Department of Energy

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DEC 05 2019

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-02-10001265-20B

Ms. Julie Corkran
Federal Facility Agreement Manager
U.S. Environmental Protection Agency, Region 4
61 Forsyth Street
Atlanta, Georgia 30303

Dear Mr. Begley and Ms. Corkran:

TRANSMITTAL OF THE 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&D1)

Please find enclosed the certified D1 *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&D1, (RAWP) for review and comment. In accordance with Section XX and Appendix F of the Paducah Federal Facility Agreement, the U.S. Environmental Protection Agency and the Kentucky Department for Environmental Protection have a 30-day review and comment period for this D1 RAWP document.

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

Sincerely,

Tracey Duncan
Federal Facility Agreement Manager
Portsmouth/Paducah Project Office

Enclosures:
1. Certification Page
2. Remedial Action Work Plan for SWMU 211-A, DOE/LX/07-2443& D1

Administrative Record File—SWP-PD

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DOE/LX/07-2443&D1
Primary Document

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

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DOE/LX/07-2443&D1
Primary Document

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

Date Issued—December 2019

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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ACRONYMS

AAD	annual average discharge
ACGIH	American Conference of Governmental Industrial Hygienists
ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate requirement
BMP	best management practice
CA	corrective action
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CRZ	contamination reduction zone
CSM	conceptual site model
CVOC	chlorinated volatile organic compound
DHC	*Dehalococcoides ethenogenes*
DMIP	Data Management Implementation Plan
DNAPL	dense nonaqueous-phase liquid
DOE	U.S. Department of Energy
DOECAP	DOE Consolidated Audit Program
DPT	direct push technology
EDD	electronic data deliverable
EISB	enhanced *in situ* bioremediation
EMS	Environmental Management System
EPA	U.S. Environmental Protection Agency
ER	environmental restoration
ES&H	environment, safety, and health
EVO	emulsified vegetable oil
EVS	C-Tech Environmental Visualization Systems Expert System
EZ	exclusion zone
FFA	Federal Facility Agreement
FLM	frontline manager
GIS	geographic information system
HAP	hazardous air pollutant
HASP	health and safety plan
HU	hydrogeologic unit
IDW	investigation-derived waste
ISMS	Integrated Safety Management System
JHA	job hazard analysis
KAR	*Kentucky Administrative Regulations*
KDEP	Kentucky Department for Environmental Protection
KPDES	Kentucky Pollutant Discharge Elimination System
LCD	Lower Continental Deposit
LDR	land disposal restriction
LLW	low-level waste
LUC	land use control
MCL	maximum contaminant level
MW	monitoring well
OREIS	Oak Ridge Environmental Information System
OSHA	Occupational Safety and Health Administration
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
PEMS	Paducah Project Environmental Measurements System

PGDP	Paducah Gaseous Diffusion Plant
PPE	personal protective equipment
PPPO	Portsmouth/Paducah Project Office
PSS	plant shift superintendent
PTW	principal threat waste
PWMC	project waste management coordinator
QA	quality assurance
QAPIP	quality assurance program and implementation plan
QAPP	quality assurance project plan
QC	quality control
RA	remedial action
RAD	radiological
RAO	remedial action objective
RAWP	remedial action work plan
RCRA	Resource Conservation and Recovery Act
RCT	radiological control technician
RDR	remedial design report
RDSI	remedial design support investigation
RFD	request for disposal
RGA	Regional Gravel Aquifer
RI	remedial investigation
ROD	record of decision
RPP	Radiation Protection Program
RTL	ready to load
RWP	radiological work permit
SDS	safety data sheet
SHS	safety and health specialist
SI	site investigation
SMO	Sample Management Office
SMP	Site Management Plan
SOW	statement of work
SWMU	solid waste management unit
TBC	to be considered
TCLP	Toxicity Characteristic Leaching Procedure
TRU	transuranic
TSCA	Toxic Substance Control Act
UCD	Upper Continental Deposit
UCRS	Upper Continental Recharge System
UIC	Underground Injection Control
VOC	volatile organic compound
WAC	waste acceptance criteria
WAG	waste area grouping
WICL	waste item container log
WMP	waste management plan
ZVI	zero-valent iron

EXECUTIVE SUMMARY

This remedial action (RA) project was selected 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). This RA satisfies, for volatile organic compound (VOC) contamination in the Upper Continental Recharge System (UCRS) soils, the mandates of the Comprehensive Environmental Response, Compensation, and Liability Act and the National Contingency Plan to be protective of human health and the environment by addressing VOC contamination through active treatment and through interim land use controls (LUCs) for any residual VOC and non-VOC contamination. The action will contribute to the final remediation of the Groundwater Operable Unit by removing contaminant trichloroethene mass (TCE) and other VOCs at Solid Waste Management Unit (SWMU) SWMU 211-A through treatment and will achieve applicable or relevant and appropriate requirements for the action (DOE 2012). The total expected TCE volume, based on data from the Remedial Design Support Investigation performed in 2012 and analyzed in development of the *Addendum to the Final Characterization Report for the 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, has been estimated to be up to 2.2 gal (DOE 2016).

The RA includes the design, installation, and monitoring of enhanced *in situ* bioremediation (EISB) with interim LUCs. EISB will be performed on UCRS soils. The bioremediation will utilize emulsified vegetable oil and will include bioaugmentation. To assist in more uniform placement of the bioamendments in the UCRS soils, fracturing of the soil will be performed. The fractures will be filled with proppant composed of sand and zero-valent iron. The completed design of the RA is contained in *90% 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&D1 (DOE 2019a).

This remedial action work plan (RAWP) provides project background information, remedial action objectives, implementation approach and the area to be treated, the project organization, and a project planning schedule. In addition, this RAWP addresses waste management and disposition, project health and safety, quality assurance and data management, and environmental compliance associated with implementing the project.

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1. INTRODUCTION

This *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&D1, (RAWP) has been prepared for source treatment using enhanced *in situ* bioremediation (EISB) with interim land use controls (LUCs) for Solid Waste Management Unit (SWMU) 211-A. The remedy planned for the SWMU 211-A 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 (DOE 2012) (ROD). The ROD specified that the remedy to be implemented for SWMU 211-A Upper Continental Recharge System (UCRS) soils would be either EISB with interim LUCs and groundwater sampling or long-term monitoring with interim LUCs. Final selection was made by the Federal Facility Agreement (FFA) parties following performance of the final characterization that was part of the Remedial Design Support Investigation (RDSI) in 2012–2013; performance of additional groundwater characterization in July 2015; issuance of an Addendum to the Final Characterization Report (DOE 2016); and Letter Notification identifying the DOE chosen remedy based on foregoing studies in December 2015 (DOE 2015a). The remedial action (RA) project to be implemented at SWMU 211-A is EISB with interim LUCs and groundwater sampling, and the RA was arrived at during the final RAs discussed in the May 23, 2018, presentation to the FFA parties. The May 23, 2018, presentation can be reviewed at the Paducah Gaseous Diffusion Plant (PGDP) Environmental Information Center at Accession Number ENV 1.A-01526 in the Search category (DOE 2018).

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*, that agreed that all projects (except C-400 and Southwest Plume SWMU 211-A) would be resequenced in the fiscal year 2018 Site Management Plan (SMP) (DOE 2017a). As a result of that agreement, the planned remedial activity for SWMU 211-B will not be included in this RAWP. Future activities associated with SWMU 211-B will be reevaluated and resequenced as part of the PGDP SMP process(es).

The interim LUCs for all three SWMUs that were included in the signed ROD are in place and operating. The LUCs associated with SWMU 211-B will remain in place pending SWMU 211-B future activities as determined in SMP development. 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 final remedy selection as part of a subsequent OU that addresses the relevant media.

An associated remedial design report (RDR) has been developed, and it will be used along with this approved RAWP to implement the selected RA at SWMU 211-A (DOE 2019a).

PGDP is located approximately 10 miles west of Paducah, Kentucky, and 3.5 miles south of the Ohio River in the western part of McCracken County. PGDP is an inactive uranium enrichment facility owned by the U.S. Department of Energy (DOE) that currently is undergoing deactivation and remediation (Figure 1). Bordering PGDP to the northeast, between the PGDP plant and the Ohio River, is the Tennessee Valley Authority Shawnee Fossil Plant. The remaining Paducah Site border is shared with the West Kentucky Wildlife Management Area. Before PGDP was constructed, a munitions production facility, the Kentucky Ordnance Works, was operated at the current PGDP location and at an adjoining area southwest of the site. Munitions, including trinitrotoluene, were manufactured and stored at Kentucky Ordnance Works between 1942 and 1945. Construction of PGDP was initiated in 1951, and the plant began operation in 1952. PGDP construction was completed in 1955, and PGDP became fully operational in that year, supplying enriched uranium for commercial reactors and military defense reactors. Uranium enrichment operations ceased at PGDP in 2013.

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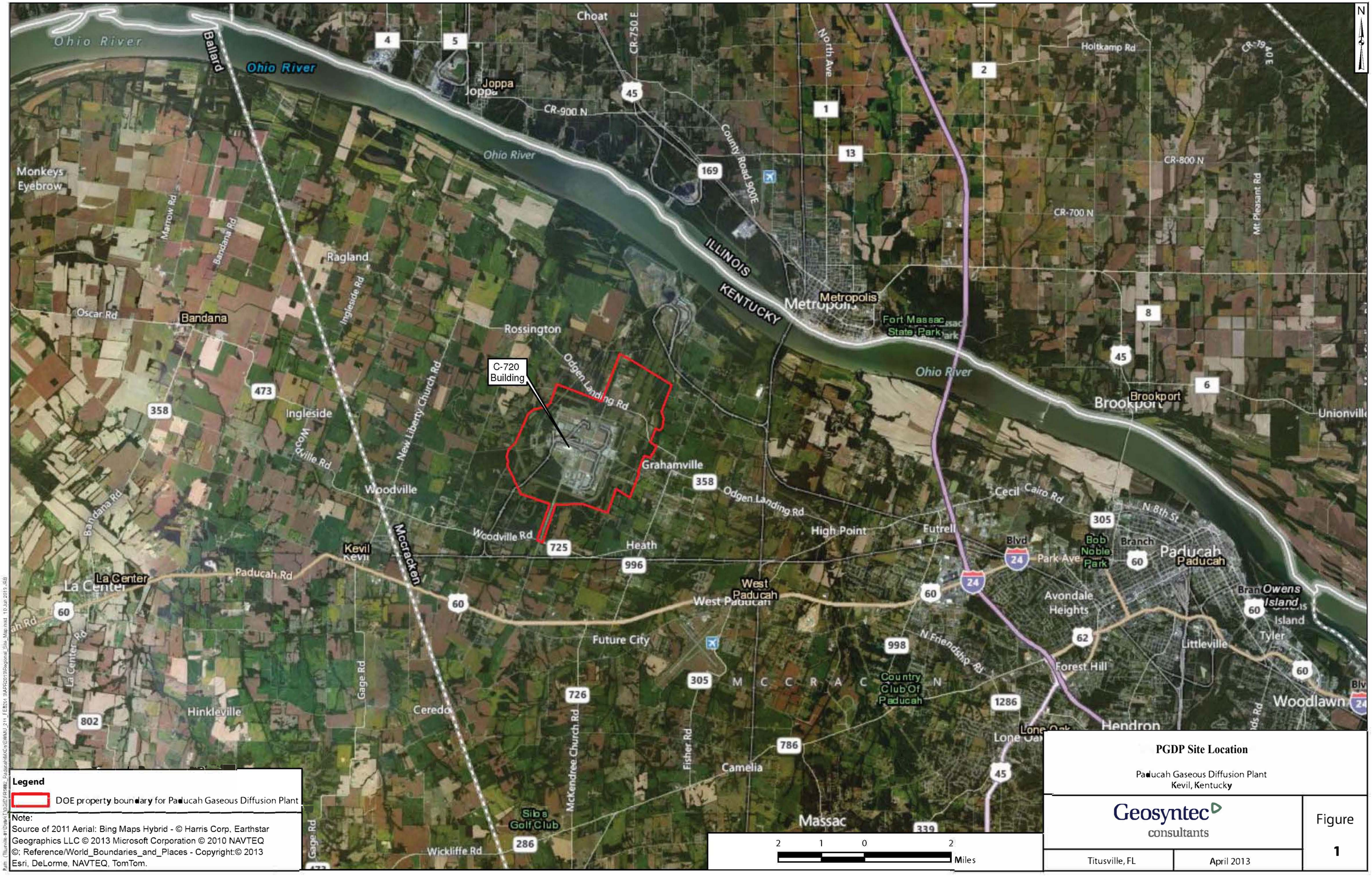

Legend

DOE property boundary for Paducah Gaseous Diffusion Plant

Note:
Source of 2011 Aerial: Bing Maps Hybrid - © Harris Corp, Earthstar Geographics LLC © 2013 Microsoft Corporation © 2010 NAVTEQ ©; Reference/World_Boundaries_and_Places - Copyright:© 2013 Esri, DeLorme, NAVTEQ, TomTom.

PGDP Site Location

Paducah Gaseous Diffusion Plant
Kevil, Kentucky

Geosyntec consultants

Titusville, FL | April 2013

Figure 1

Figure 1. PGDP Site Location

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The Southwest Groundwater Plume refers to an area of groundwater contamination at the Paducah Site in the Regional Gravel Aquifer (RGA), which is south of the Northwest Groundwater Plume and west of the C-400 Cleaning Building (also known as the C-400 Building). The plume was identified during the Waste Area Grouping (WAG) 27 Remedial Investigation (RI) in 1998 (DOE 1999). Additional work to characterize the plume was performed as part of the WAG 3 RI (DOE 2000a), Data Gaps Investigation (DOE 2000b), and the RDSI (DOE 2016). As discussed in these reports, the primary groundwater contaminant of concern for the Southwest Groundwater Plume (referred to as the Southwest Plume) is trichloroethene (TCE). Other contaminants found in the plume include additional volatile organic compounds (VOCs), metals, and the radionuclide, technetium-99 (Tc-99).

DOE conducted a site investigation (SI) in 2004 to address uncertainties associated with potential source areas to the Southwest Plume that remained after previous investigations. The SI further profiled the concentration and distribution of VOCs in the dissolved-phase plume along the west plant boundary at that time. Results of the SI were reported in the *Site Investigation Report for the Southwest Groundwater Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-2180&D2/R1 (DOE 2007). The *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, (DOE 2011) is based on the SI (DOE 2007) and previous investigations. The ROD for this action was signed in 2012. An RDSI was performed in 2012 consistent with the Remedial Design Work Plan (DOE 2015b). Additional characterization of SWMU 211-A also was performed in 2015 before the FFA parties decided to proceed with implementing the RA.

1.1 REGIONAL GEOLOGY AND HYDROGEOLOGY

1.1.1 Regional Geology

Regional Geology. The Paducah Site is located in the Jackson Purchase Region of Western Kentucky, which represents the northern tip of the Mississippi Embayment portion of the Coastal Plain. The Jackson Purchase Region is an area of land that includes all of Kentucky west of the Tennessee River. The stratigraphic sequence in the region consists of Cretaceous, Tertiary, and Quaternary sediments unconformably overlying Paleozoic bedrock. See Figure 2, which is a generalized lithostratigraphic column for the PGDP area.

Mississippian carbonates form the nearest outcrop of bedrock and are exposed approximately 9 miles northwest of PGDP in southern Illinois (MMES 1992). Coastal Plain deposits unconformably overlie Mississippian carbonate bedrock and consist of the following: the Tuscaloosa Formation; sand and clays of the Clayton/McNairy Formations; the Porters Creek Clay; and Eocene Sands and clay deposits (undivided Jackson, Claiborne, and Wilcox Formations). Continental Deposits unconformably overlie the Coastal Plain deposits, which are, in turn, covered by loess and/or alluvium.

Relative to the shallow groundwater flow system in the vicinity of the Paducah Site, the Continental Deposits and the overlying loess and alluvium are of key importance. The Continental Deposits resemble a large, low-gradient alluvial fan that covered much of the region and eventually buried the erosional topography. A principal geologic feature in the Paducah Site area is the Porters Creek Clay Terrace slope, a subsurface terrace that trends approximately east to west across the southern portion of the plant. The Porters Creek Clay Terrace slope represents the southern limit of erosion or scouring of the ancestral Tennessee River. Thicker sequences of Continental Deposits, as found underlying the Paducah Site, represent valley fill deposits and can be divided informally into a lower unit (gravel facies) and an upper unit (clay facies). The Lower Continental Deposits (LCD) are the gravel facies consisting of chert gravel in a matrix of poorly sorted sand and silt that rests on an erosional surface representing the beginning of the valley fill sequence. In total, the gravel unit averages approximately 30-ft thick, but some thicker deposits (as much as 50 ft) exist in deeper

SYSTEM	SERIES	FORMATION	THICKNESS (IN FEET)	DESCRIPTION	HYDROGEOLOGIC SYSTEMS
QUATERNARY	PLEISTOCENE AND RECENT	ALLUVIUM	0-40	Brown or gray sand and silty clay or clayey silt with streaks of sand.	Upper Continental Recharge System
	PLEISTOCENE	LOESS	0-43	Brown or yellowish-brown to tan unstratified silty clay.	
	PLEISTOCENE	CONTINENTAL DEPOSITS	3-121	Upper Continental Deposits (Clay Facies) - mottled gray and yellowish brown to brown clayey silt and silty clay, some very fine sand, trace of gravel. Often micaceous.	
TERTIARY	PLIOCENE-MIOCENE (?)			Lower Continental Deposits (Gravel Facies) - reddish-brown clayey, silty and sandy chert gravel and beds of gray sand.	Regional Gravel Aquifer
	EOCENE	JACKSON, CLAIBORNE, AND WILCOX FORMATIONS	0-200+	Red, brown or white fine to coarse grained sand. Beds of white to dark gray clay are distributed at random.	McNairy Flow System
			0-100+	White to gray sandy clay, clay conglomerates and boulders, scattered clay lenses and lenses of coarse red sand. Black to dark gray lignitic clay, silt or fine grained sand.	
	PALEOCENE	PORTERS CREEK CLAY	0-200	Dark gray, slightly to very micaceous clay. Fine grained clayey sand, commonly glauconitic in the upper part. Glauconitic sand and clay at the base.	
		CLAYTON FORMATION	Undetermined	Lithologically similar to underlying McNairy Formation.	
UPPER CRETACEOUS		McNAIRY FORMATION	200-300	Grayish-white to dark gray micaceous clay, often silty, interbedded with light gray to yellowish-brown very fine to medium grained sand with lignite and pyrite. The upper part is interbedded clay and sand, and the lower part is sand.	
		TUSCALOOSA FORMATION	Undetermined	White, well rounded or broken chert gravel with clay.	
MISSISSIPPIAN		MISSISSIPPIAN CARBONATES	500+	Dark gray limestone and interbedded chert, some shale.	

Adapted from Olive 1980.

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

Figure 2. Generalized Lithostratigraphic Column for the PGDP Region

Figure 2. Generalized Lithostratigraphic Column for the PGDP Region

scour channels. The Upper Continental Deposits (UCD) primarily is a sequence of fine grained, clastic facies varying in thickness from 15 ft to 60 ft that consists of clayey silts with lenses of sand and occasional gravel.

The area of the Southwest Plume lies within the buried valley of the ancestral Tennessee River in which Pleistocene Continental Deposits (the fill deposits of the ancestral Tennessee River Basin) rest unconformably on Cretaceous marine sediments. Pliocene through Paleocene formations in the area of the Southwest Plume have been removed by erosion of the ancestral Tennessee River Basin. In the area of the Southwest Plume and its sources, the upper McNairy Formation consists of 60 ft to 70 ft of interbedded units of silt and fine sand and underlies the Continental Deposits. Total thickness of the McNairy Formation is approximately 225 ft.

The surface deposits found in the vicinity of the Paducah Site consist of loess and alluvium. Both units are composed of clayey silt or silty clay and range in color from yellowish-brown to brownish-gray or tan, making field differentiation difficult.

1.1.2 Regional Hydrogeology

The local groundwater flow system at the Paducah Site occurs within the sands of the Cretaceous McNairy Formation, Pliocene Terrace Gravel, Plio-Pleistocene lower continental gravel deposits and UCD, and Holocene alluvium (Jacobs EM Team 1997; MMES 1992). Four specific components have been identified for the groundwater flow system and are defined as follows from lowest to uppermost.

- McNairy Flow System. Formerly called the deep groundwater system, this component consists of interbedded sand, silt, and clay of the Cretaceous McNairy Formation. Sand facies account for 40% to 50% of the total formation's thickness of approximately 225 ft. Groundwater flow is predominantly horizontal and to the north.

- Terrace Gravel. This component consists of gravel deposits and later reworked sand and gravel deposits found at elevations higher than 320 ft above mean sea level (amsl) in the southern portion of the plant site; they overlie the Paleocene Porters Creek Clay and Eocene Sands and are thought to be Pliocene in age. These deposits usually lack sufficient thickness and saturation to constitute an aquifer. Terrace Gravel is not present in the area of the Southwest Plume sources.

- RGA. This component consists of the Quaternary sand and gravel facies of the LCD and Holocene alluvium found adjacent to the Ohio River and is of sufficient thickness and saturation to constitute an aquifer. These deposits are commonly thicker than the Pliocene (?-age uncertain) gravel deposits, having an average thickness of 30 ft, and range up to 50 ft in thickness along an axis that trends east-west through the plant site. Prior to 1994, the RGA was the primary aquifer used as a drinking water source by nearby residents. The RGA has not been classified formally, but likely would be considered a Class II groundwater under U.S. Environmental Protection Agency (EPA) Groundwater Classification guidance (EPA 1988). Groundwater flow is predominantly horizontal and north toward the Ohio River.

- UCRS. The UCRS consists of the surficial alluvium and UCD. Sand and gravel lithofacies appear relatively discontinuous in cross section, but portions may be interconnected. The most prevalent sand and gravel deposits occur at an elevation of approximately 345 ft to 351 ft amsl; less prevalent deposits occur at elevations of 337 ft to 341 ft amsl. Groundwater flow primarily downward into the RGA from the UCRS (DOE 2010a; DOE 2017b).

The groundwater flow systems associated with the Southwest Plume and its sources are the UCRS and the RGA. In the area of the Southwest Plume, groundwater flow and contaminant migration through the upper 45 ft to 55 ft of subsurface soil (UCD) is predominantly vertically downward with little lateral spreading. This flow system is termed the UCRS. Locally, the UCRS consists of three hydrogeologic units (HUs), an upper

silt interval (HU1), an intermediate horizon of sand and gravel lenses (HU2), and a lower silt and clayey silt interval (HU3). The silts and clays of the UCRS readily adsorb some contaminants, such as metals and radionuclides, retarding the migration of these contaminants in groundwater from the source areas. Moreover, laterally extensive silt and clay horizons in the UCRS may halt the downward migration of dense nonaqueous-phase liquids (DNAPLs), but halting the movement results in potentially fostering the development of DNAPL pools in the subsurface or diffusion into fine-grain sediments, if present. To date, none of the investigations in the SWMU 211-A area have identified the presence of any DNAPL pools in the subsurface.

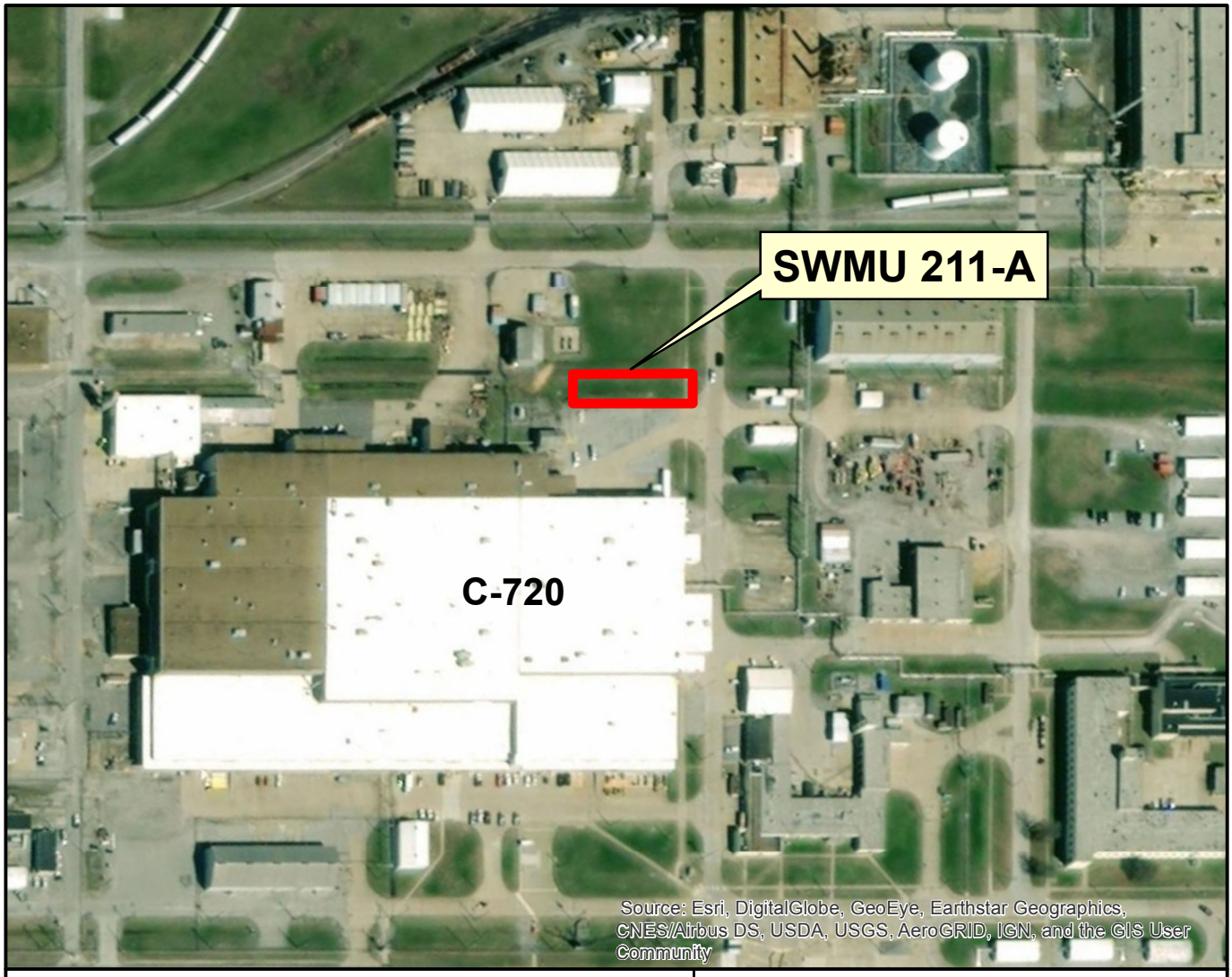
Groundwater occurrence in the UCRS primarily is the result of infiltration from natural and anthropogenic recharge. Groundwater in the UCRS provides recharge to the underlying RGA. The water table in the UCRS varies both spatially and seasonally due to lithologic heterogeneity and recharge factors (e.g., infiltration of focused run-off from engineered surfaces, seepage due to variations in water line integrity, rainfall, and evapotranspiration), and averages approximately 17 ft below ground surface (bgs) in depth with a range of 2 ft to 50 ft.

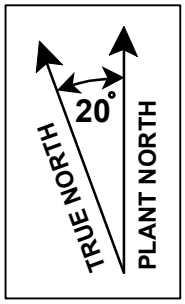
Downward vertical hydraulic gradients generally range from 0.5 ft to 1 ft per ft where measured by monitoring wells (MWs) completed at different depths in the UCRS. MWs in the south-central area of PGDP (south of the C-400 Building and east of the C-720 Building) have lower water level elevations than MWs in other areas of the plant (DOE 1999). Horizontal hydraulic conductivity of the UCRS sand units has been determined from 15 slug tests in a previous investigation (CH2M HILL 1992) in wells across the PGDP site. The field (horizontal) measured hydraulic conductivity of the UCRS sands was 3.4E-05 centimeters per second (cm/s) at the C-720 Building [1.3E-05 inches/second (in/s)] as measured in MW204 located at the northeast corner of the C-720 Building. Measurements of the vertical hydraulic conductivity of the UCRS silt and clay units are not available for the C-720 Building; measurements (laboratory) of the vertical hydraulic conductivity of UCRS silt and clay units on-site range between 1.7E-08 and 2.1E-05 cm/s (6.7E-09 and 8.2E-06 in/s) (DOE 1999; DOE 1999). [The depth-averaged vertical hydraulic conductivity of the total UCRS interval is approximately 1E-06 cm/s (3.9E-07 in/s).]

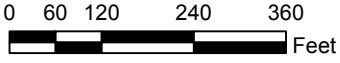
A thick interval of late Pleistocene sand and gravel from a depth interval of 60 to 90 ft (LCD) bgs represents the shallow, uppermost aquifer underlying most of the Paducah Site, referred to as the RGA. The RGA consists of a discontinuous upper horizon of fine to medium sand (HU4) and a lower horizon of medium to coarse sand, and gravel (HU5). The RGA is the main pathway for horizontal/lateral flow and dissolved contaminant migration off-site. Variations in hydraulic conductivity and the location of discrete sources of recharge govern the local direction and rate of groundwater flow; however, overall flow within the RGA trends north-northeast toward the Ohio River, which represents the regional hydraulic base level. The RGA typically has a high hydraulic conductivity with a range from 1.9E-02 to 2.0E+00 cm/s (7.5E-03 to 7.9E-01 in/s) as determined from aquifer testing. RGA horizontal hydraulic gradients range between 1.84E-04 and 2.98E-03 ft per ft and have average and median values of 7.81E-04 and 4.4E-04 ft per ft, respectively. Groundwater flow rates within higher hydraulic conductivity paths within the RGA average approximately 1 ft to 3 ft/day. Contaminant migration tends to be less retarded in the coarse sediments of the RGA due to its high groundwater flow rate and also due to the low fraction of organic carbon (0.02%) (DOE 2013).

1.2 TREATMENT SITE LOCATION

The treatment location for this RA is in the south-central portion of PGDP. More specifically, the treatment area lies northeast of the C-720 Building. The location of the SWMU 211-A is shown in Figure 3. The C-720 Building consists of several repair and machine shops, instrument shop, equipment and material storage area, and other support operations.







SWMU 211

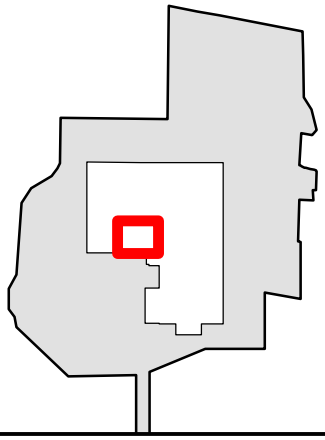


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Figure 3. SWMU 211-A Location

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The SWMU 211-A area has been investigated several times in support of remedy selection and development of this RAWP including the WAG 27 RI (1997); Southwest Plume SI (2007); and the RDSI (2012). The RDSI was conducted in 2012 and 2015 to gather supplemental data necessary to choose a remedy and support design and implementation of the EISB with interim LUCs. Data collected during these investigations supported development of the remedial design that is contained in the *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&D1 (DOE 2019a).

1.3 CONCEPTUAL SITE MODEL

The conceptual site model (CSM) is a three-dimensional "picture" that illustrates contaminant sources, release mechanisms, exposure pathways, migration routes, and potential human and ecological receptors. Figure 4 represents the CSM for SWMU 211-A and is based on all previous investigations. The Southwest Plume SI, implemented in 2004, concluded that high concentration TCE soils that would constitute principal threat waste (PTW) are present at SWMU 211-A in UCRS soils. None of the investigations of SWMU 211-A have identified DNAPL pools or large quantities of DNAPL in the UCRS thus far.

RDSI data were collected to support defining the area of SWMU 211-A to be treated and to confirm that EISB will be utilized as the treatment method. The RDSI data did not modify the SWMU 211-A conceptual model concerning UCRS contamination that was developed by the SI of the Southwest Plume (DOE 2007).

The RDSI provided updated information on the TCE and other VOC concentrations in the area to be treated. Mass quantity estimates and treatment areas were interpolated using the RDSI data, WAG 27 RI data, and the Southwest Plume SI data, and the C-Tech Environmental Visualization Systems Expert System (EVS). Volume estimates were calculated using kriging, kriging using the 90% confidence interval, investigation-derived waste (IDW), and nearest neighbor. The RDR contains a summary of the EVS modeling that identified areas to be treated and estimated TCE volume contained in those areas. The complete EVS modeling information is reported in Appendix C of the *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 (DOE 2016).

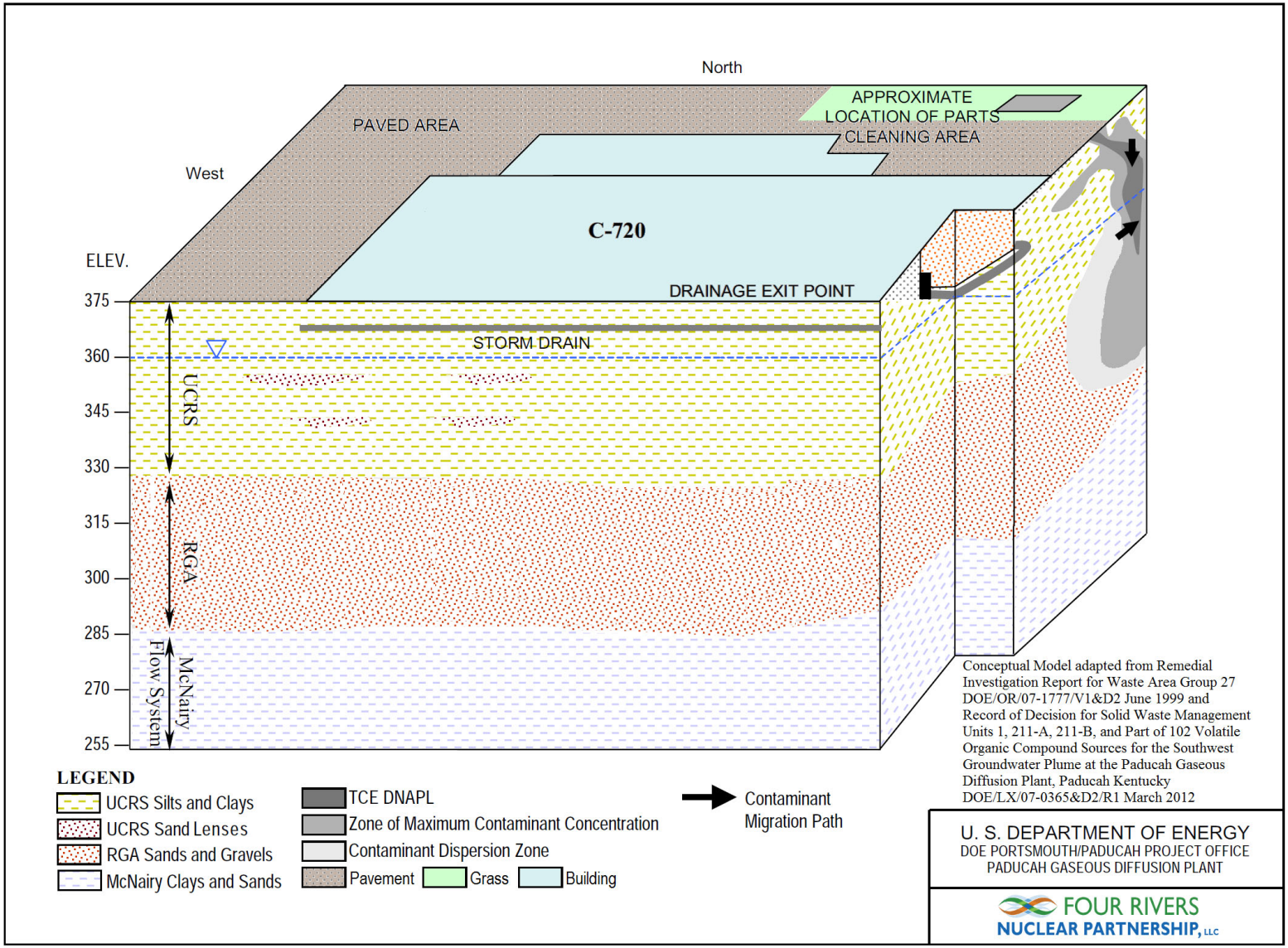

Figure 4. Conceptual Site Model for the SWMU 211-A TCE Source Area

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2. TREATMENT TECHNOLOGY

2.1 *IN SITU* SOURCE TREATMENT USING ENHANCED *IN SITU* BIOREMEDIATION DESCRIPTION

EISB implementation for SWMU 211-A will consist of the following major activities listed. A detailed description of the activities is included in the *90% 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&D1 (DOE 2019a).

- Hydraulic fracturing with direct push technology (DPT) Jet Injection—Utilizing DPT drilling methods and Jet Injection horizontal fractures will be emplaced at pre-planned depths with an expected radius estimated at 15 ft. The fractures will be injected with a mixture of guar gum, sand and zero-valent iron (ZVI). The guar gum will biodegrade while the sand and ZVI will become proppant to increase the hydraulic conductivity of the fracture. The ZVI will act to degrade TCE and its degradation products.

- Injection well installation—Following the completion of the hydraulic fracturing, a cluster (2–3) of injection wells (nested/offset) will be installed within 5 ft of each DPT Jet Injection location. The well and screen locations will be offset and stacked, respectively, consistent with the RDR. The injection wells will be utilized to inject bioamendments and perform bioaugmentation for the treatment area.

- Monitoring well installation—MWs will be installed directly in the treatment area and also outside the treatment area. The wells inside the treatment area will monitor the bioremediation process. The MWs located outside the treatment area will be utilized to ascertain the effects the bioremediation has on the RGA groundwater and the progress toward attaining the remedial action objectives (RAOs). The MWs will be screened throughout the UCRS and in the upper and middle RGA. The MW location details are contained in the 90% RDR (DOE 2019a).

- Bioamendment injection—Emulsified vegetable oil in conditioned water (chlorine and dissolved oxygen reduced) will be injected through each injection well into the UCRS to support the bioremediation process of dechlorinating TCE and its degradation products to ethene. The emulsion allows the bioamendment to be injected further into the UCRS to allow treatment of a larger radius.

- Bioaugmentation injection—Bioaugmentation in the form of *Dehalococcoides ethenogenes* (DHC) bacteria also will be injected into the treatment area. DHC bacteria can facilitate dechlorination of TCE completely to ethane. Testing of the SWMU 211-A subsurface did not identify the presence of DHC bacteria.

- Real Time Process Monitoring—Monitoring of parameters will be performed during the fracturing and injection processes to assist in verifying the successful placement of the materials in the UCRS. Among these are material volume, injection pressure, geochemical readings such as dissolved oxygen, water levels in nearby wells, and surface breakthrough of injected materials.

- Performance Monitoring—Performance monitoring using MW clusters located in the remedial treatment area will be performed. This monitoring will occur before the material injections to provide baseline parameters as well as after material injections. The purpose of the monitoring is to provide an indication of the efficacy and continuity of the RA. The data also will be utilized to determine if addition bioamendment volumes are needed to insure biological activity continues in the subsurface as needed.

- Long-Term Monitoring—Long-Term monitoring provides for periodic sampling of upgradient and downgradient MWs in the upper and middle RGA. The purpose of this monitoring is to determine the overall impact of the UCRS RA on reducing the migration of TCE and other VOC contaminants from the UCRS to the RGA.

A number of minor activities are associated with application of the EISB technology including the following:

- Civil surveying and utility locator service
- Conditioning of water to deoxygenate and dechlorinate for creating emulsion
- Emulsified vegetable oil solution operations
- Guar gum and ZVI mixing system operations
- High pressure water pump operations
- Solid and liquid waste management
- Health and safety and radiological (RAD) control
- Decontamination operations
- Procurement

2.2 APPLICABILITY TO THE PGDP SITE

The contamination at SWMU 211-A includes VOCs, and VOCs are the contaminants being addressed by implementing this RA. Specifically, TCE and its degradation components are present in unconsolidated and saturated soils of the UCRS. The target treatment horizon is generally 25 ft bgs to 65 ft bgs; however, some limited areas above 25 ft and below 16 ft also will be treated as designed.

There are several technical factors that form the basis for selecting bioremediation for SWMU 211-A UCRS soils and groundwater. A more complete description of the selection process for bioremediation, LUCs, and long-term monitoring at SWMU 211-A is provided in other documents such as DOE 2011; DOE 2012; DOE 2016; DOE 2015a; DOE 2017b; and DOE 2018.

Bioremediation is an effective treatment technology for TCE and its degradation components that are present at SWMU 211-A. It is a destructive technology, converting TCE (and TCE breakdown products) to ethene and ethane, which are innocuous products of reductive dechlorination. Reductive dechlorination is a well-established technology for the treatment of chlorinated volatile organic compounds (CVOCs) in soils and groundwater and is ongoing, passively, at SWMU 211-A. This is indicated by the presence of *cis*-1,2-DCE and 1,1-DCE in groundwater in the UCRS; these are microbially mediated intermediates of reductive dechlorination. Previous investigations at SWMU 211-A have shown that TCE concentrations are acceptable for bioremediation. None of the investigations of SWMU 211-A have identified DNAPL pools or large quantities of DNAPL in the UCRS thus far. Groundwater at SWMU 211-A is slightly oxidizing, based on historical field parameter data, but reducing in some areas because there is evidence of ongoing reduction of TCE. Amendment delivery will drive the UCRS groundwater to be more reducing and enhance these biodegradation processes by delivering the essential microbial consortium. Also by providing an electron donor in the form of ZVI during fracturing, the ZVI will generate hydrogen for assisting the biodegradation process. Concentrations of the dissolved gases ethene and ethane detected in groundwater also indicate that complete reductive dechlorination of the CVOCs has occurred in some locations in SWMU 211-A. Methane also was detected, indicating some areas within the UCRS have reducing conditions conducive to reductive dechlorination.

Please refer to Section 2.1 and 4.1 of the 90% RDR for a more detailed discussion of these technical factors and the data supporting the use of bioremediation for CVOCs at SWMU 211-A (DOE 2019a).

3. TREATMENT SYSTEM OBJECTIVES AND UNCERTAINTY MANAGEMENT

3.1 REMEDIAL ACTION OBJECTIVES

The following are the RAOs for SWMU 211-A RA, as defined by Section 2.8 of the ROD (DOE 2012).

1. Treat and/or remove the PTW consistent with the NCP.

2a. Prevent exposure to VOC contamination in the source areas that will cause an unacceptable risk to the excavation workers (< 10 ft).

2b. Prevent exposure to non-VOC contamination and residual VOC contamination through interim LUCs within the Southwest Plume source areas (i.e., SWMU 1, SWMU 211-A, and SWMU 211-B) pending remedy selection as part of the Soils Operable Unit (OU) and the Groundwater OU.

3. Reduce VOC migration from contaminated subsurface soils in the treatment areas at the Oil Landfarm and the C-720 Northeast and Southeast Sites so that contaminants migrating from the treatment areas do not result in the exceedance of MCLs in the underlying RGA groundwater.

The RDR presents the design of the treatment systems that address the RAOs (DOE 2019a).

3.2 CRITERIA FOR CEASING REMEDIAL ACTION SYSTEM OPERATIONS

EISB, once activated with addition of amendments, will be a self-sustaining passive process. As long as the subsurface conditions remain suitable for the bacteria, the reductive dechlorination process will continue without additional intervention. There are two goals of bioremedial operations at SWMU 211-A that will be addressed in this RA. The short-term goal of bioremedial operations is to attain subsurface UCRS conditions that allow bioremedial activity capable of dechlorinating TCE and degradation products to be accelerated and increase reductive dechlorination of the VOCs. This will be deemed complete when performance monitoring samples indicate that concentrations of TCE degradation products have increased above the baseline levels for those parameters. The long-term goal is to reduce VOC migration from contaminated subsurface soils in the treatment areas so that contaminants migrating from the treatment areas do not result in exceedance of maximum contaminant levels (MCLs) in the underlying RGA groundwater. Data collected from the long-term MW network will be used to determine when this goal has been attained. The time frame for attaining the long-term goal is expected to require 39 years, as indicated in the ROD.

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4. REMEDIAL ACTION APPROACH

The DOE environmental restoration (ER) contractor has overall responsibility for the design, implementation/construction, sampling and analysis, operations and maintenance, waste management, and waste disposal associated with the remedy. The major activities for this RA are outlined in this section.

Table 1 is a general list of activities typically governed by contractor procedures. Procedures referenced in the table are those followed by the current DOE prime contractor. The most current versions of all contractor procedures are to be used. The quality assurance (QA) project plan (QAPP), RAWP, RDR, and all applicable procedures will be readily available in the field to all project personnel, including subcontractors, either in hard copy or electronic format.

Table 1. General Activities Governed by Procedures

Activity	Applicable Procedure
Accident/Incident Reporting	CP3-OP-2024, *Initial Incident/Event Reporting* CP4-ES-0003, *Environmental Incident Reporting*
Analytical Laboratory Interface	CP4-ES-5004, *Sample Tracking, Lab Coordination, & Sample Handling*
Calibration of Measuring and Test Equipment	CP4-QA-2133, *Metrology Measuring Test Equipment Calibrations and Certifications* CP3-HS-2038, *Industrial Hygiene Measuring and Test Equipment Program* CP3-SM-0017 *Measuring and Test Equipment*
Chain-of-Custody	CP4-ES-2708, *Chain-of-Custody forms, Field Sample Logs, Sample Labels, and Custody Seals*
Collection of Samples	CP4-ES-0040, *Composite Sampling* CP4-ES-2101, *Groundwater Sampling* CP4-ER-1020, *Collection of Soil Samples with Direct Push Technology Sampling* CP4-ES-2702, *Decontamination of Sampling Equipment and Devices* CP4-ES-2704, *Trip, Equipment, and Field Blank Preparation* CP4-HS-2000, *Industrial Hygiene Sampling*
Conducting Assessments	CP3-QA-1003, *Management and Self Assessments* CP3-QA-2002, Surveillance
Construction Equipment and Material Inspection	CP3-SM-0054, *Mobile Construction Equipment* CP4-QA-2004, *Material Receipt Inspection* CP4-SM-2103, *Inspection, Testing, Repair and Replacement of Backflow Prevention Devices*
Control of Sample Temperature	CP4-ES-0043, *Temperature Control for Sample Storage*
Decontamination of Large Equipment	CP4-ER-2701, *Large Equipment Decontamination*
Decontamination of Sampling Equipment	CP4-ES-2702, *Decontamination of Sampling Equipment and Devices*
Document Control	CP3-OP-0025, *Document Control Process*
Documenting and Controlling Field Changes to Approved Plans	CP3-OP-0110, *Subcontract Planning and Control*
Suspect/Counterfeit Items	CP3-QA-1006, *Suspect Counterfeit Items*
MW	CP4-ES-0069, *Monitoring Well and Associated Infrastructure Installation* CP4-ES-0077, *Monitoring Well Abandonment*
Fall Prevention	CP3-HS-2014, *Fall Prevention Protection*
Field Logbooks	CP4-ES-2700, *Logbooks and Data Forms*
Graded Approach	CP3-QA-1001, *Graded Approach*

Table 1. General Activities Governed by Procedures (Continued)

Activity	Applicable Procedure
Handling, Transporting, and Relocating Waste Containers	CP4-WM-0019, *On-Site Transfer and Movement of Waste Containers and other Support Equipment*
Hoisting and Rigging Operations	CP3-SM-0051, *Hoisting and Rigging*
Inspection and Test Plans and Review of Vendor/Supplier QA Program	CP3-QA-2001, *Approved Supplier Selection, Evaluation, Approved Supplier Maintenance*
Issue Management [(includes corrective action (CA)]	CP3-QA-3001, *Issues Management*
Lithologic Logging	CP4-ES-2303, *Borehole Logging*
Nonconforming Items and Services	CP3-QA-2005, *Nonconformance Controls* CP3-OP-0204, *Out of Service Equipment Control*
Powered Industrial Trucks	CP3-SM-0020, *Administrative Controls for Powered Industrial Trucks*
Quality Assured Data	CP3-ES-5003, *Quality Assured Data*
Radiation Protection	CP4-RP-1110, *Radiation Surveys* CP3-RP-1601, *Radiation Safety Training*
Records Management	CP3-RD-0010, *Records Management Process*
Revisions to Procedures or Work Packages	CP3-SM-1101, *Work Package Development* CP3-SP-0019, *Subcontractor Work Planning Execution* CP3-SM-1102, *Activity Level Work Execution and Closeout*
Shared Site Issue Resolution	CP3-SI-0001, *Site Interface Agreement*
Shipping Samples	CP3-WM-9503, *Off-Site Shipments by Air Transport*
Suspend/Stop Work	CP3-HS-2009, *Stop Suspend Work*
Temperature Extremes	CP4-HS-2000, *Temperature Extremes*
Training	CP3-TR-0102, *Conduct of Training* CP3-OP-0208, *Required Reading Crew Briefing*
Transmission of Data	CP4-ES-1001, *Transmitting Data to the Paducah Oak Ridge Environmental Information System (OREIS)* CP4-ES-1002, *Submitting, Reviewing, and Dispositioning Changes to the Environmental Databases* CP4-ES-5007, *Data Management Coordination*
Vendor/Supplier Evaluations	CP3-QA-2001, *Approved Supplier Selection, Evaluation, Approved Supplier Maintenance* CP3-RD-0012, *Contractor/Supplier Submittal Process*
Waste Management and Disposition	CP3-WD-0016, *Waste Handling and Storage in DOE Waste Storage Facilities* CP3-WM-3015, *Waste Packaging* CP3-WM-0437, *Waste Characterization and Profiling* CP3-WM-0022, *Waste Water Accumulation, Storage, and Disposal* CP3-WM-1037, *Generation and Temporary Storage of Waste Materials* CP3-WM-2110, *Waste Container Handling, Overpacking and Transportation*

4.1 DESIGN

An RDR has been developed to support the specific implementation of this EISB RA project at SWMU 211-A (DOE 2019a). The following are the general design considerations for the RA.

- EISB will be performed on two areas of the SWMU 211-A. The total area expected to be treated is estimated at 13,200 ft^2. The areas to be treated are shown in Figure 5.

- The primary treatment depths include 25 ft bgs to 65 ft bgs with some limited areas above the 25-ft depth. Contamination located at depths shallower than approximately 18 ft bgs will be treated indirectly as contamination migrates downward through the UCRS and encounters those areas where bioremediation will occur.

- 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 DPT jet injection, which utilizes a water-jetting technique. Each jetted fracture will be injected with a mixture of guar gum, ZVI, and sand to hold the fracture open for increased permeability. The fracture ultimately will support uniform placement of bioamendments. The guar gum will degrade and assist the vegetable oil in developing reducing subsurface conditions allowing the reductive dechlorination to occur. The ZVI will assist by abiotically reducing the volatile contaminants. The sand will act as a proppant to hold-open the fractures locally increasing the permeability of the UCRS soils and providing for more uniform distribution of amendments.

- An estimated 30 injection wells will be utilized to place an emulsified vegetable oil and water mixture into the subsurface to act as an electron donor for transforming the UCRS locally into a reduced environment allowing the reductive dechlorination of the volatiles to proceed. Each injection will provide an injection radius of influence of approximately 15 ft and will overlap other injection well areas approximately 30%.

- The emulsified vegetable oil injected into each injection well will be pumped using low pressure estimated at 50 psi and in a volume of up to 2% by volume of pore space. The estimated quantity of emulsified vegetable oil (EVO) solution to be injected is 123,200 gal. Injection rates are expected to exceed 0.5 gpm.

- Bioaugmentation of each injection well also will be performed with DHC bacteria. The bacteria have the capability to dechlorinate TCE and its degradation products effectively through to ethane.

- Water conditioned to remove dissolved oxygen to assist in creating the subsurface reducing environment will be utilized to emulsify the vegetable oil for injection.

- Real time process monitoring will occur during the injection processes and will include the following observations and measurements:

  — Quantities injected,
  — Injection pressures,
  — Injection flow rates,
  — Observe ground surface for potential breakthroughs during injection operations,
  — Monitor water levels in nearby monitoring and injection wells, and
  — Measure chemical parameters of injection materials.

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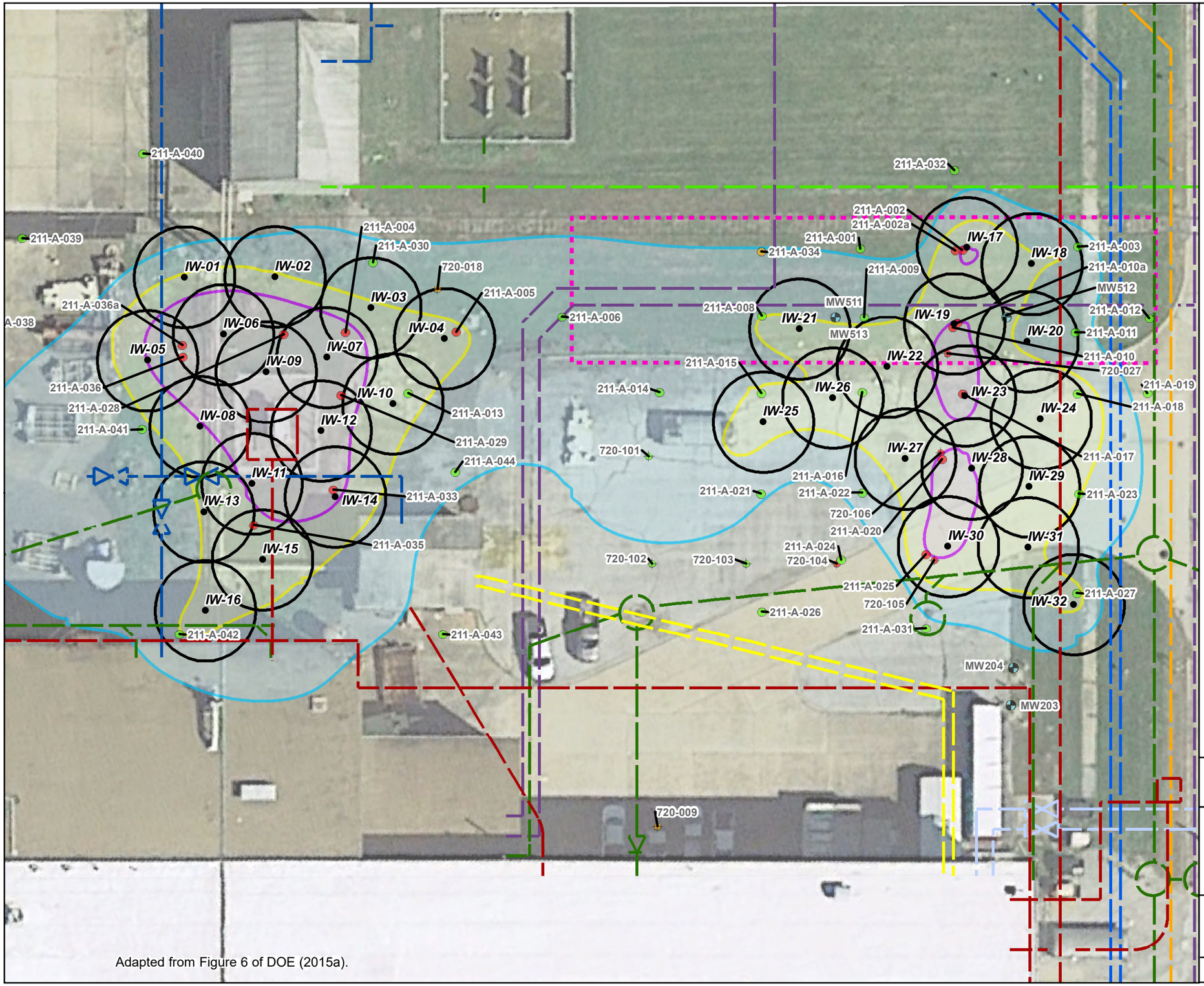

Adapted from Figure 6 of DOE (2015a).

Legend

- Injection Point
- 15' Injection Point Radius
- Soil Boring Location with Average Soil Concentration Exceeding One or Both Remediation Goals (DOE 2013)
- Soil Boring Location with Average Soil Concentration Less than Both Remediation Goals (DOE 2013)
- Archive Core Soil Boring Location - Not Sampled (DOE 2013)
- Historic Soil Boring Location with Average Soil Concentration Exceeding TCE Remediation Goal (DOE 2013)
- Historic Soil Boring Location with Average Soil Concentration Less than TCE Remediation Goal (DOE 2013)
- Historic Archive Core Soil Boring Location - Not Sampled (DOE 2013)
- Existing Monitoring Well Location
- 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
- Gas (5'-7' BG)
- Electric (5'-8' BG)
- Storm Drain (6'-10' BG)
- Plant Water (5'-14' BG)
- Chilled Water (2'-5' BG)
- Sanitary Sewer (5'-7' BG)
- Sanitary Water (2'-5' BG)
- Cathodic Protection (3'-5' BG)
- Recirculating Cooling Water (Waste/Heat)

20° True North — Plant North

Notes:
1. TCE isopleths are based upon individual soil sample results over all depths of sampling.
2. Section 7 of the Final Characterization Report includes explanation of the modeling conducted to establish the TCE contours based upon confidence levels.
3. Source of 2018 Aerial: Google Earth.
4. Existing monitoring wells MW511, MW512, and MW513 will be abandoned prior to performing injections.

30 15 0 30 Feet

SWMU 211-A Planned Injection Layout

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PADUCAH GASEOUS DIFFUSION PLANT

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Figure 5

September 2019

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- Post-injection monitoring will be performed utilizing a network of 9 MWs located external to the treatment area and 18 MWs internal to the treatment area. The wells will be screened in the UCRS and the RGA.

4.2 CONSTRUCTION

The progress of the construction phase of the SWMU 211-A RA will be phased and is outlined below.

- Contracting/Procurement
  - Site Preparation Contract/Task Order
  - Drilling Contract/Task Order
  - Bioremediation Contract/Task Order
  - Posttreatment Sampling Contract/Task Order

- Mobilization

- Site Preparation
  - Clearing Treatment Area
  - Waste Management and Decontamination
  - Surveying and Utility Clearing

- EISB
  - DPT Jet Injection Fracturing
    - Drilling site preparation and concrete coring
    - Injectant mixing equipment setup
    - Drilling, fracturing

  - Bioamendment Injection Well and MW Installation

  - EISB Amendment
    - Amendment equipment setup
    - Amendment preparation
    - Augmentation preparation
    - Amendment, augmentation injection, and monitoring

  - Demobilization

  - Posttreatment Performance and Long-Term Monitoring

Multiple procurements/task order releases are expected to be needed. Depending on the qualifications of the contractors, tasks may be combined to reduce the need for additional procurements. Procurements or task orders will be needed for drilling and bioremediation specialty services and sampling and analysis. Analysis will be performed through a task order initiated by DOE's Sample Management Office (SMO) contract laboratory.

The treatment area is directly adjacent to an occupied building which has activities that occur in or near the treatment area. To initiate field activities, the area will need to be cleared, to the degree possible, of vehicles and mobile equipment. There are some fixed equipment such as guardrails and parking blocks that may be removed to increase access to the area.

Mobilization of the equipment for implementing the RA will include drilling equipment, amendment material, mixing and preparation equipment for the Jet Injection activities as well as the placement of bioremediation amendments and bioaugmentation cultures. Drilling for the RA will include direct-push technology equipment for the Jet Injection fracturing. Injection and MWs will be installed with a more robust drilling technology such as RotoSonic or other approved equal.[1]

After the initial mobilization, DPT Jet Injection will be used at each injection well location to induce fractures in the UCRS as planned in the RDR, Table 5. The fracturing process will utilize high-pressure water jetting equipment to cut fractures in the UCRS formation and pump a mixture of guar gum, sand, and micro-scale ZVI into each fracture to hold open the fracture in order to receive bioremedial amendments more efficiently. The guar gum, sand, and micro-scale ZVI will be prepared at the surface utilizing mixing equipment as described in the RDR and shown in Figure 14 of the RDR (DOE 2019a). In order to induce fractures in the UCRS effectively and to minimize damage to infrastructure, three existing MWs will be abandoned. The MWs are MW511, MW512, and MW513; they are completed in the UCRS and are located within the planned treatment area. They were installed as part of the RDSI performed in 2012. New wells will be installed as part of the performance monitoring that effectively replaces those wells being abandoned.

After inducing the fractures in the UCRS, a second drilling phase will be performed to construct the performance MWs and the long-term MWs to be used for the RA. The performance MWs will be drilled within the area to be treated and will be completed in the UCRS and the upper RGA. Their use will be to monitor key parameters to determine the status of the bioremedial activity as it occurs in the subsurface. The long-term MWs will be installed outside of the area to be treated in both upgradient and downgradient locations and will be completed in the RGA. The MWs and performance MWs will be utilized to obtain a baseline of groundwater characteristics prior to initiating bioremedial activity. The monitoring parameters are discussed in the Operation, Maintenance, and Environmental Monitoring Plan, included as Appendix A of the RDR (DOE 2019a). The injection wells for performing the bioamendment and bioaugmentation additions also will be installed as described in the RDR as part of this drilling program (DOE 2019a).

Actual initiation of the bioremedial action will occur after the completion of the UCRS fracturing, the installation of the performance monitoring and long-term MW networks, and injection well installations. This phase which is detailed in the RDR will utilize a surface equipment system to prepare an emulsified solution of vegetable oil and water as shown in RDR, Figure 15. The water utilized will be preconditioned to reduce the dissolved oxygen content so as not to inhibit bioremedial activity. Bioaugmentation with DHC will occur also during this phase. Upon completion of this phase, the RA will have been initiated in the subsurface.

Post-injection monitoring will occur following the bioremedial initiation. This phase of the operation will include sampling the performance and long-term MWs as prescribed in Appendix A of the RDR. Bioremediation associated with EISB generally persists, provided the geochemistry of the treatment area allows the DHC to survive and there are VOCs and EVO to support the DHC. The post-remedial monitoring will provide the data to assess the status of the subsurface remedial measure. Should it become necessary to add EVO to the system, the approach will be in accordance with the Operations, Maintenance, and Environmental Monitoring Plan, Appendix A of the RDR.

[1] Throughout this report, when an approved or acceptable substitution is discussed, the FRNP Project Manager will approve or disapprove the recommended equal. A periodic (weekly) teleconference will be scheduled with the FFA parties during the fieldwork period to discuss the status of activities and modifications that may have been made or are being considered. The modifications made will be reported in the remedial action completion report.

4.3 SAMPLING AND ANALYSIS

Performance sampling and long-term sampling are components of this EISB RA project. The sampling associated with each of these components is included in the RDR, Appendix A (DOE 2019a).

4.4 INJECTION OPERATIONS MONITORING

The implementation of the EISB RA project will include injection of materials in the creation of the fractures and also with the insertion of amendments needed to create subsurface conditions allowing bioremediation to occur. The monitoring that is to be performed as these injections occur is discussed in Section 4 and Appendix A of the RDR (DOE 2019a).

4.5 WASTE MANAGEMENT AND DISPOSITION

Waste generated during the implementation of the SWMU 211-A project RA will be managed and dispositioned in accordance with the waste management plan (WMP) and applicable or relevant and appropriate requirements (ARARs). Waste characterization will be performed using analytical results from waste sample analysis and/or a combination of process knowledge where applicable. Refer to the WMP in Section 12 for additional detail concerning waste management and disposition.

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5. PROJECT ORGANIZATION

The project organization chart is provided as Figure 6. Plan-of-the-day/prejob briefings will provide personnel an opportunity to discuss daily activities and any issues. All personnel have "stop work authority" and the responsibility to use this authority in accordance with CP3-HS-2009, *Stop/Suspend Work,* when they believe the work poses imminent danger to workers, public, or the environment. The following paragraphs provide a summary of the work duties associated with certain project positions.

- DOE—Lead agency. DOE performs oversight of Four Rivers Nuclear Partnership, LLC, and the project. DOE reviews and approves project documents and participates, as needed, in field assessments. DOE also is responsible for communications with the EPA, state regulatory agencies, and the general public.

- Health, Safety, Security, & Quality Director—Provides supporting services for implementing the RA at SWMU 211-A. The following list includes the services and resources.

  — QA Specialist
  — Health and Safety Specialist
  — Safeguards and Security Services
  — Industrial Hygienist Specialist
  — Radiation Control Technicians
  — Fire and Emergency Response Services
  — Training Support Services
  — Occupational Medicine Services

- Technical Services Director—Provides supporting services needed for implementing the RA.

  — Engineering Services
  — Landfill Services
  — Nuclear Safety Services
  — Surveying Services
  — Transportation Services
  — Waste Management Facilities and Services
  — Waste Engineering Resources
  — Waste Specialist

- Environmental Remediation Manager—Serves as the primary point of contact with DOE for ER programs. Performs work as the management contact in accordance with the baseline scope and schedule and directs the day-to-day activities of DOE contractor personnel performing environmental monitoring and restoration activities. Serves as the primary management contact for implementation of the RA. Services and resources provided by Environmental Remediation Manager include subject matter experts in the following areas:

  — Project Management Services
  — Geological Services
  — Remediation Services

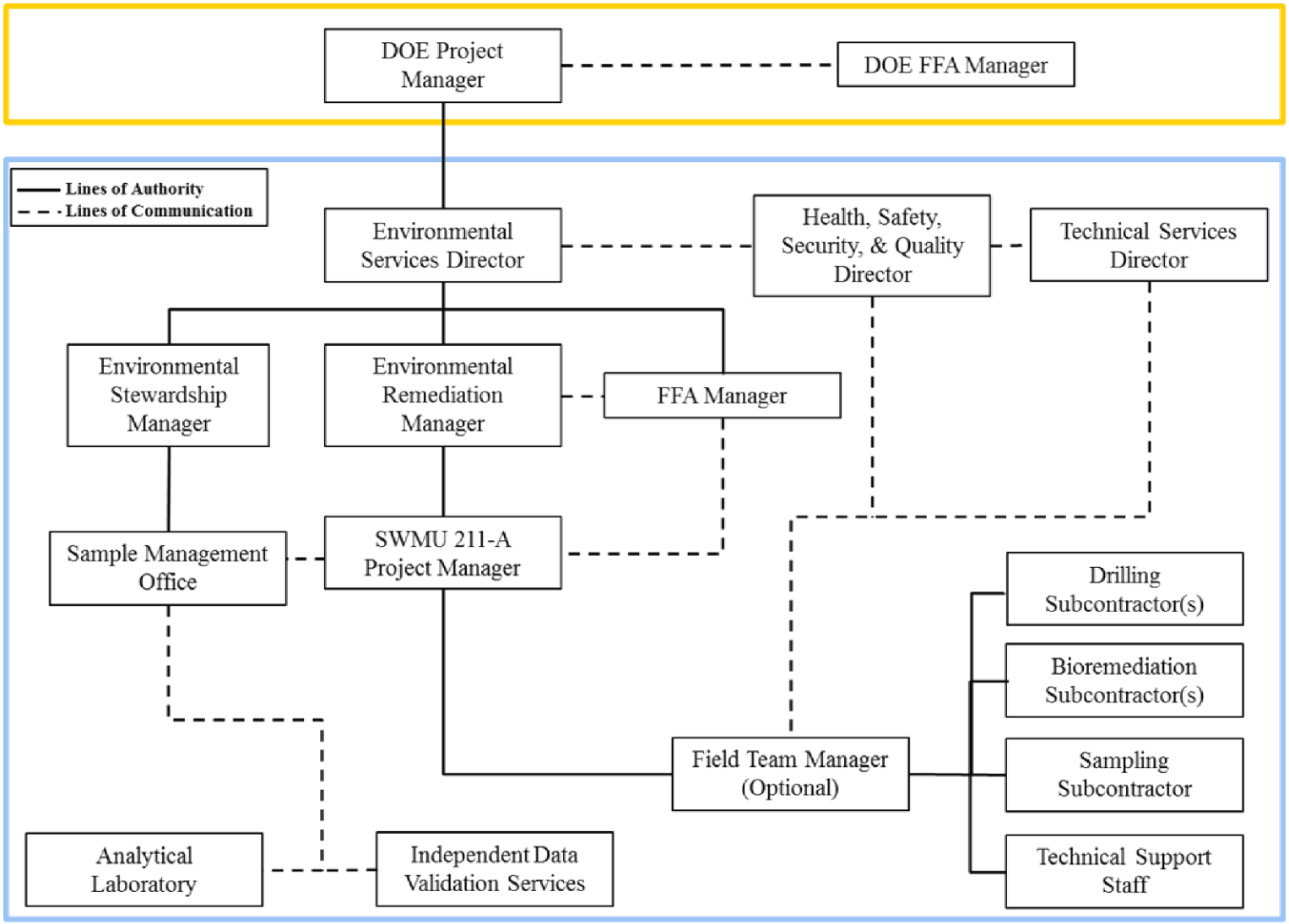

Figure 6. Project Organization

- Environmental Services Director—Provides supporting environmental services needed for implementing the RA. Provides environmental support and oversight to the project to ensure that the planning and fieldwork are being performed properly and in accordance with all applicable regulations, DOE directives, and relevant plans and procedures. The Director also serves as the point of contact with DOE for all environmental remediation activities implemented by Four Rivers Nuclear Partnership, LLC; resources provided by the Environmental Services Director's organization include the following:

  — Environmental Compliance Services
  — SMO Laboratory Services
  — Independent Data Validation Services
  — Field Support and Sampling Personnel

- SWMU 211-A Project Manager—Serves as the RA point of contact for technical matters and will be responsible for the performance, quality, and schedule for implementing EISB RA project at SWMU 211-A. Provides overall project direction and execution, implements necessary corrective actions, verifies compliance with safety and health requirements, and participates in the field assessment analysis. May be the technical contact for subcontracted project support and should ensure that the flow down of data management requirements is defined in a statement of work (SOW).

- Field Team Manager (Optional)—Supports Environmental Services Director and SWMU 211-A Project Manager to ensure established and approved designs, work plans, and procedures are performed as required. Supervises the field team activities and field data collection. Ensures that all field activities are properly recorded and reviewed in the field logbooks and on any necessary data collection forms. Responsibilities include identifying, recording, and reporting project nonconformances or deviations. Interfaces with the SWMU 211-A project manager during field activities. (Note: If the Field Team Manager position is not designated, the requirements of the position will be performed by the SWMU 211-A Project Manager.)

- Sample Management Office—Provides support services in the area of analytical analyses, data management, data verification, and independent data validation. Ensures that hard copy data records are processed according to data records management requirements. Works with field teams to facilitate data collection and with data users to ensure easy access to the data. Ensures that analytical methods, detection limits, minimum detectable activities, laboratory quality control (QC) requirements, and deliverable requirements that are specified in the SOW are utilized and that the SOW incorporates necessary deliverables so that data packages from the laboratory can be verified and validated successfully. Responsible for contracting any fixed-base laboratory utilized during sampling activities. Incorporates any existing data or new project data into the project's hardcopy data record file or database, as appropriate. Ensures that analytical and field data are validated, as required, against a defined set of criteria that includes evaluating associated QC samples to ensure that analyses were preformed within specified control parameters. Performs data reviews, as appropriate [e.g., quality checks; assessing sensitivity, precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) parameter conformance; evaluating adherence to data quality requirements]. Ensures that the project data are properly incorporated into Paducah Oak Ridge Environmental Information System (Paducah OREIS).

- Technical Support Staff—Provides direct support to the field team manager and SWMU 211-A Groundwater Operable Unit project manager concerning technical aspects of the project during remedial design, construction, drilling, equipment operation, civil survey, sampling operations, and associated operations.

- Subcontractor(s)—A number of subcontractors are expected to be utilized in performing this RA. A bioremediation specialty subcontractor will provide equipment and expertise during the implementation of the RA. Depending on subcontractor qualifications, a separate subcontractor may be needed to perform the needed drilling and fracturing of the UCRS soil. A subcontract laboratory will be retained for analytical services.

6. PROJECT PLANNING SCHEDULE

A generalized project planning schedule is shown in Table 2. A task-level-specific schedule will be developed and updated once the necessary subcontractors are selected and the work is scheduled. Once these schedules are available, they will be provided to the FFA parties for use.

Table 2. Project Planning Schedule*

Activity	Time Frame
Mobilization	2nd Quarter 2020
Initiate Fracturing and Drilling Operations	2nd Quarter 2020
Initiate EISB Implementation	3rd Quarter 2020
Initiate Post-implementation Sampling and Monitoring	4th Quarter 2020
Issue D1 Remedial Action Completion Report (FFA Milestone)	March 30, 2021

*Projected calendar year schedules for completion of activities set forth herein are estimates provided for informational purposes only and are not considered to be enforceable elements of the RA project or this document. The enforceable milestones for performance of activities included as part of the RA project are set forth in the FFA (EPA 1998). Any additional milestones, timetable, or deadlines for activities included as part of the RA project will be identified and established independent of this RAWP, in accordance with existing FFA protocols.

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7. HEALTH AND SAFETY PLAN

This health and safety plan (HASP) has been developed as an overview to discuss the general standards and practices to be used during execution of the EISB treatment at SWMU 211-A to protect workers and the public. Site-specific hazards and controls will be established for each task and location prior to performing work. These hazards and controls will be documented in the form of a site-specific HASP, job hazard analyses (JHAs), work control documents, or an approved combination thereof. Personnel will be familiar with the hazards, controls, applicable procedures, and work control documents prior to performing work in the affected areas. This work will be performed in accordance with the DOE's Integrated Safety Management System (ISMS) and its environmental compliance and health and safety requirements, both of which establish a goal of zero-accident performance. Hazard controls will include access restrictions, training requirements, exclusion of nonessential personnel from the work zone, use of engineering/administrative controls, and use of personal protective equipment (PPE).

7.1 INTEGRATED SAFETY MANAGEMENT/ENVIRONMENTAL MANAGEMENT

This RA project will utilize ISMS, which integrates the Safety Management System, the Environmental Management System (EMS), and the Quality Management System, to ensure personnel and environmental safety and quality are integrated into management and work practices at all levels so that missions are accomplished while protecting the public, the workers, and the environment. The concepts of ISMS/EMS will be utilized to provide a formal, organized process to ensure safe performance of work. The ISMS/EMS Plan identifies the methodologies that will be used to address previously recognized hazards and how the hazards are mitigated using accepted health and safety practices.

This project will pursue the DOE's goal of zero-accident performance through project-specific implementation of ISMS. The core functions and guiding principles of ISMS/EMS will be implemented by complying with 10 *CFR* Part 851, *Worker Safety and Health Program*, and incorporating applicable DOE Orders, policies, technical specifications, and guidance. A brief description of the five ISMS/EMS core functions is provided in the following sections.

7.1.1 Define Scope of Work

Defining and understanding the scope of work is the first critical step in successfully performing any specific activity in a safe manner. Each member of the project team will participate in discussions conducted to understand the scope and contribute to the planning of the work. The project team will conduct a project team-planning meeting to discuss the team's general understanding of the scope and the technical and safety issues involved. This meeting is conducted to ensure all parties are in agreement on the scope and general approach to complete the scope.

7.1.2 Analyze Hazards

In the course of planning the work, the project team will identify hazards associated with the performance of the work. Hazards may be identified and assessed by performing a site visit, reviewing lessons learned, and reviewing project plans or historical data.

7.1.3 Develop and Implement Hazard Controls

After potential safety hazards and environmental risks are identified, controls necessary to protect workers, the public, and the environment are identified and implemented. These controls are identified in the work planning process that develops how the scope of work will be performed, identifies the applicable standards, requirements, and controls that are needed. Then those processes must be established and implemented in the appropriate work control document, such as procedures, work instructions and JHAs.

Applicable work control documents/JHAs will be reviewed with the personnel who will perform the work. Participants in this review will sign and date the appropriate documentation to signify that they understand all hazards, controls, and requirements. A copy of the work control documents with appropriate signatures shall be maintained at the work location.

7.1.4 Perform Work within Controls

Prior to commencing work, the project team will verify that the appropriate work control documents are in place and have been reviewed and approved by authorized personnel. The project team also will ensure that all the requirements and controls have been communicated to the project team. These requirements and controls are communicated through the following applicable methods:

- Training
- Required reading/briefings
- Pre-job meetings
- Work permits
- Plan-of-the-day/pre-job briefings
- JHAs
- Radiological work permits (RWPs)
- Signs and postings

The project team will adhere strictly to the requirements established in approved contractor performance documents and work controls at all times. If a performance document or work control cannot be followed or clearly interpreted, the task will not be performed until a clear and operable work control document(s) can be provided for the performance of the work.

7.1.5 Feedback and Continuous Improvement

Feedback and continuous improvement is accomplished through several channels including ISMS/EMS audits, self-assessments, employee suggestions, lessons-learned, and pre- and post-job briefings. These actions will be used to solicit worker feedback, as well as to identify, address, and communicate lessons-learned using standard CA planning and continuous improvement processes.

Project management will encourage employees to freely submit suggestions that offer opportunities for continuous improvement and constructive criticism on implementing the activities. Project management or their designee will conduct periodic inspections and meetings with project personnel at the work site to discuss project status, priorities, expectations, safety/environmental issues, and/or concerns and other relevant safety topics.

During field activities, meetings and briefings will provide opportunities for project personnel to communicate the following:

- Lessons-learned and any other topics relevant to the work performed;

- How work steps/procedures could be modified to promote a safer working environment or increased efficiency;

- How communications could be improved within the project team; and

- Overall issues or concerns they may have regarding how the work was performed.

7.2 FLOWDOWN TO SUBCONTRACTORS

The ISMS/EMS approach to environment, safety, and health (ES&H) ensures that personnel, including subcontractors, are aware of their roles, responsibilities, and authorities for worker/public safety and protection of the environment. All organizations will be responsible for compliance with the prime contractor's Worker Safety and Health Program, ISMS Program, Radiation Protection Program (RPP), Environmental Protection Program, and QA Program. In addition, subcontract requirements flow down to lower-tier subcontractors, as applicable. Personnel will have the appropriate medical qualifications and health and safety training required by appropriate federal regulations but also will receive site-specific pre-job training, including safety and environmental, to ensure that ES&H issues related to the activities in implementing the EISB RA project are clearly understood. Completion of training will be documented.

7.3 SUSPENDING/STOPPING WORK

In accordance with 10 *CFR* § 851.20 and the DOE prime contractor's Worker Safety and Health Program and procedures, all employees have suspend/stop-work authority. Individuals involved in any aspect of the project have the authority and responsibility to suspend or stop work for any perceived threat to the safety and health of the workers, the public, or to the environment. Concerns shall be brought to the attention of the Site Superintendent, frontline manager (FLM) and/or safety and health specialist (SHS) and will be evaluated by project management personnel, and actions will be taken to rectify or control the situation. In the case of imminent danger or emergency situations, personnel should halt activities immediately and instruct other affected workers to pull back from the hazardous area. The appropriate authority/responders shall be notified immediately in accordance the emergency response plans.

7.4 ISMS/EMS BRIEFINGS

Plan-of-the-day/pre-job briefings detailing the specific hazards of the work to be performed and safety precautions and procedures specific for the job shall be conducted by the FLM and/or SHS at the beginning of each shift. During these briefings, work tasks and the associated hazards and mitigating controls will be discussed using approved procedures, work control documents, JHAs, and/or lessons learned as guidance.

Prior to performing work on the site, personnel shall be required to read or be briefed on the DOE prime contractor's Worker Safety and Health Program, applicable JHAs, the work package, and other applicable documents. This shall be documented as required reading, acknowledgement forms, or briefing sheets. Visitors also will be briefed on the applicable plans and potential hazards that they may encounter.

7.5 KEY PROJECT PERSONNEL AND RESPONSIBILITIES

One of the primary underlying principles of a successful project organization is establishment of clearly defined roles and responsibilities and effective lines of communication among employees and among the

prime contractor, subcontractors, and other organizations involved in the project. The project must ensure that all personnel fully understand their roles and responsibilities and that they have a thorough understanding of the scope of work and other project requirements that will provide the foundation for successful and safe completion of the project. The roles and responsibilities of key field team members in implementing the EISB RA project are described briefly in Section 5.

7.6 GENERAL PROJECT HAZARDS

7.6.1 Operation of Project Vehicles and Heavy Equipment

All field personnel operating vehicles and heavy equipment shall have the appropriate training/license for the type of vehicle/equipment being operated, drive responsibly, and comply with applicable posted speed limits. All vehicle/equipment operators and occupants shall use seat belts while in operation. The use of cellular phones or other potentially distracting activities while operating the equipment or driving on company business is prohibited. Operators should walk around the vehicle and check for obstacles and material prior to operating the equipment. Spotters should be used as necessary but especially when backing or operating in congested areas.

Large vehicles and heavy equipment, such as excavators, cranes, drilling rigs, and forklifts, have blind spots and the potential for pinch and crush hazards. Heavy equipment shall have a functioning backup alarm and a spotter will be required when the vehicle is backing up or operating in congested areas. The spotter shall not stand directly behind the equipment while backing, but should remain visible to the equipment operator as much as possible. Equipment operations will be in accordance with appropriate contractor procedures and manufacturer's operating manuals.

7.6.2 Tools and Equipment

Tools and equipment shall be inspected visually before each use to ensure that the devices are in good working order. All guards and safety devices (e.g., power tools) shall be in place when the equipment is in use. The individual conducting an inspection should look for signs of wear (e.g., frayed power cords, loose parts); missing components (e.g., lock pins, guards); and any indication of a potentially unsafe condition. Deficiencies affecting safe operation of project equipment shall cause the equipment to be taken out of service until properly repaired or replaced. Field sampling equipment shall be operated only by knowledgeable personnel with appropriate work experience and awareness of the hazards and safe operating procedures of the devices.

7.6.3 Material and Drum Handling

Material handling will be accomplished using safe lifting procedures. Vehicles, mechanical lifts, and/or carts will be used whenever possible. Whenever moving or lifting objects, travel paths and actions should be considered prior to initiating the work. Drum-handling activities include the general handling, transport, and opening and closing of drums along with the storage of wastes within the drums.

7.6.4 Fire Safety

Refueling equipment can present a significant fire/explosion hazard if subjected to sparks, static electricity, or other ignition sources. Containers dispensing and receiving flammable/combustible liquids should be bonded appropriately prior to use. Alternatively, dispensing container bonding will not be necessary if the tank being filled is appropriately bonded. Only safety containers approved by the Factory Mutual Research, Underwriters Laboratories, or the U.S. Department of Transportation will be used to transport and store

flammable/combustible liquids. Site personnel are to ensure that the equipment used to transfer the liquids is approved for the material being handled. Safety cans shall be labeled as to their contents and properly secured during transport. When applicable, equipment should be given adequate time to cool down before refueling. During refueling operations, a 20-BC-rated fire extinguisher will be located within 50 ft of the operation.

Smoking is not allowed in the work area or radiologically controlled areas. Smoking will be allowed in designated areas, and cigarette butts will be discarded properly so as not to create litter or pose a fire risk.

7.6.5 Housekeeping

Good housekeeping, including routine site cleanup and waste management, shall be practiced at all times to improve the general safety of the site activities during the implementation of the RA. Housekeeping efforts may include eliminating or minimizing slip, trip, and fall hazards. Sanitary trash shall be containerized and disposed of periodically. When not in use, supplies, materials, and ancillary equipment should be stowed properly inside trailers and separated from walk areas.

7.6.6 Slips, Trips, and Falls

The prime work location associated with the project will be northeast of, and exterior to, the C-720 Building. It is an industrial area with working surfaces either paved with concrete, tar and chip, gravel, or grass/soil covered. The working surface has possible obstructions that may pose hazards that could cause slips, trips and/or falls. Care should be taken when working around uneven surfaces, and obstructions should be avoided as much as possible. If slipping and/or tripping hazards cannot be completely eliminated, they should be marked and/or the area shall be barricaded and posted with the appropriate hazard postings. To the degree feasible, the work area will have obstructions removed.

7.6.7 Inclement Weather

Weather forecasts and conditions shall be monitored daily for potential inclement weather and lightning. Near-term weather conditions will be monitored and transmitted to the FLM by the PGDP Plant Shift Superintendent (PSS). All field activities shall be paused during thunderstorms, lightning, or high wind conditions. Personnel will safely secure equipment and materials, if feasible, and move to the designated assembly point or storm shelter as necessary.

7.6.8 Head, Eye, Hand, and Foot Hazards

Work activities have potential hazards that may result in injuries to the head, eyes, hands, or feet. The use of engineering controls or administrative controls may have limited applications for these hazards. Use of PPE may be necessary to adequately address these hazards. Where these hazards exist, the task-specific JHA and/or work control document(s) will specify the use of appropriate protective equipment, including hard hats, eye protection, gloves and/or steel-toe footwear.

7.6.9 Temperature Extremes

Heat stress and cold stress are serious hazards to workers during field activities, especially heat stress, when layers of PPE are required for protection from RAD and/or chemical hazards. Personnel will be familiarized on the symptoms of heat and cold stress during training and proper controls implemented, such as work rest regimens, in accordance applicable work controls and procedures. Additional discussion concerning temperature extremes also is contained in Section 7.11.

7.6.10 Biological Hazards

The area for implementing the EISB RA project is an industrial setting that is mowed and regularly maintained. Biological hazards, however, that may be present at the site include snakes, insects, ticks, and poisonous plants (e.g., poison ivy, oak, or sumac). Personnel should be aware of the presence of potential hazards and prevent insects and ticks with repellant and avoid hazards as much as possible. Personnel who are or may be hypersensitive to plants and insects stings should report their condition to their supervisors. Some ticks are of a particular concern due to the potential to carry Lyme disease and Southern Tick Associated Rash Illness; therefore, controls will be implemented in the work control and/or JHA.

7.6.11 Noise

Equipment such as generators, pumps, drilling rigs, pneumatic hammers, slide hammers, and hand and power tools may produce noise exceeding 85 decibels. Sound levels will be assessed and/or measurements will be taken for specific equipment and activities as necessary and controls/protection will be identified in applicable work control documentation. Personnel shall be trained in hearing conservation and their hearing will be tested in accordance with applicable rules.

7.7 SITE CONTROL

The C-720 Building is an operational facility with continuous activities ongoing. A combination of work zones for implementing EISB RA project will be utilized to control access, to minimize the number of individuals potentially exposed to site hazards, and to ensure that individuals who enter follow the required procedures. Following is a description of the different types of zones that may be established at the site.

- Exclusion Zone (EZ)—This is the area where work is being performed, and chemical, physical, and/or RAD hazards exist. Entry into this area is controlled and the area clearly marked with barrier tape, rope, or flagging and/or signage. Applicable signage will be posted to adequately communicate hazards and entry requirements. Unauthorized entry into these areas is strictly prohibited.

- Contamination Reduction Zone (CRZ)—The transition area that is between the EZ and support area. This area will provide a buffer area to reduce the probability that contamination will leave the EZ and reduce the possibility of the support area becoming contaminated by site hazards. The degree of contamination in the CRZ decreases as the distance from the contaminants increases.

- Support Area—The outermost area of the work site. This area is uncontaminated where workers provide operational and administrative support. The support area is clean and will not be entered by contaminated equipment or personnel, except under emergency or evacuation conditions. Normal work clothes are appropriate within this area.

- Construction Zone—The area outside of potential contamination, but encompasses work activities and possible hazards associated with construction activities. Entry into this area is controlled and the area is marked clearly with barrier tape, rope, flagging and/or signage. Applicable signage will be posted to adequately communicate hazards and entry requirements.

7.8 HAZARD COMMUNICATION

Occupational Safety and Health Administration (OSHA) 29 *CFR* § 1910.1200, "Hazard Communication Standard," states that all employees handling or using hazardous or potentially hazardous materials be advised and informed of the health hazards associated with those materials.

7.8.1 Safety Data Sheet

A safety data sheet (SDS) (formerly known as material safety data sheet or MSDS) provides specific material information including: identification; hazard identification; composition/ingredients; first-aid measures; fire-fighting measures; accidental release; handling and storage; exposure and personal protection; physical and chemical properties; stability and reactivity; toxicological; ecological; disposal consideration; transportation; regulatory and other information. It is the manufacturer's responsibility to provide this information to the user for any materials that contain hazardous or potentially hazardous ingredients. Each employee is to be made aware that the SDSs are available. The project shall maintain copies of all SDSs for chemicals brought on-site and shall have them readily available.

7.8.2 Chemical Inventory

A hazardous material inventory of all chemicals brought on-site will be maintained by the appropriate hazardous material custodian. Prior to bringing hazardous materials on-site, personnel/subcontractors must submit an SDS and receive approval from the facility manager and SHS.

It is the responsibility of the user to ensure that all potentially hazardous materials taken to the project site are labeled properly as to the contents of the container and with the appropriate hazard warnings.

7.9 EMERGENCY MANAGEMENT

In the event of an emergency, all site personnel shall follow the requirements and provisions of the PGDP Emergency Management Plan. Emergency response shall be provided by the PGDP emergency response organization. The site superintendent and SHS will be in charge of personnel accountability during emergency activities. All personnel working on-site will be trained to recognize and report emergencies to the SHS or the site superintendent. The SHS or site superintendent will be responsible for notifying the PGDP emergency response organization.

PGDP's emergency response organization will be contacted for emergency response to time-urgent medical emergencies, fires, spills, or other emergencies. The PSS will coordinate 24-hour emergency response coverage. The requirements of this section will be communicated to site workers. Any new hazards or changes in the plan also will be communicated to site workers.

7.9.1 Potential Emergencies

Potential emergencies that could be encountered during this project include, but are not limited to, fires, spills, and personnel exposure or injury. An emergency response plan, which contains explicit instructions and information about required emergency actions and procedures, is located in the PGDP site-specific HASP and/or in the prime contractor's facilities.

7.9.2 Fires

In the event of a fire, the PSS shall be notified immediately. If it is safe to do so, and they are properly trained, on-site personnel may voluntarily attempt to extinguish an incipient fire with the available fire extinguisher and isolate any nearby flammable materials. If there is any doubt about the safety of extinguishing the fire, all personnel must evacuate to an assembly location and perform a head count to ensure that personnel are accounted for and are safely evacuated. The site superintendent or designee will provide the fire department with relevant information.

7.9.3 Spills

In the event of a spill or leak of a hazardous material, the employee making the discovery will immediately vacate the area and notify other personnel and his/her supervisor. The site superintendent or designee will determine whether the leak is an incidental spill or whether an emergency response is required. If there is a probability that the spill will extend beyond the immediate area, result in an environmental insult, or exceed the capabilities of the on-site personnel, the site superintendent is to inform the PSS, who will determine whether a response by the PGDP spill response team is warranted. If emergency response crews are mobilized, the site superintendent or knowledgeable employee will provide the responders with relevant information.

7.9.4 Medical Emergencies

Personnel with current first aid or first responder training will serve as the designated first aid provider until the PGDP emergency personnel arrives. Any event that results in potential employee exposure to bloodborne pathogens will require a post-event evaluation and follow-up consistent with 29 *CFR* § 1910.1030. A person knowledgeable of the location and nature of the injury will meet the emergency response personnel to guide them to the injured person.

The PGDP emergency response organization will be contacted for medical emergencies, fires, spills, or other emergencies. Site personnel may take workers with injuries that are more severe than can be addressed by first aid, but that do not constitute a medical emergency, to designated medical facility. The site superintendent, SHS, and Four Rivers Nuclear Partnership, LLC, Environmental Services project manager must be informed immediately that the worker has been taken to the medical facility and the nature of the injury.

7.9.5 Reporting an Emergency

Project personnel will be able to communicate by plant radio or cellular telephone on-site. Communication among field teams also may be performed utilizing two-way radios, as needed.

7.9.5.1 Telephone

The SWMU 211-A area is located inside the PGDP security perimeter near the C-720 Building. Inside the PGDP security perimeter, if a plant telephone is accessible, dial 6333 to report an emergency. With a cellular phone, dial 270-441-6333 to report an emergency. Describe the type and the location of the emergency. Identify who is calling. Identify the number on the phone being used. Tell whether an ambulance is needed. Listen and follow any instructions that are given. Do not hang up until after the Plant Shift Superintendent/Emergency Control Center has hung up.

7.9.5.2 Fire Alarm Pull Boxes

Pulling a fire alarm box at PGDP automatically transmits the location of the emergency to the fire department and the Emergency Control Center. The person pulling the alarm should remain at the alarm box, or nearest safe location, and supply any needed information to the emergency responders. Work personnel should note the location of pull boxes in each project area, where applicable. In the event of the emergency being a chemical release, a fire alarm box should not be utilized to report the emergency.

7.9.5.3 Radio

Channel 16 is designated as the emergency channel on the plant radio system. By calling radio call number Alpha 1 and declaring "EMERGENCY TRAFFIC, EMERGENCY TRAFFIC," the PSS is alerted of the emergency. Describe the type and the location of the emergency and who is calling.

7.10 ALARM SIGNALS

7.10.1 Project-Specific Alarm

A prolonged blast of an air horn or vehicle horn will signal immediate work stoppage and evacuation to a predesignated area.

7.10.2 Evacuation Alarms

PGDP facility evacuation alarms are denoted by a steady or continuous sound from the site public address system. Proceed to the predetermined assembly station. The assembly station director will provide further instruction.

7.10.3 Radiation Alarms

PGDP radiation alarms are denoted by a steady sound from a clarion horn and rotating red beacon lights. Evacuate the site or area and proceed to the predetermined assembly station. The assembly station director will give further instruction.

7.10.4 Take-Cover Alarms

PGDP take-cover alarms are denoted by an intermittent or wailing siren sound from the site public address system. Seek immediate protective cover in a strong sheltered part of a building. Evacuate mobile structures to a permanent building or underground shelter.

7.10.5 Standard Alerting Tone

The standard alerting tone at PGDP is a high/low tone from the public address system and is repeated on the plant radio frequencies. Listen carefully; an emergency announcement will follow.

7.10.6 Evacuation Procedures

The SHS or site superintendent will designate the evacuation routes. Every on-site worker should familiarize himself/herself with the evacuation routes. In the event of an evacuation, proceed to the predetermined assembly station or designated area and wait for further instructions.

7.10.7 Sheltering In Place

Certain emergency conditions (e.g., chemical or radioactive material release, tornado warning, fire, security threat) may require that personnel be sheltered in place. Notification of a "sheltering in place" order is carried out by the PGDP emergency director on the emergency public address system and plant radio frequencies. Requirements for "sheltering in place" follow these steps:

- Go indoors immediately (the nearest substantial facility to the SWMU 211-A area is the C-720 Building complex);
- Close all windows and doors;
- Turn off all sources of outdoor air (e.g., fans and air conditioners);
- Shut down equipment and processes, as necessary for safety; and
- Remain indoors and listen for additional information on radios and/or the public address system.

7.10.8 On-Site Relocation

Certain emergency conditions (e.g., chemical or radioactive material release, tornado, fire, security threat) may require that on-site personnel be relocated from their normal workstations and activities to locations more suitable to withstand the threat. Notification of on-site relocation is carried out by the PGDP emergency director on the public address system and plant radio frequencies. Specific instructions about where to relocate will be given with the message. The Site Superintendent or SHS also may provide further detail to assist in facilitating the on-site relocation.

7.10.9 Facility Evacuation

For evacuations related to emergencies inside PGDP, the PGDP emergency director initiates notification of facility evacuation over the public address system. Assembly points serve as gathering points for evacuating personnel. In the event of an evacuation alarm, employees will evacuate to the designated assembly point for the area and immediately report to the site superintendent or the assembly station director. An accounting will be conducted of all personnel who have evacuated. Further instructions and information about the emergency situation will be given to employees by the assembly station director or over the site public address system and plant radio.

7.10.10 Emergency Equipment

The following items of emergency equipment will be maintained at the SWMU 211-A work location:

- Hard-wired telephone (inside C-720 Building) or cellular telephone and plant radio(s);
- ABC-rated fire extinguishers; and
- Basic spill kit suitable to handle small spills.

7.11 HEAT AND COLD STRESS

Common types of stress that affect field personnel are from heat and cold. Heat stress and cold stress may be one of the most serious hazards to workers at hazardous waste sites. In light of this, it is important that all

employees understand the signs and symptoms of potential injuries/illnesses associated with working in extreme temperatures.

7.11.1 Heat Stress

Heat stress occurs when the body's physiological processes fail to maintain a normal body temperature because of excessive heat. The body reacts to heat stress in a number of different ways. The reactions range from mild (e.g., fatigue, irritability, anxiety, and decreased concentration) to severe (e.g., death). Heat-related disorders generally are classified in four basic categories: (1) heat rash, (2) heat cramps, (3) heat exhaustion, and (4) heat stroke.

7.11.2 Preventive Measures

A number of steps can be taken to minimize the potential for heat stress disorders.

- Acclimate employees to working conditions by slowly increasing workloads over extended periods of time. Do not begin site work activities with the most demanding physical expenditures.

- Conduct strenuous activities during cooler portions of the day, such as early morning or early evening, as practicable.

- Provide employees with water and encourage them to drink it throughout the work shift; discourage the use of alcohol during nonworking hours. It is essential that fluids lost through perspiration be replenished. Total water consumption should equal 1 to 2 gal/day/person.

- Rotate employees wearing impervious clothing (if applicable) during hot periods.

- Provide cooling devices, as appropriate. Mobile showers and/or hose-down facilities, powered air purifying respirators, and ice vests all have proven effective in helping prevent heat stress.

7.11.3 Heat Stress Monitoring

For strenuous field activities that are part of ongoing site activities in hot weather, physiological monitoring may be used to monitor the individual's response to heat. Physiological monitoring will be implemented in accordance with applicable site procedures. The procedure CP3-HS-2000, *Temperature Extremes* and guidelines set forth in the current issue of the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values and Biological Indices shall be used to determine the work/rest regimen for working in environments conducive to heat stress.

7.11.4 Cold Stress

Persons working outdoors in low temperatures, especially at or below 32°F, are subject to cold stress disorders. Exposure to extreme cold for even a short period of time can cause severe injury to the body surfaces and/or profound cooling, which can lead to death. Areas of the body that have high surface-area-to-volume ratios (e.g., fingers, toes, and ears are the most susceptible).

Two basic types of cold disorders exist: localized (e.g., frostbite) and generalized (e.g., hypothermia).

7.11.5 Cold Stress Preventive Measures

A number of steps can be taken to minimize the potential for cold stress.

- Individuals can achieve a certain degree of acclimation when working in cold environments as they can for warm environments. The body will undergo some changes that increase the body's comfort and reduce the risk of cold injury.

- Working in cold environments causes significant water losses through the skin and the lungs as a result of the dryness of the air. Increased fluid intake is essential to prevent dehydration, which affects the flow of blood to the extremities and increases the risk of cold injury. Warm drinks should be readily available.

- The skin should not be exposed continuously to freezing temperatures.

7.11.6 Cold Stress Monitoring

Air temperature alone is not a sufficient criterion on which to judge the potential for cold-related disorders in a particular environment. Heat loss from convection (air movement at the surface of the skin) is probably the greatest and most deceptive factor in the loss of body heat. For this reason, wind speeds and air temperatures need to be considered in the evaluation of the potential for cold stress disorders. The ACGIH Threshold Limit Values and Biological Indices provide additional guidance on cold stress evaluation and the establishment of the work/rest regimen in environments conducive to cold stress.

7.12 EXPOSURE MONITORING

Air monitoring shall be used to identify and quantify airborne levels of hazardous substances and health hazards in order to determine the appropriate level of employee protection needed on-site.

7.12.1 Routine Air Monitoring Requirements

Air monitoring will be performed during the following activities:

- Intrusive activities such as drilling and opening sampling tubes;

- Injection of fluids or materials into the subsurface soils;

- Work begins on a different portion of the SWMU 211-A site;

- Contaminants other than those previously identified are being detected;

- A different type of operation is initiated; or

- Personnel are opening drums that contain material or are performing mixing operations of injectant materials.

7.12.2 Site-Specific Air Monitoring Requirements

Measurements of airborne VOCs (primarily TCE) will be conducted in the work area during intrusive activities by using photoionization detector or equivalent. VOC monitoring primarily will be focused on the breathing zones of employees. Air monitoring results will be used to determine the effectiveness and/or need for control measures.

7.12.3 Time Integrated Sample Collection

Verification sampling will be completed for VOCs and potentially other specific contaminants. Integrated sampling methodology will be evaluated by the industrial hygiene program supervisor and may be revised during the course of implementing the RA based on real-time monitoring/sampling results and changing site conditions.

7.13 RADIOLOGICAL PROTECTION

The most likely RAD contaminant to be encountered during RA implementation is Tc-99. Due to the potential presence of radionuclides, including Tc-99, work associated with the RA will be performed under an RWP. The following sections provide detail of the potential provisions, training requirements, and work practices that might be required by the RWP.

7.13.1 Radiation Protection Plan

All workers will operate under the DOE-approved RPP when performing SWMU 211-A RA activities where a potential hazard is posed by radiation exposure. The DOE contractor will assess all RAD hazards that may be encountered. This will be accomplished primarily through preparation of the work plans and the work control process. Based on these evaluation activities, appropriate engineering, administrative, and PPE controls will be selected and implemented. Whenever possible, work will be arranged to avoid (or at least minimize) entry into RAD areas. Radiation safety work practices focus on establishing controls and procedures for conducting work with radioactive material, while maintaining radiation exposures as low as reasonably achievable (ALARA).

All work associated with radiological issues will be conducted in accordance with the RPP, and, as a result, the DOE contractor will provide RAD support activities when there is a potential for radiation exposure. Radiological control technicians (RCTs) also may perform surveys and monitoring, identify RAD areas, and implement RWPs. All personnel/subcontractors will implement and maintain any controls identified as a result of these activities.

7.13.2 Contractor/Subcontractor Responsibilities

The DOE contractor and subcontractor responsibilities may include the following:

- Provide and erect any RAD barriers, barricades, warning devices, or locks needed to safely control the SWMU 211-A RA work site.
- Follow the requirements of the RWPs, including daily briefings, and requirements for signing in on all RWPs.
- Submit bioassay samples and use external dosimeters.
- Notify the Site Superintendent after any employee declares a pregnancy.
- Establish radiation control measures that comply with the requirements specified by RCT personnel supporting the project.
- Determine required RAD PPE based on appropriate work processes and JHAs.

7.13.3 Site-Specific Radiation Safety Work Practices

The DOE contractor and all subcontractors will implement the following radiation safety work practices when working in RAD areas.

- All personnel will adhere to the action levels and hold points identified in the RWP addressing the potential RAD hazards posed by work activities. Work practices and PPE will be altered according to changing RAD requirements as prescribed by the RWP and/or the RCT.

- All work activities to be performed will be designed and performed ensuring minimization of material brought into the RAD Areas. Management, design engineers, and field personnel will jointly identify the materials and equipment needed to perform this RA work. Only equipment and supplies necessary to successfully accomplish the various tasks to be performed will be taken into the EZ. RA work also will be planned and conducted in a manner that minimizes the generation of waste materials. All activities will be designed, before commencement of field activity to maintain radiation exposures and releases ALARA. Emphasis will be placed on engineering and administrative controls over the use of PPE, when feasible.

- All personnel will read the applicable RWP prior to working in the RAD areas. The RCT or the SHS also will review the RWP verbally during the initial pre-job safety briefing. The site superintendent, the RCT and the SHS will continuously monitor worker compliance with the RWP. The site superintendent and/or the SHS will communicate changes to the RWP immediately to all affected personnel, and work practices will be changed accordingly. RAD controls specified by the RWP, such as PPE and work activity hold points, will be reviewed during pre-shift briefings.

- Engineering and administrative controls will be utilized to minimize and control the spread of airborne and surface contamination. Surface contamination, in the form of waste, will be containerized properly throughout the project.

- Personnel will be instructed in the proper use and care of external dosimeters before commencement of field activities and periodically during pre-work tailgate briefings. For SWMU 211-A remedial action, all field activities will require use of a dosimeter. Personnel will be instructed to wear their dosimeters outside of company clothing in the front torso area of the body. They are not to expose the dosimeters to excessive heat or moisture. Dosimeters must be exchanged on a quarterly basis.

- All personnel will participate in the DOE contractor bioassay program. All personnel may be required to submit a baseline bioassay sample before receiving an external dosimeter and participating in any fieldwork. Periodic bioassays also will be submitted in a timely manner as directed by the RAD control organization. Personnel not complying with these requirements will be subject to removal from the project.

- The site superintendent and the SHS will observe field personnel performance with respect to ALARA.

- Additional reviews of health and safety work performance will be discussed during “tailgate” safety meetings with all field personnel.

7.13.4 Radiation Safety Training

All personnel will observe the RAD training requirements, which require General Employee Training and Radworker II Training for all general employees who will perform hands-on work in RAD areas located within SWMU 211-A work zones. The applicability of this training will be determined for each activity. Personnel, including visitors, who are not necessary to the actual performance of the scope of work and who

are not appropriately trained and qualified, will not enter any work areas where RAD exposures may occur. Visitors who are essential or otherwise approved to be present will be restricted from Contamination Areas, High Contamination Areas, High Radiation Areas, Very High Radiation Areas, or Airborne Radiation Areas. In all other RAD areas, visitors may be present only if escorted by a qualified RAD worker and will perform no hands-on activities.

7.14 HOISTING AND RIGGING PRACTICES

All hoisting and rigging will meet the DOE contractor hoisting and rigging requirements. Hoisting and rigging equipment will not be modified such that manufacturer's specifications are invalidated. Hoisting and rigging will be performed consistent with CP2-SM-0024, *PGDP Hoisting and Rigging Program*.

In order to ensure that personnel are not injured or equipment is not damaged during hoisting and rigging operations, the following safe working guidelines will be utilized. These guidelines include those outlined by OSHA and the DOE Hoisting and Rigging Standard, DOE-STD-1090-2011. A competent person will be on-site during all lifting activities.

The following types of equipment are not within the scope of this project: elevators, dumbwaiters, escalators, moving walks, conveyor systems, tree trimming and tree removal work, manipulators, specially insulated hoists for handling high-voltage lines, vehicle-mounted elevating and rotating aerial devices, elevating work platforms, aerial lifts, and earth-moving equipment. The equipment expected to be used to perform this scope of work includes drill rigs, pumps, excavators, forklifts, mixing units, tanks, electric motors, water lines, and trucks. Although not within the scope of this project, this equipment shall be maintained in a safe condition (reference OSHA General Duty Clause). Consult applicable equipment manufacturer information, OSHA, and/or American Society of Mechanical Engineers standards to ensure safe condition and use of the equipment.

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8. SAMPLING AND ANALYSIS

8.1 SAMPLING AND ANALYSIS

MW sampling will be conducted to assess the performance of the RA.

Post-implementation sampling and analysis is intended to achieve three main goals:

1. Assess the passive ongoing bioremediation in the subsurface,

2. Assess the ZVI for continued VOC reduction, and

3. Assess the continued reduction of TCE and degradation products in the RGA groundwater in support of attaining RAO 3.

The details for the performance of sampling and analysis efforts are included in Operations, Maintenance, and Environmental Monitoring Plan, Appendix A of the RDR (DOE 2019a). Appendix A also includes information concerning the following:

- EISB maintenance
- Performance MW locations and construction details
- Long-term MW locations and construction details
- Baseline sampling
- EISB performance sampling frequency and analytical parameters
- Long-term monitoring sampling frequency and analytical parameters

Baseline, first-year performance, and long-term sampling will be performed by Environmental Monitoring sampling crews in support of the project. Beginning in the second year, sampling efforts and analytical requirements will be included in the PGDP Annual Environmental Monitoring Plan and scheduled with the other EMP sampling by the Environmental Monitoring sampling crews.

8.2 SAMPLING AND ANALYSIS REPORTING

Results from performance and long-term monitoring will be submitted to the FFA parties in Five-Year Reviews. Progress utilizing data from groundwater monitoring will be communicated to the FFA parties, as necessary, between Five-Year Reviews as interim updates, particularly during the initial five years of EISB implementation.

8.3 SOURCE WATER SAMPLING

The source of water for use in performing the EISB remedial action is expected to be obtained from the PGDP water system via a nearby fire hydrant or spigot. A pre-use sample will be obtained to confirm the quality of the water from the system. The water sample collected will be analyzed for VOCs (8260C) and Resource Conservation and Recovery Act (RCRA) 8 metals (6010, 6020, and 7470). At the start of the RA, if the VOCs and RCRA 8 metals information is available for the PGDP water system from earlier samples, that information may be used in lieu of additional analyses.

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9. QUALITY ASSURANCE PLAN

A QAPP ensuring implementation of EISB for SWMU 211-A for VOC sources to the Southwest Plume and post-implementation sampling is based on guidelines in *Uniform Federal Policy for Quality Assurance Project Plans*, and is presented in the Appendix of this RAWP.

The governing QA documents for this RA include, but are not limited to, the QAPP and the *Quality Assurance Program Description at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, CP2-QA-1000, and the *Paducah Gaseous Diffusion Plant Programmatic Quality Assurance Project Plan*, DOE/LX/07-2439&D1 (DOE 2019b).

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10. DATA MANAGEMENT AND IMPLEMENTATION PLAN

10.1 INTRODUCTION

The purpose of this Data Management Implementation Plan (DMIP) is to identify and document data management requirements and applicable procedures, expected data types and information flow, and roles and responsibilities for all data management activities associated with the SWMU 211-A EISB RA project. Data management provides a system for efficiently generating and maintaining technically and legally defensible data that provide the basis for making sound decisions regarding environmental remediation and waste characterization at the Paducah Site.

Data management for this project is implemented throughout the life cycle for the environmental measurements data. This life cycle occurs from the planning of data for environmental and waste characterization, through the collection, review, and actual use of the data for decision-making purposes, to the long-term storage of data.

Data types to be managed for the project include field data and analytical data. Historical data are downloaded from Paducah OREIS, as available. Field data will be collected in field logbooks or field data forms, and the data will be entered into Paducah Environmental Measurements System (PEMS), as appropriate, for storage. Analytical data are planned and managed through PEMS and transferred to Paducah OREIS for long-term storage and reporting. Environmental data are transferred from Paducah OREIS to Portsmouth/Paducah Project Office (PPPO) Environmental Geographic Analytical Spatial Information System (PEGASIS). RAD survey results are stored and reported separately from PEMS and Paducah OREIS. In addition to the above, during the EISB process, real-time operational/injection process data will be collected. These data provide a means for determining the quantity of biological amendments and other materials.

To meet current regulatory requirements for DOE environmental management projects, complete documentation of the information flow is established. Each phase of the environmental data management process (planning, collecting, analyzing, managing, verifying/validating, assessing, reporting, consolidating, and archiving) must be planned and documented appropriately. The SWMU 211-A EISB RA project team is responsible for data collection and data management for this project.

The scope of the DMIP is limited to environmental information generated under the SWMU 211-A RA EISB project. This information includes electronic and/or hard copy records obtained by the project that describe environmental processes or conditions. Both information generated by the project (e.g., laboratory analytical results from samples collected) and information obtained from sources outside the project (e.g., historical data) fall within the scope of this DMIP. Certain types of information, such as personnel or financial records, are outside the scope of this DMIP.

10.1.1 Project Mission

The mission of the SWMU 211-A EISB RA project is reduction of the VOC source (TCE and breakdown products) in the UCRS subsurface soils at the SWMU 211-A source area to attain the RAOs. As part of the SWMU 211-A RA, two distinct phases of sampling and analysis will occur: performance sampling and long-term groundwater monitoring. Both of these sampling components occur after injection of the biological amendments into SWMU 211-A. Baseline sampling also will occur prior to the injection of the biological amendments. Performance sampling and analysis will be used to measure biological progress and to determine what effects the RA has on the subsurface contaminants. Results from each round of performance sampling and analysis will be compared to baseline results and previous sampling rounds to determine the degree of bioremedial activity occurring in the UCRS. Long-term sampling will be performed to determine

VOC levels entering the RGA below the treatment area, determine the reduction in VOC levels in the RGA as it migrates away from the treatment area, and determine the degree to which RA goals are being achieved.

10.2 DATA MANAGEMENT ACTIVITIES

- Acquire existing data;
- Plan data collection;
- Prepare for sampling activities;
- Collect field data;
- Process field data;
- Collect field samples;
- Submit samples for analysis;
- Process laboratory analytical data;
- Laboratory Contractual Screening;
- Data verification;
- Data validation;
- Data assessment;
- Consolidate, analyze, and use data and records; and
- Submit data to Paducah OREIS.

10.2.1 Acquire Existing Data

The primary background data to be used for this project consist primarily of analytical data. All available historical data pertaining to the area included in the SWMU 211-A EISB will be downloaded from Paducah OREIS and utilized as necessary in implementing and monitoring the effects of the RA. This data has been used in the development of the decision documents used to select the RA. It has been utilized further in development of the remedial design of the RA.

10.2.2 Plan Data Collection

Other sections and subsections in this RAWP provide additional information for the tasks of project environmental data collection, including the performance and long-term sampling activities, HASP, the QAPP, and the WMP. In addition, a laboratory SOW will be developed in accordance with CP4-ES-5004, *Sample Tracking, Lab Coordination, and Sample Handling*, following approval of this work plan.

10.2.3 Prepare for Sampling Activities

The data management tasks involved in sample preparation activities, as specified in CP4-ES-5004, *Sample Tracking, Lab Coordination, and Sample Handling*, include identifying all sampling locations and preparing descriptions of these locations, developing summaries of all the samples and analyses to be conducted at each sampling location consistent with planning documents and work plans, identifying sample containers and preservation, developing sample data forms for capturing field data, preparing sample kits and chain-of-custody forms, and coordinating sample delivery to the laboratories. The SMO conducts activities associated with analytical laboratories. Coordinates for sample locations will be obtained using a Global Positioning System (GPS) and/or civil survey. The SWMU 211-A EISB RA project manager or the field team manager and the SMO will coordinate data management activities with field sampling activities.

Before the start of field sampling, the SMO will specify and provide the contents of sample kits, which will include sample containers, labels, preservatives, chain-of-custody forms, and any necessary sampling data

forms. Samples will be collected according to contractor-approved procedures. Logbooks, sample labels, and chain-of-custody forms will be completed according to CP4-ES-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*, and CP4-ES-2700, *Logbooks and Data Forms*. Sampling information contained in Sections 8, 9, and Appendix A of this RAWP, and Appendix A of the RDR will be used as the basis for determining the following:

- Sample collection;
- Ordering sufficient amount of containers and other supplies; and
- Verifying the numbers of samples presented in the laboratory scope of work.

As a result of the type of remediation, real-time process field data collection will occur during operations. The measurement of these data points and readings will be performed by field instruments that require periodic calibration consistent with the manufacturer's direction.

10.2.4 Collect Field Data

Field data will be collected, documented, and maintained according to the requirements contained in this document and in the approved RDR and contractor-approved procedures.

10.2.5 Process Field Data

Field measurements such as pressures, volumes, times, etc., will be recorded on sample data forms, field project forms, or in data collection equipment. The sample data forms will be used for entering data manually into Paducah PEMS.

PEMS is used to identify, track, and monitor each sample and associated data from the point of collection through final data reporting. Project documentation includes sample data forms, chain-of-custody forms, and analytical results.

Data management requirements for sample data forms and field forms specify that (1) sampling documentation must be controlled from initial preparation to completion, (2) sampling documentation must be maintained in a project file, and (3) modifying planned activities and deviating from procedures will be recorded.

Before the start of sampling, the SMO specifies the contents of sample kits, which include sample containers provided by the laboratories, preservatives, and chain-of-custody forms. Sample labels and chain-of-custody forms are completed according to CP4-ES-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*.

10.2.6 Collect Field Samples

Personnel collecting samples for the project will record pertinent sampling information on the chain-of-custody forms and sample data forms. The SMO will enter the information from the chain-of-custody forms and sample data forms manually into PEMS. Sampling locations will be surveyed using a GPS and/or civil survey, which will have at least sub-meter accuracy. Sample coordinates will be transferred to the plant coordinate system.

10.2.7 Real-Time Process Sampling and Analysis

Process monitoring data such as injection pressures, volumes, times, etc., will be collected during injection operations. This process monitoring data will be recorded on field project forms or on electronic data forms if

available. Process samples or real-time samples are samples that are collected to show removal or destruction of a contaminant of concern as a result of the process. EISB occurs in the subsurface after completion of amendment injections and the required subsurface chemistry has been generated over an extended period of time. Because of the delay in the treatment process, samples are not collected during injection operations. After injection is completed, performance and long-term monitoring begins and will be performed consistent with this RAWP and the RDR.

10.2.8 Submit Samples for Analysis

The sampling team coordinates the delivery of samples with the SMO who, in turn, coordinates with the analytical laboratories, according to CP4-ES-5004, *Sample Tracking, Lab Coordination, and Sample Handling*. The SMO presents a general sampling schedule to the analytical laboratories. The SMO also coordinates the receipt of samples and containers with the laboratories. The SMO ensures that laboratory data packages and electronic data deliverables (EDDs) from the laboratories contain the appropriate information and are in the correct format.

10.2.9 Process Laboratory Analytical Data

Data packages and EDDs received from the laboratory are tracked, reviewed, and maintained in a secure environment. PEMS is used for tracking project-generated data. The following information is tracked, as applicable: sample delivery group number, date received, number of samples, sample analyses, receipt of EDD, and comments. The laboratory EDDs are checked as specified in CP4-ES-5007, *Data Management Coordination*.

10.2.10 Laboratory Contractual Screening

Laboratory contractual screening is the process for evaluating a set of data against the requirements specified in the analytical SOW to ensure that all requested information is received. The contractual screening includes, but is not limited to, the analytes requested, total number of analyses, method used, EDDs, units, holding times, and reporting limits achieved. Contractual screening is performed for 100% of the data. The SMO is responsible for the contractual screening upon receipt of data from the analytical laboratory according to CP3-ES-5003, *Quality Assured Data*.

Real-time process data is reviewed by the system operator through the data acquisition system or on project data forms. This data includes pressures, volumes, times, etc. The real-time data collected will be available for use by the project team and utilized in developing project reports.

10.2.11 Data Verification

Data verification is the process for comparing a data set against a set standard or contractual requirement. Verification is performed by the SMO electronically, manually, or by a combination of both according to CP3-ES-5003, *Quality Assured Data.* Verification is performed for 100% of the data. Data verification includes contractual screening and criteria specific to the SWMU 211-A EISB RA project. Verification qualifiers may be applied to the data based on holding time exceedance, criteria exceedance, historical exceedance, or background exceedance, if applicable. Verification qualifiers are stored in PEMS and transferred with the data to Paducah OREIS. Additional information relating to data verification is included in the QAPP in the appendix to this document.

10.2.12 Data Validation

To ensure the quality of the analytical data, all laboratory data packages will be produced by the laboratory performing the analysis as Level IV laboratory data deliverables, to the extent possible. Level IV data deliverables contain all raw data and QC such that data verification and data validation of all sample collection, sample handling, sample preparation, analytical performance, data reduction, and data manipulation (i.e., calculations and weights) can be performed.

Data validation is the process performed by a qualified third-party individual. Third-party validation is defined as validation performed by persons independent of sampling, laboratory, and decision making for the program/project (i.e., not the program/project manager). Data validation evaluates the laboratory adherence to analytical-method requirements. Data validation is managed and coordinated with the SMO. The data validator performs data validation according to DOE Prime Contractor data validation plans. Data validation is documented in a formal deliverable from the data validator. Validation qualifiers are input and stored in PEMS and transferred to Paducah OREIS.

A minimum of 10% of the total number of SWMU 211-A EISB RA project samples will be validated for this project. Data validation will apply only to the definitive data.

10.2.13 Data Assessment

Data assessment is the process for assuring that the type, quality, and quantity of data are appropriate for their intended use. It allows for the determination that a decision can be made with the desired level of confidence, given the quality of the data set. Data assessment follows data verification and data validation (if applicable) and must be performed at a rate of 100% to ensure data is usable.

The data assessment is conducted by the SWMU 211-A EISB RA project according to CP3-ES-5003, *Quality Assured Data.* Assessment qualifiers are stored in PEMS and transferred with the data to Paducah OREIS. Any problems found during the review process are resolved and documented in the data assessment package.

10.2.14 Data Consolidation and Usage

The data consolidation process consists of the activities necessary to prepare the evaluated data for the users. The SMO prepares files of the assessed data from PEMS and transmits them to Paducah OREIS for future use in accordance with CP4-ES-1001, *Transmitting Data to the Paducah Oak Ridge Environmental Information System.* The SMO is responsible for transferring the data to Paducah OREIS. Data used in reports distributed to external agencies are obtained from data in Paducah OREIS and have been through the data review process. All data reported have the approval of the SMO.

10.3 DATA MANAGEMENT INTERACTIONS

The SMO oversees the use of PEMS and ensures that data deliverables meet DOE's standards. The SMO enters information into PEMS related to the fixed-base laboratory data once the samples have been delivered, and the results of analyses have been received. The fixed-base laboratory EDDs are loaded into PEMS by the SMO. The SMO performs electronic data verification and coordinates data validation. The SWMU 211-A EISB RA project is responsible for data assessment. The SMO is responsible for preparing the data for transfer from PEMS to Paducah OREIS.

SMO develops the SOW to be performed by an analytical laboratory in the form of a project-specific laboratory SOW. Analytical methods, reporting limits, and deliverable requirements are specified in this SOW.

The SMO receives EDDs, performs contractual screenings, distributes data packages and ensures that electronic deliverable formats are specified properly, and interfaces with the laboratory to ensure the requirements are understood and met.

10.4 DATA NEEDS AND SOURCES

10.4.1 Data Types

Multiple data types will be generated and/or assessed during this project. These data types include field measurements, inspection checklists, historical data, analytical data (including environmental data and waste data), and geographic information system (GIS) data.

10.4.2 Field Measurements

Field measurements that may be collected include field measurements of environmental and waste samples and GPS readings for each sample location. Field measurements may be recorded on appropriate logbooks or sample data forms. The SMO will enter the data from these forms, manually or from the electronic recorder devices, into Paducah PEMS. A QC check of this data entry will be conducted.

10.4.3 Analytical Data

Analytical data for the project consist of volatile analyses, bacterial analyses, hydrocarbon gases, and organic carbon concentrations from groundwater samples.

10.5 GEOGRAPHIC INFORMATION SYSTEM DATA

The Paducah GIS network is used to prepare maps used in data analysis and reporting of both historical and newly generated data. Coordinates will be recorded as state plane coordinates along with plant coordinates. The following details the coverage anticipated for use during the project.

- Stations (station coordinates will be downloaded from Paducah OREIS)
- Facilities
- Plant roads
- Plant fences
- Topographic contours (as available from the 1990 and most recent flyover)
- Utilities
- Creeks/Streams
- Monitoring and injection wells
- Plumes

10.6 DATA FORMS/LOGBOOKS

Field logbooks, chain-of-custody forms, data packages with associated QA/QC information, and sample data forms are maintained properly according to CP3-RD-0010, *Records Management Process*.

Duplicates of field records are maintained until the completion of the project. Logbooks and field documentation are copied periodically. The originals are forwarded to Records Management, and copies are maintained in the field office.

10.6.1 Field Forms

On sample data forms, chain-of-custody forms, or sample labels, this information is entered directly into PEMS by the SMO.

Chain-of-custody forms contain sample-specific information recorded during collection of the sample. Any deviations from the sampling plan are noted on the chain-of-custody form or sample data form. The Sampling Team reviews each chain-of-custody form for accuracy and completeness, as soon as practical, following sample collection.

Chain-of-custody forms are generated from PEMS with the following information:

- Information that is preprinted
  - Chain-of-custody number
  - Project name or number
  - Sample ID number
  - Sampling location (e.g., MW203, PW001)
  - Sample type (e.g., REG = regular sample)
  - Sample matrix (e.g., WG = Groundwater)
  - Analysis (e.g., TCE)
  - Sample container (volume, type, preservation)

- Information that is entered manually
  - Sample date and time
  - Top and bottom depths and units (if applicable)
  - Sample comments (optional)
  - Preservation method

The performance monitoring and long-term monitoring that will be performed as part of this RA involve collecting only groundwater samples. A listing of the groundwater samples to be collected is contained in Table 2 and Table 3, Appendix A, *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 2019a). The following is an example of the sample identification naming convention.

211AMW203XXYY

where:

211A	Designates the SWMU 211-A EISB RA project
MW203	Identifies the monitoring well location (PW001–indicates performance well location)
XXYY	Quarter and Year of Sample

Well Construction Details Forms

Well construction details forms will be used as necessary for this project. Well construction and installation are entered into the field logbook and later added to a well construction detail form. Copies of the well

construction details forms will be provided to the SMO and GIS organizations in order for the information to be added to Paducah OREIS and PEGASIS. An example of a completed well construction detail form can be found in CP4-ES-0069, *Monitoring Well and Associated Infrastructure Installation*.

10.7 DATA AND DATA RECORDS TRANSMITTALS

Official data reporting will be generated from data stored in Paducah OREIS.

10.8 DATA MANAGEMENT SYSTEMS

10.8.1 PEMS

PEMS is the data management system that supports the project's sample and measurement collection activities and generates Paducah OREIS ready to load (RTL) files. The SMO accesses PEMS throughout the life cycle of the project. The SMO uses PEMS to support the following functions.

- Initiate the project properly
- Plan for sampling
- Record sample collection and field measurements
- Record sample shipment information
- Receive and process analytical results
- Evaluate and verify data
- Access and analyze data
- Assess data and enter data validation qualifiers
- Transfer project data (in RTL format) to Paducah OREIS
- Store non-Paducah OREIS

PEMS is used to generate chain-of-custody forms and sample data forms, import laboratory-generated data, update field and laboratory data based on data verification, data validation if applicable, data assessment, and transfer data to Paducah OREIS. Requirements for addressing the day-to-day operations of PEMS include backups and security.

The Information Technology group performs system backups daily. The security precautions and procedures implemented by the SMO are designed to minimize the vulnerability of the data to unauthorized access or corruption. Only members of the SMO have access to the project's PEMS and the data files.

10.8.2 Paducah OREIS

Paducah OREIS is the centralized, standardized, quality assured, and configuration-controlled data management system that is the long-term repository for environmental data (measurements and geographic) for Paducah environmental projects. Paducah OREIS is comprised of hardware, commercial software, customized integration software, an environmental measurements database, a geographic database, and associated documentation. The SWMU 211-A EISB RA project will use Paducah OREIS for the following functions.

- Access to existing data
- Access to project data
- Report generation
- Long-term storage of project data (as applicable)

10.8.3 Paducah Analytical Project Tracking System

The Paducah Analytical Project Tracking System is the business management information system that manages analytical sample analyses for Paducah environmental projects. The Paducah Analytical Project Tracking System generates the SOW, tracks collection and receipt of samples by the laboratory, flags availability of the analytical results, and allows invoice reconciliation. The Paducah Analytical Project Tracking System interfaces with PEMS (output from the Paducah Analytical Project Tracking System is transferred automatically to PEMS).

10.8.4 PEGASIS

The PEGASIS application provides a systematic approach to retrieve, display, and download analytical, geotechnical, and hydrological data, maps, and geophysical information for PPPO sites, regulators, and the public using a web browser. The information includes analytical sample results from various environmental studies, restoration reports and supporting documents, maps, facility drawings, and photography.

PEGASIS is a website that allows data users to access sampling data for hundreds of investigative wells and sampling events, SWMUs, and site-specific GIS features from all of the environmental studies at the site. Analytical data available on PEGASIS are copied from Paducah OREIS periodically.

10.9 DATA MANAGEMENT ROLES AND RESPONSIBILITIES

The data management activities are described in Section 10.2. Contractor-approved procedures will be used to complete all of the necessary data management tasks. The following project roles are defined, and the responsibilities are summarized.

10.9.1 DOE Prime Contractor SWMU 211-A Project Manager

The SWMU 211-A project manager is responsible for the day-to-day technical operation of the RA project. The project manager ensures the requirements of policies and procedures are met. The project manager or designee assesses data in accordance with CP3-ES-5003, *Quality Assured Data*. The project manager is responsible to flow down data management requirements to subcontractors, as required.

10.9.2 DOE Prime Contractor Project Team

This team consists of the technical staff and support staff (including the SMO) that conduct the various tasks required to complete the project successfully.

10.9.3 Data User

Data users are members of the project team who require access to project information to perform reviews, analyses, or ad hoc queries of the data. The data user determines project data usability by comparing the data against predefined acceptance criteria and assessing that the data are sufficient for the intended use.

10.9.4 DOE Prime Contractor SMO

The SMO enters the data into Paducah PEMS, including chain-of-custody information, field data, data assessment and data validation qualifiers, and any pertinent sampling information. After receiving a notification that a fixed-base laboratory EDD is available to download, the SMO loads the EDD to Paducah

PEMS, performs electronic verification of the data, and then compiles the data assessment package. The SMO also prepares data for transfer from PEMS to Paducah OREIS.

The SMO is responsible for contracting any fixed-base laboratory utilized during the sampling activities. The SMO also coordinates sample shipment to the laboratory, ensures contractual screening of data packages, coordinates data validation support, and ensures transmittal of data packages to Records Management.

10.9.5 DOE Prime Contractor Project Records Custodian

The Project Records Custodian is responsible for the long-term storage of project records. The SWMU 211-A project team will interface with the Project Records Custodian and will transfer documents and records in accordance with DOE requirements.

10.9.6 DOE Prime Contractor QA Specialist

The QA Specialist is part of the project team and is responsible for reviewing project documentation to determine if the project team followed applicable procedures.

10.9.7 DOE Prime Contractor Environmental Monitoring and SMO Manager

The Environmental Monitoring and SMO Manager is responsible for long-term storage of project data and for transmitting data to external agencies according to the *Data and Documents Management and Quality Assurance Plan for Paducah Environmental Management and Enrichment Facilities*, DOE/OR/07-1595&D2, and the Paducah Data Management Policy. The Environmental Monitoring and SMO Manager ensures compliance with procedures relating to data management with respect to the project and that the requirements of CP3-ES-5003, *Quality Assured Data*, are followed.

11. ENVIRONMENTAL COMPLIANCE

11.1 INTRODUCTION

Environmental regulatory compliance will be facilitated during the implementation of the SWMU 211-A RA by complying with ARARs that have been identified throughout the project planning, scoping and decision making process, and documented in the signed ROD. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, requires, in part, that RAs for cleanup of hazardous substances comply with ARARs. Because this EISB RA project will be conducted entirely on-site in accordance with Section XXI of the FFA for PGDP and Section 121(e)(1) of CERCLA, no federal, state, or local permits are required for any portion of the EISB RA project.

The EISB RA project with Interim LUCs will reduce the source of TCE and other VOC contaminants that result in groundwater contamination in the SWMU 211-A area. Upon initiation of the RA, a continued decrease is expected in concentrations of TCE and other VOCs in the UCRS soils and groundwater.

The ARARs/to be considered (TBC) listing associated with the SWMU 211-A RA are contained in Appendix A of 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 (DOE 2012). A summary of the ARARs/TBCs associated with this RA follows.

11.2 CHEMICAL-SPECIFIC ARARS/TBCS

These requirements provide health or risk-based concentration limits or values in environmental media for hazardous substances, pollutants, or contaminants. Consistent with the ROD, there were no chemical-specific ARARs/TBCs identified for this SWMU 211-A RA.

11.3 LOCATION-SPECIFIC ARARS/TBCS

Location-specific requirements establish restrictions on activities conducted within protected or environmentally sensitive areas. In addition, these requirements establish restrictions on permissible concentrations of hazardous substances within these areas. Section 11.5 provides additional information concerning the ARARs for this remedial action; the ARARs are located in the ROD (DOE 2012).

11.3.1 Protection of Wetlands

No wetlands have been mapped in the area near SWMU 211-A; therefore, performance of the remedial activities and installation of mixing and injection systems are not expected to impact delineated or nondelineated wetlands during the remedy implementation. The area of implementation is covered with pavement, gravel, or grass-covered soil and is bisected by a small storm-drainage ditch. There are, however, storm drains in the treatment area. In order to protect wetlands that are located away from the treatment area, all activities have been designed to avoid or minimize impacts to wetlands. The use of best management practices (BMPs) and proper siting of equipment and construction areas also will be considered and conducted, as necessary, to prevent impacts to wetlands in other areas of PGDP.

11.3.2 Protection of Aquatic Ecosystems

There are no aquatic systems in or nearby the EISB treatment area. Performance of the RA may include placement of a limited amount of backfilled material around the injection wells and MWs to create a level working surface. There are storm drains and a drainage ditch that could lead to an aquatic system located elsewhere in or outside of PGDP. All activities have been designed to avoid or minimize impacts to waters of the United States within the area of deployment of the RA. The use of BMPs and proper siting of equipment, construction areas, and placement of sediment migration control material will be determined and performed, as necessary, to comply with these substantive requirements to protect aquatic systems.

11.4 ACTION-SPECIFIC ARARS/TBCS

Action-specific ARARs include requirements that pertain to the operation, performance, and design of a remedial response and are based on waste types, media being treated, and treatment technology being implemented. Activities for this RA include drilling, placement of biological amendments in the subsurface, use of temporary mixing equipment, MW surface completions, and groundwater sampling. The actual treatment of the VOC contaminants occurs *in situ* within UCRS soils. The approach for meeting the requirements of the ARARs during the RA implementation is described below.

11.4.1 Fugitive Dust Emissions

Substantive requirements for the control of fugitive dust provide ARARs for all construction and site preparation activities for this project. Reasonable precautions must be taken, including the application of water on exposed soil/debris surfaces to prevent particulate matter from becoming airborne. The substantive requirements are contained in 401 *KAR* 63.010. In addition, diffuse or fugitive emissions of radionuclides to the ambient air from remediation activities, which are only one of potentially many sources of radionuclide emissions at a DOE facility, must comply with the Clean Air Act of 1970, as amended, requirements in 40 *CFR* § 61.92 (substantive requirements).

General surface activities have the potential to create dust. The treatment area is covered by pavement, gravel and grass covered soil. Soils generated during drilling activities will be moist and are not expected to result in the generation of dust. The limited backfilling operations around MWs may generate limited dust. Water sprays and ground covers will be used as needed to prevent generation of dust, including any coring of pavement surfaces. The preparation of ZVI and sand mixtures for the purpose of fracturing will involve mixing of the materials which could generate a limited amount of dust. As with ground generated dust, water sprays will be utilized as needed to prevent the generation of iron or sand dust.

11.4.2 Toxic Emissions and Operation Emissions

SWMU 211-A potential hazardous air pollutants (HAPs) have been identified based on characterization of the soils and development of decision documents. The potential HAPs identified are TCE, vinyl chloride, *trans*-1,2-DCE, *cis*-1,2-DCE, and 1,1-DCE. The RA chosen for this SWMU is EISB and interim LUCs, which will not extract these contaminants from the subsurface. The contaminants will be treated *in situ*. The RA will not generate toxic emissions and will not require the treatment of vapor/gases to comply with the contaminant concentration requirements of 401 *KAR* 63:020.

11.4.3 Monitoring Well Installation

This RA will use injection wells to treat subsurface contaminants *in situ.* Performance wells and long-term MWs will be used to ascertain the efficacy of the biological reactions and to determine the degree to which

the action will result in attaining RAOs. The injection wells will be used to place sand, ZVI, vegetable oil emulsion, and bacteria cultures into the subsurface. The combination of these materials in the subsurface will generate biological reactions to destroy the VOC contaminants. Performance wells will be installed to obtain samples of the water inside the treatment area to determine the operational efficiency. Long-term MWs will be installed around the treatment area to assist in assessing the degree to which the RAOs are being attained. Consistent with 401 *KAR* 6:350, these well components will be installed to minimize the potential for the introduction of pollutants into the subsurface. A Commonwealth of Kentucky licensed well driller will be utilized for MW installation and abandonment. Plugging and abandoning of the wells is not planned because the wells will remain in place for a number of years to support ongoing EISB. If needed, they could be used to add additional biological amendments to promote continued biological remediation.

11.4.4 Discharge of Storm Water and Treated Groundwater

Management of aqueous wastes will include procedures to minimize the possibility of spills and releases to the environment. Berms and dikes will be constructed, as needed, to minimize contact of waste with surface water run-on and runoff. If precipitation accumulates in the diked areas that hold contaminated wastes, it will be managed as contaminated water until analyses show otherwise. It will be treated, as needed, to meet the applicable surface water discharge limits prior to discharge.

Contaminated water, including decontamination water, and development groundwater will be treated on-site as necessary to meet discharge requirements as contained in the ARARs located in the ROD and subsequently discharged through a KPDES or CERCLA outfall (DOE 2012). Where these waters cannot be treated on-site, they will be shipped to an appropriate off-site wastewater treatment facility for treatment and subsequent disposition in accordance with applicable requirements. Off-site shipment to any facility shall be conducted in accordance with the applicable requirements of 40 *CFR* § 300.440 (CERCLA Off-site Rule).

The use of the tanks for containerizing the generated water will allow for batch sampling. The sampling will provide the Tc-99 activity to insure wastewater, when added to the outfall flow, will not exceed the Table II (902 *KAR* 100:019 §44) effluent limits at the applicable outfall(s). The *MEMORANDUM OF AGREEMENT FOR RESOLUTION of Informal Dispute for the Focused Feasibility Study for the Southwest Plume Volatile Organic Compound Sources Oil Landfarm and C-720 Northeast and Southeast sites) at the Paducah Gaseous Diffusion Plant, Paducah, KY* (DOE/LX/07-0186&D2), paragraph 2, requires that the method for calculating the annual average discharge (AAD) of Tc-99 shall be detailed (DOE 2010b). Because effluent water will be containerized and sampled prior to discharge, this same process will be used to determine AAD of Tc-99. After each tank has been filled to the appropriate level, each tank will be sampled and analyzed for the Tc-99 activity present in the water contained in the tank. The volume of the filled tank will be noted upon sampling. These two data points (water volume and Tc-99 activity) will be collected for each filled tank throughout the project. The laboratory results for the Tc-99 and volumes of the tanks then will be used to calculate a volume weighted average discharge for the project to help determine the AAD at the outfall(s) in conjunction with contributions from any other CERCLA discharges subject to this ARAR.

If the project operation does overlap fiscal/calendar years, the average annual discharge for Tc-99 will be calculated for the operational discharges that occurred during each fiscal/calendar year. The following equation provides the detail for the AAD calculation.

Where:

AAD = Annual Average Discharge, pCi/L
N = Total Number of Wastewater Tanks, #

X_N = Tc-99 activity in each tank, pCi/L
V_N = Volume of water in tank N, gal

$$AAD = [(X_1V_1 + X_2V_2 + X_3V_3 + \ldots X_NV_N)/(V_1 + V_2 + V_3 + \ldots V_N)]$$

Note: Field implementation of the bioremedial activity is expected to be less than one year; therefore, the AAD is not expected to require normalization for multiple years.

11.4.5 Hazardous Waste Management

All primary wastes (i.e., groundwater and contaminated soils) and secondary wastes (i.e., treatment residuals and decontamination wastewaters) generated during remedial activities will be characterized as RCRA wastes (solid or hazardous); PCB waste; radioactive waste(s); and/or mixed waste(s), as appropriate, and will be managed in accordance with appropriate RCRA, Toxic Substance Control Act (TSCA), or DOE Order/Manual requirements. Wastes managed on-site must comply with the requirements of the ARARs contained in the signed ROD (DOE 2012). When wastes are transferred off-site, waste management must be conducted in compliance with all applicable laws and regulations. Shipment of CERCLA wastes to any off-site facility shall be conducted in accordance with the approval requirements of 40 *CFR* § 300.440 *et seq.* (CERCLA Off-site Rule).

For contained-in/no-longer-contaminated-with determinations for environmental media and debris, DOE will apply the contained-in/no-longer-contaminated levels of 39.2 ppm TCE in solids and 0.081 ppm TCE in aqueous wastes generated by this RA. The analytical results will be compared against the contained-in, health-based levels listed above, and a determination made. Land disposal restrictions (LDRs) continue to apply to media and debris for which a contained-in/no-longer-contained-in or a no-longer-contaminated-with determination has been made.

11.4.6 National Emission Standards for Hazardous Air Pollutants

EPA regulations also include limitations on the RAD dose allowed to members of the public in the National Emission Standards for Hazardous Air Pollutants regulations in 40 *CFR* Part 61 (and 401 *KAR* 57:002, which incorporates the federal regulations by reference). Codified at 40 *CFR* § 61.92, there is a limit of 10 millirem (mrem)/year from all radioactive air emissions at a DOE facility to the most exposed member of the public from radionuclide emissions to the atmosphere.

Tc-99 is the radionuclide that is expected to be present in the groundwater at SWMU 211-A. Because this RA will occur at natural temperature conditions and the materials will not be heated, Tc-99 will not vaporize. Moreover, because treatment will occur in the subsurface, radioactive emissions of Tc-99 are not expected to occur. Because the Tc-99 will remain in the liquid phase, there will be no release of vapor phase Tc-99 that will exceed the 10 mrem/year limit.

11.4.7 Transportation

Any remediation wastes transferred or transported in commerce along public rights-of-way must meet all applicable requirements found in the federal and Commonwealth of Kentucky transportation laws and regulations. These transportation requirements include provisions for proper packaging, labeling, marking, manifesting, recordkeeping, licensing, and placarding that must be complied with fully for shipment. Before shipment of CERCLA wastes to any off-site facility, DOE must ensure the acceptance of the receiving site under the CERCLA Off-site Rule (40 *CFR* § 300.440).

11.4.8 Underground Injection Control

The project design for this RA requires implementation of EISB. This action will include the use of jet injection to create fractures in the UCRS formation. Those fractures will be filled with proppant which will allow the UCRS formation to more readily receive injected materials. The proppant will contain a mixture of water, guar gum, sand, and ZVI particles. Following the jet injection fracturing activity, injection of emulsified vegetable oil and water and *Dehalococcoides* bacteria will be performed to initiate the biological reduction of VOC contaminants in the UCRS treatment area.

Injection of vegetable oil emulsion, ZVI, *Dehalococcoides* bacteria, sand, guar gum, and water, which are not hazardous wastes, into the UCRS triggers certain ARARs under the Underground Injection Control (UIC) program of the Safe Drinking Water Act. Accordingly, the following substantive requirements of the UIC regulations are considered relevant and appropriate: (1) 40 *CFR* § 144.12(a), and 144.82(a). These regulations, in general, prohibit any injection activity that allows the movement of fluid containing any contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation or standard or may otherwise adversely affect the health of persons. The utilization of injection wells to place the bioamendments and to effect the jet fractures qualifies the injection wells as aquifer remediation wells. Although aquifer remediation wells may be used for several purposes, for SWMU 211-A, they are for placement of remediation agents and microorganisms (EPA 1999). The implementation of the remedial action is being performed under CERCLA; as such, approval of the remedial design and remedial action work plan by the FFA parties provides the needed approval that allows the use of aquifer remediation wells.

The injection of the components described in the previous paragraphs will contribute to the efficiency of the *in situ* bioremediation operation and result in an overall reduction in VOC concentrations in the UCRS. The area affected by the injection of biological amendments is expected to be limited to the immediate area within the treatment zone as a result of hydraulic control measures that will be taken during injection operations. Hydraulic controls include the use of controlled injection volumes to reduce subsurface pressures. Controlling the injection volumes at various depths and targeted screens reduces the ability for contamination to migrate outside the treatment area by keeping subsurface pressures low. The design of this remedy is intended to meet the substantive requirements of 40 *CFR* § 144.12(a) and 144.82(a). The injections are designed to maintain control of injected material to prevent movement of fluid containing any contaminant into underground sources of drinking water. The RAWP will be approved by the EPA and Commonwealth of Kentucky.

11.5 SUMMARY OF ARARS

The RA will be performed using the location-specific and action-specific ARARs/TBCs for the selected remedy as documented in the ROD (2012a). No chemical-specific ARARs/TBCs were identified for this RA.

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12. WASTE MANAGEMENT PLAN

12.1 OVERVIEW

This WMP documents management and disposition of IDW, decontamination water, and wastewater that will be generated during the implementation of the SWMU 211-A EISB RA project. The implementation of the EISB RA project entails drilling of jet fracturing wells, injection wells, MWs, and preparation and injection of bioamendments. Previous investigations and process knowledge indicate that elevated levels of radiological contamination and VOCs may be present at the SWMU 211-A location.

This WMP addresses the specific management of wastes generated during the performance of the EISB RA project from generation through final disposition. All waste generated also will be managed according to the most recent revision of the *Four Rivers Nuclear Partnership, LLC Paducah Deactivation and Remediation Project Waste Management Plan*, CP2-WM-0001.

The major activities associated with this SWMU 211-A EISB RA project are listed below.

- Drilling to install:
  - Performance MWs
  - Long-term MWs
  - Jet injection wells
  - Biological amendment injection wells
- Fracturing operations [including injection of any of the following (jet injection)]:
  - Guar gum
  - Sand
  - ZVI
  - Deoxygenated water
- Biological amendment mixing and injection operations
  - Vegetable oil and water emulsion
  - *Dehalococcoides* bacteria
- MW sampling
- Decontamination operations

A copy of the WMP (electronic or hardcopy) will be available on-site during execution of the EISB RA. The Waste Management Coordinator will be responsible for daily oversight of waste management activities and for ensuring compliance with this WMP.

This WMP emphasizes the following objectives:

- Manage the waste(s) in a manner that is protective of human health and the environment.

- Minimize waste generation, as feasible, thereby reducing unnecessary costs (analytical, storage, disposal, etc.).

- Select appropriate storage and/or disposal methods for generated waste(s).

All waste management activities must comply with this WMP, applicable contractor procedures, and *Waste Acceptance Criteria for the Treatment, Storage and Disposal Facilities at the Paducah U.S. Department of Energy Site*, CP2-WM-0011 (WAC), for on-site treatment, storage, and disposal facilities that may be

designated to receive EISB RA project waste. Off-site disposal of CERCLA-generated waste must comply with the CERCLA Off-Site Rule.

During the course of the EISB RA project, additional contractor and DOE waste management requirements may be identified. If necessary, revisions will be made to the WMP to ensure project compliance.

12.2 TYPES AND MANAGEMENT OF IDW, SAMPLE RESIDUALS, AND MISCELLANEOUS WASTE

A variety of IDW is expected to be generated during the EISB RA project. All waste generated has the potential to contain contaminants related to known or suspected past operational or disposal practices. IDW generated during remedial activities may include materials such as soil, concrete, PPE, plastic, sampling residuals and returns, sampling equipment, wastewater, sediment and mud from wastewater treatment, filter media, filter bags/cloths, purge and development wastewater.

The waste generated from field-related activities of this EISB RA project has the potential to contain contaminants related to past operations. Waste that is likely to have either hazardous or radiological contamination typically will be stored on-site in containers within the area of contamination and/or other CERCLA waste storage areas in accordance with CP3-WM-1037, *Generation and Temporary Storage of Waste Materials*, during the characterization period and prior to treatment/disposal.

The activities that are performed as part of the EISB RA project will produce the waste materials covered by this WMP and include the following:

- Drill cuttings/Soil
- Decontamination wastewater
- Well development water
- Guar gum and ZVI mixtures (solids)
- Personnel protective equipment
- Contaminated debris and concrete cores
- Noncontaminated debris and construction waste
- Guard rail steel and concrete (foundation)
- Mud from decontamination and water treatment (soil)

Brief descriptions of each expected waste stream are outlined in the following sections.

12.2.1 Drill Cuttings/Soil

Drilling cuttings will be generated from installation of the new wells. It is assumed that all drill cuttings will have a 30% swell factor. An estimated total of this waste that is expected to be generated is listed in Section 12.2.8. Waste soil will be segregated from other waste to facilitate waste characterization at the conclusion of the EISB RA project activities. Soil will be containerized in appropriate containers.

12.2.2 Decontamination Waste Water

Decontamination water or other similar materials may be generated during drilling equipment decontamination. The decontamination water will be containerized and stored at on-site storage facilities. The water will be characterized by associated analytical results and/or process knowledge and treated, if necessary, to meet discharge limits before it is discharged through an existing KPDES outfall or a CERCLA

outfall or managed at an off-site wastewater treatment facility, if needed. Each waste steam will be segregated and will be labeled and stored in an approved container.

12.2.3 Personal Protective Equipment

PPE will be worn as specified in JHAs, RWP, and other work control documents. While site personnel use procedures and BMPs to minimize opportunities for contacting TCE-contaminated media and equipment, it is likely that some PPE or related debris (e.g., plastic sheeting) will come into contact with TCE-contaminated materials during the remediation process. Process knowledge, visual inspections, or direct sampling will be used to characterize PPE and any related debris. Based on the results of the characterization, any PPE or related debris determined to be contaminated by a listed waste or exhibiting a RCRA characteristic will be managed as hazardous waste, decontaminated, or a no longer contaminated-with determination will be made.

12.2.4 Wastewater

Wastewater may be generated by well development activities, purge water, drilling activities, or decontamination or cleaning of equipment including bioamendment mixing equipment. The wastewater will be containerized and stored at on-site storage facilities. The water will be sampled and, if necessary, processed to remove sediment and then treated (e.g., C-612 Treatment Facility) before it is discharged consistent with ARARs through an existing KPDES outfall or a CERCLA outfall or managed at an off-site wastewater treatment facility, if needed.

Wastewater will be generated during the installation and development of newly constructed MWs and when decontaminating the equipment used in performing the remedial operations. Groundwater and any related aqueous wastes generated from well sampling, well development, and well purging shall not be considered a hazardous waste at the point of generation, if the TCE concentrations are below 1 ppm, provided that the subject aqueous waste will be treated further in an on-site wastewater treatment unit and discharged through a PGDP KPDES and/or CERCLA outfall. Other aqueous environmental media waste contaminated with TCE that does not qualify for the exemption cited herein will use a health-based concentration of 0.081 ppm as the criterion for making contained-in determinations for media destined for on-site treatment and discharge through a KPDES and/or CERCLA outfall.

12.2.5 Guar Gum and ZVI Mixtures

ZVI and guar will be mixed and injected into the UCRS soils at locations where jet fracturing will be performed. Small excess quantities of the guar and ZVI are expected to be generated as part of this process from the cleaning of mixing and injection equipment, pumps, pipes, etc. This excess material will not be contaminated because they will not have been injected into the subsurface. The material will be containerized and disposed of appropriately. It is expected that the guar portion of the mixture will degenerate over time leaving a water and iron mixture. Depending on its characteristics, the materials may require disposal or may be reused. Because typically it will be in the form of water emulsions with some solids, the material will be processed to separate the solids and liquids for disposal along with other solids and liquids generated by the action. This excess material will not be contaminated with VOCs, radioactive elements, or other contaminants since it will not have been in contact with the contaminated soil or groundwater.

12.2.6 Miscellaneous Noncontaminated Clean Trash

DOE has implemented waste management activities for the segregation of all clean trash (i.e., trash that is not chemically or radiologically contaminated). Examples of clean trash are packaging materials, glass bottles not used to store potentially hazardous chemicals, cardboard, plastic wrap. During implementation of this WMP,

all clean trash will be segregated according to those guidelines and then collected and recycled or disposed of by the Project Waste Management Coordinator (PWMC), once it has been approved for removal.

12.2.7 Contaminated Debris and Concrete Cores

Infrastructure items that otherwise would interfere in performing EISB RA project activities will be removed, if possible. A metal vehicle guardrail bisects the areas to be treated. Removal of the guardrail and support posts will allow much more flexibility to align the drilling rigs for operations. The treatment area also is covered partially with concrete or asphalt pavement that will need to be cored to allow access to drill the subsurface. The guardrail and many of the coring locations are within a RAD control zone. As such, it is currently assumed these waste materials will be contaminated. These wastes will be containerized and characterized to determine if they meet the WAC of the C-746-U Landfill. Based on these characterization results, the waste will be dispositioned appropriately.

12.2.8 Waste Generation Estimate

A rough order of magnitude estimate of the quantity of waste expected to be generated during the performance of the SWMU 211-A RA project is shown below. The wastes are subdivided into expected waste types.

- Drill cuttings 1608 ft^3
- Decontamination wastewater 50,400 gal
- Well development and purge water 10,100 gal
- Guar gum and ZVI mixtures (solids) 5 ft^3
- Personnel protective equipment 225 ft^3
- Contaminated debris and concrete cores 37 ft^3
- Noncontaminated debris and construction waste 540 ft^3
- Contaminated guard rail steel and concrete (foundation) 270 ft^3
- Mud from decontamination and water treatment 178 ft^3

12.3 MANAGEMENT OF WASTE

EISB RA project activities may result in generation of the following waste:

- RCRA solid waste or hazardous waste (e.g., hazardous debris containing lead paint, metals considered RCRA Toxicity Characteristic waste, and/or RCRA Listed Wastes F001/F002/U228),

- Low-level radioactive waste,

- Mixed waste, and

- TSCA waste, as amended (PCB remediation soil waste).

All primary wastes (e.g., soil, sediment, sludge, removed waste materials) and secondary wastes (e.g., contaminated PPE, decontamination wastes) generated during the EISB RA project will serve as the point of generation and be characterized appropriately as RCRA (solid or hazardous waste), TSCA, low-level waste (LLW), and/or mixed wastes and managed accordingly. In many cases, debris generated from EISB RA project activities can result in heterogeneous waste streams. Characterization activities will focus on determining the overall average properties of the waste streams using both representative sampling and/or process/generator knowledge in accordance with state and federal regulations and approaches described in

EPA preamble discussions contained in 57 *FR* 990 (Preamble to the Proposed Rule—Treatment Standards for Contaminated Debris, January 9, 1992). Any RCRA hazardous debris must be treated to meet LDR treatment standards for hazardous debris at 40 *CFR* § 268.45 prior to disposal.

12.3.1 Contained-In/Contaminated-With Determinations

Based on process knowledge of past operations at the SWMU 211-A and review of existing historic sampling data, waste streams (e.g., environmental media and debris contaminated by environmental media) generated during EISB RA project activities may be contaminated with listed hazardous waste (i.e., TCE, 1,1,1-TCA). If either TCE and/or 1,1,1-TCA is determined to be present based on detectable concentrations of TCE and/or 1,1,1-TCA, the waste stream in question shall be managed as a RCRA hazardous waste per the contained-in policy until such time the waste stream is determined no longer to contain the listed hazardous waste. Contaminated debris and environmental media is no longer considered to contain hazardous waste when (1) they no longer exhibit a characteristic of hazardous waste, and (2) concentrations of the listed hazardous constituents are below health-based levels. Sampling, process knowledge, or a combination of both may be used to make such determinations. Kentucky Division of Waste Management and EPA Region 4 previously have approved site-specific, health-based levels for making no longer contained-in/contaminated-with determinations for environmental media and debris at the Paducah Site, with respect to TCE and 1,1,1-TCA. The health-based levels originally were approved by Kentucky Division of Waste Management in the 2003 Agreed Order. These same health-based levels subsequently were approved by EPA and Kentucky in the *Remedial Investigation/Feasibility Study Work Plan for the C-400 Complex Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-2433&D2 (DOE 2019c). The approved health-based levels for TCE and 1,1,1-TCA that will be used for this project are shown in Table 3.

Table 3. Approved Health-Based Contaminant Levels for Solids and Aqueous Liquids

Listed Constituent	Solids	Aqueous Liquids
TCE	39.2 ppm	0.081 ppm
1,1,1-TCA	2,080 ppm	Not Applicable*

*Aqueous solutions that meet the health-based level for TCE also shall be deemed no longer to contain 1,1,1-TCA.

DOE shall be responsible for comparing characterization data and/or using process knowledge for the environmental media/debris streams suspected as being contaminated with TCE and/or 1,1,1-TCA to the approved health-based levels. If, based on DOE's comparison, the total detectable concentrations of TCE and/or 1,1,1-TCA are below the approved health-based levels, the waste stream will be deemed as not to contain or be contaminated-with a listed hazardous waste.

12.4 WASTE MANAGEMENT TRACKING RESPONSIBILITIES

Waste generated during the EISB RA project activities will require implementation of a comprehensive waste tracking system to maintain waste inventory. The tracking system will document waste container numbers and locations; waste description; generation date; sampling, treatment and disposal date; and disposal location. The Technical Services Organization includes the Waste Generator Services Group, Waste Transportation Group, and Waste Operations Group. The Waste Generator Services Group will maintain the tracking system and will maintain a waste inventory system such that all waste generated during the EISB RA project is tracked properly and identified. To prevent inappropriate disposal of waste, generation data and information necessary to determine the amount of contamination present will be documented so that proper disposal methods can be implemented. Determination of the ultimate disposal method is the responsibility of the

Waste Transportation Group and the SWMU 211-A EISB RA project PM. The following are additional responsibilities of the Waste Generator Services Group.

- Ensure that waste storage areas are properly established, maintained, and closed in accordance with ARARs contained in the ROD (DOE 2012).
- Track and update waste inventory database and reports.
- Support project waste personnel in the selection of containers and in the segregation of wastes.
- Maintain waste container inventories.
- Coordinate with off-site disposal facilities on waste acceptance and disposal pricing and disposition.

The following information is included in the waste inventory database.

- Generation date
- Request for disposal (RFD) number
- Origin location
- Waste type
- Description
- Quantity
- Storage location

Additional support personnel who fall under the Technical Services Director and may support the EISB RA project are included below.

12.4.1 DOE Prime Contractor Project Waste Management Coordinator

The Project's Frontline Supervisor, Field Team Leader, or designee will assume responsibility of the PWMC to ensure that all waste management activities comply with contractor procedures, contractor requirements, and the WMP, as appropriate. Responsibilities of the PWMC include coordination of activities with field personnel, oversight of waste management operations, and maintenance of the waste management logbook that contains a complete history of generated waste and the current status of individual waste containers.

Additional responsibilities of the PWMC include the following:

- Generation and containerization of all project waste;
- Ensuring adequate containers are available at worksite by coordinating with Waste Operation group;
- Maintaining an adequate supply of labels;
- Interfacing with Waste Transportation and Waste Operations Groups for necessary support;
- Preparing RFDs;
- Preparing Waste Item Container Log (WICL) for each waste container;
- Ensuring waste containers are properly labeled;

- Coordinating waste transfers from field; and

- Providing field support for sampling of waste containers to characterize wastes.

12.4.2 DOE Prime Contractor Transportation Group and Waste Operations Group

The Waste Transportation Group and Waste Operations will ensure that procurement and inspection of equipment, material, or services critical for shipments of waste to off-site treatment, storage, and disposal facilities are conducted in accordance with procedure CP3-QA-2500, *Procurement, Inspection, and Management of Items Critical for Paducah Off-Site Waste Shipments*. Additionally, the PWMC will ensure that wastes expected to be disposed of at the C-746-U Landfill are packaged and managed according to the WAC.

Additional responsibilities of the Waste Transportation Group and Waste Operations Group include the following by individual group.

12.4.3 Waste Transportation Group

- Interface with necessary personnel.

- Provide subject matter experts to support project field activities when needed.

- Characterize and document project waste.

- Provide technical support associated with waste handling and segregation to project personnel.

- Prepare Sample Analysis Event Plans for the sampling of waste containers.

- Manifest off-site shipments of waste.

- Verify container packaging and labeling are U.S. Department of Transportation compliant.

- Confirm compliance with U.S. Department of Transportation, DOE Orders, and regulations.

12.4.4 Waste Operations Group

- Provide containers as requested to project location.
- Pick up and move waste containers to approved storage facility.
- Pick up and transport waste containers as needed for on-site movement.
- Assist project in waste handling as required.

12.5 IDW WASTE REQUEST FOR DISPOSAL, STORAGE, AND LABELING

12.5.1 Request for Disposal

All waste will be documented using Forms CP2-WM-0011 F02, *Request for Disposal*, and CP2-WM-0011 F03, *Request for Disposal RCRA Regulatory Codes-Attachment B* (if applicable), in accordance with the WAC.

The PWMC is responsible for initiating an RFD, identifying, and documenting the type and quantity of waste that will be generated.

Waste Transportation Group Waste Engineer(s) is responsible for reviewing and approving the waste stream prior to generating waste. In addition, the Waste Engineer(s) will determine the anticipated path to disposal of the waste, the on-site storage facility, and provide guidance in selecting a container.

After Waste Engineer approval, PWMC is responsible for processing RFD documentation to the Waste Generator Services Group for processing.

The Waste Generator Services Group will enter the RFD into the Waste Tracking System.

12.5.2 Waste Identification Container Log

The PWMC will document each container of waste on Form CP3-WM-3015 F01, *Waste Item Container Log*. The PWMC completes the form, filling in all information including, but not limited to, RFD number, description, volume, container type, container number.

After container is filled, the PWMC is responsible for processing WICL documentation to the Waste Generator Services Group for processing.

The Waste Generator Services Group will enter the container into the Waste Tracking System.

12.5.3 Labeling

The PWMC is responsible for labeling each container in accordance with the WAC and CP3-WM-3015, *Waste Packaging*.

12.5.4 Storage

Containers will be stored in an appropriate storage area set up by Waste Generator Services Group in accordance with CP3-WM-1037.

Waste also may be stored within the area of contamination.

12.6 TRANSPORTATION AND STORAGE OF IDW

12.6.1 Transportation of IDW

Any remediation waste transferred or transported in commerce along public rights-of-way must be conducted in compliance with all applicable laws and regulations. These transportation requirements include provisions for proper packaging, labeling, marking, manifesting, recordkeeping, and placarding that must be complied with fully for shipment. In addition, CERCLA Section 121(d)(3) provides that the off-site transfer of any hazardous substance, pollutant, or contaminant generated during CERCLA response actions be sent to a treatment, storage, or disposal facility that complies with applicable federal and state laws and has been approved by EPA for acceptance of CERCLA waste (see the CERCLA "Off-Site Rule" at 40 *CFR* § 300.440 et seq.). The generation, packaging, transportation, and storage of waste on-site will be performed consistent with the applicable procedures as listed in Section 4, Table 1.

12.6.2 Storage of IDW

The WMES Waste Generator Services Group will establish and maintain an appropriate waste storage area for the EISB RA project in accordance with contractor procedure CP3-WM-1037, *Generation and Temporary Storage of Waste Materials*.

12.6.3 Required Equipment

Equipment that will be used to move or handle IDW must be inspected following procedure CP3-SM-0020, *Administrative Controls for Powered Industrial Trucks*. Equipment that does not pass this inspection will be tagged out-of-service until corrective actions have been completed and the equipment reinspected. Transportation of waste will require the use of forklift trucks, flatbed trailers, and flatbed trucks. A drum grabber will be mounted on the forklift to place drums onto pallets for transport.

12.6.4 Containerization and Transportation of Solid IDW

Solid waste must be containerized consistent with applicable procedures contained in Section 4, Table 1. Absorbent material will be added to the wastes; the quantity depends on potential free liquids and will be established by the Waste Transportation Group Waste Engineer and added under the supervision of the PWMC prior to transporting waste material to a treatment, storage, or disposal facility in accordance with CP3-WM-3015, *Waste Packaging*, and applicable state and federal regulations for waste going off-site.

12.6.5 Containerization and Transportation of Liquid IDW

Liquid waste must be containerized in containers in accordance with CP3-WM-3015, *Waste Packaging*, and applicable state and federal regulations for waste transportation.

12.7 SCREENING OF ANALYTICAL SAMPLES

In situ screenings of analytical samples are performed by RADCON personnel for radiation and radioactive contamination. Additional screenings are performed prior to samples being shipped off-site. Prior to shipping samples, analytical samples are surveyed in accordance with CP3-WM-3028, *Off-site Shipping*. Survey procedures CP3-RP-1109, *Radiation Contamination Control and Monitoring*; CP3-RP-1108, *Posting and Labeling*; and CP4-RP-1110, *Radiation Surveys*, are used to perform the various radiation and contamination surveys required.

12.8 IDW CHARACTERIZATION, SAMPLING, AND ANALYSIS

12.8.1 IDW Characterization

Sampling and analysis of all SWMU 211-A RA project waste shall comply with this Work Plan and the WAC. The waste will be segregated by borehole or operation and characterized. The potential COCs for this EISB RA project include radionuclides, PCBs, polycyclic aromatic hydrocarbons, VOCs, and metals. The PPE waste will be characterized based on analytical results of the samples used to characterize the soils. Since most PPE such as Tyvek coveralls, tape, inner gloves, booties, etc. will be used throughout the entire borehole, the most stringent waste classification based on analytical results will be applied to all PPE from a given borehole or operation.

For solid waste, the "20 times" rule may be used to determine if the waste is characteristically hazardous. If the total concentration of RCRA constituents is greater than 20 times the toxicity characteristic leachate

procedure (TCLP) limits in 40 *CFR* § 261.24, then the waste initially will be considered characteristically hazardous and placed into RCRA storage until further TCLP analysis can be performed for complete analysis.

Characterization requirements and guidance are provided in the site WAC, CP3-WM-0437, *Waste Characterization and Profiling*, and CP3-WM-1037, *Generation and Temporary Storage of Waste Materials*. Tables 4 through 7 list the analytical testing methods that will be used for analysis. The Waste Transportation Group will coordinate with the SWMU 211-A RA project PM and SMO for required analyses and guidance on collection and transfer of waste characterization samples to a fixed-base laboratory that participates in DOE Consolidated Audit Program (DOECAP).

Table 4. TCLP Parameters for Analysis of Solid Waste

Constituent	Method	TCLP Regulatory Limit (mg/L)	20 Times TCLP Regulatory Limit (mg/kg)
1,1-Dichloroethene	8260	0.7	14
1,2-Dichloroethane	8260	0.5	10
Arsenic	6010/6020	5.0	100
Barium	6010/6020	100.0	2,000
Benzene	8260	0.5	10
Cadmium	6010/6020	1.0	20
Carbon tetrachloride	8260	0.5	10
Chlordane	8081	0.03	0.6
Chlorobenzene	8260	100.0	2,000
Chloroform	8260	6.0	120
Chromium	6010/6020	5.0	100
Lead	6010/6020	5.0	100
Mercury	7470	0.2	4
Methyl ethyl ketone	8260	200.0	4,000
Selenium	6010/6020	1.0	20
Silver	6010/6020	5.0	100
Tetrachloroethene	8260	0.7	14
Trichloroethene	8260	0.5	10
Vinyl chloride	8260	0.2	4

Table 5. Analytical Parameters for Radiological and PCB Characterization

Constituent	Method
Total Uranium	Mass Spec
Uranium-234	Mass Spec
Uranium-235	Mass Spec
Uranium-238	Mass Spec
Americium-241	Alpha Spec
Neptunium-237	Alpha Spec
Plutonium-239/240	Alpha Spec
Plutonium-238	Alpha Spec
Thorium-228/232	Alpha Spec
Thorium-230	Alpha Spec
Technetium-99	Liquid Scintillation
Cesium-137	Gamma Spec
PCB	8082

Table 6. Waste Characterization Requirements for Solid Waste

Constituent	Method
TCLP VOCs	SW-846 1311, 8260
TCLP metals	SW-846 1311, 6010/6020/7470
Acetone	8260
Toluene	8260

Table 7. Waste Characterization Requirements for Decontamination, Development, and Purge Water

Parameter	Method	Detection Limit
TCE	EPA 624.1	0.001 mg/L
1,1,1-TCA	EPA 624.1	0.001 mg/L
PCBs	EPA 608.3	varies by Aroclor
Total recoverable metals*	EPA 200.8/245.2	varies by metal
Total suspended solids	EPA 160.2	30 mg/L

*Total recoverable metals: antimony, arsenic, beryllium, cadmium, chromium, copper, iron, lead, nickel, calcium, silver, tantalum, uranium, zinc, and mercury.

12.8.2 Waste Sampling and Analysis Plan

Wastes generated from sites designated as potentially contaminated will be characterized to classify the waste for proper handling, recordkeeping, transfer, storage, and disposal. Waste analyses will be performed using EPA-approved procedures, as applicable. Analyses required for hazardous waste classification will reference EPA SW-846 or other EPA-approved methods. QA/QC requirements and data management requirements, as specified in Chapter 10 of this document, will be followed for waste characterization sampling activities.

12.8.2.1 Waste Classification

Waste characterization sampling will be performed in accordance with procedure CP3-WM-0437, *Waste Characterization and Profiling*. Based on sample analyses, existing data, and/or process knowledge, the waste may be classified into one of the following categories.

- RCRA listed hazardous waste
- RCRA characteristic hazardous waste
- PCB waste
- Transuranic waste (TRU) LLW
- Mixed waste or
- Nonhazardous solid waste

12.8.2.1.1 RCRA-listed hazardous waste

Based on process knowledge and existing historical sample data, generation of RCRA-listed hazardous waste is expected on this project due to the presence of TCE and/or 1,1,1-TCA. Environmental releases of listed waste sources from SWMU 211-A have resulted in contamination of environmental media and debris, including subsurface soils and groundwater. Waste generated from soil borings and well installations (i.e., drilling cuttings, purge water, sample residuals) with detectable TCE and/or 1,1,1-TCA will be classified as RCRA-listed hazardous wastes with waste codes F001, F002, and U228, if analytical results for the associated soil samples and water samples are above the health-based levels discussed in Table 3. If the concentrations are below the levels contained in Table 3, then the waste will be deemed not to contain or not to be contaminated-with a RCRA listed waste (based on TCE/TCA content). If the WAC is met, the waste will be disposed of properly in the C-746-U Landfill.

Aqueous liquids that meet the health-based levels listed in Table 3 shall be considered no longer to contain listed hazardous waste (i.e., TCE). Aqueous liquid that meets the surface discharge limits may be discharged directly to a permitted KPDES Outfall or CERCLA outfall.

12.8.2.1.2 RCRA-characteristic hazardous waste

Based on process knowledge and/or existing historical sample data, generation of RCRA characteristic-hazardous waste is possible during this EISB RA project.

12.8.2.1.3 PCB waste

Based on process knowledge generation of PCB-contaminated waste is possible on this project.

12.8.2.1.4 TRU waste

TRU wastes are those that are contaminated with elements that have an atomic number greater than 92, including neptunium, plutonium, americium, and curium, that are in concentrations greater than 100 nCi/g. Although it is possible that TRU elements may be detected in characterization samples collected on this project, it is unlikely that any of the waste generated will be at or above the TRU threshold limit. If TRU waste is generated in performing this work, the waste will be managed in accordance with DOE Prime Contractor procedures.

12.8.2.1.5 Low-level waste

LLWs is defined by Section 2021b of the Low-Level Radioactive Waste Policy Act of 1980 and the Low-level Radioactive Waste Policy Amendments Act of 1985 as radioactive material that—

A. Is not high-level radioactive waste, spent nuclear fuel, or byproduct material; and

B. The Nuclear Regulatory Commission, consistent with existing law and in accordance with paragraph A, classifies as low-level radioactive waste.

See also 10 *CFR* §§ 20.1003 and 61.2 (Nuclear Regulatory Commission definition of waste and low-level radioactive waste).

12.8.2.1.6 Mixed wastes

Mixed waste contains both hazardous waste and source, special nuclear, or byproduct material subject to the Atomic Energy Act of 1954. The generation of mixed waste is possible on this project.

12.8.2.1.7 Nonhazardous wastes

Waste that does not meet the classification requirements of RCRA hazardous wastes, PCB wastes, LLW, TRU waste, or mixed wastes will be classified as nonhazardous solid waste. Nonhazardous solid waste will be generated as part of this project. The types of materials expected to be nonhazardous solid wastes are construction debris, waste concrete, grout, shipping materials, and containers (e.g., boxes, bags).

Wastes generated from sites designated as potentially contaminated will be characterized to classify the waste for proper handling, recordkeeping, transfer, storage, and disposal. Waste analyses will be performed using the EPA-approved procedures, as applicable. Analyses required for hazardous waste classification will reference EPA SW-846 or other EPA-approved methods. QA/QC requirements and data management requirements will be followed for waste characterization sampling activities. Characterization requirements and guidance are provided in the site WAC and CP3-WM-0437, *Waste Characterization and Profiling*. The Waste Transportation Group will coordinate with the SWMU 211-A RA project PM and SMO for required analyses and guidance on collection and transfer of characterization samples to a fixed-base laboratory that participates in DOECAP.

12.8.2.2 Sampling IDW

12.8.2.2.1 SWMU 211-A RA Project Sampling Team

The EISB RA project sampling team must coordinate closely with the PWMC concerning daily drilling and operational locations and types. The PWMC will contact the Waste Operations Manager or designee and have waste containers delivered to the sampling location.

12.8.2.2.2 Waste Sampling Operations

When necessary, the PWMC will be responsible for interfacing with the SWMU 211-A RA project sampling team to schedule characterization sampling of waste for on-site disposal. The sampling team will complete all chain-of-custody forms, and the sampling team is responsible for packaging and submitting samples to the contracted laboratory.

12.8.2.2.3 IDW Segregation

To facilitate waste characterization each PPE and waste will be segregated until analytical results are obtained or process knowledge is available. Using the analytical results and/or process knowledge, the appropriate waste classification will be applied to all PPE and waste soil or other waste generated. As feasible, soil waste and PPE will be segregated and bagged to facilitate storage of the materials while awaiting final disposition. Each bag of waste will be labeled with the key information such as boring number, date, potentially applicable sample numbers, etc. PPE and plastic also will be placed in an appropriate container.

12.8.2.2.4 Container Labeling and Identification

Each waste stream (soil, PPE and plastic, etc.) will be tracked and labeled with the RFD (form CP2-WM-0011 F02, "Request for Disposal") system. All containers of a single waste stream will be tracked under the same RFD number and each container's contents represented on a WICL (form CP3-WM-3015 F01). Containers will be labeled per the WAC.

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APPENDIX

QUALITY ASSURANCE PROJECT PLAN

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CONTENTS

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LIST OF QAPP WORKSHEETS

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ACRONYMS

A	analytical
AA	atomic absorption
CAS	Chemical Abstracts Service
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	chemical (or radionuclide) of potential concern
CRQL	contract-required quantification limit
CSM	conceptual site model
DHC	*Dehalococcoides ethenogenes*
DOE	U.S. Department of Energy
DOECAP	DOE Consolidated Audit Program
DQO	data quality objective
ECD	electron capture detector
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
FFS	focused feasibility study
FID	flame ionization detector
FIDLER	field instrument for detection of low energy radiation
FRNP	Four Rivers Nuclear Partnership, LLC
FSP	field sampling plan
GC	gas chromatography
GC/MS	gas chromatography/mass spectrometry
GPS	Global Positioning System
HSS&Q	Health, Safety, Support, and Quality
IDQTF	Intergovernmental Data Quality Task Force
KDEP	Kentucky Department for Environmental Protection
MCL	maximum contaminant level
MDL	method detection limit
MPC	measurement performance criteria
MS	matrix spike
MW	monitoring well
N/A	not applicable
NAL	no action level
OREIS	Oak Ridge Environmental Information System
PAH	polycyclic aromatic hydrocarbon
PAL	project action limit
PCB	polychlorinated biphenyl
PEGASIS	Portsmouth/Paducah Project Office Environmental Geographic Analytical Spatial Information System
PGDP	Paducah Gaseous Diffusion Plant
PM	project manager
P-QAPP	Programmatic Quality Assurance Project Plan
PQL	practical quantitation limit
PQO	project quality objective
PT	proficiency testing
QA	quality assurance
QC	quality control
RAWP	remedial action work plan
RCT	radiological control technician

RG	remediation goal
RGA	Regional Gravel Aquifer
RMD	Risk Methods Document
RPD	relative percent difference
S	sampling
S&A	sampling and analytical
SAP	sampling and analysis plan
SOP	standard operating procedure
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TBD	to be determined
TOC	total organic carbon
TPD	training position description
TSA	technical systems audit
UCRS	Upper Continental Recharge System
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plans
VOA	volatile organic analyte
VOC	volatile organic compound
XRF	X-ray fluorescence

QAPP Worksheets #1 and #2. Title and Approval Page

(UFP-QAPP Manual Section 2.1)
(EPA 2106-G-05 Section 2.2.1)

Site Name/Project Name: Paducah Gaseous Diffusion Plant (PGDP)/Enhanced In Situ Bioremediation for Volatile Organic Sources to the Southwest Groundwater Plume at SWMU 211-A
Site Location: Paducah, Kentucky
Site Number/Code: KY8890008982
Contractor Name: Four Rivers Nuclear Partnership, LLC (FRNP)
Contractor Number: Contract No. DE-EM0004895
Contract Title: Paducah Gaseous Diffusion Plant Paducah Deactivation and Remediation Project
Work Assignment Number: *(to be added)*

Document Title: *Quality Assurance Project Plan for 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&D1, December 2019.

Lead Organization: U.S. Department of Energy (DOE)

Preparer's Name and Organizational Affiliation: Four Rivers Nuclear Partnership, LLC (FRNP) Bryan Clayton

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Preparation Date (Month/Year): 12/2019
Document Control Number: DOE/LX/07-2443&D1

FRNP Environmental Services Director	_____ Signature David Hutchison	Date:_____
FRNP Characterization Manager	_____ Signature Tom Price	Date:_____
FRNP Environmental Monitoring and Sample Management Office Project Manager	_____ Signature Lisa Crabtree	Date:_____
FRNP Quality Assurance/ Quality Control Program Manager	_____ Signature Jennie Freels	Date:_____

QAPP Worksheets #1 and #2. Title and Approval Page (Continued)

1. Identify guidance used to prepare QAPP:

   - Intergovernmental Data Quality Task Force, March 2005. The *Uniform Federal Policy for Implementing Environmental Quality Systems*, Version 2.0, 126 pages.
   - Intergovernmental Data Quality Task Force, March 2005. The *Uniform Federal Policy for Quality Assurance Project Plans: Part 1 UFP QAPP Manual*, Version 1.0, 177 pages (DTIC ADA 427785 or EPA-505-B-04-900A).
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   - Intergovernmental Data Quality Task Force, March 2005. The *Uniform Federal Policy for Quality Assurance Project Plans: Part 2B: Quality Assurance/Quality Control Compendium: Minimum QA/QC Activities*, Version 1.0.
   - Intergovernmental Data Quality Task Force, March 2012. *Uniform Federal Policy for Quality Assurance Project Plans, Optimized UFP QAPP Worksheets*.
   - *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Volume* 1. *Human Health* (DOE 2019a).
   - *Paducah Gaseous Diffusion Plant Programmatic Quality Assurance Project,* DOE/LX/07-2439&D1, April 2019.
   - *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&D1, November 2019.

2. Identify regulatory program: Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and *Federal Facility Agreement for the Paducah Gaseous Diffusion Plant*, DOE/OR/07-1707 (FFA)

3. Identify approval entities: DOE, U.S. Environmental Protection Agency (EPA) Region 4, and Kentucky Department for Environmental Protection (KDEP)

4. Indicate whether the QAPP is a generic or a project-specific QAPP (circle one).

5. List dates of scoping sessions that were held: List dates of scoping sessions that were held: May 23, 2018, Solid Waste Management Unit (SWMU) 211-A and SWMU 211-B Options.

NOTE: The date above was the scoping meeting held for selecting the remedial action (RA) to be implemented at SWMU 211-A. The *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, provides the approved Operation, Maintenance, and Environmental Monitoring Plan as Exhibit A. The Operations, Maintenance, and Environmental

QAPP Worksheets #1 and #2. Title and Approval Page (Continued)

Monitoring Plan, provides the approved sampling and analysis requirement for supporting the baseline sampling, performance of the bioremediation activities, and the long-term monitoring for assessing attainment of the remedial action objectives (RAOs) for the action.

6. List dates and titles of QAPP documents written for previous site work, if applicable:

Title*:*	**Approval Date(s):**
Data and Documents Management and Quality Assurance Plan for Paducah Environmental Management and Enrichment Facilities, DOE/OR/07-1595&D2 (DOE 1998)	10/5/1998
Paducah Gaseous Diffusion Plant Programmatic Quality Assurance Project Plan, DOE/LX/07-1269&D2/R1	5/14/2013 5/20/2013
Paducah Gaseous Diffusion Plant Programmatic Quality Assurance Project Plan, Paducah, Kentucky, DOE/LX/07-1269&D2/R2 (P–QAPP) (April 2015)	Not Applicable (N/A)
Paducah Gaseous Diffusion Plant Programmatic Quality Assurance Project Plan, Paducah, Kentucky, DOE/LX/07-2402&D1 (P–QAPP) (March 2016)	N/A
Paducah Gaseous Diffusion Plant Programmatic Quality Assurance Project Plan, Paducah, Kentucky, DOE/LX/07-2409&D1 (P–QAPP) (March 2017)	N/A
Paducah Gaseous Diffusion Plant Programmatic Quality Assurance Project Plan, Paducah, Kentucky, DOE/LX/07-2421&D1 (P–QAPP) (April 2018)	N/A

7. List organizational partners (stakeholders) and connection with lead organization:
   EPA Region 4 and KDEP – PGDP Federal Facility Agreement Parties

8. List data users: DOE, FRNP, subcontractors, EPA Region 4, KDEP

9. Table 1 provides a crosswalk of required QAPP elements.

   If any of the elements and/or information is not applicable to the project, then indicate the omitted QAPP elements/information on Table 1.

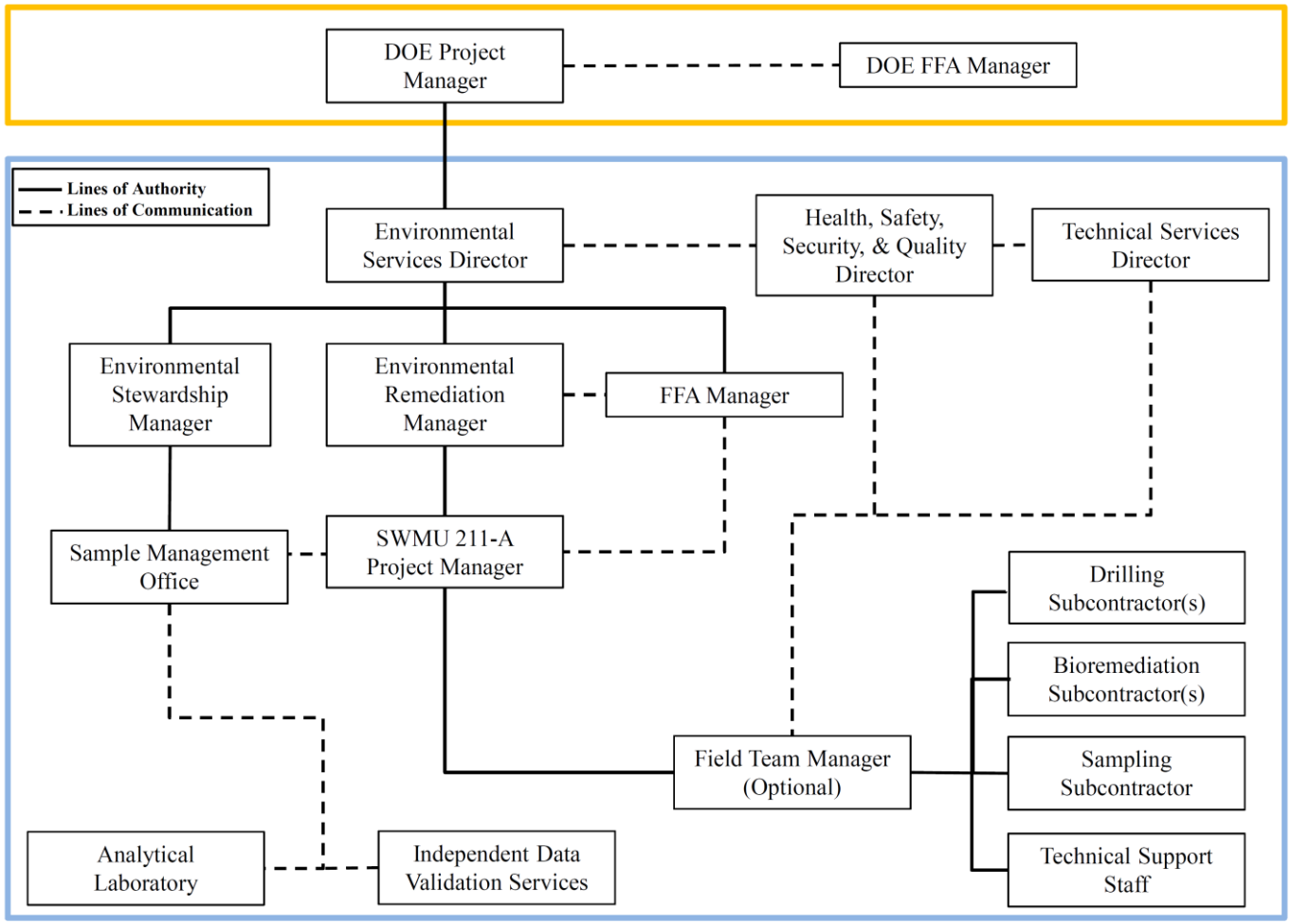
This QAPP includes all the combined worksheets that are required based on UFP-QAPP guidance, as updated by the optimized worksheet guidance (37 total worksheets). Each of these worksheets has been reviewed to ensure the accuracy of the information presented in this QAPP.

Table 1. Crosswalk: UFP-QAPP Workbook to 2106-G-05-QAPP

Optimized UFP-QAPP Worksheets		CIO 2106-G-05 QAPP Guidance Section	
1 & 2	Title and Approval Page	2.2.1	Title, Version, and Approval/Sign-Off
3 & 5	Project Organization and QAPP Distribution	2.2.3	Distribution List
		2.2.4	Project Organization and Schedule
4, 7, & 8	Personnel Qualifications and Sign-off Sheet	2.2.1	Title, Version, and Approval/Sign-Off
		2.2.7	Special Training Requirements and Certification
6	Communication Pathways	2.2.4	Project Organization and Schedule
9	Project Planning Session Summary	2.2.5	Project Background, Overview, and Intended Use of Data
10	Conceptual Site Model	2.2.5	Project Background, Overview, and Intended Use of Data
11	Project/Data Quality Objectives	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
12	Measurement Performance Criteria	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
13	Secondary Data Uses and Limitations	Chapter 3	QAPP Elements for Evaluating Existing Data
14 & 16	Project Tasks & Schedule	2.2.4	Project Organization and Schedule
15	Project Action Limits and Laboratory-Specific Detection/Quantitation Limits	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
17	Sampling Design and Rationale	2.3.1	Sample Collection Procedure, Experimental Design, and Sampling Tasks
18	Sampling Locations and Methods	2.3.1	Sample Collection Procedure, Experimental Design, and Sampling Tasks
		2.3.2	Sampling Procedures and Requirements
19 & 30	Sample Containers, Preservation, and Hold Times	2.3.2	Sampling Procedures and Requirements
20	Field QC Summary	2.3.5	Quality Control Requirements
21	Field SOPs	2.3.2	Sampling Procedures and Requirements
22	Field Equipment Calibration, Maintenance, Testing, and Inspection	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables
23	Analytical SOPs	2.3.4	Analytical Methods Requirements and Task Description
24	Analytical Instrument Calibration	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies, and Consumables
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables
26 & 27	Sample Handling, Custody, and Disposal	2.3.3	Sample Handling, Custody Procedures, and Documentation
28	Analytical Quality Control and Corrective Action	2.3.5	Quality Control Requirements
29	Project Documents and Records	2.2.8	Documentation and Records Requirements
31, 32, & 33	Assessments and Corrective Action	2.4	Assessments and Data Review (Check)
		2.5.5	Reports to Management
34	Data Verification and Validation Inputs	2.5.1	Data Verification and Validation Targets and Methods
35	Data Verification Procedures	2.5.1	Data Verification and Validation Targets and Methods
36	Data Validation Procedures	2.5.1	Data Verification and Validation Targets and Methods
37	Data Usability Assessment	2.5.2	Quantitative and Qualitative Evaluations of Usability
		2.5.3	Potential Limitations on Data Interpretation
		2.5.4	Reconciliation with Project Requirements

QAPP Worksheets #3 and #5. Project Organization and QAPP Distribution

(UFP-QAPP Manual Section 2.3 and 2.4)
(EPA 2106-G-05 Section 2.2.3 and 2.2.4)



Note: DOE personnel are in Orange Box, and DOE Prime Contractor personnel are in Blue Box.

SWMU 211-A Remedial Action Organizational Chart

QAPP Worksheets #3 and #5. Project Organization and QAPP Distribution (Continued)

Minimum Distribution List

Position Title	Organization	QAPP Recipients	Current Telephone Number	Current E-mail Address	Document Control Number
Paducah Site Lead	DOE	Jennifer Woodard	(270) 441-6820	jennifer.woodard@pppo.gov	1
DOE FFA Manager	DOE	Tracey Duncan	(270) 441-6862	tracey.duncan@pppo.gov	2
DOE Project Manager (PM)	DOE	David Dollins	(270) 441-6819	dave.dollins@pppo.gov	3
Environmental Services Director	FRNP	David Hutchison	(270) 441-5929	dave.hutchison@pad.pppo.gov	4
Environmental Remediation Manager	FRNP	Bruce Ford	(270) 441-5357	bruce.ford@pad.pppo.gov	5
Environmental Stewardship Manager	FRNP	Kelly Layne	(270) 441-6726	kelly.layne@pad.pppo.gov	6
SWMU 211-A Project Manager	FRNP	Bryan Clayton	(270) 441-5412	bryan.clayton@pad.pppo.gov	7
EPA FFA Manager	EPA	Julie Corkran	(404) 562-8547	corkran.julie@epa.gov	8
KDEP FFA Manager	KDEP	Brian Begley	(502) 564-6716	brian.begley@ky.gov	9
Kentucky PM	KDEP	Chris Jung	502-782-6391	christopher.jung@ky.gov	10
EPA PM	EPA	Victor Weeks	(404) 562-8547	weeks.victor@epa.gov	11
FRNP FFA Manager	FRNP	Jana White	(270) 441-5185	jana.white@pad.pppo.gov	12
QA Program Manager	FRNP	Jennie Freels	(270) 441-5407	jennie.freels@pad.pppo.gov	13
Sample Management Office (SMO)	FRNP	Lisa Crabtree	(270) 441-5135	lisa.crabtree@pad.pppo.gov	14
Health, Safety, Security, and Quality (HSS&Q) Director	FRNP	Bob Macfarlane	(270) 441-6920	bob.macfarlane@pad.pppo.gov	15
SMO	FRNP	Jaime Morrow	(270) 441-5508	jaime.morrow@pad.pppo.gov	16
Technical Services Director	FRNP	James Miller	(270) 441-5068	james.miller@pad.pppo.gov	17
Field Team Manager	FRNP	To be determined (TBD)	TBD	TBD	18
Contract Laboratory PM	TBD	TBD	TBD	TBD	19
Subcontractor PM (Sampling)	TBD	TBD	TBD	TBD	20
Subcontractor PM (Drilling)	TBD	TBD	TBD	TBD	21

QAPP Worksheets #3 and #5. Project Organization and QAPP Distribution (Continued)

Distribution is based on the position title. A change in the individual within an organization will not trigger a resubmittal of the QAPP. DOE may choose to update this worksheet and submit page changes to the document holders. This change will not require a review by FFA stakeholders because it is not a substantive change. Alternatively, as with other changes to the approved project-specific QAPP, personnel changes may be tracked and included as an attachment to the QAPP. Managers are responsible for distribution to their staffs.

Controlled copies of the project-specific QAPP derived from this programmatic QAPP will be distributed according to the distribution list below. This list will be updated, as needed, and kept by the FRNP Records Management Department. Each person receiving a controlled copy also will receive updates/revisions. If uncontrolled copies are distributed, it will be the responsibility of the person distributing the uncontrolled copy to provide updates/revisions.

QAPP Worksheets #4, #7, and #8. Personnel Qualifications and Sign-off Sheet

(UFP-QAPP Manual Sections 2.3.2–2.3.4)
(EPA 2106-G-05 Section 2.2.1 and 2.2.7)

This worksheet is used to identify key project personnel for each organization performing tasks defined in this QAPP. In this example, organizations include the prime contractor and laboratory. Add spaces for additional organizations and personnel as needed. This worksheet lists individual's project titles or roles; qualifications; and any specialized/nonroutine training, certifications, or clearances required by the project (e.g., explosives and ordnance disposal technician, professional engineer, certified professional geologist).

ORGANIZATION: Four Rivers Nuclear Partnership, LLC

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications**	Signature/Date*
David Hutchison	Environmental Services Director, FRNP	> 4 years relevant work experience	No specialized training or certification. See Training Project Description (TPD).	
Bruce Ford	Environmental Remediation Manager, FRNP	> 4 years relevant work experience	No specialized training or certification. See TPD.	
Lisa Crabtree	Environmental Monitoring and SMO PM	> 4 years relevant work experience	No specialized training or certification. See TPD.	
Jaime Morrow	SMO Coordinator	> 4 years relevant work experience	No specialized training or certification. See TPD.	
TBD	Sample Team Leader, TBD	> 4 years relevant work experience	No specialized training or certification. See TPD.	
TBD	Drilling Contract PM, TBD	> 4 years relevant work experience	No specialized training or certification.	

ORGANIZATION: Laboratory

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date*
Laboratory PM	Analytical Laboratory PM	> 4 years relevant work experience	No specialized training or certification. See TPD.	

*Signature indicates personnel have read and agree to implement this QAPP as written and approved.
**Each position will have a training position description that is available at the FRNP Training Department.

QAPP Worksheet #6. Communication Pathways

(UFP-QAPP Manual Section 2.4.2)
(EPA 2106-G-05 Section 2.2.4)

NOTE: Formal communication across company or regulatory boundaries occurs via letter. Other forms of communication, such as telephone calls, e-mail, meetings, etc., will occur throughout the project. Regular project communication among DOE, the Prime Contractor, and the regulatory agencies concerning project progress is expected. Deviations from the work plan/QAPP will be communicated upward through the chain of command to regulatory agencies using communication tools commensurate with the issue.

Communication Driver	Organization	Name	Contact Information	Procedure (timing, pathway, documentation, etc.)
Regulatory agency interface	DOE, EPA, KDEP	DOE PM: David Dollins, EPA Remedial PM: Victor Weeks KDEP PM: Chris Jung	david.dollins@pppo.gov victor.weeks@epa.gov christopher.jung@ky.gov	Formal communication among the FFA parties of DOE, EPA, and KDEP.
Field progress reports	FRNP	FRNP Environmental Services Director: David Hutchison	dave.hutchison@pad.pppo.gov	Formal communication among the project staff, the site lead, and the DOE PM.
Stop work due to safety issues	FRNP	FRNP Environmental Services Director: David Hutchison and FRNP HSS&Q Director: Bob Macfarlane	dave.hutchison@pad.pppo.gov bob.macfarlane@pad.pppo.gov	FRNP will communicate work stoppages to DOE PM as required by procedure.
QAPP changes during project execution	FRNP	FRNP Environmental Services Director: David Hutchison and FRNP QA/QC Program Manager: Jennie Freels	dave.hutchison@pad.pppo.gov jennie.freels@pad.pppo.gov	Obtain approval from DOE PM. Submit QAPP amendments to DOE, KDEP, and EPA.

QAPP Worksheet #6. Communication Pathways (Continued)

Communication Driver	Organization	Name	Contact Information	Procedure (timing, pathway, documentation, etc.)
Field corrective actions	FRNP	Environmental Services Director: David Hutchison	dave.hutchison@pad.pppo.gov	Field corrective actions will need to be approved by FRNP Project Director and communicated to the DOE, EPA, and KDEP PMs.
Analytical laboratory interface	FRNP	SMO PM: Lisa Crabtree	lisa.crabtree@pad.pppo.gov	Communication between FRNP and analytical laboratory.
Laboratory quality control variances	Contracted Laboratory	Laboratory PM	TBD	Notify FRNP SMO. SMO will notify FRNP PM to determine corrective actions.
Analytical corrective actions	Contracted Laboratory, FRNP	Laboratory PM, SMO PM: Lisa Crabtree	TBD lisa.crabtree@pad.pppo.gov	Notify FRNP SMO. SMO will notify the FRNP PM.
Data verification issues (e.g., incomplete records)	Veolia Nuclear Solutions Federal Services	Data Validator, SMO PM: Lisa Crabtree	TBD lisa.crabtree@pad.pppo.gov	Data verification issues will be reported to the FRNP SMO.
Data validation issues (e.g., noncompliance with procedures)	Veolia Nuclear Solutions Federal Services	VNSFS Data Validator, SMO PM: Lisa Crabtree	TBD lisa.crabtree@pad.pppo.gov	Issues with data quality will be reported to the FRNP SMO.

NOTE: This QAPP worksheet is position-based with names of the current positions presented. In the event the contractor changes and the position titles change, DOE will notify EPA and KDEP of the change.

QAPP Worksheet #9. Project Planning Session Summary

(UFP-QAPP Manual Section 2.5.1 and Figures 9-12)
(EPA 2106-G-05 Section 2.2.5)

Project scoping is the key to the success of any project and is part of the systematic planning process. A scoping meeting was held to develop the DQOs of the project. The scoping meeting identified the borings for the remedial design support investigation (RDSI) as well as the posttreatment sampling and analysis. The volatile organic compound (VOC) analytical soil data obtained during the RDSI provides the basis for the determining the treatment action. The scoping meeting held February 4, 2010, for the RDSI also supports this RA. The RDSI scope covered both the SWMU 1 area as well as the SWMUs at the C-720 Building included in the record of decision (ROD). This RA is limited to the SWMU 211-A area. A teleconference was held on May 23, 2018 for the FFA parties to determine whether the selected RA for SWMU 211-A would be Enhanced *In Situ* Bioremediation with Interim land use controls (LUCs) or Long-Term Monitoring with Interim LUCs; Enhanced *In Situ* Bioremediation (EISB) with Interim LUCs was selected. Following this teleconference, the *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, (RDR) was developed, and it contains the Operation, Maintenance, and Environmental Monitoring Plan for the EISB RA. The RDR will be approved by the FFA parties prior to implementation of the RA.

QAPP Worksheet #9. Project Planning Session Summary (Continued)

Name of Project: EISB for SWMU 211-A
Date of Session: May 23, 2018
Scoping Session Purpose: Confirm the selection of the RA to be implemented as selected in the signed 2013 ROD. The confirmation of the selected alternative also confirms the use of the RAOs developed in the ROD.

Position Title	Affiliation	Name	Phone #	E-mail Address	Project Role
Project Manager	DOE	Dollins, David	270-441-6819	dave.dollins@pppo.gov	Project Management
Project Manager	FRNP	Powers, Todd	270-441-5791	todd.powers@pad.pppo.gov	Project Management
FFA Manager	EPA	Corkran, Julie	404-562-8547	corkran.julie@epa.gov	Project Management
FFA Manager	KDEP	Begley, Brian	502-782-6317	brian.begley@ky.gov	Project Management
Project Manager	KDEP	Brewer, Gaye	270-898-8468	gaye.brewer@ky.gov	Technical Support
Technical Advisor	EPA	Ahsanuzzaman, Noman		ahsanuzzaman.noman@epa.gov	Technical Support
Technical Support	EPA	Bentkowski, Ben	404-562-8507	bentkowski.ben@epa.gov	Technical Support
Technical Support	DOE	Bonczek, Richard	859-219-4051	richard.bonczek@pppo.gov	Technical Support
Technical Support	Pro2Serve	Butterworth, George	270-441-6803	george.butterworthIII@pppo.gov	Technical Support
Technical Support	SMSI	Clauberg, Martin		martin.clauberg@pppo.gov	Technical Support
Technical Support	FRNP	Clayton, Bryan	270-441-5412	bryan.clayton@pad.pppo.gov	Technical Support
Technical Support	EPA	Davis, Eva	580-436-8548	davis.eva@epa.gov	Technical Support

QAPP Worksheet #9. Project Planning Session Summary (Continued)

Position Title	Affiliation	Name	Phone #	E-mail Address	Project Role
Technical Support	FRNP	Davis, Ken	270-441-5049	ken.davis@pad.pppo.gov	Technical Support
Technical Support	TechLaw	Dawson, Jana	703-627-0821	jdawson@techlawinc.com	Technical Support
Technical Support	FRNP	Fountain, Stefanie	270-441-5722	stefanie.fountain@pad.pppo.gov	Technical Support
Technical Support	KDEP	Jung, Christopher	502-782-6391	christopher.jung@ky.gov	Technical Support
Technical Support	TechLaw	McRae, Mac	678-493-1247	mmcrae@techlawinc.com	Technical Support
Technical Support	FRNP	Morgan, John	270-441-5206	john.morgan@pad.pppo.gov	Technical Support
Technical Support	FRNP	Miller, James	270-441-5068	james.miller@pad.pppo.gov	Technical Support
Technical Support	KDEP	Newton, Aaron	502-523-8023	aaron.newton@ky.gov	Technical Support
Technical Support	TechLaw	Rapal, Kristen	312-345-8929	kristen.rapal@techlawinc.com	Technical Support
Technical Support	Pro2Serve	Taylor, Tracy	270-441-6866	tracy.taylor@pppo.gov	Technical Support
Technical Support	FRNP	White, Jana	270-441-5185	jana.white@pad.pppo.gov	Technical Support

SMSI = Strategic Management Solutions, LLC

Decision Reached: The DOE determined as a result of the meeting that it would move forward with implementing the Enhanced *In Situ* Bioremediation with LUCs RA for SWMU 211-A.

QAPP Worksheet #10. Conceptual Site Model

(UFP-QAPP Manual Section 2.5.2)
(EPA 2106-G-05 Section 2.2.5)

The site conceptual model is contained and discussed in Section 1.3 of this Remedial Action Work Plan (RAWP).

QAPP Worksheet #11. Project/Data Quality Objectives

(UFP-QAPP Manual Section 2.6.1)
(EPA 2106-G-05 Section 2.2.6)

Step 1: State the problem:

PGDP Southwest Plume consists of groundwater in the Regional Gravel Aquifer (RGA) contaminated primarily with trichloroethene. SWMU 211-A is a source of contamination to the Southwest Plume. A revised focused feasibility study (FFS) was performed for the Southwest Plume Upper Continental Recharge System (UCRS) source area. The following are the RAOs defined in the revised Southwest Plume FFS and the signed ROD:

(1) Treat and/or remove the principal threat waste consistent with the National Contingency Plan;

(2a) Prevent exposure to VOC contamination in the source areas that will cause an unacceptable risk to excavation workers (< 10 ft);

(2b) Prevent exposure to non-VOC contamination and residual VOC contamination through interim LUCs within the Southwest Plume source areas (i.e., SWMU 1, SWMU 211-A, and SWMU 211-B) pending remedy selection as part of the Soils Operable Unit and the Groundwater Operable Unit;

(3) Reduce VOC migration from contaminated subsurface soils in the treatment areas at the Oil Landfarm and the C-720 Northeast and Southeast Sites so that contaminants migrating from the treatment areas do not result in the exceedance of maximum contaminant limits (MCLs) in the underlying RGA groundwater.

Soil remediation goals (RGs), volume-averaged UCRS soil concentrations that would meet RAO 3, were calculated in the revised Southwest Plume FFS Appendix C and also were included in the signed ROD. EISB is not a remedial activity that results in instantaneous reduction of contaminant levels in the UCRS. As such, the measure of meeting the RAOs in the groundwater are attainment of MCLs in the RGA as measured in the Long-term groundwater monitoring system. Additionally, the biological reactions that occur in the subsurface require a specific range of subsurface conditions to be continuous. These conditions are measured via water samples obtained in monitoring and performance wells.

Step 2: Identify the Goals of the Study

- Monitor the EISB to determine:
  - Status of the biological reactions occurring in the subsurface
  - Status of RA in attaining RA goal #3.

QAPP Worksheet #11. Project/Data Quality Objectives (Continued)

Step 3. Identify Information Inputs:

Groundwater sample results for quantitative use in determining contamination levels in the groundwater and the geochemical conditions of the groundwater contained in the area being bioremediated.

Step 4. Identify the Boundaries of the Study:

The boundary is the SWMU 211-A treatment area. The specific area is shown in Figure 9 of the RDR.

Step 5. Develop the Analytical Approach:

- The samples will undergo chemical analysis at a contract laboratory, consistent with the contract protocols.

Step 6. Specify Performance or Acceptance Criteria:

- Analytical sample results must successfully undergo assessment and validation to be used to support the evaluation of the SWMU 211-A remedial action and support development of the PGDP CERCLA Five-Year Review Documents.

Step 7. Develop the Detailed Plan for Obtaining Data:

The process of obtaining the data has been laid out in the Operation, Maintenance, and Monitoring Plan contained in the Appendix of the RDR.

QAPP Worksheet #12. Measurement Performance Criteria

(UFP-QAPP Manual Section 2.6.2)
(EPA 2106-G-05 Section 2.2.6)

This worksheet documents the quantitative measurement performance criteria (MPC) in terms of precision, bias, and sensitivity for both field and laboratory measurements and is used to guide the selection of appropriate measurement techniques and analytical methods. MPC are developed to ensure collected data will satisfy the project quality objectives (PQOs) or DQOs documented on Worksheet #11. Example MPC include relative percent difference (RPD) comparisons and no target compounds greater than practical quantitation limit (PQL) or minimum detectable activity. A separate worksheet should be completed for each type of field or laboratory measurement. For analytical methods, MPC should be determined for each matrix, analyte, and concentration level. [Qualitative MPC (representativeness and comparability) should be addressed in the sample design, which is documented on Worksheet #17.] If MPC are analyte-specific, include this detail in a separate table or modify this worksheet as necessary. Example QAPP Worksheet #12 information is provided below, representing the currently used analytical methods. The listed methods have been reviewed to ensure that the criteria summarized below are aligned with those presented in the method. In the preparation of the project-specific QAPP, this information shall be confirmed. Changes in the method or laboratory can result in changes to these criteria.

Sampling will follow the referenced standard operating procedures. The following tables provide the measurement performance criteria.

QAPP Worksheet #12-A. Measurement Performance Criteria (VOCs, Water)

Sampling of groundwater will follow the standard operating procedures (SOPs) included in this RAWP. The following table provides the measurement performance criteria.

Matrix	Groundwater				
Analytical Group[1]	Volatile Organic Compounds (VOCs)				
Concentration Level	Medium to High				
Sampling Procedure[2]	**Analytical Method/SOP**[3]	**Data Quality Indicators**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See Worksheet #21	SW-846-8260C See Worksheet #23	Precision—Lab	RPD—≤ 25%	Laboratory Duplicates	A
		Precision	RPD—≤ 25%	Field Duplicates	S
		Accuracy/Bias	% recovery[5]	Laboratory Sample Spikes	A
		Accuracy/Bias Contamination	No target compounds > PQL	Method Blanks/Instrument Blanks	A
		Accuracy/Bias Contamination	No target compounds > PQL	Field Blanks	S
		Accuracy/Bias Contamination	No target compounds > PQL	Trip Blanks	S
		Accuracy/Bias Contamination	No target compounds > PQL	Equipment Rinseates	S
		Completeness[4]	90%	Data Completeness Check	S&A

[1] If information varies within an analytical group, separate by individual analyte.
[2] Reference number from QAPP Worksheet #21.
[3] Reference number from QAPP Worksheet #23.
[4] Completeness is calculated as the number of valid analytical results reported divided by the number of analytical results requested , multiplied by 100 to obtain the percentage.
[5] Percent recovery is laboratory-specific, calculated from studies performed every six months. Percent recovery ranges will be provided in the laboratory data packages based on the most current study.

QAPP Worksheet #12-B. Measurement Performance Criteria (Dissolved Hydrocarbon Gases, Water)

Sampling of groundwater will follow the SOPs included in this RAWP. The following table provides the measurement performance.

Matrix	Groundwater				
Analytical Group[1]	Dissolved Hydrocarbon Gases, (Methane, Ethane, Ethene, etc.)				
Concentration Level	Low to Medium				
Sampling Procedure[2]	**Analytical Method/SOP**[3]	**Data Quality Indicators**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See Worksheet #21	RSK SOP 175 Modified See Worksheet #23	Precision—Lab	RPD—< 25%	Laboratory Duplicates	A
		Precision	RPD—< 25%	Field Duplicates	S
		Accuracy/Bias	% recovery[5]	Laboratory Sample Spikes	A
		Accuracy/Bias Contamination	No target compounds > PQL	Method Blanks/Instrument Blanks	A
		Accuracy/Bias Contamination	No target compounds > PQL	Field Blanks	S
		Accuracy/Bias Contamination	No target compounds > PQL	Equipment Rinseates	S
		Completeness[4]	90%	Data Completeness Check	S&A

PQL = practical quantitation limit; RPD = relative percent difference.
[1] If information varies within an analytical group, separate by individual analyte.
[2] Reference number from QAPP Worksheet #21.
[3] Reference number from QAPP Worksheet #23.
[4] Completeness is calculated as the number of valid analytical results reported divided by the number of analytical results requested , multiplied by 100 to obtain the percentage.
[5] Percent recovery is laboratory-specific, calculated from studies performed every six months. Percent recovery ranges will be provided in the laboratory data packages based on the most current study.

QAPP Worksheet #12-C. Measurement Performance Criteria (Total Organic Carbon)

Matrix	Groundwater				
Analytical Group[1]	Total Organic Carbon				
Concentration Level	Low				
Sampling Procedure[2]	**Analytical Method/SOP**[3]	**Data Quality Indicators**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See Worksheet #21	SW-846-9060A See Worksheet #23	Precision—Lab	RPD—≤ 20%	Laboratory Duplicates	A
		Precision	RPD—≤ 25%	Field Duplicates	S
		Accuracy/Bias	% recovery[5]	Laboratory Sample Spikes	A
		Accuracy/Bias Contamination	No target compounds > PQL	Method Blanks/Instrument Blanks	A
		Accuracy/Bias Contamination	No target compounds > PQL	Field Blanks	S
		Accuracy/Bias Contamination	No target compounds > PQL	Equipment Rinseates	S
		Completeness[4]	90%	Data Completeness Check	S&A

[1] If information varies within an analytical group, separate by individual analyte.
[2] Reference number from QAPP Worksheet #21.
[3] Reference number from QAPP Worksheet #23.
[4] Completeness is calculated as the number of valid analytical results reported divided by the number of analytical results requested , multiplied by 100 to obtain the percentage.
[5] Percent recovery is laboratory-specific, calculated from studies performed every six months. Percent recovery ranges will be provided in the laboratory data packages based on the most current study.

QAPP Worksheet #12-D. Measurement Performance Criteria (Dehaloccoccoides Bacteria)

Matrix	Groundwater				
Analytical Group[1]	Dehalococcoides Bacteria (Quantitative)				
Concentration Level	Low				
Sampling Procedure[2]	**Analytical Method/SOP**[3, 4]	**Data Quality Indicators**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See Worksheet #21	DHC by quantitative polymerase chain reaction See Worksheet #23	Precision—Lab	RPD—≤ 20%	Laboratory Duplicates	A
		Accuracy/Bias Contamination	No target compounds > PQL	Method Blanks/Instrument Blanks	A
		Completeness[5]	90%	Data Completeness Check	S&A

[1] If information varies within an analytical group, separate by individual analyte.
[2] Reference number from QAPP Worksheet #21.
[3] Reference number from QAPP Worksheet #23.
[4] The most current version of the method the laboratory is accredited to perform will be used.
[5] Completeness is calculated as the number of valid analytical results reported divided by the number of analytical results requested , multiplied by 100 to obtain the percentage.
[6] Percent recovery is laboratory-specific, calculated from studies performed every six months. Percent recovery ranges will be provided in the laboratory data packages based on the most current study.

QAPP Worksheet #13. Secondary Data Uses and Limitations

(UFP-QAPP Manual Section 2.7)
(EPA 2106-G-05 Chapter 3: QAPP Elements for Evaluating Existing Data)

Secondary Data Type	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Factors Affecting Reliability and Limitations on Data Use
Oak Ridge Environmental Information Systems (OREIS) Database	Various	Various	OREIS data will be used to provide data point(s) from which to measure the current status of groundwater near the treatment area.	Data have been verified, assessed, and validated (if validation is required). Rejected data will not be used.
Historical Documentation	Waste Area Grouping 27 RI Report, DOE/OR/07-1777&D2	DOE contractors, soil and water, 1998	Data will be used to provide a baseline data point(s) from which to measure the current status of groundwater near the treatment area.	Data have been verified, assessed, and validated (if validation required). Rejected data will not be used.
Historical Documentation	Southwest Plume Site Investigation Report, DOE/OR/07-2180&D2/R1	DOE contractors, soil and water, 1997	Data will be used to provide a baseline data point(s) from which to measure the current status of groundwater near the treatment area.	Data have been verified, assessed, and validated (if validation required). Rejected data will not be used.
Historical Documentation	*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*, DOE/LX/07-1288&D2/A1/R1	DOE contractors, soil and water, 2013 and 2015	Data will be used to provide a baseline data point(s) from which to measure the current status of groundwater near the treatment area.	Data have been verified, assessed, and validated (if validation required). Rejected data will not be used.

NOTE; Oak Ridge Environmental Information System (OREIS) is the repository for environmental and waste characterization analytical results. OREIS is a limited access database. Most of the results in OREIS are downloaded to Portsmouth/Paducah Project Office Environmental Geographic Analytical Spatial Information System (PEGASIS) periodically (usually on a quarterly basis). The general public can access data in PEGASIS.

QAPP Worksheets #14 and 16. Project Tasks & Schedule

(UFP-QAPP Manual Section 2.8.2)
(EPA 2106-G-05 Section 2.2.4)

Activity	Responsible Party	Planned Start Date	Planned Completion Date	Deliverable(s)	Deliverable Due Date
Mobilization/demobilization	FRNP	April 1, 2020	TBD	Field notes	TBD
Sample collection	FRNP	April 1, 2020	TBD*	Field notes	TBD*
Analysis	Contract Lab	April 1, 2020	TBD*	Report of analysis	TBD*
Validation	Wastren Advantage, Inc.; Veolia Nuclear Solutions Federal Services	May 1, 2020	TBD*	Validation summary	TBD*
Data Report	Project Team	May 2020	April 2021	Remedial Action Completion Report	April 2021*

*Performance and Long-term monitoring is scheduled for a period of 5 years. The FFA members will determine the need for additional monitoring beyond the 5-year period. CERCLA will require a five-year review of the RA. Section 6 of this RAWP also provides the project-specific schedule of activities for this RA.

QAPP Worksheet #15. Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

(UFP-QAPP Manual Section 2.6.2.3 and Figure 15)
(EPA 2106-G-05 Section 2.2.6)

This worksheet should be completed for each matrix, analyte, analytical method, and concentration level (if applicable). Its purpose is to ensure the selected analytical laboratory and method can provide accurate data (i.e., quantitative results with known precision and bias) at the project action limit (PAL). During the systematic planning process, identify target analytes, PALs, and the reference limits (e.g., regulatory limits or risk-based limits) on which action limits are based. (If more than one set of reference limits is applicable, add additional columns.) Target analytes that are critical to project-specific decision-making should be highlighted. Next, determine the matrix-specific quantitation limit goal. The quantitation limit goal should be lower than the PAL by an amount determined by the DQOs/PQOs. This information, along with the MPC documented on Worksheet #12, should be used to select analytical methods and laboratories. Once the methods and laboratories have been selected, the remaining columns should be completed with laboratory-specific information. Project teams need to keep in mind that the laboratory-specific quantitation limit usually is determined in reagent water; therefore, the project quantitation limit goal (matrix-specific quantitation limit) will be higher. Explanations should be provided in cases where the quantitation limit is greater than either the project quantitation limit goal or the PAL. The laboratory must provide documentation that demonstrates precision and bias at the laboratory-specific quantitation limit. The laboratory-specific quantitation limit cannot be lower than the lowest calibration standard for any given method and analyte.

For the initially developed project-specific QAPP, the laboratory-specific columns should be filled out with target values to be used in laboratory solicitation and to support identification of the potential need to seek lower detection limits. The final laboratory-specific values will be populated and the project-specific QAPP updated once the laboratory has been contracted.

As part of the preparation of a project-specific QAPP, the PAL values should be updated with the most recent values or with project-specific values, as appropriate. As these values are updated, the P-QAPP will need to be updated accordingly.

Consideration also should be given to ecological values found in the *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Volume 2. Ecological*, DOE/LX/07-0107&D2/R3/V2 (DOE 2019b).

QAPP Worksheet #15-A. Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Groundwater
Analyte Group: VOCs

Analyte	Chemical Abstracts Service (CAS) Number	Project Action Limit/NAL (µg/kg)	Project Action Limit Reference*	Site Chemical or Radionuclide of Potential Concern (COPC)	Laboratory-Specific	
					PQLs (µg/L)	MDLs (µg/L)
1,1-Dichloroethene	75-35-4	7	MCL	Yes	2	0.3
cis-1,2-Dichloroethene	156-59-2	70	MCL	Yes	2	0.3
trans-1,2-Dichloroethene	156-60-5	100	MCL	Yes	2	0.3
Trichloroethene	79-01-6	5	MCL	Yes	2	0.3
Vinyl chloride	75-01-4	2	MCL	Yes	2	0.3

*This project does not have applicable groundwater cleanup levels, The Project Action Limits shown are groundwater protection RGs from Table 2.2 of Revised FFS. These groundwater protection RGs provided the basis for determining the UCRS soil cleanup levels applicable for this RA.

QAPP Worksheet #15-B. Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Groundwater
Analytical Group: Dissolved Hydrocarbon Gases

Analyte	CAS Number	Project Action Limit/NAL (µg/L)*	Project Action Limit Reference*	Site COPC?	Laboratory-Specific	
					PQLs (µg/L)	MDLs (µg/L)
Methane	74-82-8	N/A	N/A	No	25	10
Ethene	74-85-1	N/A	N/A	No	25	10
Ethane	74-84-0	N/A	N/A	No	25	10

*This project does not have applicable groundwater cleanup levels. These analytes are used to evaluate the presence of biological reactions occurring in the subsurface.

QAPP Worksheet #15-C. Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Groundwater
Analytical Group: Bacteria

Analyte	CAS Number	Project Action Limit/NAL (µg/L)*	Project Action Limit Reference*	Site COPC?	Laboratory-Specific	
					PQLs (µg/L)	MDLs (µg/L)
Dehalococcoides ethenogenes (DHC)	N/A	N/A	N/A	No	N/A	N/A

*This project does not have applicable groundwater cleanup levels. These analytes are used to evaluate the presence of biological reactions occurring in the subsurface.
Note: Laboratory will be required to have an Nuclear Regulatory Commission Radiological License.

QAPP Worksheet #15-D. Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Groundwater
Analytical Group: Total Organic Carbon

Analyte	CAS Number	Project Action Limit/NAL (µg/L)*	Project Action Limit Reference*	Site COPC?	Laboratory-Specific	
					PQLs (mg/L)	MDLs (mg/L)
Total Organic Carbon	N/A	N/A	N/A	No	1	0.33

*This project does not have applicable groundwater cleanup levels. These analytes are used to evaluate the presence of biological reactions occurring in the subsurface.

QAPP Worksheet #17. Sampling Design and Rationale

(UFP-QAPP Manual Section 3.1.1)
(EPA 2106-G-05 Section 2.3.1)

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, judgmental statistical approach):

The purpose of this project-specific QAPP is to document the collection protocols and sampling methodologies associated with the SWMU 211-A EISB RA near the C-720 Building. The only environmental media to be collected and analyzed by laboratory methods is groundwater. The analysis of the groundwater will provide information for two key areas which are:

- Determine the presence and status of the associated biological reactions occurring in the subsurface, and
- Determine the status of the RA in attaining the RAOs as documented in the signed ROD (DOE 2012).

The specifics concerned with the collection of these groundwater samples is contained in the Operations, Maintenance, and Environmental Monitoring Plan appended to the RDR. In addition to the groundwater sampling and chemical analyses, radiological field scans, measurement and collection of field parameters will be performed as appropriate and as included in the remedial design report and associated operation, maintenance, and environmental monitoring plan.

QAPP Worksheet #18. Sampling Locations and Methods

(UFP-QAPP Manual Section 3.1.1 and 3.1.2)
(EPA 2106-G-05 Section 2.3.1 and 2.3.2)

Sampling Location/Identification Number	Matrix	Depth (units)	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
SWMU 211-A	Groundwater	Subsurface	VOCs	372[1]+39 field duplicates	See Worksheet #21	See Worksheet #17
SWMU 211-A	Groundwater	Subsurface	Dissolved Hydrocarbon Gasses	252[1]+28 field duplicates	See Worksheet #21	See Worksheet #17
SWMU 211-A	Groundwater	Subsurface	DHC Bacteria	56[1]+28 field duplicates	See Worksheet #21	See Worksheet #17
SWMU 211-A	Groundwater	Subsurface	Total Organic Carbon	252+28 field duplicates	See Worksheet #21	See Worksheet #17

[1] Sample numbers are based on 18 performance wells and 10 long-term MWs being sampled consistent with the Operation, Maintenance, and Environmental Monitoring Plan, Tables 2 and 3 schedule for first 5 years.
Note: Sample analytical results after the first year will be performed as part of and consistent with the PGDP Environmental Monitoring Plan and will support the required CERCLA five-year reviews of RAs.

QAPP Worksheet #19 and 30. Sample Containers, Preservation, and Hold Times

(UFP-QAPP Manual Section 3.1.2.2)
(EPA 2106-G-05 Section 2.3.2)

Laboratory: (To be Determined – Laboratory usage will be through Sample Management Office Laboratories under contract at the time of the sampling efforts.

List any required accreditations/certifications: DOE Consolidated Audit Program (DOECAP), if applicable.

Back-up Laboratory: N/A

Sample Delivery Method: Overnight delivery

Analytical Group	Matrix	Method/SOP Reference	Accreditation Expiration Date	Containers (number, size, and type per sample)	Preservation	Preparation Holding Time	Analytical Holding Time, days	Data Package Turnaround Time
Volatile Organic Compounds	Groundwater	SW-846-8260C	TBD	3 × 40 mL Glass volatile organic analyte (VOA) vial	0-6°C, HCl to pH < 2, zero headspace	N/A	14	28
Dissolved Hydrocarbon Gases	Groundwater	RSK SOP 175 Modified	TBD	3 × 40 mL Glass VOA vial	0-6°C, HCl to pH < 2, zero headspace	N/A	14	28
Total Organic Carbon	Groundwater	SW-846-9060A	TBD	250 mL Amber glass	0-6°C, H2SO4 to pH < 2	N/A	28	28
DHC Bacteria	Groundwater	-	TBD	1L poly bottle with screw cap	Cool < 4°C	N/A	48 Hours	28

NOTE: Sample volume container requirements will be specified by the laboratory. Sample bottle requirements will be documented and relayed to the field sampling team via labels and chain-of-custody forms generated by PEMS (Paducah Project Environmental Measurements System).

QAPP Worksheet #20. Field QC Summary

(UFP-QAPP Section 3.1.1 and 3.1.2)
(EPA 2106-G-05 Section 2.3.5)

Matrix	Analyte/ Analytical Group	Field Samples	Field Duplicates	Matrix Spikes	Matrix Spike Duplicates	Field Blanks	Equipment Blanks	Trip Blanks	Other	Total # of Analyses
Groundwater	VOCs	372	39	14	14	14	14	1 per cooler containing VOC or hydrocarbon gas samples	N/A	467
Groundwater	Dissolved Hydrocarbon Gases	252	28	14	14	14	14	1 per cooler containing VOC or hydrocarbon gas samples	N/A	336
Groundwater	Total Organic Carbon	252	28	14	14	14	14	N/A	N/A	336

QAPP Worksheet #21. Field SOPs

(UFP-QAPP Manual Section 3.1.2)
(EPA 2106-G-05 Section 2.3.2)

Site-specific SOPs have been developed for site sampling activities. The following is a list of site sampling procedures that projects will select from for implementing sampling activities.

Reference Number	Title, Revision Date, and/or Number[a]	Originating Organization[b]	Equipment Type	Modified for Project Work? (Y/N)	Comments
1.	CP4-ES-0043, *Temperature Control for Sample Storage* (12/19/2017)	Contractor	Sampling	N	N/A
2.	CP4-ES-1001, *Transmitting Data to the Paducah Oak Ridge Environmental Information System* (12/19/2017)	Contractor	N/A	N	None
3.	CP4-ES-2101, *Groundwater Sampling* (1/10/2018)	Contractor	Sampling	N	None
4.	CP4-ES-2100, *Groundwater Level Measurement* (1/2/2018)	Contractor	Sampling	N	N/A
5.	CP4-ES-2700, *Logbooks and Data Forms* (12/4/2017)	Contractor	N/A	N	None
6.	CP4-ES-2702, *Decontamination of Sampling Equipment and Devices* (1/4/2018)	Contractor	Sampling	N	None
7.	CP4-ES-2704, *Trip, Equipment, and Field Blank Preparation* (1/2/2018)	Contractor	Sampling	N	None
8.	CP4-ES-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals* (12/12/2017)	Contractor	Sampling	N	None
9.	CP3-ES-5003, *Quality Assured Data* (1/9/2018	Contractor	N/A	N	None
10.	CP4-ES-5004, *Sample Tracking, Lab Coordination, and Sample Handling* (12/5/2017)	Contractor	N/A	N	None
11.	CP4-ES-5007, *Data Management Coordination* (12/7/2017)	Contractor	N/A	N	None

[a] SOPs are posted to the FRNP intranet website. External FFA parties can access this site using remote access with privileges upon approval. It is understood that SOPs are contractor specific.
[b] The work will be conducted by FRNP staff or a subcontractor. In either case, SOPs listed will be followed.
N/A = Not Applicable

QAPP Worksheet #22. Field Equipment Calibration, Maintenance, Testing, and Inspection

(UFP-QAPP Manual Section 3.1.2.4)
(EPA 2106-G-05 Section 2.3.6)

This worksheet should document procedures for calibrating, maintaining, testing, and/or inspecting field equipment (e.g., tools, pumps, gauges, magnetometers, pH meters, water-level measurement devices). If these activities are documented in an SOP or manufacturer's instructions, and the relevant SOP or instruction is attached, then the frequency, acceptance criteria, and corrective action columns may be left blank. Note that the information summarized in this worksheet should be recorded in the field notes/logs.

Field Equipment*	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
MiniRAE Photoionization Detector (PID) Toxic Gas Monitor with 10.5 eV Lamp or Similar Meter	Calibrate at the beginning of the day; check at the end of the day	As needed in the field; semiannually by the supplier	Measure known concentration of isobutylene 100 ppm (calibration gas)	Upon receipt, successful operation	Calibrate a.m., check p.m.	± 10% of the calibrated value	Manually zero meter or service as necessary and recalibrate	Field Team Leader	Manufacturer's specifications
Water Quality Meter	Calibrate at the beginning of the day	Performed monthly and as needed	Measure solutions with known values (National Institute for Standards and Technology traceable buffers and conductivity calibration solutions)	Upon receipt, successful operation	Daily before each use	pH: ± 0.1 s.u. Specific Conductivity: ± 3% ORP: ± 10 mV DO: ± 0.3 mg/L Temp.: ± 0.3ºC	Recalibrate or service as necessary	Field Team Leader	Manufacturer's specifications

QAPP Worksheet #22. Field Equipment Calibration, Maintenance, Testing, and Inspection (Continued)

Field Equipment*	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Alpha Scintillator	Annually or as specified by manufacturer	Annually or as needed	Daily prior to use	Upon receipt, successful operation	Daily prior to use	Pass/Fail	Return to rental company for replacement	RCT Supervisor	Manufacturer's specifications
Geiger Mueller	Annually or as specified by manufacturer	Annually or as needed	Daily prior to use	Upon receipt, successful operation	Daily prior to use	Pass/Fail	Return to rental company for replacement	RCT Supervisor	Manufacturer's specifications
Gamma Scintillator or FIDLER	Annually or as specified by manufacturer	Annually or as needed	Daily prior to use	Upon receipt, successful operation	Daily prior to use	Pass/Fail	Service by manufacturer	RCT Supervisor	Manufacturer's specifications
Field Equipment GPS	Daily check of known point beginning and end of each field day	Per manufacturer's specifications	Measure known control points and compare values	Upon receipt, successful operation	Beginning and end of each field day	Pass/Fail	Service by manufacturer	Field Team Leader	Manufacturer's specifications

*Additional equipment may be needed; additional equipment will follow manufacturer's specifications for calibration, maintenance, inspection, and testing. Calibration data will be documented in logbooks consistent with CP4-ES-2700, *Logbooks and Data Forms*.
FIDLER = field instrument for detection of low energy radiation
GPS = Global Positioning System
RCT = radiological control technician

QAPP Worksheet #23. Analytical SOPs

(UFP-QAPP Manual Section 3.2.1)
(EPA 2106-G-05 Section 2.3.4)

Reference Number*	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
SW-846-8260C	VOCs by GC/MS	Definitive	VOCs	GC-MS	TBD	TBD*
RSK SOP 175 Modified	Nonhalogenated Organics by GC	Definitive	Dissolved Hydrocarbon Gases	GC	TBD	TBD*
SW-846-9060A	Total Organic Carbon	Definitive	Total Organic Carbon	Carbonaceous Analyzer	TBD	TBD*
Census—TBD	Dehalcoccoides Bacteria	Screening	Bacteria	TBD	TBD	TBD*

*Information will be based on laboratory used. Laboratory will be chosen from available SMO laboratories prior to initiation of fieldwork.
GC/MS = gas chromatography/mass spectroscopy
TBD = to be determined

QAPP Worksheet #24. Analytical Instrument Calibration

(UFP-QAPP Manual Section 3.2.2)
(EPA 2106-G-05 Section 2.3.6)

Laboratories used by the DOE Prime Contractor are participants in DOE Consolidated Audit Program (DOECAP). In the fall of 2017, DOECAP began implementing accreditation of environmental laboratories through third party organizations. If not in DOECAP, laboratories are audited by contractors for compliance with DOECAP program requirements. As such, laboratory equipment and instruments used for quantitative measurements are calibrated in accordance with the laboratory's formal calibration program as summarized in the SOPs. The laboratory is responsible for maintaining instrument calibration information per its QA Plan, including control charts established for instrumentation.

Whenever possible, the laboratory uses recognized procedures for calibration such as those published by EPA or American Society for Testing and Materials. If established procedures are not available, the laboratory develops a calibration procedure based on the type of equipment, stability, characteristics of the equipment, required accuracy, and the effect of operation error on the quantities measured. Whenever possible, physical reference standards associated with periodic calibrations such as weights or certified thermometers with known relationships to nationally recognized standards are used. Where national reference standards are not available, the basis for the reference standard is documented. Equipment or instruments that fail calibration or become inoperable during use are tagged to indicate they are out of calibration. Such instruments or equipment are repaired and successfully recalibrated prior to reuse. High resolution mass spectrometer instruments undergo extensive tuning and calibration prior to running each sample set. The calibrations and ongoing instrument performance parameters are recorded and reported as part of the analytical data package.

Instrument*	Calibration Procedure	Calibration Range	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
*							

*The laboratory is responsible for maintaining instrument calibration information per their QA Plan, including control charts established for instrumentation. This information is audited. Additional certifications may be needed based on project-specific requirements (e.g., National Environmental Laboratory Accreditation Program, KDEP Drinking Water Laboratory Program). Field survey/sampling instrumentation will be calibrated according to manufacturer's instructions.

QAPP Worksheet #25. Analytical Instrument and Equipment Maintenance, Testing, and Inspection

(UFP-QAPP Manual Section 3.2.3)
(EPA 2106-G-05 Section 2.3.6)

Laboratories used by the DOE Prime Contractor are participants in DOECAP. In the fall of 2017, DOECAP began implementing accreditation of environmental laboratories through third party organizations. If not in DOECAP, laboratories are audited by contractors for compliance with DOECAP program requirements. As such, laboratory equipment and instruments used for quantitative measurements are calibrated in accordance with the laboratory's formal calibration program as summarized in the SOPs. The laboratory is responsible for maintaining instrument calibration information per its QA Plan, including control charts established for instrumentation. If the project has specific requirements that are different from those contained in the laboratory's quality manual, this table should be completed for those items.

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference*
All	Per laboratory quality manual	QC standards	Per laboratory quality manual	As needed	Must meet initial and/or continuing calibration criteria	Repeat maintenance activity or remove from service	Laboratory Section Manager	See Worksheet #23

QAPP Worksheet #25. Analytical Instrument and Equipment Maintenance, Testing, and Inspection (Continued)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GC/MS	Replace/clean ion source; clean injector, replace injector liner, replace/clip capillary column, flush/replace tubing on purge and trap; replace trap	QC standards	Ion source, injector liner, column, column flow, purge lines, purge flow, trap	As needed	Must meet initial and/or continuing calibration criteria	Repeat maintenance activity or remove from service	Laboratory Section Manager	See Worksheet #23
GC	Electron capture detector (ECD)/flame ionization detector (FID) maintenance; replace/clip capillary column	QC standards	ECD, FID, injector, injector liner, column, column flow	As needed	Must meet initial and/or continuing calibration criteria	Repeat maintenance activity or remove from service	Laboratory Section Manager	See Worksheet #23

ECD = electron capture device
FID = flame ionization detector

QAPP Worksheet #26 and 27. Sample Handling, Custody, and Disposal

(UFP-QAPP Manual Section 3.3)
(EPA 2106-G-05 Section 2.3.3)

Sampling Organization: FRNP

Laboratory: TBD
Method of sample delivery (shipper/carrier): Overnight
Number of days from reporting until sample disposal: Six months (182 days)

Activity	Organization and title or position of person responsible for the activity	SOP reference
Sample labeling	Sampling Teams/DOE Prime Contractor and Subcontractors	CP4-ES-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*; and CP3-ES-5004, *Sample Tracking, Lab Coordination, and Sample Handling Guidance*
Chain of custody form completion	Sampling Teams/DOE Prime Contractor and Subcontractors	CP4-ES-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*; and CP3-ES-5004, *Sample Tracking, Lab Coordination, and Sample Handling Guidance*
Packaging	Sampling Teams/DOE Prime Contractor and Subcontractors	CP4-ES-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*; and CP3-ES-5004, *Sample Tracking, Lab Coordination, and Sample Handling Guidance*
Shipping coordination	SMO/DOE Prime Contractor	CP4-ES-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*; and CP3-ES-5004, *Sample Tracking, Lab Coordination, and Sample Handling Guidance*
Sample receipt, inspection, & log-in	Sample Management/Contracted Laboratory	TBD
Sample custody and storage	Sample Management/Contracted Laboratory	TBD
Sample disposal	Sample Management/Contracted Laboratory	TBD

QAPP Worksheet #28. Analytical Quality Control and Corrective Action

(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6)
(EPA 2106-G-05 Section 2.3.5)

Matrix: Groundwater
Analytical Group/Concentration Level: VOCs, Dissolved Hydrocarbon Gases, and Total Organic Carbon
Sampling SOP: See Worksheet #21
Analytical Method/SOP Reference: See Worksheet #23
Sampler's Name/Field Sampling Organization: TBD/FRNP
Analytical Organization: TBD
No. of Sample Locations: 30+

QC Sample	Frequency/Number*	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field blank	Minimum 5%	≤ CRQL**	Verify results; reanalyze	Laboratory should alert project	Contamination—Accuracy/bias	See procedure CP3-ES-5003, *Quality Assured Data*
Trip blank	1 per cooler containing VOC or hydrocarbon gas samples	≤ CRQL**	Verify results; reanalyze		Contamination—Accuracy/bias	See procedure CP3-ES-5003, *Quality Assured Data*
Equipment blank	Minimum 5%	≤ CRQL**	Verify results; reanalyze		Contamination—Accuracy/bias	See procedure CP3-ES-5003, *Quality Assured Data*
Spiked field samples (MS and/or MSD)	1 per analytical batch	See data validation plans CP2-ES-0026, -5105	Check calculations and instrument; reanalyze affected samples		Accuracy/Precision	See procedure CP3-ES-5003, *Quality Assured Data*
Laboratory spiked blanks (LCS)	1 per analytical batch	See data validation plans CP2-ES-0026, -5105	Check calculations and instrument; reanalyze affected samples		Contamination—Accuracy/Bias	See procedure CP3-ES-5003, *Quality Assured Data*

Worksheet #28. Analytical Quality Control and Corrective Action (Continued)

QC Sample	Frequency/Number*	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per analytical batch	See data validation plans CP2-ES-0026, -5105,	Check calculations and instrument; reanalyze affected samples	Laboratory should alert project	Accuracy	See procedure CP3-ES-5003, *Quality Assured Data*
Surrogate Standards	All samples, blanks, and QA samples	See data validation plans CP2-ES-0026, -5105	Check calculations and instrument; reanalyze affected samples		Accuracy	See procedure CP3-ES-5003, *Quality Assured Data*
Internal standards	All samples, blanks, and QA samples	See data validation plans CP2-ES-0026, -5105,	Check calculations and instrument; reanalyze affected samples		Accuracy	See procedure CP3-ES-5003, *Quality Assured Data*
Field duplicate	Minimum 5%	None	Data reviewer will place qualifiers on samples affected	Project	Homogeneity/ Precision	RPD ≤ 50% soils, RPD < 25% aqueous, Specific RPD defined for each group in Worksheet #12
Laboratory duplicate	Per laboratory procedure	See data validation plans CP2-ES-0026, -5105	Verify results re-prepare and reanalyze	Laboratory analyst	Precision	See procedure CP3-ES-5003, *Quality Assured Data*

CRQL = contract-required quantification limit
*The number of QC samples is listed on Worksheet #20.
**Unless dictated by project-specific parameters, ≤ CRQL.

QAPP Worksheet #29. Project Documents and Records

(UFP-QAPP Manual Section 3.5.1)
(EPA 2106-G-05 Section 2.2.8)

Sample Collection and Field Records			
Record	**Generation**	**Verification**	**Storage location/archival**
Field logbook or data sheets	Field Team	Field Team Leader	Project File
Chain-of –Custody Forms	Field Team	Field Team Leader	Project File
Air Bills	Contract Laboratory	Contract Laboratory	Project File
Equipment Calibration Forms	Field Team	Field Team Leader	Project File
Deviations	Project Manager	Project Director	Project File
Corrective Action Reports	Project Manager	Project Director	Project File
Correspondence	Project Manager	Project Director	Project File

Project Assessments			
Record	**Generation**	**Verification**	**Storage location/archival**
Data verification checklists	SMO/Data Validator	SMO	Project File
Data validation report	Data Validator	SMO	Project File
Data usability assessment report	Data Validator	SMO	Project File

Laboratory Records			
Record	**Generation**	**Verification**	**Storage location/archival**
Level IV Laboratory Reports	Laboratory Staff	Laboratory Project Manager	Project File
Electronic Data Deliverables	Laboratory Staff	Laboratory Project Manager	Project File

QAPP Worksheets #31, 32, and 33. Assessments and Corrective Action

(UFP-QAPP Manual Sections 4.1.1 and 4.1.2)

(EPA 2106-G-05 Section 2.4 and 2.5.5)

Assessments:

Assessment Type	Responsible Party & Organization	Number/Frequency	Estimated Date	Assessment Deliverable	Deliverable Due Date
Off-site Laboratory Technical Systems Audit	Laboratory Manager/Technical Director	Annually	Annually/Ongoing	Internal Audit Repot	Per Individual Laboratory QA Manual

Assessment Response and Corrective Action:

Assessment Type	Responsibility for Responding to Assessment Findings	Assessment Response Documentation	Time Frame for Response	Responsibility for Implementing Corrective Action	Responsible for Monitoring Corrective Action Implementation
Off-site Laboratory Technical Systems Audit	Laboratory Manager/Technical Director	Internal Audit Report Deficiency Memorandum	7 days following receipt of proficiency testing (PT) deficiency report and before analysis field samples	Laboratory Technical Director	QA/QC Program Manager/FRNP

QAPP Worksheet #34. Data Verification and Validation Inputs

(UFP-QAPP Manual Section 5.2.1 and Table 9)
(EPA 2106-G-05 Section 2.5.1)

Item	Description	Verification (Completeness)	Validation (Conformance to Specifications)
Planning Documents/Records			
1	Approved QAPP	X	
2	Contract	X	
3	Field SOPs	X	
4	Laboratory SOPs	X	
Field Records			
5	Field Logbooks and/or sample data forms	X	X
6	Equipment calibration records	X	X
7	Chain-of-Custody forms	X	X
8	Sampling diagrams/surveys	X	X
9	Drilling logs	X	X
10	Geophysics reports	X	X
11	Relevant correspondence	X	X
12	Change orders/deviations	X	X
13	Field audit reports	X	X
14	Field corrective action reports	X	X

QAPP Worksheet #34. Data Verification and Validation Inputs (Continued)

Item	Description	Verification (Completeness)	Validation (Conformance to Specifications)
Analytical Data Package			
15	Cover sheet (laboratory identifying information)	X	X
16	Case narrative	X	X
17	Internal laboratory chain-of-custody	X	X
18	Sample receipt records	X	X
19	Sample chronology (i.e., dates and times of receipt, preparation, and analysis)	X	X
20	Communication records	X	X
21	Project-specific PT sample results	X	X
22	Limit of detection/limit of quantification establishment and verification	X	X
23	Standards Traceability	X	X
24	Instrument calibration records	X	X
25	Definition of laboratory qualifiers	X	X
26	Results reporting forms	X	X
27	QC sample results	X	X
28	Corrective action reports	X	X
29	Raw data	X	X
30	Electronic data deliverable	X	X

QAPP Worksheet #35. Data Verification Procedures

(UFP-QAPP Manual Section 5.2.2)
(EPA 2106-G-05 Section 2.5.1)

This worksheet documents procedures that will be used to verify project data. It applies to both field and laboratory records. Data verification is a completeness check to confirm that required activities were conducted, specified records are present, and the contents of the records are complete. As illustrated in the following example, verification often is performed at more than one step by more than one person.

Records Reviewed	Requirement Documents	Process Description	Responsible Person/Organization
Field logbook and/or sample data forms	QAPP, Field SOPs	Verify that records are present and complete for each day of field activities. Verify that all planned samples including field QC samples were collected and that sample collection locations are documented. Verify that meteorological data were provided for each day of field activities. Verify that changes/exceptions are documented and were reported in accordance with requirements. Verify that any required field monitoring was performed and results are documented.	Field Team Leader/FRNP— SMO/FRNP
Data deliverables, analytes, and holding times	QAPP, contract, and procedures	The documentation from the contractual screening will be included in the data assessment packages, per DOE Prime Contractor procedure CP3-ES-5003, *Quality Assured Data*.	Laboratory PM/Contract Laboratory SMO/FRNP

QAPP Worksheet #35. Data Verification Procedures (Continued)

Records Reviewed	Requirement Documents	Process Description	Responsible Person/Organization
Chain-of-custody, sample handling, sampling methods and procedures, and field transcription	QAPP, contract, and procedures	These items will be validated during the data assessment process as required by DOE Prime Contractor procedure CP3-ES-5003, *Quality Assured Data*, and CP3-ES-1003, *Developing, Implementing, and Maintaining Data Management Plans*. The documentation of this validation will be included in the data assessment packages.	SMO/FRNP
Analytical methods and procedures, laboratory data qualifiers, and standards	QAPP, contract, and procedures	These items will be reviewed during the data validation process as required by DOE Prime Contractor data validation procedures. Data validation will be performed in parallel with data assessment. The data validation report and data validation qualifiers will be considered when the data assessment process is being finalized.	Data Validation Subcontractor and SMO/FRNP
Audit reports, corrective action reports	QAPP and procedures	Verify that all planned audits were conducted. Examine audit reports. For any deficiencies noted, verify that corrective action was implemented according to plan.	CPAP Manager/FRNP
Deviations and qualifiers	QAPP and procedures	Any deviations and qualifiers resulting from process will be documented in the data assessment packages.	SMO/FRNP

QAPP Worksheet #36. Data Validation Procedures

(UFP-QAPP Manual Section 5.2.2)
(EPA 2106-G-05 Section 2.5.1)

Data Validator: Veolia Nuclear Solutions Federal Services

Analytical Group/Method:	**Volatile Organics–SW-846-8260C**
Data deliverable requirements:	Level IV
Analytical specifications:	WS 28-1
Measurement performance criteria:	WS 12A
Percent of data packages to be validated:	10%
Percent of raw data reviewed:	10%
Percent of results to be recalculated:	10%
Validation procedure:	CP2-ES-5105
Validation code (see attached table*):	SV3EM
Electronic validation program/version:	TBD

QAPP Worksheet #37. Data Usability Assessment

(UFP-QAPP Manual Section 5.2.3 including Table 12)
(EPA 2106-G-05 Section 2.5.2, 2.5.3, and 2.5.4)

The purpose of the project is to obtain groundwater samples from select areas within the SWMU 211-A. The samples collected then will be analyzed for potential contaminant concentrations.

FRNP will determine the adequacy of data based on the results of validation and verification. The usability step involves assessing whether the process execution and resulting data meet PQOs documented in this work plan.

Summarize the usability assessment process and procedures, including interim steps and any statistics, equations, and computer algorithms that will be used: Field and analytical data are verified and assessed per procedure CP3-ES-5003, *Quality Assured Data*. Data assessment packages will be created per this procedure. Data assessment packages will include field and analytical data, chains-of-custody, data verification and assessment queries, and other project-specific information needed for personnel to review the package adequately. Data assessment packages will be reviewed to document any issues pertaining to the data and to indicate if DQOs of the project were met. The following plans are used for data validation: CP2-ES-0026 and CP2-ES-5105.

Describe the evaluative procedures used to assess overall measurement error associated with the project: Precision, accuracy, representativeness, comparability, completeness, and sensitivity parameters will be evaluated per procedure, CP3-ES-5003, *Quality Assured Data*. This information will be included in the data assessment packages for review by project personnel. Data assessment also will include documentation of QC exceedances, trends, and/or bias in the data set. Data assessment will document any statistics used.

Identify the personnel responsible for performing the usability assessment:

Project Director: Dave Hutchison
Project QA Manager: Jennie Freels
SMO: Lisa Crabtree
Risk Assessor: LeAnne Garner
Data Validator: Veolia Nuclear Solutions Federal Services
Field Team Leader: TBD (Optional)