requirements of the Fernald Preserve's system complicate these factors. All of these factors and requirements were considered in developing this plan. First, all the Fernald Preserve's extraction wells are placed in and are extracting water from the uppermost portions of the Great Miami Aquifer. This complicates both pump/motor cooling and iron fouling of the extraction well screen. Normal water well practice would place the screened section of the well deeply in the aquifer, and the pump/motor assembly would be placed above the screen in a submerged section of blank casing. Since the extraction wells are intended to intercept a plume of contamination located near the top of the aquifer, the screened sections begin near the normal water level. In order to provide the required submergence of the motor assembly, this assembly must be placed within the screened section. The high flow rates required for plume capture combined with the targeted removal of the contamination plume have led to difficulties ensuring that the flow of water passing the motor is adequate for cooling.

Placement of the pump/motor assembly within a screen that is located near the aquifer water table also complicates the impacts of iron-fouling. Moody's and Groundwater Science have confirmed that iron fouling is prevalent throughout the regional aquifer and that the configuration of the Fernald Preserve installation enhances the problem. These conditions and the fact that this region of the Great Miami Aquifer contains some of the highest concentrations of iron and iron-fouling bacteria have resulted in fouling of the well screens and other downstream equipment.

Continuous operation of the extraction wells also exacerbates the factors noted above. Normal water well industry practice does not require pumping wells to operate continuously. Typical water supply well systems pump between 6 and 10 hours per day and have spare wells that can be rotated in and out as demand requires (especially when maintenance is required). The Fernald Preserve's extraction well system, however, runs continuously and has no spare wells to compensate for wells taken out of service for maintenance. In fact, when a well is shut down for an extended period to perform maintenance, the remaining wells may need to increase their flow to continue the planned capture of the plume.

6.2.3 Maintenance and Operational Monitoring

Several routine activities are performed to optimize performance of the extraction wells in the South Plume, South Field, and Waste Storage Area groundwater restoration modules. The following maintenance and operational monitoring activities are described in this section:

- Routine system maintenance, which includes maintenance actions related to valves, instrumentation, and controls associated with each extraction well
- Operational monitoring, which includes quarterly monitoring of extraction well capacity as well as pump and motor assembly performance
- Well and pump cleaning

Table 4 lists planned outages for the South Plume, South Field, and Waste Storage Area wells. Routine well and screen maintenance (i.e., superchlorination) is no longer an activity of the OMMP. External technical advice, coupled with lessons learned by operating extraction wells at the Fernald Preserve, indicate that the superchlorination procedure is not effective and in fact may exacerbate well and pump fouling.

Table 4. Planned Outages

Item	Description	Frequency	Duration per Event
1	Performance Testing	Quarterly	4 hours per well
2	Pressure Transmitter Operational Check	Annually	2 hours per well
3	Magnetic Flow Meter Operational Check[a]	Semiannually	2 hours per well
4	Check Valve Inspect/Clean	Semiannually	4 hours per well
5	Rehabilitation	Variable	3 weeks
6	Well/Pump Cleaning	Variable	1–2 days

[a] Flow meter operational check may occur as a post-maintenance test using a portable flow meter.

6.2.3.1 Maintenance of the Pumps, Piping, and Controls

These maintenance activities are directed primarily at the valves, instrumentation, and controls associated with each extraction well. In addition to formal preventive maintenance activities, several routine system checks are performed by operations personnel, between scheduled preventive maintenance activities, to ensure that equipment is functioning properly.

The following is a list of preventive maintenance and operational checks that are routinely performed:

<u>Flow Meters: Operational Check Semiannually</u>

Operational checking of the flow meter is estimated to require an outage of 2 hours per extraction well in the South Plume and 2 hours for each on-property extraction well.

Check Valves: Inspect and Clean Seat Semiannually

All wells have a single in-line check valve that is removed, inspected, and cleaned. This maintenance activity is estimated to require each well to be shut down for approximately 4 hours.

Pressure-Indicating Transmitters: Annual Operational Checks

Each extraction well has a pressure-indicating transmitter that is used in performance testing to determine the pump's discharge head (pressure). Accurate pressure sensing in the full range of pumping pressures is required for accurate testing. No well shutdown is required.

Performance Testing

The main system performance indicators for the South Plume and South Field extraction well modules are gathered and summarized in performance tests conducted quarterly. These tests monitor the specific capacity of each recovery/extraction well and the pump/motor assembly performance. The test results are used to determine the need for well and pump cleaning, well redevelopment, or pump/motor rebuilding. The information helps minimize unscheduled, unplanned emergency maintenance and shortens the duration of well outages. Several of the parameters measured may be monitored more frequently to develop additional system data for trending purposes.

Parameters to Be Monitored

Extraction well operating parameters that are required to be routinely monitored include the following:

- Water level—static and pumping
- Flow
- Discharge pressure
- Motor amperage draw

Water Level Monitoring

Water level, both static and pumping, can vary significantly in a short time period and therefore needs to be measured routinely. The drawdown from static water level to the pumping water level is used to calculate a specific capacity for the well and is a direct indication of the degree of fouling of the well screen and the adjacent formation. The installation depth of the extraction well pump/motor assemblies has been established, based upon an anticipated worst-case drawdown of 10 ft below the seasonal low static water levels. Historical data were reviewed to determine seasonal lows. While each setting has some added submergence to be conservative, pumping levels are monitored routinely to ensure that adequate pump/motor submergence is maintained and to prevent severe component damage.

If the pumping water level measured during the quarterly performance testing approaches the top of the pump's bowl assembly, rehabilitation efforts may be necessary. Rehabilitation efforts include cleaning of the well using dual swab and airlift pumping to remove debris. After cleaning, the well will be acid-treated to break down encrustation on the well screen and within the local formation. These processes may, if necessary, be repeated several times to ensure that the well has been rehabilitated to its optimal condition.

<u>Flow Monitoring</u>

The ability of an extraction well pump and motor to sustain the desired flow is a key indicator of the health of the flow meter, controls, VFD, well, and pump/motor assembly. Testing to determine the ability of a pump and motor assembly to perform as expected will be completed quarterly. Additionally, individual extraction well flow is monitored continuously by the flow controller for each well. The actual flow verses the controller set point is checked by operations personnel at least once per day. Any significant deviation from the flow set point is investigated, and required maintenance actions are determined and carried out.

<u>Discharge Pressure Monitoring</u>

Pump discharge pressure, coupled with flow, is monitored quarterly to assess the pump/motor assemblies' performance against the manufacturer's published performance specifications.

<u>Amperage</u>

As with flow and pressure, amperage is a good indicator of how the pump/motor assembly is performing. During performance testing, motor amperage draw is measured on each of the three phases of the electrical supply. Amperage draw is compared to the motor manufacturer's published specifications. Amperage should be below the manufacturer's full-load amperage and should be approximately equal across the phases of the motor. An imbalance of greater than 20 percent across the phases indicates a motor or electrical supply situation that triggers more extensive diagnosis. Additional diagnostics and repairs are not within the scope of this plan.

6.3 Treatment Facilities Performance Monitoring and Maintenance

This section describes the key performance monitoring parameters and maintenance needs for the wastewater treatment systems and their ancillary facilities. Based on past performance, meeting the Fernald Preserve effluent discharge uranium limit of 30 ppb on a monthly average basis is routinely achievable.

6.3.1 Treatment Facilities Performance Monitoring

The CAWWT uses strong base-anion exchange as the final unit process for uranium removal. The strong base-anion exchange resins have a strong affinity for the uranyl carbonates in the Fernald Preserve's wastewater. The technology is reliable; however, treatment to the effluent levels required at the Fernald Preserve (i.e., less than 30 ppb) is not widely practiced in wastewater systems.

Measurable parameters for the CAWWT system are the total volume of water treated, the influent and effluent uranium concentrations and mass, and the total mass of uranium removed by treatment. The Fernald Preserve total effluent flow rate is metered. Flow-weighted composite samples of the effluent are analyzed daily for total uranium. Those two parameters are used to measure compliance with the OU5 ROD requirements for uranium discharge in the Fernald

Preserve's effluent. The sample results and treatment flow rates are reported, tracked, and used to determine the need for troubleshooting, process adjustments, and corrective actions. All of the routine uranium analytical work is conducted in a laboratory located within the CAWWT.

6.3.2 Treatment Facilities Maintenance Practices

Because the treatment systems have spare equipment installed along with bypass piping and valving, most of the routine preventive maintenance and repair work in the systems can be accomplished without a unit shutdown. For planned maintenance shutdowns, advance EPA approval will be obtained if relief allowances are requested. Some breakdowns will lead to system shutdowns. Loss of utilities or a failure in the CAWWT's computerized control system would result in a system shutdown. All treatment systems will fail safely on loss of a utility or a major component and are not complicated to restart.

6.4 Regulatory Issues

Current extraction well rehabilitation screen- and pump-cleaning efforts require the use of a blend of glycolic and hydrochloric acids (e.g., Cotey Chemicals Liquid Acid Descaler). The hydrochloric acid is used to break down flow-limiting mineral encrustation on the well screen/pump, and the glycolic acid removes fouling caused by bacterial growth. The spent hydrochloric-glycolic acid blend is purged from the well by pumping to a portable tank. The tank is emptied into the CAWWT backwash basin for subsequent treatment at the CAWWT before being discharged to the Great Miami River via the Parshall Flume.

The use of these acids in well rehabilitation and well and pump cleaning to date has been monitored closely. Ohio EPA has been notified and has approved of the intended chemical additions and subsequent discharges. After the addition of these chemicals, the water pumped initially from the extraction well is turbid, contains iron residual and dissolved scale, and has a low pH.

Placement of this wastewater stream in the CAWWT backwash basin is adequate to prevent turbidity and low pH from exceeding NPDES outfall limits.

7.0 Organizational Roles, Responsibilities, and Communications

This section presents the organizational roles and responsibilities with respect to implementation of this OMMP. Also presented are information needs and communications protocol for coordination with other Fernald Preserve project organizations, and interaction with EPA and Ohio EPA.

7.1 Organization Roles and Responsibilities

7.1.1 DOE Office of Legacy Management

DOE is responsible for providing direction and oversight of all activities at the Fernald Preserve.

7.1.2 LMS Operating Contractor

The LMS Operating Contractor is responsible for all engineering, design, and construction activities for the OMMP, which include:

- Engineering functional requirements, design basis, and detailed design drawings and documents.
- Engineering support during construction.
- Start-up plans, system operability test procedures, and test supervision.
- Standard start-up review plans and coordinating resolution of operational issues.
- Technical support of well field and water treatment operations.
- Coordination of project-specific activities associated with procurement and management of construction contractors.

The LMS Operating Contractor is also responsible for all aquifer restoration planning and defining groundwater monitoring/reporting activities within the project, which include:

- Developing and maintaining the aquifer restoration strategy.
- Defining groundwater remedy performance monitoring requirements.
- Completing groundwater data evaluation and reporting.
- Providing technical input on well operation and maintenance.
- Providing technical input to operations regarding compliance with discharge limits.
- Providing technical input to design and construction of site groundwater extraction systems.
- Preparing required Comprehensive Environmental Response, Compensation, and Liability Act documentation (e.g., RA Work Plan, aquifer remedy design documents, the IEMP groundwater section, and various other required reports).

Site Operations personnel are responsible for all operations and maintenance activities within the project, which include:

- Operation of groundwater extraction well systems.
- Operation of all site wastewater conveyance and treatment systems and their ancillary facilities.
- Estimating, planning, and executing corrective and preventive maintenance.
- Training and qualification of operators and supervisors.
- Developing, reviewing, and revising standard operating procedures.
- Sampling of process streams for compliance with operational parameters and established regulatory limits.

Site Environmental Monitoring/Data Management and Reporting personnel are responsible for:

- Collection of groundwater monitoring samples and aquifer water level data.
- Coordination of sample analysis, data management, and preparation of the annual Site Environmental Report.
- Analysis of wastewater treatment operations process control samples.

Site Environmental Compliance personnel are responsible for:

- Fulfilling site NPDES reporting requirements.
- Analysis of state and federal regulations to identify project-specific regulatory requirements.

The site Safety and Health team, in conjunction with Safety and Health personnel, are responsible for the following Safety and Health activities within the project:

- Development and revision of Safety and Health project matrices for operations, maintenance, and construction.
- Radiological monitoring of activities.
- Industrial health monitoring of activities.
- Oversight of construction and operations safety programs.
- Safety design reviews and technical input.

Individual project team members are responsible for the safe execution of the work assigned to them and have the right to stop work if unsafe conditions are observed.

The Project Controls and Finance personnel, in conjunction with Fernald project management, are responsible for:

- Project cost and schedule baseline development and maintenance.
- Cost performance and variance reporting.
- Estimate at completion funding analysis and reporting.
- Change proposal and cost-savings coordination.
- Project quality assurance oversight.

7.2 Regulatory Agency Interaction

As noted in Sections 1.0 and 3.0, Attachment D (the IEMP) provides for the collection and reporting of groundwater remedy performance (Section 3.0 of Attachment D) and treated effluent (Section 4.0 of Attachment D) information that supports operational decisions regarding groundwater restoration and water treatment. The current plan is that well field and treatment operational summaries are included in the annual Site Environmental Report. In addition, the NPDES reporting will continue as outlined in Section 4.0 of Attachment D. Meetings and conference calls will continue as necessary.

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