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Level 5

Quality Assurance Project Plan Weldon Spring, Missouri, Site

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U.S. DEPARTMENT OF ENERGY | Legacy Management

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Abbreviations

AEC	U.S. Atomic Energy Commission
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CPOU	Chemical Plant Operable Unit
DNT	dinitrotoluene
DOE	U.S. Department of Energy
DQI	data quality indicator
EDD	electronic data deliverable
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
GWOU	Groundwater OU
IC	institutional control
IRA	interim response action
LM	Office of Legacy Management
LMS	Legacy Management Support
LTS&M	long-term surveillance and maintenance
MCL	maximum contaminant level
MDNR	Missouri Department of Natural Resources
µg/L	micrograms per liter
MS	matrix spike
MSD	matrix spike duplicate
NPL	National Priorities List
OU	operable unit
pCi/L	picocuries per liter
QA	quality assurance
QAPP	Quality Assurance Project Plan
QBWOU	Quarry Bulk Waste Operable Unit
QC	quality control
QROU	Quarry Residuals Operable Unit
QSM	Quality Systems Manual
ROD	Record of Decision
RPD	relative percent difference

SAP	Sampling and Analysis Plan
SOP	standard operating procedure
SOW	statement of work
TCE	trichloroethene
TNT	trinitrotoluene
UFP	Uniform Federal Policy

1.0 Introduction

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) objective is to provide long-term environmental monitoring and site maintenance to protect the health of the environment, workers and the public. The Weldon Spring, Missouri, Site, is managed by LM. Routine surface and groundwater monitoring through a mature system of sampling, analysis, data validation, data management, and reporting has been in place to meet performance goals established when sites transferred from the DOE Office of Environmental Management to LM following completion of remediation.

The Legacy Management Support (LMS) contractor for LM uses a management system that applies to all programs, projects, and business management systems. The management system incorporates the philosophy, policies, and requirements of safety and health, environmental compliance, and quality assurance (QA) in all aspects of project planning and implementation.

The Weldon Spring Site is in St. Charles County, Missouri, about 30 miles west of St. Louis, Missouri. The site comprises two geographically distinct, DOE-owned properties: the former Weldon Spring Chemical Plant and Raffinate Pit sites (Chemical Plant) and the former Weldon Spring Quarry (Quarry). The Chemical Plant is about 2 miles southwest of the junction of Missouri State Route 94 and Interstate 64. The Quarry is about 4 miles southwest of the Chemical Plant. Both sites are accessible from Missouri State Route 94.

The Weldon Spring Site was remediated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The U.S. Environmental Protection Agency (EPA) and DOE signed a Federal Facility Agreement (FFA) in 1986 and amended it in 1992. The main purpose of the agreement is to establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at the site in accordance with CERCLA. Subsequently, EPA, DOE, and Missouri Department of Natural Resources (MDNR) signed an updated FFA, which addresses long-term surveillance and maintenance (LTS&M) activities; EPA provided the final signature on March 31, 2006.

The EPA placed the Quarry and Chemical Plant areas on the National Priorities List (NPL) in 1987 and 1989, respectively. Initial remedial activities at the Chemical Plant (a series of Interim Response Actions authorized through the use of the engineering evaluation/cost analysis [EE/CA] process [DOE 1996]) included:

- Removal of electrical transformers, electrical poles and lines, and overhead piping and asbestos that presented an immediate threat to workers and the environment.
- Construction of an isolation dike to divert runoff around the Ash Pond area to reduce the concentration of contaminants going offsite in surface water.
- A detailed characterization of onsite debris, the separation of radiological and nonradiological debris, and the transport of materials to designated staging areas for interim storage.
- Dismantling of 44 Chemical Plant buildings under four separate Interim Response Actions.
- Treatment of contaminated water at the Chemical Plant and the Quarry.

Remediation of the Weldon Spring Site was administratively divided into four operable units (OUs): the Chemical Plant OU (CPOU), the Quarry Bulk Waste OU (QBWOU), the Quarry Residuals OU (QROU), and the Groundwater OU (GWOU). The Southeast Drainage was remediated under a CERCLA removal action. This Quality Assurance Project Plan (QAPP) covers QA measures specific to the management of the post closure monitoring and maintenance of the Weldon Spring Site. Sample collection, analysis for contaminants of concern, data validation of analytical data packages, and reporting progress toward performance goals are the major elements of this work. This site-specific QAPP replaces the previous *Legacy Management CERCLA Sites Quality Assurance Project Plan* (DOE 2007), which covered several LM managed sites. Section 14 of the FFA states that DOE shall use quality assurance, quality control (QA/QC) and chain of custody procedures during all field investigation, monitoring, sample collection, and laboratory analysis activities in accordance with EPA guidance and the *Uniform Federal Policy for Quality Assurance Project Plans* (EPA 2005), hereafter referred to as the Uniform Federal Policy (UFP)-QAPP.

The UFP-QAPP recommends the use of worksheets to document the requirements of the QAPP. The specific elements of the worksheets are outlined in the UFP-QAPP, and templates are provided. The use of the worksheets is expected to expedite the review of QAPPs by an approval authority. The QAPP is not being used as an initial project planning tool and will not be used as a standalone document containing all specifications and procedures necessary for project personnel to conduct their assigned responsibilities. Therefore, a graded approach has been implemented to respond to the worksheet instructions. Worksheet #9 is not used because this is not a newly defined project.

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QAPP Worksheets #1 and #2: Title and Approval Page
(UFP-QAPP Manual Section 2.1) (EPA 2106-G-05 Section 2.2.1)

Management for the Weldon Spring, Missouri, Site is committed to establishing, maintaining, and implementing an effective Quality Assurance Program that achieves quality in all activities through planning, performing, assessing, and continually improving the process. The achievement of quality is an interdisciplinary function led by management and it is the responsibility of all personnel. Work is accomplished through the resources of people, equipment, and procedures. Managers are responsible for ensuring that personnel have the information, resources, and support necessary to complete the work in a safe, efficient, and quality manner. All work performed for the U.S. Department of Energy Office of Legacy Management at the Weldon Spring, Missouri, Site must comply with the requirements of this Quality Assurance Project Plan.

Approved:

Rebecca M. Roberts
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Rebecca Roberts, Weldon Spring Site LM Site Manager
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Environmental Protection Agency, Region 7 Quality Assurance Manager
approved w/condition

LM and LMS contractor work assignments are subject to change. Names are not identified due to the difficulty in keeping the QAPP current. Separate regulator concurrence letters will be maintained in the project file with the QAPP.

[1] **Project Identifying Information**

[a] Weldon Spring Site

[b] Weldon Spring, MO

[c] LM service contract/DE-89303020DLM000001

[2] **Lead Organization**

[a] LM site manager (see previous page for signature)

[b] LM QA manager (see previous page for signature)

LMS Contractor Organization

[a] LMS site lead

[b] LMS Quality Assurance manager

[3] **Federal Regulatory Agency**

EPA, Region 7

[4] **State Regulatory Agency**

MDNR

[5] **List plans and reports from previous investigations relevant to this project**

Key documents for the Weldon Spring Site are available on the LM public website at https://www.energy.gov/lm/weldon-spring-site-missouri

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)

Organizational Responsibilities

LM has jurisdiction over the Weldon Spring Site. DOE is responsible for implementing the requirements of the FFA and maintaining the CERCLA remedy for the Weldon Spring Site. The LM organization is illustrated by an organization chart(s) which is maintained and updated regularly and available upon request. LM assigns a site manager, who is responsible for managing the Weldon Spring Site, implementing the CERCLA remedy, and implementing the requirements of the FFA and LTS&M Plan. The LM QA manager works with the LM site manager to provide oversight for implementation of the requirements of this QAPP. LM task activities at the Weldon Spring Site include cost-effective management of the site in full compliance with the Records of Decision, the FFA, LTS&M Plan, and applicable local, state, and federal rules, regulations, and policies. Core activities are records management, site inspection and maintenance, stakeholder relations, water quality monitoring, and operation of treatment systems.

The LMS contractor assists LM in implementing the regulatory agreements and provides technical support to LM for LTS&M of the site as identified in the scope of work specified under the contract with LM. The LMS contractor uses a management approach that draws on the expertise within its various functional organizations to support the task and subtask activities. Figure 1 shows an organizational chart for the site and lines of communication between LM and the LMS contractor. The chart also shows communication lines with the regulators. Each person whose position is shown on this chart will receive an electronic copy of this QAPP.

The Weldon Spring Site is one of many sites managed by LM. Though the basic structure illustrated in

Figure 1 remains stable, the details of the LMS contractor’s organization are updated monthly and maintained internally.

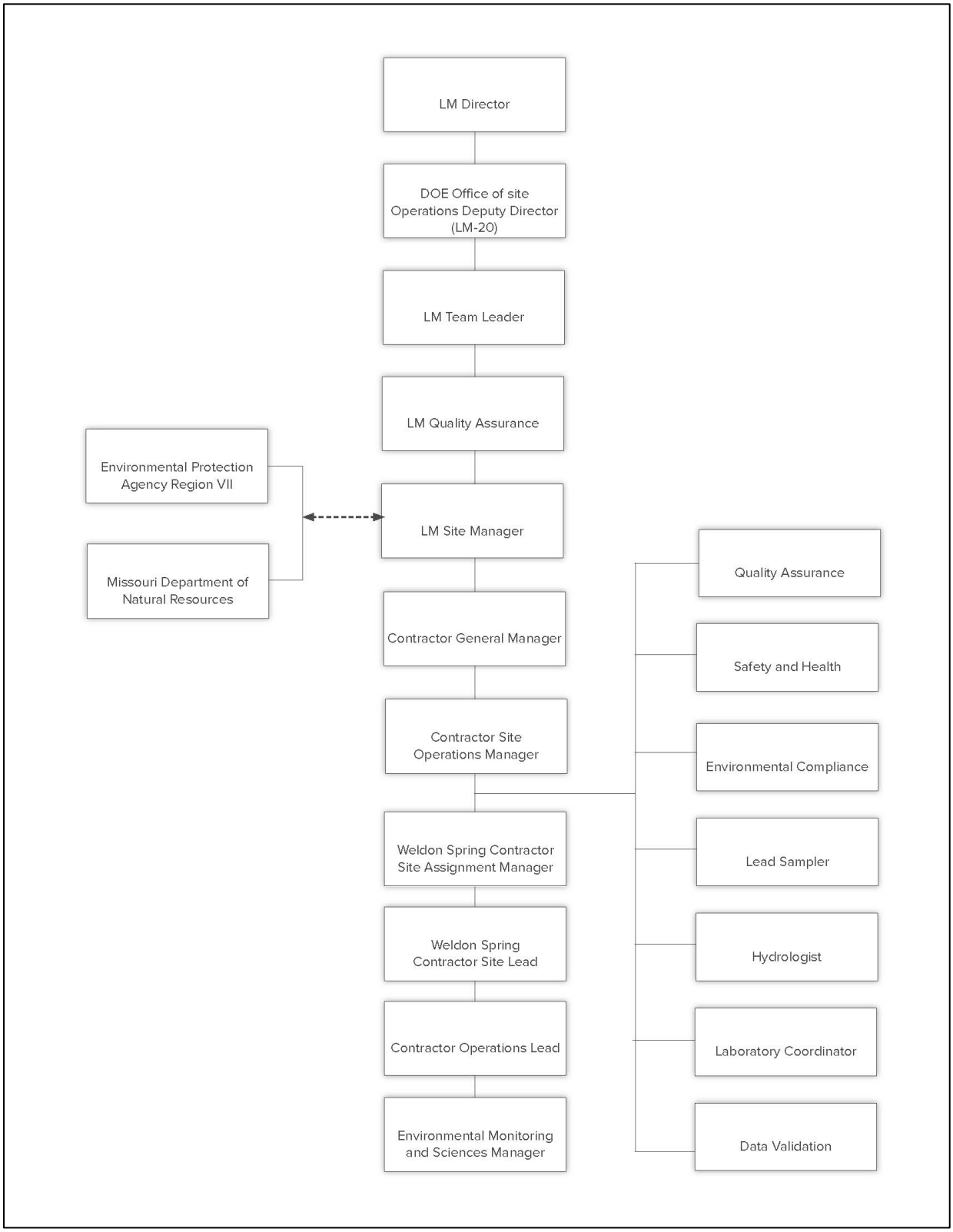

Figure 1. Abbreviated LM and LMS contractor Organization Structure

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)

Training

Personnel will be qualified to perform their assigned job through meeting basic job description requirements, education standards, experience, and ongoing performance reviews. Training will be provided when needed to maintain proficiency; to adapt to new technologies, equipment, or instruments; and to perform new assigned responsibilities.

The LMS Learning and Development department uses electronic folders to manage, maintain, and track employee training records for each person working on the LMS contract. These folders may contain the individual's previous transcripts, scored examinations, equivalency forms, certificates of course completions, qualifications, and any other correspondence deemed appropriate to retain. The Learning and Development department also provides in-house and online training and coordinates offsite and vendor-provided training.

Site access training requirements and personal protective equipment needs are specified in safety and health procedures and site-specific job safety analyses. Compliance to these requirements are mandatory before access is granted to workers to perform tasks in sampling and work areas.

The LMS functional manager, site lead, and supervisors are responsible for determining site-required training and for communicating the requirements to their direct staff and to the managers.

Managers are responsible for determining the training needs of their staff and for ensuring that required training (including site-specific training) is documented in the training database.

Personnel assigned to project activities are responsible for ensuring that their required training and medical surveillance (if applicable) are documented and are maintained in a current status as required by the project and their position or assignments. At a minimum, individual training requirements will be reviewed annually and updated as needed.

The LMS site lead and sampling supervisor are responsible for ensuring that personnel assigned to project tasks are sufficiently familiar with the project implementing documents (e.g., plans, procedures, and drawings) and the requirements established for inspection, systems monitoring, sample collection, analysis, documenting and reporting project activities, and demonstrating proficiency.

The LMS sampling supervisor lead will ensure that personnel assigned to field sampling activities can demonstrate proficiency when performing the work or that they are properly supervised by a team lead who is proficient.

Certifications

Personnel assigned to waste shipment activities will be certified in accordance with the appropriate level of U.S. Department of Transportation certified shipper requirements for the work they perform.

Personnel assigned waste management responsibilities must have training in appropriate requirements to insure appropriate storage, characterization, and disposition of waste materials.

Laboratories used for analysis of samples collected for characterization or compliance are required to be accredited under the DOD (U.S. Department of Defense) and DOE (U.S. Department of Energy) (2017) *Department of Defense (DoD Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories* , hereafter referred to as the Quality System Manual (QSM). LMS contractor data validation staff may observe some third-party certification audits. State and regional requirements for registration or certification (e.g., state-licensed engineer or surveyor) are addressed in a site-specific LTS&M Plan(s), as necessary.

LMS contractor work assignments are fluid based on the matrix functional management organization. The key roles, education and experience, and specialized training and certification in support of environmental monitoring for the Weldon Spring Site are shown in the table below.

LM's mission is to fulfill DOE's postclosure responsibilities and ensure the future protection of human health and the environment. The LMS contractor has established nationwide systems for performing the work to accomplish LM's mission for its more than 100 sites. For each site, an LMS contractor site lead draws from support groups to perform the work. The established work control system verifies personnel qualifications and training needs for each job during work planning, including signatures from the workers that acknowledge they understand the requirements of the work.

The LMS Environmental Monitoring and Sciences functional group has established contracts with various laboratories based on a common procurement statement of work (SOW) that requires compliance with the QSM.

Individual names and signatures are not provided in the following charts because assignments are fluid based on a matrix organization. Laboratories and names of its personnel are not provided because multiple laboratory contracts for QSM-accredited laboratories will change throughout this long-term monitoring effort. Work planning includes briefing personnel on the project requirements, and signatures are required.

Organization: LM and LMS Contractor

Project Title/Role	Education/Experience	Specialized Training/Certifications
LM Weldon Spring Site manager	Site management experience in environmental monitoring projects	
LM Quality Assurance manager	Quality Assurance Program implementation experience	
LMS Program Manager	Experienced in overseeing multiple projects in environmental monitoring environment	
LMS Long-Term Surveillance and Maintenance Manager	Experienced in overseeing multiple projects in environmental monitoring environment	
LMS Site Lead	Site management experience in environmental monitoring projects	
LMS Site Operations Manager	Site management experience	
LMS Quality Assurance Manager	Quality Assurance Program implementation experience	
LMS Laboratory Coordinator	Science degree Experience in analytical data in environmental monitoring environment	
LMS Environmental Monitoring and Sciences Manager	Science degree Experience in sampling in environmental monitoring environment	*Water Sampler* training course (WS300)
LMS Environmental Monitoring and Sciences sample team members	Science degree Experience in sampling surface and groundwater	*Water Sampler* training course (WS300)
LMS data validation staff	Chemistry degree Laboratory data validation experience in environmental samples	Experienced DOECAP auditor *Data Validation Training* (LMS HIS121JPM)
LMS Hydrologist	Degree in geology, hydrology, or engineering Groundwater modeling experience	

Abbreviation:
DOECAP = DOE Consolidated Audit Program

The roster of current sampling, data validation, and data management project personnel, their roles, education and experience, and training and certifications, is maintained by the LMS contractor. The roster is available upon request.

The roster of currently contracted accredited QSM laboratories, laboratory personnel, their roles, education and experience, and training and certifications, is maintained by the QSM laboratory that is used for analysis. The roster of laboratories is available upon request.

QAPP Worksheet #6: Communication Pathways
(UFP-QAPP Manual Section 2.4.2) (EPA 2106-G-05 Section 2.2.4)

Regulatory Interaction with EPA and MDNR

Regulatory interaction with EPA is defined by the regulatory agreements that describe LTS&M requirements at the Weldon Spring Site.

EPA and DOE signed an FFA in 1986 and amended it in 1992. The main purpose of the agreement is to establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at the site in accordance with CERCLA. Subsequently, EPA, DOE, and MDNR signed an updated FFA, which addresses LTS&M activities; EPA provided the final signature on March 31, 2006.

The following table summarizes pathways and contact methods utilized for various communication drivers under the QAPP.

Communication Driver	Organization	Position	Contact Method	Procedure (timing, pathway, documentation, etc.)
Regulatory agency interface	LM	Site manager	Email Phone Mail	With assigned EPA Region 7 and Missouri state representatives (e.g., annual inspection report, Five-Year Review)
Field progress reports	LMS contractor	Sampling staff	EDGE information available to management	EDGE real-time entry during sampling
Stop Work due to safety issues	LMS contractor	Site lead	Phone	Notify LM site manager at discovery
QAPP changes	LMS contractor	Site lead	Email	LMS staff supporting the Weldon Spring Site for all changes LM site manager for all changes Post each revision on LM public webpage and notify EPA and MDNR All signatories review for significant changes
Field corrective actions	LMS contractor	Sampling staff	EDGE	LM contractor data management via field notes in EDGE documentation
Sample receipt variances	Contract laboratory	Laboratory coordinator	Email	Laboratory project manager contacts laboratory coordinator
Data review corrective actions	LMS contractor	Laboratory coordinator	Data report	LMS contractor site lead
Laboratory data quality issues	LMS contractor	Laboratory coordinator	Email	Laboratory coordinator contacts laboratory project manager for issue resolution

Abbreviation:
EDGE = Environmental Quality Information System Data Gathering Engine

QAPP Worksheet #10: Conceptual Site Model
(UFP-QAPP Manual Section 2.5.2) (EPA 2106-G-05 Section 2.2.5)

Project Definition

The objectives of the long-term environmental monitoring program for the Weldon Spring Site is to confirm that the success and effectiveness of the remedial actions and selected remedies, demonstrate compliance with applicable regulations, and ensure the long-term protection of human health and the environment. The following is a summary of the site background, history of contamination, and remedy information. Refer to the LTS&M Plan, Five-Year Review documents, and annual reports for detailed site information.

Background

The Weldon Spring Site is in St. Charles County, Missouri, about 30 miles west of St. Louis (Figure 2). The site comprises two geographically distinct DOE-owned properties: the former Weldon Spring Chemical Plant and Raffinate Pit sites (Chemical Plant) and the Weldon Spring Quarry (Quarry). The former Chemical Plant is located about 2 miles southwest of the junction of Missouri State Route 94 and Interstate 64. The Quarry is about 4 miles southwest of the former Chemical Plant. Both sites are accessible from Missouri State Route 94.

During the early 1940s, the U.S. Department of the Army (Army) acquired 17,232 acres of private land in St. Charles County for the construction of the Weldon Spring Ordnance Works facility. The former Ordnance Works site has since been divided into several contiguous areas under different ownership, as depicted in Figure 3. Current land use of the Ordnance Works site includes the Chemical Plant and Quarry, the U.S. Army Reserve Weldon Spring Training Area, the Missouri Department of Conservation, the MDNR Division of State Parks, Francis Howell High School, a St. Charles County highway maintenance (formerly Missouri Department of Transportation) facility, the Public Water Supply District No. 2 water supply facility, the St. Charles County law enforcement training center, the village of Weldon Spring Heights, and the University of Missouri research park.

The Chemical Plant and Quarry areas total 228.16 acres. The Chemical Plant property occupies 219.50 acres, and the Quarry occupies 8.66 acres.

History of Contamination

In 1941, the U.S. government acquired 17,232 acres of rural land in St. Charles County to establish the Weldon Spring Ordnance Works. In the process, the towns of Hamburg, Howell, and Toonerville and 576 citizens of the area were displaced. From 1941 to 1945, the Army manufactured trinitrotoluene (TNT) and dinitrotoluene (DNT) at the Ordnance Works site. Four TNT production lines were situated on what was to be the Chemical Plant. These operations resulted in nitroaromatic contamination of soil, sediments, and some offsite springs.

Following a considerable amount of explosives decontamination of the facility by the Army, 205 acres of the former Ordnance Works property were transferred to the U.S. Atomic Energy

Commission (AEC) in 1956 for the construction of the Weldon Spring Uranium Feed Materials Plant, now referred to as the Weldon Spring Chemical Plant. An additional 14.88 acres were transferred to AEC in 1964. The plant converted processed uranium ore concentrates to pure uranium trioxide, intermediate compounds, and uranium metal. A small amount of thorium was also processed. Wastes generated during these operations were stored in four raffinate pits located on the Chemical Plant property. Uranium-processing operations resulted in radiological contamination of the same locations previously contaminated with nitroaromatic compounds by former Army operations.

The Quarry was mined for limestone aggregate used in construction of the Ordnance Works. The Army also used the Quarry for burning wastes from explosives manufacturing and disposal of TNT-contaminated rubble during Ordnance Works operations. These activities resulted in nitroaromatic contamination of the soil and groundwater at the Quarry.

In 1960, the Army transferred the Quarry to AEC, who used it from 1963 to 1969 as a disposal area for uranium and thorium residues (both drummed and uncontained) from the former Chemical Plant.

Uranium-processing operations ceased in 1966 and, on December 31, 1967, AEC returned the facility to the Army for use as a defoliant production plant. In preparation for the defoliant-process, the Army removed equipment and materials from some of the buildings and disposed of them principally in Raffinate Pit 4. The defoliant project was canceled before any process equipment was manufactured, and the Army transferred 50.65 acres of land encompassing the raffinate pits back to AEC while retaining the Chemical Plant. AEC and, subsequently, DOE managed the site, including the Army-owned Chemical Plant, under caretaker status from 1968 through 1985. Caretaker activities included site security oversight, fence maintenance, grass cutting, and other incidental maintenance. In 1984, the Army repaired several of the buildings at the Chemical Plant, decontaminated some of the floors, walls, and ceilings, and isolated some equipment. In 1985, the Army transferred full custody of the Chemical Plant to DOE.

Initial Response

EPA placed the Quarry and former Chemical Plant areas on the NPL on July 30, 1987, and March 30, 1989, respectively. An FFA was signed by EPA and DOE in 1986, and it was amended in 1992. A new FFA was signed in 2006 between EPA, DOE, and MDNR. The main purpose of this FFA was to focus more on long-term site management activities. Initial activities at the Chemical Plant, a series of Interim Response Actions (IRAs) undertaken with removal authority, included:

- Removal of electrical transformers, electrical poles and lines, and overhead piping and asbestos that presented an immediate threat to workers and the environment.
- Construction of an isolation dike to divert runoff around the Ash Pond area to reduce the concentration of contaminants going off site in surface water.
- Detailed characterization of onsite debris, separation of radiological and nonradiological debris, and transport of materials to designated staging areas for interim storage.

- Dismantling of 44 Chemical Plant buildings under four separate IRAs.
- Treatment of contaminated water at the former Chemical Plant and the Quarry.

Remediation of the Weldon Spring Site was administratively divided into four OUs: QBWOU, QROU, CPOU, and GWOU. The Southeast Drainage was remediated as a removal action through an EE/CA report (DOE 1996) as part of the CPOU. The following section describes the selected remedies.

Selected Remedies

DOE implemented remedial activities for the QBWOU set forth in the *Record of Decision for the Management of the Bulk Wastes at the Weldon Spring Quarry* (DOE 1990).

The selected remedy included:

- Excavation and removal of bulk waste (i.e., structural debris, drummed and unconfined waste, process equipment, sludge, soil).
- Transportation of the waste along a dedicated haul road to a temporary storage area located at the former Chemical Plant.
- Staging of bulk wastes at the temporary storage area.

The QROU remedy was described in the *Record of Decision for the Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri* (DOE 1998). The QROU addressed residual soil contamination in the Quarry proper, surface water and sediments in the Femme Osage Slough and nearby creeks, and contaminated groundwater.

The selected remedy included:

- Long-term monitoring and institutional controls (ICs) to prevent exposure to contaminated groundwater north of the Femme Osage Slough.
- Long-term monitoring and ICs to protect the quality of the public water supply in the Missouri River alluvium and implementing a well field contingency plan (DOE 1992).
- Confirming the model assumptions regarding extraction of contaminated groundwater and establishing controls to protect naturally occurring attenuation processes.

In the *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (DOE 1993), DOE established the remedy for controlling contaminant sources at the Chemical Plant and disposing of contaminated materials in an onsite disposal cell.

The selected remedy included:

- Removal of contaminated soils, sludge, and sediment.
- Treatment of wastes, as appropriate, by chemical stabilization/solidification.
- Disposal of wastes removed from the former Chemical Plant and stored Quarry bulk wastes in an engineered onsite disposal facility.

The remedy included remediation of 17 offsite vicinity properties affected by Chemical Plant operations. The vicinity properties were remediated in accordance with Chemical Plant Record of Decision (ROD) cleanup criteria.

DOE implemented the *Interim Record of Decision for Remedial Action for the Groundwater Operable Unit at the Chemical Plant Area of the Weldon Spring Site* (DOE 2000), which was approved on September 29, 2000, to investigate the practicability of remediating trichloroethene (TCE) contamination in Chemical Plant groundwater using in situ chemical oxidation. It was determined, based on extensive monitoring, that in situ oxidation did not perform adequately under field conditions; therefore, the remediation of TCE was reevaluated with the remaining contaminants of concern.

In the *Record of Decision for the Final Remedial Action for the Groundwater Operable Unit at the Chemical Plant Area of the Weldon Spring Site* (DOE 2004), DOE established the remedy of monitored natural attenuation to address contaminated groundwater and springs. The *Interim Remedial Action Report for the Groundwater Operable Unit of the Weldon Spring Site* (DOE 2005) was finalized in March 2005.

The selected remedy included:

- Sampling of groundwater and surface water, including springs, to verify the effectiveness of naturally occurring processes to reduce contaminant concentrations over time.
- ICs to prevent exposure to contaminated groundwater at the former Chemical Plant and to the north toward Burgermeister Spring.

Remedial action for the Southeast Drainage was addressed as a separate action under CERCLA. The *Engineering Evaluation/Cost Analysis for the Proposed Removal Action at the Southeast Drainage near the Weldon Spring Site, Weldon Spring, Missouri* (DOE 1996) was prepared in August 1996 to evaluate the human and ecological health risks within the drainage. The EE/CA recommended that selected sediment in accessible areas of the drainage should be removed with track-mounted equipment and transported by off-road haul trucks to the Chemical Plant. Soil removal occurred in two phases: 1997–1998 and 1999. Postremediation soil sampling was conducted. More details are included in Section A.1.1.4.7 of Appendix A of the *Southeast Drainage Closeout Report Vicinity Properties DA-4 and MDC-7* (DOE 1999).

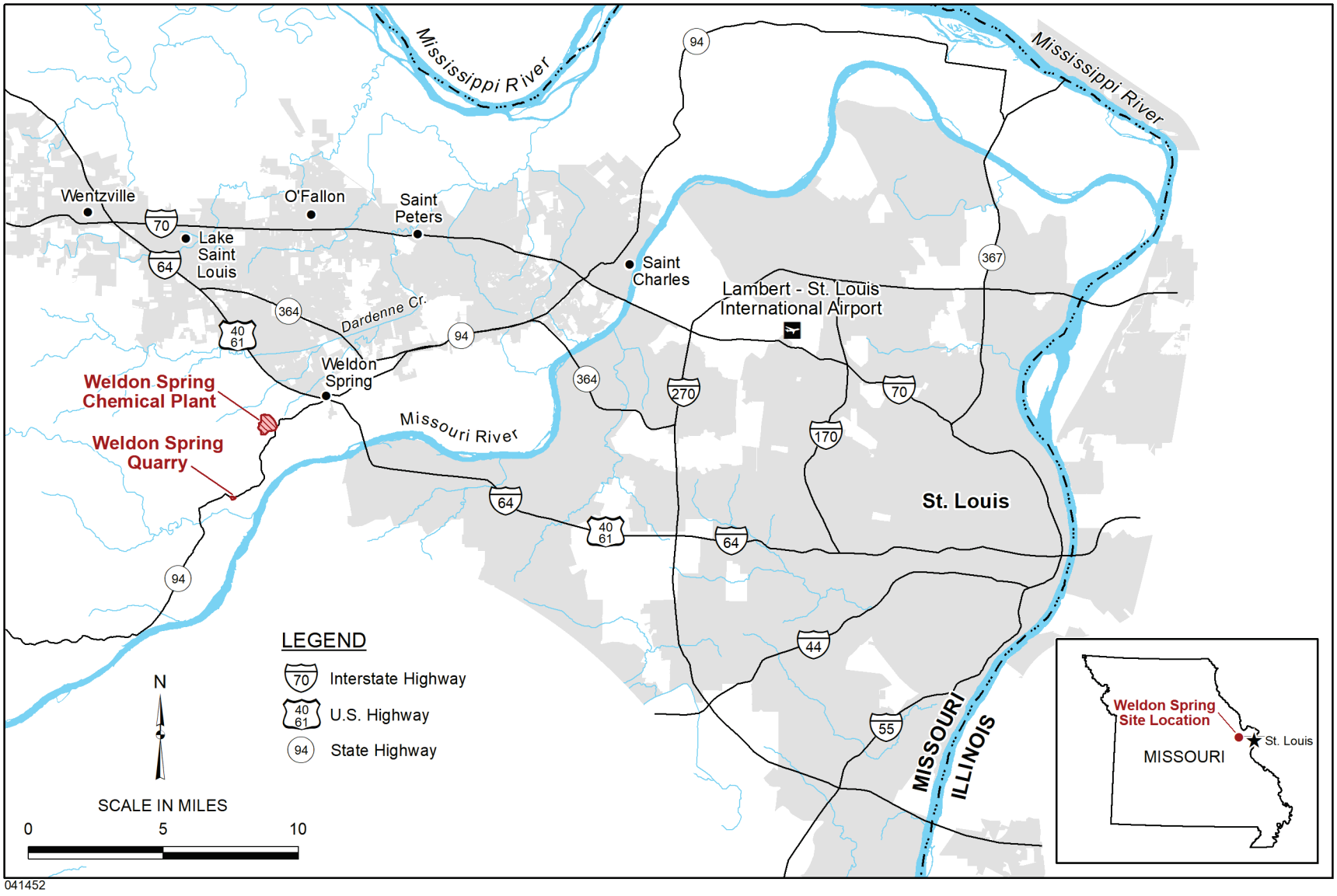

Figure 2. Weldon Spring, Missouri, Site

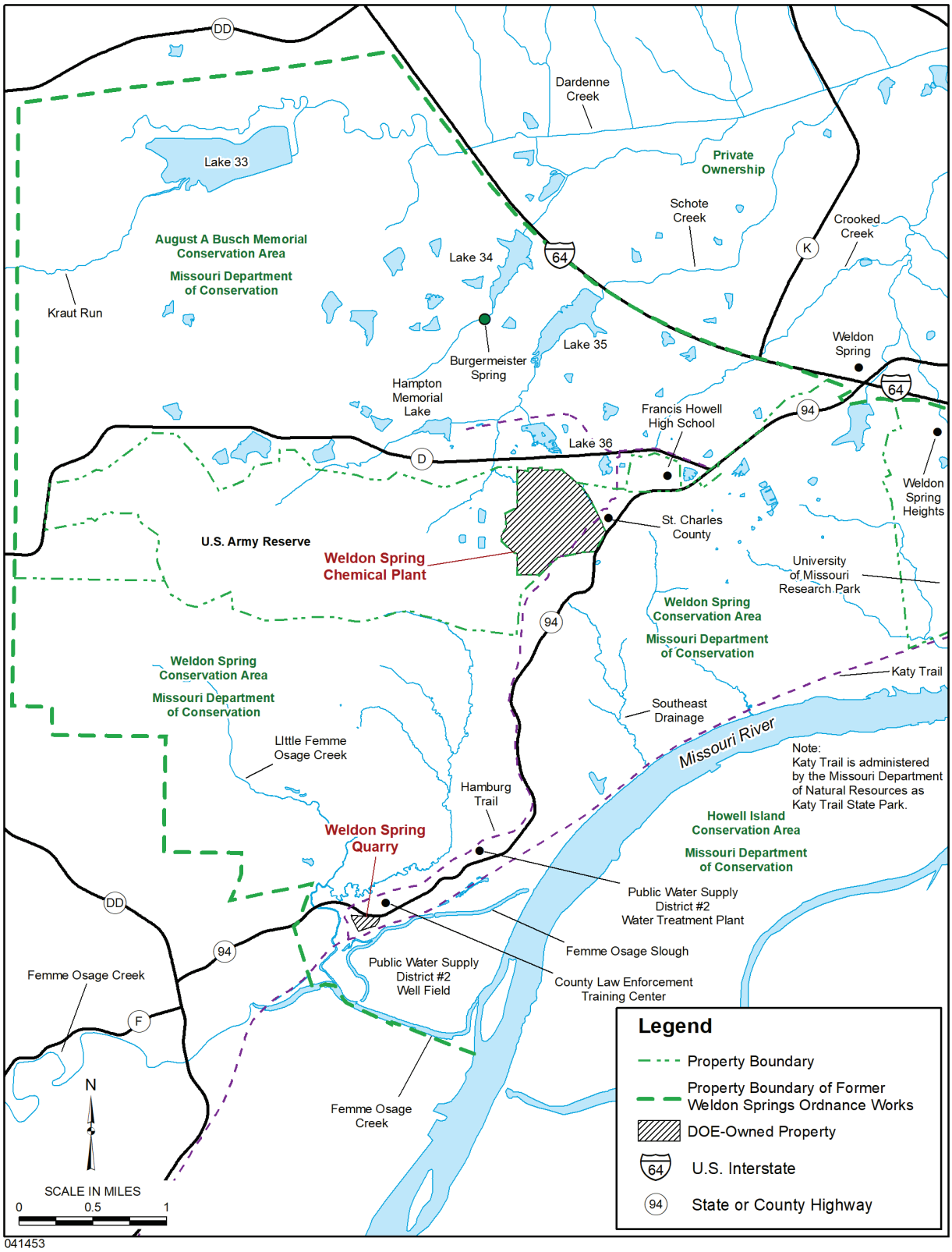

Figure 3. Vicinity Map of the Weldon Spring, Missouri, Site

QAPP Worksheet #11: Project and Data Quality Objectives
(UFP-QAPP Manual Section 2.6.1) (EPA 2106-G-05 Section 2.2.6)

Quality Objectives and Criteria for Measurement Data

The surveillance, monitoring, and maintenance plan for the Weldon Spring Site is in the LTS&M Plan. The LTS&M Plan defines what monitoring and maintenance is required, the frequency of each required activity, and the monitoring and maintenance locations.

Environmental sampling, analysis, and data management required by the LTS&M Plan conforms to this Quality Assurance Project Plan for the Weldon Spring, Missouri, Site and meets the QA/QC requirements in current EPA guidance.

Data Quality

Environmental data for the Weldon Spring Site, derived through ongoing monitoring programs and data interpretation, will be of sufficient quantitative and qualitative value for use in determining whether performance criteria are being met. The type and quality of the data provided to the regulating agencies will be used to document the performance of the remedy and attainment of remedial action goals.

The field and analytical methods chosen for use in completing the work are industry standards and, when used in combination with EPA data quality requirements, are consistent with accepted standards for conducting environmental investigations. Where applicable, method precision, accuracy, and sensitivity are reviewed to determine whether they are sufficient to meet project objectives.

Data quality for sampling and analytical data is described in the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (LMS/PRO/S04351), also known as the SAP. A copy of the SAP is available on the LM public website at https://www.energy.gov/lm/downloads/sampling-and-analysis-plan-us-department-energy-office-legacy-management-sites. Data generated from routine water-sampling activities using procedures specified in the SAP will be of sufficient quality to make defensible decisions regarding compliance with applicable standards, establishment of remediation strategies, assessment of the progress of remedial actions, regulatory issues, and assessment of risk to human health and the environment.

Data of known, documented quality are produced through the following aspects of the SAP:

- Defensible and comprehensive sampling procedures
- Calibration of field instrumentation
- Collection of field quality control (QC) samples
- Documentation of sampling activities
- Training of sampling personnel

- Records management
- Use of accredited commercial laboratories that conform to QSM, and use approved analytical procedures and associated QA/QC requirements specified within the QSM
- Data validation and qualification

Site-specific monitoring requirements for sampling and analytical data are described in the LTS&M Plan.

QAPP Worksheet #12: Measurement Performance Criteria
(UFP-QAPP Manual Section 2.6.2) (EPA 2106-G-05 Section 2.2.6)

Matrix: Water
Analytical Methods Listed in the LTS&M Plan

Data Quality Indicator	QC Sample or Measurement Performance Activity	Measurement Performance Criteria [a]
Overall precision	Field duplicates	A control limit of ±20% RPD for sample results that are greater than 5 times the PQL. For sample results less than 5 times the PQL, the control limit is plus or minus the PQL.
Analytical precision (laboratory)	Laboratory control sample duplicates Matrix spike duplicates	RPD ≤ 20%
Analytical accuracy/bias (laboratory)	Laboratory Control Samples	QSM Appendix C
Analytical accuracy/bias (matrix interference)	Matrix spike duplicates	QSM Appendix C
Overall accuracy/bias (contamination)	Equipment blanks, trip blanks, field blanks, method blanks, calibration blanks	No target analyte concentrations > 1/10 associated sample concentrations
Sensitivity	Low-level calibration check standard	All reported analytes within ± 20% of the true value
Completeness	Completeness check performed during data validation	As specified in the *Environmental Data Validation Procedure* (LMS/PRO/S15870)

Note:
[a] General measurement performance criteria listed. For specific measurement performance criteria for laboratory methodology and field measurement, see the *Environmental Data Validation Procedure* (LMS/PRO/S15870). See worksheet #36 for discussion on comparability and representativeness.

Abbreviations:
PQL = practical quantitation limit
RPD = relative percent difference

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)

Data Acquisition Requirements Through Nondirect Measurements

Data acquired through nondirect measurements may include data from historical databases, literature references, background information from historical facility files, climate data, and regional geology or hydrology descriptions. Generally, these data are ancillary to the project.

Historical data are evaluated in context and a determination is made as to how accurate the data of interest may be. The nature of the evaluation is determined on a case-by-case basis. Information obtained from literature references is from peer-reviewed journals or books whenever possible. Information such as climate data and regional geology or hydrology descriptions is obtained from documents produced by state or federal agencies whenever possible.

Secondary data are from an independent contractor via a grant to DOE from Public Water and Sewer District #2. These data are collected monthly from the active water pump houses and biannually from wells RMW-1, RMW-2, RMW-3, and RMW-4. Data are reviewed, and if results are out of range, then further investigations are discussed with EPA and MDNR.

The Remedial Investigation/Feasibility Study nature and extent of contamination evaluation contains extensive discussion of characterization, data adequacy, and data quality.

QAPP Worksheets #14 and #16: Project Tasks and Schedule
(UFP-QAPP Manual Section 2.8.2) (EPA 2106-G-05 Section 2.2.4)

The LTS&M Plan defines the required project tasks and schedule. This includes monitoring, inspections, and reporting. Other tasks and the associated schedules are developed to support LTS&M Plan requirements. The monitoring locations and schedule are updated in the annual report and Five-Year Review. The updated annual schedule is submitted to the regulators in December of each year. This QAPP will be reviewed on an annual basis to ensure that it remains up to date. The QAPP will remain valid for up to 5 years. The QAPP will be submitted to the regulators every 5 years for reapproval. Any new analytical methods or changes in regulations require an addendum to the QAPP or a separate QAPP for additional investigations not currently defined in the LTS&M Plan.

The project lead defines the scope of the work to be performed, major job steps, and activity hazards. Work planning is coordinated with members of a cross-organizational, matrixed core team of subject matter experts, as applicable, and a project schedule that incorporates work planning and implementation. Work performance activities are developed and updated on an ongoing basis to meet requirements.

All field work is controlled and authorized by the site lead. The site lead authorizes work activities only after verifying that the work activity is within the contractually approved scope, that the work has been adequately defined and planned, that appropriate work controls for safety have been established, and that qualified personnel and necessary equipment are available to safely perform the work activity.

QAPP Worksheet #15: Project Action Limits and Laboratory-Specific Detection and Quantitation Limits
(UFP-QAPP Manual Section 2.6.2.3 and Figure 15) (EPA 2106-G-05 Section 2.2.6)

The principal applicable or relevant and appropriate requirements for the impacted groundwater at the Chemical Plant are the maximum contaminant levels (MCLs) and Missouri Title 10 *Code of State Regulations* Chapter 20 (10 CSR 20-7.031), "Water Quality Standards," which were established in the GWOU ROD (DOE 2004) and are shown in the following table.

Long-term groundwater monitoring for the QROU consists of two programs. Groundwater monitoring is necessary to continue to ensure that uranium-contaminated groundwater has a negligible potential to affect the well field owned by Public Water Supply District No. 2. The first program details the monitoring of uranium and 2,4-DNT south of the slough to ensure that levels remain protective of human health and the environment. The second program consists of monitoring groundwater contaminant levels within the area north of the slough until they attain a predetermined target level indicating negligible potential to affect groundwater south of the slough.

Federal and State Water Quality Standards for the Chemical Plant GWOU

Constituents	Standards	Citations
Nitrate (as N)	10 mg/L	40 CFR 141.62
Total uranium	20 pCi/L[a]	40 CFR 141
1,3-DNB	1.0 µg/L	10 CSR 20-7[b]
2,4-DNT	0.11 µg/L	10 CSR 20-7[b]
NB	17 µg/L	10 CSR 20-7[b]
TCE	5 µg/L	40 CFR 141.61
2,6-DNT	1.3 µg/L	Risk-based[c]
2,4,6-TNT	2.8 µg/L	Risk-based[d]

Notes:
[a] The uranium MCL of 30 µg/L is reported as an activity (20 pCi/L) based on the site conversion factor (680 picocuries per milligram).
[b] Missouri Water Quality Standard.
[c] Risk-based concentration equivalent to 10^{-5} for a residential scenario.
[d] Risk-based concentration equivalent to 10^{-6} for a residential scenario.

Abbreviations:
CFR = *Code of Federal Regulations*
DNB = dinitrobenzene
mg/L = milligrams per liter
µg/L = micrograms per liter
NB = nitrobenzene
pCi/L = picocuries per liter

Uranium concentrations south of the slough and in the area of production wells at the well field remain within the observed natural variation within the aquifer. The MCL for uranium of 20 picocuries per liter (pCi/L) (30 micrograms per liter [µg/L]) has been established as a trigger level only in this area. If concentrations in groundwater south of the slough exceed the MCL of

20 pCi/L, DOE will evaluate risk and take appropriate action as documented in the LTS&M Plan.

Under current conditions, groundwater north of the slough poses no imminent human health risk or impact to the potable water of the well field. A target level of 300 pCi/L for uranium (10% of the 1999 maximum) was established to represent a significant reduction in the contaminant levels north of the slough. The target level for 2,4-DNT has been set at 0.11 µg/L (Missouri Water Quality Standard).

For organic and inorganic analyses, method detection limit is an estimate of the minimum amount of a substance that an analytical process can reliably detect. Method detection limits are a component of analytical sensitivity. A method detection limit is analyte and matrix specific and may be laboratory dependent. The laboratory shall determine the method detection limit for the method for each target analyte of concern in the quality system matrixes as specified in the QSM. All sample processing steps of the analytical method shall be included in the determination of the method detection limit.

Reporting limits for organic and inorganic analyses shall be the required detection limits as defined by the SOW and related requirements documents.

For radiochemical analysis, the minimum detectable limit is reported. The minimum detectable limit is the smallest amount (activity), expressed in terms of concentration, of an analyte in a sample that will be detected with a beta (β) probability of nondetection (Type II error) while accepting an alpha (α) probability of erroneously deciding that a positive(nonzero) quantity of analyte is present in an appropriate blank sample (Type I error). The α and β probabilities are both set at 0.05 unless otherwise specified.

All analytes listed on this worksheet are covered by the SAP.

Matrix: Water, Analytical Method: 6010

Analyte	CAS Reference Number	Laboratory-Specific MDL (µg/L)	Laboratory-Specific PQL (µg/L)
Iron	7439-89-6	33	165

Abbreviations:
CAS = Chemical Abstracts Service
MDL = method detection limit
PQL = practical quantitation limit

Matrix: Water, Analytical Method: SW-846 6020

Analytes	CAS Reference Numbers	Laboratory-Specific MDL (µg/L)	Laboratory-Specific PQL (µg/L)
Arsenic	7440-38-2	2	10
Uranium	7440-61-1	0.067	0.335
Barium	7440-39-3	0.67	20.0
Chromium	7440-47-3	3.0	10.0
Cobalt	7440-48-4	0.3	50.0
Copper	7440-50-8	0.3	3.0
Lead	7439-92-1	0.5	2.0
Manganese	7439-96-5	1.0	5.0
Nickle	7440-02-0	0.6	10.0
Selenium	7782-49-2	1.5	5.0
Silver	7440-22-4	0.3	1.0
Thallium	7440-28-0	0.6	4.0
Zinc	7440-66-6	3.3	15.0

Abbreviations: CAS = Chemical Abstracts Service, MDL = method detection limit, PQL = practical quantitation limit

Matrix: Water, Analytical Method: EPA 353.2

Analyte	CAS Reference Number	Laboratory-Specific MDL (µg/L)	Laboratory-Specific PQL (µg/L)
Nitrate + nitrite as nitrogen	NA	17	85

Abbreviations: CAS = Chemical Abstracts Service, MDL = method detection limit, NA = not applicable, PQL = practical quantitation limit

Matrix: Water, Analytical Method: 9056

Analyte	CAS Reference Number	Laboratory-Specific MDL (µg/L)	Laboratory-Specific PQL (µg/L)
Sulfate	14808-79-8	300	665

Abbreviations: CAS = Chemical Abstracts Service, MDL = method detection limit, PQL = practical quantitation limit

Matrix: Water, Analytical Method: 8535SM2540C

Analyte	CAS Reference Number	Laboratory-Specific MDL (µg/L)	Laboratory-Specific PQL (µg/L)
Total dissolved solids	10-33-3	30	190

Abbreviations: CAS = Chemical Abstracts Service, MDL = method detection limit, PQL = practical quantitation limit

Matrix: Water, Analytical Method: EPA903.1 Modified

Analyte	CAS Reference Number	Laboratory-Specific MDL (pCi/L)	Laboratory-Specific PQL (pCi/L)
Radium 226	7440-14-4	1	5

Abbreviations: CAS = Chemical Abstracts Service, MDL = method detection limit, PQL = practical quantitation limit

Matrix: Water, Analytical Method: EPA904.0, SW-846 9320 Mod

Analyte	CAS Reference Number	Laboratory-Specific MDL (pCi/L)	Laboratory-Specific PQL (pCi/L)
Radium 228	15262-20-1	1	5

Abbreviations: CAS = Chemical Abstracts Service, MDL = method detection limit, PQL = practical quantitation limit

Matrix: Water, Analytical Method: SW-846 3510C

Analyte	CAS Reference Number	Laboratory-Specific MDL (µg/L)	Laboratory-Specific PQL (µg/L)
PAH	50-32-8	5	25

Abbreviations: CAS = Chemical Abstracts Service, MDL = method detection limit, PAH = polycyclic aromatic hydrocarbon, PQL = practical quantitation limit

Matrix: Water, Analytical Method: SW-846 8082

Analyte	CAS Reference Number	Laboratory-Specific MDL (µg/L)	Laboratory-Specific PQL (µg/L)
PCB	11096-82-5	5	25

Abbreviations: CAS = Chemical Abstracts Service, MDL = method detection limit, PCB = polychlorinated biphenyl, PQL = practical quantitation limit

Matrix: Water, Analytical Method: SW-846 8321A

Analyte	CAS Reference Number	Laboratory-Specific MDL (µg/L)	Laboratory-Specific PQL (µg/L)
1,3-DNB	99-65-0	0.10	0.022
1,3,5-TNB	99-34-4	0.10	0.023
2,4,6-TNT	118-96-7	0.10	0.030
2,4-DNT	121-14-2	0.10	0.027
NB	98-95-3	0.15	0.028
2,6-DNT	606-20-2	0.10	0.025

Abbreviations: CAS = Chemical Abstracts Service, MDL = method detection limit, NB = nitrobenzene, PQL = practical quantitation limit, TNB = trinitrobenzene

Matrix: Water, Analytical Method: EPA 900.0

Analyte	CAS Reference Number	Laboratory-Specific MDL (µg/L)	Laboratory-Specific PQL (µg/L)
Gross Alpha	NA	1.17	4.0

Abbreviations: CAS = Chemical Abstracts Service, MDL = method detection limit, NA = not applicable, PQL = practical quantitation limit

Matrix: Water, Analytical Method: TH-01-RC Modified

Analyte	CAS Reference Number	Laboratory-Specific MDL (µg/L)	Laboratory-Specific PQL (µg/L)
Thorium, isotopic	7440-29-1	0.33	1.00

Abbreviations: CAS = Chemical Abstracts Service, MDL = method detection limit, PQL = practical quantitation limit

Matrix: Water, Analytical Method: SM2540 D

Analyte	CAS Reference Number	Laboratory-Specific MDL (µg/L)	Laboratory-Specific PQL (µg/L)
Total Suspended Solids	NA	1.10	3.0

Abbreviations: CAS = Chemical Abstracts Service, MDL = method detection limit, NA = not applicable, PQL = practical quantitation limit

Matrix: Water, Analytical Method: SW-846 8260B

Analyte	CAS Reference Number	Laboratory-Specific MDL (µg/L)	Laboratory-Specific PQL (µg/L)
VOCs	7550-45-0	0.33	1.00

Abbreviations: CAS = Chemical Abstracts Service, MDL = method detection limit, PQL = practical quantitation limit, VOC = volatile organic compound

QAPP Worksheet #17: Sampling Design and Rationale
(UFP-QAPP Manual Section 3.1.1) (EPA 2106-G-05 Section 2.3.1)

Sampling Process Design

The sampling design and rationale were developed through the Weldon Spring Site CERCLA process, including characterization and remediation efforts. The end result is defined in the LTS&M Plan, which is a regulatory agreement among the DOE, MDNR, and EPA. Through the postclosure era at the Weldon Spring Site, the requirement is to monitor as defined in the LTS&M Plan. This includes details such as the specific locations, analytical suites, minimum monitoring frequency, data evaluation, and related topics.

The LTS&M Plan serves as the primary document to communicate how the requirements of the RODs are implemented at the Weldon Spring Site. The LTS&M Plan summarizes how LM will fulfill its LTS&M obligations.

The data obtained through monitoring site conditions will be of sufficient quantity and quality to achieve project objectives.

Changes to sampling frequency and strategies may be proposed based on analytical results, site conditions, or changes to applicable regulations. The locations and schedule are updated in the annual report and Five-Year Review. The annual schedule is submitted to the regulators in December of each year.

It may be necessary and beneficial to conduct sampling at nearby monitoring locations or to increase sampling frequency to confirm data trends or results. No new or additional analytical methods are expected to be needed; however, should additional analytical methods be necessary, an addendum to the QAPP would be created and sent for review and approval.

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)

Required routine sampling locations are defined in the LTS&M Plan. The locations and schedule are updated in the annual report and Five-Year Review. The updated annual schedule is submitted to the regulators in December of each year. Procedures for environmental sampling, analysis, and data management for the Weldon Spring Site are provided in the SAP maintained by the LMS contractor. The SAP contains site-specific appendixes that detail site-specific methods. Additional internal procedures maintained by the LMS contractor provide applicable site-specific details.

Field measurements and sample collection will follow the above-listed procedures or nationally recognized consensus standards such as EPA methods, ASTM International standards, or instrument manufacturer recommended procedures. Deviation from approved procedures requires approval by the project manager before the start of work.

QAPP Worksheets #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)

Procedures for environmental sampling, analysis, and data management for the Weldon Spring Site are provided in the SAP. The SAP contains site-specific appendixes that detail site-specific methods. Field measurements and sample collection will follow procedures in the SAP or nationally recognized consensus standards such as EPA methods, ASTM International standards, or instrument manufacturer recommended procedures. Deviation from approved procedures requires approval by the project manager before the start of work.

Sample Collection Procedures

Water-sampling procedures used for all LM sites are defined in the SAP.

Procedures established in the SAP and relevant requirements identified in this QAPP must be followed for documenting field activities and delivering the samples to the laboratory. Procedures will identify the methods used to obtain representative field measurements and samples of specified media. The procedures will identify the equipment, instruments, and sampling tools that are needed and, where appropriate, performance criteria (e.g., special handling, operational checks, field calibrations) to ensure the quality of the field data.

The sampling lead is responsible for ensuring that inspections, operations and maintenance activities, field measurements, and specified samples are properly documented, occur at the prescribed frequency and locations, and are obtained in compliance with procedures and requirements specified in the project documents. Daily QC checks and data reviews will ensure that requirements have been met. If field conditions prevent inspections, required field measurements, or specified sample collection, the conditions will be fully documented in the field computer as a field variance. The appropriate technical staff will be notified of such deviations. Variances will be summarized in the appropriate reports.

Field Measurements and Sampling Methods

The LTS&M Plan presents the background and objectives of the monitoring program. Field measurements and sampling schedules are detailed in these plans. The data obtained through these activities are used to monitor compliance with requirements.

Field procedures used in field measurements, sample collection methods, field data, equipment and supplies applicable to the field activities, sample preservation requirements, and QC sample requirements are described in the SAP.

Preparation and Decontamination Requirements for Sampling Equipment

Requirements for Sample Containers, Preservation, and Holding Times
Container Requirements

Sample containers will be new and precleaned to EPA standards. Certificates of cleanliness, when utilized, will be kept on file. Containers will be of an adequate size to contain the required sample volume and of an approved material (e.g., amber or clear glass or high-density polyethylene) that does not promote sample degradation. Suspect containers will be d**i**scarded in a manner that will preclude their inadvertent use, or they will be tagged and segregated for return to the supplier.

Preservation and Holding Times

Efforts to preserve the integrity of the samples (e.g., using chemical additives or temperature-controlled storage) will be maintained as appropriate from the time the containers are filled, throughout the sample collection and shipping process, and will continue until all analyses are performed. Procedures that will be used to collect and preserve the integrity of the samples are described in the SAP. Holding times will be observed for all analyses. Holding time is the amount of time allowed between sample collection and sample analysis and those for typical analyses are listed in the SAP. If a holding time is exceeded, a judgment on the impact on data quality will be made during the data validation process, and qualification of the affected data may be required.

Decontamination Procedures and Materials

Nondedicated equipment used in obtaining samples will be visually inspected and decontaminated before use at each sample location as specified in the SAP. Measures will be taken (e.g., storage in marked separate areas) to protect clean or decontaminated equipment while it is not being used. Sample containers will be inspected for integrity and cleanliness before being used.

Where practical, dedicated pumps will be installed in monitor wells, sample ports will be used at treatment systems, and disposable materials will be used to minimize the decontamination requirements. The final rinse following equipment decontamination will be collected as an equipment blank QC sample, in accordance with the type and frequency prescribed in the SAP. Procedures to decontaminate nondedicated sampling equipment are provided in the SAP.

Information regarding sample containers, preservation and hold times are included in the following table:

Sample Containers, Preservation, and Hold Times

Analyte or Analyte Group	Matrix	Methods	Containers (number, size and type per sample)	Preservation	Holding Time (days)	Standard Deliverables Turnaround Time (days)
Nitrogen, nitrate + nitrite	Water	353.2	125 mL HDPE bottle	H_2SO_4 to pH < 2 Cool to 0–6°C	28	28
Metals[a]	Water	6010D/6020	250 mL HDPE bottle	HNO_3 to pH < 2	180	28
Sulfate	Water	7470	250 mL HDPE bottle	Cool to 0–6°C	28	28
Volatiles	Water	8260B	3, 40 mL VOA vials	Cool to 0–6°C HCl pH < 2	14	28
Radium 226	Water	EPA903.1 Mod	4 L HDPE	HNO_3	182	28
Radium 228	Water	EPA 904.0 SW-846 9320 Mod	4 L HDPE	HNO_3	182	28
Nitroaromatic	Water	8321A	1 L amber glass	Cool to 0–6°C	7	28
PAH compounds	Water	SW-846 3510C	2 L amber glass	Cool to 0–6°C	14	28
Thorium isotopes	Water	HASL-300, Th-01-RD Mod	1 L HDPE	HNO_3	182	28
PCBs	Water	SW-846 8082	2 L amber glass	Cool to 0–6°C	365	28
COD	Water	EPA 410.4	250 mL HDPE	H_2SO_4 to pH < 2 Cool to 0–6°C	28	28
TSS	Water	SM2540 D	1 L HDPE	Cool to 0–6°C	7	28
TDS	Water	SM2540 C	125 mL HDPE	Cool to 0–6°C	28	28

Note:
[a] Includes uranium.

Abbreviations:
COD = chemical oxygen demand
HDPE = high-density polyethylene
HNO_3 = nitric acid
H_2SO_4 = sulfuric acid
L = liters
mL = milliliters
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
TDS = total dissolved solids
TSS = total suspended solids
VOA = volatile organic analyte

QAPP Worksheet #20: Field QC Summary
(UFP-QAPP Section 3.1.1 and 3.1.2) (EPA 2106-G-05 Section 2.3.5)

Field QA/QC

A variety of instruments, equipment, sampling tools, and supplies will be used to collect samples and to monitor site conditions. Proper inspection, calibration, maintenance, and use of the instruments and equipment are required to ensure field-data quality. In addition, field QA will be implemented through the use of approved standard operating procedures (SOPs), proper cleaning, decontamination, protective storage of equipment and supplies, and timely data reviews during field activities. The QC objective of these data collection activities is to obtain reproducible and comparable measurements to a degree of accuracy consistent with the intended use of the data.

QC samples will consist of field duplicates, equipment rinsate blanks, and trip blanks as appropriate for the matrix and analytes involved. An additional volume of groundwater for selected organic analyses will be collected for matrix spike/matrix spike duplicate (MS/MSD) use, as requested by the laboratory. Requirements for QC samples are specified in Section 5.0 of the SAP. Field QC samples will be used to quantitatively and qualitatively evaluate the analytical performance of the laboratory and to assess external and internal effects on the accuracy and comparability of the reported results. Field QC samples will be uniquely identified in a manner consistent with the project sample-numbering scheme. Additional groundwater sample volume collected for MS/MSD use by the laboratory will receive the same identification as the investigative sample.

Only water samples are collected for routine chemical analysis at the site. QA/QC samples that support those samples are also routinely collected and include:

- Trip blanks, collected at a frequency of one per sample cooler containing “real” field samples that are to be analyzed for volatile organic compounds.
- Field duplicates, collected at a frequency of one per 20 “real” samples analyzed for the same constituent(s).
- Equipment blanks, collected at a frequency of one per 20 “real” samples collected with reusable equipment that must be decontaminated between locations.

QA/QC samples that are not collected on a routine basis include field blanks and spiked samples. Laboratory QA/QC samples are prepared by the laboratory in accordance with the QSM.

Field Measurement Data Comparison

Where applicable, field measurement data will be compared to previous measurements obtained at the same location. Large variations (greater than 30%) in field measurement data at a location will be examined to evaluate whether general trends are developing. Variations in data that cannot be explained will be assigned a lower level of confidence through assignment of qualifiers or will be flagged for additional sampling or evaluation.

QAPP Worksheet #21: Field SOPs
(UFP-QAPP Manual Section 3.1.2) (EPA 2106-G-05 Section 2.3.2)

SOP Number or Reference	Title, Revision, Date, and URL (if available)	Originating Organization	SOP option or Equipment Type (if SOP provides different options)	Modified for Project? Y/N	Comments
LMS/PRO/S04351	*Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* https://www.energy.gov/lm/downloads/sampling-and-analysis-plan-us-department-energy-office-legacy-management-sites	LMS contractor, Environmental Monitoring Operations	Details in the document	Y	Program directives in Appendix A of the SAP

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)

Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites

Field instruments must be calibrated before a sampling event begins. For occupied sites that sample continually and do not sample in distinct events, field instrumentation will be calibrated at least monthly. Calibration and operational check requirements for field instruments are shown in the following table. If the acceptance criteria are not met during the operational check, then a primary calibration of the affected probes and instruments must be conducted.

Calibration and Operational Check Requirements for Field Instruments

Parameters	Requirements	Frequency	Operational Check Criteria
pH	3-point calibration	Prior to start of sampling event	NA
	1-point check with pH 4, 7, or 10 buffer	Daily and at end of sampling event	±0.2 pH s.u.
Specific conductance	1-point calibration	Prior to start of sampling event	NA
	1-point operational check	Daily and at end of sampling event	±10% of standard
Oxidation-reduction potential	1-point calibration	Prior to start of sampling event	NA
	1-point operational check	Daily and at end of sampling event	±10% of standard
DO	Calibration in water-saturated air	Prior to start of sampling event	NA
	1-point operational check in water saturated air	Daily and at end of sampling event	±0.3 mg/L of theoretical DO in water-saturated air
Turbidity	3 or 4-point calibration	Every 3 months	NA
	3-point operational check	Daily and at end of sampling event	±10% of standard
Temperature	Operational check	Prior to start of sampling event	±1.5 °C compared to NIST-traceable thermometer

Abbreviations:
DO = dissolved oxygen
mg/L = milligrams per liter
NA = not applicable
NIST = National Institute of Standards and Technology
s.u. = standard unit

QAPP Worksheet #23: Analytical SOPs
(UFP-QAPP Manual Section 3.2.1) (EPA 2106-G-05 Section 2.3.4)

Analytical Methods

Laboratories shall perform routine sample analyses as specified by line item code for the constituents or analytical packages specified in an attachment to the SOW provided by the LMS contractor. The analytical techniques and methods to be used are listed in the attachment. The laboratory shall have SOPs that detail how the required method or technique is implemented. Method performance shall meet the requirements specified in the QSM.

Required analytical methods are documented in Appendix A of the SAP.

Subcontracted Laboratory Requirements

Laboratories providing analytical services must meet the general QA requirements documented in the QSM, the primary analytical services requirements document for LM. Compliance with the QSM will be verified biennially by audit by the applicable accreditation body.

Data turnaround times, sample disposition, and other requirements of the analytical laboratory are identified in procurement documents (e.g., the SOW).

Work submitted to the laboratory may not be subcontracted by the laboratory without prior consent from the laboratory coordinator. From the analytical methods listed in the following table, each laboratory develops its own detailed SOPs in compliance with the QSM. The adequacy of a laboratory's SOPs is demonstrated through laboratory accreditation.

QAPP Worksheet #24: Analytical Instrument Calibration
(UFP-QAPP Manual Section 3.2.2) (EPA 2106-G-05 Section 2.3.6)

Field Equipment and Instruments

Field equipment, instruments, and associated supplies used to obtain field measurements and collect samples are described in the SAP and in site-specific documents.

Field personnel will conduct visual inspections and operational checks of field equipment and instruments before they are carried to the field and before using the equipment or instruments in field-data collection activities. Whenever any equipment, instrument, or tool is found to be defective or fails to meet project requirements, it will not be used, and, as appropriate, it will be tagged defective and segregated to prevent inadvertent use. The sampling team lead is responsible for the overall maintenance, operation, calibration, and repairs to field equipment, instruments, and tools. The sampling team lead is also responsible for ensuring that the field records have adequate documentation that describes any maintenance, repairs, and calibrations performed in the field.

Equipment and instruments used to obtain data will be maintained and calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturers' specifications. Calibration of equipment and instruments will be performed at approved intervals, as specified by the manufacturer, or more frequently as conditions dictate. Calibration standards used as reference standards will be traceable to the National Institute of Standards and Technology or with other recognized standards when available.

In some instances, calibration periods will be based on usage rather than periodic calibration. Equipment will be calibrated or checked as a part of its operational use. Calibrations and operational checks will be performed and documented in accordance with the SAP.

Instrument and Equipment Calibration and Frequency

Calibration procedures for field equipment are described in the SAP, Appendix A.

Calibration of analytical laboratory equipment will be based on requirements specified in the QSM, which includes approved written procedures. The concentration of standards and frequency of initial and continuing calibration of analytical instruments will be as specified in the laboratory SOPs. The analytical laboratory will maintain calibration records. Calibration data will be provided with the analytical data package, as specified in the procurement documents.

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)

Field Equipment and Instruments

Field equipment, instruments, and associated supplies used to obtain field measurements and collect samples are described in the SAP and in the LTS&M Plan.

Field personnel will conduct visual inspections and operational checks of field equipment and instruments before they are carried to the field and before using the equipment or instruments in field-data collection activities. Whenever any equipment, instrument, or tool is found to be defective or fails to meet project requirements, it will not be used, and as appropriate, it will be tagged defective and segregated to prevent inadvertent use. The sampling team lead is responsible for the overall maintenance, operation, calibration, and repairs made to field equipment, instruments, and tools. The sampling team lead is also responsible for ensuring that the field records have adequate documentation that describes any maintenance, repairs, and calibrations performed in the field.

Equipment preventive maintenance is performed as recommended by the manufacturer. Equipment users (e.g., field samplers) are responsible for ensuring that routine maintenance is performed and that tools and spare parts used to conduct routine maintenance are available.

Laboratory Equipment and Instruments

As part of the QA/QC program for the analytical laboratory, routine preventive maintenance is conducted to minimize the occurrence of instrument failure and other system malfunctions. Laboratory instruments will be maintained in accordance with the manufacturers' specifications. The laboratory may perform routine maintenance or arrange for vendor maintenance and repair service, as required.

The LMS contractor contracts with laboratories that operate under the requirements of the QSM. The QSM is based on ISO/IEC 17025:2005(E), ISO/IEC 17025:2017(E), and Volume 1 of The NELAC Institute Standards, Volume 1 (TNI 2009). Requirements for analytical instrument and equipment maintenance, testing, and inspection are documented in the QSM, Section 5.5.

QAPP Worksheets #26 and #27: Sample Handling, Custody, and Disposal
(UFP-QAPP Manual Section 3.3) (EPA 2106-G-05 Section 2.3.3)

Sample Handling and Custody Requirements

The SAP specifies LM SOPs are used in environmental monitoring activities and is implemented at most sites managed by LM. This document provides detailed procedures for the field sampling teams so that samples are collected in a consistent and technically defensible manner.

Sample handling, custody, and shipping procedures are addressed in the SAP and supplemental implementing procedures. A minimum number of individuals should be involved in sample collection and handling to ensure integrity of the sample and compliance with custody procedures. All samples collected must be properly labeled as specified in the SAP. To maintain the integrity of the sample, proper preservation, storage, and shipping methods will be used.

Unused sampling equipment, sample containers, and coolers that have been shipped or transported to a sampling location will be kept in a clean, temperature-controlled, and secure location to minimize damage, tampering, degradation, and possible cross-contamination.

Identification, Handling, Packaging, and Storage

Sample Identification

Environmental samples and associated QC samples will be assigned a unique identification number. In addition to the unique number, QC samples will be assigned a fictitious location identifier.

Samples will be identified by a label or container markings attached to the sample container that specifies, as appropriate, the project, sample location, unique identification number, preservatives added, date and time collected, and the sampler's name. Sample labels or container markings should be completed with indelible (waterproof) ink. Clear tape may be placed over each sample label for added protection, if needed.

Sample Handling and Storage

During field collection, sample containers may be stored in boxes, trays, or coolers, as dictated by protection and preservation needs. Samples that require refrigeration will be stored in coolers with sufficient ice (or, if appropriate, ice packs such as "blue ice") to maintain the required temperature controls during field collection, packaging, and shipping. Samples that are not transported to the laboratory the day of collection must be stored in containers (including a designated sample refrigerator, if refrigeration is appropriate or required) that will prevent damage or degradation of the sample. In addition, samples must be stored in locked containers, vehicles, or buildings when they are out of the direct control of the responsible custodian. Samples stored overnight or at locations where access is not solely controlled by the contractor will have custody seals placed on the outside of the container (cooler or box) as a measure of security.

Sample Custody

To ensure the integrity of the sample, the field custodian is responsible for the care, packaging, and custody of the samples until they are transferred to the laboratory. The procedures described in the SAP will be implemented to provide security and to document sample custody.

Chain of custody (COC) forms will be used to list all samples and transfers of sample possession from contractor personnel to other noncontractor personnel to provide documentation that the samples were in constant custody between collection and analysis. The completed chain of custody form, a copy of which is retained by the originator, will accompany samples that are sent or transported to the analytical laboratory. Figure 4 is an example of the COC form used at the Weldon Spring Site.

Sample Packaging and Shipping

All samples will be handled, packaged, and transported or shipped in accordance with applicable U.S. Department of Transportation requirements. Sample storage containers (e.g., boxes or coolers) and sample containers will be securely packaged to protect the contents from damage, spilling, leaking, or breaking. Void space in shipping containers should be filled with an inert material or additional ice, if appropriate, to further protect and secure the contents.

Custody seals are not required for containers or samples that are transported by contractor personnel and taken directly to the analytical laboratory for analysis or interim storage. Custody seals are required for shipping containers (e.g., coolers or boxes) that are sent by common carrier. Clear tape should be placed over the seals as protection against tearing during shipment.

Mailed sample packages will be registered with return receipt requested or otherwise tracked online. Carrier receipts and associated documentation are retained as part of the chain of custody documentation and maintained with the chain of custody records.

Laboratory Requirements

Laboratory Sample Receipt

The subcontracted analytical laboratory personnel are responsible for the care and custody of samples from the time they are received until the time the sample is analyzed and archive portions are discarded. On arrival at the laboratory, laboratory personnel must examine the container and document the receiving condition, including the integrity of custody seals, when applicable. When opening the shipping container, laboratory personnel will examine the contents and record the condition of the individual sample containers (e.g., bottles broken or leaking), the temperature (when applicable), method of shipment, carrier name(s), and other information relevant to sample receipt and login. Laboratory personnel will verify that the information on the sample containers matches the information on the chain of custody form.

Discrepancies Identified During Sample Receipt

If discrepancies are identified during the sample receiving process, laboratory personnel will document the discrepancies on the sample receiving form and contact the laboratory coordinator for resolution.

If the laboratory judges the sample integrity to be questionable (e.g., samples arrive damaged or leaking, or the temperature range is exceeded), the laboratory coordinator will be contacted for further instructions. Damaged samples may be rescheduled for collection and analysis, if necessary.

Sample Disposition

Unused sample portions are retained by the laboratory for a minimum of 60 days from the time of receipt of the final report. The laboratory is solely responsible for lawful disposal of all LM samples after the 60-day sample storage requirement is fulfilled, if the exceptions given in items (a) or (b) below do not apply:

(a) LM may request that samples from a specific task be returned to LM.

(b) If, due to the nature of the samples, the laboratory has no outlet for disposal or disposal is prohibitively expensive, then samples may be returned to LM.

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Chain of Custody / Sample Submittal Form

Print COC
Ver 6.4.2.1

Task Code:	WEL01-02.2207023	COC ID:	WEL01-02.2207023_COC.1	TURNAROUND TIME:	28

PROJECT INFORMATION		LABORATORY			SAMPLING / SHIPPING	
Facility Name	Weldon Spring Site (Chemical Plant)	Lab Name:	GEL Laboratories LLC		Shipping Company:	
Project Number	LMIDIQ.002.00.02.01.090.CWS203	Address:	2040 Savage Road		Tracking Number:	
Project Name:	Weldon Spring LTS&M	City:	Charleston	State: SC	Cooler Count:	
		Postal Code:	29407		Date Shipped:	
		Phone Number:	843-556-8171		Sampled by:	
		PO Number:				
					Sampler 2:	

SAMPLE DETAILS | ANALYSIS REQUESTED | Filtered - F: Field, L: Lab, FL: Field & Lab, N: None

								Container	HDPE 250 ML	HDPE 125 ML										
								Filtered	N	N										
								Preserv.	HNO3	4 C, H2SO4										
								ANALYSIS	LMM02: U	Nitrate+Nitrite as N										
Sample ID	Location	Matrix	Date	Time (24hr)	G=Grab C=Comp	QC	# of Cont	X = shared container												
WEL01-02.2207023-001	MW-4043	GW			G		2		1 N	1 N										
WEL01-02.2207023-022	MW-3026	GW			G		2		1 N	1 N										
WEL01-02.2207023-027	MW-4007	GW			G		2		1 N	1 N										
WEL01-02.2207023-036	MW-4036	GW			G		2		1 N	1 N										
WEL01-02.2207023-037	MW-4040	GW			G		2		1 N	1 N										
WEL01-02.2207023-038	MW-4041	GW			G		2		1 N	1 N										
WEL01-02.2207023-039	MW-4042	GW			G		2		1 N	1 N										
WEL01-02.2207023-041	MW-8002	SW			G		2		1 N	1 N										
WEL01-02.2207023-043	MWD-2	GW			G		2		1 N	1 N										
WEL01-02.2207023-044	MWS-1	GW			G		2		1 N	1 N										

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS	RELINQUISHED BY	DATE/TIME	ACCEPTED BY	DATE/TIME

Figure 4. Example of COC Form Used to Document Sample Transfers from the Weldon Spring, Missouri, Site

QAPP Worksheet #28: Analytical QC and Corrective Action
(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6) (EPA 2106-G-05 Section 2.3.5)

Laboratory QC

Laboratory QC is designed to detect, reduce, and correct deficiencies in a laboratory's internal analytical processes to improve the quality of the results reported by the laboratory. The QC system includes measurement performance criteria for data quality indicators (DQIs). DQIs provide a measure of the accuracy, bias, and precision of the reported results as follows:

Accuracy: Accuracy is the closeness of a measured result to an accepted reference value. Accuracy is usually measured as a percent recovery. QC analyses used to measure accuracy include standard recoveries, laboratory control samples, spiked samples, and surrogates.

Bias: Bias is the systematic or persistent distortion of a measurement process that causes error in one direction (e.g., the sample measurement is consistently lower than the sample's true value). Analytical bias can be assessed by comparing a measured value in a sample of known concentration to an accepted reference value or by determining the recovery of a known amount of contaminant spiked into a sample (the MS).

Precision: Precision is the agreement among a set of replicate measurements. Analytical precision is estimated by duplicate or replicate analyses, usually on laboratory control samples, spiked samples, or field samples. The most commonly used estimates of precision are the relative standard deviation and, when only two samples are available, the relative percent difference (RPD).

QC Methods are shown in the following table.

Matrix: Water
Analytical Methods Listed in the LTS&M Plan

QC Samples	Number/ Frequency	Methods/SOP Acceptance Criteria[b]	Corrective Actions	Project-Specific MPC
MB	One per preparatory batch	The absolute values of all analytes must be <½ LOQ or <1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Correct problem. If required, re-prep and reanalyze MB and all QC samples and field samples processed with the contaminated blank.	The absolute values of all analytes must be <1/10 the amount measured in any sample
Calibration blank	Immediately after the ICV and immediately after every CCV	The absolute values of all analytes must be <½ LOQ or <1/10 the amount measured in any sample	All samples following the last acceptable calibration blank must be reanalyzed.	The absolute values of all analytes must be <1/10 the amount measured in any sample
LCS	One per preparatory batch	QSM[a], Appendix C	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available.	QSM[a], Appendix C
MS	One per preparatory batch	QSM[a], Appendix C	Examine the project-specific requirements. Contact the laboratory coordinator if additional guidance is needed.	QSM[a], Appendix C
MSD or MD	One per preparatory batch	MSD or MD: RPD of all analytes ≤20% (between MS and MSD or sample and MD)	Examine the project-specific requirements. Contact the laboratory coordinator if additional guidance is needed.	RPD ≤ 20%
Low-level calibration check standard	Daily	All reported analytes within ±20% of the true value	Correct problem and repeat calibration.	All reported analytes within ±20% of the true value

Note:
[a] As referenced in the QSM (DOD and DOE 2017).
[b] General methods/SOP acceptance criteria listed. For specific methods/SOP acceptance criteria for laboratory methodology, see the *Environmental Data Validation Procedure* (LMS/PRO/S15870).

Abbreviations:
CCV = calibration check verification
ICV = initial calibration verification
LCS = laboratory control sample
LOQ = limit of quantitation
MB = method blank
MD = matrix duplicate
MPC = measurement performance criteria

QAPP Worksheet #29: Project Documents and Records
(UFP-QAPP Manual Section 3.5.1) (EPA 2106-G-05 Section 2.2.8)

Documentation and Records

Electronic distribution of this QAPP through the LM portal will ensure that personnel have the most recent version of this the document. The QAPP will also be posted to the LM public website.

LMS records requirements are specified in the LMS *Quality Assurance Manual* (LMS/POL/S04320) and records procedures. LTS&M Plans describe specific documentation and records requirements for each site.

Field and laboratory data are sufficiently documented to provide a scientifically defensible record of the activities and analyses performed. Records of field variance reports, internal reviews, field and laboratory records of tests and analyses, field logs, chain of custody forms, and project reports are used, as appropriate, to interpret and assess the usability of the data. Standardized forms and computer files, codes, programs, and printouts are designed to eliminate errors made during data entry and reduction. Calculation steps are described in the technical and analytical procedures and software lists. Routine data-transfer and data-entry verification checks are performed.

Records File Plans

Site-specific file plans have been prepared to identify the records to be generated, file locations, and retention schedule for each LM CERCLA site. The file plans are augmented by *Records and Information Management* (LM Policy-1-11-1.0), which is maintained by the LMS contractor and establishes the requirements for preparing, preserving, and storing records. Project personnel will work with the Information Management lead to ensure that project records are correctly identified and maintained in accordance with the applicable file plan. Modifications to the file plans shall be submitted to the Information Management lead and are subject to review and approval by the project manager.

All records generated during the sampling and analytical process, including analytical reports, field-data sheets, field calibration records, trip reports, chain of custody forms, and data validation documentation, are stored electronically in a task-specific folder in a protected network location. After all the information is completed, the designated records coordinator in the Information Management organization captures the contents of the folder for inclusion as records. Retention time for these records is 75 years.

The FFA specifies in Section XIX, “Record Retention,” that:

> The PARTIES shall attempt to reach agreement as to the continued need for records prior to the end of the records’ applicable record retention periods. If such agreement is not reached, DOE shall provide written notice to EPA and MDNR when a record retention Weldon Spring Site Federal Facility Agreement period has

> elapsed. The notice shall contain the following information: (1) the records data that the National Archives sends to DOE with respect to documents covered by the Notice of Eligibility for Disposal, and (2) the DOE contact point with respect to the records, if it is someone other than the DOE Project Manager. EPA and MDNR shall have 60 days from receiving this notice to provide any comments and recommendations as to the continued need for some or all of the documents. If DOE decides not to retain any records that EPA or MDNR recommend be kept, DOE shall so notify EPA and MDNR at least ten (10) business days prior to authorizing the destruction of these records. DOE shall, as requested by EPA or MDNR, either retain these records for an additional time period or transfer custody of the records to EPA or MDNR.

Document Control and Changes

Company policy and procedures will be followed to ensure that the preparation, issuance, and revisions to project documents and forms will be controlled so that current and correct information is available at the work location. These project documents (e.g., plans, procedures, drawings, and forms) and subsequent revisions will be reviewed for adequacy and approved before being issued for use. Written records and photo documentation will be handled in a manner that ensures association to the activity, the samples, and their locations. At a minimum, personnel assigned to the work will have access to the applicable project documents and will be knowledgeable of the contents before the associated work.

Changes to established routine sampling events will be managed in accordance with each site's LTS&M Plan. Nonroutine sampling and field investigations will be documented in sampling plans and prepared to meet the specific objectives. The LM site manager will be briefed on all program directives and nonroutine field investigations before the work begins.

Procedure Requirements

Project personnel will comply with the requirements of written procedures or other instructions that have been approved for the work. Any deviation from approved field procedures must be documented by the field supervisor and authorized by the project manager in advance. Field changes to project plans or deviation from procedures will be documented as appropriate as a field variance, communicated to the project manager as soon as possible, and noted in the trip report to management.

The laboratory coordinator will be notified of any substantive changes to subcontract laboratory procedures. The project manager will be informed of changes to laboratory procedures that may impact project objectives. Procedural changes that affect laboratory data will be identified and documented during the data review, verification, and validation activities.

Field Documentation

Field documentation requirements are specified in the sampling procedures that are provided as an appendix to the SAP. Field documents are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the field sampling

activities. Most field documentation, including water-sampling data, field measurements, instrument calibration and operational checks, observations, and safety meetings, is collected electronically using a specifically designed field data collection software application. The field data collection application has numerous QC functions that enhance data quality, including user notifications, automated data transfer, built-in calculations, and pass-fail alerts. The field data collection application is loaded on ruggedized field computers and used for data entry and documentation of sampling activities in the field. The use of a ruggedized field computer will protect data from loss or damage from field conditions. Electronic data is backed up daily to a secondary digital storage media (in addition to the hard drive on the ruggedized field computer). Some paper forms will still be used (e.g., chain of custody) and will be stored in a manner that protects them from loss or damage. All entries on the chain of custody form are made with ink and will be legible, accurate, and complete. Corrections on paper forms are made by a single line through the original entry along with the initials of the person making the correction and the date of the correction. A signature and initials log will be maintained to identify personnel who are authorized to record, review, and authenticate field data. At the conclusion of a field task or sampling event, the field and data collection activities are reviewed and summarized in a report to the project manager, as specified in the discussions of data review and QA/QC assessment in this document.

The field sampling team will adequately document and identify field measurements and each sample collected. Field records are completed at the time the observation or measurement is made and when the sample is collected. Project documents and written procedures are stored on the field computer so that they are readily accessible during field work. The field supervisor will ensure that specified requirements are followed so that an accurate record of sample collection and transfer activities is maintained.

Sample disposition is managed by the subcontracted laboratory as specified in the appropriate procurement documents.

Field Books and Forms

The field sampling team will manage field data collection software, applicable forms, or a logbook to provide a daily record of field activities associated with drilling and sampling events and to document relevant treatment system operations and measurements. If initials are used in place of signatures, a signature and initials log will be maintained to identify personnel who are authorized to record, review, and authenticate field data.

Field Variance and Nonconformance Documentation

Changes from specified field protocols established in planning documents or SOPs that are necessary prior to field work must be authorized by the project manager or approved planning document and fully documented by the field sampling team. Field variances that are unanticipated and occur during field activities will be reported in a timely manner to evaluate the impact the variance has on the data or system operations. Field variance reporting applies to deviations from (1) prescribed field sampling and measurement requirements; (2) specified shipping, handling, or storage requirements; and (3) decontamination procedures.

A variance must be documented when an activity is performed or a sample is obtained as follows:

- The activity performed or sample collection technique does not fall within the methods or protocols specified
- The monitoring or measurement instrument that was used was out of calibration or had failed an operational check
- Insufficient documentation results in the inability to trace the activity, measurement, or sample to the prescribed or selected location
- There is a loss of or damage to records that cannot be duplicated

The variance should be fully described, and corrective action, if applicable, should be taken immediately. Comments describing the variance will be used during data evaluation to assess the use of associated results and validity of the data. Field variances should be noted in the comments portion of the field-data sheet, on a general log sheet, or in the activity logbook. Nonconformances will be identified in the QA tracking system where initial actions, evaluation of extent of conditions, cause analysis, and corrective and preventive actions are tracked. As appropriate, field variances will be summarized in the trip report at the conclusion of the activity.

Laboratory Documentation

Commercial laboratories provide analytical services to support LM environmental monitoring in accordance with the QSM to ensure that data are of known, documented quality. The QSM provides specific technical requirements, clarifies DOE requirements, and conforms to DOE Order 414.1D Chg 2, *Quality Assurance*. The QSM is based on Volume 1 of The NELAC Institute Standards (TNI 2009), which incorporates ISO/IEC standard 17025:2005(E), "General requirements for the competence of testing and calibration laboratories." The QSM provides a framework for performing, controlling, documenting, and reporting laboratory analyses.

The laboratory data report will include the following items:

- Analytical method used
- Date and time of analysis
- The chain of custody form
- Sample receiving documentation
- QC data results and report
- Sample data results by analysis, including method detection limits, quantitation limits, and dilution factors
- Summary of analyses (e.g., case narrative)
- Certification by the laboratory that the analytical data meet applicable data quality requirements

Analytical data that do not meet specified criteria are qualified to allow data evaluation before use. Any nonconformances or difficulties encountered during analyses is documented in the case narrative with each data package.

Reports Received from Subcontractors

Procurement documents will specify the criteria for technical and administrative plans and reporting requirements for technical reports received from subcontracted services. For subcontracted laboratory services, reporting requirements and formats meeting the electronic data deliverable (EDD) specifications will be specifically described or referenced.

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 Sections 2.4 and 2.5.5)

Quality Improvement, Assessment, and Oversight

All personnel must continually seek to improve the quality of their work to provide the highest quality goods and services for customers, both internal and external. This section addresses the activities for assessing the effectiveness of the implementation of the project and associated QA/QC requirements. Processes to detect and prevent problems and improve quality are addressed in the QA program description and associated procedures covering quality improvement, assessment, and oversight.

Quality Improvement

Management encourages innovation and continuous improvement in the work environment by fostering a "no fault" attitude and an atmosphere of openness. All personnel are encouraged to identify problems and suggest improvements.

All personnel have a responsibility to Pause Work or Stop Work (including work performed by subcontractors) immediately for imminent threats to health, safety, environmental release, or conditions with significant adverse effect on quality. Restarting work related to such stoppages will be at the direction of the project manager.

Quality Assurance Assessment and Response Actions

QA assessments of LMS project activities are planned with appropriate levels of management and scheduled on the oversight schedule managed by the Quality Assurance manager. Results are evaluated to measure the effectiveness of the implemented quality system.

At the project or task level, assessment activities include routine oversight reviews, management assessments (planned and conducted within the organization), and independent assessments (usually planned and conducted by the LMS QA organization).

QA assessments are conducted and findings documented and verified in accordance with the requirements of the QA program description and associated procedures.

QA assessments involving subcontracted services are coordinated with appropriate levels of project management and administered in conjunction with the Procurement and Contracts Management organization.

The responsible manager will promptly respond to findings, define corrective actions, and correct deficiencies identified through assessments. Corrective actions are determined by the manager of the assessed organization, and completion is documented, verified, and approved at the next highest level. The QA organization is responsible for tracking the completion of corrective actions related to assessments and for managing the associated records.

QA assessment reports are issued to the responsible manager and distributed internally to project management, the QA lead, and appropriate levels of LMS management.

Typical QA assessments include:

- **Management Assessments:** The project or functional manager determines the scope, schedule, and responsibilities for management assessments and notifies the QA manager for inclusion in the oversight schedule.

  These internal assessments typically examine human performance elements, operations, resource allocation, financial performance, financial controls, data quality, outcome-to-mission alignment, product quality, process efficiencies, and customer relations.
- **Independent Assessments:** Independent assessments are planned, performed, and documented by QA staff. Personnel who lead independent assessments must be qualified, have reporting independence, and have access to the areas of inquiry.
- **Surveillances:** Surveillances verify compliance with procedures, practices, and other requirements. Surveillances are performed by QA in support of assigned projects and functional areas.

Reviews

- **Readiness Reviews:** These reviews ensure that appropriate planning has taken place to allow the work to proceed safely and effectively and ensure that as many contingencies and prerequisites as possible have been reviewed and addressed. The project manager is responsible for determining the level of rigor and formality of project readiness reviews based on complexity, frequency, and risk of work. Readiness reviews are routinely planned and conducted before the start of major project activities, before the start of new or infrequent tasks, and before scheduled sampling events. Review responsibilities are typically delegated based on type and significance to the overall process success.
- **Data Review:** These reviews ensure the quality of data collected. The field team will routinely conduct data reviews to ensure the adequacy of field activities. In addition, data review, verification, and validation will be conducted after a sampling event to provide a tabulated summary of the field activities to the project manager. Analytical data will be reviewed and summarized in the laboratory report. The results will include a tabulation of analytical data and an explanation of any laboratory QA/QC problems and their possible effects on data quality.

Reports to Regulators

CERCLA Reports

Results of environmental monitoring and maintenance and other ongoing activities are summarized in annual reports as required by the LTS&M Plan. These reports are provided to EPA and MDNR and are available to the public. In addition, the site prepares CERCLA Five-Year Review reports.

If results of an internal assessment determine a data issue or regulatory noncompliance, then EPA and MDNR will be notified.

Assessments

Planned assessments are recorded on a schedule maintained by the LMS contractor QA organization. All records created during the course of planning or assessment activities are maintained in accordance with QA and records management procedures.

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)

Data Management

Project data are generated mainly from routine sampling of monitor wells, surface water sampling, and routine operations system sampling. The LM environmental data system for project environmental data is managed and maintained in accordance with documented policy and procedural requirements.

Electronic field data forms hosted on laptops and other handheld electronic devices may be used to document and temporarily store the information collected during sampling events. The configuration and control of electronic data forms and the supporting software will be managed in accordance with LM software configuration management procedures. Data and information collected using electronic field data forms will be temporarily stored on the electronic device and uploaded to the LM environmental data system at the earliest convenience of the field sampling team.

Data from samples submitted to an analytical laboratory are received in EDD format. The electronic data are loaded into the LM environmental data system maintained by Environmental and Spatial Data Management. The data are accessible using reporting functions designed to provide data users with environmental data and information specific to their needs. The software for performing these reporting functions is maintained and managed in accordance with LM software configuration management procedures. Database security is maintained by keeping the majority of the records in a read-only mode and limiting the ability to change data in the database to a limited set of qualified data analysts who are assigned specific database roles and responsibilities. Access to the database and read or write capabilities are enforced by the relational database management system through configuration of specific database user roles.

The LM environmental data system is strictly controlled in accordance with LM software configuration and data management procedures, which ensures the quality and integrity of the data maintained in the system. In addition, the LM environmental data system includes automated validation functions that support the maintenance of the integrity and quality of data uploaded and stored in the system. The use of standardized and controlled reference values for data reporting and data management tasks provides assurance that information regarding the type, quality, and use of data is available to users of LM environmental data through standardized reporting functions. Data validation procedures are described in the *Environmental Data Validation Procedure* (LMS/PRO/S15870). Electronic copies of analytical reports are archived with the project records along with the original field-data forms and other relevant hardcopy forms or documents containing project data and categorized in the project records library according to the project Working File Index spreadsheet.

Well construction and lithology logs are generated for all new wells drilled. These logs are archived in the project records library and are also entered into the LM environmental data system form of geologic log and well construction information software (gINT) logs.

In addition to the data collected from sampling, physical project data are also collected and maintained. Physical project data describe the layout of the site, such as buildings, survey markers, fence lines, utilities, and roads. Any modification to these features requires documentation and base map feature updates. These updates can be documented by redlining an existing as-built map. If a contractor is used, both hardcopy and electronic drawing files are needed. These deliverables will be archived as appropriate. Where appropriate, a detailed as-built set of maps will be created and maintained for a specific area.

Some cases require the services of a licensed surveyor. In these cases, the surveyor must submit both hardcopy and EDD products. These deliverables will then be archived and verified, and the appropriate data sources will be updated.

The data verification and validation inputs are listed in the following table.

Data Verification and Validation Inputs

Item No.	Description	Verification (completeness)	Validation (conformance to specifications)
Planning Documents or Records			
1	Approved QAPP	**X**	
2	Contract	**X**	
4	Field SOPs	**X**	
5	Laboratory SOPs	**X**	
Field Records			
6	Field logbooks	**X**	**X**
7	Equipment calibration records	**X**	**X**
8	Chain of custody forms	**X**	**X**
9	Sampling diagrams or surveys		
10	Drilling logs		
11	Geophysics reports		
12	Relevant correspondence	**X**	**X**
13	Change orders or deviations	**X**	**X**
14	Field audit reports		
15	Field corrective action reports		
Analytical Data Package			
16	Cover sheet (laboratory identifying information)	**X**	**X**
17	Case narrative	**X**	**X**
18	Internal laboratory chain of custody	**X**	**X**
19	Sample receipt records	**X**	**X**
20	Sample chronology (i.e., dates and times of receipt, preparation, and analysis)	**X**	**X**
21	Communication records	**X**	**X**
22	Project-specific PT sample results		
23	LOD/LOQ establishment and verification	**X**	**X**
24	Standards traceability	**X**	**X**

Data Verification and Validation Inputs (continued)

Item No.	Description	Verification (completeness)	Validation (conformance to specifications)
Analytical Data Package (continued)			
25	Instrument calibration records	**X**	**X**
26	Definition of laboratory qualifiers	**X**	**X**
27	Results reporting forms	**X**	**X**
28	QC sample results	**X**	**X**
29	Corrective action reports	**X**	**X**
30	Raw data	**X**	**X**
31	EDD	**X**	**X**

Abbreviations:
LOD/LOQ = limit of detection/limit of quantitation
PT = performance testing

QAPP Worksheet #35: Data Verification Procedures
(UFP-QAPP Manual Section 5.2.2) (EPA 2106-G-05 Section 2.5.1)

Records Reviewed	Requirement Documents	Process Descriptions	Responsible Person or Organization
Field activities records	SAP[a], QAPP	Verify that records are present and complete for each day of field activities. Verify that all planned samples including field QC samples were collected. Verify that calibration or operational check records are available. Verify that any required field monitoring was performed and results are documented.	Daily: Field sampler At conclusion of field activities: Data validation staff
Chain-of-custody forms	SAP[a], QAPP	Verify the completeness of chain of custody records. Examine entries for consistency with the field records. Check that appropriate methods and sample preservation have been recorded. Verify that all required signatures and dates are present. Check for transcription errors.	Daily: Field sampler At conclusion of field activities: Data validation staff
Laboratory deliverable	SOW[b], QAPP	Verify that the laboratory deliverable contains all records specified in the SOW. Check sample receipt records to ensure sample condition upon receipt was noted, and any missing or broken sample containers were noted and reported as required. Compare the data package with the chain of custody forms to verify that results were provided for all collected samples. Review the narrative to ensure all QC exceptions are described. Verify that necessary signatures and dates are present.	Data validation staff
Audit reports, Corrective Action reports	QAPP	Verify that all planned audits were conducted. Examine audit reports. For any deficiencies noted, verify that corrective action was implemented according to plan.	Project QA manager

Notes:
[a] As referenced in *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites*.
[b] As referenced in *Statement of Work for Laboratory Analytical Services*.

QAPP Worksheet #36: Data Validation Procedures
(UFP-QAPP Manual Section 5.2.2) (EPA 2106-G-05 Section 2.5.1)

Data Validation and Usability

Data validation is a rigorous data review of the field and laboratory data generated during sampling events. The work is performed by the Environmental Monitoring and Sciences group. Data validation is the principal means of assessing the usability of data. Validation also improves overall data quality by allowing the laboratory coordinator to closely monitor laboratory performance and to provide feedback to each laboratory regarding its ability to produce quality data that meets subcontract requirements. Data validation is performed as specified in the *Environmental Data Validation Procedure*. This procedure is based on the following guidance documents:

- EPA Contract Laboratory Program *National Functional Guidelines for Inorganic Superfund Methods Data Review* (EPA 2017a)
- EPA Contract Laboratory Program *National Functional Guidelines for Organic Superfund Methods Data Review* (EPA 2017b)
- *Evaluation of Radiochemical Data Usability* (Paar and Porterfield 1997)
- Results of data validation documented in task-specific data validation reports that become part of the project record

Field Measurement Data

The objective of field data validation is to ensure that data are collected in a consistent manner and in accordance with the SAP and site-specific environmental planning documents. Field data validation procedures include a review of documentation generated during field sampling events. The data are reviewed for completeness, transcription errors, compliance with SOPs, and accuracy of calculations. Standardized SOPs for sample collection and analysis ensure that samples are representative of site conditions.

Laboratory Data

Validation of laboratory data is performed to determine whether data meet the specific technical and quality criteria established in the QSM and other applicable documents and to establish the usability and extent of bias of any data not meeting those criteria. Data validation includes the evaluation of DQIs associated with the data. DQIs are the quantitative and qualitative descriptors that are used to interpret the degree of acceptability or utility of data. Indicators of data quality include the analysis of laboratory control samples to assess accuracy, duplicates and replicates to assess precision, and interference check samples to assess bias. The DQIs' comparability, completeness, and sensitivity are also evaluated during the validation process. Comparability should be evaluated when split samples are collected by different agencies, and the specific criteria should be established between agencies before sample collection and laboratory analysis.

All data are considered valid unless problems are identified during data validation that require data qualification. When it is necessary to qualify individual data records, standard qualifier codes are applied.

Common data qualifiers used by LM are defined below. Refer to the *Environmental Data Validation Procedure* for further information.

- U—For organic and inorganic analytes, the analyte was not detected at a concentration greater than the method detection limit. For radiochemistry, the analyte was not detected at a concentration greater than the decision-level concentration.
- J—The associated numerical value is an estimated quantity.
- R—The data are unusable (analyte may or may not be present). Resampling and reanalysis may be necessary for verification.

Qualification of Data and Corrective Actions

Qualification criteria are defined in the *Environmental Data Validation Procedure*. Additional corrective action may be required, such as reanalysis of the sample by the laboratory or resampling the affected locations.

Determination of Anomalous Data

New data are assessed for potential outliers by comparison to the historical dataset when appropriate. Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers can result from transcription errors, data coding errors, or measurement system problems. However, outliers can also represent true extreme values of a distribution and can indicate more variability in the population than was expected. Data are initially screened for values that fall outside a designated historical data range. Outlier data are further evaluated by the data validation lead. That evaluation may include any of the following:

- The use of statistical outlier tests that give probabilistic evidence that an extreme value does not “fit” with the distribution of the remainder of the data and, therefore, is a statistical outlier
- Trends in the analytical data
- Correlation with other analytes or other analytical methods
- Possible sample misidentification
- Possible sample contamination

The outlier evaluation may result in one or more follow-up actions, including the following:

- Additional laboratory review of the suspect data
- Sample reanalysis
- Resampling
- Comparison to results from the next sampling event

Based on the results of the follow-up action, the data validator will make a final determination of validity of the data point and document the results of the evaluation in the data validation report.

Information regarding data validation procedures is discussed in the following table.

Data Validation Procedures

Validation procedure	*Environmental Data Validation Procedure*
Data deliverable requirements	Level 3 data package, DOE_EQEDD
Measurement performance criteria	*Department of Defense (DoD) Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories* (DOD and DOE 2017)
Percentage of data packages to be validated	100%
Percentage of raw data reviewed	100%
Percentage of results to be recalculated	0%
Electronic validation program or version	EQuIS SMSPlugin, current version

Abbreviation:
EQuIS = Environmental Quality Information System

QAPP Worksheet #37: Data Usability Assessment
(UFP-QAPP Manual Section 5.2.3, including Table 12)
(EPA 2106-G-05 Sections 2.5.2, 2.5.3, and 2.5.4)

The data usability assessment is performed at the conclusion of data collection activities using the outputs from data verification and validation while preparing annual and 5-year reports. It is performed to qualitatively and quantitatively interpret environmental data associated with the Weldon Spring site to determine whether the project data are of the right type, quality, and quantity to support the decisions that need to be made. Details of the data usability assessment are described below.

Personnel responsible for participating in the data usability assessment are as follows:

- LM Weldon Spring Site Manager
- LMS Weldon Spring Site Lead
- LMS Hydrologist or Geochemist
- LMS Report Coordinator (annual and 5 year)
- LMS Quality Assurance Specialist

Evaluation and interpretation of site monitoring data are documented in annual groundwater reports, and conclusions regarding data usability are included in annual and 5-year reports.

Data Usability Assessment Process

Step 1	**Review the project's objectives and sampling design.** *Review the data quality objectives for long-term monitoring. Review the monitoring plan to ensure that it continues to be consistent with the monitoring goals.*
Step 2	**Review the data verification and data validation outputs.** *Review data validation reports, field verification checklists, and trip reports. Review deviations from planned activities to determine their impacts on data usability. Evaluate implications of unacceptable QC sample results. Summarize the data with tables, time series plots, or maps. Assess the reliability and importance of anomalous data.*
Step 3	**Verify assumptions.** *Review statistical methods used to evaluate uranium trends, such as Mann-Kendall trend tests or linear regression. Review assumptions, which will depend on the method used and may include linearity, constant variance, statistical independence, or normality of regression residuals. Minor deviations from assumptions are not considered critical to meeting the data quality objectives. If serious deviations from assumptions are discovered, assess alternative methods for trend evaluation such as trending and comparing different periods.* *Review methods for generating water level contour maps or plume maps. Select data that represent distinct or homogenous populations (e.g., separate uranium results from different geologic units before generating plume maps). Use evaluations from step 2 of the data usability assessment to account for outliers and verify that datasets used for interpolation are representative of the intended populations.*
Step 4	**Implement data analysis methods.** *Apply data transformations as necessary. Perform trend analysis of analyte data. Generate water level contour maps or plume maps. Perform additional data analyses as appropriate or as necessary. Review results for consistency with the conceptual site model. Consider the reliability of conclusions regarding aquifer restoration progress.*
Step 5	**Document data usability and draw conclusions.** *Document significant conclusions regarding data usability in annual groundwater reports.*