



Department of Energy

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RECEIVED
By Terri.Drake at 7:02 am, Jul 18, 2022

July 15, 2022

Mr. Brian Begley
Federal Facility Agreement Manager
Division of Waste Management
Kentucky Department for Environmental Protection
300 Sower Boulevard, 2nd Floor
Frankfort, Kentucky 40601

PPPO-02-10020882-22C

Mr. Victor Weeks
Federal Facility Agreement Manager
U.S. Environmental Protection Agency, Region 4
Federal Facilities Branch
61 Forsyth Street
Atlanta, Georgia 30303

Dear Mr. Begley and Mr. Weeks:

TRANSMITTAL OF THE EXPLANATION OF SIGNIFICANT DIFFERENCES TO THE RECORD OF DECISION FOR SOLID WASTE MANAGEMENT UNITS 1, 211-A, 211-B, AND PART OF 102 VOLATILE ORGANIC COMPOUND SOURCES FOR THE SOUTHWEST GROUNDWATER PLUME AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY, DOE/LX/07-2480&D1

Please find enclosed the Explanation of Significant Differences to the Record of Decision for Solid Waste Management Units 1, 211-A, 211-B, and Part of 102 Volatile Organic Compound Sources for the Southwest Groundwater Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, DOE/LX/07-2480&D1 (ESD). This ESD is a primary document under the Federal Facility Agreement (FFA) and documents the modifications to the remedial action for Solid Waste Management Unit (SWMU) 211-A.


Review of the final characterization data by the FFA parties resulted in the final remedy selection of Alternative 8, In Situ Source Treatment Using Enhanced In Situ Bioremediation with Interim Land Use Controls for SWMU 211-A. The final remedy required an increase in the area and volume of soil to be treated at SWMU 211-A, which resulted in an increase in the number of injection and monitoring wells. The increase in area and volume of soil to be treated resulted in a procured remedial action cost of approximately \$10 million, as compared to the estimated remedial action cost provided in the Record of Decision (ROD) of \$3.7 million. This ESD describes the changes to the remedial action that have been identified as significant changes from the action declared in the ROD, but do not fundamentally alter the basic features of the remedy as presented in the ROD. The document includes a placeholder section pending support agency

comments and concurrence. The U.S. Department of Energy respectfully requests review of the document within 60 days of the date of this letter.

If you have any questions or require additional information, please contact David Dollins at (270) 441-6819.

Sincerely,

Tracey L.
Duncan

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Date: 2022.07.15 08:41:58 -05'00'

Tracey Duncan
Federal Facility Agreement Manager
Portsmouth/Paducah Project Office

Enclosures:

1. Certification Page
2. ESD to the Record of Decision for Solid Waste Management Units 1, 211-A, 211-B, and Part of 102 Volatile Organic Compound Sources for the Southwest Groundwater Plume

Administrative Record File—SWP-PD

cc w/enclosures:

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CERTIFICATION

Document Identification: *Explanation of Significant Differences to the Record of Decision for Solid Waste Management Units 1, 211-A, 211-B, and Part of 102 Volatile Organic Compound Sources for the Southwest Groundwater Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, DOE/LX/07-2480&D1, dated June 2022*

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Four Rivers Nuclear Partnership, LLC

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7/14/2022

Myrna E. Redfield, Program Manager
Four Rivers Nuclear Partnership, LLC

Date Signed

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

U.S. Department of Energy

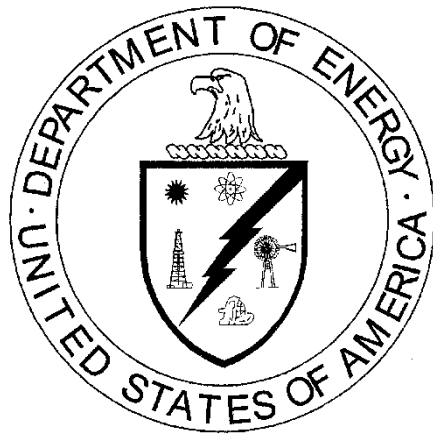
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Joel Bradburne, Manager
Portsmouth/Paducah Project Office
U.S. Department of Energy

Date Signed

**DOE/LX/07-2480&D1
Primary Document**

**Explanation of Significant Differences to the
Record of Decision for Solid Waste Management Units 1,
211-A, 211-B, and Part of 102 Volatile Organic Compound
Sources for the Southwest Groundwater Plume
at the Paducah Gaseous Diffusion Plant,
Paducah, Kentucky**



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**Explanation of Significant Differences to the
Record of Decision for Solid Waste Management Units 1,
211-A, 211-B, and Part of 102 Volatile Organic Compound
Sources for the Southwest Groundwater Plume
at the Paducah Gaseous Diffusion Plant,
Paducah, Kentucky**

Date Issued—June 2022

U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

Prepared by
FOUR RIVERS NUCLEAR PARTNERSHIP, LLC,
managing the
Deactivation and Remediation Project at the
Paducah Gaseous Diffusion Plant
under Contract DE-EM0004895

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PREFACE

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) requires changes made to remedial actions that are proposed after the adoption of a signed Record of Decision (ROD) be documented using one of the following three processes: (1) ROD Amendment if the change “fundamentally alters” basic features of the remedy; (2) Explanation of Significant Differences (ESD) if the change to a component of the remedy does not fundamentally alter the overall cleanup approach; or (3) Memorandum to File if the proposed changes to the remedy are minor. The proposed changes to the Solid Waste Management Unit (SWMU) 211-A remedial action, an increase in the area and volume of treated soil and a resulting significant increase in the cost of the remedial action, do not “fundamentally alter” the basic features of the remedy as presented in the ROD, but are “significant” changes that require the development of an ESD. This *Explanation of Significant Differences to the Record of Decision for Solid Waste Management Units 1, 211-A, 211-B, and Part of 102 Volatile Organic Compound Sources for the Southwest Groundwater Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-2480&D1, was prepared in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act, Section 117 (c); 40 *CFR* § 300.435(c)(2)(i) of the NCP; and *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and other Remedy Selection Decision Documents*, EPA 540-R-98-031, July 1999. It provides the public with information to understand the significant differences between the remedial action, as implemented, and the approach proposed in the *Record of Decision for Solid Waste Management Units 1, 211-A, 211-B, and Part of 102 Volatile Organic Compound Sources for the Southwest Groundwater Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0365&D2/R1 (DOE 2012).

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ACRONYMS

ARAR	applicable or relevant and appropriate requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
<i>CFR</i>	<i>Code of Federal Regulations</i>
DOE	U.S. Department of Energy
EISB	enhanced <i>in situ</i> bioremediation
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
FC	final characterization
FFA	Federal Facility Agreement
FFS	focused feasibility study
FY	fiscal year
KDEP	Kentucky Department for Environmental Protection
LUC	land use control
MW	monitoring well
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
PGDP	Paducah Gaseous Diffusion Plant
RAWP	remedial action work plan
RCRA	Resource Conservation and Recovery Act
RDR	remedial design report
RDSI	remedial design support investigation
RGA	Regional Gravel Aquifer
SMP	site management plan
SWMU	solid waste management unit
UCRS	Upper Continental Recharge System
VOC	volatile organic compound

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EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) has prepared this Explanation of Significant Differences (ESD) to document significant differences between the remedial action proposed in the Record of Decision (ROD) for Solid Waste Management Unit (SWMU) 211-A at the Paducah Gaseous Diffusion Plant (PGDP) and the final remedial action. The differences are an increase in the area and volume of treated soil, and a resulting significant increase in cost for the action. SWMU 211-A is one of two areas associated with the Southwest Plume that is located near the C-720 Maintenance & Storage Building.

The ROD was signed by DOE and the U.S. Environmental Protection Agency in March 2012 (DOE 2012). The Kentucky Department for Environmental Protection concurred with the selected remedy. The selected remedy for SWMU 211-A includes the following:

- A final characterization (FC)/remedial design support investigation (RDSI) of the extent and magnitude of contamination present in the subsurface soils.
- A review of the data by the Federal Facility Agreement (FFA) parties and subsequent selection of either Alternative 8, *In Situ* Source Treatment Using Enhanced *In Situ* Bioremediation with Interim LUCs; or Alternative 2, Long-term Monitoring with Interim LUCs.

Review of the final characterization data by the FFA parties resulted in the final remedy selection of Alternative 8, *In Situ* Source Treatment Using Enhanced *In Situ* Bioremediation with Interim LUCs, for SWMU 211-A, and required an increase in the area and volume of soil to be treated at SWMU 211-A, which resulted in an increase in the number of injection and monitoring wells. While the basic features of the selected remedy with respect to scope and performance did not change, the increase in area and volume of soil to be treated resulted in a procured remedial action cost of approximately \$10M compared to the estimated remedial action cost provided in the ROD of \$3.7M. The expanded treatment area will ensure the remedy adequately covers the full nature and extent of the targeted level of contamination. This expanded treatment area does not change the overall cleanup approach; is necessary to ensure protection of human health and the environment; and will ensure the protectiveness of the ROD.

In August 2017, the FFA parties signed the *Memorandum of Agreement on the C-400 Complex under the Federal Facility Agreement for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 2017a), which established that all projects, with the exception of C-400 and Southwest Plume SWMU 211-A, would be resequenced in the fiscal year (FY) 2018 site management plan (SMP) (DOE 2017b). Because of that agreement, this ESD will only focus on the planned remedial activity for SWMU 211-A. SWMU 211-B will not be included in this ESD, and the remedial action for SWMU 211-B will be reevaluated as part of the C-720 Complex as described in the FY 2022 SMP (DOE 2021b).

In April 2022, DOE prepared a memorandum that: (1) documented the FFA parties' historical discussions and agreements concerning the path forward for the use of two applicable or relevant and appropriate requirements (ARARs) identified in the ROD (DOE 2012); (2) provided clarification for the Southwest Plume Sources Post-decision File of the Administrative Record use of the ARARs with respect to the Southwest Plume Sources Comprehensive Environmental Response, Compensation, and Liability Act remedial actions; and (3) documented the FFA parties' agreement that a modification to the 2012 ROD is not required. The memorandum can be found in the Southwest Plume Post-Decision File of the Administrative Record at <https://eic.pad.pppo.gov/> (DOE 2022a).

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1. INTRODUCTION AND PURPOSE

The U.S. Department of Energy (DOE) is conducting cleanup activities at the Paducah Gaseous Diffusion Plant (PGDP) under its environmental management program. Cleanup efforts are necessary to address contamination resulting from past waste-handling and disposal practices at the plant. The cleanup activities comply with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) in accordance with the Federal Facility Agreement (FFA) (EPA 1998).

The remedy selected for Solid Waste Management Unit (SWMU) 211-A at the C-720 Maintenance & Storage Building is documented in the *Record of Decision for Solid Waste Management Units 1, 211-A, 211-B, and Part of 102 Volatile Organic Compound Sources for the Southwest Groundwater Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0365&D2/R1 (ROD) (DOE 2012). The ROD specified that the selected remedy for SWMU 211-A includes the following:

- A final characterization (FC)/remedial design support investigation (RDSI) of the extent and magnitude of contamination present in the subsurface soils.
- A review of the data by the FFA parties and subsequent selection of either Alternative 8, *In Situ* Source Treatment Using Enhanced *In Situ* Bioremediation with Interim LUCs; or Alternative 2, Long-term Monitoring with Interim LUCs (DOE 2012).

The final remedial action selected for SWMU 211-A is Alternative 8, *In Situ* Source Treatment Using Enhanced *In Situ* Bioremediation with Interim LUCs. The FFA parties made the final remedy selection following the completion of the final characterization as part of the RDSI in 2012–2013; completion of additional groundwater characterization in July 2015; identification of DOE’s chosen remedy based on foregoing studies in December 2015 (DOE 2015); and issuance of an addendum to the final characterization report (DOE 2016). Remedial action selection was presented to the FFA parties on May 23, 2018; the presentation can be reviewed at <https://eic.pad.pppo.gov/> (DOE 2018). A remedial design report (RDR) (DOE 2019) and a remedial action work plan (RAWP) (DOE 2021a) have been developed and approved by the FFA parties. Both the RDR and the RAWP will be used to implement the selected remedial action.

Review of the final characterization data by the FFA parties resulted in the final remedy selection of Alternative 8, *In Situ* Source Treatment Using Enhanced *In Situ* Bioremediation with Interim LUCs, for SWMU 211-A. The final remedy required an increase in the area and volume of soil to be treated at SWMU 211-A, which resulted in an increase in the number of injection and monitoring wells (MWs). While the basic features of the selected remedy with respect to scope and performance did not change, the increase in area and volume of soil to be treated resulted in a procured remedial action cost of approximately \$10M, as compared to the estimated remedial action cost provided in the ROD of \$3.7M. The expanded treatment area will ensure the remedy adequately covers the full nature and extent of the targeted contamination. This expanded treatment area does not change the overall cleanup approach, is necessary to ensure the protection of human health and the environment, and will ensure the protectiveness of the ROD.

In August 2017, the FFA parties signed the *Memorandum of Agreement on the C-400 Complex under the Federal Facility Agreement for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 2017a) which established that all projects, with the exception of C-400 and Southwest Plume SWMU 211-A, would be resequenced in the fiscal year (FY) 2018 site management plan (SMP) (DOE 2017b). Because of that agreement, this Explanation of Significant Differences (ESD) will only focus on the planned remedial activity for SWMU 211-A. SWMU 211-B will not be included in this ESD, and the remedial action for

SWMU 211-B will be reevaluated as part of the C-720 Complex, as described in the FY 2022 SMP (DOE 2021b).

In April 2022, DOE prepared a memorandum that (1) documented the FFA parties' historical discussions and agreements concerning the path forward for the use of two applicable or relevant and appropriate requirements (ARARs) found in the ROD (DOE 2012); (2) provided clarification for the use of the ARARs, with respect to the Southwest Plume Sources CERCLA remedial actions; and (3) documented the FFA parties' agreement that a modification to the ROD is not required. The memorandum can be found in the Administrative Record under the Post-decision File for Southwest Plume Sources (SWMUs 1, 211-A, 211-B) at <https://eic.pad.pppo.gov/> (DOE 2022a).

The interim land use controls (LUCs) for SWMU 211-A that were included in the signed ROD are in place and operating. The interim LUCs consist of the excavation/penetration permit program and warning signs. The interim LUCs for SWMU 211-A will remain in place pending selection of final remedies in subsequent operable units for other contaminants of concern in environmental media at SWMU 211-A.

This ESD has been prepared in accordance with CERCLA Section 117(c) and 40 *CFR* § 300.435(c)(2)(i) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). An ESD is required when a significant change is made to the remedy defined in the decision document (e.g., ROD). A significant change generally involves a change to a component of a remedy that does not fundamentally alter the overall cleanup approach. This ESD describes the nature of the significant changes, summarizes the information that led to making the changes, and affirms that the revised remedy complies with the NCP and the statutory requirements of CERCLA. As required by 40 *CFR* § 300.435(c)(2)(i)(B), a notice of availability and a brief description of the ESD is to be published in a major local newspaper of general circulation. The ESD is to be made public and placed in the Administrative Record File and information repository [40 *CFR* § 300.435(c)(2)(i)(A) and § 300.825(a)(2)].

1.1 SITE NAME AND LOCATION

PGDP is located in the northwestern corner of Kentucky in western McCracken County, about 10 miles west of Paducah, Kentucky, and 3.5 miles south of the Ohio River (Figure 1). Past operations and disposal of waste material resulted in the contamination of the groundwater migrating from PGDP. The Southwest Groundwater Plume is one of three groundwater plumes at the facility with the primary contaminant being trichloroethene (TCE). The Southwest Plume is a component of the Groundwater Operable Unit that is currently being addressed under the FFA. The C-720 Building Northeast Site—SWMU 211-A (Figure 2) is one volatile organic compound (VOC) source within the Southwest Groundwater Plume.

1.2 REGULATORY BACKGROUND

PGDP was placed on the National Priorities List in 1994. Pursuant to Section 120 of CERCLA, the PGDP FFA (EPA 1998) was negotiated and implemented to coordinate the CERCLA remedial action and RCRA corrective action process into a set of comprehensive requirements for site remediation. Since 1998, DOE, the U.S. Environmental Protection Agency (EPA), and the Kentucky Department for Environmental Protection (KDEP) have operated under the FFA, with DOE acting as the lead agency and EPA and KDEP acting as support agencies that provide oversight.

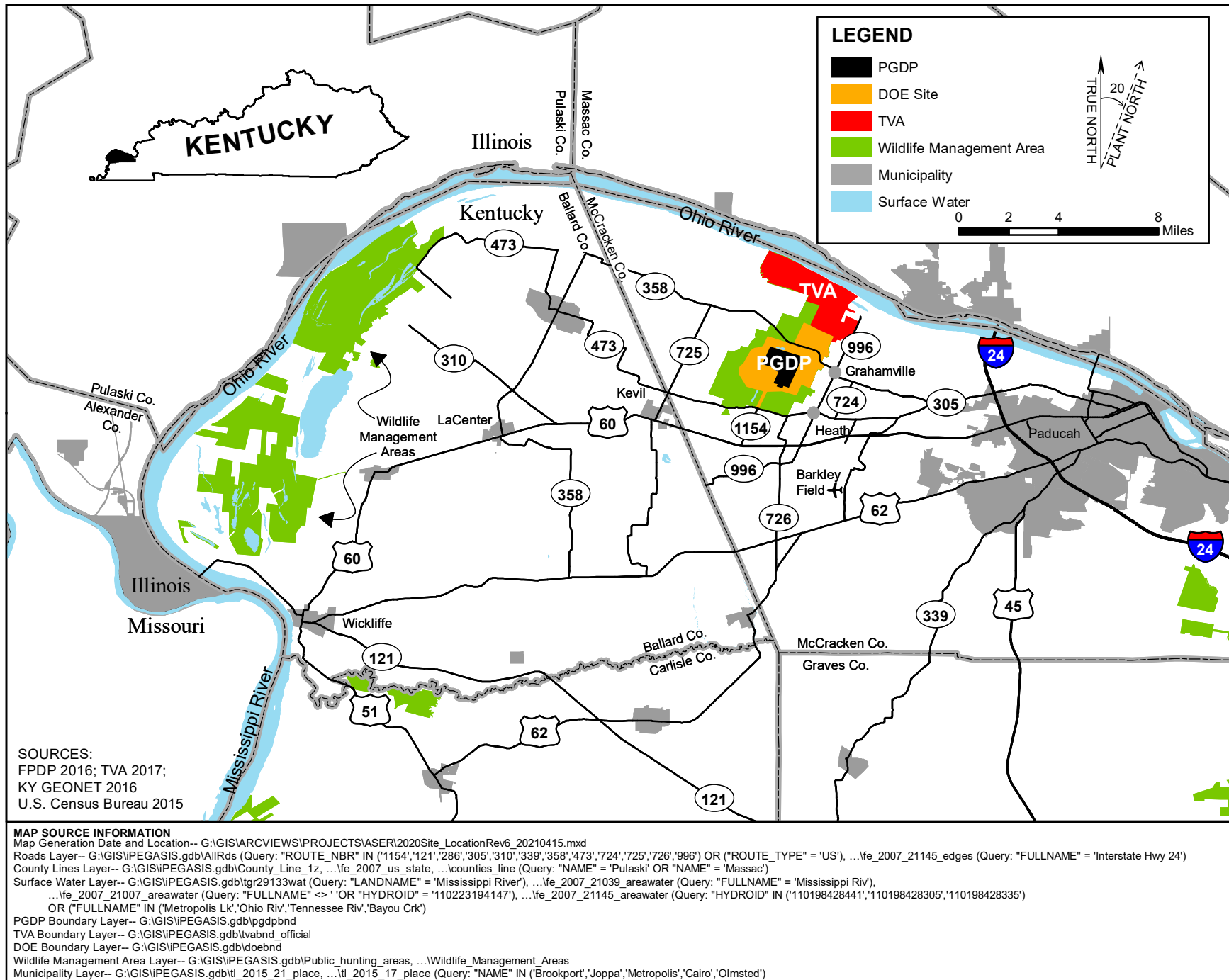
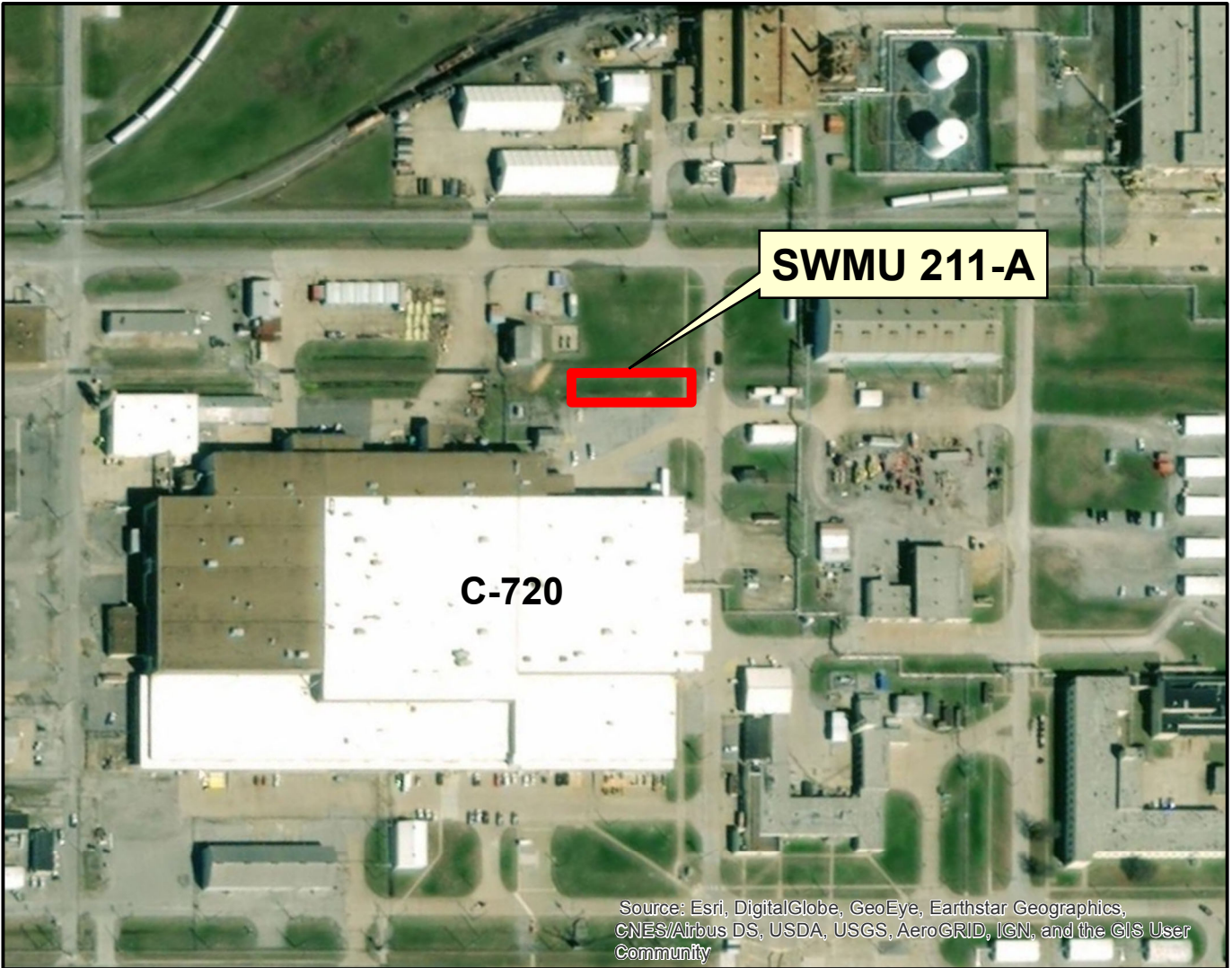
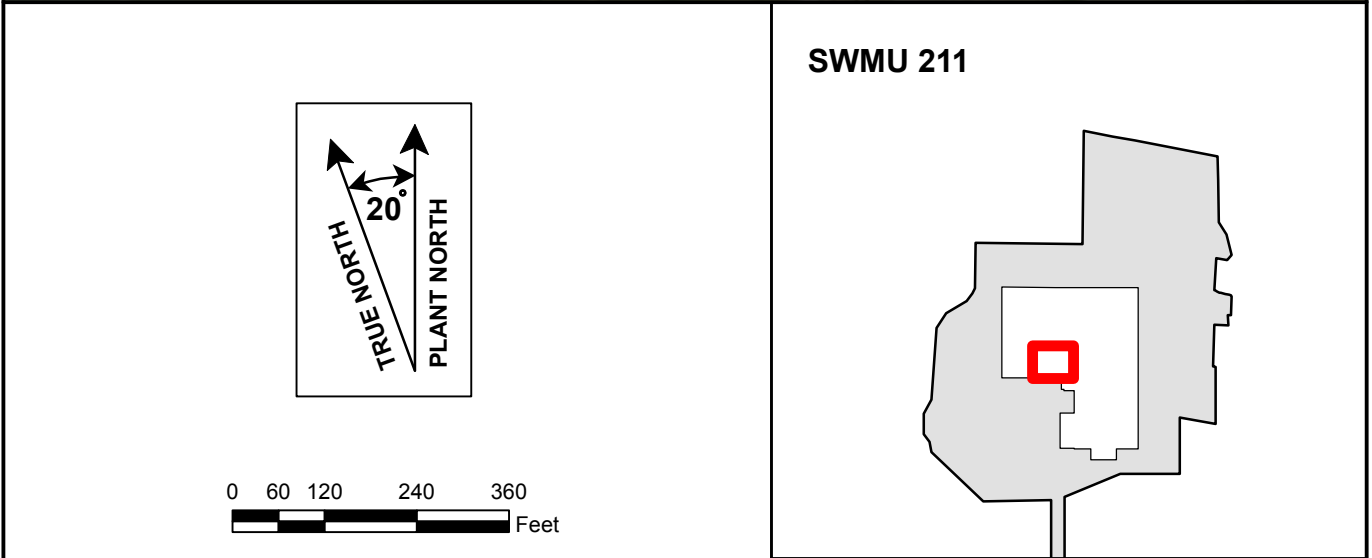


Figure 1. PGDP Site Location



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



SWMU 211

0 60 120 240 360 Feet

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT



Figure 2. SWMU 211-A Location

Source: DOE 2021a

The ROD was signed in March 2012 and specified that the remedy to be implemented for SWMU 211-A Upper Continental Recharge System (UCRS) soils would be either Alternative 8, *In Situ* Source Treatment Using Enhanced *In Situ* Bioremediation with Interim LUCs; or Alternative 2, Long-term Monitoring with Interim LUCs, based on the findings of the FC/RDSI. Final selection was made by the FFA parties following performance of the final characterization that was part of the RDSI in 2012–2013; performance of additional groundwater characterization in July 2015; letter notification that identified the DOE chosen remedy based on foregoing studies in December 2015 (DOE 2015); and issuance of an addendum to the final characterization report (DOE 2016). Remedial action selection was presented to the FFA parties on May 23, 2018; the presentation can be reviewed at <https://eic.pad.pppo.gov/> (DOE 2018). An RDR (DOE 2019) and a RAWP (DOE 2021a) have been developed and approved by the FFA parties. Both the RDR and the RAWP will be used to implement the selected RA. Public notice of the selected remedy by the FFA parties was published in *The Paducah Sun* on February 12–13, 2022. The public notice can be found at <https://eic.pad.pppo.gov/> (DOE 2022b).

1.3 CIRCUMSTANCES CREATING THE NEED FOR AN EXPLANATION OF SIGNIFICANT DIFFERENCES

Because the ROD required a FC/RDSI to determine the extent and magnitude of contamination present in the subsurface soils, the ROD did not specify a treatment area for SWMU 211-A. For costing purposes, it was assumed in the ROD that SWMU 211-A would have six estimated injection well locations and a MW network of four wells (DOE 2012). Based on the results of the FC/RDSI and additional groundwater characterization, the treatment area is approximately 13,200 ft². Approximately 33 injection well locations and 27 MWs (9 MWs outside the treatment area and 18 in the treatment area) are required for the remedial action (DOE 2021a). The engineering design changes resulted in a procured remedial action cost of approximately \$10M, as compared to the original estimated remedial action cost provided in the ROD of \$3.7M.

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2. SITE HISTORY, CONTAMINATION, AND SELECTED REMEDY

This section provides a brief summary of the site contamination and history, along with a presentation of the selected remedy as originally described in the ROD.

2.1 SITE HISTORY AND CONTAMINATION ASSOCIATED WITH SWMU 211-A

SWMU 211-A is one of two areas associated with the Southwest Plume located near the C-720 Maintenance & Storage Building. The C-720 building consists of several repair and machine shops, an instrument shop, equipment and material storage areas, and other support operations for the PGDP. The building is located in the southwest portion of the plant. The source of the contaminants to SWMU 211-A is not known; however, it is suspected that SWMU 211-A originated from spills that included leaks of solvents that were released during the routine cleaning and rinsing of equipment that was performed in C-720.

2.2 REMEDIAL ACTION REMEDY APPROVED IN THE ROD; FINAL REMEDY SELECTED

The selected remedy for SWMU 211-A includes the following:

- An FC/RDSI of the extent and magnitude of contamination present in the subsurface soils.
- A review of the data by the FFA parties and subsequent selection by the FFA parties of either Alternative 8, *In Situ* Source Treatment Using Enhanced *In Situ* Bioremediation with Interim LUCs; or Alternative 2, Long-term Monitoring with Interim LUCs (DOE 2012).

Following the FC/RDSI and the performance of additional groundwater characterization, the final remedy selected by the FFA parties for SWMU 211-A was Alternative 8, *In Situ* Source Treatment Using Enhanced *In Situ* Bioremediation with Interim LUCs. Public notice of the selected remedy by the FFA parties was published in *The Paducah Sun*, February 12–13, 2022. The public notice can be found at <https://eic.pad.pppo.gov/> (DOE 2022b).

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3. BASIS FOR THE EXPLANATION OF SIGNIFICANT DIFFERENCES

This section presents information that formed the basis for the selection of the final remedial action of *in situ* source treatment using enhanced *in situ* bioremediation (EISB) with interim LUCs and the engineering design changes that resulted in an increase to remedial action costs, as compared to the ROD cost estimate.

3.1 INFORMATION SUPPORTING THE FINAL REMEDY SELECTION

3.1.1 Record of Decision

In situ source treatment using EISB with interim LUCs was not evaluated for the source zone at SWMU 211-A in the revised focused feasibility study (FFS) based on low technical implementability when compared to other alternatives (DOE 2011). Subsequent to the final evaluation in the revised FFS, however, DOE determined that EISB would be applicable to SWMU 211-A using pressure injection methods, as opposed to gravity injection and infiltration, which was evaluated in the revised FFS for SWMU 1. This determination was based on the larger grain-size soils that make up the UCRS soils at the C-720 area (DOE 2012).

For Alternative 8 of the ROD, which included application of EISB at SWMU 211-A, the ROD anticipated that the number of injection points required for the SWMU 211-A treatment area would be determined in the design phase, but for costing purposes in the ROD, it was assumed that the SWMU 211-A treatment area would have six injection points. The MW network was expected to include four wells (DOE 2012).

The ROD also assumed that a bioamendment mixture (i.e., microbes, nutrients, reductants) would be introduced into the subsurface via vertical injection wells. The specific bioamendment mixture would be determined through the use of sample results from the RDSI (DOE 2012).

The ROD cost estimate for Alternative 8, *In Situ* Source Treatment Using Enhanced *In Situ* Bioremediation with Interim LUCs, for SWMU 211-A was \$3.7M, and was based on the best available information in regard to the anticipated implementation costs of the remedial alternative. Per the ROD, an RDSI would be performed to better determine the extent and distribution of VOCs, which included dense nonaqueous-phase liquid TCE, and the UCRS soil and groundwater parameters specific to the EISB technology. As a result, changes to the cost elements were anticipated to occur because of new information and data collected during the engineering design of the remedial alternative (DOE 2012).

3.1.2 Addendum to the Final Characterization Report

The 2015 phase of the SWMU 211-A investigation sampled groundwater from the Regional Gravel Aquifer (RGA) in 5-ft intervals from a depth of 65 ft to the base of the RGA. The sampling results and subsequent analysis determined that TCE contamination in soil in the UCRS in the SWMU 211-A treatment area contributed more than 400 parts per billion (ppb) but less than 11,000 ppb TCE to the RGA, consistent with the conceptual site model in the ROD. The SWMU 211-A decision rules utilized for the additional groundwater investigation directed implementation of enhanced bioremediation and long-term monitoring (i.e., ROD Alternative 8).

3.1.3 Southwest Plume SWMU 211-A Presentation to FFA Parties

Remedial action selection was presented to the FFA parties on May 23, 2018, and included implementation of Alternative 8 from the ROD, *In Situ* Source Treatment Using Enhanced *In Situ* Bioremediation with Interim LUCs, for a treatment area of approximately 13,200 ft² (DOE 2018).

3.1.4 Remedial Design Report for SWMU 211-A

An RDR has been developed to support the specific implementation of Alternative 8, *In Situ* Source Treatment Using Enhanced *In Situ* Bioremediation with Interim LUCs, at SWMU 211-A (DOE 2019). EISB will be performed on the SWMU 211-A treatment area (see Figure 3). The recommended implementation of EISB increased the treatment area size and resulted in an increase of the following:

- Injection wells—33 locations (85 wells) from 6 locations (18 wells) in the ROD;
- MW network—9 wells external to the treatment area from 4 wells in the ROD; and
- Performance MW network—18 wells internal to the treatment area from 0 wells in the ROD.

The SWMU 211-A monitoring well layout is shown on Figure 4. The procured remedial action cost to support the increase is approximately \$10M, as compared to the ROD's estimated cost of \$3.7M. While the cost increase is a significant change, it does not alter or fundamentally change the remedy selected in the ROD.

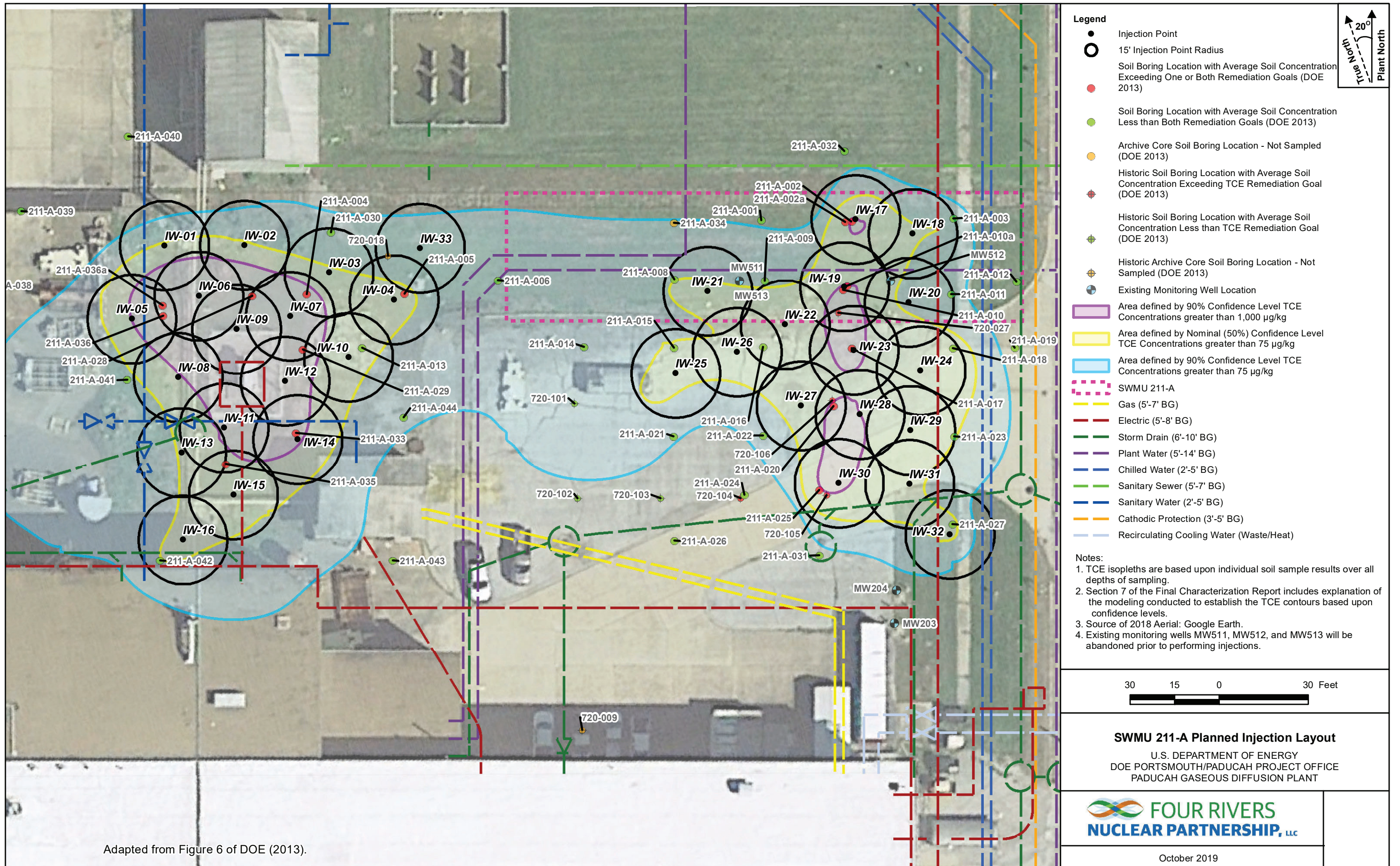
3.2 REMEDIAL ACTION WORK PLAN FOR SWMU 211-A

The RAWP for SWMU 211-A Enhanced *In Situ* Bioremediation documents the design and construction associated with the remedial action (DOE 2021a). Detailed information is included in regard to the planned injection layout, treatment areas and depths, injection techniques, bioaugmentation of each injection well, real-time process monitoring, and post-injection monitoring.

3.3 ADMINISTRATIVE RECORD INFORMATION SUPPORTING THE NEEDED CHANGE

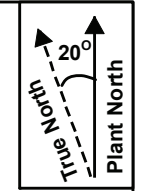
Information contained in the Administrative Record that supports the final remedy is discussed in Section 3.1. As required by 40 *CFR* § 300.825(a)(2), this ESD will be made available to the public through the Administrative Record for the Southwest Plume Sources. Contact information for the Administrative Record is as follows:

DOE Environmental Information Center
Emerging Technology Center, Room 221
5100 Alben Barkley Drive
Paducah, KY 42001
(270) 554-3004
<https://eic.pad.pppo.gov>
Hours of Operation: Monday through Friday,
8:00 a.m.–12:00 p.m.



Adapted from Figure 6 of DOE (2013).

Figure 3. SWMU 211-A Planned Injection Layout



Legend

Existing Monitoring Well Locations That Will Remain

- Well screened within the middle UCRS
- Well screened within the middle RGA

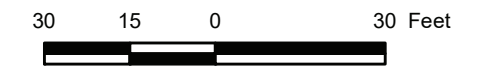
Proposed Monitoring Well Locations

- Well screened within the middle UCRS
- Well screened within the lower UCRS
- Well screened within the upper RGA
- Well screened within the middle RGA

- Area defined by 90% Confidence Level TCE Concentrations greater than 1,000 µg/kg
- Area defined by Nominal (50%) Confidence Level TCE Concentrations greater than 75 µg/kg
- Area defined by 90% Confidence Level TCE Concentrations greater than 75 µg/kg
- SWMU 211-A

Notes:

1. Section 7 of the Final Characterization Report includes explanation of the modeling conducted to establish the TCE contours based upon confidence levels.
2. Source of 2018 Aerial: Google Earth.



SWMU 211-A Monitoring Well Layout
 U.S. DEPARTMENT OF ENERGY
 DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
 PADUCAH GASEOUS DIFFUSION PLANT



September 2019

Adapted from Figure 6 of DOE (2013).

Figure 4. SWMU 211-A Monitoring Well Layout

4. DESCRIPTION OF SIGNIFICANT DIFFERENCES

This section describes the key differences between the remedy in the ROD and the modifications documented in this ESD, which highlight scope, cost, performance, and any changes to expected outcomes when the modifications are implemented.

4.1 SIGNIFICANT DIFFERENCES BETWEEN THE REMEDY AND ESD MODIFICATIONS

Table 1 summarizes the main components of the selected remedy and identifies how the remedy modification impacts these components.

Table 1. Summary of Modifications to the Proposed Remedy in the ROD

Proposed Remedy in the ROD	Remedy Modification
EISB will be performed at SWMU 211-A. The total area expected to be treated is estimated at approximately 1,300 ft ² .	EISB will be performed in a treatment area of approximately 13,200 ft ² .
Because the ROD required an FC/RDSI to determine the extent and magnitude of contamination present in the subsurface soils, the ROD did not specify a treatment depth for SWMU 211-A.	Primary treatment depths include 25 ft bgs to 65 ft bgs, with some limited areas above the 25 ft depth.
Jet injection technology—not discussed in the ROD estimate.	Because of the fine-grained nature of the UCRS soils, prior to initiating the bioremediation component, each of the injection well locations will be fractured with direct-push technology jet injection, which utilizes a water jetting technique.
Six injection well locations, with three wells each (18 wells).	An estimated 33 injection well locations (85 wells), plus 325 jet fracturing operations will be utilized.
Because the ROD required an FC/RDSI to determine the extent and magnitude of contamination present in the subsurface soils, the ROD did not identify injection rates.	The emulsified vegetable oil injected into each injection well will be pumped using low pressure estimated at 15 to 40 pounds per square inch (psi) (not to exceed 60 psi), and in a volume of up to 2% by volume of pore space.
Geochemical concerns—not discussed in the ROD cost estimate.	Water conditioned to remove dissolved oxygen to assist in the creation of the subsurface-reducing environment will be utilized to emulsify the vegetable oil for injection.
Real-time process monitoring—not discussed in the ROD cost estimate.	Real-time process monitoring will occur during the injection processes.
MW network—four wells.	Post-injection monitoring will be performed utilizing a network of nine MWs located external to the treatment area and 18 performance MWs located internal to the treatment area. The wells will be screened in the UCRS and in the RGA.

As documented in the ROD, EISB is expected to remove approximately 95% of the contaminant mass in the UCRS, with the remaining mass estimated to attenuate and attain groundwater protection remediation goals within approximately 39 years (DOE 2012). As documented in the addendum to the FC report, the total TCE volume present in the UCRS is estimated to be up to 2.2 gal (DOE 2016).

The basic features of the selected remedy with respect to scope and performance did not change; however, the increased soil treatment area and volume resulted in a procured remedial action cost of approximately \$10M, as compared to the estimated remedial action cost provided in the ROD of \$3.7M. The expanded treatment area will ensure the remedy adequately addresses the full nature and extent of the targeted level of contamination. This expanded treatment area does not change the overall cleanup approach, is necessary to ensure the protection of human health and the environment, and will ensure the protectiveness of the ROD. Under EPA guidance, the engineering design and cost changes would be considered a “significant” change that should be documented in an ESD. The guidance states that while the ESD is being prepared and made available to the public, the lead agency may proceed with the predesign, design, construction, or operation activities associated with the remedy (EPA 1999).

4.2 EXPECTED OUTCOMES OF THE ESD

The increased SWMU 211-A treatment area is intended to effectively reduce UCRS VOC contamination to acceptable levels through active treatment by the removal of a contaminant mass of TCE and other VOCs.

5. SUPPORT AGENCY COMMENTS AND CONCURRENCE

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6. STATUTORY DETERMINATION

The selected remedial action was determined in the ROD to satisfy the relevant mandates of CERCLA Section 121 and the NCP, including the threshold statutory requirements that the remedial action protect human health and the environment and attain ARARs. The changes in the remedial action described in this ESD do not change any of the statutory or regulatory determinations set forth in CERCLA Section 121 or the NCP, including the two threshold statutory determinations.

The remedial action, until the TCE remaining after treatment attenuates within approximately 39 years to the remediation goal for TCE of 0.075 mg/kg, will result in hazardous substances, pollutants, or contaminants preventing unlimited use and unrestricted exposure. Because the selected remedial action will result in hazardous substances remaining on-site in excess of levels that allow for unlimited use and unlimited exposure, a statutory review of the remedial action under CERCLA Section 121(c) will be conducted every five years until the levels of contaminants of concern allow for unlimited use and unrestricted exposures of the SWMU 211-A treatment area. The five-year reviews will be conducted to ensure that the remedy is or will be protective of human health and the environment. If the results of a five-year review reveals that protection of human health and the environment is insufficient, the potential benefits of implementing additional remedial actions will be evaluated by the FFA parties. The statutory reviews will be conducted in accordance with CERCLA 121(c), 40 *CFR* § 300.430(f)(5)(iii)(C) of the NCP, and EPA guidance. These reviews, although required by CERCLA, are not considered components of the selected remedy.

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7. PUBLIC PARTICIPATION REQUIREMENTS

As required by 40 *CFR* § 300.435(c)(2)(i), a Notice of Availability and brief description of this ESD will be published in the local newspaper that announces the availability of the ESD for review through the Administrative Record and information repository, as required by the NCP [40 *CFR* § 300.435(c)(2)(i)(A) and 300.825(a)(2)]. The Administrative Record File that contains the ROD and other associated documentation is available for review at the following location:

DOE Environmental Information Center
Emerging Technology Center, Room 221
5100 Alben Barkley Drive
Paducah, KY 42001
(270) 554-3004

<https://eic.pad.pppo.gov>

Hours of Operation: Monday through Friday,
8:00 a.m.–12:00 p.m.

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8. APPROVALS

*Explanation of Significant Differences to the
Record of Decision for Solid Waste Management Units 1,
211-A, 211-B, and Part of 102 Volatile Organic Compound
Sources for the Southwest Groundwater Plume
at the Paducah Gaseous Diffusion Plant
Paducah, Kentucky*

DOE/LX/07-2480&D1

June 2022

APPROVAL

Joel Bradburne, Manager
Portsmouth/Paducah Project Office
U.S. Department of Energy

Date

Carol Monell, Director
Superfund Division
U.S. Environmental Protection Agency, Region 4

Date

CONCURRENCE

Tammi Hudson, Director
Division of Waste Management
Kentucky Department for Environmental Protection

Date

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9. REFERENCES

- DOE (U.S. Department of Energy) 2011. *Revised Focused Feasibility Study for Solid Waste Management Units 1, 211-A, and 211-B Volatile Organic Compound Sources for the Southwest Groundwater Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0362&D2, U.S. Department of Energy, Paducah, KY, May.
- DOE 2012. *Record of Decision for Solid Waste Management Units 1, 211-A, 211-B, and Part of 102 Volatile Organic Compound Sources for the Southwest Groundwater Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0365&D2/R1, U.S. Department of Energy, Paducah, KY, March.
- DOE 2015. Letter from T. Duncan, U.S. Department of Energy, to B. Begley, Kentucky Department for Environmental Protection, and J. Corkran, U.S. Environmental Protection Agency, “Final Characterization Notification for Solid Waste Management Unit 211-A and Solid Waste Management Unit 211-B at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,” PPO-02-3287657-16, December 17.
- DOE 2016. *Addendum to the Final Characterization Report for Solid Waste Management Units 211-A and 211-B Volatile Organic Compound Sources for the Southwest Groundwater Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-1288&D2/A1/R1, U.S. Department of Energy, Paducah, KY, April.
- DOE 2017a. *Memorandum of Agreement on the C-400 Complex under the Federal Facility Agreement for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, U.S. Department of Energy, Paducah, KY, August.
- DOE 2017b. *Site Management Plan Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Annual Revision—FY 2018*, DOE/LX/07-2418&D1, U.S. Department of Energy, Paducah, KY, November.
- DOE 2018. “SWMU 211-A and SWMU 211-B Options,” Webex meeting presented by U.S. Department of Energy, May 23.
- DOE 2019. *Certified for Construction Remedial Design Report for SWMU 211-A for Volatile Organic Compound Sources to the Southwest Groundwater Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-2435&D2, U.S. Department of Energy, Paducah, KY, December.
- DOE 2021a. *Remedial Action Work Plan for SWMU 211-A Enhanced In Situ Bioremediation for Volatile Organic Compound Sources to the Southwest Groundwater Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-2443&D2/R2, U.S. Department of Energy, Paducah, KY, December.
- DOE 2021b. *Site Management Plan Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Annual Revision—FY 2022*, DOE/LX/07-2473&D2, U.S. Department of Energy, Paducah, KY, December.
- DOE 2022a. “Southwest Plume Volatile Organic Compound Sources Applicable or Relevant and Appropriate Requirements,” memorandum from the U.S. Department of Energy to Southwest Plume Post-Decision Record File—SWP-PD, May 16.

DOE 2022b. “Public Notice Remedial Action Selection for the Solid Waste management Unit 211-A of the Southwest Plume Sources at the Paducah Gaseous Diffusion Plant Site (Groundwater Operable Unit)” *The Paducah Sun*, February 12, 2022.

EPA (U.S. Environmental Protection Agency) 1998. *Federal Facility Agreement for the Paducah Gaseous Diffusion Plant*, DOE/OR/07-1707, U.S. Environmental Protection Agency, Atlanta, GA, February.

EPA 1999. *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents*, EPA 540-R-98-031, U.S. Environmental Protection Agency, Washington, DC, July.