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Rocky Flats Site, Colorado

Site Operations Guide

December 2021

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Abbreviations

Ag	silver
Am	americium
AMP	Adaptive Management Plan
ANOVA	Analysis of Variance
AOC	Area of Concern
AR	Administrative Record
ARAR	applicable or relevant and appropriate requirement
BA	biological assessment
Be	beryllium
BMP	best management practice
BO	biological opinion
BZ	Buffer Zone
CAD/ROD	Corrective Action Decision/Record of Decision
Cd	cadmium
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CESQG	conditionally exempt small quantity generator
CFR	*Code of Federal Regulations*
CHWA	Colorado Hazardous Waste Act
CNWA	Colorado Noxious Weed Act
COU	Central Operable Unit
Cr	chromium
CY	calendar year
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQA	data quality assessment
ECP	*Erosion Control Plan for Rocky Flats Property Central Operable Unit*
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ESA	Endangered Species Act
ESD	Explanation of Significant Difference
ET	evapotranspiration
ETPTS	East Trenches Plume Treatment System
FC	functional channel
FYR	Five-Year Review
GEMS	Geospatial Environmental Mapping System
gpm	gallons per minute

HRR	Historical Release Report
IA	Industrial Area
IATA	International Air Transport Association
IDW	investigation-derived waste
IHSS	Individual Hazardous Substance Site
IM/IRA	interim measure/interim remedial action
ITSS	Intercept Trench System Sump
L	liters
LM	Office of Legacy Management
LMS	Legacy Management Support
m^3	cubic meters
MBTA	Migratory Bird Treaty Act
MG	million gallons
mg	milligrams
µg	micrograms
M-K	Mann-Kendall
mL	milliliters
M&M	monitoring and maintenance
mrem	millirem
MSPCS	Mound Site Plume Collection System
MSPTS	Mound Site Plume Treatment System
NARA	National Archives and Records Administration
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NPH	no public hazard
NPL	National Priorities List
NSQ	nonsufficient quantity
NWP	nationwide permit
OLF	Original Landfill
O&M	operation and maintenance
OU	Operable Unit
PAH	polycyclic aromatic hydrocarbons
PBA	*Programmatic Biological Assessment for Department of Energy Activities at the Rocky Flats Environmental Technology Site*
PBO	Programmatic Biological Opinion
PCE	tetrachloroethene
pCi	picocuries
PGP	Pesticide Discharge Permit
PIP	Public Involvement Plan
PL	Public Law

PLF	Present Landfill
PLFTS	Present Landfill Treatment System
POC	Point of Compliance
POE	Point of Evaluation
POU	Peripheral Operable Unit
PPA	Pollution Prevention Act
PQL	practical quantitation limit
Pu	plutonium
PU&D	Property Utilization and Disposal
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFETS	Rocky Flats Environmental Technology Site
RFLMA	*Rocky Flats Legacy Management Agreement*
RFP	Rocky Flats Plant
RFSOG	*Rocky Flats Site Operations Guide*
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SDRP	Soil Disturbance Review Plan
SEPs	Solar Evaporation Ponds
SID	South Interceptor Ditch
S-K	Seasonal-Kendall
SME	subject matter expert
SPP	Solar Ponds Plume
SPPTS	Solar Ponds Plume Treatment System
SVOC	semivolatile organic compound
TCE	trichloroethene
U	uranium
UHSU	upper hydrostratigraphic unit
USACE	U.S. Army Corps of Engineers
USC	*United States Code*
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
WALPOC	POC monitoring location at Walnut Creek at the eastern COU boundary
WOMPOC	POC monitoring location at Woman Creek at the eastern COU boundary
ZVI	zero-valent iron

1.0 Introduction

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) is responsible for implementing the final response action specified in the final Corrective Action Decision/Record of Decision (CAD/ROD) for the Rocky Flats Plant (EPA et al. 2006) issued on September 29, 2006. The CAD/ROD is available on the LM website at https://www.lm.doe.gov/Rocky_Flats/Regulations.aspx. Figure 1 shows the general location of the Rocky Flats property.

Under the CAD/ROD, two Operable Units (OUs) were established within the boundaries of the Federal Rocky Flats property: the Central OU (COU) and the Peripheral OU (POU). The COU consolidates areas of Rocky Flats under DOE jurisdiction that require additional actions to implement and maintain the remedy while also considering the practicalities of future land management. The CAD/ROD documented the selected remedy for the COU as institutional and physical controls, incorporating continued monitoring and maintenance. A CAD/ROD amendment (EPA et al. 2011) to clarify the implementation of institutional controls was approved on September 21, 2011. The CAD/ROD amendment is also available on the LM website at https://www.lm.doe.gov/Rocky_Flats/Regulations.aspx.

The POU surrounds the COU and includes the remaining portions of the former Rocky Flats Site that are under federal jurisdiction. The final CAD/ROD indicated that conditions in the POU are suitable for unrestricted use, and no response action was required. The U.S. Environmental Protection Agency (EPA) subsequently published a Notice of Partial Deletion from the National Priorities List (NPL) for the POU on May 25, 2007.

On July 12, 2007, the property outside the COU, except for some lands with active mineral rights, was transferred to the U.S. Department of the Interior to establish a National Wildlife Refuge to be managed by the U.S. Fish and Wildlife Service (USFWS), pursuant to the Rocky Flats National Refuge Act of 2001 (PL 107-107). EPA certified that cleanup and closure of Rocky Flats were complete, the POU was suitable for unlimited use and unrestricted exposure (UU/UE), and the COU remedy was operating properly and successfully in accordance with requirements for DOE to transfer land to USFWS for establishing the refuge. On December 31, 2012, a land exchange involving several parties was completed, which added Section 16 land to the Refuge. As part of this expansion of the Refuge, USFWS transferred a 300-foot-wide strip of land along Indiana Street on the eastern boundary of the Refuge to the Jefferson Public Parkway Highway Authority for transportation improvement purposes. The transfer of the Indiana Street transportation corridor was provided for in the Refuge Act by the Refuge's authorizing legislation.

The COU remedy is managed by the *Rocky Flats Legacy Management Agreement* (RFLMA) (DOE et al. 2007; https://www.lm.doe.gov/Rocky_Flats/RFLMA.pdf), which is an enforceable three-party agreement. The RFLMA was executed on March 14, 2007; Attachment 2 has been modified since, most recently in 2018. In this report, the term "Site" refers to the COU. The term "Rocky Flats" refers to the federally owned property (i.e., both the COU and the POU), while "the Site" refers to the land under the jurisdiction and control of LM. The terminologies that may be used to designate various portions of Rocky Flats are presented below.

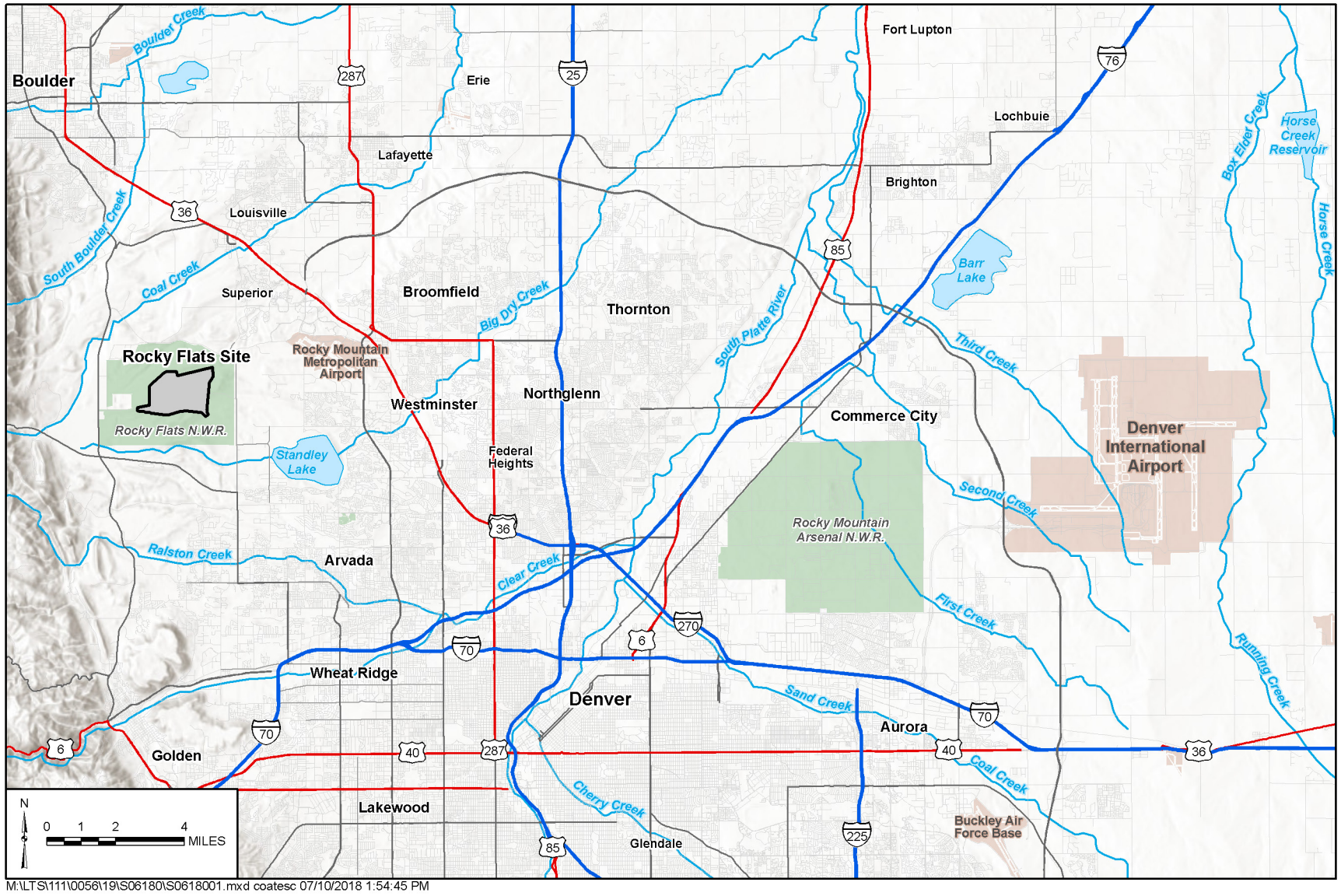

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Figure 1. General Location of the Rocky Flats Site

Terminology	The Land That the Terminology Refers To
“Rocky Flats”	Federally owned property (i.e., the COU and the POU together).
“Rocky Flats Plant” (RFP)	Original name for the facility, which was changed to the Rocky Flats Environmental Technology Site (RFETS).
“the historical Rocky Flats Site”	The former RFP and RFETS, which existed prior to the 2006 CAD/ROD.
“the Refuge”	The National Wildlife Refuge portion of the POU.
“the Site”	The COU, which is listed on the NPL.

Figure 2 is a map of Rocky Flats showing the location of the COU, the lands retained by LM outside of the COU, and the remaining property that has been transferred to USFWS.

DOE, EPA, and the Colorado Department of Public Health and Environment (CDPHE), as required by the CAD/ROD, implemented the monitoring and maintenance (M&M) requirements of the CAD/ROD as described in the RFLMA. RFLMA Attachment 2 defines the COU remedy surveillance and maintenance requirements. The RFLMA may be amended, and RFLMA attachments may be modified from time to time, as approved by CDPHE and EPA in accordance with RFLMA Part 10, “Amendment of Agreement and Modification of Attachments.” Remedy requirements include environmental monitoring; maintenance of the erosion controls, access controls (i.e., signs), landfill covers, and groundwater treatment systems; and operation of the groundwater treatment systems.

RFLMA Attachment 2 stipulates that DOE use administrative procedures to control activities in accordance with the institutional controls and to meet quality assurance and control program requirements. The RFLMA also recognizes that other procedures are established to guide work and implement best management practices (BMPs).

1.1 Purpose

This *Rocky Flats Site Operations Guide* (RFSOG) was prepared by LM to serve as the primary document to communicate how the requirements of the RFLMA are implemented at the COU. The RFSOG summarizes how LM will fulfill its long-term surveillance and maintenance obligations and provides information necessary to understand LM reports, presentations, and correspondence.

The RFSOG is periodically reviewed, and changes are made as part of a continuous improvement process. Also, RFLMA requirements may be modified upon approval of CDPHE and EPA. If there is any conflict between the RFSOG and the modifications to the RFLMA, then the RFLMA takes precedence. The RFSOG will be revised as needed to incorporate any changes that are necessitated by RFLMA modifications, which may occur before the next RFSOG review process.

The RFSOG incorporates, either directly or by reference, applicable LM policy and guidance. LM is responsible for radiological and other hazardous substances that remain at the Site. Implementation of surveillance and maintenance activities at the Site is guided by this RFSOG and internal operating procedures.

The information in this document represents the most current and best understanding of technical and regulatory issues and responsibilities regarding the Rocky Flats Site in Colorado. This document will be revised as necessary to reflect changes based on newly obtained information.

1.2 Rocky Flats Background

The Rocky Flats Plant (RFP) was established in 1951 as part of the nationwide nuclear weapons complex to manufacture nuclear weapons components from various radioactive and hazardous materials. DOE (or its predecessor, the Atomic Energy Commission) and its contractors managed and operated the RFP under authorization of the Atomic Energy Act. Nuclear weapons production activities within the former Industrial Area (IA) resulted in contamination of environmental media, including surface water, groundwater, soil, and air within the IA. The nature and extent of contamination, potential impacts to human health and the environment, and interim actions performed to mitigate the risk to human health and the environment are described in the *RCRA Facility Investigation-Remedial Investigation/Corrective Measures Study Feasibility- Study Report for the Rocky Flats Environmental Technology Site* (DOE 2006a) (Remedial Investigation/Feasibility Study [RI/FS] Report) and summarized in the *Rocky Flats Environmental Technology Site Proposed Plan* (DOE 2006b). The final remedy of institutional and physical controls with continued monitoring was selected in the CAD/ROD.

Figure 3 shows the subsurface features of buildings, process waste lines, and associated infrastructure remaining after closure. Figure 4 shows the pits and trenches remaining in the subsurface after closure. Most utilities have been disconnected in the COU; a few active utility lines (electric and natural gas) still running through the COU are in easements and maintained by the utility company.

Numerous other active infrastructure features exist at the Site, including wells, groundwater treatment systems, surface water gaging stations, landfills, groundwater collection systems, and others. All of these features are tracked and managed using as-built drawings, geographic information systems (GIS), databases, and other tools. Any construction project or activity at the Site requires a mandatory review to protect these infrastructure features.

Additional information related to the setting and features of the historical Rocky Flats Site is included in Section 2.0.

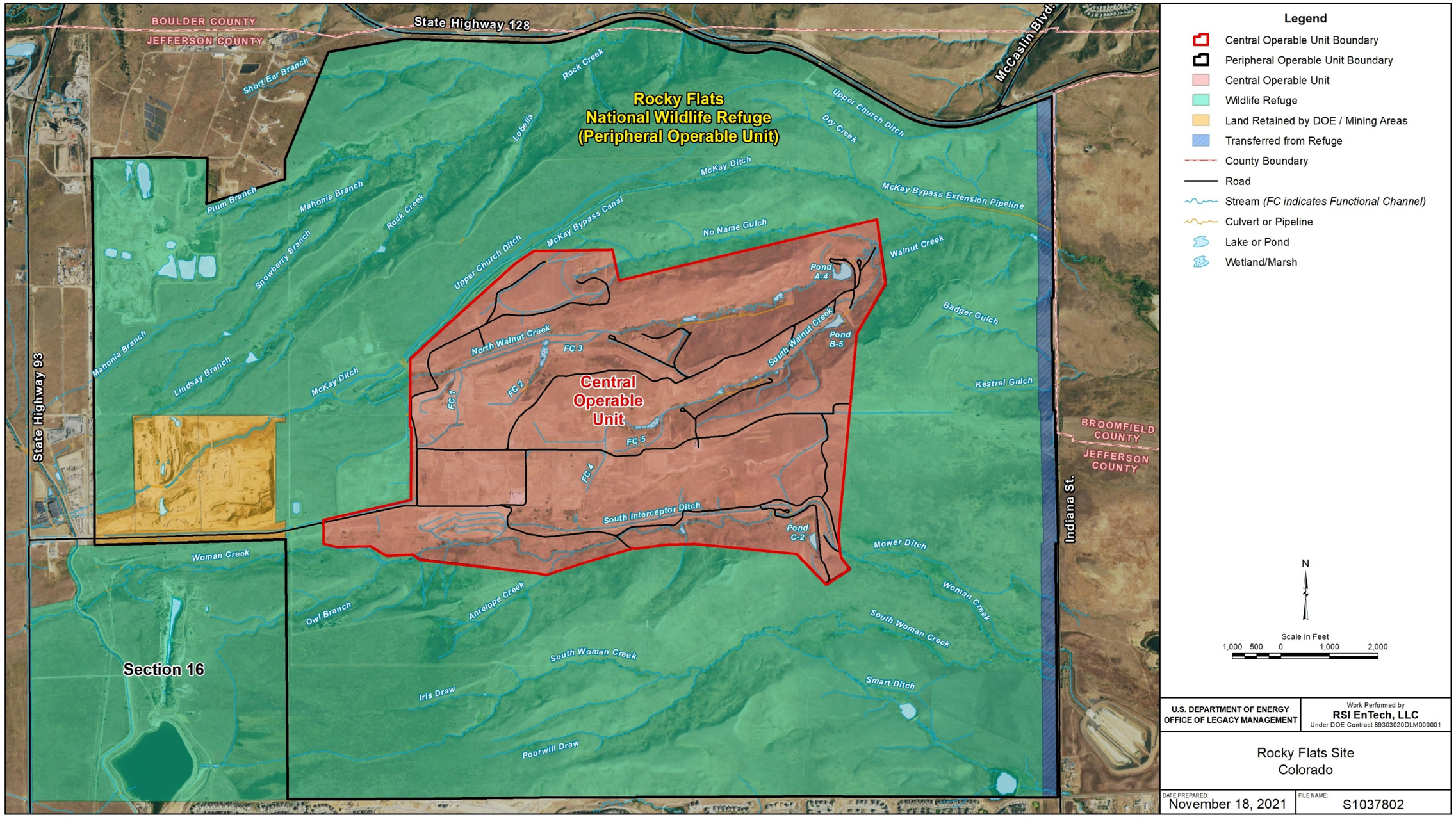

Figure 2. Map of the Rocky Flats Federal Property

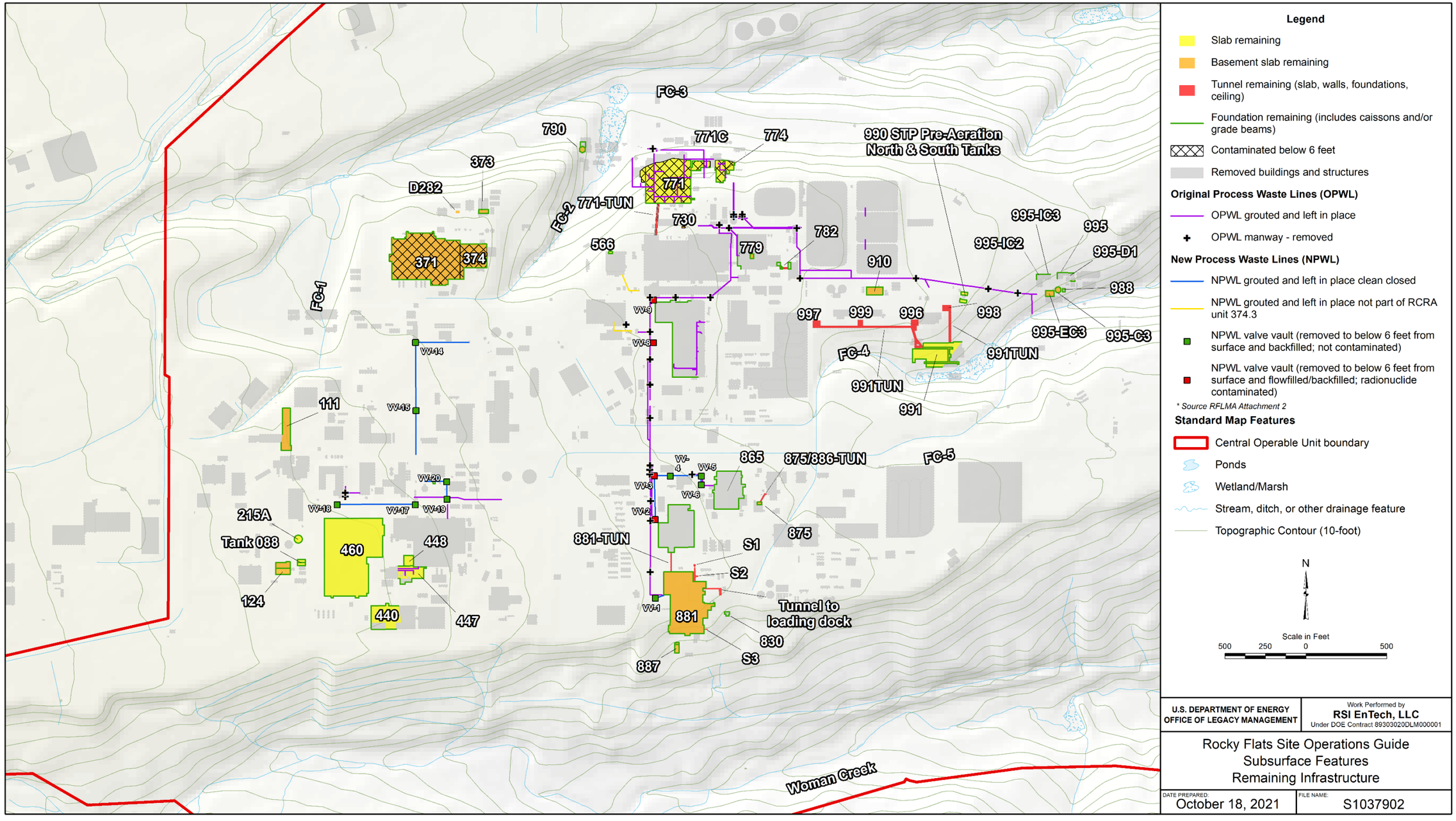

Figure 3. Subsurface Features–Remaining Infrastructure (Adapted and Modified from the RFLMA)

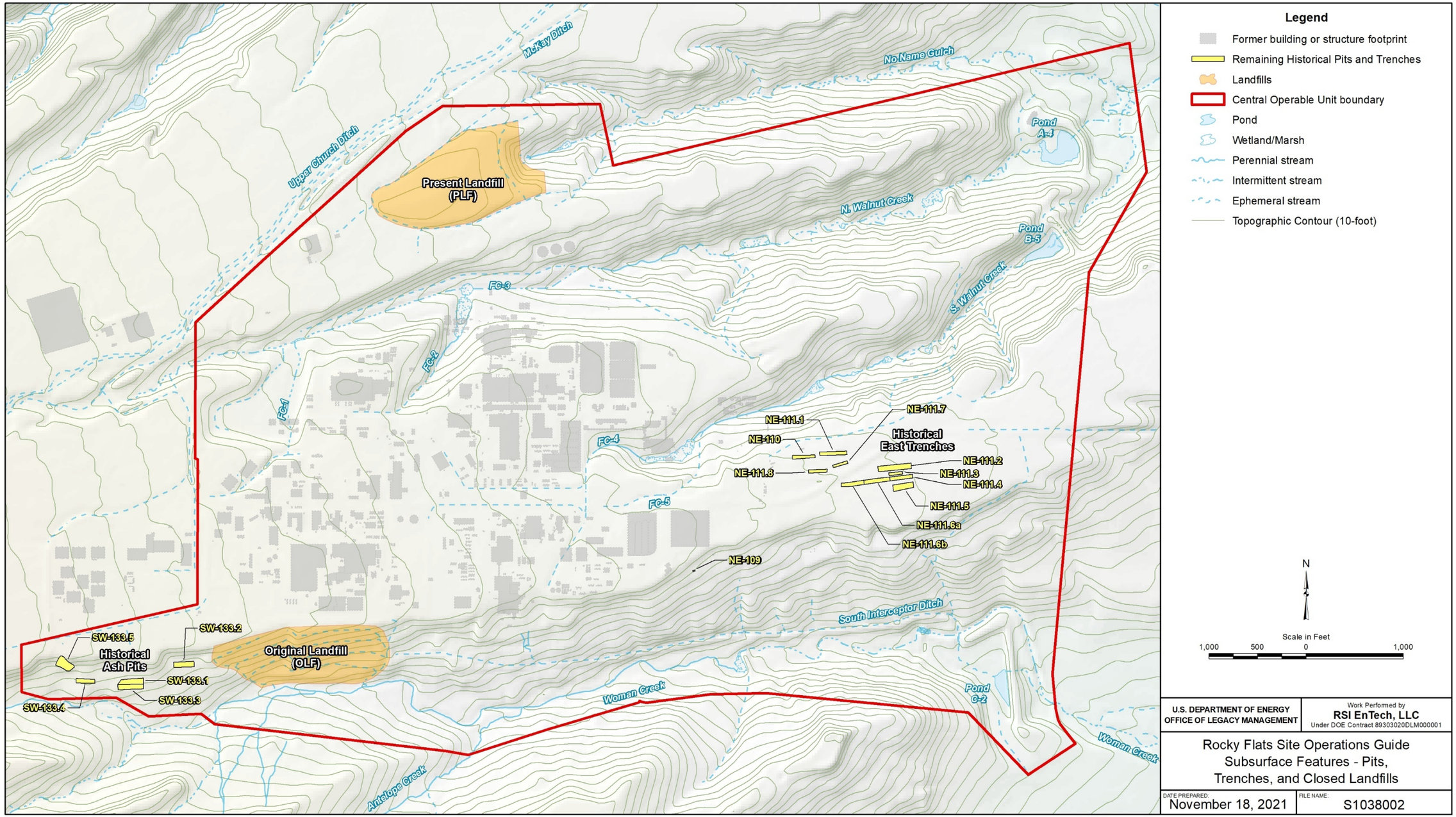

Figure 4. Subsurface Features–Pits and Trenches (Adapted and Modified from the RFLMA)

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1.3 RFSOG Organization

The RFSOG is organized as follows:

- Section 1.0, "Introduction," presents the purpose and organization of the RFSOG, a regulatory overview, and a brief Site history.
- Section 2.0, "Environmental Setting," describes the geology, hydrology, hydrogeology, and ecology of the historical Rocky Flats Site.
- Section 3.0, "Access Controls," includes a discussion of the Site's institutional and physical controls.
- Section 4.0, "Routine Site Operation and Maintenance," provides an overview of the operation and maintenance (O&M) of the Site's monitoring locations, ponds and surface water control features, the Present Landfill (PLF) and Original Landfill (OLF), and the groundwater collection and treatment systems. Erosion control and revegetation at the Site are also included.
- Section 5.0, "Routine Site Inspections," describes routine inspections at the Site.
- Section 6.0, "Routine Environmental Monitoring," provides a discussion of the various routine monitoring activities conducted at the Site, including water (i.e., surface water and groundwater) and ecological monitoring.
- Section 7.0, "Information Management," provides an overview of the Administrative Record (AR) and the corresponding postclosure record system.
- Section 8.0, "Regulatory Compliance," describes activities at the Site that may require regulatory compliance activities, notification, or reporting in addition to what is required by the RFLMA.
- Section 9.0, "Reporting," describes the various reporting requirements for the Site, including RFLMA reportable conditions, routine reporting, emergency notification, and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Five-Year Review.
- Section 10.0, "References," lists the references used to generate this RFSOG.

The following complementary documents are meant to be referenced when using this RFSOG:

Corrective Action Decision/Record of Decision for Rocky Flats Plant (USDOE) Peripheral Operable Unit and Central Operable Unit and amendment
https://www.lm.doe.gov/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=2890

Rocky Flats Legacy Management Agreement
https://www.lm.doe.gov/Rocky_Flats/RFLMA.pdf

The Rocky Flats Closure Legacy Report
https://www.lm.doe.gov/Rocky_Flats_Closure.pdf

Restrictive Notice (formerly Environmental Covenant) for the Rocky Flats Site
https://www.lm.doe.gov/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=9013

Annual Site Inspection Checklist
https://www.lm.doe.gov/Rocky_Flats/2018SOG/LMS6519RFS.pdf

Example Contact Record
https://www.lm.doe.gov/Rocky_Flats/CR/CR_2018-01.pdf

Rocky Flats National Wildlife Refuge Act
https://www.lm.doe.gov/Rocky_Flats/2018SOG/RefugeAct.pdf

Ronald W. Reagan Defense Authorization Act for Fiscal Year 2005, Sect. 3118, Local Stakeholder Organizations for 2006 Closure Sites
https://www.lm.doe.gov/Rocky_Flats/2018SOG/RonaldReaganDefense.pdf

H.R. 1815 National Defense Authorization Act for Fiscal Year 2006 (Mining Rights at Rocky Flats)
https://www.lm.doe.gov/Rocky_Flats/2018SOG/HR_1815.pdf

Erosion Control Plan for Rocky Flats Property Central Operable Unit
https://www.lm.doe.gov/Rocky_Flats/2018SOG/ECP_COU.pdf

Standley Lake Protection Project Operations Agreement
https://www.lm.doe.gov/Rocky_Flats/2018SOG/StandleyLake.pdf

Original Landfill Monitoring and Maintenance Plan
https://www.lm.doe.gov/Rocky_Flats/2018SOG/OLF_MMPlan.pdf

Present Landfill Monitoring and Maintenance Plan and Post-Closure Plan
https://www.lm.doe.gov/Rocky_Flats/S03965_RFS__PLF_M_M_Plan.pdf

Additional Field Implementation Detail for Selected Monitoring Objectives
https://www.lm.doe.gov/Rocky_Flats/2019SOG/S08202_FieldImplement.pdf

Programmatic Biological Assessment for Department of Energy Activities at the Rocky Flats Environmental Technology Site, Part I
https://www.lm.doe.gov/Rocky_Flats/2019SOG/ProgramBA_PartI.pdf

Programmatic Biological Assessment for Department of Energy Activities at the Rocky Flats Environmental Technology Site, Part II
https://www.lm.doe.gov/Rocky_Flats/2019SOG/ProgramBA_PartII.pdf

Programmatic Biological Opinion
https://www.lm.doe.gov/Rocky_Flats/2019SOG/PBA_BO.pdf

Rocky Flats Site, Colorado, Revegetation Plan
https://www.lm.doe.gov/Rocky_Flats/2019SOG/S04513_RevegPlan.pdf

Rocky Flats Site, Colorado, Vegetation Management Plan
https://www.lm.doe.gov/Rocky_Flats/2019SOG/S04512_VegMgmtPlan.pdf

Conservation Easement License and Management Agreement (PMJM)
https://www.lm.doe.gov/Rocky_Flats/2019SOG/ConservationEasement.pdf

Surface Water Configuration Adaptive Management Plan for the Rocky Flats Site, Colorado
https://www.lm.doe.gov/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=12115&libID=12201

Rocky Flats Surface Water Configuration Environmental Assessment and Finding of No Significant Impact (FONSI)
https://www.lm.doe.gov/Rocky_Flats/Surface_Water_Configuration_Environmental_Assessment.pdf
https://www.lm.doe.gov/Rocky_Flats/FONSI-Rocky_Flats_Surface_Water_Configuration.pdf

Adverse Biological Conditions Definition
https://www.lm.doe.gov/Rocky_Flats/2018SOG/S18843_AdverseBioCondition.pdf

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2.0 Environmental Setting

2.1 Geology

Rocky Flats is located along Colorado's Front Range on the western margin of the Colorado Piedmont section of the Great Plains Physiographic Province (Spencer 1961), which also coincides with the western limit of the Denver Basin. Rocky Flats is primarily located on an alluvium-covered pediment; the general topography of this stream-bisected alluvial fan is evident in Attachment 1 to the RFLMA. The surface of this alluvial deposit slopes approximately 1 to 2 degrees to the east.

The geologic history of the Colorado Rocky Mountain region where Rocky Flats is located is summarized in *Geologic History of the Rocky Mountain Region* (Haun and Kent 1965). Comprehensive geologic studies were performed as part of the preclosure Rocky Flats characterization studies (e.g., EG&G 1991, 1995a, 1995b). Through these and other resources, including lithologic cores, geophysical logs, field geologic mapping, aerial photographs, and mine development (particularly along the western margin of Rocky Flats), a large quantity of lithologic and stratigraphic information was collected.

Surficial deposits at Rocky Flats predominantly include unconsolidated clastics of the Quaternary-age Rocky Flats Alluvium, hillslope colluvium, valley fill alluvium, and artificial fill. These deposits are often collectively and informally referred to as "alluvium"; they unconformably overlie the Cretaceous-age Arapahoe and Laramie Formations. Where present at Rocky Flats, the Arapahoe Formation often contains a basal sandstone unit that is important to groundwater transport; elsewhere, the dense claystones of the Laramie Formation, which also includes isolated lenses of siltstone and fine-grained sandstone, underlie surficial deposits. Underlying the Laramie Formation are the Fox Hills Sandstone and Pierre Shale. These units are steeply eastdipping and are not exposed at Rocky Flats except in the quarries along its western edge.

Structure at Rocky Flats is controlled by the Rocky Mountain uplift on the west and the Denver Basin on the east. The north-south trending Denver Basin is an asymmetrical feature containing Paleozoic, Mesozoic, and Cenozoic strata that dip steeply eastward along this western margin. In the area of Rocky Flats, the Denver Basin-related strata include Pennsylvanian to Cretaceous formations that are exposed in mines and stream valleys west of the Site.

Landslide and slump deposits have been identified in nearly all of the drainages on and around Rocky Flats, and the drainages can be subject to erosion, especially subsequent to the occurrence of slides and slumping.

Several faults have been identified in the area of Rocky Flats using seismic and stratigraphic techniques, and some are inferred (EG&G 1995a). These faults appear to be inactive and limited to bedrock formations rather than extending into the overlying surficial deposits. At Rocky Flats, the inferred faults appear to have limited hydrologic significance (RMRS 1996).

Elevated concentrations of natural uranium are present in granite, metamorphic rocks, lignites, monazite sand, and phosphate deposits, as well as in the uranium-rich minerals of uraninite, carnotite, and pitchblende. High concentrations of uranium in the South Platte River Basin are

directly related to the local geology. The local bedrock, particularly the crystalline rocks (primarily granitic) in the mountains and marine shales and coal deposits in the plains, is naturally high in uranium. Sediments derived from crystalline rocks in the mountains are transported by the streams eastward onto the plains, and "roll-front" type uranium deposits, similar to those in the Uravan belt in Montrose County, are found primarily in the northeast section of the state (CDRMS 2014).

Because of the relative natural abundance of uranium in Colorado, uranium has historically been mined throughout the state, and Colorado ranks third for uranium reserves, behind Wyoming and New Mexico (CDRMS 2014). Of greatest importance at the Site is the fact that these deposits are particularly notable in Jefferson County, where the largest vein-type uranium deposit in the United States exists at the Schwartzwalder mine, approximately 5 miles southwest of the Site in the Ralston Creek drainage (Zielinski et al. 2007). As a result, significant concentrations of naturally occurring uranium are frequently observed in groundwater and surface water at the Site. The presence of this natural uranium is not related to the weapons-related mission of the Rocky Flats Plant and does not represent Site-related contamination.

2.2 Hydrology

Streams and seeps at the Site are mostly ephemeral, with stream reaches gaining or losing flow depending on the season and precipitation amounts. Surface water flow across the Site is primarily from west to east, with two major drainages traversing the site. Twelve retention ponds were constructed during operation of the Rocky Flats Plant for surface water management. The retention ponds and associated dams are not a component of the CERCLA remedy. Nine dams have been breached by constructing armored notches in the dam embankments.
The remaining three dams are the following (Figure 2):

- Dam A-4 on North Walnut Creek
- Dam B-5 on South Walnut Creek
- Dam C-2 at the end of the South Interceptor Ditch (SID) near Woman Creek

The drainages, ponds, and other features are described below and shown in Figure 5.

DOE intends to breach these remaining dams to eliminate the retention of surface water and return the surface water flow configuration to the approximate conditions existing prior to construction of the dams. DOE's proposed action is described in the *Surface Water Configuration Environmental Assessment and Finding of No Significant Impact (FONSI)* (DOE 2011a). In accordance with the Environmental Assessment, DOE proposed to breach the A-4, B-5, and C-2 dams in the 2018 to 2020 time frame. The Adaptive Management Plan (AMP) was developed in June 2011 and has been updated several times since (DOE 2021). The AMP provides for a monitoring and data evaluation program to assist in deciding when to implement the final steps of the proposed action, which includes breaching the terminal dams. Ponds A-4, B-5, and C-2, referred to as the terminal ponds, were historically operated in batch and release mode, but after evaluation in the Environmental Assessment, they are now operated in flow-through mode.

Dam C-1 was breached prior to closure in 2004. Dams at six other ponds (A-1, A-2, B-1, B-2, B-3, and B-4) were breached in 2008–2009 as described in the *Environmental Assessment,*

Comment Response, and Finding of No Significant Impact: Pond and Land Configuration (DOE 2004b); the PLF Dam and Dam A-3 were breached in 2012 as described in the later Environmental Assessment (DOE 2011a) discussed above. The reconfiguration is discussed in more detail below. The Site drainages, remaining retention ponds, and other surface water features are described below and shown in Figure 5.

The major stream drainages leading off the Site, from north to south, are Walnut Creek and Woman Creek; neither of these creeks flows into a drinking water supply. North Walnut Creek flows through Pond A-4, and South Walnut Creek flows through Pond B-5; both are tributaries to Walnut Creek. The South Interceptor Ditch (SID) flows to Pond C-2, which subsequently discharges to Woman Creek. Rock Creek is another major stream drainage in the area, and it flows through the Refuge, north of the Site.

2.2.1 Walnut Creek

Walnut Creek receives surface water flow from a portion of the Refuge and the majority of the COU. It consists of several tributaries: McKay Ditch, No Name Gulch, North Walnut Creek, and South Walnut Creek. These tributaries join Walnut Creek upstream of the Refuge's eastern boundary (Indiana Street). East of Indiana Street, Walnut Creek flows through a diversion structure normally configured to divert flow to the Broomfield Diversion Ditch around Great Western Reservoir and into Big Dry Creek. The Walnut Creek tributaries, from north to south, are described below.

2.2.1.1 McKay Bypass Canal/McKay Ditch

The McKay Ditch was formerly a tributary to Walnut Creek within the Refuge boundary but was modified in July 1999 to allow for diversion into a new pipeline to prevent McKay Ditch water from commingling with water from the Site in Walnut Creek. Although not normally a contributor to Walnut Creek (depending on headgate configuration), the McKay Ditch drainage is described here to clarify water routing. The current configuration allows the City and County of Broomfield to direct water through the McKay Ditch, across the northern portion of the Refuge around the COU, through the McKay Bypass Pipeline, and directly into Great Western Reservoir, without entering Walnut Creek. McKay Ditch, the McKay Bypass Canal, and the McKay Bypass Pipeline are all outside the COU; these features are not maintained by LM.

2.2.1.2 No Name Gulch

This drainage is located downstream of the PLF. A surface water diversion ditch is constructed around the perimeter of the PLF to divert surface water runoff around the landfill area to No Name Gulch. Effluent from the Present Landfill Treatment System (PLFTS) is also a surface water source to No Name Gulch. Although the majority of No Name Gulch is outside the COU, it reenters the COU and joins Walnut Creek just upstream of the COU eastern boundary.

2.2.1.3 North Walnut Creek

Runoff from the northern portion of the Site flows into this drainage, which has one remaining retention pond (Pond A-4). Under normal conditions, the Walnut Creek Diversion Dam in the Refuge west of the COU isolates North Walnut Creek from surface water originating west

(upgradient) of the Site. Upstream surface water is normally diverted to the McKay Bypass Canal; however, under extreme flood conditions, runoff may flow over the diversion dam and ultimately into North Walnut Creek. During plant operations, there were four dams and associated ponds along North Walnut Creek. Three of the dams, A-1, A-2, and A-3, were breached in 2008 and 2012 and now function as flow-through structures. In the normal operational configuration, streamflow passes through former Ponds A-1, A-2, and A-3 to Pond A-4. The former ponds are essentially wetland habitat and have no storage capacity. North Walnut Creek flow can also be diverted through the North Walnut Creek Bypass Pipeline (subsurface) around former Pond A-1 to former Pond A-2, former Pond A-3, or Pond A-4. Pond A-4 is normally operated in flow-through mode, allowing water to flow directly to lower Walnut Creek and then the Site boundary. The elevated outlet works tower maintains approximately 10% of the pond's capacity (3.3 million gallons) during flow-through mode. If the valve is closed at Pond A-4 to temporarily retain water, a predischarge sample is collected and the data are reviewed with regulators before discharge is restarted. The capacity of Pond A-4 is approximately 121,650 cubic meters (m^3) (32.1 million gallons [MG] or 98.6 acre-feet).

2.2.1.4 South Walnut Creek

Runoff from the central portion of the Site flows into this drainage, which has one remaining retention pond (Pond B-5). Unlike North Walnut Creek, the South Walnut Creek headwaters are located entirely within the COU boundary. During plant operations, there were five dams and associated ponds along South Walnut Creek. Four of the dams, B-1, B-2, B-3, and B-4, were breached in 2008–2009 and now function as flow-through structures. Streamflow passes through former Ponds B1, B-2, B-3, and B-4 to Pond B-5. The former ponds are essentially wetland habitat and have no storage capacity. The South Walnut Creek Bypass Pipeline (subsurface) was formerly used to route water around Ponds B-1 through B-3. In 2013, the diversion structure was repurposed, the upstream end of the pipeline was grouted closed, and the remaining portions of the pipeline were abandoned in place. Water entering Pond B-5 is normally allowed to flow through to South Walnut Creek and then the Site boundary. The elevated outlet works tower maintains approximately 10% of the pond's capacity (2.5 million gallons) during flow-through mode. If the valve is closed at Pond B-5 to temporarily retain water, a predischarge- sample is collected and the data are reviewed with regulators before discharge is restarted. The capacity of Pond B-5 is approximately 87,434 m^3 (23.1 MG or 71 acre-feet).

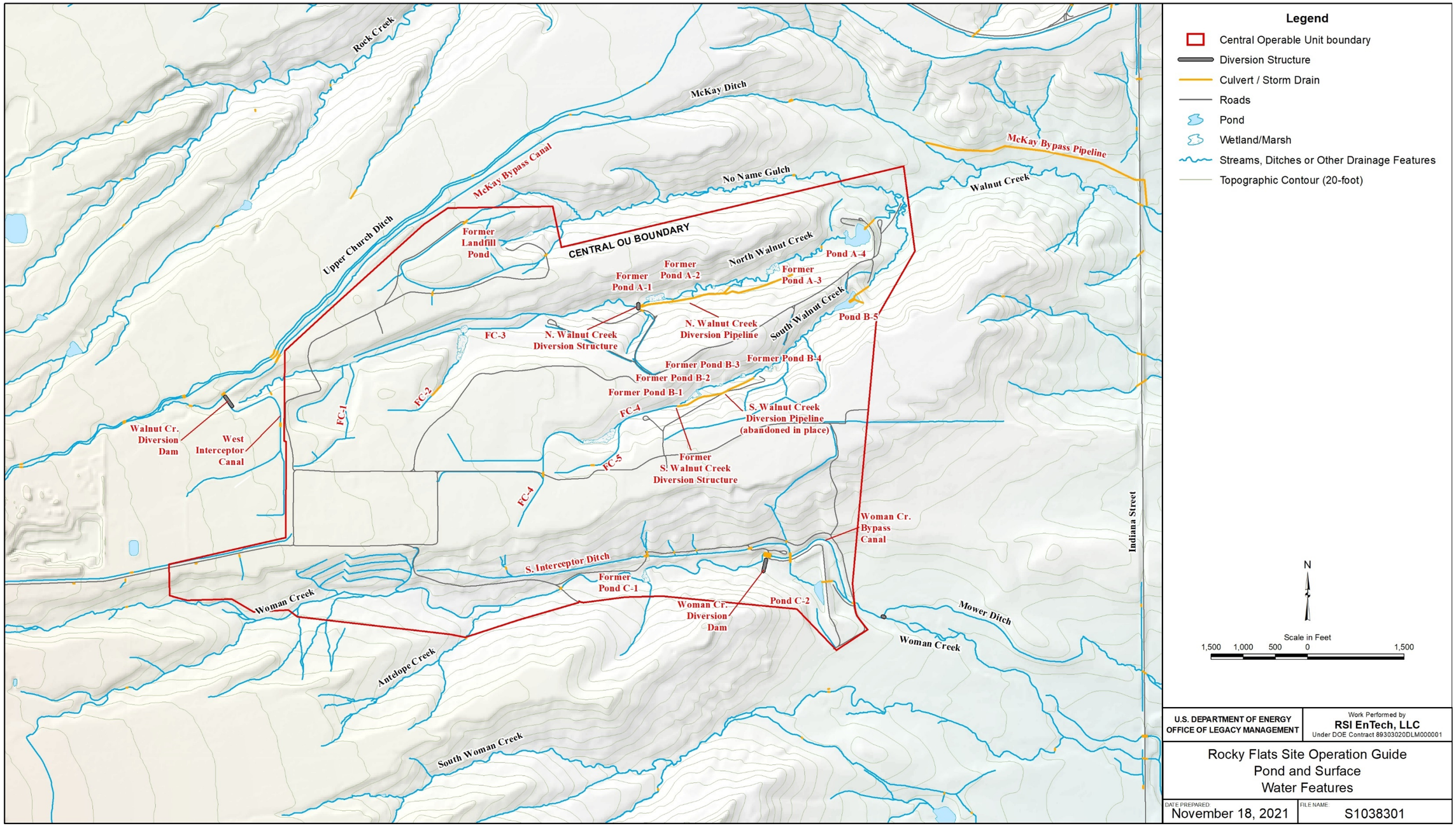

Figure 5. Rocky Flats Site Ponds and Surface Water Features

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2.2.2 Woman Creek

Along the southern boundary of the Site is Woman Creek, which flows through former Pond C-1, around Pond C-2, and offsite onto Refuge lands toward Indiana Street. During plant operations, there were two dams and associated ponds on Woman Creek. The C-1 dam was breached in 2004, the only dam breached prior to site closure in 2005.

Under normal conditions, the Woman Creek Diversion Dam prevents Pond C-2 from receiving surface water inflows from Woman Creek. Woman Creek is normally diverted around Pond C-2 via the Woman Creek Diversion Canal; under extreme flood conditions, runoff may flow over the diversion dam into Pond C-2.

The Woman Creek drainage basin extends eastward from the base of the foothills, near Coal Creek Canyon, to Standley Lake. In the current configuration, Woman Creek flows into the Woman Creek Reservoir located east of Indiana Street and upstream of Standley Lake, where the water is held until being pump-transferred to Big Dry Creek downstream of the Great Western Reservoir. The Woman Creek Reservoir is managed by the Woman Creek Reservoir Authority.

2.2.2.1 South Interceptor Ditch

The SID is in the southern portion of the Site, and it is tributary to Pond C-2. Surface water runoff from the southern portion of the Site is intercepted by the SID, which flows from west to east into Pond C-2. The capacity of Pond C-2 is approximately 85,920 m^3 (22.7 MG or 69.6 acre-feet). Pond C-2 is normally operated in a flow-through mode. The elevated outlet works tower maintains approximately 2% of the pond's capacity (0.4 million gallons) during flow-through mode. If the valve is closed at Pond C-2 to temporarily retain water, a predischarge sample is collected and the data are reviewed with regulators before discharge is restarted.

2.2.3 Other Drainages

The third major drainage, in addition to Walnut and Woman Creeks, is Rock Creek. The Rock Creek drainage covers the northwestern portion of the historical Rocky Flats Site and is wholly outside the COU boundary. East-sloping alluvial plains to the west and multiple steep gullies and stream channels to the east characterize the drainage.

Smart Ditch/South Woman Creek, located south of Woman Creek, is also completely outside the COU. The D-Series ponds (D-1 and D-2) are located on the Smart Ditch. This drainage and these ponds are not maintained by LM.

2.3 Hydrogeology

Groundwater that has been impacted by historical Site operations occurs in the upper hydrostratigraphic unit (UHSU), which comprises the surficial deposits and subcropping weathered bedrock of the Arapahoe and Laramie formations. As evaluated prior to closure (K-H 2005), the UHSU is roughly analogous to the "upper aquifer" at Rocky Flats, although in many areas the amount of groundwater available is insufficient to meet the definition of an aquifer in Title 40 *Code of Federal Regulations* Section 260.10 (40 CFR 260.10).

The Site is in a regional groundwater recharge area (EG&G 1991). Direct precipitation and baseflow along the upgradient portion of the site's drainage basin, which extends west to Coal Creek, are the source of UHSU recharge. Infiltrating precipitation is reduced significantly by evapotranspiration (ET) (K-H 2002); this loss increases near streams due to the shallower groundwater and more abundant vegetation.

Bedrock claystones separate the UHSU from the lower hydrogeologic features. The bedrock surface closely resembles the surface topography and represents the main control on groundwater migration. Groundwater flows laterally through the unconsolidated surficial materials because its vertical transport is limited by the relatively low-permeability bedrock claystones. Groundwater resources in the regional Laramie/Fox Hills aquifers are separated from the UHSU by several hundred feet of these upper Laramie Formation claystones, which act as an aquitard and restrict the occurrence of contaminated groundwater to shallower intervals.

The general direction of groundwater flow sitewide is from west to east. Locally, this is modified by the presence of drainages. As groundwater within the UHSU of a pediment flows toward the east and nears a drainage, the topographic depression represented by that drainage diverts the groundwater toward it, and the groundwater that is not withdrawn via ET discharges to surface water either as seepage or baseflow. This results in considerable hydraulic connection between surface water and groundwater at the site. Segments of streams have been shown to either gain or lose water as groundwater is discharged to streams or stream water is discharged to groundwater from the stream channel. Groundwater discharges to surface water prior to leaving the COU. Therefore, gaining reaches of streams in the Site are more likely to receive groundwater impacted by past RFP/RFETS activities and have traditionally been the focus of most groundwater monitoring.

Notable seep areas are easily identified by the presence of phreatophytes (i.e., plant species with roots that extend to the water table). Most seeps remain inactive (i.e., do not show a surface expression of groundwater) during typical climate years and become active only during wetter climate years.

In addition to natural hydrologic processes, groundwater can also be transported to surface water directly through former utility corridors, building sumps, foundation drains, and sanitary sewers. Although these systems have been removed or disrupted as part of the RFP/RFETS closure, the trenches in which they were installed may represent preferential pathways for groundwater. Overall, water quality data pertaining to these corridors have indicated that their importance as preferential pathways for contaminated groundwater migrating to surface water is relatively minor.

Depth to groundwater is greatest in the western portion of the site, where the Rocky Flats Alluvium can exceed 100 feet in thickness. As the Rocky Flats Alluvium thins toward the east, the depth to groundwater and the saturated thickness decrease. In some portions of the site, groundwater is absent from the UHSU or is present only within the weathered bedrock, causing a decrease in groundwater flow velocities due to the lower hydraulic conductivity of the weathered claystones. However, where the basal Arapahoe Formation sandstone, informally referred to in geologic and hydrologic studies at Rocky Flats as the Arapahoe Sandstone No. 1, forms part of the UHSU, flow velocities tend to increase in comparison to the Rocky Flats Alluvium or claystone due to the higher hydraulic conductivity of this material. This sandstone unit comprises

a preferential flow path, such as in the East Trenches area and elsewhere. Maps of this sandstone are included in earlier RFP/RFETS reports, such as the *Geologic Characterization Report for the Rocky Flats Environmental Technology Site* (EG&G 1995a). Note that this 1995 depiction was not updated following the collection of additional lithologic information.

Numerous potentiometric surface maps have been generated for the RFP/RFETS and for localized areas within the COU; for examples, see previous annual reports. These maps are used to assess changing conditions over time, particularly with respect to groundwater gradients and flowpaths. Potentiometric surface maps and groundwater flow velocities for the second and fourth calendar quarters of each year are included in RFLMA annual reports.

2.4 Ecology

Vegetation communities at Rocky Flats provide specific habitats for associated wildlife, rare plants, and unusual plant associations. These communities include the xeric mixed grassland, mesic mixed grassland, high-quality wetlands, tall upland shrubland, Great Plains riparian woodland complex, and reclaimed grassland communities. The aquatic ecosystem at Rocky Flats consists primarily of the flora and fauna associated with the surface water features described in Sections 2.2 and 2.4.2. No threatened or endangered plant species are known to occur at the Site.

As a result of the diverse vegetation communities found at Rocky Flats, a considerable diversity of wildlife is also present. Many species of birds, large and small mammals, amphibians, reptiles, and fish make their home at Rocky Flats. The Preble's meadow jumping mouse (*Zapus hudsonius preblei*) (Preble's mouse) is the only federally listed threatened or endangered species found at Rocky Flats.

2.4.1 Vegetation

2.4.1.1 Xeric Mixed Grassland

Rocky Flats includes two types of xeric mixed grassland units: the xeric tallgrass prairie and the xeric needle-and-thread grass prairie. Identification of the xeric tallgrass vegetation community is based on the presence of big bluestem (*Andropogon gerardii*), little bluestem (*Andropogon scoparius*), prairie dropseed (*Sporobolus heterolepis*), Indian-grass (*Sorghastrum nutans*), and switchgrass (*Panicum virgatum*). These five species are considered to be tallgrass prairie relicts. Of these species, only big bluestem and little bluestem are abundant at Rocky Flats. When the foliar cover of these five species is approximately 10% or more of a xeric mixed grassland community, the community is classified as xeric tallgrass prairie. The soil on the xeric tallgrass prairie is visibly cobbly on the surface and is considered to be a very cobbly sandy loam. This vegetation community covers the high, rocky pediment on the western third of Rocky Flats. The xeric tallgrass prairie has been classified as a rare plant community type for Colorado and North America by the Colorado Natural Heritage Program.

The other type of xeric mixed grassland, the xeric needle-and-thread grass prairie, is also considered rare at Rocky Flats. Xeric needle-and-thread grass prairie is differentiated from xeric tallgrass prairie by a greater cover of needle-and-thread grass (*Stipa comata*) and New Mexico feather grass (*Stipa neomexicana*) than big bluestem and little bluestem or other tallgrass species. The soils beneath the xeric needle-and-thread grass prairie are not as cobbly as those in the xeric

tallgrass prairie and have a higher visible component of caliche at the soil surface. This vegetation community occupies the tops of many of the easternmost ridges of Rocky Flats.

2.4.1.2 Mesic Mixed Grassland

Mesic mixed grassland is characterized by western wheatgrass (*Agropyron smithii*) and blue grama grass (*Bouteloua gracilis*). Other common species include green needlegrass (*Stipa viridula*), Canada bluegrass (*Poa compressa*), and Kentucky bluegrass (*Poa pratensis*). The mesic grassland has a more turf appearance in contrast to the bunchgrass appearance of the xeric mixed grasslands. Surficial soils are clay loams that do not have the cobbly appearance typical of xeric mixed grassland soils. Most hillsides at Rocky Flats are considered mesic mixed grassland habitat.

The quality of these grasslands varies considerably across Rocky Flats depending on the annual precipitation received. Non-native species such as diffuse knapweed (*Centaurea diffusa*), Japanese brome (*Bromus japonicus*), dalmatian toadflax (*Linaria dalmatica*), alyssum (*Alyssum minus*), musk thistle (*Carduus nutans*), common mullein (*Verbascum thapsus*), Scotch thistle (*Onopordum acanthium*), and others are often abundant in wet years. For classification purposes, a grassland is designated as mesic mixed if western wheatgrass and blue grama grass form an understory beneath non-native species, regardless of dominance by non-native species.

Mesic mixed grasslands comprise one of the largest contiguous vegetation communities at Rocky Flats. In addition to its essential role as a foraging habitat, the size and isolation of the mesic mixed grassland often makes it important to certain wildlife species. A variety of grassland birds breed and forage in this habitat. Small mammals are abundant and diverse and provide a suitable prey base for a variety of avian and mammalian predators.

2.4.1.3 High-Quality Wetlands

Several high-quality wetlands are present at Rocky Flats, with the largest contiguous areas and the most complex plant associations found at the Rock Creek and Antelope Springs/Apple Orchard Springs complexes. The Rock Creek complex is entirely outside the COU and the Antelope Springs complex is predominantly outside the COU.

The Rock Creek wetlands are a large, seep-fed wetland complex extending approximately 1 mile from the foot of the easternmost seep-fed wetlands to the westernmost short marsh areas. The Antelope Springs/Apple Orchard Springs wetland complex encompasses the predominantly wet meadow, short marsh, and tall marsh habitat mosaic of the upper Woman Creek Drainage Basin. These are also seep-fed wetlands that depend on groundwater discharge for their continued existence.

Predominant vegetation in these wetlands includes cattails (*Typha* sp.) and bulrush (*Scirpus* sp.) in tall marsh community; Nebraska sedge (*Carex nebraskensis*) and Baltic rush (*Juncus balticus*) in short marsh habitat; and prairie cordgrass (*Spartina pectinata*), redtop (*Agrostis stolonifera*), showy milkweed (*Asclepias speciosa*), and Missouri iris (*Iris missouriensis*) in wet meadow habitat.

These wetlands support a variety of terrestrial and aquatic organisms. Portions of these wetlands have been designated as prime habitat for Ute Ladies'-tresses (*Spiranthes diluvialis*), which is a federally listed threatened plant that has never been found at Rocky Flats. Other portions support amphibian species and waterfowl. Many predatory mammals and bird species depend on these areas as hunting and foraging grounds due to their high prey species productivity.

2.4.1.4 Tall Upland Shrubland

The tall upland shrubland comprises stands of hawthorn (*Crataegus erythropoda*), chokecherry (*Prunus virginiana*), and occasionally wild plum (*Prunus americana*). Tall upland shrubland is found primarily on north-facing slopes above seeps, wetlands, and streams in the Rock Creek drainage, but small units also occur at other locations across Rocky Flats. This vegetation community may be unique, because no similar units have been identified outside the general Rocky Flats vicinity. It is important habitat for the resident mule deer (*Odocoileus hemionus*) population and elk (*Cervus canadensis*). Both the mule deer and elk are highly reliant on tall upland shrubland for fawning cover, winter thermal cover and browse, and summer shade and isolation cover. A number of rare bird species (e.g., bluegray gnatcatchers [*Polioptila caerulea*] and chestnut-sided warblers [*Dendroica pensylvanica*]) occupy this community as well.

2.4.1.5 Great Plains Riparian Woodland Complex

Riparian areas are well known for the diversity of plant and animal species they support. The riparian woodland complex at Rocky Flats is a combination of two vegetation community classifications: riparian woodland and riparian shrubland, which form a complex mosaic habitat along the drainage bottoms. Due to their contiguous mixture of both trees and shrubs, the riparian areas are described as a complex. The woodland component of the complex is characterized by stands of plains cottonwood (*Populus deltoides*), peach leaf willow (*Salix amygdaloides*), Siberian elm (*Ulmus pumila*), and silver poplar (*Populus albus*). The shrubland component of the complex includes chokecherry, snowberry (*Symphoricarpos occidentalis*), coyote willow (*Salix exigua*), leadplant (wild indigo) (*Amorpha fruticosa*), and other shrubs.

The riparian woodland complex is an important habitat for a different songbird association than the grasslands and shares some species with the tall upland shrubland. Several of the bird species using the riparian woodland complex as foraging and nesting cover are rare species (e.g., blue grosbeak [*Guiraca caerulea*]). Like the tall upland shrubland community, this vegetation community is also seasonally important to the mule deer and elk as shelter, forage source, and fawning grounds. Large cottonwood trees embedded within this unit provide nesting habitat for several raptor species, including the great horned owl (*Bubo virginianus*), redtailed-hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsoni*, a Colorado "at-risk" species), and American kestrel (*Falco sparverius*).

2.4.1.6 Reclaimed Grasslands

Since closure of the Rocky Flats Site in 2005, considerable effort has been made to restore disturbed areas to their more natural ecological state (i.e., prairie, wetlands, and riparian areas). As a result, various seed mixes have been used at different locations based on slope, aspect, soils, and moisture regimes to attempt to mimic the native plant communities in the area. Since the mid-1990s, only native plant species have been used in seed mixes at the site. However, prior to that, a common, non-native rangeland mix that included such species as smooth brome (*Bromus*

inermis), intermediate wheatgrass (*Agropyron intermedium*), and crested wheatgrass (*Agropyron cristatum*) was commonly used for revegetation projects. As a result, many areas of the site are dominated by these species. The 1996 vegetation map classified all reclaimed grassland areas into one classification, Reclaimed Mixed Grassland. However, the 2014 update of the vegetation map subdivided the reclaimed grassland classification into four classifications to more accurately represent the various seed mixes that were used at different locations and the current vegetation communities that are present.

- Reclaimed Mixed Grassland

  This classification is dominated by smooth brome, intermediate wheatgrass, crested wheatgrass, sheep fescue (*Festuca ovina*), and other non-native planted or adventive species. This classification covers all site areas that were revegetated with various non-native graminoid seed mixtures. Large areas of this habitat type are found around the former and current ponds and surrounding the former Industrial Area.

- Reclaimed Mesic Grassland

  This classification is dominated by western wheatgrass, slender wheatgrass (*Agropyron caninum*), blue grama grass, side-oats grama (*Bouteloua curtipendula*), buffalograss (*Buchloe dactyloides*), and green needlegrass. This classification differs from the Mesic Mixed Grassland classification in the fact that this is a reclaimed area. The upland seed mix used in this classification was designed to mimic the native hillsides at the site.

- Reclaimed Xeric Grassland

  This classification is dominated by big bluestem, little bluestem, Indian-grass, western wheatgrass, slender wheatgrass, blue grama grass, side-oats grama, and buffalograss. This classification differs from the Xeric Mixed Grassland classification in the fact that it is also a reclaimed area. It was seeded with a native upland seed mix designed to mimic the grasslands on the pediment tops at the site.

- Reclaimed Riparian Grassland

  This classification is similar to the Reclaimed Mesic Grassland or Reclaimed Xeric Grassland areas with the exception that it also includes significant cover of either switchgrass or Canada wild rye (*Elymus canadensis*). These two species were often added to the other two seed mixes and used along streams, ponds, and wetland margins. Areas dominated by either of these two species were classified as this category.

2.4.2 Aquatic Community

The aquatic ecosystem at Rocky Flats consists of a network of primarily ephemeral streams, wetlands, retention ponds, and several scattered old stock ponds. In the Walnut Creek and Woman Creek drainages, the remaining terminal ponds (A-4, B-5, and C-2) retain moderate bodies of water (when they have water in them). These ponds are now configured in flow-through condition, so the only water retained is what remains below the outlet structures. Several mitigation wetland areas were created for wetland disturbances related to Rocky Flats Site closure activities. These are located primarily in the COU in the North and South Walnut Creek drainages. Numerous seep springs feed streams at Rocky Flats and provide additional limited wetland habitat. Other than the outflow of the seeps and the water in the wetlands and remaining ponds, very little permanent surface water exists at Rocky Flats. Macroinvertebrate

populations typical of ephemeral streams and limited small populations of fish are found in the various waters at the Rocky Flats (Aquatic Associates 1998, K-H 1998, DOE 2003).

2.4.3 Wildlife

Birds occur in all available habitats at Rocky Flats. The most common raptors are red-tailed hawks, American kestrels, and great horned owls. Other common migratory raptors are Swainson's hawks, northern harriers (*Circus cyaneus*), golden eagles (*Aquila chrysaetos*), and turkey vultures (*Cathartes aura*). Other species that occasionally visit the Site include the bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrinus*), ferruginous hawk (*Buteo regalis*), and burrowing owl (*Athene cunicularia*). Among the more than 45 species of waterfowl and shorebirds observed at Rocky Flats, mallards (*Anas platyrhynchos*), Canada geese (*Branta canadensis*), and great blue herons (*Ardea herodias*) are the most common. Other frequently observed waterfowl species include buffleheads (*Bucephala albeola*), blue-winged teal (*Anas discors*), green-winged teal (*Anas crecca*), common mergansers (*Mergus merganser*), hooded mergansers (*Lophodytes cucullatus*), ring-necked ducks (*Aythya collaris*), redheads (*Aythya americana*), and lesser scaups (*Aythya affinis*). Several waterfowl and shorebirds have been observed to breed near the ponds and wetlands. Over 95 neotropical migrant species have been recorded at Rocky Flats, several of which have been confirmed as breeding in a variety of habitats. Common neotropical migrant species observed include Say's phoebe (*Sayornis saya*), eastern kingbirds (*Tyrannus tyrannus*), western kingbirds (*Tyrannus verticalis*), cliff swallows (*Hirundo pyrrhonota*), barn swallows (*Hirundo rustica*), American robins (*Turdus migratorius*), yellow warblers (*Dendroica petechia*), common yellowthroats (*Geothlypis trichas*), grasshopper sparrows (*Ammodramus savannarum*), vesper sparrows (*Pooecetes gramineus*), red-winged blackbirds (*Agelaius phoeniceus*), and western meadowlarks (*Sturnella neglecta*).

Mule deer are common across Rocky Flats with an occasional white-tailed deer (*Odocoileus virginianus*) mixed in the population. Elk have become more common since closure and cleanup activities were completed, and observations of 200 or more elk at a time are not uncommon. In recent years, mountain lions (*Puma concolor*) and black bear (*Ursus americanus*) have been observed occasionally. The most commonly observed carnivore is the coyote (*Canis latrans*). Several active coyote dens are often present each year. Mid- to small-sized animals include desert cottontails (*Sylvilagus audubonii*), white-tailed jackrabbits (*Lepus townsendii*), black tailed jackrabbits (*Lepus californicus*), raccoons (*Procyon lotor*), muskrats (*Ondatra zibethicus*), and black-tailed prairie dogs (*Cynomys ludovicianus*).

Amphibians and reptiles can be observed at Rocky Flats in the appropriate habitats for each species. Common species include the prairie rattlesnake (*Crotalus viridis*), boreal chorus frogs (*Pseudacris triseriata maculata*), northern leopard frogs (*Rana pipens*), western painted turtles (*Chrysemys picta*), and bullfrogs (*Rana catesbeiana*). Occasionally, the eastern short-horned lizard (*Phrynosoma douglassi*) can be observed on the xeric tallgrass prairie. Fish can be found in the intermittent streams and most ponds. Common species include fathead minnows (*Pimephales promelas*), creek chubs (*Semotilus atromaculatus*), and an occasional small-mouth bass (*Micropterus dolomieui*) and large-mouth bass (*Micropterus salmoides*).

2.4.4 Preble's Mouse Habitat and Populations

The Preble's mouse is a species of particular concern at the Site because it is listed as threatened by USFWS. This listing provides special protection for the species under the Endangered Species Act (ESA), and actions must be evaluated for potential impact to the mouse.

Preble's mice have been recorded in the major drainages of the site, Walnut Creek and Woman Creek. Native plant communities in these areas provide a suitable habitat for this small mammal. Preble's mouse populations are found in association with the riparian zone and seep wetlands and apparently prefer multistrata vegetation with abundant herbaceous cover. The vegetation communities that provide Preble's mouse habitat include the Great Plains riparian woodland complex, tall upland shrubland, the wetlands adjacent to these communities, and some of the upland grasslands surrounding these areas. Activities occurring in Preble's mouse habitat require approval from USFWS prior to initiation. On December 15, 2010, USFWS finalized a ruling that designated critical habitat for the Preble's mouse at the Site (*Federal Register* Vol. 75, No. 240, page 78430). Figure 6 shows the locations of Preble's mouse protection areas and critical habitat at Rocky Flats. Both areas protect the Preble's mouse at Rocky Flats and must be considered when evaluating potential project impacts.

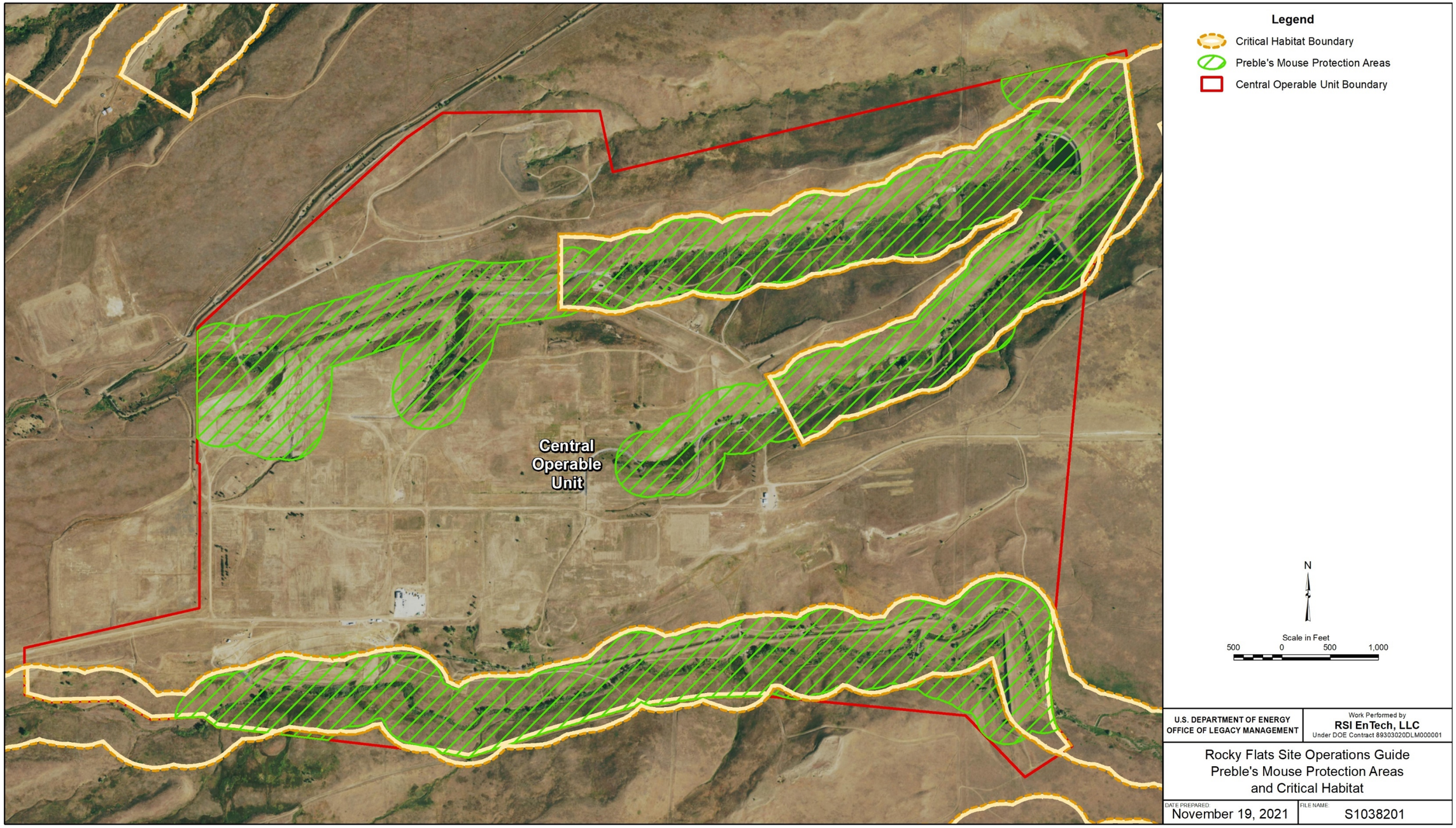

Figure 6. Preble's Mouse Protection Areas and Critical Habitat in the Central Operable Unit at the Rocky Flats Site, Colorado

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3.0 Access Controls

The effectiveness of RFLMA-required physical controls (signs and other features that protect engineered elements of the remedy) that work as access controls at the Site is monitored regularly in accordance with the RFLMA. Inspections of the physical controls and institutional controls and reporting are discussed in Section 5.0. During the inspections, LM will note needed repairs and maintenance and take subsequent action promptly. If LM finds evidence of activities that violate institutional controls (Section 3.1), it will immediately commence notifications and repairs or other corrective action in consultation with EPA and CDPHE, as defined in the RFLMA.

3.1 Institutional Controls

Institutional controls for the COU include land-use restrictions that are established in the CAD/ROD and CAD/ROD amendment (EPA et al. 2011), embodied in the Restrictive Notice,[1] and implemented through the RFLMA. The institutional controls are summarized in Table 4 of Attachment 2 to the RFLMA and are reproduced below for reference (Table 1). The CAD/ROD specifies the objectives and rationale for each institutional control in the table. Institutional controls are to be implemented in accordance with Section 4.0 of Attachment 2 to the RFLMA.

An Environmental Covenant was originally put in place for the COU after the Site closed. In April 2017, this Environmental Covenant was replaced with a Restrictive Notice, as allowed by Colorado law. Section 5.3.6 of Attachment 2 to the RFLMA requires that an annual verification be performed to ensure that the Environmental Covenant or Restrictive Notice remains on file with Jefferson County. This verification is documented in the Site annual reports (Section 9.0).

Signs are posted at each gate to the COU listing the land-use restrictions. In accordance with Section 5.3.6 of Attachment 2 to the RFLMA, the COU must be inspected at least annually for evidence of violation of institutional controls; however, personnel are expected to be observant during their daily activities and immediately report evidence of violation of institutional controls to the LM Site manager.

The *Erosion Control Plan for Rocky Flats Property Central Operable Unit* (ECP) (DOE 2007, update forthcoming) required by institutional control 3 will be submitted to CDPHE for approval (see Section 4.4). Soil Disturbance Review Plans (SDRPs) required in certain circumstances by institutional controls 2 and 3 are project-specific and are approved by CDPHE and EPA as part of the RFLMA consultation process. CDPHE may also approve specific activities that are otherwise prohibited by the institutional controls.

[1] The purpose of this Restrictive Notice is to ensure protection of human health and the environment by creating a legal mechanism for enforcing (by both CDPHE and DOE) the use restrictions specified in the CAD/ROD as institutional controls.

Table 1. Institutional Controls for the COU

Controls	Use Restrictions
1	The construction and use of buildings that will be occupied on a permanent or temporary basis (such as for residences or offices) is prohibited. The construction and use of storage sheds or other, non-occupied structures is permitted, consistent with the restrictions contained in controls 2 and 3 below, and provided such use does not impair any aspect of the response action at Rocky Flats.
	Objective: Prevent unacceptable exposures via the indoor air pathway. Rationale: The analysis of the indoor air pathway in the Comprehensive Risk Assessment indicated that subsurface volatile organic compounds were at levels in certain portions of the Central OU that could pose a risk of unacceptable exposure to the wildlife refuge worker if occupied structures were built in these areas.
2	Excavation, drilling, and other intrusive activities below a depth of 3 feet are prohibited, without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent unacceptable exposure to residual subsurface contamination. Rationale: Contaminated structures, such as building basements, exist in certain areas of the Central OU, and the Comprehensive Risk Assessment did not evaluate the risks posed by exposure to this residual contamination. Thus, this restriction eliminates the possibility of unacceptable exposures. Additionally, it prevents damage to subsurface engineered components of the remedy.
3	No grading, excavation, digging, tilling, or other disturbance of any kind of surface soils is permitted, except in accordance with an erosion control plan (including Surface Water Protection Plans submitted to EPA under the Clean Water Act) approved by CDPHE or EPA. Soil disturbance that will not restore the soil surface to preexisting grade or higher may not be performed without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent migration of residual surface soil contamination to surface water. Rationale: Certain surface soil contaminants, notably plutonium-239/240, were identified in the fate and transport evaluation in the Remedial Investigation as having complete pathways to surface water if disturbed. This restriction minimizes the possibility of such disturbance and resultant impacts to surface water. Restoring the soil surface to preexisting grade maintains the current depth to subsurface contamination or contaminated structures.
4	Surface water may not be used for drinking water or agricultural purposes.
	Objective: Prevent unacceptable exposure to local surface water contamination above the terminal ponds. Rationale: While the Comprehensive Risk Assessment did not evaluate the risks posed by the use of surface water for drinking or agricultural purposes, the nature and extent of contamination evaluation in the Remedial Investigation showed that certain contaminants were found at levels exceeding standards above the terminal ponds. This restriction reduces the possibility of unacceptable exposures to future users from this source.
5	The construction or operation of groundwater wells is prohibited, except for remedy-related purposes.
	Objective: Prevent unacceptable exposure to contaminated groundwater. Rationale: While the Comprehensive Risk Assessment did not evaluate the risks posed by the use of groundwater for drinking or agricultural purposes, the nature and extent of contamination evaluation in the Remedial Investigation identified areas in the Central OU where groundwater contaminants exceeded water quality standards or MCLs. This restriction reduces the possibility of unacceptable exposures to future users from this source. Additionally, it prevents the disruption of groundwater flow paths so as to avoid impacts on groundwater collection and treatment systems.
6	Digging, drilling, tilling, grading, excavation, construction of any sort (including construction of any structures, paths, trails or roads), and vehicular traffic are prohibited on the covers of the Present Landfill and the Original Landfill, except for authorized response actions.
	Objective: Ensure the continued proper functioning of the landfill covers. Rationale: This restriction helps ensure the integrity of the landfill covers.
7	Activities that may damage or impair the proper functioning of any engineered component of the response action, including but not limited to any treatment system, monitoring well, landfill cap, or surveyed benchmark, are prohibited. The preceding sentence shall not be construed to prohibit the modification, removal, replacement, or relocation of any engineered component of the response action in accordance with the action determinations in RFLMA Attachment 2.
	Objective: Ensure the continued proper functioning of engineered portions of the remedy. Rationale: This restriction helps ensure the integrity of other engineered components of the remedy, including monitoring and survey points.

Abbreviation: MCL = maximum contaminant level

3.2 Intrusive Work and Soil Disturbance Evaluation

Project activities that involve intrusive work or soil disturbance must be evaluated prior to implementation as part of the RFLMA consultative process. This evaluation must be documented in a Soil Disturbance Review Plan, as required by RFLMA Attachment 2, Section 4.0, "Institutional Controls." Actions that require an SDRP are defined in institutional controls 2 and 3 in Table 1:

- Excavation, drilling, and other intrusive activities below a depth of 3 feet (institutional control 2)
- Soil disturbance that will not restore the soil surface to preexisting grade or higher (institutional control 3)

For those activities that will not return the surface to the preexisting grade or higher, information regarding the final grade after the activity is completed must be documented. In most cases, the documentation will consist of design documents (e.g., "as-built" drawings) that contain the final elevation details. In some cases, an engineering design might not be needed to accomplish the activity, but measurements can be made to document changes in elevation at particular locations. The documentation of the change in elevation will be identified as part of the SDRP and the applicable contact record or written correspondence.

The SDRP is attached to the applicable contact record or written correspondence and must include:

- A description of the proposed project, including the purpose, location, and lateral and vertical extent of excavation.
- Information about any remaining subsurface structures in the vicinity of the proposed project or a statement that there are none, if that is the case.
- Information about any former Individual Hazardous Substance Sites, Potential Areas of Concern, or other known or potential soil or groundwater contamination in the vicinity of the proposed project or a statement that there is no known contamination.

Activities that require an SDRP may not take place until 10 calendar days after the contact record or written correspondence approving the activity is posted to the Rocky Flats Site public website, and stakeholders have been notified of the posting. An example of a contact record that contains an approved SDRP can also be found at the Rocky Flats Site public website.

Internal procedures also require evaluation before intrusive work is performed to understand conditions such as buried utilities and residual subsurface infrastructure. Soil disturbance in some areas may also require evaluation and notification because of wetlands or endangered species habitat designations.

3.3 Physical Controls

Physical controls required by the RFLMA include those controls necessary to protect engineered elements of the remedy, such as landfill covers, groundwater treatment systems, and monitoring equipment.

Section 3.2 of Attachment 2 to the RFLMA provides requirements for signs around the perimeter and at access points to the COU. These signs must be inspected quarterly to ensure they remain legible and meet the requirements of the RFLMA. The inspections are documented in the quarterly reports.

As a BMP, the following additional measures are currently implemented, or will be implemented, as appropriate:

- Monitoring wells are locked.
- Treatment system hatches are locked.
- Monitoring stations will be locked or fenced as necessary if vandalism, intrusion, or tampering appear to be a problem.
- The storage shed is locked.
- Gates to the COU will remain locked or properly attended at all times.

The Site is currently closed to the public, and access is managed for official use only.

All personnel, subcontractors, and official visitors to the Site must complete read-and-sign training to acquaint them with Site conditions and emergency response information.

4.0 Routine Site Operation and Maintenance

Routine O&M at the Site applies to both remedy and non-remedy facilities and structures remaining after closure. These include the monitoring locations (i.e., groundwater and surface water), dams and surface water control features, landfills, groundwater treatment systems, erosion controls, and revegetation efforts. These O&M activities are summarized below. Detailed operating procedures are contained in internal documents.

4.1 Ponds and Surface Water Control Features

Ongoing O&M of Site surface water retention ponds and surface water control features will continue in order to provide ecological benefits, storm-water management, and dam safety. Dams and other structures are maintained in accordance with applicable state regulations. Control features such as flow-measurement flumes and weirs are integral to the remedy because of their role in water quality monitoring.

The Site dams are earthen structures that are monitored, maintained, and inspected to ensure dam safety. State dam hazard classifications range from "High Hazard Dam" (i.e., highest concern with loss of human life expected if the dam fails) to "No Public Hazard (NPH) Dam" (i.e., lowest concern with no loss of human life expected if the dam fails, and damage only to the dam owner's property expected). Dams A-4, B-5, and C-2 are all classified as "Low Hazard Dams" (i.e., no loss of human life or significant downstream damage expected).

Only water containment and conveyance structures within the COU are managed by LM (Figure 5). Diversion structures and canals and ditches located in the Refuge that have the potential to affect DOE facilities within the Site will be periodically inspected by LM personnel. Unacceptable observations will be communicated to USFWS.

4.2 Landfills

The PLF is approximately 22 acres in area with an engineered Resource Conservation and Recovery Act (RCRA) Subtitle C-compliant cover. A diversion channel surrounds the landfill and diverts runoff away from the landfill to No Name Gulch. The PLF has a seep collection and passive aeration treatment system that discharges into the former PLF pond area. A gas extraction system is also built into the landfill and allows subsurface gas to vent to the atmosphere. The PLF is managed in accordance with the *Present Landfill Monitoring and Maintenance Plan and Post-Closure Plan, U.S. Department of Energy Rocky Flats Site* (also called the PLF M&M Plan) (DOE 2014a).

The OLF is approximately 20 acres in area with a soil cover. The original surface was regraded to provide a consistent slope. The cover consists of a 2-foot-thick Rocky Flats Alluvium soil layer that was constructed over the regraded surface. At closure, a 20-foot-high, 1000-foot-long soil mass buttress fill was placed at the toe of the landfill to enhance stability. Surficial erosion is minimized by a series of diversion berms that divert runoff from the cover into perimeter channels on the east and west side of the landfill. The two perimeter channels collect runoff from the diversion berms and carry it away from the landfill. Conditions that warranted repair or triggered further investigation were found at the OLF beginning in 2007. Weather events and resulting soil movement on the east and west sides prompted additional evaluations, repairs, and

maintenance actions at the OLF in 2010, 2013, 2015, 2016, and 2017. After completing several investigations followed by a detailed design in 2019, the OLF Stabilization Project was completed in 2020. The hillside stabilization features include subsurface drains, ground anchors, and tieback plates located on the east and west edge of the landfill. Since closure of the OLF in 2005, the portion of the hillside that is directly uphill from the toe buttress (the area in which the bulk of the OLF waste is located) has remained stable. The engineered stabilization on the eastern and western sides of the OLF helps to prevent localized settlements, slumping, and other movements that would have destabilized larger portions of the OLF over time. The OLF is managed in accordance with the *U.S. Department of Energy Rocky Flats Site Original Landfill Monitoring and Maintenance Plan* (DOE 2009).

Inspections of the PLF and OLF are conducted on a quarterly and monthly frequency, respectively, and after precipitation events exceeding 1.0 inch as set forth in the corresponding M&M plans referenced above and in RFLMA Attachment 2. Changes to the inspection frequency can be developed and documented through the RFLMA consultation process and will be evaluated during the periodic CERCLA review process. The findings and observations of the landfill inspections are submitted to EPA and CDPHE and presented in the quarterly and annual reports. Groundwater and surface water monitoring results will be included in the appropriate quarterly report. Inspections and monitoring activities include groundwater and surface water sampling, and observations of subsidence/consolidation, slope stability, soil cover, vegetation, storm-water management structures, institutional controls, and erosion in surrounding features so that maintenance actions can be taken in a timely manner.

Settlement monuments that monitor for settlement or slope instability are surveyed by a land surveyor at a frequency designated by each landfill's respective M&M plan.

4.3 Groundwater Plume Treatment Systems

Contaminated groundwater at the Site is currently being collected in four areas and treated in three treatment systems: the East Trenches Plume Treatment System (ETPTS), the Solar Ponds Plume Treatment System (SPPTS), and the PLFTS. The ETPTS and PLFTS are designed to treat contaminated groundwater containing volatile organic compounds (VOCs), and the SPPTS is designed to treat elevated nitrates and uranium. The Mound Site Plume Collection System (MSPCS) was converted from a collection and treatment system to collection only in 2016, with the collected water being routed to the ETPTS for treatment.

Each of the collection and treatment systems was installed prior to Site closure. Changes in the treatment requirements and in available technology have led to upgrades to all but the PLFTS. Additional information on the numerous modifications that have been made is available in the annual reports issued since 2006.

Sampling and analysis at these treatment systems are addressed in Section 6.1 and are performed in compliance with the RFLMA. Additional sampling may be performed beyond that required by the RFLMA (e.g., to support optimization studies or assess media conditions).

O&M requirements for these treatment systems are contained in site-specific internal procedures and the PLF M&M Plan (DOE 2014a). Each of the systems must be routinely inspected and

maintained to ensure continued flow and treatment and to ensure any automated instrumentation that may be present continues to function as designed.

Routine inspection and maintenance at the MSPCS, ETPTS, and SPPTS include the following, as applicable:

- Checking water levels
- Checking and cleaning flow meters and dedicated instrumentation (e.g., pressure transducers and temperature sensors)
- Checking valves and piping
- Cleaning effluent lines
- Inspecting the instruments in the associated instrument vaults
- Checking and servicing the solar panels, batteries, associated electronics, pumps, and (if present) float switches
- At the ETPTS only, installing, operating, cleaning/maintaining, and monitoring air-stripper components (trays, ventilation components, pressure gages, blower motor, etc.)
- Sampling
- Inspecting and potentially flushing the filters in the instrument vaults
- At the SPPTS only, checking and servicing the nutrient dosing pumps and checking and maintaining an adequate store of the vendor-supplied liquid nutrient
- At the SPPTS only, ensuring lagoon-insulating tiles are in place and lagoon-related safety infrastructure (fence, gate, railing, etc.) is in place and in good condition

At the PLFTS, routine inspection and maintenance include the following:

- Checking piping, manholes, grates, and steps for damage and proper operation
- Removing anything that might be blocking flow

Uranium treatment at the SPPTS is currently being developed and is scheduled to be reconfigured in 2024. Associated O&M requirements will be conducted once the appropriate equipment has been installed but are not yet known.

4.4 Erosion Control and Revegetation

The final phase of closure included the implementation of erosion controls, including revegetation. Revegetation requirements for the Site have been established and are described in the *Rocky Flats Site, Colorado, Revegetation Plan* (DOE 2018b). The selection and application of erosion control materials varied throughout the former RFP/RFETS, depending on area-specific contaminant levels, physical conditions, proximity to surface water, and slope and soil characteristics. Erosion controls serve to protect the reclaimed areas from significant erosion and promote infiltration and ET of surface water. The primary goals of erosion control and revegetation will continue to be protection of surface water quality and enhancement of wildlife habitat.

The ECP (DOE 2007, update forthcoming) provides the regulatory approach, applicability, and scope of erosion control activities for the Site. It also lists various BMPs, erosion control implementation, and monitoring at the Site. The erosion control areas are designed to require minimal maintenance but will be inspected on a routine basis (according to the ECP) to ensure they are functioning correctly. If a revegetated area is seriously affected by surface erosion or deposition, such as from a heavy storm event, the area will be repaired. Repairs may include placing and grading fill material or topsoil. After the erosion feature is repaired, the area will be reseeded, and an appropriate erosion control material will be applied. Also, erosion controls may be needed after a wildfire when significant vegetation is burned and erosion may result (Section 6.2.2.2).

Erosion control inspections are made weekly in the Preble's mouse habitat (as required in the *Programmatic Biological Assessment for Department of Energy Activities at the Rocky Flats Environmental Technology Site* [PBA], Part II [DOE 2004a]) until the area has become revegetated to the point where the vegetation has established, and the erosion controls no longer serve a purpose. At other Site locations, erosion controls are inspected and observed as Legacy Management Support (LMS) personnel perform their day-to-day business, after significant storm events, and in accordance with the ECP.[2] Areas that have problems or appear susceptible to erosion will be reported. Conducting routine, ad hoc, and after-storm inspections is important and will minimize the cost of maintenance or repairs.

[2] Significant storm events are defined as 1 inch or more of rain in a 24-hour period or significant melt of a 10-inch or more snowstorm.

5.0 Routine Site Inspections

Routine site inspections are performed by technical and field personnel. In addition to the frequent inspections and monitoring occurring routinely throughout the year, an annual inspection and monitoring of other remedy components is also required.

5.1 Annual Inspection

The following categories are inspected or monitored:

- Evidence of significant erosion at the Site and evaluation of the proximity of significant erosion to the subsurface features on Figures 3 and 4 of RFLMA Attachment 2. This monitoring includes visual observation for precursor evidence of significant erosion (e.g., cracks, rills, slumping, subsidence, and sediment deposition).
- Effectiveness of institutional and physical controls, as determined through evidence of the violation of these controls.
- Evidence of adverse biological conditions, such as unexpected morbidity or mortality, observed during the inspection and monitoring activities. The definition of adverse biological conditions is found in the *Adverse Biological Condition Definition* (DOE 2018a).
- Verification that the Restrictive Notice for the Site remains in the AR and is on file with the Jefferson County land records.

5.1.1 Frequency/Timing of Annual Inspection

The annual inspection of the surface of the Site is scheduled for late winter or early spring to allow adequate observation of surface features after snow cover has melted and the surface is dry enough to avoid muddy conditions and before vegetation growth might obscure land surface features.

The annual inspection includes items that are not otherwise inspected throughout the year. Individual, separate inspections for ponds and dams, landfills, groundwater treatment systems, erosion controls, and revegetation areas occur within a reasonable time frame prior to the overall annual inspections. DOE may propose modifications to the inspection frequency at any time through the consultative process or during the CERCLA Five-Year Review.

5.1.2 Inspection Checklist and Map

Annual Site inspections are guided and documented by the *Annual Site Inspection Checklist* (LMS 6519RFS) that addresses the conditions of the features to be inspected. An inspection map is used to record field notes, photograph locations, and annotate other inspection findings. The field maps become part of the permanent Site record.

At the conclusion of a Site inspection, inspectors may recommend revisions to the inspection checklist in anticipation of the next Site inspection. The inspectors may also recommend consultation with the RFLMA parties to amend inspection requirements or to discuss the response to a problem discovered during the inspection. The checklist will be reviewed and revised as necessary before each inspection to incorporate changes in RFLMA requirements or

changes to Site features or systems. Revisions to the checklist may include instructions addressing new observations, notes about maintenance conducted since the previous inspection, changes to requirements for the inspection, and descriptions of progressive changes in Site conditions.

The Annual Inspection Checklist will support the preparation of appropriate protocols and procedures necessary to satisfy the requirements of this RFSOG and the RFLMA. Concurrent with each annual inspection, inspectors will review the *Comprehensive Five-Year Review Guidance* (EPA 2001) to ensure inspection objectives are consistent with requirements for the CERCLA Five-Year Review.

5.1.3 Inspection Procedure

To conduct the annual inspection, knowledgeable DOE and LMS staff members (i.e., the inspection team) will walk the Site surface. The areas to be walked are designated as areas A through E as shown in the inspection maps. These areas generally coincide with the location of the remaining subsurface features shown in RFLMA Attachment 2, Figures 3 and 4, or afford adequate viewing of the surface in these locations (e.g., sloping areas). Several team members are assigned to walk a particular area or areas identified on the maps.

DOE may invite the CDPHE and EPA RFLMA project coordinators to participate in the inspections. DOE will conduct a pre-inspection meeting with the inspection participants. The checklist will be reviewed at the meeting, and inspection participants will be informed of Site conditions. Overall Site conditions will be inspected in consideration of regulatory and Site management requirements. Attachment 2 to the RFLMA describes specific items that must be included in the annual inspection.

Marker flags, as appropriate, will be used to identify locations for follow-up, such as locations where debris or trash that cannot be collected during the inspection can be picked up later. Inspectors will photograph flagged items or areas as documentation that may be needed to facilitate follow-up by subject matter experts (SMEs); the photograph information will be recorded on the checklist and map. Site field operations SMEs will later visit the identified areas to determine whether items are significant indicators of erosion or exposure of the subsurface. In evaluating significance, SMEs may compare current results with previous inspection results to determine whether inspection areas remain consistent over time or whether additional degradation or other changes have occurred.

If SMEs identify problems with the features or conditions at the Site, DOE will be notified so that notification of the other RFLMA parties, if required in accordance with the RFLMA, may be made in a timely manner. Section 9.0 provides a summary of reportable conditions that require RFLMA party notification. Any actions related to the annual inspection will be discussed in the appropriate RFLMA quarterly report, as well as the annual report.

5.1.4 Personnel

Annual inspections are typically performed by a team of inspectors. Inspectors will be experienced personnel who have the required knowledge, skills, and abilities to evaluate Site conditions and recognize potential or actual problems. The team will be led by the LM Site manager or designee.

Inspectors will be assigned to a specific component of the inspection on the basis of Site conditions and inspector expertise. Areas of expertise may include civil and geotechnical engineering, as well as geology, hydrology, biology, and environmental science (e.g., ecology, soils, or range management). Additional Site staff may assist with the inspection, but unless trained in one or more relevant area of expertise, they will mainly act as "additional eyes" and assist with recordkeeping and tracking.

5.1.5 Ash Pits

A survey marker was installed in the immediate vicinity of the Ash Pits prior to closure. The purpose of this marker, which is identified as marker 1001, is to enable the evaluation of slope instability that might affect the Ash Pits.

The Ash Pits area will be inspected, at a minimum, during each annual Site inspection to identify signs of potential slumping (fractures and subsidence). If significant erosion or precursor evidence of significant erosion as defined in the RFLMA is identified, the conditions must be evaluated to determine whether they are reportable conditions under the RFLMA; the survey marker will be surveyed to determine the amount of movement at the location, if any; and a geotechnical engineer will inspect the area. Response actions will be determined through the consultative process.

Survey marker 1001 will be surveyed annually. More frequent surveys, such as during surveys of settlement monuments at the landfills, may also be performed if desired or if conditions at the Ash Pits have been observed that suggest this would be necessary. Survey results will be compared with the original coordinates generated during installation of the marker. If coordinates differ by more than 0.5 foot in any direction, a detailed inspection of the area will be performed to identify signs of potential slumping (e.g., fractures and subsidence). If such signs are identified, the conditions must be evaluated to determine whether they are reportable conditions under the RFLMA, and a geotechnical engineer will inspect the area. Response actions will be determined through the consultative process.

5.1.6 Reports

Results of the annual Site inspections will be included in the appropriate RFLMA quarterly report, as well as the annual report (Section 9.0).

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6.0 Routine Environmental Monitoring

The current scope of environmental monitoring includes water (i.e., surface water and groundwater) and ecology. Section 6.1 addresses water monitoring, and Section 6.2 describes ecological monitoring. Prior to 2009, air quality monitoring was also performed; this is summarized in Section 6.3.

The RFLMA consultative process will be followed to evaluate proposed modifications to the monitoring that is performed in accordance with Attachment 2 to the RFLMA. Consultation will be documented in RFLMA contact records or written correspondence (Section 9.1.1), and any approved monitoring changes will be incorporated into Attachment 2 to the RFLMA during the next Attachment 2 modification.

This RFSOG will be revised as needed to incorporate changes that are necessitated by RFLMA modifications.

6.1 Water Monitoring Objectives

The primary objective of water monitoring at the Site is to confirm that the remedy remains protective of surface water quality. Groundwater is monitored because groundwater contaminant plumes occur within the Site boundaries (Figure 7) and, because groundwater within the COU discharges to surface water, have the potential to affect surface water quality. Groundwater is monitored along pathways to surface water to provide early indication of potential impacts to surface water quality. Groundwater contaminants of interest include VOCs, nitrate, and uranium.

(Note: Although they do not form contaminant plumes, additional constituents are monitored at the former landfills in accordance with the RFLMA. These include semivolatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), and metals at the OLF; and metals at the PLF. In addition, for community assurance purposes groundwater downgradient of two former buildings is analyzed for plutonium (Pu) and americium (Am).

This contamination is the result of decades of production-related activities, including waste storage and disposal practices that were acceptable at the time of site operations, as well as spills and leaks. The *Interim Measures/Interim Remedial Action for Groundwater at the Rocky Flats Environmental Technology Site* (hereafter referred to as the Groundwater IM/IRA) (K-H 2005) and the RI/FS (DOE 2006a) provide discussions of groundwater contamination at the Site.

Groundwater is also monitored within and downgradient of groundwater contaminant plumes, downgradient of certain former building areas, and both upgradient and downgradient of the OLF and PLF.

Surface water is similarly monitored to evaluate impacts from groundwater and surface runoff and to confirm that water quality is consistent with expected conditions. Surface water is defined here as water flowing above ground in natural or man-made channels and water in Site retention

ponds. Surface water may originate as water flowing from upgradient sources, precipitation,[3] or groundwater discharge to the surface via seeps.

Prior to closure, a consultative process among DOE, CDPHE, EPA, and representatives of local cities, counties, and other stakeholder entities was used to define the groundwater and surface water monitoring network, determine the function of each location in the network, define the analytical suite for each location in the network, and identify the decisions supported by information collected at each location.

Table 1 of Attachment 2 to the RFLMA provides surface water standards and practical quantitation limits (PQLs) at the Site, which are also applicable to groundwater monitoring. Laboratory detection limits need to be adequate to enable comparison with the corresponding standards and PQLs. Specific monitoring locations, analyte suites, and sampling frequencies are provided in Table 2 of Attachment 2 to the RFLMA.

Figure 8 shows specific monitoring locations referenced under each monitoring objective described in the following water monitoring sections. In the interest of fiscal and operational efficiency, some of these locations collect data to support multiple monitoring objectives.

Water monitoring objectives are summarized in Table 2.

Specific data collection protocols are discussed in the following water monitoring sections. Each water monitoring section includes a brief description of the monitoring objective, a map of the locations, and tables detailing the data collection and evaluation protocols. The RFLMA requires that analyte concentrations (i.e., individual results and summary statistics) be compared against the greater of the standard or PQL listed in Table 1 of Attachment 2 to the RFLMA or to the appropriate uranium threshold also defined in Attachment 2 and discussed further below. The surface water standards and PQLs are hereafter referred to collectively as "surface water standards" or "standards."

In this document, "plutonium" or "Pu" refers to plutonium-239,240 or $^{239}Pu + ^{240}Pu$; "americium" or "Am" refers to americium-241 or ^{241}Am; and "nitrate" refers to nitrate + nitrite as nitrogen (N). In addition, the terms "activity" and "concentration" are used interchangeably for both plutonium and americium to represent the amount of radioactivity or radioactive material per unit of water (i.e., picocuries per liter [pCi/L]).

[3] Though not a RFLMA requirement, precipitation gages are positioned across the Site to capture sitewide variations and allow for areal precipitation calculations.

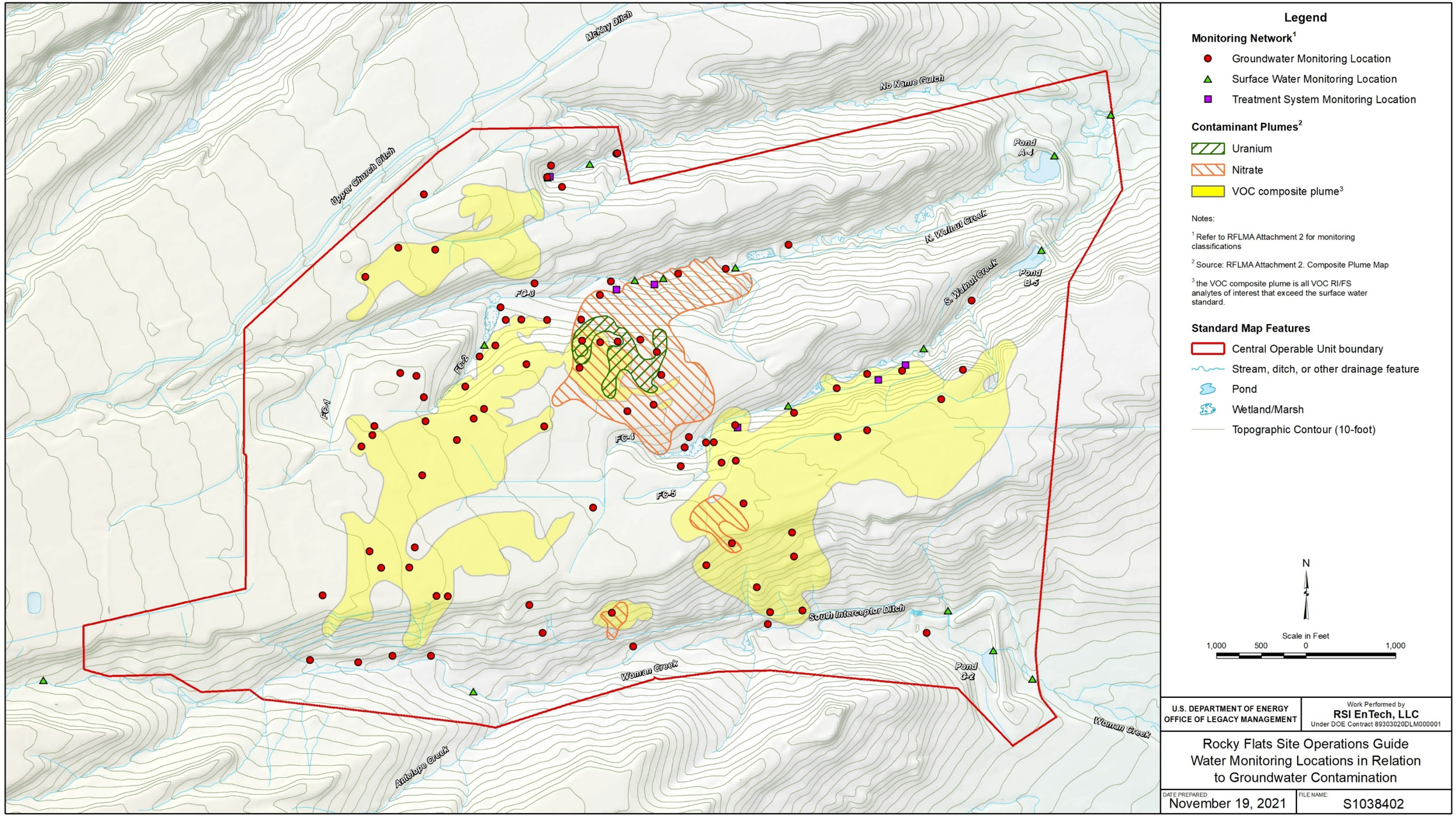

Figure 7. Water Monitoring Locations in Relation to Groundwater Contamination

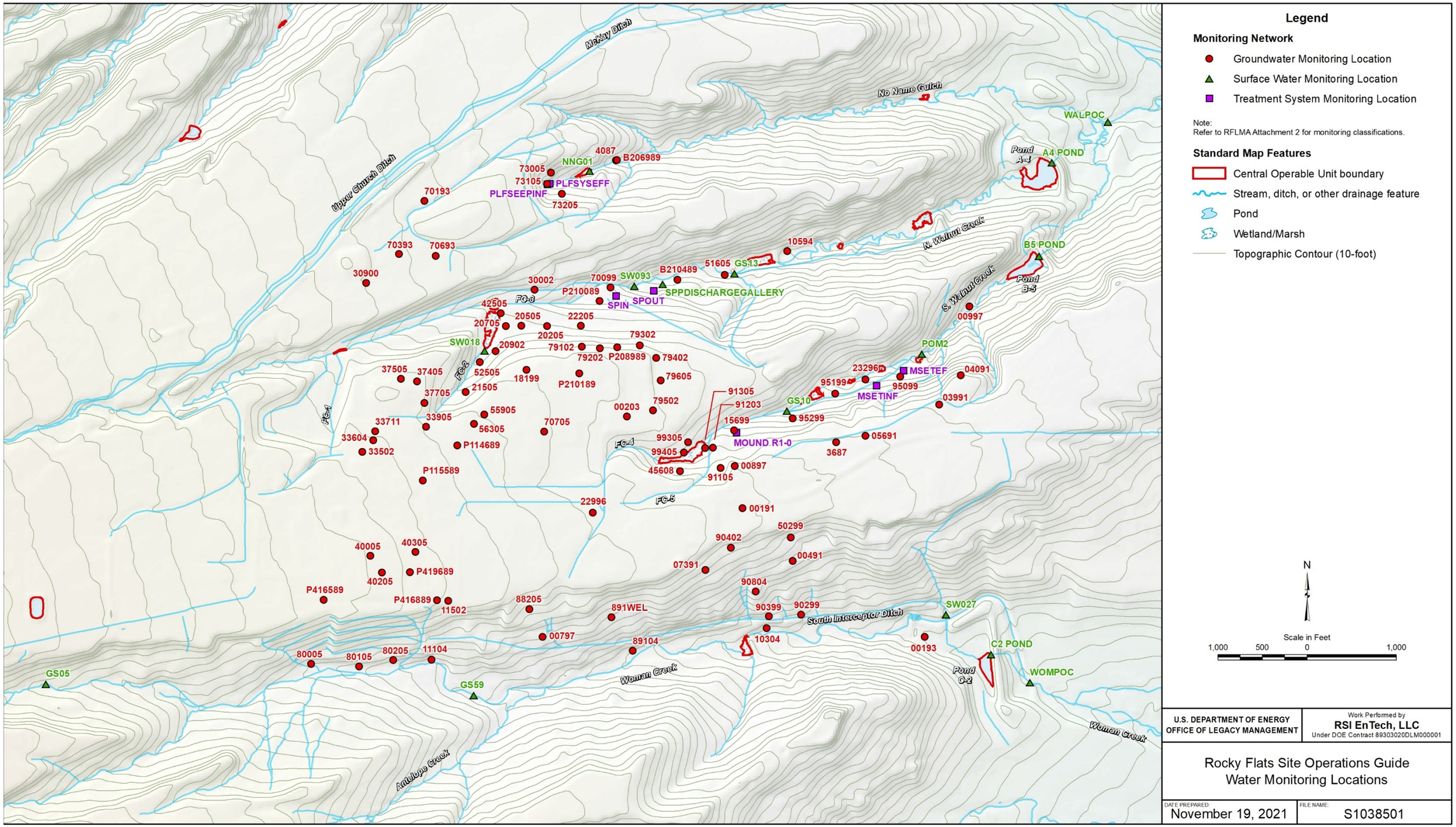

Figure 8. Rocky Flats Site Water Monitoring Locations

Table 2. Rocky Flats Site Generalized Water Monitoring Objectives

Monitoring[a]	Media	General Objective Description	Number of Locations[b]	Sampling Frequency
Point of Compliance (POC)	SW	Monitoring of surface water in Woman and Walnut creeks at the eastern COU boundary to demonstrate compliance with RFLMA surface water quality standards.	2	Flow paced (varies)
Point of Evaluation (POE)	SW	Monitoring of runoff and baseflow from the Site to the A-, B-, and C-Series ponds to evaluate water quality in comparison to RFLMA surface water quality standards.	3	Flow paced (varies)
Area of Concern (AOC) Wells and Surface Water Performance Locations	GW, SW	Wells within a drainage and downgradient of a contaminant plume or group of contaminant plumes; also surface water monitored downgradient of a source-removal action. Monitored to determine whether the plume(s) may be discharging to surface water.	10	Semiannually
Sentinel Wells	GW	Typically located near downgradient edges of contaminant plumes, in drainages, and downgradient of groundwater treatment systems. Monitored to determine whether concentrations of contaminants are increasing, which could indicate plume migration or treatment system problems.	27	Semiannually
Evaluation Wells	GW	Typically located within groundwater plumes and near plume source areas, or in the interior of the Site. Data from these wells will help determine when monitoring of an area or plume can cease. A subset of these wells is located in areas that may experience significant changes in groundwater conditions as a result of closure activities.	42	Biennially (every 2 years)
Investigative Wells	GW, SW	Monitoring upstream of POCs and POEs to provide support for source evaluations. Particular objectives are specified in the evaluation plan(s).	varies	Flow paced and grabs (varies)
RCRA Wells	GW	Dedicated to monitoring the PLF and the OLF.	10	Quarterly
OLF Surface Water Locations	SW	Dedicated to monitoring surface water upgradient and downgradient of the OLF to confirm the effectiveness of the remedy.	2	Flow paced (varies), and quarterly grabs
Treatment Systems	GW, SW	The groundwater treatment systems collect and treat contaminated groundwater. Each system is monitored, at a minimum, for influent and effluent water quality and for impacts to surface water downstream of the effluent discharge point. Other locations not required by the CAD/ROD or the RFLMA may also be monitored to provide data that may help optimize treatment performance or simplify operations and maintenance requirements.	10	GW: Semiannually SW: Semiannually, quarterly, monthly Varies by monitoring objective
Predischarge	SW	Predischarge sampling of Ponds A-4, B-5, and C-2 as operational monitoring[c] to evaluate retained water (after an outlet valve has been closed for a period of time) in comparison to RFLMA surface water quality standards. This monitoring objective is not required by the CAD/ROD but is included in the RFLMA as operational monitoring.	3	Varies; based on discharge frequency
Water Level Wells	GW	Located between areas being actively monitored and in areas subject to changing flow conditions. Also available to support groundwater evaluations if needed. Only water-level data will typically be collected from these wells. These wells are not required by the CAD/ROD or the RFLMA but are included in the network as operational monitoring.	8	Varies; minimum of quarterly to semiannually

Notes:
[a] Monitoring objectives for groundwater wells are also referred to as well classifications.
[b] Surface water locations can serve multiple monitoring objectives. Groundwater wells may also serve multiple data needs but are only assigned a single well classification.
[c] Operational monitoring is not a requirement of the CAD/ROD, but is a requirement of Attachment 2 to the RFLMA. Operational monitoring provides information that supplements CAD/ROD required monitoring.

Abbreviations:
GW = groundwater
POC = point of compliance
POE = point of evaluation
SW = surface water

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6.1.1 Point of Compliance Monitoring

Point of Compliance (POC) monitoring is conducted at two surface water locations to demonstrate compliance with surface water quality standards (Table 1 of RFLMA Attachment 2). The POCs are located at the eastern Site boundary at WALPOC on Walnut Creek and WOMPOC on Woman Creek (Figure 9). Water quality data from POCs trigger a reportable condition under RFLMA when the applicable evaluation parameters (Figure 5 in Attachment 2 to the RFLMA) are greater than the corresponding Table 1 values.

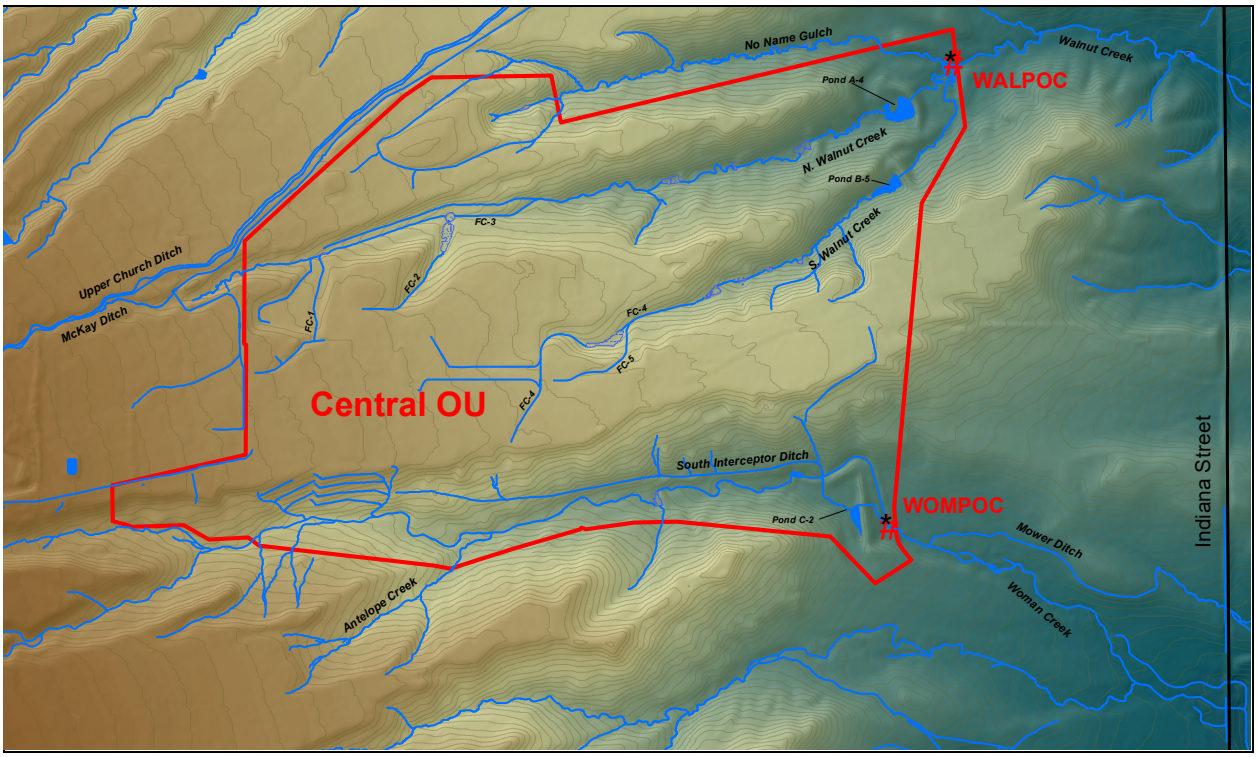


Figure 9. Rocky Flats Site POC Monitoring Locations

6.1.1.1 Data and Sample Collection Protocols

Details on the instrumentation for the POC locations are provided in Table 3. Continuous flow and precipitation data are collected using automated instrumentation (Table 4).[4] POCs collect continuous flow-paced composite samples for selected analytes (Table 5). The method used to determine appropriate flow pacing for composite samples is discussed in Section 6.1.10.1. Sample scheduling targets are listed in Table 6.

[4] Precipitation monitoring is not required by RFLMA; flow measurement is required to flow pace the automated samplers and perform water quality evaluations.

Table 3. POC Monitoring Location Instrumentation

Location Code	Location Description	Primary Flow Measurement Device
WALPOC	Walnut Creek at COU Boundary	3-foot HL-flume
WOMPOC	Woman Creek at COU Boundary	3-foot HL-flume

Table 4. POC Field Data Collection: Parameters and Frequency

Location Code	Flow Rate	Precipitation[a]
WALPOC	5-minute continuous	5-minute continuous
WOMPOC	5-minute continuous	5-minute continuous

Note:
[a] Not required by the RFLMA

Table 5. POC Sample Collection: Type and Analytes

Location Code	Type	Analytes
WALPOC	Continuous flow-paced composites	Pu-239,240; Am-241; U; nitrate[a]
WOMPOC	Continuous flow-paced composites	Pu-239,240; Am-241; U

Note:
[a] Collected during pond discharge periods as grab samples at the start of each automated composite sample period. If there is no flow when the automated composite sample is started, then the nitrate grab is collected at the start of the next period of flow, as is practicable (nitrate is analyzed as nitrate+nitrite as N).

Table 6. Annual POC Monitoring Targets (Number of Composite Samples)[a]

Time Period	Walnut Creek at COU Boundary (WALPOC)	Woman Creek at COU Boundary (WOMPOC)	Total Number of Samples
October	0	0	0
November	0	1	1
December	1	1	2
January	0	1	1
February	2	2	4
March	3	3	6
April	5	4	9
May	6	6	12
June	4	2	6
July	0	0	0
August	0	0	0
September	1	1	2
Annual Total	22	21	43

Note:
[a] The monthly sample distribution is based on expected water availability that is predicted from historical flow data. This distribution is intended to be periodically modified as additional flow data are collected.

On the basis of the variability of past monitoring data and to achieve sufficient confidence for decision making, the frequency target for sampling at WALPOC and WOMPOC is 22 and 21 composites per year, respectively, with a maximum target of six samples during any one month (Table 6). These sample counts are annual targets only. During dry years, it is unlikely the targets will be achieved; during wet years, more samples than the target number are likely to be collected.

6.1.1.2 Data Evaluation

Compliance with surface water quality standards (Table 1 of RFLMA Attachment 2) at POCs is demonstrated according to the Figure 5 flowchart in Attachment 2. Methods for determining the appropriate calculated values are discussed in Section 6.1.10.2.

Generally, analytical data evaluation is performed as data become available. If an initial qualitative screening indicates an analytical result is higher than the standard for a particular analyte, then the calculated values are determined immediately. If the calculated values suggest a reportable condition, then validation is immediately requested for data packages used in the calculation. The desired evaluation frequency is semimonthly, within 1 week of the 15th and the last day of a given month.

6.1.2 Point of Evaluation Monitoring

Point of Evaluation (POE) monitoring is conducted at three surface water locations to evaluate the water quality of runoff and baseflow from the interior of the COU as compared to surface water quality standards (Table 1 of RFLMA Attachment 2). Surface water is monitored by POEs SW093, GS10, and SW027 on North Walnut Creek, South Walnut Creek, and the SID, respectively (Figure 10). Water quality data trigger a reportable condition under RFLMA when the applicable evaluation parameters (Figure 6 in Attachment 2 to the RFLMA) are greater than the corresponding RFLMA Attachment 2 Table 1 values.

6.1.2.1 Data and Sample Collection Protocols

Details on instrumentation for the three POE locations are provided in Table 7. Continuous flow data are collected using automated instrumentation (Table 8). POEs collect continuous flowpaced- composite samples for selected analytes (Table 9). The method used to determine appropriate flow pacing for composite samples is discussed in Section 6.1.10.1. Sample scheduling targets are listed in Table 10.

Based on the variability of past monitoring data, and to achieve sufficient confidence for decision making, annual frequency targets for SW093, GS10, and SW027 will be 12, 32, and 12 composites, respectively. Additionally, no more than six composites per month per location will be targeted (Table 10). These sample counts are annual targets only. During dry years, it is unlikely the targets will be achieved.

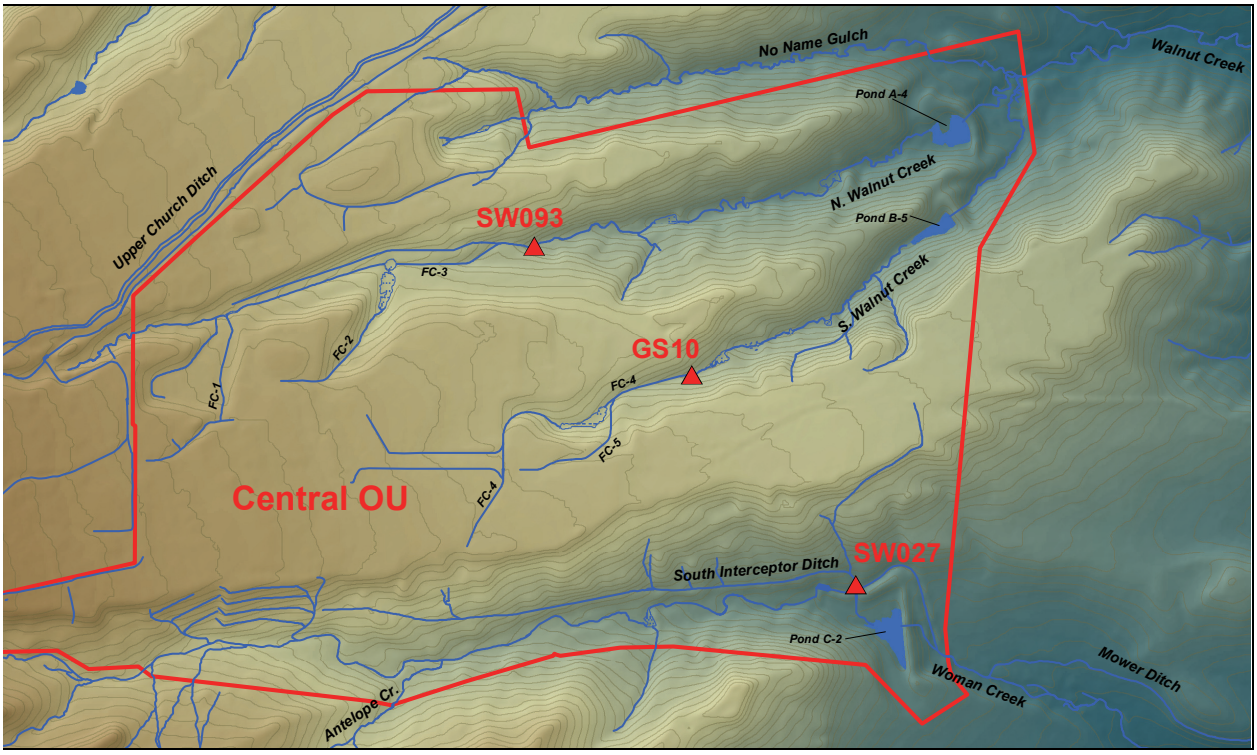


Figure 10. Rocky Flats Site POE Monitoring Locations

Table 7. POE Monitoring Locations

Location Code	Location Description	Primary Flow Measurement Device
GS10	South Walnut Creek upstream from former Pond B-1	2.5-foot H-flume
SW027	SID just upstream of Pond C-2	Dual Parallel 120° V-notch weirs
SW093	North Walnut Creek 1300 feet upstream from the A-1 Bypass	3-foot H-flume

Table 8. POE Field Data Collection: Parameters and Frequency

Location Code	Flow Rate
GS10	5-minute continuous
SW027	5-minute continuous
SW093	5-minute continuous

Table 9. POE Sample Collection: Type and Analytes

Location Code	Type	Analytes
GS10	Continuous flow-paced composites	Pu-239,240; Am-241; U; total Be and Cr; dissolved Cd and Ag
SW027	Continuous flow-paced composites	Pu-239,240; Am-241; U; total Be and Cr; dissolved Cd and Ag
SW093	Continuous flow-paced composites	Pu-239,240; Am-241; U; total Be and Cr; dissolved Cd and Ag

Abbreviations:
Ag = silver Am = americium Be = beryllium Cd = cadmium
Cr = chromium Pu = plutonium U = uranium

Table 10. Annual POE Monitoring Targets (Number of Composite Samples)

Month	Number of Samples[a]			
	SW093	GS10	SW027	Total
October	0	1	0	1
November	0	1	0	1
December	1	2	0	3
January	0	1	0	1
February	1	2	0	3
March	1	4	1	6
April	3	6	4	13
May	3	6	5	14
June	2	5	1	8
July	0	2	0	2
August	0	1	0	1
September	1	1	1	3
Annual Total	12	32	12	56

Note:
[a] Monthly sample distribution is based on expected water availability that is predicted from historical flow data. This distribution is intended to be periodically modified as additional flow data are collected.

6.1.2.2 Data Evaluation

Evaluation of analytical results in comparison to surface water quality standards (Table 1 of RFLMA Attachment 2) at POEs is performed according to the Figure 6 flowchart in Attachment 2. Methods for calculating the appropriate values for comparison are discussed in Section 6.1.10.2.

Generally, analytical data evaluation is performed as data become available. If an initial qualitative screening indicates an analytical result is higher than the standard for a particular analyte, then the calculated values are determined immediately. If the calculated values suggest a reportable condition, then validation is immediately requested for data packages used in the calculation. The desired evaluation frequency is semimonthly, within 1 week of the 15th and the last day of a given month.

6.1.3 Area of Concern Wells and Surface Water Support Location

Area of Concern (AOC) wells (Figure 11) are monitored to evaluate potential groundwater impacts to surface water. Evaluation of data is based on a minimum of two consecutive, routinely scheduled sampling events, not on a single data point. Analytical results from AOC wells are compared directly against the appropriate surface water standards in Table 1 of Attachment 2 to the RFLMA or the uranium threshold. Analytical data from Surface Water Support location SW018, where grab samples for VOCs are collected to support groundwater objectives, are assessed in a manner similar to data from AOC wells.

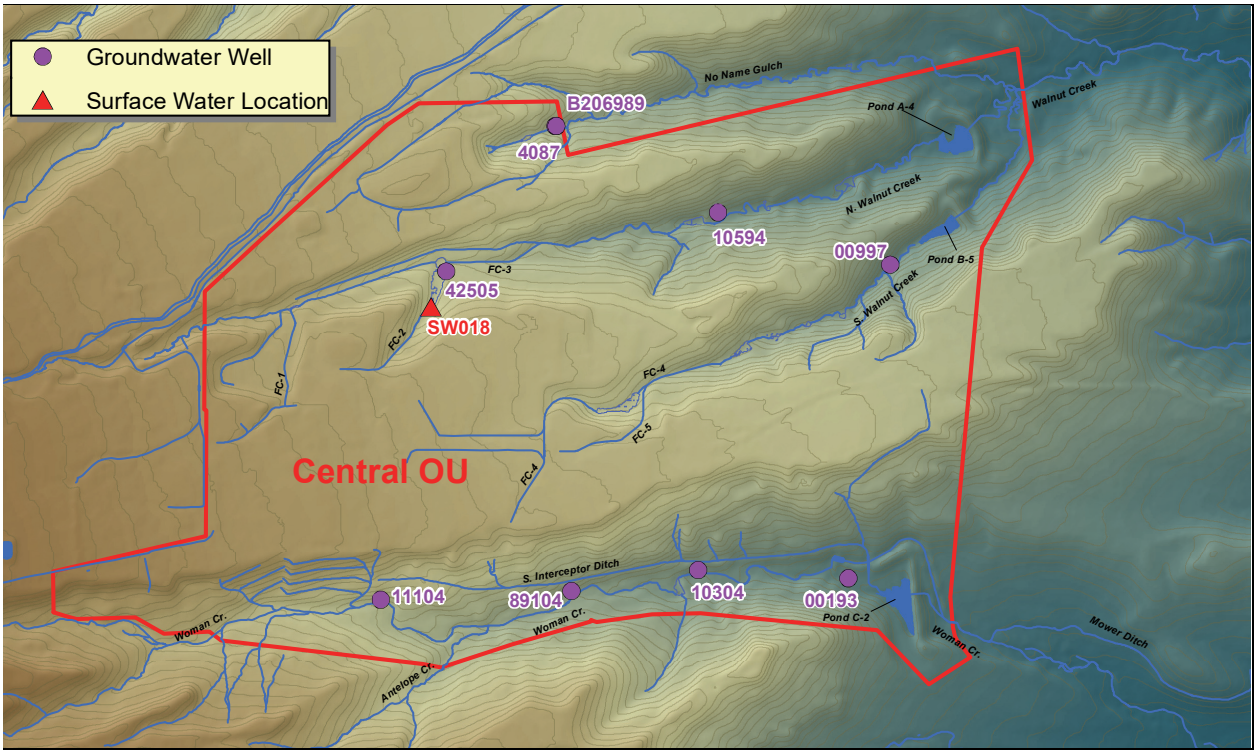


Figure 11. Rocky Flats Site AOC Wells and Surface Water Support Location

Additional explanation is warranted for surface water location SW018. This location is in the unnamed tributary to North Walnut Creek that is part of the larger Functional Channel (FC)-2 drainage and is generally downgradient (west-northwest) of IHSS 118.1. This IHSS was the site of historical spills of carbon tetrachloride; however, an associated plume of VOC-contaminated groundwater persists. The historical flow direction of this plume was toward the west and the tributary to North Walnut Creek. To assess whether the plume is impacting surface water in this unnamed drainage, location SW018 is monitored for VOCs.

6.1.3.1 Data and Sample Collection Protocols

General monitoring information for AOC wells and location SW018 is provided in Table 11. Sampling frequencies are summarized in Table 12.

6.1.3.2 Data Evaluation

The evaluation of AOC well and location SW018 data is guided by Figure 7 of RFLMA Attachment 2. Analytical data undergo preliminary evaluation as data become available; this is necessary because of the strict timeline attached to "reportable conditions" for AOC wells (the requirement for SW018 is slightly different, as shown in RFLMA Figure 7). In accordance with and as defined in the RFLMA, if the data are confirmed to be valid and meet the requirements of a reportable condition, the reporting process is initiated.

Table 11. AOC Wells and Surface Water Support Location

Location Code	Location Description	Analytes[a]
00193	Woman Creek upstream of Pond C-2	VOCs, U
00997	South Walnut Creek upstream of Pond B-5	VOCs, U, nitrate
10304	Southeast of 903 Pad/Ryan's Pit Plume at Woman Creek	VOCs, U, nitrate
10594	North Walnut Creek downstream of former Pond A-1	VOCs, U, nitrate
11104	Downgradient, downstream of the OLF and downgradient of the IA Plume	VOCs, U
4087	Below former Landfill Pond	VOCs, U, nitrate
42505	Terminus of FC-2	VOCs
89104	Downgradient of OU 1 Plume at Woman Creek	VOCs
B206989	Below former Landfill Pond	VOCs, U, nitrate
SW018	Upstream of FC-2 wetland	VOCs

Note:
[a] Samples for the analysis of U will be field-filtered using a 0.45-micron in-line filter. Nitrate is analyzed as nitrate+nitrite as N.

Table 12. Sampling Frequency for AOC Wells and Surface Water Support Location

Sampling Frequency	Timing	Schedule Considerations
Semiannual	Second and fourth calendar quarters (high- and low-water conditions, respectively)	Attempt to sample with other locations monitoring the same plume(s)

The data will be reviewed to determine whether monitoring may be discontinued as upgradient monitoring ceases and analytical results at a given AOC well (or location SW018) reach the exit requirements described on the data evaluation flowchart in RFLMA Attachment 2 (Figure 7). When monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required.

6.1.4 Sentinel Wells

Sentinel wells (Figure 12) are located near downgradient edges of contaminant plumes, in drainages, downgradient of groundwater treatment systems, and along contaminant pathways to surface water. These wells are monitored to determine whether concentrations of contaminants are increasing, which could indicate plume migration or treatment system problems, and thereby potential groundwater-related impacts to the downgradient surface water. Confirmation of a

potential impact will require an analytical record that consistently indicates an impact, not a single data point that indicates a contaminant has been detected.

Sentinel wells are used to monitor the performance of an accelerated action, including soil/source removals, in situ contaminant plume treatment, groundwater intercept components of treatment systems, and facility demolitions; and to assess contaminant trends at important locations. Data from Sentinel wells are supplemented by those from Evaluation wells and are used to determine when monitoring may cease or additional remedial work should be considered.

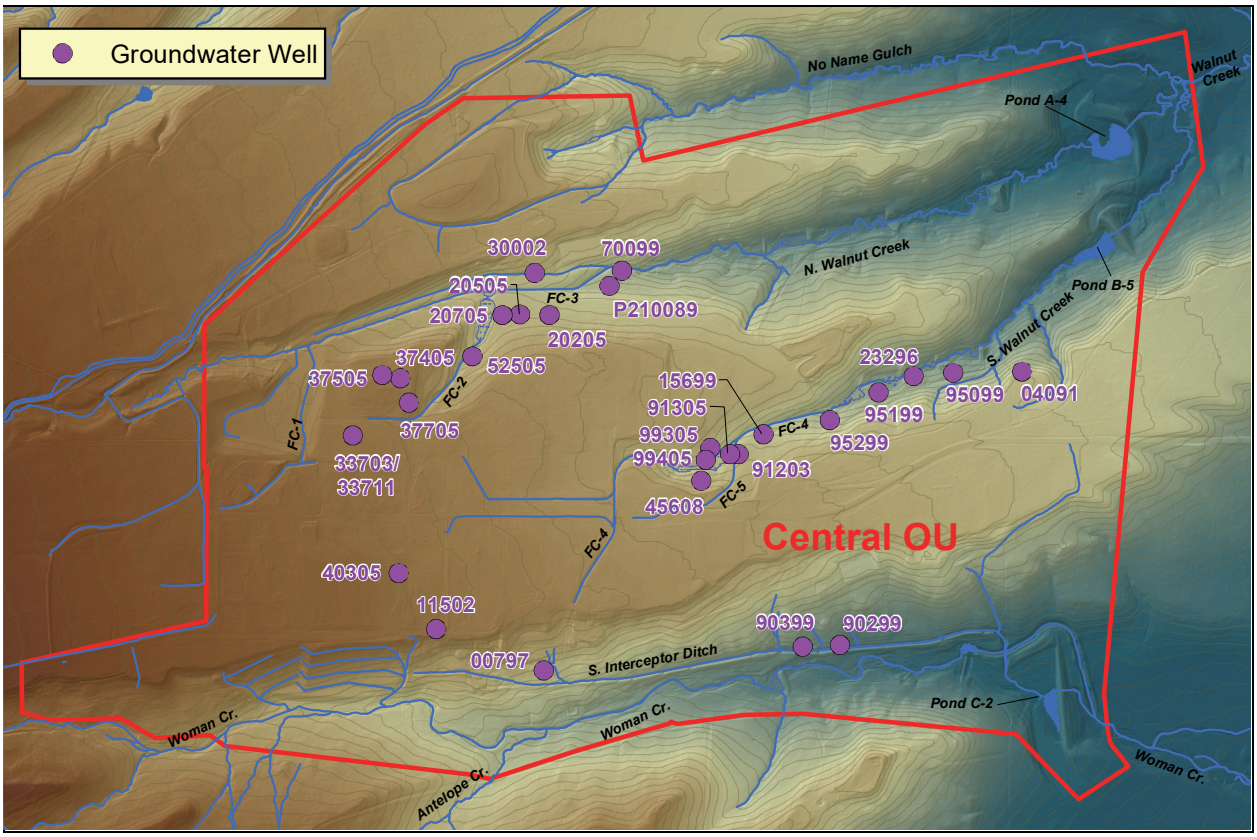


Figure 12. Rocky Flats Site Sentinel Well Locations

6.1.4.1 Data and Sample Collection Protocols

General monitoring information for Sentinel wells is provided in Table 13. Sampling frequencies are summarized in Table 14.

6.1.4.2 Data Evaluation

Analytical data from Sentinel wells are evaluated according to the Figure 8 flowchart in the RFLMA Attachment 2. Analytical data should be reviewed upon receipt. Data evaluation may be performed as validated data become available but only needs to be reported in the corresponding annual report. A discussion on the statistical analysis of data is provided in Section 6.1.10.2.

Review of data to determine whether monitoring may cease will be performed as upgradient well monitoring and analytical results approach exit requirements. An upgradient well is defined as one that monitors an area of interest or source area where groundwater contamination has the potential to migrate to a given Sentinel well. When upgradient monitoring ceases, either entirely or for a given analyte or suite of analytes, and groundwater quality in the given Sentinel well meets RFLMA criteria, discussions with the regulatory agencies regarding exiting monitoring will be initiated. If more than one Sentinel well is in the same downgradient direction of the area or plume of interest, it may be that each of these wells will need to satisfy the exit criteria before discontinuing monitoring. For example, Sentinel wells 90299 and 90399 are both downgradient from the Ryan's Pit/903 Pad Plume.

When monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required.

Table 13. Rocky Flats Site Sentinel Wells

Location Code	Location Description	Analytes[a]
00797	South of former Building 881 (B881) area	VOCs, U
04091	East of East Trenches Plume source area	VOCs
11502	Southeast of former B444 area	VOCs, U
15699	Downgradient of MSPCS intercept trench	VOCs
20205	North/northeast of former B771/774 area	VOCs, U, Pu, Am
20505	North of former B771/774 area	VOCs, U, Pu, Am
20705	North/northwest of former B771 area	VOCs, U, nitrate, Pu, Am
23296	Downgradient of ETPTS intercept trench	VOCs, U
30002	Downgradient of PU&D Yard Plume at North Walnut Creek	VOCs
33711	Downgradient of Oil Burn Pit #1 source area	VOCs
37405	North/northeastern part of former B371/374 area	VOCs, U, nitrate, Pu, Am
37505	Northern part of former B371 area	VOCs, U, nitrate
37705	East/southeast of former B371/374 area at foundation drain confluence	VOCs, U, nitrate, Pu, Am
40305	Eastern part of former B444 area	VOCs, U
45608	Adjacent to remnants of SW056 French drain and drain interruption	VOCs
52505	West of former IHSS 118.1 area	VOCs
70099	Northwest (sidegradient) of SPPTS intercept trench	U, nitrate
90299	Southeastern part of 903 Pad/Ryan's Pit Plume at SID	VOCs
90399	Southeastern part of 903 Pad/Ryan's Pit Plume at SID	VOCs
91203	Downgradient of Oil Burn Pit #2 source area	VOCs
91305	South of confluence of FC-4 and FC-5	VOCs, U, nitrate
95099	Downgradient of ETPTS intercept trench	VOCs
95199	Downgradient of ETPTS intercept trench	VOCs
95299	Downgradient of ETPTS intercept trench	VOCs
99305	Eastern part of former B991 area	VOCs, U, nitrate
99405	Southeastern part of former B991 area	VOCs, U, nitrate
P210089	Downgradient (north) portion of Solar Ponds Plume	VOCs, U, nitrate

Notes:
[a] Samples for the analysis of U, Pu, and Am will be field-filtered using a 0.45-micron in-line filter.
Nitrate is analyzed as nitrate+nitrite as N.

Table 14. Sampling Frequency for Sentinel Wells

Sampling Frequency	Timing	Schedule Considerations
Semiannual	Second and fourth calendar quarters (high- and low-water conditions, respectively)	Attempt to sample with other locations monitoring the same plume(s)/area(s)

6.1.5 Evaluation Wells

Evaluation wells (Figure 13) are located within groundwater contaminant plumes, near plume source areas, and within the interior of the Site. As such, they may monitor the effects of accelerated actions that have been performed (e.g., source removal and in situ treatment). Data from these Evaluation wells are appropriate to (1) determine whether monitoring of a particular plume and source area may cease; and (2) provide data to support the determination of whether corresponding groundwater plume treatment systems may be decommissioned. In addition, Evaluation wells are used to support groundwater evaluations that may be needed as a result of changing contaminant characteristics in downgradient Sentinel or AOC wells. Data from these wells also assist evaluations of predictions made through groundwater modeling efforts.

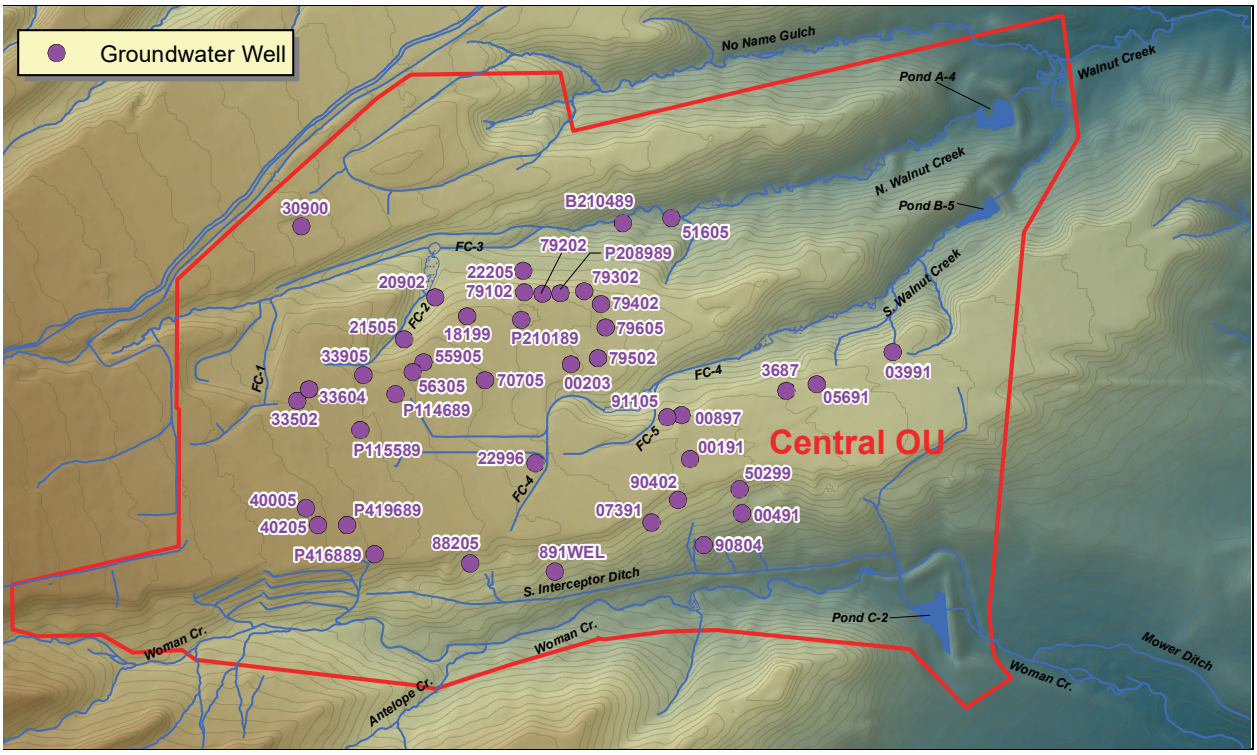


Figure 13. Rocky Flats Site Evaluation Well Locations

6.1.5.1 Data and Sample Collection Protocols

General monitoring information for Evaluation wells is provided in Table 15. Sampling frequencies are summarized in Table 16.

Table 15. Rocky Flats Site Evaluation Wells

Location Code	Location Description	Analytes[a]
00191	East of former 903 Pad source area	VOCs
00203	Downgradient (southern) portion of SPP	VOCs, U, nitrate
00491	Southeast of former 903 Pad source area	VOCs
00897	Mound Site Plume source area	VOCs
3687	East Trenches source area	VOCs
03991	East of East Trenches Plume source area	VOCs
05691	East Trenches source area	VOCs
07391	Ryan's Pit source area	VOCs, U
18199	North of former IHSS 118.1 source area	VOCs
20902	Northwest of former IHSS 118.1 source area	VOCs
21505	West of former B776/777 area	VOCs
22205	Downgradient (northern) portion of SPP	VOCs, U, nitrate
22996	East/northeastern part of former B886 area	VOCs, U
30900	PU&D Yard Plume source area	VOCs
33502	Oil Burn Pit #1 source area	VOCs
33604	Oil Burn Pit #1 source area	VOCs
33905	North of former 231 Tanks area	VOCs
40005	Western part of former B444 area	VOCs, U
40205	Southern part of former B444 area	VOCs, U
50299	East of former 903 Pad area	VOCs
51605	Downgradient of SPPTS, adjacent to GS13	U, nitrate
55905	Northern part of former B559 area	VOCs, U, nitrate
56305	Western part of former B559 area	VOCs, U, nitrate
70705	Eastern part of former B707 area	VOCs, U
79102	SPP source area - northwest	VOCs, U, nitrate
79202	SPP source area - north	VOCs, U, nitrate
79302	SPP source area - northeast	U, nitrate
79402	SPP source area - northeast	U, nitrate
79502	SPP source area - east	U, nitrate
79605	SPP source area - east	U, nitrate
88205	Southern part of former B881 area	VOCs, U
891WEL	OU1 Plume source area	VOCs
90402	Southeast of former 903 Pad area	VOCs
90804	Southeastern part of 903 Pad/Ryan's Pit Plume	VOCs
91105	Oil Burn Pit #2 source area	VOCs
B210489	Downgradient of SPPTS	U, nitrate
P208989	SPP source area - north	VOCs, U, nitrate

Table 15. Rocky Flats Site Evaluation Wells (continued)

Location Code	Location Description	Analytes[a]
P210189	SEP-area VOC plume source area	VOCs, U, nitrate
P114689	Southwest of former B559 area	VOCs
P115589	Western part of former B551 Warehouse area	VOCs
P416889	Southeast of former B444 area	VOCs, U
P419689	Southeast of former B444 area	VOCs, U

Notes:
[a] Samples for the analysis of U will be field-filtered using a 0.45-micron in-line filter.
Nitrate is analyzed as nitrate+nitrite as N.

Abbreviations:
SEP = Solar Evaporation Pond
SPP = Solar Ponds Plume

Table 16. Sampling Frequency for Evaluation Wells

Sampling Frequency	Timing	Schedule Considerations
Biennial (every 2 years)	Second calendar quarter (high-water conditions)	Attempt to sample with other locations monitoring the same plume(s)/area(s)

6.1.5.2 Data Evaluation

Analytical data from Evaluation wells are assessed according to the Figure 9 flowchart in the RFLMA, Attachment 2. Analytical data evaluation may be performed as data become available but only need to be reported in the corresponding annual report. Review of data to determine whether monitoring may cease will be performed as analytical results approach exit requirements. When concentrations in a well exhibit an indeterminate or statistically significant decreasing trend at the 95% confidence level, or when the 85th percentile concentration is less than the corresponding surface water standard or Evaluation well uranium threshold, then conditions will be reviewed with the regulatory agencies to seek approval to exit monitoring by well or analyte suite, as appropriate. When monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required.

6.1.6 PLF Monitoring

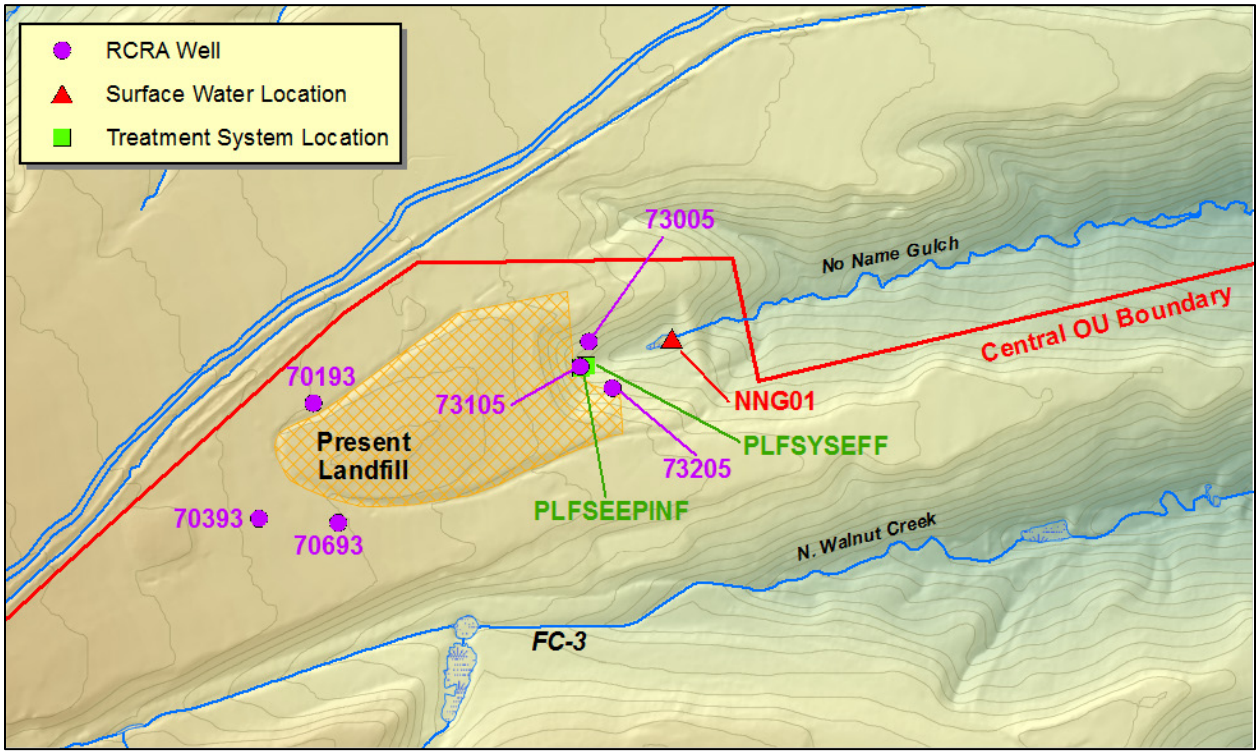
Monitoring of surface water and groundwater at the PLF is conducted to determine the short- and long-term effectiveness of the remedy. These requirements were initially identified in Appendix B of the *Final Interim Measures/Interim Remedial Action for IHSS 114 and RCRA Closure of the RFETS Present Landfill* (DOE 2004c) and finalized in the PLF M&M Plan (DOE 2014a).

Water monitoring locations for the PLF are shown in Figure 14. The surface water and treatment system monitoring requirements that deal specifically with the PLFTS are discussed in Section 6.1.8.4. Details regarding general groundwater monitoring are provided below.

6.1.6.1 Data and Sample Collection Protocols

Monitoring wells supporting the PLF are classified as RCRA wells. Three of these wells are located upgradient of the landfill, and three are downgradient of the landfill but upgradient of the former Landfill Pond. Note that two of the upgradient wells are impacted by the Property Utilization and Disposal (PU&D) Yard Plume, the source of which is a short distance upgradient of the PLF. This impact is graphically illustrated in Figure 2 of Attachment 2 to the RFLMA. The PLF RCRA well network and monitoring requirements are specified in the PLF M&M Plan (DOE 2014a). Prior to late 2005 when this network was finalized, a different set of monitoring wells composed the RCRA network for the PLF. As a result of this change, data from the current network cannot be compared accurately against data from the older (preclosure) network. Additional monitoring wells are present in the general vicinity of the PLF; however, they do not contribute to the RCRA monitoring of the facility and are addressed elsewhere.

General monitoring information for the RCRA wells at the PLF is provided in Table 17. Sampling frequencies are summarized in Table 18.



Note:
PLFSYSEFF serves as both the treatment system effluent monitoring location and a performance surface water monitoring location, but is not displayed using both symbols for purposes of legibility.

Figure 14. Rocky Flats Site PLF Monitoring Locations

Table 17. RCRA Monitoring Wells at the PLF

Location Code	Location Description	Analytes[a]
70193	Upgradient (northwest) of the upgradient end of the PLF	VOCs, metals
70393	Upgradient (west/southwest) of the upgradient end of the PLF	VOCs, metals
70693	Upgradient (southwest) of the upgradient end of the PLF	VOCs, metals
73005	Downgradient (northeast) of the downgradient end of the PLF	VOCs, metals
73105	Downgradient (east) of the downgradient end of the PLF at the PLFTS	VOCs, metals
73205	Downgradient (southeast) of the downgradient end of the PLF	VOCs, metals

Note:
[a] Samples for the analysis of metals will be field-filtered using a 0.45-micron in-line filter.

Table 18. Sampling Frequency for RCRA Wells at the PLF

Sampling Frequency	Timing	Schedule Considerations
Quarterly	Each calendar quarter	Attempt to sample RCRA wells at the PLF as a group; if possible, also sample other PLF-area wells at the same time

6.1.6.2 Data Evaluation

Analytical data from RCRA wells at the PLF are assessed according to the Figure 10 flowchart in RFLMA Attachment 2. Because similar rules guide the use of data at the OLF RCRA wells, this figure applies to both sets of RCRA wells.

Groundwater analytical data are generally reviewed as they become available and are formally evaluated annually. As shown in the Figure 10 flowchart in RFLMA Attachment 2, this evaluation is designed to assess whether mean concentrations in downgradient wells are statistically different from those in upgradient wells, and whether downgradient concentrations show a significant increasing trend.

Review of data to determine whether monitoring may cease will be performed as described in the Figure 10 flowchart in RFLMA Attachment 2 and will be based on the two previous CERCLA Five-Year Reviews. If the 85th percentile concentrations in each downgradient well do not exceed the applicable standards and indicate an indeterminate or decreasing trend at the 95% confidence level, termination of monitoring will be discussed with the regulatory agencies. When monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required.

6.1.7 OLF Monitoring

Monitoring of surface water and groundwater at the OLF is conducted to determine the short- and long-term effectiveness of the remedy. The monitoring requirements were initially identified in the *Final Interim Measures/Interim Remedial Action for the Original Landfill (Including IHSS Group SW-2; IHSS 115, Original Landfill and IHSS 196, Filter Backwash Pond)*, "Appendix B: Post-Accelerated Action Monitoring and Long-Term Surveillance and Monitoring

Considerations" (DOE 2004d). They were finalized in the OLF M&M Plan (DOE 2009). Water monitoring locations for the OLF are shown in Figure 15.

6.1.7.1 Data and Sample Collection Protocols

Surface water in Woman Creek will be sampled both upstream (GS05) and downstream (GS59) of the OLF (Table 19). Table 20 presents a list of the analytes sampled for as part of the OLF surface water sampling.

Table 19. OLF Surface Water Monitoring Locations

Location Code	Location Description	Primary Flow Measurement Device	Telemetry?
GS05 (upstream)	Woman Creek at western site boundary	9-inch Parshall flume with weir insert	Yes
GS59 (downstream)	Woman Creek 700 feet east of the OLF	1.5-foot Parshall flume	Yes

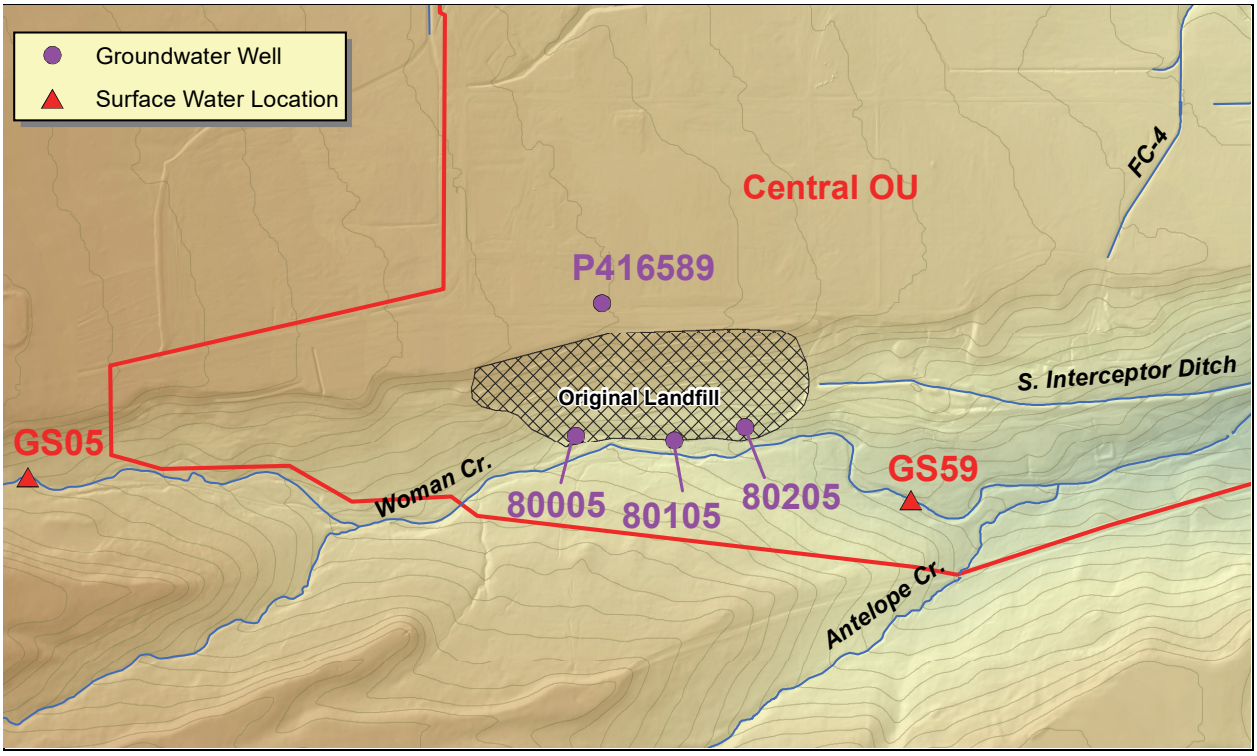


Figure 15. Rocky Flats Site OLF Water Monitoring Locations

Table 20. OLF Surface Water Sample Collection: Type and Analytes

Location Code	Type	Frequency	Analytes
GS05	Grabs[a]	Quarterly	U; total and dissolved metals; VOCs
GS59	Grabs[a]	Quarterly	U; total and dissolved metals; VOCs

Note:
[a] Quarterly grabs are the minimum requirement to meet the monitoring objective. Since automated samplers and flow measurement devices were in place at closure, the current sampling consists of eight flowpaced- composites collected annually (for uranium and metals). It is expected that sampling will gradually be reduced to the minimum requirement over time, subject to the consultative process. Grab samples are collected for VOCs and mercury.

Because complying with RCRA is an applicable or relevant and appropriate requirement (ARAR) at the OLF, the monitoring wells supporting the OLF are classified as RCRA wells. One is located upgradient of the landfill, and three are downgradient of the landfill but upgradient of Woman Creek. Note that groundwater within the OLF is potentially impacted by the IA Plume, one source of which is a short distance upgradient of the OLF. This impact is graphically illustrated in Figure 2 of Attachment 2 to the RFLMA. Although earlier groundwater data exist for the OLF, RCRA monitoring at the landfill was not performed prior to late 2005 when this network was finalized. Likewise, although additional monitoring wells are present in the general vicinity of the OLF, they do not contribute to the RCRA monitoring and are addressed elsewhere.

General monitoring information for RCRA wells at the OLF is provided in Table 21. Sampling frequencies are summarized in Table 22.

Table 21. RCRA Monitoring Well Information at the OLF

Location Code	Location Description	Analytes[a]
P416589	Upgradient (north) of the OLF	VOCs, SVOCs, PAHs, metals
80005	Downgradient (south) of the western portion of the OLF	VOCs, SVOCs, PAHs, metals
80105	Downgradient (south) of the central portion of the OLF	VOCs, SVOCs, PAHs, metals
80205	Downgradient (south) of the eastern portion of the OLF	VOCs, SVOCs, PAHs, metals

Note:
[a] Samples for the analysis of metals will be field-filtered using a 0.45-micron in-line filter.

Table 22. Sampling Frequency for RCRA Wells at the OLF

Sampling Frequency	Timing	Schedule Considerations
Quarterly	Each calendar quarter	Attempt to sample RCRA wells at the OLF as a group; if possible, also sample other OLF-area wells at the same time

6.1.7.2 Data Evaluation

The evaluation of surface water data collected at OLF monitoring locations is guided by the Figure 12 flowchart in RFLMA Attachment 2. Generally, surface water analytical data evaluation is performed as data become available. If an initial qualitative screening indicates an analytical result is higher than the surface water quality standard for a particular analyte, then the calculated values are determined immediately. If the evaluation suggests initiation of the consultative process, then validation is requested for data packages used in the calculation.

Groundwater analytical data are generally reviewed as they become available and are formally evaluated annually. Analytical data for RCRA wells at the OLF are assessed according to the Figure 10 flowchart in RFLMA Attachment 2. Because similar rules guide the use of data at the PLF RCRA wells, this figure applies to both sets of RCRA wells. This evaluation is designed to assess whether mean concentrations in downgradient wells are statistically different from those in upgradient wells, and whether downgradient concentrations show a significant increasing trend and the 85th percentile concentration is above the applicable standard. This 85th percentile comparison is modeled after the statistical evaluation of Sentinel well data.

Groundwater data will also be reviewed, as described on the Figure 10 flowchart in RFLMA Attachment 2, to determine whether monitoring may cease. This review will be based on the results of upgradient/downgradient water quality comparisons, 85th percentile concentrations in each downgradient well, and trending. Once monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required.

6.1.8 Groundwater Treatment System Monitoring

Contaminated groundwater is intercepted and collected in four areas of the Site and treated in three treatment systems. Three of the collection systems (the Mound Site Plume Collection System [MSPCS] and collection infrastructure at the East Trenches Plume Treatment System [ETPTS] and Solar Ponds Plume Treatment System [SPPTS]) include a groundwater intercept trench (also referred to as a collection trench), which is similar to a French drain with an impermeable membrane on the downgradient side. Groundwater entering the trench is routed through a drainpipe to the treatment components, where it is treated and then discharged to the subsurface. The third treatment system (Present Landfill Treatment System [PLFTS]) treats water from the north and south components of the Groundwater Intercept System (GWIS) and flow from the PLF Seep.

The former Mound Site Plume Treatment System (MSPTS) was installed in 1998; groundwater treatment capabilities were removed in 2016, and the MSPTS was reconfigured to transfer this intercepted groundwater to the ETPTS for treatment. Following removal of treatment capabilities, the Mound Site Plume Treatment System was renamed the Mound Site Plume Collection System. Although this document focuses on the current MSPCS, some reference is made to the MSPTS. The ETPTS and SPPTS were installed in 1999, and the PLFTS was installed in 2005.

The PLFTS is essentially unchanged since installation. In contrast, numerous improvements and upgrades have been made to the MSPTS/MSPCS, ETPTS, and SPPTS to improve treatment effectiveness and efficiency. These changes were largely driven by the fact that the treatment

systems were initially designed to operate passively to reduce contaminant loads, while the RFLMA imposed more stringent requirements (i.e., treated effluent is to meet surface water standards).

Previous versions of the RFSOG and annual reports issued for the years 2006 through 2020 identify and discuss the various upgrades made to the treatment systems through 2020; additional upgrades will be described in subsequent annual reports. These documents also provide summary information on the contaminant source areas and remedial actions taken prior to closure at those areas.

The following are the original decision documents for these systems:

- *Final Mound Site Plume Decision Document* (DOE 1997)
- *Final Proposed Action Memorandum for the East Trenches Plume* (DOE 1999a)
- *Final Solar Ponds Plume Decision Document* (DOE 1999b)
- *Present Landfill Monitoring and Maintenance Plan and Post-Closure Plan* (DOE 2014a)

RFLMA-required water monitoring is performed at each collection or treatment system. For the ETPTS and SPPTS, this includes a minimum of three sample collection points each: untreated influent entering the treatment system, treated effluent exiting the system, and a surface water performance location. Because the MSPCS collects influent but routes it to the ETPTS for treatment, only influent sampling is performed at the MSPCS. At the PLFTS, the treated effluent and surface water sampling locations are typically the same. Each treatment system is discussed below.

The fundamental questions at each system are whether (1) influent water quality indicates treatment is still necessary, (2) effluent water quality indicates system maintenance is required, and (3) surface water quality suggests impacts from inadequate groundwater treatment.

6.1.8.1 Mound Site Plume Collection System

The MSPTS was installed in 1998 and was converted to the MSPCS in 2016. As with the earlier MSPTS, the MSPCS intercepts and collects contaminated groundwater that would otherwise impact surface water in FC-4 and South Walnut Creek (Figure 16). The sources of the contaminants are the Mound and Oil Burn Pit #2, referred to prior to closure as IHSS 113 and IHSS 153, respectively. The primary groundwater contaminants are the chlorinated solvents tetrachloroethene (PCE) and trichloroethene (TCE), with lesser amounts of carbon tetrachloride. Following source removal at Oil Burn Pit #2, groundwater from that area was directed to the collection infrastructure of the MSPCS (at that time referred to as the MSPTS). The flow increased as a result, and the suite of VOCs present in the intercepted groundwater expanded to include 1,1,1-trichloroethane and much higher concentrations of degradation byproducts, most notably *cis*-1,2-dichloroethene and vinyl chloride, due to the addition of electron donor material in the backfill to the Oil Burn Pit #2 source area. Flows at the MSPTS initially averaged well under 0.5 gallon per minute (gpm), increasing substantially after closure to around 1 gpm.

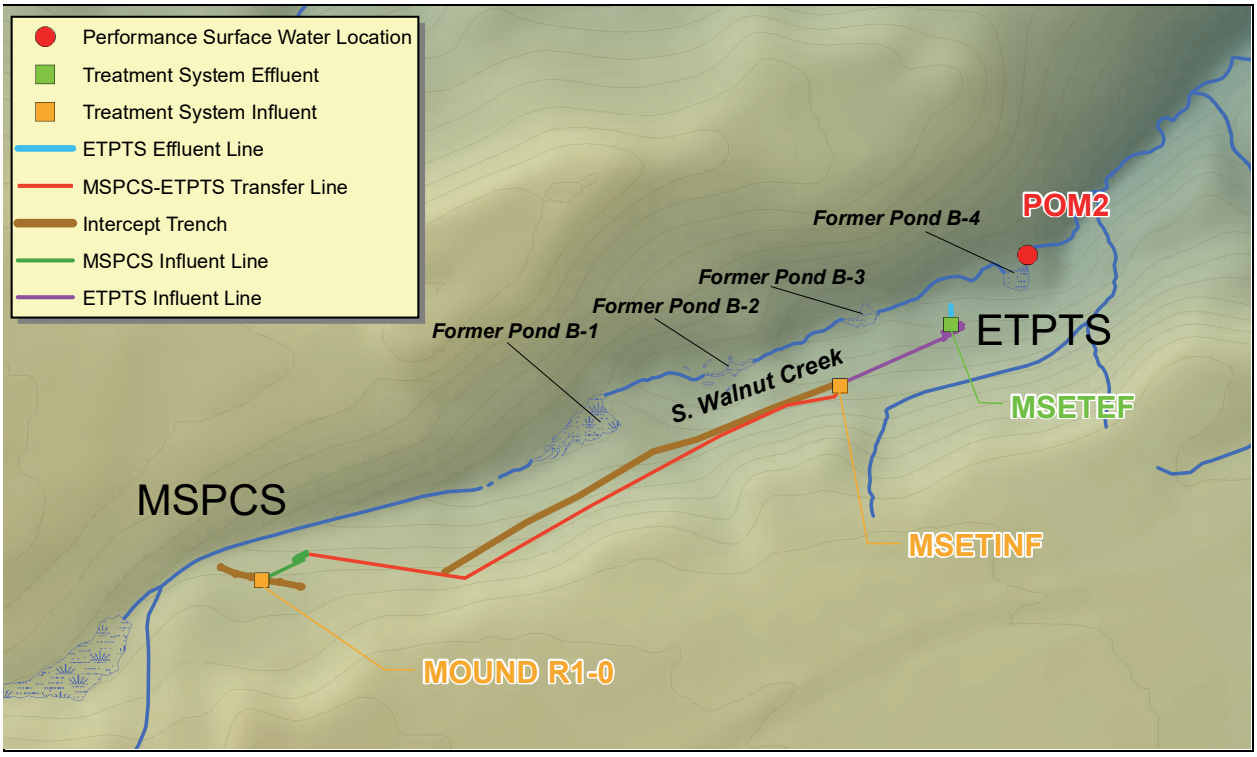


Figure 16. Rocky Flats Site MSPCS Monitoring Locations

The most critical components of the MSPCS include the groundwater intercept trench and its associated influent manhole, which continue to receive Mound Site Plume groundwater and flow from the Oil Burn Pit #2 area; a concrete lift station and pump; a transfer pipeline extending from this lift station to the ETPTS influent manhole; and solar/battery power and other electrical equipment to support transfer of the water and monitoring system conditions. Other components that are present but are only used as needed include a flow configuration vault, two backup water-storage tanks, and a subsurface water discharge gallery. When treatment was performed here by the MSPTS, these two tanks were filled with zero-valent iron (ZVI) media, the vault allowed the flow to be reconfigured from series to parallel and upflow to downflow, and the treated water was discharged to the discharge gallery. The tanks are currently used to manage excess sample and purge water from groundwater monitoring activities.

Data and Sample Collection Protocols

Monitoring locations specific to the MSPCS are displayed in Figure 16. General monitoring information for these locations is provided in Table 23. Sampling frequencies are summarized in Table 24. In addition to the monitoring locations shown, several piezometers are present within the collection trench and are retained for troubleshooting purposes. Furthermore, the transfer line from the MSPCS lift station to the ETPTS influent manhole is equipped with cleanouts that can be used to collect operational information, primarily related to conditions within that line.

Table 23. MSPCS Sampling Location Information

Location Code	Location Description	Analytes[a]
MOUND R1-0	Influent sampling location	VOCs
MSETEF	Effluent sampling location (supports MSPCS and ETPTS)	VOCs
POM2	Surface water performance location (supports MSPCS and ETPTS)	VOCs

Note:
[a] Samples for the analysis of VOCs at the above location will be collected as grab samples.

Table 24. Sampling Frequency for MSPCS Sampling Locations

Sampling Frequency	Timing	Schedule Considerations
Semiannual	Second and fourth calendar quarters (high- and low-water conditions, respectively)	Attempt to sample all MSPCS- and ETPTS-area locations as a group

Data Evaluation

The data evaluation process guiding the use of analytical data for the MSPCS locations is shown in the Figure 11 flowchart in RFLMA Attachment 2. Because similar rules guide the use of data at the ETPTS, SPPTS, and PLFTS, this figure also applies to those systems.

Compliance with surface water quality standards (Table 1 of Attachment 2 to the RFLMA) at the MSPCS is demonstrated via the Figure 11 flowchart in the RFLMA. Generally, analytical data evaluation is performed as data become available. This is particularly important for VOC data from MSPCS/ETPTS effluent and performance locations MSETEF and POM2, respectively. If the data suggest additional system maintenance is required, additional inspections and data collection are performed to confirm and support this issue. Data are reported in the corresponding quarterly report and evaluated in the annual report.

The determination of whether the MSPCS may be closed (i.e., physically or administratively removed from service) is made using influent water quality data and in consultation with the regulatory agencies. When monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required.

6.1.8.2 East Trenches Plume Treatment System

The ETPTS was installed in 1999 to intercept and treat contaminated groundwater from the East Trenches Plume. The primary contaminants in this groundwater are chlorinated VOCs, particularly PCE and TCE. Its original configuration was modeled after the MSPTS. As at the MSPTS, the ETPTS originally consisted of a groundwater intercept trench that collected and diverted VOC-contaminated groundwater to cells containing ZVI, which treated the water (Figure 17). The reconfiguration completed in 2015 replaced the ZVI with a powered, commercial air stripper. Since the addition of MSPCS water, this system generally flows within the 1.5–2.5 gpm range.

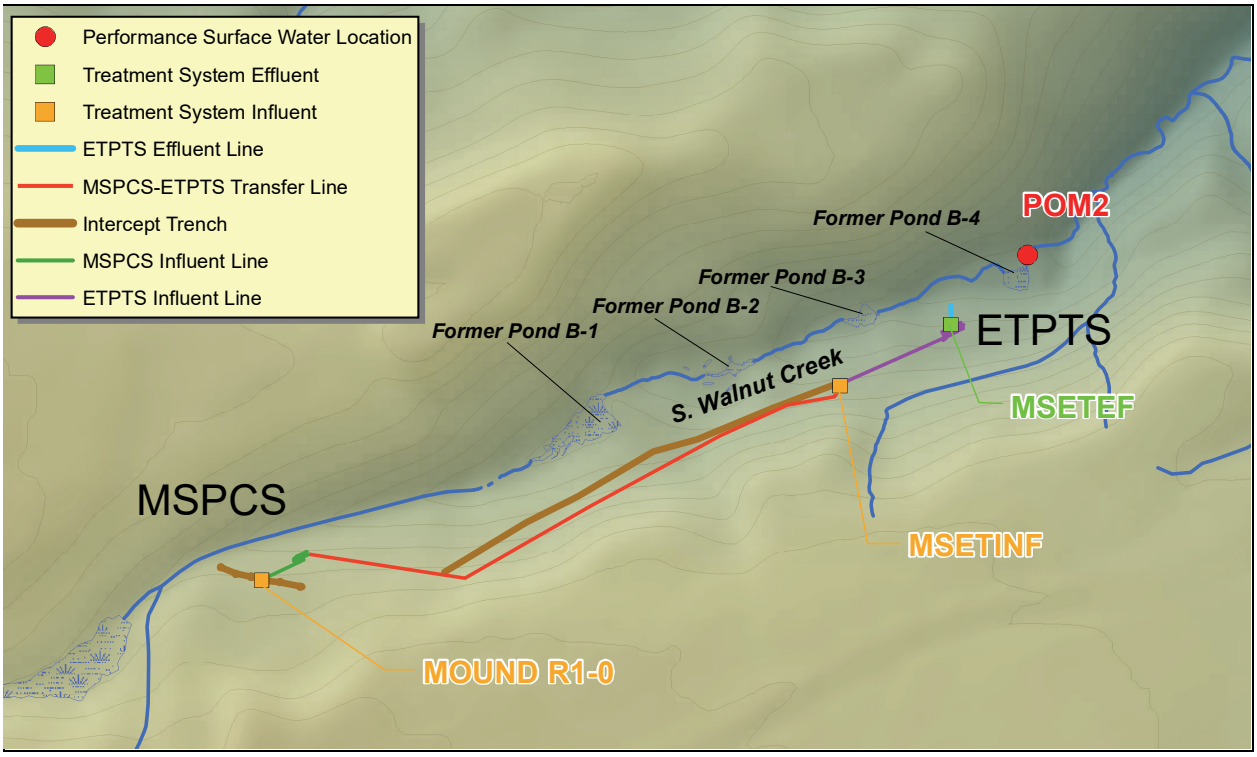


Figure 17. Rocky Flats Site ETPTS Monitoring Locations

The primary components at the ETPTS include a groundwater intercept trench and influent manhole, which now also receives transferred water from the MSPCS; the commercial air stripper in its dedicated enclosure; influent and effluent batch tanks; an effluent manhole and subsurface discharge gallery; and solar/battery power components and electrical equipment.

Data and Sample Collection Protocols

Monitoring locations specific to the ETPTS are displayed in Figure 17 (and also support the MSPCS, as described above). General monitoring information for these locations is provided in Table 25. Sampling frequencies are summarized in Table 26. In addition to the monitoring locations shown, several piezometers are present within the collection trench and are retained for troubleshooting purposes. Sampling locations are also installed on the lines feeding and draining the air stripper; these locations will be monitored as requested by the groundwater lead.

Table 25. ETPTS Sampling Location Information

Location Code	Location Description	Analytes[a]
MSETINF	Influent sampling location (supports MSPCS and ETPTS)	VOCs
MSETEF	Effluent sampling location (supports MSPCS and ETPTS)	VOCs
POM2	Downgradient surface water performance location (supports MSPCS and ETPTS)	VOCs

Note:
[a] Samples for the analysis of VOCs at the above locations will be collected as grab samples.

Table 26. Sampling Frequency for ETPTS Sampling Locations

Sampling Frequency	Timing	Schedule Considerations
Semiannual	Second and fourth calendar quarters (high- and low-water conditions, respectively)	Attempt to sample all ETPTS- and MSPCS-area locations as a group

Data Evaluation

The data evaluation process guiding the use of analytical data from ETPTS locations is shown in the Figure 11 flowchart in RFLMA Attachment 2. Because similar rules guide the use of data at the MSPCS, SPPTS, and PLFTS, this figure also applies to those systems.

Compliance with surface water quality standards (Table 1 of Attachment 2 to the RFLMA) at the ETPTS is demonstrated via the Figure 11 flowchart in RFLMA Attachment 2. Generally, analytical data evaluation is performed as data become available. If the data suggest additional system maintenance is required, additional inspections and data collection may be performed to confirm and support this issue. Data are reported in the corresponding quarterly report and are evaluated in the annual report.

If contaminant concentrations in ETPTS effluent as monitored at MSETEF do not meet all corresponding RFLMA requirements, responses may include increasing the air flow of the air-stripper blower. (This action has been successful in the past; see annual report for 2015, for example.) As long as concentrations of VOCs in ETPTS effluent are below RFLMA Table 1 standards, no action beyond continued maintenance, monitoring, and evaluation is warranted. Analytical results for ETPTS locations, particularly MSETEF and POM2, should be reviewed promptly upon receipt to confirm there is no need for immediate maintenance.

The determination of whether the ETPTS may be closed (i.e., physically or administratively removed from service) is made using influent water quality data and in consultation with the regulatory agencies. Note that this influent is now a mixture of MSPCS groundwater and groundwater from the East Trenches Plume. Therefore, it is necessary to consider the ETPTS influent as well as the MSPCS influent before confirming that the ETPTS may be closed. Once monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required.

6.1.8.3 Solar Ponds Plume Treatment System

The SPPTS (Figure 18) was installed in 1999 to intercept and treat contaminated groundwater from the Solar Ponds Plume (SPP). The primary contaminant in this groundwater is nitrate, and the system also treats uranium. Its original configuration was modeled after the MSPTS and ETPTS, consisting of a groundwater intercept trench that collected and diverted contaminated groundwater to one cell containing sawdust and ZVI, and a second cell containing gravel and ZVI. Several upgrades have been completed at the SPPTS to collect additional contaminated groundwater and to improve treatment effectiveness and efficiency; refer to the RFLMA annual reports for details. Reconfigurations completed in 2016 and 2018 replaced the media-filled treatment cells with a single “lagoon” designed to treat nitrate within the original treatment cell

structure. Uranium treatment continues to be optimized. The SPPTS typically flows in the 1–2 gpm range.

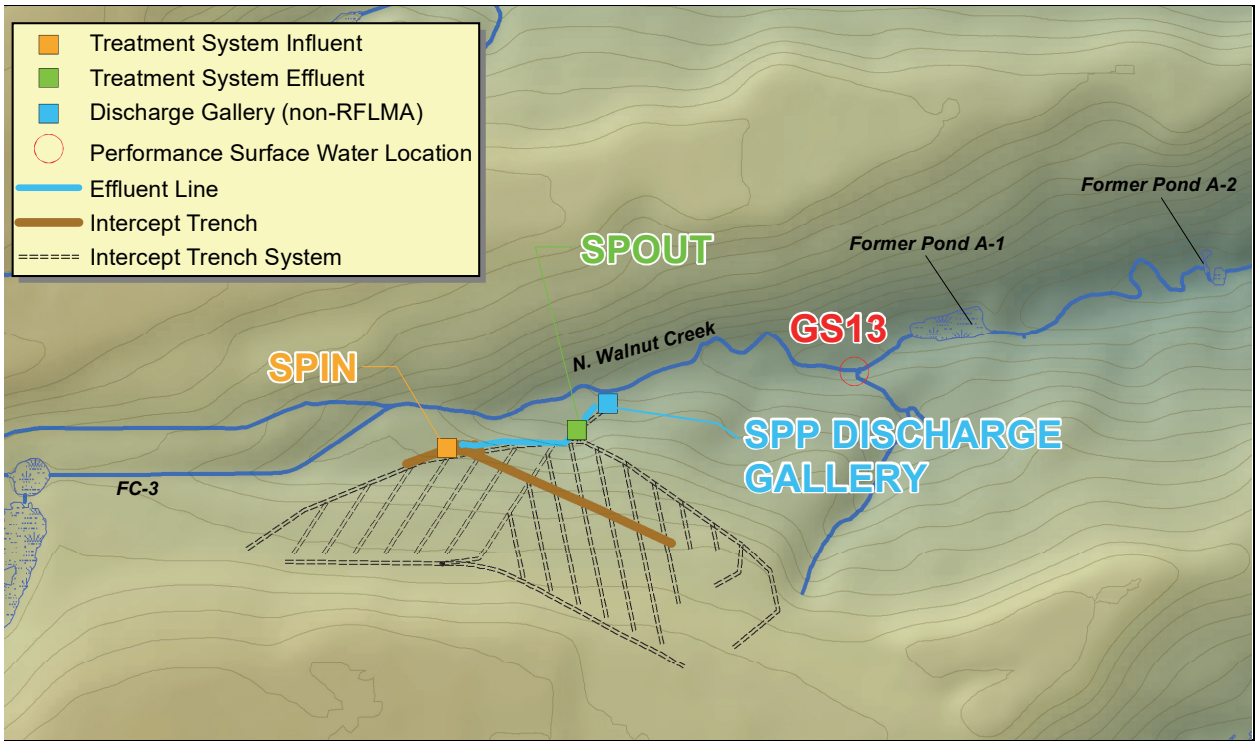


Figure 18. Rocky Flats Site SPPTS Monitoring Locations

The primary components at the SPPTS include a groundwater intercept trench and a second groundwater collection component referred to as the Interceptor Trench System Sump (ITSS), both of which are fed groundwater by the Interceptor Trench System installed in 1980–1981; an influent manhole on the main trench, which also receives transferred water from the ITSS; pumps in the influent manhole and ITSS; the nitrate-treating lagoon; a carbon storage vault that stores the liquid nutrient used to support the denitrifying bacteria in the lagoon; a series of vaults in which flows are monitored, samples are collected, and water is dosed with the nutrient using a dosing pump; an effluent manhole and subsurface discharge gallery; and solar/battery power components and electrical equipment. Additional vaults and infrastructure remains from past treatment studies and obsolete configurations, and may be repurposed or removed following implementation of full-scale uranium treatment in the next few years. One of the former test vaults is now used to manage excess sample and purge water from surface water and groundwater monitoring activities. The SPPTS treatment and power components are contained within a locked chain-link fence to further reduce the potential for wildlife or unauthorized visitors to fall into the lagoon.

Data and Sample Collection Protocols

Routine monitoring locations specific to the SPPTS are presented in Figure 18. General monitoring information for these locations is provided in Table 27. Sampling frequencies are summarized in Table 28. In addition to the monitoring locations, several locations within and between system components may be sampled to evaluate treatment studies and treatment in

general. These extra samples currently inform conditions within the nitrate treatment component (the lagoon) and in the near future may be used to support uranium treatment testing. After a full-scale uranium treatment component is identified, constructed, and online, additional or replacement sampling locations may be defined. The locations supporting treatment studies and optimization are monitored as requested by the groundwater lead. Also, several piezometers are installed within the collection trench. Although no longer routinely monitored, the piezometers are retained for troubleshooting purposes.

Table 27. SPPTS Sampling Location Information

Location Code	Location Description	Analytes
SPIN	Influent sampling location	U, nitrate[a]
SPOUT	Effluent sampling location	U, nitrate[a]
SPPDISCHARGEGALLERY[b]	Pooled effluent above buried discharge gallery	U, nitrate[a]
GS13[c]	Downgradient surface water performance location	U, nitrate[a]

Notes:
[a] Nitrate is analyzed as nitrate+nitrite as N.
[b] The RFLMA does not require sampling of the Solar Ponds Plume (SPP) Discharge Gallery. However, DOE has agreed to continue to monitor this location as requested by downstream communities.
[c] Samples collected for U at GS13 will typically be flow-paced composites; however, if desired, they may be collected as grab samples to meet minimum requirements. Due to sample hold time constraints, nitrate samples are collected as grab samples.

Table 28. Sampling Frequency for SPPTS Sampling Locations

Sampling Frequency	Timing	Schedule Considerations
Semiannual	Second and fourth calendar quarters (high- and low-water conditions, respectively)	Attempt to sample all SPPTS-area locations as a group

Data Evaluation

The data evaluation process guiding the use of analytical data from SPPTS locations is shown in the Figure 11 flowchart in RFLMA Attachment 2. Because similar rules guide the use of data at the MSPTS, ETPTS, and PLFTS, this figure also applies to those systems.

Compliance with surface water quality standards (Table 1 of Attachment 2 to the RFLMA) at the SPPTS is demonstrated via the Figure 11 flowchart in RFLMA Attachment 2. Treatment effectiveness by the SPPTS for nitrate has been excellent since completion of the reconfiguration in 2016, while that for uranium continues to be actively worked. The lagoon was completed in 2016 as a full-scale, interim test lagoon and was then optimized to represent the formal treatment component in 2018. Further testing and refinement of uranium treatment will continue and lead to the design and construction of a full-scale uranium treatment component. In the years since site closure, multiple consultations have been conducted with the regulatory agencies regarding the status and path forward for this system, and the consultative process is ongoing.

Generally, analytical data evaluation is performed as data become available. If the data suggest additional system maintenance is required, additional inspections and data collection are

performed to confirm and support this issue. Data are reported in the corresponding quarterly report and are evaluated in the annual report. (Note: this pertains specifically to analytical data generated by contract laboratories. Nonroutine samples may be collected outside of the RFLMA to support operational needs. These are typically submitted to the Environmental Sciences Laboratory (ESL) operated for LM in the Grand Junction, Colorado, office. The associated results are viewed as screening-level data, as they cannot be validated. Therefore, data reported by the ESL may be summarized or described in reports, but are not included in the data appended to these reports.)

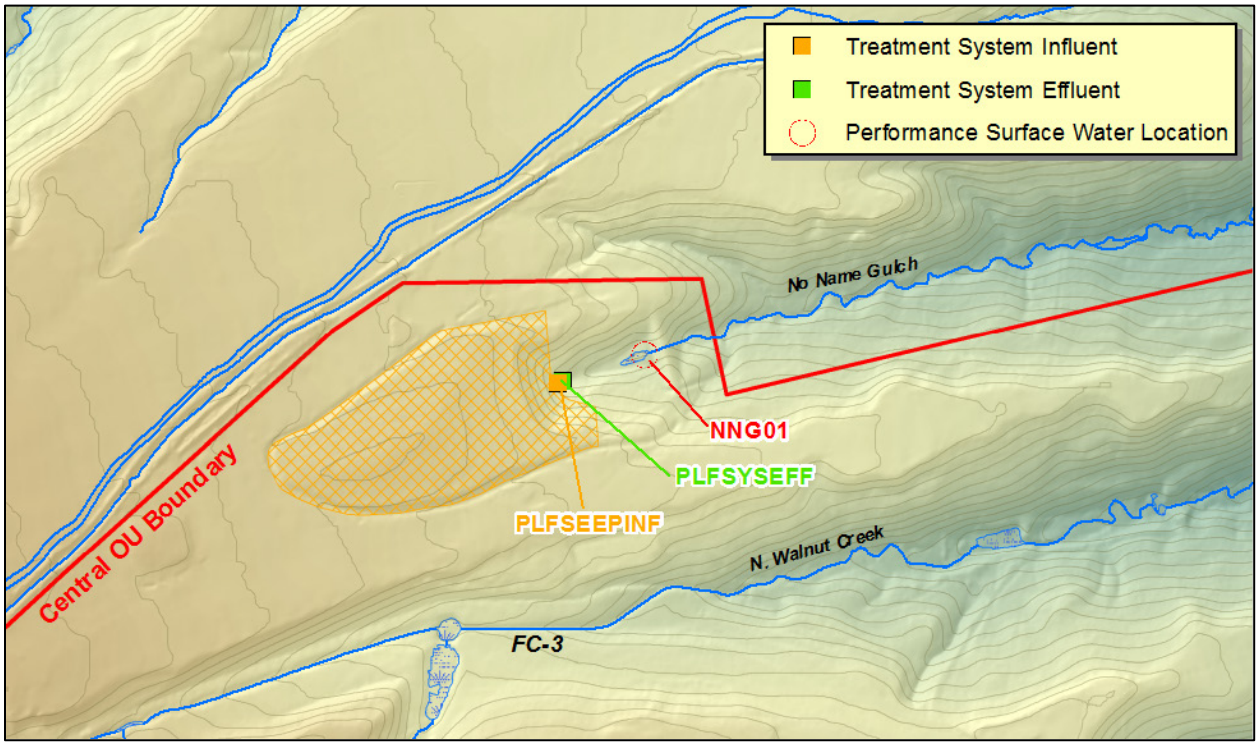
Because the SPP Discharge Gallery is not a RFLMA monitoring location, no data evaluation requirements are associated with this location. For convenience, water quality at this location is assessed in the same manner as the other locations; however, results of this evaluation do not force decisions.

The determination of whether the SPPTS may be closed (i.e., physically or administratively removed from service) is made using influent water quality data and in consultation with the regulatory agencies. After monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required.

6.1.8.4 Present Landfill Treatment System

The PLFTS is monitored to determine the short- and long-term effectiveness of the remedy. Monitoring requirements were initially identified in the *Final Interim Measures/Interim Remedial Action for IHSS 114 and RCRA Closure of the RFETS Present Landfill*, Appendix B, "Post-Accelerated Action Monitoring and Long-Term Surveillance and Monitoring Considerations" (DOE 2004c), and finalized in the PLF M&M Plan (DOE 2014a).

Water monitoring locations for the PLFTS and sampling location details are shown in Figure 19 and Figure 20. Groundwater monitoring for the PLF is discussed in detail in Section 9.1.6.



Note:
PLFSYSEFF serves as both the treatment system effluent monitoring location and a performance surface water monitoring location, but is not displayed using both symbols for purposes of legibility.

Figure 19. Rocky Flats Site PLFTS Monitoring Locations

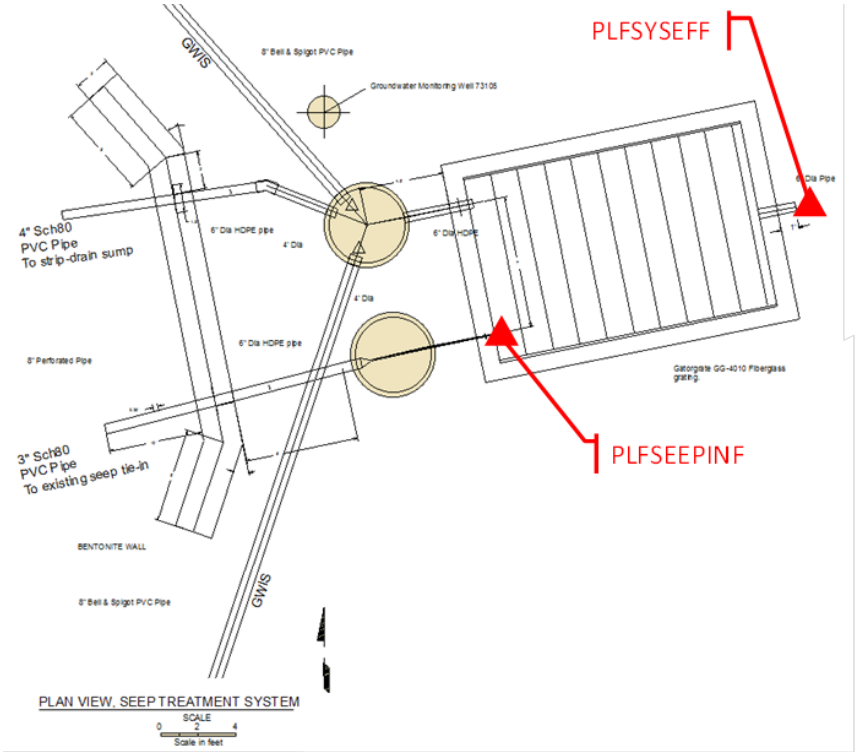


Figure 20. PLFTS Sampling Locations (Detail)

Data and Sample Collection Protocols

The PLFTS is routinely sampled at the treatment system influent and effluent sampling locations (Table 29 and Table 30).

Table 29. PLFTS Water Monitoring Locations

Location Code	Location Description
PLFSEEPINF	Seep influent to treatment system
PLFSYSEFF	PLFTS effluent
NNG01	At the discharge location for water flowing through the former PLF pond area (eastern end)

Table 30. PLFTS Sample Collection: Type and Analytes

Location Code	Type	Frequency	Analytes[a]
PLFSEEPINF	Grab	Quarterly	U; total and dissolved metals; VOCs; manual flow measurement (field)
PLFSYSEFF	Grab	Quarterly; monthly by decision[b]	U; total and dissolved metals; VOCs; SVOCs
NNG01	Grab	Determined by decision[b]	Determined by decision[b]

Notes:
[a] Nitrate is analyzed as nitrate+nitrite as N.
[b] Refer to the decision logic on the Figure 11 flowchart in RFLMA Attachment 2.

Data Evaluation

Compliance with surface water quality standards (Table 1 of Attachment 2 to the RFLMA) at the PLFTS is demonstrated by the Figure 11 flowchart in the RFLMA. Because similar rules guide the use of data at the MSPTS, ETPTS, and SPPTS, this figure also applies to those systems.

Generally, analytical data evaluation is performed as data become available. If an initial qualitative screening indicates that an analytical result is higher than the standard for a particular analyte, then evaluation is performed immediately. If the evaluation suggests initiation of the consultative process, then validation is requested for the data packages used in the evaluation.

The determination of whether the PLFTS may be closed will be made using influent water quality data and in consultation with the regulatory agencies. After monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required. The PLF M&M Plan (DOE 2014a) would require modification to reflect the end of operation of the treatment system.

6.1.9 Predischarge Monitoring

This monitoring objective is intended to evaluate whether pond water from Ponds A-4, B-5, or C-2 is expected to meet water quality standards (Table 1 of RFLMA Attachment 2) at downstream POCs prior to opening a valve to initiate discharge. This monitoring would only occur after an outlet valve has been closed and prior to reopening the valve to release the

retained water; during flow-through operations this type of monitoring is not required. These ponds have been continuously operating in flow-through since 2011. Predischarge samples are collected at Ponds A-4, B-5, and C-2 on North Walnut Creek, South Walnut Creek, and Woman Creek, respectively. These locations are shown in Figure 21.

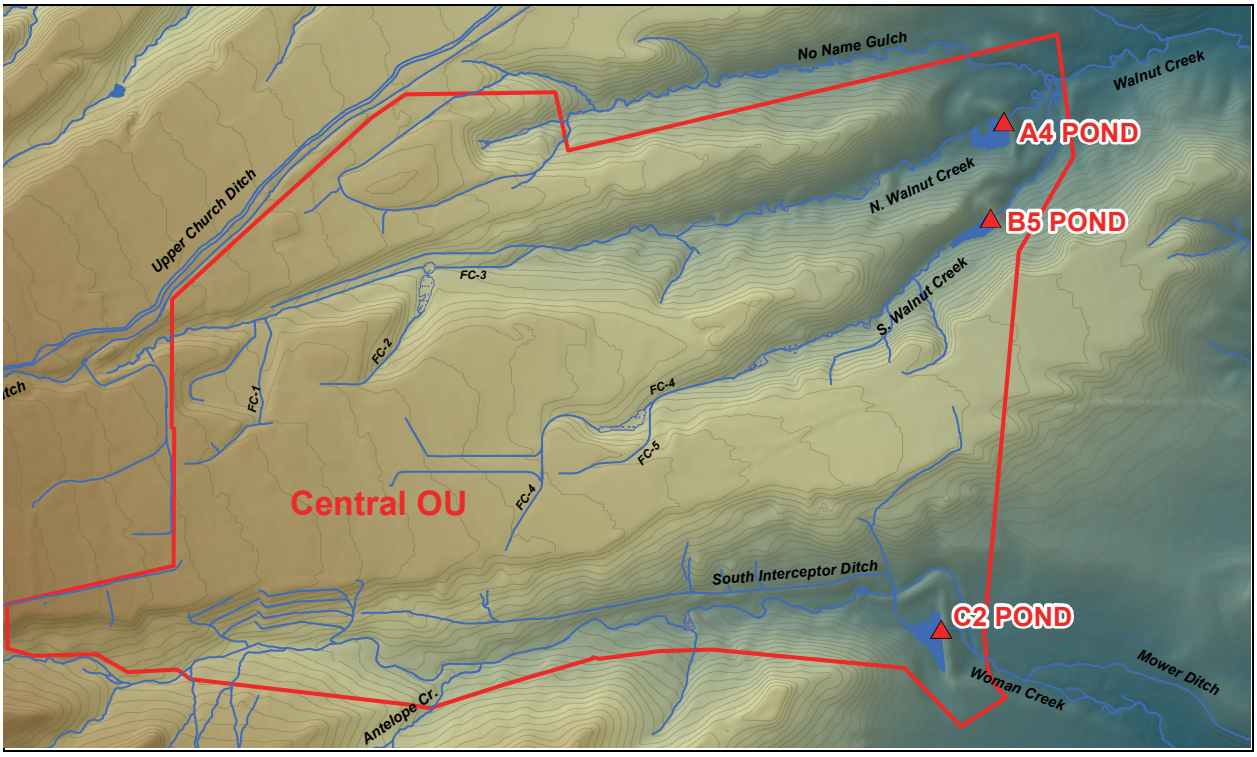


Figure 21. Rocky Flats Site Predischarge Sampling Locations

6.1.9.1 Data and Sample Collection Protocols

Predischarge samples are collected as grab samples for POC analytes only (Table 31). Samples should represent the water to be discharged (i.e., grab sample locations in each pond should be chosen appropriately, and addition of water to the discharge should be minimized after the grab sample is collected[5]).

Table 31. Predischarge Sample Collection: Type and Analytes

Location Code	Sample Type	Analytes
A4 POND	Grab	Pu-239,240; Am-241; U; nitrate[a]
B5 POND	Grab	Pu-239,240; Am-241; U; nitrate[a]
C2 POND	Grab	Pu-239,240; Am-241; U

Note:
[a] Nitrate is analyzed as nitrate+nitrite as N.

[5] Predischarge samples are analyzed on short turnaround to limit the amount of inflow to the ponds after sampling.

Site personnel will notify the appropriate parties in accordance with the Figure 13 flowchart in RFLMA Attachment 2 in advance of predischarge pond sampling. CDPHE and EPA will be allowed the opportunity to collect duplicate or split samples. Samples will be analyzed far enough in advance of a routine discharge to allow action to be taken if unacceptable water quality is indicated but near enough to the time of discharge to be representative of the discharge composition. The ponds will be operated to ensure dam safety regardless of the status or results of pre-discharge sampling.

6.1.9.2 Data Evaluation

Predischarge sampling results are evaluated according to the Figure 13 flowchart in RFLMA Attachment 2.

6.1.10 Water Monitoring Data Collection, Compilation, and Evaluation

6.1.10.1 Water Sample Collection

Sample collection is performed to meet the requirements of the RFLMA and to support implementing BMPs for overall Site surveillance and maintenance activities.

Surface Water Sample Collection

Automated Continuous Flow-Paced Composite Samples

The majority of surface water sampling at the Site is accomplished through the use of automated samplers. These samplers operate in an unattended mode, collecting flow-paced composite samples continuously. The following list of assumptions regarding automated sampling acknowledges that monitoring under all potential Site conditions may not be possible:

- For computation in regulatory reporting, the sample date for a multiday composite sample will generally be the date that the composite sample was started. Although this could give the impression that multiweek samples are being reported months late, this convention is consistent with other Site data. There may be situations where high flows result in the collection of more than one composite sample for a particular date.
- Successful completion of a flow-paced composite sample is determined by several factors that are evaluated by the sampling team. These include, but are not limited to, the required sample volume for analysis (Table 32) (see nonsufficient quantity [NSQ] discussion below), equipment failures, off-normal conditions (e.g., emergencies, severe weather, or other chance events), end-of-year reporting, or health and safety concerns.
- If sample accumulation is terminated for cause, and sample volume is inadequate for routine laboratory analyses, then no analyses are required, and the sample will not be used in the data evaluation. For example, routine laboratory analysis for plutonium and americium currently requires 4.0 liters (L). Therefore, samples of less than 4.0 L may be discarded, if necessary, and not used in the data evaluation, but the sample collection must be reported. This requirement may be referred to as the NSQ requirement regarding insufficient quantity of sample.

Examples of reasons to terminate a composite sample are as follows:

— A new composite sample is started at the start of a calendar year to close out the previous year.

— A new composite sample is started at a lower or higher collection pace, based on current flow conditions, because the previous sample was started at too high or low a pace, based on past flow conditions, due to changing hydrologic conditions in the field.

— A partial composite sample has been sitting in the sample bottle for so long it is no longer considered representative, either due to evaporation or constituent degradation.

- Where there is no significant flow, there may be no composite samples completed within an evaluation period (see NSQ above). However, flow-paced sampling will continue during low-flow periods, even though flows may be so low that it may take longer than the target evaluation period to fill the composite sample container.
- If no samples are collected during an evaluation interval due to a low- or no-flow condition, then no sample result will be available for use in the evaluation of calculated values, and no such calculated value will be reported for that period.
- Samples collected for RFLMA monitoring must be reported, even if they are not analyzed, and the reason for not analyzing (e.g., NSQ) must also be reported.

Table 32. Water Sample Size by Analyte

Analysis	Sample Size (milliliters)
Total Cr/Be	500
Dissolved Ag/Cd	500
Total metals	500
Dissolved metals	500
Total suspended solids	125
Mercury	500
Nitrate+nitrite as N	250
Semivolatiles/PAHs	1000 (each)
Volatiles	40 (x3)
Uranium	500
Hardness	125
Plutonium, americium, uranium	4000

Abbreviations:
Ag = silver Be = beryllium Cd = cadmium Cr = chromium

Continuous flow-paced composite samples are collected during all flow conditions. Automated samplers collect grab samples year-round. When a composite sample is removed from the sampler for analysis, the next composite sample starts filling immediately, if flow is available. If the location is dry at the initiation of a new composite sample, the flow meter is programmed to trigger sample collection at the next available flow period.

A composite sample consists of multiple grab samples[6] that are flow-paced. In other words, one grab sample is deposited in the composite sample bottle each time a specified volume of stream discharge is measured by the flow meter. Figure 22 shows a hydrograph of stream discharge at POC WALPOC with symbols depicting when the actual grab samples were collected. The plot shows two complete composite sampling periods. The red symbols are for a composite sample collected over about 4 days with grabs being collected each time 30,000 cubic feet are measured by the flow meter (the "pace" is 30,000 cubic feet per grab). The green symbols are for a composite sample collected over about 8 days with a pace of 8000 cubic feet per grab.

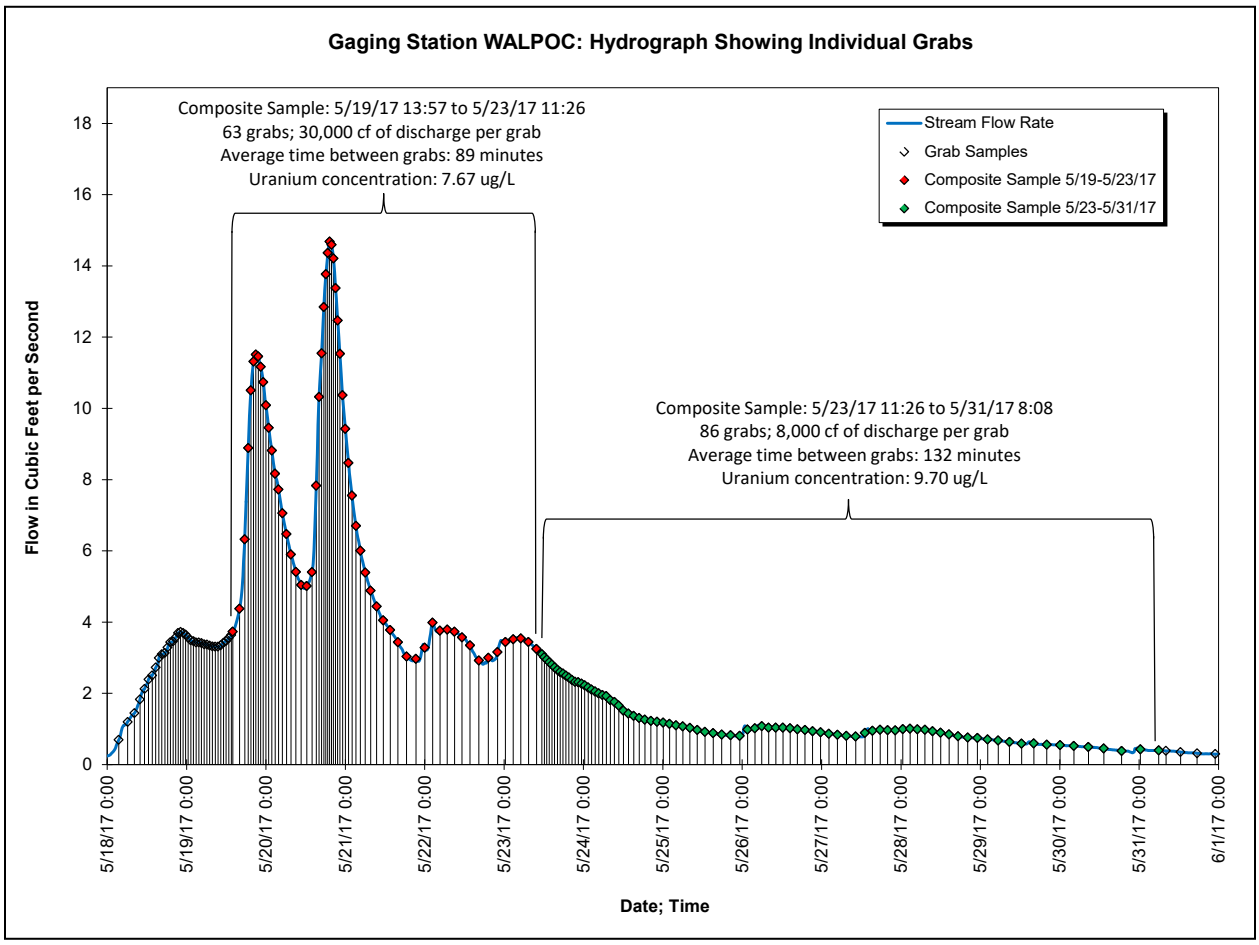


Figure 22. Example Hydrograph Showing Continuous Flow-Paced Composite Sampling

By flow pacing composite samples and effectively collecting more frequent grabs during higher flow rates, an analytical result—in terms of concentration (e.g., milligrams per liter [mg/L]) or activity (e.g., picocuries per liter [pCi/L])—that is representative of the entire sampling period is obtained. This result can then be used with the corresponding discharge volume to calculate a constituent load and concentration summary values.

[6] The current grab sample volume for continuous flow-paced composite samples is 200 milliliters (mL). This volume was chosen to maximize the number of grabs while achieving adequate repeatability. ISCO samplers have a sample volume repeatability of ±10 mL. Therefore, a volume error of ±5% can be expected.

Details on the method used to determine the desired flow pace are provided in the following section.

Flow Pacing of Automated Samplers

The chosen flow pacing for a composite sample must satisfy the following criteria:

- The collected composite sample volume must be adequate such that the location-specific analyses can be conducted by the laboratory.[7]
- The adequate composite sample volume should be collected during the specified time period as determined by the targeted sample collection frequencies.[8,9]

The following steps are used to determine the appropriate flow pace for a continuously collected composite sample:

1. The location-specific targeted time period for the composite sample must be known.

   For example, assume four composite samples are targeted for the month of May at location GS10.

2. The expected discharge volume for the targeted time period must then be calculated using historical flow record.[10] For locations with limited historical flow record, professional judgment, estimations related to basin size, and/or the flow record at upstream or downstream locations are used to determine expected discharge volumes.

   For example, at GS10 the expected discharge volume for May is 5.48 MG. To collect four composite samples for the month, one composite sample is collected for every 1.37 MG (183,142 cubic feet).

3. The targeted number of 200-milliliter (mL) grab samples for the composite sample is then determined. The targeted number of grabs is set using professional judgment to collect a composite volume between the minimum sample volume required for complete analysis and the maximum volume that can be contained in the sample container.[11] This allows for variation in actual measured discharge (from the expected discharge based on historical record), while still collecting the composite sample during the targeted time period.

   For example, at GS10 the composite sample bottles can contain a maximum of 22 L, and the minimum required sample volume for complete laboratory analysis at GS10 is 5.8 L.

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[7] Specific analyses each require some minimum volume of sample. Therefore, the minimum required sample volume depends on the location-specific analyte suite.

[8] Annual composite sample totals are determined by statistically evaluating historical data. Software programs such as Visual Sample Plan (VSP; Battelle Memorial Institute; https://vsp.pnl.gov/) are used to suggest appropriate sample counts to achieve a level of confidence in the results such that decisions can be made. Annual sample counts are distributed monthly based on historical flow data.

[9] Samples are flow-paced based on average expected discharge rates calculated from historical discharge records. Consequently, samples may fill in periods shorter than the targeted period when flow rates are significantly higher than normal. Similarly, samplers may not fill during the targeted period if flow rates are significantly lower than predicted by historical flow record.

[10] The expected discharge volume is the historical average volume. Generally, the available flow record after October 1, 1996, is used (data prior to October 1, 1996, is generally considered less reliable). The actual period of record depends on monitoring location. Due to the significant reduction in runoff following site closure, professional judgment is used where appropriate.

[11] The Site currently uses 15, 22, and 50 L composite sample bottles (carboys).

Consequently, the sampler at GS10 is normally paced to collect sixty 200 mL grab samples if the stream discharge volume is average for the target period, resulting in a composite sample volume of 12 L. The actual stream discharge volume would be expected to vary from historical averages. Therefore, composite samples are collected from the field with a total number of grabs varying from 30 (6 L) to 110 (22 L).

4. The expected discharge volume is then divided by the targeted number of grab samples to obtain a discharge volume per grab sample. This is the flow pace for the composite sample.

   Continuing with the GS10 example, collecting 60 grab samples for a stream discharge of 183,142 cubic feet results in a flow pace of 3052 cubic feet of stream discharge per grab sample.

Grab Sample Collection

Surface water grab sampling is conducted according to internal LMS procedures and work control documents and is consistent with technical standards.

Groundwater Sample Collection

Routine chemical analysis of groundwater identifies contaminants that are present and their concentrations with respect to applicable water quality standards. These data are compared against predetermined and/or well-specific concentrations to identify whether reported concentrations in groundwater are indicative of worsening conditions.

Depending on the well classification and analyte, concentrations are compared in accordance with requirements summarized in Attachment 2 to the RFLMA.

Groundwater samples are collected according to internal LMS procedures, work control documents, and technical standards.

Scheduling

Wells that are sampled semiannually will be sampled during the spring and winter quarters (second and fourth calendar quarters, respectively) because these generally represent relatively higher- and lower-water conditions at the Site. Data from these wells will reflect a broad range of conditions. Wells scheduled for biennial sampling (once every other year) will be sampled during the spring quarter of even-numbered years. Wells that are sampled quarterly should be sampled around the same time each quarter (e.g., in the middle of each quarter) to help maintain relatively even temporal spacing between samples.

To the extent that it is feasible, groundwater samples and corresponding surface water grabs (where appropriate) that are collected in support of a given plume or source area should be collected together, over a short period of time, so that data from the individual locations correspond closely in time with each other. This allows a more accurate “snapshot” of groundwater conditions and, in some cases, related surface water conditions in each area and also enhances the efficiency of the monitoring program. Additionally, within each scheduled sampling area, wells that produce water with lower levels of contaminants should be visited before those presenting higher levels of contaminants in the conventional “clean to dirty” sampling approach. This approach is particularly important if sampling employs reusable

equipment that must be decontaminated after use, instead of dedicated equipment that remains in or is assigned to a given well. If feasible, wells that are consistently low producers should be sampled in the early part of a sampling period to allow more time for the water level to equilibrate before the next scheduled water-level measurement. Table 33 summarizes groundwater sample collection schedule considerations via suggested well groupings.

Sampling according to the suggested groupings is not required but may enhance the usability of the data, and may also save time through greater efficiency. Some locations are not as closely associated with others in their groupings, and may be monitored when convenient. Finally, only a subset of the wells in each group might need to be monitored in any given quarter.

6.1.10.2 Water Data Evaluation

Data evaluation is performed to meet requirements of the RFLMA and to support implementation of BMPs for overall Site surveillance and maintenance activities.

Surface Water Quality Data

Routine chemical analysis of surface water identifies the contaminants present and their concentrations with respect to applicable water quality standards. These data are compared against standards to identify whether measured water quality is acceptable.

Depending on the monitoring objective and analyte, concentrations are compared using one or more of the following criteria:

- Calculated values[12] are compared with surface water standards identified in Table 1 of Attachment 2 to the RFLMA according to the applicable data evaluation flowcharts in RFLMA Attachment 2 (additional detail is provided below)
- Individual results are compared with surface water standards identified in Table 1 of Attachment 2 to the RFLMA according to the applicable data evaluation flowcharts in RFLMA Attachment 2
- Results from downstream locations are compared against those in upstream locations according to the applicable data evaluation flowcharts in RFLMA Attachment 2

Monitoring objectives, which determine which of the criteria above apply, are summarized in Table 2 in Section 6.1 above; details are in the specific objective sections above.

Comparing Calculated Values with Standards

The RFLMA requires that analyte concentrations in surface water be compared against the greater of the standard or PQL listed in Table 1 of Attachment 2 to the RFLMA. The surface water standards and PQLs are hereafter referred to collectively as "surface water standards."

[12] Applicable calculated values are detailed in the specific monitoring objective sections (12-month rolling averages, 30-day averages, etc.). Methods for calculating these summary parameters are given below.

Table 33. Scheduling Monitoring Location Groups for Optimal Data Usability

North Supergroup	*North Supergroup (continued)*	*East Supergroup*
Oil Burn Pit #1/B371 Group	**PLF/PU&D Group**	**Oil Burn Pit #2/B991/Mound Group**
33502	70193	45608
33604	70393	91105
33711	70693	91203
33905	73005	91305
37405	73105	99305
37505	73205	99405
37705	4087	00897
North-Central IA Group	B206989	15699
P114689	30900	MOUND R1-0
55905	30002	
56305		
21505		**903 Pad/Ryan's Pit Plume Group**
P115589		22996
70705		00191
B771/IHSS 118.1 Group		07391
20205		90402
20505		50299
20705	***South Supergroup***	00491
42505	**B444 Group**	90804
18199	40005	90299
20902	40205	90399
52505	40305	10304
SW018 (grab)	P419689	00193
SEP Group	P416889	**East Trenches Plume Group**
P210189	11502	3687
79102	**OLF Group**	05691
79202	P416589	03991
P208989	80005	04091
79302	80105	95099
79402	80205	95199
79502	11104	95299
79605	**B881/881 Hillside Group**	23296
00203	88205	MSETINF
22205	00797	MSETEF
P210089	891WEL	POM2 (grab)
70099	89104	00997
B210489		
51605		
10594		
SPOUT		
SPPDISCHARGEGALLERY (grab)		
SPIN		
GS13 (grab)		

Evaluation Using 30-Day and 12-Month Averages

Evaluation of analytical data using 30-day averages is currently performed for POC monitoring locations as specified in the RFLMA. Evaluation of analytical data using 12-month averages is currently performed for POC and POE monitoring locations as specified in the RFLMA. The methods are as follows:

- Calculations for 30-day averages are performed using daily time steps. The 30-day average for a particular day is calculated using a "window" of time that includes the previous 30 days that had both flow (i.e., measured flow greater than zero) and valid analytical measurements. Therefore, for a location with continuous flow and complete analytical results, 365 (366 in a leap year) 30-day average values are calculated annually. For a location that flows intermittently, the 30-day window includes the previous 30 days with greater-than-zero flow. Therefore, the 30-day average at an intermittently flowing location will include more than 30 *calendar* days.
- Calculations for 12-month averages are also performed using daily time steps; however, a value is only calculated for the last calendar day of each month. The 12-month rolling average for the last day of each month is calculated using a window of time that includes the previous 365 calendar days. Therefore, for a location with continuous flow and complete analytical results, 365 daily measurements (flow and concentration) are included in each window (12 windows per year). For a location that flows intermittently, the rolling 12-month window will include fewer than 365 daily measurements because days of zero flow have no applicable analytical result or discharge volume.
- When no analytical result or measured flow value is available for a particular day, then that day is not included in the average. No analytical result may be available either due to NSQ for analysis or a failed laboratory analysis. Flow measurement may be missing due to equipment failures or adverse weather conditions (e.g., winter freezing).
- When a negative radionuclide result (e.g., −0.002 pCi/L) is returned from the laboratory due to blank correction, then a value of 0.0 pCi/L is used for calculation purposes. When a nondetect result is returned from the laboratory for metals and water quality parameter analyses, then one-half the detection limit is used for calculation purposes.
- When a field sample result has a corresponding duplicate (i.e., "DUP") or reanalysis ("re-run"), the analytical result used in calculations is the arithmetic average of the individual analytical results.

Calculation of 30-Day and 12-Month Averages

- Each calendar day is assigned the activity or concentration (e.g., analytical result in pCi/L or µg/L) from the composite sample that was in progress at the end of that day (specifically, at 23:59:59).

  Table 34 is an example of the calculation showing colored blocks representing actual sampling periods for individual composite samples collected at WALPOC. The columns on the left show daily values for stream discharge, uranium concentration, and uranium load.

  In the event that more than one composite sample was collected during a single day due to high flows, the results for each composite sample will be volume-weighted to calculate an

appropriate single concentration or activity value to be applied to the day. The equation can be given as follows:

$$\text{Volume} - \text{Weighted Result} = \frac{(R_0V_0) + (R_1V_1) + (R_2V_2)}{V_0 + V_1 + V_2} \qquad \text{(Eqn. 1)}$$

where R_0 = the value of the first composite period
R_1 = the value of the second composite period
R_2 = the value of the third composite period
V_0 = the streamflow volume during the first composite period of the day
V_1 = the streamflow volume during the second composite period of the day
V_2 = the streamflow volume during the third composite period of the day

An example is as follows where a particular day (May 10 in this example) was covered by three composite samples:

Composite No.	Period of Collection	Analytical Result (µg/L)	Streamflow Volume During Collection on May 10th (L)
1	5/5 9:10–5/10 8:45	1.0	1.5×10
2	5/10 8:45–5/10 15:00	3.0	2.0×10^6
3	5/10 15:00–5/15 7:40	2.0	0.5×10^6

Abbreviation:
µg/L = micrograms per liter

Therefore, the volume-weighted result to apply to 5/10 is as follows:

$$\text{Volume} - \text{Weighted Result} = \frac{(1.0 \times 1.5) + (3.0 \times 2.0) + (2.0 \times 0.5)}{(1.5 + 2.0 + 0.5)} = 2.125 \ \mu\text{g/L} \qquad \text{(Eqn. 2)}$$

- Each calendar day has an associated surface water discharge volume (L) that was measured by the flow meter. The flow record may contain estimated values for certain conditions.[13]

  This is the second column in the Table 34 example.

- The daily surface water discharge volume is then multiplied by the corresponding activity/concentration to calculate a load in pCi, milligrams [mg], or micrograms [µg] for each day.

  This is the fourth column in the Table 34 example.

[13] Estimates are required when flow rates exceed the capacity of the flow-control structure (e.g., a flume), winter ice conditions result in an inaccurate measurement, or equipment fails.

- To calculate a 30-day average, the sum of the daily loads (pCi, mg, or µg) for the preceding 30 days, with both flow and an analytical result, is divided by the sum of the daily surface water volumes (liters [L]) for the preceding 30 days, with both flow and an analytical result, to calculate the volume-weighted 30-day average (pCi/L, mg/L, or µg/L). The equation can be given as follows:

$$\frac{\sum_{\text{day}=0}^{\text{day}=-29}(\text{pCI, mg, or } \mu\text{g})}{\sum_{\text{day}=0}^{\text{day}=-29}(\text{L})} = \text{30-Day Average}_{\text{day}=0}\left(\frac{\text{pCi}}{\text{L}}, \frac{\text{mg}}{\text{L}}, \text{or} \frac{\mu\text{g}}{\text{L}}\right) \quad \text{(Eqn. 3)}$$

  Table 35 shows the example calculation of the 30-day average for May 30, 2017, using actual WALPOC data. The blue block encompasses 30 days of measured discharge, while the purple block encompasses 30 days of calculated load.

- To calculate the 12-month average, the sum of the daily loads (pCi or mg) for the preceding 365 calendar days, with both flow and an analytical result, is divided by the sum of the daily surface water volumes (L) for the preceding 365 calendar days to calculate the 12-month rolling average (pCi/L or mg/L). The equation can be given as follows:

$$\frac{\sum_{\text{day}=0}^{\text{day}=-364}(\text{pCi or } \mu\text{g})}{\sum_{\text{day}=0}^{\text{day}=-364}\text{L}} = \text{Rolling 12-Month Average}_{\text{day}=0}\left(\frac{\text{pCi}}{\text{L}} \text{or} \frac{\mu\text{g}}{\text{L}}\right) \quad \text{(Eqn. 4)}$$

  where "day = 0" is the last day of each month.

  Table 35 shows 12-month averages in the last column. Values are shown for April 30 and May 31, the last day of each month in this example. The value shown for May 31, 2017, would include all daily discharge and load values back through June 1, 2016.

- The average values are then rounded to a number of significant figures that matches the applicable standard from Table 1 of Attachment 2 to the RFLMA. No rounding occurs with the measured input numbers prior to calculation of the 30-day averages. Only the final calculated value is rounded. For example, a calculated uranium value of 9.74 µg/L would be rounded to 9.7 µg/L (the uranium standard is 16.8 µg/L). Similarly, a value of 9.77 µg/L would be rounded to 9.8 µg/L.
- These calculated averages are then compared to the appropriate water quality standards according to the criteria in the applicable data evaluation flowcharts in RFLMA Attachment 2.

Table 34. Example Data Evaluation Values from Location WALPOC

Date	Daily Discharge (L)	Uranium Concentration (ug/L)	Daily Uranium Load (ug)	30-Day Average Uranium Concentration (ug/L)	12-Month Average Uranium Concentration (ug/L)
4/29/2017	189276	14.9	2820214	14.6	
4/30/2017	602021	14.9	8970120	14.7	12.0
5/1/2017	1164920	14.9	17357311	14.7	
5/2/2017	933584	14.9	13910398	14.8	
5/3/2017	810226	14.9	12072363	14.8	
5/4/2017	599846	17.6	10557291	15.0	
5/5/2017	355191	17.6	6251368	15.1	
5/6/2017	286580	17.6	5043805	15.3	
5/7/2017	185416	17.6	3263328	15.4	
5/8/2017	183025	17.6	3221246	15.5	
5/9/2017	936515	17.6	16482655	15.8	
5/10/2017	1273741	17.6	22417838	16.1	
5/11/2017	3383850	15.6	52788065	16.0	
5/12/2017	1742210	15.6	27178481	15.9	
5/13/2017	1010025	15.6	15756390	15.9	
5/14/2017	650822	15.6	10152823	15.9	
5/15/2017	465452	15.6	7261055	15.9	
5/16/2017	355034	15.6	5538532	15.9	
5/17/2017	305840	13.6	4159431	15.8	
5/18/2017	5269698	13.6	71667886	15.3	
5/19/2017	13215741	7.67	101364731	12.4	
5/20/2017	21223576	7.67	162784828	10.6	
5/21/2017	11205957	7.67	85949687	10.1	
5/22/2017	8321444	7.67	63825477	9.8	
5/23/2017	7329144	9.7	71092699	9.8	
5/24/2017	3958496	9.7	38397414	9.8	
5/25/2017	2348920	9.7	22784520	9.8	
5/26/2017	2457614	9.7	23838856	9.8	
5/27/2017	2179928	9.7	21145305	9.8	
5/28/2017	2166422	9.7	21014289	9.8	
5/29/2017	1521960	9.7	14763008	9.8	
5/30/2017	1125345	9.7	10915844	9.7	
5/31/2017	874018	10.1	8827585	9.7	10.8
6/1/2017	797917	10.1	8058959	9.6	
6/2/2017	1016256	10.1	10264185	9.6	

Table 35. Example 30-Day Average Values from Location WALPOC

Date	Daily Discharge (L)	Uranium Concentration (ug/L)	Daily Uranium Load (ug)	30-Day Average Uranium Concentration (ug/L)	12-Month Average Uranium Concentration (ug/L)
4/29/2017	189276	14.9	2820214	14.6	
4/30/2017	602021	14.9	8970120	14.7	12.0
5/1/2017	1164920	14.9	17357311	14.7	
5/2/2017	933584	14.9	13910398	14.8	
5/3/2017	810226	14.9	12072363	14.8	
5/4/2017	599846	17.6	10557291	15.0	
5/5/2017	355191	17.6	6251368	15.1	
5/6/2017	286580	17.6	5043805	15.3	
5/7/2017	185416	17.6	3263328	15.4	
5/8/2017	183025	17.6	3221246	15.5	
5/9/2017	936515	17.6	16482655	15.8	
5/10/2017	1273741	17.6	22417838	16.1	
5/11/2017	3383850	15.6	52788065	16.0	
5/12/2017	1742210	15.6	27178481	15.9	
5/13/2017	1010025	15.6	15756390	15.9	
5/14/2017	650822	15.6	10152823	15.9	
5/15/2017	465452	15.6	7261055	15.9	
5/16/2017	355034	15.6	5538532	15.9	
5/17/2017	305840	13.6	4159431	15.8	
5/18/2017	5269698	13.6	71667886	15.3	
5/19/2017	13215741	7.67	101364731	12.4	
5/20/2017	21223576	7.67	162784828		
5/21/2017	11205957	7.67	85949687		
5/22/2017	8321444	7.67	63825477		
5/23/2017	7329144	9.7	71092699		
5/24/2017	3958496	9.7	38397414		
5/25/2017	2348920	9.7	22784520		
5/26/2017	2457614	9.7	23838856		
5/27/2017	2179928	9.7	21145305	9.8	
5/28/2017	2166422	9.7	21014289	9.8	
5/29/2017	1521960	9.7	14763068	9.8	
5/30/2017	1125345	9.7	10915844	9.7	
5/31/2017	874018	10.1	8827585	9.7	10.8
6/1/2017	797917	10.1	8058959	9.6	
6/2/2017	1016256	10.1	10264185	9.6	

$$\frac{\sum_{day=0}^{day=-29}(\mu g)}{\sum_{day=0}^{day=-29}(liters)} = 30-\text{day average}\left[\frac{\mu g}{liter}\right]$$

Groundwater Quality Data

Routine chemical analysis of groundwater identifies contaminants and their concentrations. These data are compared against RFLMA standards or well-specific concentrations to identify whether reported concentrations in groundwater are indicative of worsening conditions. The required comparisons are presented in the RFLMA decision flowcharts, which are different for each well classification (e.g., for AOC wells vs. Evaluation wells).

Shallow groundwater in some areas of the Site has been impacted by historical operations. Because shallow groundwater discharges to surface water before leaving the Site, protection of surface water quality is the primary objective of groundwater monitoring and treatment. The RFLMA well classifications, their associated decisions, and the monitoring frequencies reflect the distribution of contaminated groundwater, how groundwater moves at the Site, and whether surface water quality is threatened. The well classifications include AOC, Sentinel, Evaluation, and RCRA. Other RFLMA monitoring locations include one surface water location assigned the Surface Water Support classification and locations associated with groundwater treatment systems as discussed above.

AOC wells are located within drainages and downgradient of one or more contaminant plumes. These wells are monitored to determine whether the contaminated groundwater may be discharging to surface water. Because of their importance, reportable conditions are defined for AOC wells. The Surface Water Support location is evaluated similarly to AOC wells.

Typically located upgradient of AOC wells are Sentinel wells, which monitor downgradient edges of plumes and treatment systems, usually along pathways to surface water. Generally farther upgradient are the Evaluation wells, which are mainly located within contaminant plumes and inform consideration of whether monitoring of an area may cease.

The fourth primary well classification is RCRA wells, which focus on groundwater upgradient and downgradient of the PLF and the OLF. In this case, analytical data are reviewed for evidence of worsening conditions related to the closed landfills, including increasing concentrations in the downgradient wells and significantly higher concentrations in the groundwater downgradient vs. upgradient of a landfill.

Depending on the well classification and analyte, concentrations are compared in accordance with one or more of the following criteria:

- Individual analytical results are compared with surface water standards identified in Table 1 of Attachment 2 to the RFLMA
- Statistically derived 85th percentile concentrations are compared with the same surface water standards
- Specific statistical methods are used to determine concentration trends
- Concentrations in downgradient wells are compared against those in upgradient wells

Data Usage

Of the analytical data received from laboratories, 100% will be validated and verified. In addition, analytical results that appear anomalous or are of special interest may receive more

detailed validation on request. The groundwater lead will determine whether this additional validation is warranted and, if so, will work with the analytical data lead to have this done. Data qualified as "rejected" during the validation process (validation qualifier containing an "R") will not be used in data evaluations.

Analytical data for an analyte in which the result is qualified with a "U" (i.e., not detected at the reported detection limit), either by the laboratory or via data validation, will be considered "nondetect."

Groundwater data evaluations typically will be based on water sampling performed since January 1, 2000. This period of record allows sufficient historical data for evaluation of recent groundwater quality trends without the bias introduced by including older data collected when the Rocky Flats Site was far from closure. However, exceptions to this date may be made if necessary and if supported by professional judgment. In particular, when detection limits for a constituent decrease, and subsequent results are identified as "detections" while previous data are nondetects, the required statistical evaluations may be based on the newer population of data with the reduced detection limit after sufficient results are accumulated. As another example, if the treatment media or method at a treatment system is changed, it may not be appropriate to include effluent data from both in any statistical evaluation.

Analytical data for primary ("FIELD SAMPLE" or "F" in the database) samples will be used for evaluating groundwater quality. Samples collected to meet quality assurance (QA)/quality control (QC) requirements (e.g., field duplicates, trip blanks, and equipment blanks) may be used in performing data quality assessments (DQAs) but are not used for groundwater quality evaluation.

Numerous wells were replaced as a result of Rocky Flats Site closure activities. The appropriateness of pooling data from the "original" well with those from the "replacement" well (or wells, if the well has been replaced more than once) will be determined on a case-by-case basis, using professional judgment, and will typically depend on the objective of the data evaluation (e.g., simple time-series plots as opposed to statistical trending). Three examples illustrate why inflexible data-pooling requirements would be inappropriate:

- Some wells were replaced because the original well was inadvertently damaged or had to be removed to accommodate demolition activities. Construction, design, and location of the replacement well may be essentially identical to that of the original well. In these cases, analytical data from the original and replacement wells probably should be pooled.
- In some cases, original wells were installed within a contaminant source area that was subsequently remediated via source removal, thereby removing the original well. A replacement well might then have been installed at the downgradient edge of the excavation boundary after source removal activities were completed. Pooling of analytical data from the original and replacement wells in this case may not be appropriate, at least for purposes such as trend calculations.
- If the geochemical conditions indicated by the analytical data from the replacement well are markedly inconsistent with those from the original well (as may be evident in time-series plots, for example), it may be appropriate to discontinue data pooling. Discontinuous trend plot behavior would be evident in the second example above, but in some instances the reason for the inconsistencies may not be known (e.g., no source removal occurred, but the discontinuity coincides with well replacement).

Table 36 provides a crosswalk of original and replacement well identifications.

Table 36. Crosswalk of Original and Replacement Well Identifications

Original Well	Replacement Well[a]	General Location Description
00200	70705	East side of B707
00297	00203	South side of Solar Evaporation Ponds
1386	51605	North Walnut Creek west of former Pond A-1
1986	52505	West of B771/774 in unnamed drainage
20298	20205	North of B771/774
20598	20505	North of B771/774
20798	20705	North of B771/774
20998	20902	West of B771 in unnamed drainage
21098	21002	West of B771 in unnamed drainage
21398	21305	West of B776 in unnamed drainage
21598	21505	West of B776 in unnamed drainage
21698	21605	West of B559, B776 in unnamed drainage
2187	91305	South Walnut Creek southeast of B991
22298	22205	North of Solar Evaporation Ponds
33603	33604	South of B371/374 near Oil Burn Pit #1 source area
33703	33711	South of B371
33904	33905	Southeast of B371/374
37101	37105	West of B371/374
37401, 37402	37405	North of B371/374
37501	37505	North of B371/374
37701	37705	East of B371/374
39691	39605	West of B881
40099	40005	West of B444
40299	40205	South of B444
40399	40305	East of B444
45605	45608	South of B991
5187	88205	South of B881
55901	55905	North of B559
56301	56305	West of B559
891COLWEL	891WEL	OU 1 Plume source area
90803	90804	903 Pad/Ryan's Pit Plume
91103, 91104	91105	Oil Burn Pit #2 source area
99301	99305	East of B991
99401	99405	East of B991
P207989	79605	East of Solar Evaporation Ponds

Notes:

[a] Only original/replacement wells currently included in the RFLMA monitoring network or used for non-RFLMA operational monitoring are included in this table.

Refer to the 2006 Integrated Monitoring Plan (DOE 2006d) for additional information related to preclosure well replacements.

Comparing Data with Standards

The RFLMA requires that analyte concentrations in groundwater be compared against the greater of the surface water standard or PQL listed in Table 1 of Attachment 2 to the RFLMA or to the

appropriate uranium threshold also defined in that attachment and discussed further below. These standards and PQLs are hereafter referred to collectively as "standards." Analyte concentrations in groundwater may also be compared against concentrations reported at other wells.

Concentrations of a particular analyte in a particular monitoring well or other monitored location are referred to as an "analyte-well" combination. Except in specific instances concerning results from AOC wells and the Surface Water Support location, as provided in the Figure 7 flowchart in RFLMA Attachment 2, concentrations of an analyte-well will not be considered greater than the applicable surface water standard until the 85th percentile of the data for that analyte-well is above the standard. This will prevent a single data point, with its associated uncertainty in sampling and analysis, from causing unnecessary follow-up actions. The 85th percentile of the analyte-well data is estimated by the nonparametric method described by the Colorado Water Quality Control Commission guidance (CWQCC 2004).

Trend Analysis

The RFLMA requires statistical evaluation of groundwater data for certain wells based on well classification. Assessing whether concentrations of monitored constituents are on a statistically significant trend is required of Sentinel, Evaluation, and downgradient RCRA wells. In addition, RCRA wells monitoring the former landfills are to be assessed to determine whether the corresponding landfill may be impacting downgradient water quality. Trends calculated to have a 95% level of statistical significance are considered statistically significant. The following statistical approaches will be used to perform these evaluations:

- Seasonal Kendall trend testing: Sentinel wells and downgradient RCRA wells, as concentrations may reflect seasonal influences
- Mann Kendall trend testing: Evaluation wells, as their monitoring frequency would not be affected by seasonality
- Analysis of Variance (ANOVA) testing: RCRA wells for each landfill to statistically compare downgradient with upgradient groundwater

These statistical evaluations will be performed annually and documented in the corresponding annual report. Results will also be considered according to the RFLMA protocols presented in RFLMA Attachment 2, Figures 8, 9, and 10. (RFLMA Attachment 2 Figures 7 and 11 also apply to groundwater data, but similar statistical evaluation is not required for the monitoring locations to which those figures apply.)

Groundwater quality data are compiled into a database and evaluated for statistical trending using a commercially available statistical program. Currently, the Sanitas software program is used.

Where statistical trending is performed using data that represent more than one season (i.e., representing semiannual or quarterly sampling, as in the case of Sentinel and RCRA wells, respectively), the Seasonal Kendall (S-K) statistical method is used. This is consistent with preclosure evaluation of groundwater data as reported in *Statistical Methods for Trending Groundwater Quality Data, Rocky Flats Environmental Technology Site* (K-H 2004). When only one season is represented, as in the case of Evaluation wells, which are sampled biennially or once every other year, the Mann Kendall (M-K) approach is used.

The following will guide statistical evaluation of groundwater data:

1. Statistical evaluation of data will not be performed until a minimum of eight regularly scheduled concentration measurements are achieved (i.e., eight successful sampling events from the RFLMA-required semiannual or other applicable schedule) for an analyte-well. Statistical results based on fewer routinely collected data will not influence compliance decisions.

   - Trend analysis requires a minimum of four data points per sampled season.
   - If the analyte-well data include results from a predecessor well and a replacement well, and analytical data or other information suggest the data from the two wells should not be pooled, the statistical calculations should be postponed until a sufficient dataset is available for the replacement well. Data from the predecessor well should be excluded from the calculations in such cases.

2. Potential data outliers are retained in the working dataset.

3. Nondetect concentrations represent a complication when performing statistical evaluations. The convention has been to replace the reported value of a nondetect with a near-zero value, 0.001, so that nondetects are lower than detects at the reporting limit. (Replacement by zeros may lead to mathematical error because of division by zeros.)

   It is not necessary to test for trend if the concentrations for an analyte-well are consistently nondetect.

   If nondetects are associated with a historically higher detection limit (e.g., before 2008 the detection limits for several metals were higher than from 2008 on), perform the statistical evaluation as described above and consider performing an additional statistical evaluation of the data reported since the detection limit changed. The following approach may be considered for datasets with a mix of detections and nondetects under relatively uniform detection limits:

   (a) Retain analytes represented by more than 40% detects at a location, and remove the remaining analytes and perform the statistical tests, utilizing the nondetects at face value (i.e., not replaced by 0.001 or half the detection limit). The 40% threshold is more conservative than a simple majority. Also, for wells that are sampled semiannually or more frequently, this yields at least eight results. If there are at least four detections per season, this allows S-K trending calculations.

   (b) If fewer than 40% detects, additional statistical evaluation may be omitted.

   The optimal approach to how nondetects should be treated when performing statistical evaluations is not known, and alternatives continue to be considered.

4. Statistical tests (S-K or M-K trend testing and ANOVA comparisons) will be applied at the 95% level of confidence.

Further considerations on trend testing of Rocky Flats Site groundwater data are in *Statistical Methods for Trending Groundwater Quality Data, Rocky Flats Environmental Technology Site* (K-H 2004).

6.1.10.3 Source Evaluations

Special groundwater investigations may be required in response to indications of increased contaminant concentrations that may have the potential to impact surface water. These projects are referred to as "groundwater source evaluations" and are typically of limited duration and focused scope. Their primary purpose is to investigate observed conditions, identify possible causes, and estimate the potential impact on surface water. In areas where an impact to surface water has been previously recognized and evaluated, a significant increasing trend adjacent to surface water may require the performance of another evaluation.

When reportable condition water quality measurements are detected by surface water monitoring at POEs or POCs, additional monitoring may be required to identify[14] the source and evaluate a mitigating action. Designing and implementing a source evaluation in response to a RFLMA reportable condition would take place as part of a consultation with the regulatory agencies. Analyte suites for source evaluation are determined based on the contaminant of current concern that has initiated the source evaluation activities or related indicators. The information types are entirely dependent on the results of other monitoring objectives under which the source was detected. The analyte suites are limited to parameters that will aid in the identification and evaluation of a contaminant source. Source evaluation activities may be implemented anywhere within the site surface water drainage area where a contaminant source is suggested. The distribution of monitoring points is dictated by the details of the specific source evaluation to determine source location and efficiently use resources. For example, if POE monitoring suggests a previously unidentified source within the COU, then monitoring may be implemented within the COU to locate the source. Source evaluation monitoring should begin as soon as practical after source detection and continue until the source is identified and evaluated or is no longer detected. The source evaluation scope will be periodically reevaluated based on the status of the source evaluation, taking into account, but not limited to, sample results, weather conditions, water availability, and process knowledge. CDPHE may make requests that affect the monitoring that is performed or its duration.

In general, a source evaluation will begin by generating focused objectives through the RFLMA consultative process that apply to the concern being investigated. These objectives are qualitative and quantitative statements that specify the type, quality, and quantity of the data required to support the decision-making process. Objectives are established to ensure a source evaluation has been logically defined and planned and that the scope and data collection will support the eventual decisions required. QC objectives are established to ensure data generated by a source evaluation will be gathered or developed using procedures appropriate for the intended use of the data. The objective development process is generally derived from EPA guidance documents (e.g., EPA 1994) but has been used primarily as a decision support tool, as opposed to a sample optimization tool.

Objectives developed for a given source evaluation will consider factors such as relative impact, priority, and risk to the public. This approach will identify areas with the highest potential for surface water contamination. Each source evaluation will be implemented under a project-specific contact record or written correspondence, Sampling and Analysis Plan, work plan, or other document, which will identify the specific investigation objectives, data collection methods and locations, and follow-up actions that apply to the existing circumstances. If a

[14] Note that the term "identify" is used here to mean "locate." Characterization is also implied.

significant impact to surface water is identified, the findings will be provided to CDPHE, and further action will be discussed. Where modeling results form part of the basis of decisions, these predictive components of the evaluation will be weighed against actual field data in setting the priority for action. Monitoring to be performed following the selected action will also be determined in consultation with CDPHE.

In most cases, a preliminary data review will be performed immediately upon recognition of a potential concern. Sources of data and other information may include the analytical database, recent quarterly and annual reports, the Historical Release Report (HRR) (first published in 1992 [DOE 1992] and updated annually through fiscal year 2005 [DOE 2006c]), the Groundwater IM/IRA, the RI/FS, individual Closeout Reports for buildings or Individual Hazardous Substance Sites (IHSSs) of interest, and other applicable sources of information. The results of this review may be sufficiently clear to indicate a cause of the given concern without the need for additional sampling and analysis. In such cases, CDPHE will be notified, and discussions will be held on the conclusions reached through the reviews.

In other cases, more intrusive activities may be required, such as well installations, excavation, and so forth. These intrusive activities must be evaluated in accordance with RFLMA requirements before implementation. In cases where surface water quality is threatened, these activities will be selected and discussed in coordination with CDPHE.

An evaluation of surface water impact may include, but not be limited to, the following possible components:

- Review of historical data from the well(s) indicating a potential surface water impact and other wells nearby (including abandoned wells if appropriate)
- Review of historical data from the surface water location indicating a surface water impact and other locations nearby (including discontinued locations if appropriate)
- Review of the HRR (first published in 1992 [DOE 1992] and update annually through fiscal year 2005 [DOE 2006c]) to identify possible sources of the contamination observed
- Inspection of the area surrounding and upgradient of the well or surface water location to investigate physical changes that could be factors in the reported data
- Contaminant fate and transport modeling
- Definition of the extent of contaminants or the contaminant pathway through additional sampling of soil, sediment, groundwater, surface water, or seeps and through additional well, borehole, or surface water monitoring station installations
- Measurement or estimation of contaminated groundwater flow velocity, flow direction, and discharge to surface water
- Measurement of surface water flow rate in the area of the impact
- Measurement of the area of surface water directly impacted by the contaminated groundwater
- Determination of the nature and extent of ecological impact from contaminated groundwater discharging to a surface water receptor

- Determination of concentration loadings and mass flux of contaminants to the surface water receptor
- Estimation of impacts due to seasonal variations, discharges, or removal of groundwater collection systems

6.1.10.4 Exit Strategy for Water Monitoring

Water monitoring at the Site will not be required forever because contaminant concentrations will decrease through natural attenuation mechanisms. Therefore, rules have been established to logically guide termination of water monitoring. The logical process by which this monitoring is terminated is referred to as the "exit strategy." Note that a "contaminant" is distinguished from any naturally present constituent. Concentrations of constituents that are naturally elevated, such as uranium in groundwater at many areas of the Site, are not indicative of Site-related contamination and should not form the basis for continuing water monitoring or similar decisions. Also, elevated concentrations of constituents that are both present and naturally elevated would not be expected to decrease in concentration over the same length of time as Site-related contamination.

Concentrations below which monitoring for the various water contaminants is no longer needed will vary based on analyte, media (i.e., groundwater versus surface water), and monitoring classification. For example, wells at a groundwater discharge area will be held to stricter requirements than wells within a pediment-top contaminant source area because of the importance of protecting surface water quality at the discharge area. Similarly, exit criteria for surface water locations and groundwater treatment systems vary from those for monitoring wells.

Ceasing to monitor water may take place area-by-area rather than for the Site as a whole and may also occur by analyte suite (e.g., discontinuing monitoring a given well or group of wells for uranium but continuing to monitor for VOCs). As concentrations of contaminants in groundwater in a given area decrease to the point that they meet exit criteria, groundwater monitoring will no longer be required in that area. Similarly, as groundwater in an area ceases to be a threat to surface water quality and is no longer monitored, corresponding surface water monitoring reductions are appropriate.

Specific exit criteria are presented in the flowcharts in Attachment 2 to the RFLMA. The consultative process will be used to ensure that the RFLMA parties are included in the decision to stop monitoring. The decision to exit monitoring will be documented in a RFLMA contact record or written correspondence and incorporated into Attachment 2 to the RFLMA during the next revision.

6.2 Ecological Monitoring

This section describes the technical and regulatory basis for the approach to ecological monitoring at the Site. The Ecological Monitoring Program (hereafter referred to as the Ecology Program) at Rocky Flats has historically focused on the characterization of ecological components in the former BZ (roughly equivalent to the current POU), natural resource conservation and management, and compliance with laws and regulations (e.g., the ESA, the Migratory Bird Treaty Act [MBTA], wetlands regulations, and weed control acts).

Ecological monitoring has been conducted continuously at Rocky Flats (both COU and POU areas) since the early 1990s, with occasional earlier studies. Rocky Flats has been well characterized in terms of both the flora and fauna. Summaries of these data are available in the various ecology reports that have been produced over the years.

Management of natural resources has been conducted since Rocky Flats became DOE property in the early 1950s. However, until the 1990s, natural resource management was mostly conducted on an occasional basis as different issues arose. With the advent of the Ecology Program at the Site in the early 1990s, management of the natural resources (weed control and revegetation) has been more proactive. Compliance with environmental regulations has been performed by various groups depending on the media under consideration. The Ecology Program in recent years has been largely responsible for ensuring compliance with the ESA and MBTA and focusing on wetland and noxious weed issues.

Ecological conservation and management goals include the protection of currently viable ecosystems, unique and ecologically valuable natural resources, and special-concern species, as well as compliance with wildlife and natural resource protection regulations. Early detection and management of undesirable impacts to the Site's ecological resources before they become problematic is extremely important. The Ecology Program focuses on the collection of data necessary to ensure regulatory compliance and assess the effectiveness of DOE's natural resource conservation and habitat management efforts. These efforts are intended to comply with DOE's demonstrated desire to practice natural resource conservation (DOE 1994) and ecosystem management (Congressional Research Service 1994) on its properties.

The role of the Ecology Program at the site is to:

- Ensure compliance with ecological environmental regulations (federal, state, and local).
- Collect ecological monitoring data, analyze data, interpret data, and prepare technical reports and other documents according to specific project/regulatory requirements.
- Manage the ecological resources for long-term sustainability.
- Maintain ecological datasets for the Site.
- Maintain historical ecology information for the Site.

Currently, ecological monitoring is conducted at the Site to:

- Ensure regulatory compliance (e.g., Preble's mouse mitigation reporting requirements and wetland mitigation reporting requirements).
- Provide useful information for the management of revegetated areas, and demonstrate when success criteria have been met.
- Provide information necessary to assist with the control of noxious weeds and compliance with state noxious weed control reporting requirements, if needed.
- Provide information necessary for the wise management and conservation of native flora and fauna.

6.2.1 Regulatory Issues

The information presented below outlines the regulatory issues associated with the Site's Ecology Program.

6.2.1.1 ESA Issues–Preble's Mouse Mitigation Monitoring and Management

The Ecology Program oversees and addresses the various activities that occur under the federal ESA at the Site. Currently, the species of concern at the Site is the Preble's mouse, which resides in the drainages at the Site. Although other listed species may occur nearby, they do not occur at the Site. The Preble's mouse is a federally listed, threatened species under the ESA of 1973, as amended. As a result, activities or projects that occur in Preble's mouse habitat (defined in the PBA, Parts I and II) must be consulted on as part of the Section 7 consultation requirements of the ESA. During Rocky Flats Site closure, the PBA was written to address potential impacts to the Preble's mouse and other federally listed species resulting from cleanup and closure activities. Many LM activities are also addressed in the PBA. A programmatic biological opinion (PBO) (DOE 2004e) was received from USFWS approving the PBA and outlining the implementation requirements. Additional biological assessments (BAs) were written separately prior to or after the PBA documents to address other projects not included in the PBA. New activities or projects not included in the PBA must be consulted on prior to project initiation.

As part of the consultation process, after submitting a BA, the USFWS issues a biological opinion (BO), which allows the project to proceed. The project must abide by the conservation measures, activity-specific measures, reasonable and prudent measures, and terms and conditions listed in the BO. In some cases, the BO specifies mitigation measures that must be taken by DOE to offset the impacts to Preble's mouse habitat. In these cases, mitigation monitoring and reporting requirements typically must be fulfilled annually. Until concurrence is received from USFWS that mitigation efforts are successful, the monitoring and reporting requirements continue indefinitely. The Site must request concurrence from USFWS when successful mitigation has been achieved.

After concurrence is received, the mitigation monitoring is removed from the annual monitoring list of activities. The Preble's Meadow Jumping Mouse Mitigation Tracking Spreadsheet for PBA Part II Activities is the debit/credit ledger for tracking disturbances (debits) to Preble's mouse habitat and mitigation efforts (credits) for restoring or enhancing habitat. It also contains information on how the calculations for disturbances have been made. The tracking spreadsheet is in the annual Preble's mouse reports submitted to USFWS by December 1 of each year (Section 9.1). Past annual reports submitted to USFWS provide an overview of the type of information contained in each report. Specific monitoring, management, and reporting requirements are outlined for each project in the appropriate BA or BO.

On December 15, 2010, USFWS finalized a ruling that designated critical habitat for the Preble's mouse at the Site (*Federal Register* Vol. 75, No. 240, p 78430). Figure 6 shows the locations of Preble's mouse protection areas and critical habitat at Rocky Flats. Both areas protect the Preble's mouse at Rocky Flats and must be considered when evaluating potential project impacts.

6.2.1.2 Wetland Mitigation Monitoring and Management

Wetlands and waters of the United States are protected by the Clean Water Act and other regulations. Rocky Flats projects that have the potential to impact wetlands require evaluation first to ensure the appropriate approvals and permits are obtained prior to work. Some projects may be covered under a Nationwide Permit (NWP). If an NWP is not available or if the project is too large for an NWP, then an individual Section 404 Permit may be required. Depending on the project, the permit may also list monitoring/mitigation requirements or other requirements that must be followed.

In 1994, the U.S. Army Corps of Engineers (USACE) delineated wetlands at Rocky Flats and produced a wetlands map and associated document that was used during and after Site cleanup and closure. As a result of Site closure, significant reductions in the volume of water in the creeks and ponds occurred, and reconfiguration of the drainages in the former Industrial Area resulted in new wetland conditions at several locations at the Site. Therefore, the 1994 wetland map is no longer accurate at many locations. In 2015–2016, wetlands were delineated within the COU to produce a more up-to-date wetland map. The new map is designed to help project leads identify the potential for wetlands in their project areas. Specific project area wetland delineations are necessary for actual wetlands within a project area.

During Site closure, CERCLA wetland impacts were evaluated by EPA and non-CERCLA impacts were overseen by USACE. Impacts from both CERCLA and non-CERCLA closure activities have been mitigated and closed out (see the *2014 Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Site* [DOE 2015]). Currently, CERCLA activities that have the potential to impact wetlands are dealt with by following the substantive requirements of the regulations without going for permits, and potential non-CERCLA impacts are addressed with USACE. Wetland impacts from projects and mitigation credit are discussed and tracked in the annual environmental monitoring report for the Rocky Flats Site mentioned above.

6.2.1.3 Migratory Bird Treaty Act

The Ecology Program oversees and addresses MBTA issues at the Site. The MBTA protects listed migratory birds and their parts, including eggs, nests, and feathers. Therefore, projects at the Site need to be assessed to determine whether potential "take" may occur. The MBTA defines take as "any attempt at hunting, pursuing, wounding, killing, possessing or transporting any migratory bird, nest, egg, or part thereof." Because the removal of most of the buildings at the Site eliminated much of the nesting habitat for urban birds, MBTA issues associated with structures have become less of a concern. However, nesting birds still occur across the Site in various habitats ranging from the grasslands to the shrublands and woodlands, and a migratory bird clearance nest survey must be made to determine whether impacts or take may occur. Various actions may be required to deter birds from nesting in and around project areas. These may include mowing grasslands to remove potential nesting habitat prior to project activities, hanging shiny reflective or moving objects in trees or shrubs, or placing coyote cutouts in the project area. If project impacts are unavoidable, the USFWS migratory bird permit office is contacted after consulting with DOE for further information and direction. In some cases, a permit may be required prior to proceeding with the project. In other cases, modification of the

project is required. Specific monitoring conducted pursuant to the MBTA is addressed on a case-by-case basis.

6.2.1.4 Colorado Noxious Weed Act

In general, the Colorado Noxious Weed Act (CNWA) designates state noxious weeds, classifies these weeds into categories, and develops and implements management plans for control of noxious weeds in Colorado. The Ecology Program oversees and addresses CNWA issues at the Site. Depending on the species of noxious weeds found at the Site, potentially different control activities must or may be conducted in addition to monitoring and reporting requirements. In recent years, the CNWA has been updated annually to incorporate changes in the noxious weed list as well as new state species-specific management plans. Updates to the CNWA are posted on the Colorado Department of Agriculture website. The latest version should be evaluated prior to the field season to determine what, if any, monitoring, control efforts, and reporting requirements may be required.

On October 31, 2011, EPA finalized the National Pollutant Discharge Elimination System (NPDES) Pesticide General Permit (PGP) for point discharges from the application of pesticides or herbicides to waters of the United States. Under this rule, weed control activities that are in or near water may require submission of a Notice of Intent and incur additional planning, monitoring, and reporting requirements. This rule must be considered for herbicide applications at the Site.

Herbicide applications conducted within Preble's mouse habitat must be applied following the guidelines provided within the PBA and associated additional consultations that were conducted specifically for weed control activities. The *Rocky Flats Site, Colorado, Vegetation Management Plan* (DOE 2018c) lists these documents and summarizes the requirements.

As changes are made to environmental rules or regulations that apply to the ecological resources at the Site, the scope of the Ecology Program may be modified to address these changes.

6.2.1.5 Notifications/Consultations

Depending on project locations and planned activities, notifications may be required for ESA, wetland, MBTA, and weed control issues. Planned projects should be evaluated for these issues during the early planning stages and prior to scheduling activities to prevent project delays should consultation and permits be required prior to conducting the project. For some projects, notifications prior to project initiation are required under existing agreements or permits. For other projects, new consultation will be required because they have not been previously addressed with the regulatory agencies. Depending on the type of consultation required, these can take up to several months to get in place.

6.2.2 Natural Resource Management

The Ecology Program also oversees and directs the natural resource management activities at the Site. The natural resource management goal at the Site is to exercise good stewardship for the preservation and long-term sustainability of the natural resources while complying with applicable federal, state, and local regulations. Prior to completion of the RFP/RFETS Closure

Project, the total area that DOE managed was approximately 6400 acres. After the transfer of land to USFWS for the Rocky Flats National Wildlife Refuge, the DOE-retained lands comprise approximately 1526 acres (COU and active mining lands). The COU is approximately 1308 acres. General goals for different community types, species of particular interest, and regulatory compliance issues are presented in Table 37.

6.2.2.1 Vegetation Management

Vegetation management activities have been conducted for many years at the Site. These activities have included revegetation of disturbed areas; integrated weed management, including use of administrative, cultural, mechanical, biological, and chemical controls; prescribed burns; and mowing. These activities, as well as grazing, may be options for future vegetation management at the Site. Two plans are currently available that provide basic vegetation management guidance at the Site: the *Rocky Flats Site, Colorado, Revegetation Plan* (DOE 2018b) and the *Rocky Flats Site, Colorado, Vegetation Management Plan* (DOE 2018c).

The Revegetation Plan provides basic guidance for revegetation activities at the Site and includes specific seed mixes for different plant communities. It is not a regulatory document and is occasionally updated to reflect changes to improve revegetation techniques and methods. It also includes criteria for evaluating revegetation success.

Table 37. Rocky Flats Site Conservation and Management Goals

Community	Goal
Grasslands	Maintain the quantity and quality of the vegetation community, and maintain the populations of bird and mammal species characteristic of the grasslands
Wetlands	Maintain the quantity and quality of the vegetation community, and maintain the populations of bird and mammal species characteristic of the wetlands
Great Plains Riparian Woodland Complex	Maintain the quantity and quality of the vegetation community, populations of bird and mammal species characteristic of the riparian woodland complex, and the abundance and extent of Preble's mice within the habitat
Mitigation Wetlands	Manage the mitigation wetlands for reestablishment of native plant and wildlife species
Revegetation Areas	Manage the revegetation areas for reestablishment of native plant and wildlife species
Aquatic Community	Maintain the quality of aquatic communities at the Site, including macroinvertebrate and vertebrate species characteristic of the community
Species of Particular Interest	**Goal**
Preble's Mouse Populations	Maintain the quantity and quality of Preble's mouse habitat, and protect existing populations of the Preble's mouse
Regulatory Compliance	**Goal**
Threatened and Endangered Species and Species of Special Concern	Protect threatened and endangered species and species of special concern at the Site, and comply with applicable state and federal threatened and endangered species protection regulations and policies
Threatened and Endangered Species Habitat Mitigation	Reestablish Preble's mouse habitat at project disturbances per requirements of USFWS regulatory documents
Migratory Birds	Protect migratory birds at the Site, and comply with applicable state and federal migratory bird protection requirements
Wetlands	Protect Site wetlands, and comply with applicable state and federal wetland protection requirements
Wetland Mitigation	Reestablish wetlands (where required) at project disturbances or using the Standley Lake Wetland Mitigation Bank per requirements of EPA and USACE regulatory documents
Noxious Weeds	Protect the plant communities from invasion by noxious weeds, and comply with the CNWA and other applicable noxious weed regulatory regulations and policies

The Vegetation Management Plan provides guidance for an integrated weed management approach to noxious weed control at the Site. It includes discussions of the use of administrative, cultural, mechanical, biological, and chemical noxious weed controls. It also notes the potential use of prescribed burns and grazing for vegetation management; the introduction of either of these actions would require development of more specific plans before either could be conducted. The Vegetation Management Plan is not a regulatory document but is occasionally updated to reflect changes to improve weed control techniques and methods at the Site. As mentioned above, the NPDES PGP requirements must be considered and adhered to for herbicide applications in or near waters of the United States. The Vegetation Management Plan also lists the consultation documents that must be followed for herbicide applications within Preble's mouse habitat.

6.2.2.2 Wildfires and Controlled Burns

To maintain healthy, robust communities of native vegetation at the Site, it may be desirable to conduct controlled burns. Despite its obvious and well-documented success, the use of this once-natural process has been controversial at the Site due to stakeholder and community concerns about potential mobilization of contamination via the resulting smoke and ash from the fire and the potential for increased soil erosion due to fire's impacts on vegetation. An alternative preferred by some is grazing, despite the fact that this method has a much higher potential for soil disruption and resulting erosion than is the case with fire. At this point, controlled burns and DOE-managed grazing are not planned. If controlled burns are needed in the future, planning will include discussions with the appropriate external parties, which include the RFLMA parties, USFWS, and fire response authorities. The Rocky Flats Stewardship Council will be informed of the burn during the planning phase. Although the Stewardship Council does not have approval authority, LM may choose to accept comments and modify plans accordingly. Applicable permits to conduct a controlled burn would be obtained prior to the controlled burn, and the permit conditions would be followed.

Studies performed in the 1990s and early 2000s, including data collection from actual controlled burns, wildfires, and modeling, have shown no significant increase in radiological risk to downwind residents associated with smoke from these fires. As a worst-case scenario, one modeling effort considered the hypothetical effects on a firefighter with no respiratory protection who is standing directly in the smoke plume immediately downwind of the former 903 Pad (K-H 2000). Unless activities in the soil were significantly greater than closure cleanup levels for plutonium, americium, or uranium, this firefighter would receive a dose of less than 1 millirem (mrem) from the fire. Therefore, due to dispersion of the smoke plume, the dose to downwind residents from the smoke would be many orders of magnitude lower. The average annual per-person dose across the United States from all sources is 620 mrem.

Increased erosion from a burned area may be a concern if not properly addressed. Erosion can be minimized via the application of appropriate controls, such as erosion mats, wood straw, or sprayed FlexTerra. Application of wattles, straw bales, silt fences, and so forth can also be effective. The specific control(s) will be selected based on the topography and ease of application, season, and other factors and will be properly maintained until adequate vegetation has been reestablished. Section 4.4 provides a discussion of erosion control and revegetation.

6.2.2.3 Wildlife Management

Wildlife monitoring has been conducted in the past to inventory the fauna, to provide an indication of the abundance of the various wildlife species that occur at the Site, and to answer specific wildlife questions. Past studies have included small mammal trapping, Preble's mouse surveys, relative abundance surveys, breeding bird surveys, aquatic surveys (i.e., fish surveys), nest box surveys, prairie dog surveys, raptor surveys, herpetological surveys, aquatic and terrestrial arthropod surveys, and annual deer counts. Depending on the type of monitoring conducted, special collection permits from the regulatory agencies are sometimes required prior to monitoring.

Potential future wildlife monitoring issues may be related to chronic wasting disease, elk management, prairie dog relocations, nest box use, or other unforeseen activities. Coordination with the Colorado Division of Wildlife and/or USFWS may be required for some of these activities.

6.2.3 Ecological Monitoring Planning Process

Ecological monitoring at the Site consists of monitoring conducted for regulatory compliance as well as BMP monitoring. Regulatory compliance monitoring consists of the monitoring required by regulatory agreements, primarily Preble's mouse and wetland mitigation monitoring. Additional monitoring for MBTA compliance issues may also be required depending on specific project needs. Monitoring of BMPs is conducted to provide information for wise management of the natural resources at the Site. Examples of this type of monitoring include identifying weed infestation locations, evaluating weed control efforts, identifying locations of active prairie dog towns in relation to the landfills or other buried infrastructure, and assessing revegetation success and the need for additional management actions. The latter type of monitoring varies from year to year depending on the information needed.

The decision to conduct a specific type of ecological monitoring should be based on a need for information and not just for the sake of monitoring. Regulatory requirements have specific information "needs" (in addition to natural resource management) where monitoring information can help improve techniques and methodologies and determine whether objectives are being met. Issues that should be considered for both types of monitoring when developing the annual ecological monitoring schedule are provided below. The lists are a starting point for consideration. Other aspects may be added, and over time some of the regulatory drivers will no longer apply as agency concurrence for mitigation projects is received and monitoring is no longer a requirement. BMP monitoring may also vary from year to year based on changing conditions at the Site and resource management needs.

6.2.3.1 Regulatory Monitoring Issues

Questions to be addressed when developing monitoring to meet Site regulatory requirements include the following:

- What regulatory agreements or documents does DOE have currently that require ecological monitoring?
- Do other regulations apply that require ecological monitoring?
- What specific types of ecological monitoring are required in these agreements or documents?
- Are specific monitoring methodologies required? What are they?
- Is monitoring required to be conducted during specific time frames? If so, when?
- What are the reporting requirements? When are required reports due?

The typical types of ecological regulatory issues and their regulating agencies are presented in Table 38.

Table 38. Rocky Flats Site Regulatory Issues to Consider

Issue	Agency	Comments
ESA	USFWS	Preble's mouse mitigation monitoring
Wetlands	EPA and/or USACE	Wetland mitigation monitoring
MBTA	USFWS	Nesting birds, nest surveys, etc.
Nationwide permits	USACE	Certificates of Completion, project-specific mitigation monitoring and reporting
CNWA	State of Colorado	Noxious weed issues
NPDES PGP	EPA	Herbicide applications in or near waters of the U.S.
Wildlife	Colorado Division of Wildlife and/or USFWS	Prairie dog issues, wildlife management issues

6.2.3.2 BMP Monitoring Factors

Vegetation Monitoring Factors—Things to Consider

- Revegetation: Establishment, success or failure, and management actions (impacts, effectiveness, etc.)
- Weed control: Effectiveness on target species, impacts to nontarget species, targeting control efforts, evaluating specific species, and surveys for new noxious weed species
- Prescribed burn/wildfire: Effects, success or failure, and management actions
- Grazing: Effects, success or failure, and management actions
- Mapping: Vegetation, wetland, weed, and Preble's mouse habitat
- Photopoint monitoring
- Native plant community management: Weed control, prescribed fire, grazing, drought, and interseeding
- Additional issues that may arise or have informational needs

Wildlife Monitoring Factors—Things to Consider

- Preble's mouse issues: See regulatory issues
- Prairie dog issues/impacts: Locations of prairie dog towns in relation to landfills and other buried infrastructure (i.e., mapping), other remedy locations, and population counts
- Deer/elk populations: Herd size, carrying capacity, habitat impacts, and chronic wasting disease
- Raptors: Nesting sites and abundance (see MBTA regulatory issues)
- Waterfowl, songbirds: Abundance and nesting areas (see MBTA regulatory issues), nest box use
- Amphibian/reptile: Abundance and habitat areas
- Mosquito control issues

- Aquatic vertebrate (fish) and invertebrate (macro- and microinvertebrates) issues: Species richness, abundance, additional measures
- Additional issues that may arise or have informational needs

6.3 Air Quality Monitoring

In the past, the air monitoring program at the RFP/RFETS has included ambient (Radioactive Ambient Air Monitoring Program), effluent, and meteorological monitoring activities. Based on decades of air monitoring (onsite and offsite) showing concentrations well below exposure limits, extensive studies such as the Actinide Migration Evaluation[15] that specifically evaluated the air transport pathway, and culminating with the CERCLA Remedial Investigation/Feasibility Study (RI/FS) Report (DOE 2006a), long-term air monitoring is unnecessary. As of September 2005, only ambient air monitoring was voluntarily performed at one upgradient location near Highway 93 and two locations along Indiana Street, to confirm low emissions. Additional information can be found in the 2005–2008 Annual Reports. LM ceased ambient air monitoring in September 2008.

6.4 Data Management

The LMS contractor is responsible for managing and maintaining the electronic monitoring data and geospatial data in compliance with LM requirements. Environmental monitoring data are produced mainly from sampling and automated monitoring systems.

Data will be accessible over the Internet at https://www.lm.doe.gov/rocky_flats/Sites.aspx through the Geospatial Environmental Mapping system (GEMS). Spatial data in GEMS include physical features and roads, nonphysical features such as the Site boundary and access control boundaries, and imagery such as orthorectified aerial photography and satellite imagery.

[15] The AME Pathway Analysis Summary Report can be found at:
https://www.lm.doe.gov/cercla/documents/rockyflats_docs/SW/SW-A-004544.PDF
The AME Pathway Analysis Report Technical Appendix can be found at:
https://www.lm.doe.gov/cercla/documents/rockyflats_docs/SW/SW-A-004547.pdf

7.0 Information Management

7.1 Rocky Flats Site Records

Records, hard copy and electronic, generated by the Rocky Flats Site are subject to the retention periods established by the National Archives and Records Administration (NARA) General Records Schedules and/or NARA-approved DOE Administrative and Program records retention schedules. Records determined to have permanent value are transferred to NARA in accordance with those same schedules.

The Rocky Flats records program is administered in accordance with the following directives:

- 36 CFR Parts 1220–1238, NARA
- 44 *United States Code* (USC), Chapters 29, 31, and 33

7.2 AR and Post-Decision Record

7.2.1 Administrative Record

An AR is a collection of documents that establishes the basis for the selection and performance of environmental removal and remedial actions at a CERCLA site. An AR File may contain correspondence, results of the RI/FS, the Record of Decision (ROD), and public comments. An AR File may also consist of a public portion that includes documents available to the public and stakeholders and a confidential portion that includes documents that may be restricted from release due to the sensitive information they contain.


Note

If new information is received after a ROD is approved that could affect the implementation of the remedy or indicate that reassessment of the remedy is necessary, the lead agency must respond to this information and place comments in the AR. This is necessary if comments contain significant information, the new information is not contained elsewhere in the AR, it was not possible to submit the information during the public comment period, or the new information supports the need to significantly alter the remedial action. The type of documentation required for a post-ROD change depends on the extent of the change. A minor change requires a memo or note. A significant change requires an explanation of major differences. A fundamental change requires a ROD amendment.

The Rocky Flats AR has been formally closed. An addition to the AR must be approved by the LM Site manager.

7.2.2 Post-Decision Record

The Rocky Flats Post-Decision Record consists of records required by the CAD/ROD or the RFLMA after approval of the CAD/ROD, particularly surveillance and monitoring documentation that supports the long-term activity requirements of the CAD/ROD. The Post Decision-Record is maintained in conjunction with the AR, but post-decision records are flagged

with the “PD” identifier to distinguish them from the AR documents. Post-decision documents include, but are not limited to:

- Periodic reports about site surveillance and maintenance activities.
- Contact records or written correspondence.
- Communications with the regulatory agencies including emails and correspondence.
- Meeting minutes from public meetings.
- Newspaper advertisements.
- RFLMA compliance documents.

The Post-Decision Record is available to the public in the same formats and accessibility requirements as the AR.

Access to publicly available Rocky Flats records (AR and post-decision documents) is via the LM website at https://www.lm.doe.gov/Rocky_Flats/Documents.aspx.

8.0 Regulatory Compliance

Some activities at the Site may require regulatory compliance activities, notification, or reporting in addition to that required by the RFLMA. In accordance with the CAD/ROD, the selected remedy for the COU must achieve compliance with ARARs (EPA et al. 2011, Table 21). Activities that are required to implement the remedy and conducted in the COU are not subject to administrative requirements such as requirements related to the approval of or consultation with administrative bodies, documentation, permit, issuances, reporting, recordkeeping, and enforcement otherwise required by an environmental law. However, the activities must comply with the substantive requirements that would be incorporated into a permit, generally as stated in the implementing regulations or general or NWPs provided for by rule. Activities that are not required as a component of the remedy or work that is not related to the maintenance of a remedy component are potentially subject to various environmental laws and implementing regulations, including administrative requirements to obtain a permit.

This section presents an overview of the regulatory requirements that may be applicable to long-term maintenance and routine monitoring at the Site. The purpose of this section is to provide guidance to (1) maintain continuity of past, current, and future compliance activities associated with Site activities; (2) manage long-term maintenance activities in compliance with applicable permits, state and federal regulations, and local requirements; and (3) compliantly manage and minimize wastes derived from maintenance activities for the protection of human health and the environment. The LMS and Site-specific work planning processes require consideration of environmental laws that might apply to work either as ARARs or as applicable administrative and substantive requirements.

Federal regulations applicable to Site maintenance activities may include requirements promulgated under RCRA, Clean Water Act, the Clean Air Act, the National Environmental Policy Act (NEPA), the Pollution Prevention Act (PPA), and the Emergency Planning and Community Right-to-Know Act (EPCRA), as well as U.S. Department of Transportation (DOT) regulations, EPA guidance documents, and DOE orders.

8.1 RCRA

RCRA and the Colorado Hazardous Waste Act (CHWA) regulate the management of hazardous wastes in Colorado. The CAD/ROD identifies hazardous waste management requirements as ARARs for hazardous wastes that are generated during implementation of the remedy. Evaluation of wastes generated by Site activities is required as part of the LMS work planning process to determine whether such wastes are hazardous wastes, and to provide for the appropriate management under CHWA requirements.

RCRA Section 3016 is a biennial reporting requirement for federal agencies that are required to provide an inventory of facilities they currently own or operate or have previously owned or operated at which hazardous waste is stored, treated, or disposed or was disposed. This report is due in January of even-numbered years, and was submitted to CDPHE in January 2018. In 2018, CDPHE agreed that if there have been no changes to the form in the last two years, then a 3016 Report is not required to be submitted. If there is a change, then a RCRA 3016 Report would have to be submitted to CDPHE in the next even-numbered year.

To ensure that a hazardous waste generator identification number for LM work and a permit for treatment, storage, or disposal is not required, the type and quantity of chemicals and other materials that may become solid wastes are controlled through internal site procedures for chemical management. The volume of chemicals allowed under the chemical management procedure is strictly limited so that the amount of hazardous chemical waste generated, including waste that could be generated in a spill response, qualifies as conditionally exempt small quantity generator (CESQG) hazardous waste under the Colorado Hazardous Waste Regulations. Hazardous wastes will be accumulated and managed for disposal so that the CESQG status is maintained. Section 8.12 provides additional information on waste handling and disposition.

8.2 Clean Water Act

8.2.1 National Pollutant Discharge Elimination System

NPDES regulations at 40 CFR 122.26 and 40 CFR 122.28 are identified as ARARs in the CAD/ROD. The Rocky Flats Site does not currently have any point sources as defined in NPDES regulations. However, the Rocky Flats Site may conduct construction activities as part of remedy maintenance or repair that require compliance with the storm-water ARARs. While these remedy-related construction activities do not require permits, they must meet the substantive requirements for a site-specific or general NPDES storm-water permit. EPA Region 8 has jurisdiction over NPDES permitting activities at federal facilities within the state of Colorado.

For construction activities that are exempt from ARARs requirements (e.g., projects that impact a small area), the Rocky Flats Site implements the soil erosion BMPs in the ECP. Compliance with the ECP is required as part of the institutional controls at the Rocky Flats Site. The ECP BMPs are designed to adequately control storm-water runoff of soils that could ultimately discharge into surface water. The purpose of these controls at the Rocky Flats Site is to address the objective and rationale of the institutional control that prohibits soil-disturbing activities so that the RFLMA remedy performance standard for surface water is met.

Storm-water runoff from construction activities can have a significant impact on water quality by contributing sediment and other pollutants to water bodies. If construction activities are not associated with remedy maintenance or repair, a storm-water permit may be required in addition to the ECP BMPs. The Rocky Flats Site may choose to apply for permit coverage under an EPA general permit or may apply for an individual permit. A general permit requires completion of a notice of intent, application, possibly a fee, and a storm-water pollution prevention plan prior to commencing construction activities. Periodic documented inspections are required until the area has been adequately stabilized using permanent erosion control measures.

The PLFTS, which discharges to No Name Creek, does not require an NPDES or RCRA permit under the CERCLA permit waiver for onsite treatment. Substantive requirements for an NPDES permit are identified for the PLFTS. The *Final Interim Measures/Interim Remedial Action for IHSS 114 and RCRA Closure of the RFETS Present Landfill*, Section 6.4.3, provides a discussion of the RCRA wastewater treatment exclusion (DOE 2004c).

On November 1, 2016, EPA reissued the NPDES Pesticide General Permit (PGP) for point discharges from the application of pesticides or herbicides to waters of the United States. On

January 19, 2017, EPA reissued the general permit for stormwater discharges from construction activities to waters of the United States, also referred to as the "2017 Construction General Permit (CGP)." EPA issued a final modification to the 2017 CGP on May 28, 2019.

8.2.2 Wetlands

The wetlands protection aspects of the Clean Water Act, under 33 CFR 323.2, "Definitions," and 33 CFR 323.3, "Discharges Requiring Permits," are identified as ARARs and address requirements for dredging or filling of wetlands that may lead to destruction of wetlands. Implementation of the remedy is not impacted because activities subject to this ARAR are conducted in accordance with NWP substantive requirements. Evaluation of possible discharges from construction activities that could impact surface water quality and wetlands requires evaluation of whether an NWP applies to the activity or whether an individual permit may be required. If a USACE permit is required, it may establish wetland mitigation requirements.

8.3 Clean Air Act

Fugitive dust emissions during construction activities at the Site require best management controls. Generally, these types of emissions are below the permitting threshold. If a nonroutine activity is planned that may act as an emissions source, the activity will be reviewed by environmental compliance personnel to determine whether the activity is exempt from notification requirements or is subject to notification and permitting.

The East Trenches Plume Treatment Systems air-stripper vents VOCs that have been removed from the groundwater. The pounds of VOCs vented to the air in a year from this source are well below the Colorado Clean Air Act threshold requirements for submitting an Air Pollution Emission Notice. The VOC emissions are calculated periodically using the groundwater influent and effluent concentrations from the air stripper and the volume of water treated during the year.

8.4 SARA Title III

The EPCRA, also known as the Superfund Amendments and Reauthorization Act (SARA), Title III, was signed into law in October 1986. It was established to inform the public of hazardous chemicals that may affect their communities and assist local emergency planners to prepare for possible emergencies involving hazardous chemicals.

Notification is required to state and local emergency planning organizations in accordance with 40 CFR 355 if a listed hazardous substance that exceeds a reportable quantity is released to the environment. Additionally, emergency officials are to be notified for planning purposes if a listed chemical will be used or stored at the facility that may exceed a threshold planning quantity. The volume of chemicals allowed under the Site chemical management procedure is strictly limited so that the amount of chemicals that constitute a reportable quantity or otherwise trigger EPCRA reporting are known in advance of authorized uses.

The requirements in 40 CFR 370 mandate the maintenance of Safety Data Sheets for chemicals present at a facility and that personnel be trained on the hazards of using these chemicals. A list of chemicals maintained at the facility is available for local and state emergency response

officials. This list includes chemicals that are used in maintenance activities at the Site. For the Rocky Flats Site, the internal chemical addresses these requirements and will be followed.

8.5 Natural Resource and Wildlife Protection Laws

A number of natural resource and wildlife protection laws are identified as ARARs in the CAD/ROD. Section 2.0 provides a discussion of the ecological attributes of the site that are subject to certain of these protection laws. Several components of the RFSOG provide more details on implementation of requirements related to these laws, in addition to the Erosion Control and Revegetation, Ecological Monitoring, and Ecology Data Management subsections in Sections 4.0, 6.0, and as follows:

- ESA.
- MBTA.
- Colorado wildlife statutes, including Nongame, Endangered, or Threatened Species Conservation Act and the State Statutes Regarding Illegal Possession. In 2006, the Colorado Wildlife Commission modified the legal methods of take for game species, including the black-tailed prairie dogs, where necessary to control damage on privately owned land. Inspections for adverse biological conditions are required under the RFLMA and are addressed in Sections 5.0 and 9.0.
- Federal Noxious Weed Act and CNWA.

8.6 Pollution Prevention Program

The PPA, established in 1990, requires EPA to develop and implement a strategy that promotes source reduction and other practices that reduce or eliminate the creation of pollutants. The PPA amended EPCRA reporting requirements and required facilities to provide information on pollution prevention and recycling for each toxic chemical. EPA published its pollution prevention strategy to integrate pollution prevention objectives into its existing programs.

8.7 NEPA Planning

NEPA requires federal agencies to assess the impacts that major federal actions may have on the quality of human health and the environment. DOE procedures for implementing NEPA are contained in 10 CFR 1021, 40 CFR 1500–1508, and DOE Order 451.1B. The purpose of DOE Order 451.1B is to establish requirements and responsibilities and foster teamwork within DOE for cost-effective implementation of NEPA. Rocky Flats will follow DOE policy to implement CERCLA requirements when conducting remedy activities in a manner that incorporates NEPA values; separate NEPA review is not required.

Projects that are not required to implement the CERCLA remedy at the Site require a NEPA review to establish that the activity is eligible for a categorical exclusion from NEPA evaluation or may require an environmental assessment or environmental impact statement. The extent of NEPA review required for site activities is considered in the work planning process.

8.8 Well Construction and Water Use Permits

The Colorado State Engineer's Office issued letters in 2006 and 2009 acknowledging that monitoring wells and boreholes installed at CERCLA sites need not follow State permitting requirements. Unless the Rocky Flats Site status or state requirements change, new monitoring wells and boreholes will not require notices of intent or permitting. However, well installation and abandonment methods at the Rocky Flats Site are and will continue to be consistent with methods defined by the Colorado State Engineer's Office.

Monitoring wells will be installed and abandoned in accordance with the applicable LM requirements and consistent with the intent of the Water Well Construction Rules (Colorado 2016 or most recent version). In addition, any associated LM documentation that may be required will be completed. Documents that may be required by the State of Colorado are described in the Colorado Division of Water Resources, Ground Water Administration and Well Permitting web page (http://water.state.co.us/groundwater/groundwater.asp); see also the letter from the Office of the State Engineer regarding well permitting requirements for CERCLA (Colorado 2006) for additional clarification.

8.9 DOT and IATA Regulations

DOT regulations regarding transporting, packaging, placarding, and manifesting hazardous and radioactive materials and wastes are in 49 CFR 171–178. These regulations pertain to the transportation in commerce (e.g., on U.S. highways) of hazardous materials that may include process wastes, contaminated media, and investigation-derived waste (IDW) that are contaminated with RCRA-regulated levels of constituents. These regulations also pertain to samples and off-specification products meeting the definition of hazardous materials. An evaluation has been performed using process knowledge for the environmental samples normally collected under the Site's current sampling program. The process knowledge evaluation determined that the current environmental samples normally collected are not 49 CFR 171-180 hazardous materials. However, samples or wastes from new areas, or when conditions of samples or locations indicate conditions may have changed, must be evaluated by a trained shipper prior to transport off the Site.

International Air Transport Association (IATA) regulations pertain to the transportation of dangerous goods by air, including samples. Environmental samples collected at the Rocky Flats Site are often transported by air. In addition to the requirements of IATA, the packaging and shipping procedures recommended by the carriers commonly used by Rocky Flats Site (e.g., UPS, FedEx, and DHL) are used for transportation with the carriers. Rocky Flats Site samples destined for air transport must be evaluated for compliance with IATA by a shipper trained in IATA regulations.

8.10 EPA Guidance to Management of IDW

EPA developed guidance in January 1992 (EPA 1992) to ensure that management of IDW generated by CERCLA field investigations is protective of human health and the environment and complies with applicable regulatory requirements.

EPA's guidance describes the allowable disposal of IDW within an area of contamination as follows (EPA 1992):

> Storing IDW in a container… within the (area of contamination) and then returning it to its source… **is** allowable without meeting the specified (Land Disposal Restriction) treatment standards…. Therefore, returning IDW that has been stored in containers… within the (area of contamination) to its source does not constitute land disposal, as long as containers are not managed in such a manner as to constitute a RCRA storage unit as defined in 40 CFR 260.10. In addition, sampling and direct replacement of waste within an (area of contamination) do **not** constitute land disposal.

This management scenario is a viable option for environmental monitoring work at the Site as long as best professional judgment and available information indicate that dispersal of solid IDW, such as drill cuttings and excess soil samples in or around wells, will not increase the threat to human health or the environment.

8.11 Spills and Cleanup Guidelines

The immediate response to mitigate spills is addressed in the internal site procedures for chemical management. When the immediate response is complete, an evaluation must be completed to describe whether external notifications may be required, the appropriate cleanup needed, and the proper management of any waste from the spill.

8.12 Waste Management

Sanitary, nonsanitary, hazardous, radioactive, and mixed wastes may be generated during the monitoring surveillance and maintenance activities described in this RFSOG. These wastes will be characterized, managed, and disposed of based on applicable laws and DOE requirements.

9.0 Reporting

9.1 Routine Reporting

9.1.1 RFLMA-Required Reporting

9.1.1.1 Record of Consultative Agreement

The RFLMA establishes the consultation process for approving postclosure activities at the Rocky Flats Site (Site) (RFLMA Paragraph 11). The consultation process utilizes a cooperative approach in which the RFLMA parties confer to reach agreement regarding a proposed course of action. A contact record is often the vehicle for documenting the consultation process. However, as recognized by the RFLMA, written correspondence may also be used to document consultations (RFLMA Attachment 2, Section 4.0). Refer to Contact Record 2018-03 for further discussion of written correspondence and posting guidelines that may be considered by the RFLMA parties.

RFLMA references the use of contact records to document CDPHE oral approvals of field modifications to implement approved response actions (RFLMA paragraph 34). RFLMA Attachment 2 also references the use of contact records or written correspondence to document the outcome of consultation related to implementation of institutional controls and addressing reportable conditions (RFLMA Attachment 2, Sections 4.0 and 6.0). Finally, the *Rocky Flats Site, Colorado, Legacy Management Public Involvement Plan* (PIP) (DOE 2014b) provides that a contact record of consultative process discussions between the RFLMA parties will be made available to the Rocky Flats Stewardship Council and other interested stakeholders as early in the process as is practicable following signature approval by the parties. The PIP process to make contact records and written correspondence available is implemented by posting contact records or written correspondence on the Rocky Flats Site public website and, via email message, by providing timely notice to stakeholders that the contact record or written correspondence is posted.

The RFLMA parties agreed, as documented in RFLMA Contact Record 2007-08, that the status of actions or evaluations in RFLMA contact records will be documented by DOE from time to time and included in RFLMA quarterly and/or annual surveillance and maintenance reports for tracking purposes. An action or evaluation discussed and approved in a contact record or written correspondence will be considered complete based on criteria described in the contact record or written correspondence (e.g., when erosion control measures have been installed). The status of the action/evaluation will be presented in the next RFLMA annual report. An example of a contact record can be found at the Rocky Flats webpage.

When an action discussed in a contact record also constitutes an Explanation of Significant Difference (ESD) under CERCLA, the approval letter for the contact record will be signed by both CDPHE and EPA and posted with the contact record on the Rocky Flats Site public website. In addition, a notice of the ESD action will be posted in the Denver Post newspaper.

A contact record or written correspondence can be rescinded by CDPHE. If CDPHE rescinds a contact record or written correspondence, it will notify DOE by letter. That letter will be posted on the website under the rescinded contact record or written correspondence, and the posted contact record or written correspondence heading will indicate it has been rescinded.

Stakeholders will be notified by email of the posting of the CDPHE letter and change in the status of the posted contact record or written correspondence.

9.1.1.2 Environmental Monitoring

Results of environmental monitoring will be reported in three quarterly reports and one annual report each year. The quarterly reports will provide data and limited evaluation; the annual report will provide more extensive data evaluation. The required contents of each report are provided in Section 7.2 of Attachment 2 to the RFLMA.

Each quarterly report will be posted on the LM website by the 15th of the fourth month after completion of the quarter covered by the report. The annual report will be posted on the LM website by April 30 of the following year. If the official required date for posting falls on a weekend or holiday, the report will be posted on the first business day after the required date.

A summary presentation of each report will be provided to the Rocky Flats Stewardship Council at an appropriate regularly scheduled meeting.

9.1.1.3 Annual Site Inspections and Maintenance

RFLMA requires an annual report documenting Site inspection and maintenance. This inspection report will be included in the annual report for the Site (and appropriate quarterly report) and will include information identified in the RFLMA as well as information compiled as a result of the Site inspections performed in accordance with Section 5.0 of this RFSOG.

9.1.1.4 Landfill Monitoring and Maintenance

Monitoring includes periodic inspections described in the OLF (DOE 2009) and PLF (DOE 2014a) M&M Plans at the frequencies specified in RFLMA Attachment 2, Table 3. Annual reports are required for the OLF and PLF, as described in the M&M Plan for each landfill and RFLMA Attachment 2. These reports will be included in the RFLMA annual report.

9.1.1.5 Pond Discharge Notification

For routine pond discharges when the ponds are operating in batch and release mode, downstream water users will be notified in accordance with Figure 13 of Attachment 2 to the RFLMA. Ponds will be operated to maintain dam safety regardless of the status of pond sampling or notification status; however, downstream users will be notified promptly even if an emergency discharge is required. The remaining terminal ponds are currently operated in flow-through mode; discharge notifications are not applicable when ponds are operating in flow-through mode.

9.1.1.6 Geospatial Environmental Mapping System

Environmental monitoring data will be posted to the GEMS website, available to the public via the LM website, after data validation and QA are complete.

9.1.2 Other Routine Reporting

Other routine reports are required by various agencies and organizations or as agreed to by DOE. Table 39 summarizes routine reports not otherwise discussed in this section.

Table 39. Other Routine Rocky Flats Site Reporting

Report	Agency	Driver	Due Date
Preble's Mouse Mitigation Monitoring Report for the Programmatic Biological Opinion at the Environmental Technology Site. Annual Report. Biological Opinion: ES/LK-6-CO-04-F-012 and associated Biological Opinions.	USFWS	Biological Opinion: ES/LK-6-CO-04-F-012	Annually on December 1
EPCRA reporting of reportable chemicals stored or used onsite	CDPHE	EPCRA (sulfuric acid and lead) in solar batteries used on site	Annually on or before March 1 for the prior year
Colorado Noxious Weed Act monitoring/reporting	Colorado Department of Agriculture	Colorado Noxious Weed Act	Annually (if due)
Dam Safety Inspection Report	Colorado State Engineer	Colorado Rules and Regulations for Dam Safety and Dam Construction	Every 6 years; next inspection 2024
Annual Water Lease Report	State of Colorado; City and County of Broomfield	Water Lease Agreement between DOE and the City and County of Broomfield	Annually the first 2 weeks of November
Monthly Water Lease Report	State of Colorado; City and County of Broomfield	Water Lease Agreement between DOE and the City and County of Broomfield	Monthly on the first business day of each month (covers previous calendar month)
Biweekly Water Lease Report	City and County of Broomfield	Water Lease Agreement between DOE and the City and County of Broomfield	Monthly on the first business day 2 weeks following the Monthly Report (covers preceding period back through first calendar day of current month)
Daily Event Water Lease Report	City and County of Broomfield	Water Lease Agreement between DOE and the City and County of Broomfield	EVENT: Daily during a significant runoff event (see Lease)
Event Summary Water Lease Report	City and County of Broomfield	Water Lease Agreement between DOE and the City and County of Broomfield	EVENT: Following a significant runoff event (see Lease)
RCRA 3016 Report	DOE and CDPHE	RCRA	Biennially in even-numbered years
Surface Water Configuration Adaptive Management Plan (DOE 2021)	none	Surface Water Configuration Environmental Assessment and Finding of No Significant Impact	Annual Report on last day of February and Quarterly Report on April 30, July 31, and October 31
Rocky Flats West Access Bridge	DOE in compliance with Federal Highway Administration, USACE, and Colorado Department of Transportation	23 CFR 650.301 National Bridge Inspection Standards	Every 2 years; next inspection October 2022

Note:
Regulatory reports will be deleted from the list after concurrence is received from the agencies that no longer require the reports.

9.2 CERCLA Five-Year Review

The CERCLA process requires a periodic review at 5-year intervals to evaluate whether the implemented remedy remains protective of human health and the environment. The Five-Year Review (FYR) will determine whether remedy components will be continued, modified, or discontinued. EPA published a guidance document, EPA-OSWER Directive 9355.7-03B-P, and subsequent EPA directives (EPA 2001) that are used to assist in preparation of the FYR and associated report.

The schedule for the Rocky Flats CERCLA FYR was established by the first FYR, issued in July 2002. The RFLMA established the date for the second CERCLA FYR process in 2007, and subsequent reviews will follow the submittal schedule provided in RFLMA Attachment 2 until such time as EPA determines that CERCLA periodic reviews are no longer required.

In accordance with RFLMA Attachment 2 and CERCLA guidance, the public will be notified when the reviews are conducted, and results of the reviews will be made public; however, no formal public comment process is required under CERCLA guidance.

10.0 References

10 CFR 1021. "National Environmental Policy Act Implementing Procedures," *Code of Federal Regulations*.

33 CFR 323. "Permits for Discharges of Dredged or Fill Material into Waters of the United States," *Code of Federal Regulations*.

36 CFR Chapter XII. "National Archives and Records Administration," *Code of Federal Regulations*.

40 CFR 122. "EPA Administered Permit Programs: The National Pollutant Discharge Elimination System," *Code of Federal Regulations*.

40 CFR 302.4. "Designation of Hazardous Substances," *Code of Federal Regulations*.

40 CFR 355. "Emergency Planning and Notification," *Code of Federal Regulations*.

40 CFR 370. "Hazardous Chemical Reporting: Community Right-to-Know," *Code of Federal Regulations*.

40 CFR 1500–1508. "CEQ Regulations for Implementing the Procedural Provisions of NEPA," *Code of Federal Regulations*.

49 CFR 171–178. "Hazardous Materials Regulations (DOT)," *Code of Federal Regulations*.

44 USC 29. "Records Management by the Archivist of the United States and by the Administrator of General Services," *United States Code*.

44 USC 31. "Records Management by Federal Agencies," *United States Code*.

44 USC 33. "Disposal of Records," *United States Code*.

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DOE (U.S. Department of Energy), 1999a. *Final Proposed Action Memorandum for the East Trenches Plume*, RF/RMRS-98-258.UN, Rocky Flats Environmental Technology Site, February.

DOE (U.S. Department of Energy), 1999b. *Final Solar Ponds Plume Decision Document*, RF/RMRS-98-286.UN, Rocky Flats Environmental Technology Site, June.

DOE (U.S. Department of Energy), 2003. *Results of the Aquatic Monitoring Program in Streams at the Rocky Flats Site, Golden, CO 2001-2002*, Rocky Flats Field Office, Golden, Colorado, May.

DOE (U.S. Department of Energy), 2004a. *Programmatic Biological Assessment for Department of Energy Activities at the Rocky Flats Environmental Technology Site*, Part II, April.

DOE (U.S. Department of Energy), 2004b. *Environmental Assessment, Comment Response, and Finding of No Significant Impact: Pond and Land Configuration*, October.

DOE (U.S. Department of Energy), 2004c. *Final Interim Measures/Interim Remedial Action for IHSS 114 and RCRA Closure of the RFETS Present Landfill*, "Appendix B: Post-Accelerated Action Monitoring and Long-Term Surveillance and Monitoring Considerations," Golden, Colorado.

DOE (U.S. Department of Energy), 2004d. *Final Interim Measures/Interim Remedial Action for the Original Landfill (Including IHSS Group SW-2; IHSS 115, Original Landfill and IHSS 196, Filter Backwash Pond)*, "Appendix B: Post-Accelerated Action Monitoring and Long-Term Surveillance and Monitoring Considerations," Golden, Colorado.

DOE (U.S. Department of Energy), 2004e. *Programmatic Biological Opinion for the Programmatic Biological Assessment for Department of Energy Activities at the Rocky Flats Environmental Technology Site, Part II*, U.S. Department of the Interior, U.S. Fish and Wildlife Service, Lakewood, CO, April.

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