

## **E1.0 Groundwater and Surface Water Monitoring**

### **E1.1 Groundwater**

The designated groundwater use classification at the COU is surface water protection. This is based on the fact that groundwater contaminated by historical operations emerges to surface water prior to exiting the COU. The numeric values for measuring potential effects of contaminated groundwater on surface water quality are the surface water standards in RFLMA Attachment 2, Table 1. It should be noted that the CAD/ROD and RFLMA incorporated some MCL values as surface water standards, in cases where surface water standards were not available.

The groundwater monitoring network includes four types of monitoring wells: AOC, Sentinel, Evaluation, and RCRA. The AOC wells provide data directly relevant to groundwater RAO 1; the Sentinel wells provide data directly relevant to groundwater RAO 2 and soil RAO 1 and are discussed in Section 6.1.2. The RCRA wells are directly related to the remedies implemented at the PLF and OLF and are discussed in Sections 6.1.4.1 and 6.1.4.2, respectively. The data collected during this FYR period at the Evaluation wells are summarized in this appendix.

The remedy in the CAD/ROD included the operation and maintenance of four groundwater collection and treatment systems (DOE, EPA, and CDPHE 2006). As a result of technology improvements and optimization during this FYR period, the number of treatment system was reduced to three, although there are still four groundwater collection systems. The reconfiguration of the treatment systems is summarized in Section 6.1.4.3 and discussed in detail in the COU annual reports. Monitoring of treatment system influent, effluent, and surface water locations associated with the treatment systems is summarized in this appendix.

#### **E1.1.1 Evaluation Wells**

Evaluation wells are typically located within plumes or near plume source areas or in the interior of the COU (Figure E-1). There are 42 Evaluation wells within the COU that are sampled every 2 years (biennially) in accordance with the RFLMA. The primary purpose of these wells is to determine when monitoring can be modified or discontinued. Data from these wells may also be used to support other objectives, such as providing input to groundwater modeling efforts, modification of groundwater monitoring and treatment requirements, or evaluation of changing contaminant conditions as indicated by downgradient AOC or Sentinel wells.

The RFLMA Attachment 2 decision logic flowchart Figure 9, "Evaluation Wells" (Appendix B), is relevant to Evaluation well data. In general, groundwater quality within plumes that were identified and characterized through the decades of pre-closure groundwater monitoring at the former RFP has changed little since site closure. As anticipated, due to their location within or adjacent to groundwater contaminant plumes, groundwater monitoring wells did not meet applicable RFLMA surface water standards at most Evaluation wells during this FYR period. Thus, continued monitoring of Evaluation wells is necessary to determine when groundwater is of sufficient quality to remove institutional control use restrictions and monitoring may cease. Discussion of plume-specific Evaluation well data may be found in the COU annual reports for 2012 and 2014 (DOE 2013; 2015) and 2016, when published.

During this FYR period, additional, nonroutine samples from Evaluation wells were collected following the heavy precipitation event in 2013 and the wet conditions in 2015. The COU annual reports for 2013 and 2015 provide an evaluation of these sample results (DOE 2014; 2016). Despite the relatively extreme weather events, groundwater quality in the COU in 2013 and 2015 was largely consistent with data reported in prior years.

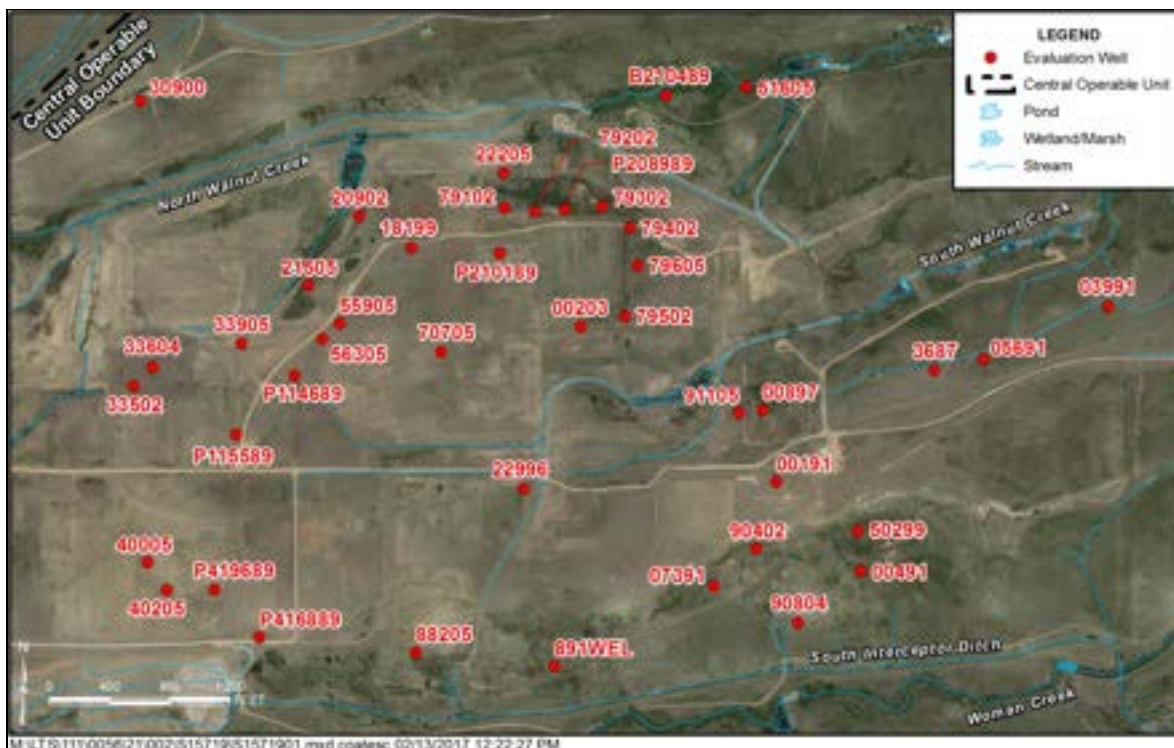


Figure E-1. Evaluation Well Locations

### E1.1.2 Groundwater Treatment System Monitoring

The locations of the groundwater treatment systems in the COU are shown in Figure E-2. The groundwater treatment systems are designed to reduce target contaminant concentrations in groundwater and contaminant load to surface water. Each groundwater treatment system is monitored, at a minimum, for untreated influent and treated effluent and for impacts to surface water downstream of each subsurface effluent discharge point. Evaluation of groundwater treatment system performance determines whether (1) influent water quality indicates that treatment is still necessary, (2) effluent water quality indicates that system maintenance is required, and (3) surface water quality suggests impacts from inadequate treatment of influent. The RFLMA Attachment 2 decision logic flowchart Figure 11, “Groundwater Treatment Systems” (Appendix B), is relevant to the treatment systems monitoring data.

The groundwater treatment systems are being properly maintained and operated, but some constituents in system effluent have not consistently met applicable RFLMA standards. This triggers RFLMA consultation to determine if any mitigating actions should be implemented. The actions resulting from the RFLMA consultative process during this FYR period have focused on optimizing treatment capabilities of the systems and are summarized in Section 6.1.4.3.

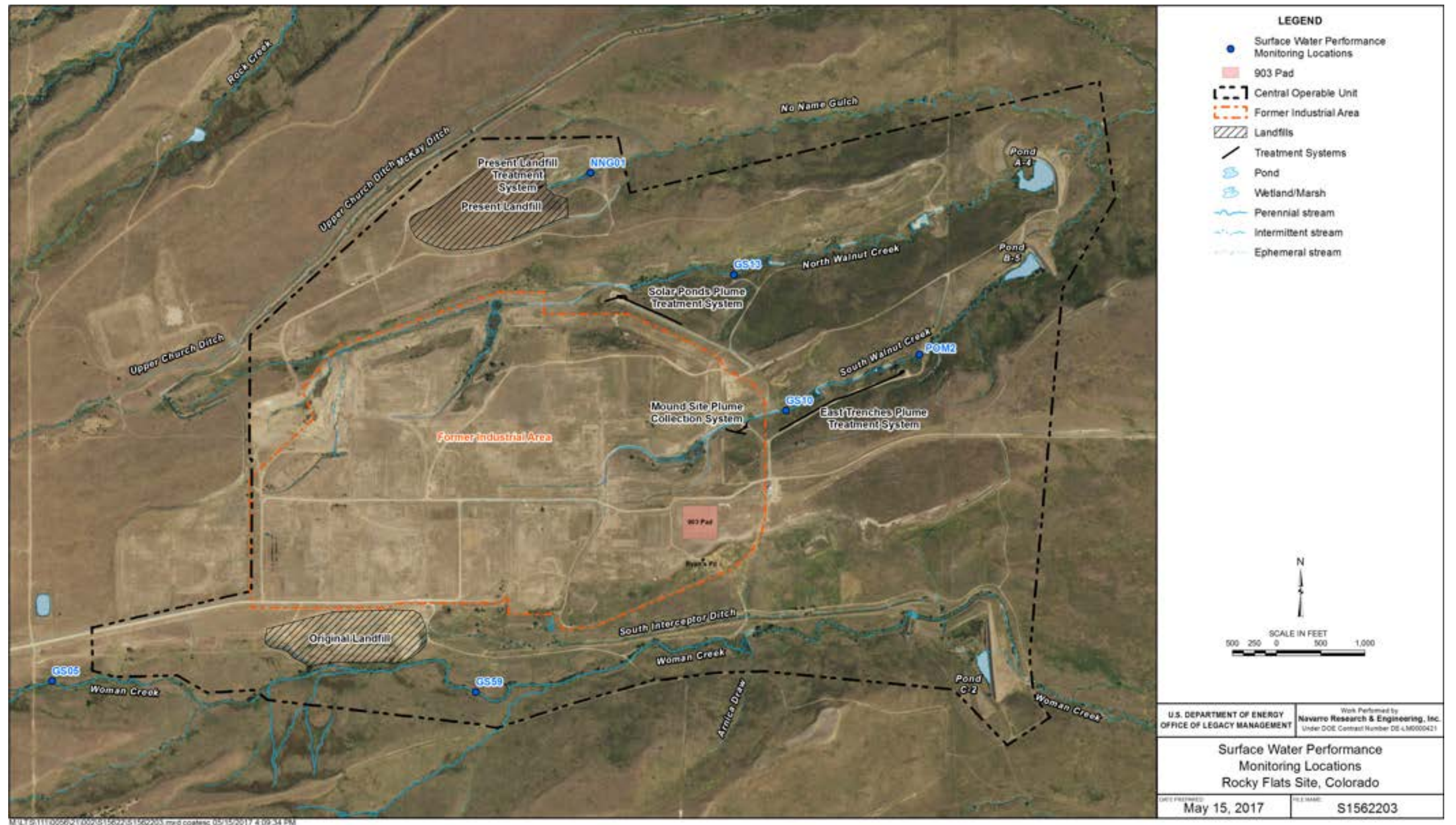


Figure E-2. Groundwater Treatment Systems and Surface Water Performance Monitoring Locations

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### ***E1.1.2.1 PLFTS***

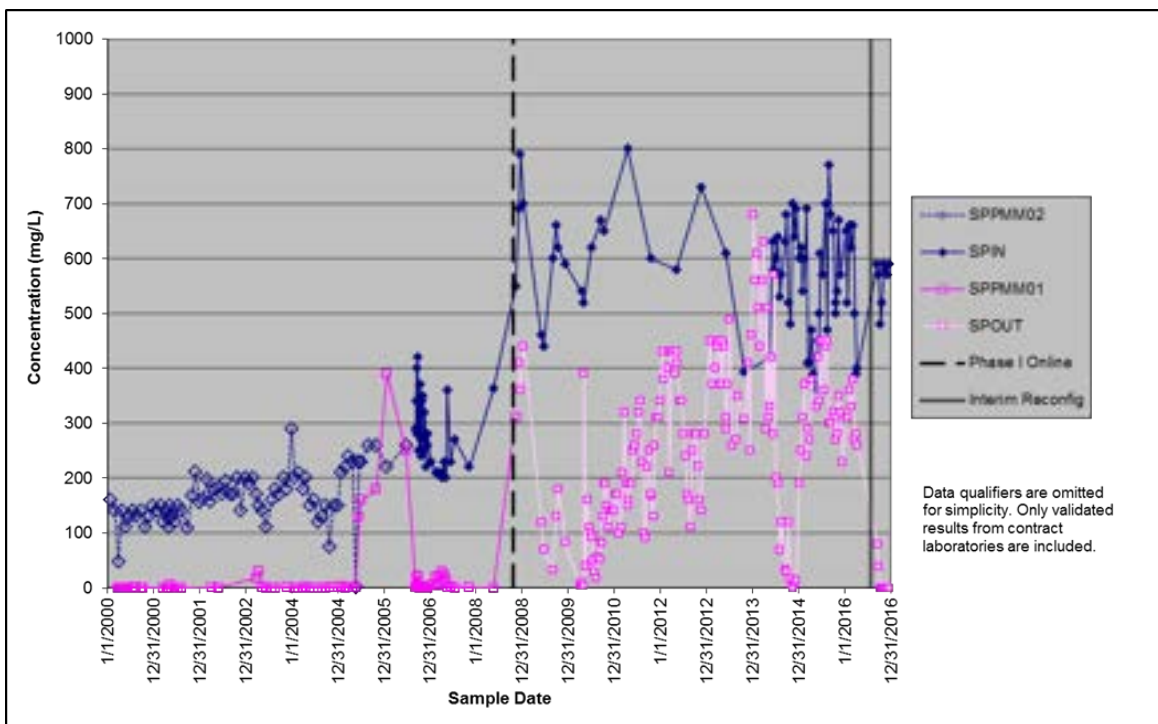
The PLFTS was installed in 2005 and consists of a gravity-fed, passive system designed to treat groundwater and seep water for VOCs. In contrast to the other treatment systems in the COU, there have been no alterations to this system since it was installed, and no opportunities for optimization have been identified. Operation and monitoring of the PLFTS during this FYR period is discussed in Section 6.1.4.1 and is not repeated herein. A yearly account of sampling data and evaluation of the PLFTS may be found in the COU annual reports.

### ***E1.1.2.2 SPPTS***

The SPPTS was installed in 1999 and was designed to treat groundwater contaminated with nitrate and uranium from the Solar Ponds source area. Throughout this FYR period, work has progressed in an attempt to refine treatment at the SPPTS and identify the most appropriate and efficient long-term system configuration. Optimization of this treatment system is summarized in Section 6.1.4.3. Evaluation and testing of system performance is ongoing and is planned to continue into the next FYR period. In conjunction with treatment system testing, additional nonroutine monitoring samples of the influent, effluent, and downstream surface water location GS13 have been collected.

Figures E-3 and E-4 present nitrate and uranium data, respectively, for influent and effluent monitoring at the SPPTS from 2000 through 2016. While reduction of nitrate and uranium loads to surface water from the Solar Ponds plume has continued throughout this FYR period, the reduction of constituent concentrations to below applicable RFLMA surface water standards has not consistently been achieved. For both nitrate and uranium, routine samples of SPPTS influent and effluent have been above RFLMA standards during this FYR period, as have some samples from surface water monitoring location GS13. An evaluation of the Walnut Creek drainage system concluded that approximately 5% of the uranium load measured at location GS13 and approximately 20% of the nitrate load (prior to system reconfiguration) comes from SPPTS effluent (Wright Water Engineers 2015). This suggests that effluent from the SPPTS does not have a large impact on uranium concentrations detected in North Walnut Creek at GS13 or WALPOC. Although the nitrate standard at WALPOC has been continuously met in surface water samples, uranium concentrations have exceeded the RFLMA standard intermittently throughout this FYR period. The uranium 12-month rolling average at WALPOC exceeded the standard for a 4-month period in 2014–2015 and currently exceeds the standard as of December 2016. Uranium conditions at WALPOC are discussed further in Section 6.1.3.1. Based on the Walnut Creek evaluation, however, the concentrations of uranium at WALPOC do not appear to be a direct result of SPPTS operations.

In general, effluent conditions at the SPPTS did not show improvement during this FYR period until completion of the SPPTS interim reconfiguration project in late 2016, which focused on constructing a full-scale, test nitrate treatment component. Since reconfiguration completion, nitrate concentrations in SPPTS effluent have consistently been below RFLMA standards, with nitrate typically not detected in the effluent. The results of uranium treatment to date have proven less encouraging; however, efforts to identify an effective long-term system configuration continue through the RFLMA consultative process.



**Abbreviations:**

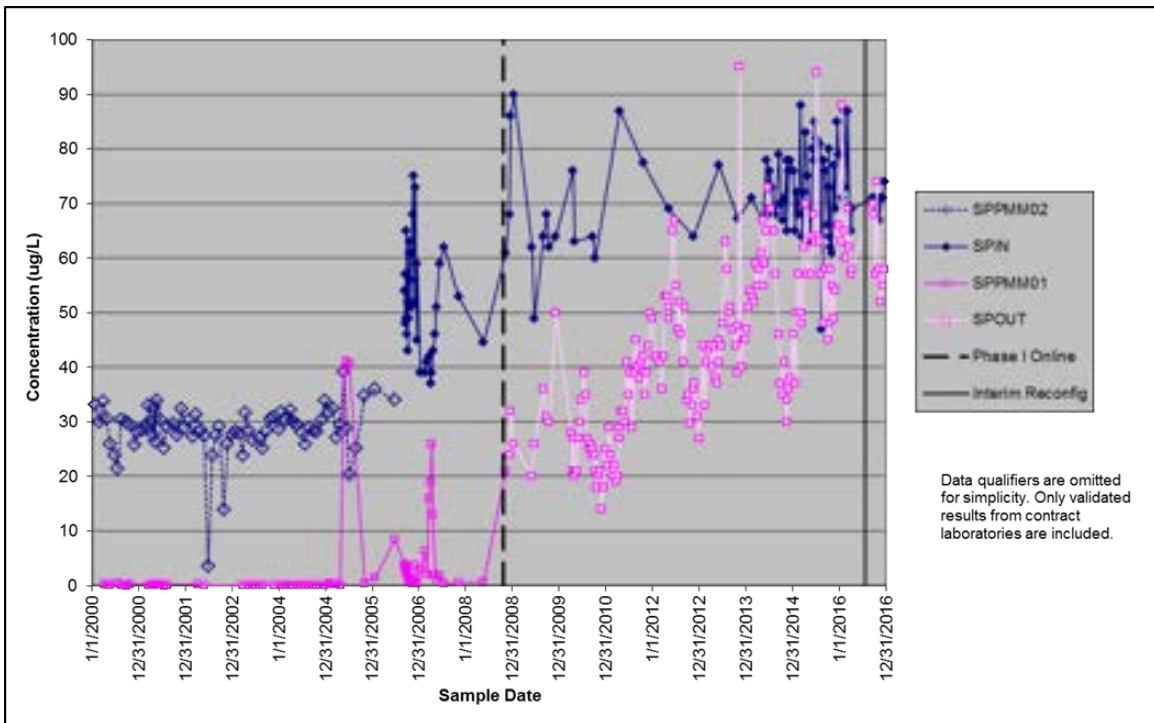
Interim Reconfig indicates when the 2016 interim reconfiguration project was completed.

Phase I Online = date when Phase I upgrades to collect additional impacted groundwater were completed.

SPPMM02 and SPIN = system influent

SPPMM01 and SPOUT = system effluent

*Figure E-3. Total Nitrate Concentrations in SPPTS Influent and Effluent (2000–2016)*



**Notes:**

SPPMM02 and SPIN = system influent

SPPMM01 and SPOUT = system effluent

Interim Reconfig = date when the 2016 interim reconfiguration was completed.

Phase I Online = date when Phase I upgrades to collect additional impacted groundwater were completed.

*Figure E-4. Total Uranium in SPPTS Influent and Effluent (2000–2016)*

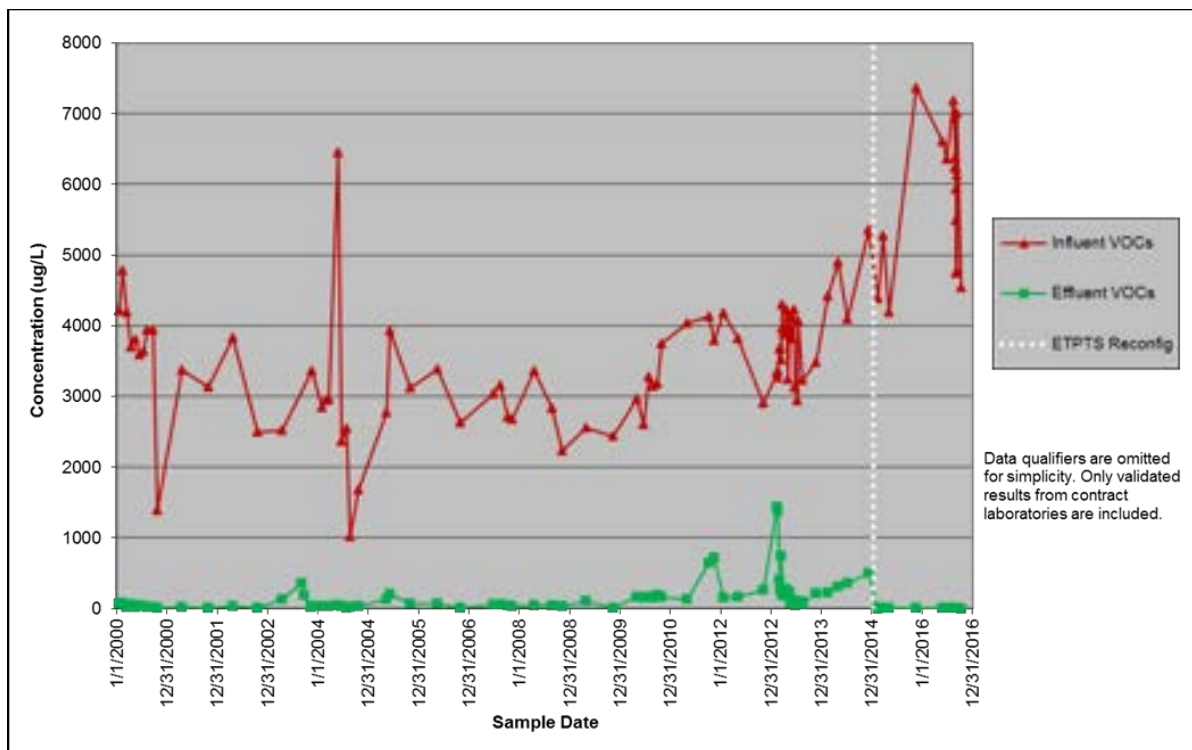
### E1.1.2.3 ETPTS

The ETPTS was designed to treat groundwater contaminated with VOCs from the East Trenches source area and was installed in 1999. Optimization of this treatment system is summarized in Section 6.1.4.3.

Figure E-5 presents total VOC concentration data for influent and effluent monitoring at the ETPTS from 2000 through 2016. Throughout this FYR period, several VOCs exceeded applicable RFLMA standards in both the influent and effluent. Since completion of the ETPTS reconfiguration in early 2015, however, treatment effectiveness is much improved and effluent concentrations of VOCs are almost always below applicable RFLMA standards. Of the 12 effluent samples collected since the reconfiguration project was completed, concentrations of TCE exceeded the RFLMA standard in three samples (the highest concentration of TCE in ETPTS treated effluent since the reconfiguration was 3.3  $\mu\text{g/L}$ ; the standard is 2.5  $\mu\text{g/L}$ ). Figure E-5 illustrates that the ETPTS has been effective, now much more effective, in reducing contaminant concentrations in groundwater treated by the system and reducing contaminant load to surface water. The reconfiguration of the system to include an air stripper has significantly reduced contaminant concentrations in ETPTS effluent.

The surface water performance monitoring location associated with the ETPTS is POM2 (Figure E-2). Low concentrations of VOCs were occasionally detected in surface water samples

from this location collected during this FYR period. However, no VOCs have ever exceeded their respective RFLMA standards at this location.



**Notes:**

“ETPTS Reconfig” refers to when the ETPTS Reconfiguration Project to install a commercial air stripper was completed.

Data in late 2016 represent treatment of combined MSPTS+ETPTS influent.

*Figure E-5. Total Detected VOCs in ETPTS Influent and Effluent*

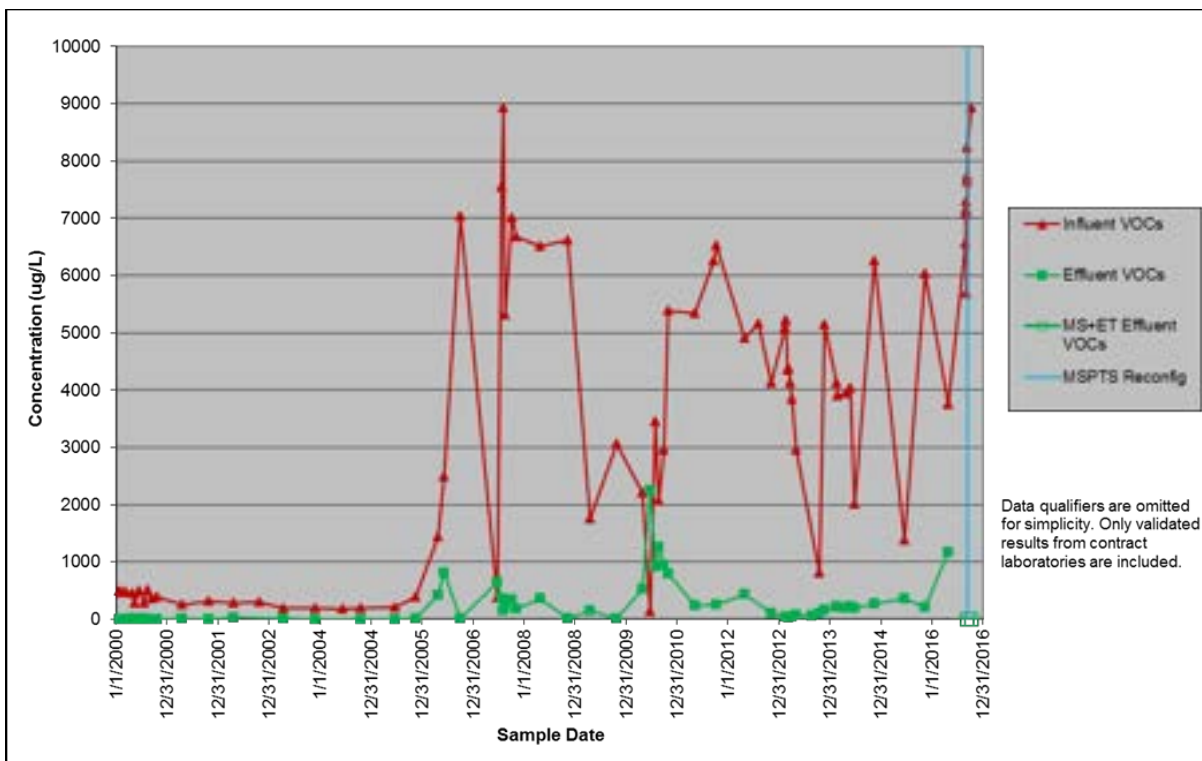
**E1.1.2.4 MSPTS**

The MSPTS was designed to treat groundwater contaminated with VOCs from the Mound source area and was installed in 1998. Groundwater impacted by residual contaminants in the nearby Oil Burn Pit No. 2 (OBP No. 2) area was directed to this treatment system beginning in 2005. Optimization of this treatment system is summarized in Section 6.1.4.3.

Figure E-6 presents total VOC concentration data for influent and effluent monitoring at the MSPTS from 2000 through 2016. Throughout this FYR period, several VOCs have exceeded applicable RFLMA standards in both the influent and effluent. In late 2016, reconfiguration of the MSPTS was completed, and groundwater from the Mound plume was routed to the ETPTS for treatment (CR 2015-04). The reconfiguration resulted in significant improvement in treatment of VOCs originating at the Mound and OBP No. 2 areas. The treatment of TCE has posed the greatest challenge to the MSPTS since operations began. Following system reconfiguration, however, TCE in system effluent has consistently been below the RFLMA standard. Figure E-6 illustrates that throughout the operating life of the MSPTS, the system was effective in reducing contaminant concentrations in groundwater treated by the system and in reducing contaminant load to surface water. The last data points shown in Figure E-6 for MSPTS



effluent represent the treatment of combined MSPTS and ETPTS influent and show that all applicable RFLMA standards were met.



**Notes:**

VOC data shown represent arithmetic sums of all validated detections at locations MOUND R1-0 (influent) and MOUND R2-E (effluent) until the latter location was eliminated in late 2016. “MSPTS Reconfig” refers to the date when the MSPTS Reconfiguration Project was completed, routing MSPTS influent to the ETPTS for treatment. Data in late 2016 represent treatment of combined MSPTS+ETPTS influent.

*Figure E-6. Total VOCs in MSPTS Influent and Effluent, 2000 Through 2016*

For the majority of this FYR period, the surface water performance monitoring location associated with the MSPTS was GS10, located in the South Walnut Creek drainage (Figure E-2). No VOCs were detected above applicable RFLMA standards at GS10 in 2012 or 2013; TCE was detected above the RFLMA standard at this location in 2014, 2015, and 2016. The high groundwater flows resulting from heavy precipitation in 2013 and 2015, and the consequentially reduced residence time for influent within the ZVI reactive media in the MPSTS, are factors in these TCE exceedances. Since treatment of Mound and OBP No. 2 plume groundwater no longer occurs at the MSPTS, surface water location GS10 is no longer used to evaluate treatment system performance. This role is now filled by POM2, the surface water performance location assigned to the ETPTS, as discussed below. The GS10 location, however, continues to serve as a POE in the surface water monitoring network in the COU.

**E1.2 Surface Water**

The protection of surface water was a basis for making cleanup decisions at the former RFP so that surface water within, and leaving, the COU would be of sufficient quality to support all uses.

The applicable surface water uses are consistent with the following Colorado surface water use classifications:

- Water Supply
- Aquatic Life—Warm 2
- Agriculture
- Recreation N (North Walnut Creek, South Walnut Creek, Pond C-2)
- Recreation E (Woman Creek)

These classifications are applicable to surface water in the COU; however, the institutional controls established in the remedy for the COU prohibit some of these uses, specifically, water supply and agriculture uses. That is, although the state regulations mandate the protection of the surface water in the COU to support each of the use classifications above and surface water must meet the water quality standards for each classification, the ICs prohibit some uses.

The surface water monitoring network includes three types of locations: points of compliance (POCs), points of evaluation (POEs), and performance monitoring locations. The evaluation of data collected at the POCs during this FYR period is directly relevant to surface water RAO 1 and is discussed in Section 6.1.3. This section summarizes data collected during this FYR period at the POEs and performance monitoring locations.

### **E1.2.1 Points of Evaluation**

The POEs (locations GS10, SW027, and SW093) are located upstream of the POCs (Figure 2) and provide an early indication of the quality of surface water flowing toward the POCs. The RFLMA Attachment 2 decision logic flowchart Figure 6, “Points of Evaluation” (Appendix B), is relevant to data collected at these locations. During this FYR period, there were periodic exceedances of the surface water quality standards for actinides (e.g., plutonium and americium) and uranium at locations GS10 and SW027. The exceedances of 12-month rolling averages for uranium, americium, and plutonium at GS10 and americium and plutonium at location SW027 resulted in reportable conditions for these locations. There were no reportable conditions during this review period for location SW093.

#### ***E1.2.1.1 GS10***

Surface water monitoring location GS10 is the POE in South Walnut Creek upstream of WALPOC. This location monitors surface water from the drainage area for a major portion of the former industrial area of the RFP. The monitoring equipment at GS10 was upgraded and relocated in 2013 to avoid the potential for monitoring interruptions due to the movement of an adjacent hillside slump. The new location is approximately 40 feet east of its original location (CR 2013-01).

***Uranium.*** The 12-month rolling average for uranium at GS10 (18.8 µg/L) exceeded the RFLMA standard of 16.8 µg/L at the end of April 2011 (CR 2011-04). The plan to evaluate this reportable condition included the collection of surface water and groundwater samples from locations upstream and downstream of GS10. Based on these results, additional evaluation of this condition was determined necessary (CR 2011-05). The 12-month rolling average for uranium at

GS10 did not fall below the RFLMA standard until March 2013. The average remained below the standard until the end of May, when the standard was again exceeded. In September 2013, the 12-month rolling average for uranium (14.6  $\mu\text{g/L}$ ) fell below the RFLMA standard and remained below the standard through the end of this FYR period. Figure E-7 presents the 12-month rolling average data for total U at GS10 from 2005–2016.

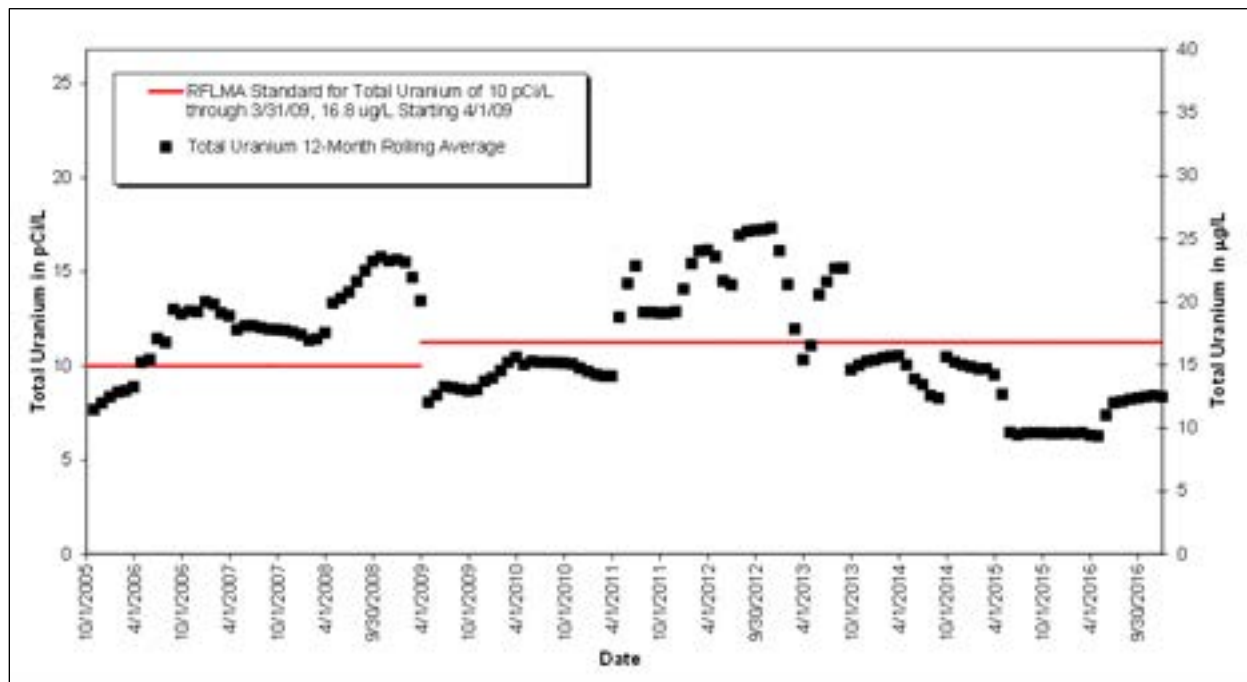


Figure E-7. Volume-Weighted 12-Month Rolling Average Total Uranium Concentrations at GS10: Post-Closure Period

From the initial reportable condition at GS10 in April 2011 until late 2013, uranium concentrations downstream of GS10 at WALPOC were below the RFLMA standard. In December 2013, the 30-day average uranium concentration (16.9  $\mu\text{g/L}$ ) at WALPOC exceeded the standard (16.8  $\mu\text{g/L}$ ) and became a reportable condition (CR 2014-05). Other reportable conditions for uranium occurred at WALPOC in October 2014 (CR 2015-01), January 2016 (CR 2016-01), and December 2016 (CR 2017-02). The 12-month rolling averages for uranium WALPOC from 2011 through the end of 2016 are shown in Figure 5. Data collected prior to mid-2015 to evaluate these reportable conditions were included in extensive evaluation of conditions in the Walnut Creek drainage system. The results of this evaluation and additional discussion of the reportable conditions at WALPOC are presented in Section 6.1.3.1.

**Americium and Plutonium.** In August 2011, the 12-month rolling average for americium at location GS10 (0.21 pCi/L) exceeded the RFLMA standard of 0.15 pCi/L, resulting in a reportable condition at GS10 (CR 2011-08). The plan to evaluate this reportable condition included the inspection of upstream areas for seeps and indications of soil erosion, the collection of surface water and seep samples from upstream and downstream locations, and the review of historical data. At the time, the Pu concentration at GS10 was not reportable, but since Pu and Am are found together and behave similarly in the environment, the evaluation plan for the Am reportable condition included sample analyses for both Am and Pu. In May 2012, the 12-month

rolling average for Pu at location GS10 (0.17 pCi/L) exceeded the RFLMA standard of 0.15 pCi/L and became a reportable condition. Figure E-8 presents the 12-month rolling averages for Am and Pu from 2005 through 2016.

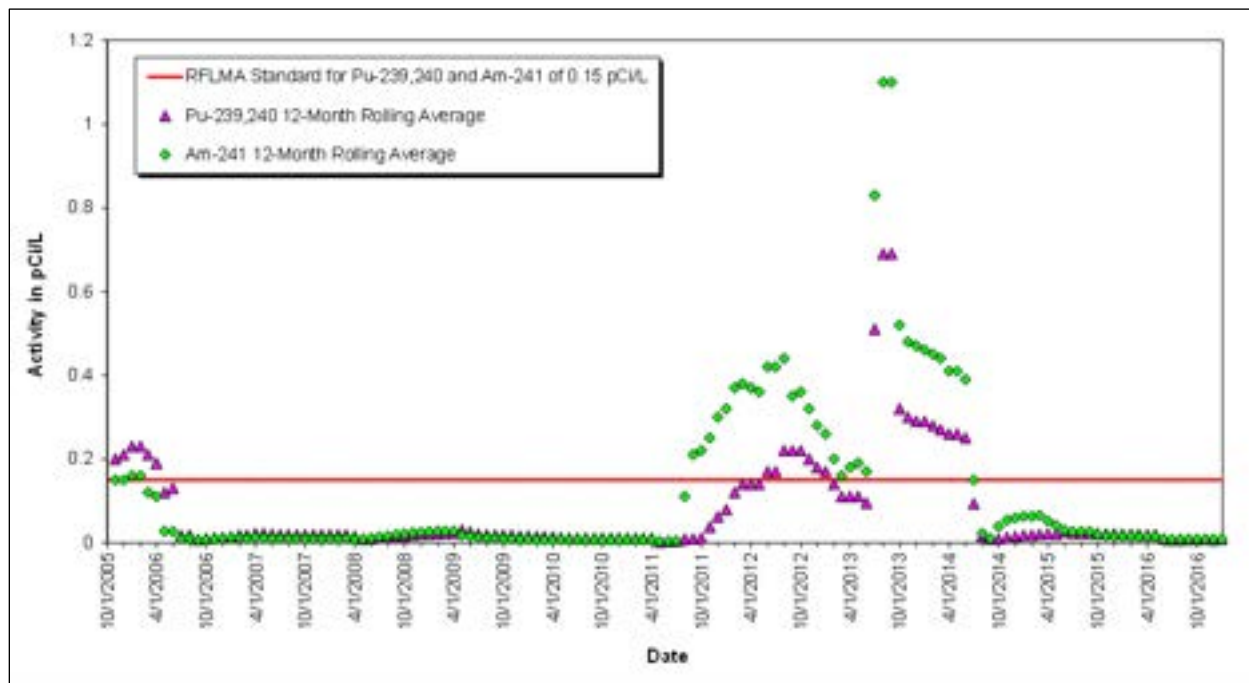


Figure E-8. Volume-Weighted 12-Month Rolling Average Plutonium and Americium Activities at Location GS10: Post-Closure Period

The evaluation of the Am and Pu reportable conditions focused on assessment of the potential transport mechanisms for these radionuclides, namely, soil erosion and transport in water via various mechanisms. Inspection of the location GS10 drainage did not identify any obvious soil erosion that could potentially impact surface water quality. This observation, coupled with the fact that the elevated Pu/Am results for GS10 were obtained during relatively dry conditions at the site, suggested that soil/sediment transport was not a primary contributor to the reportable condition at GS10. Sampling of several seeps identified upstream of GS10 (DOE 2014) suggested that seeps may be contributing some Pu/Am to surface water at location GS10; however, seep contributions alone could not adequately explain the measured Pu/Am concentrations at GS10. Evaluation of data for colloidal transport was also conducted by analyzing filtered and nonfiltered seep samples. Plutonium and americium were not detected in the filtered samples but were detected at low concentrations in the unfiltered samples. This suggests that the majority of Am and Pu in the seep samples is associated with larger particles or colloids that could not pass through the 0.45 micron filter, as opposed to very small colloids.

Mitigating actions were not required to address these reportable conditions because downstream conditions remained well below the RFLMA standards for Pu and Am during the evaluation period. The downstream locations associated with GS10 at the time are shown in Figure E-9; monitoring data for these locations are shown in Figures E-10 and E-11. Plutonium and americium 12-month averages at GS10 have remained below the RFLMA standards from mid-2014 through the end of this FYR period.

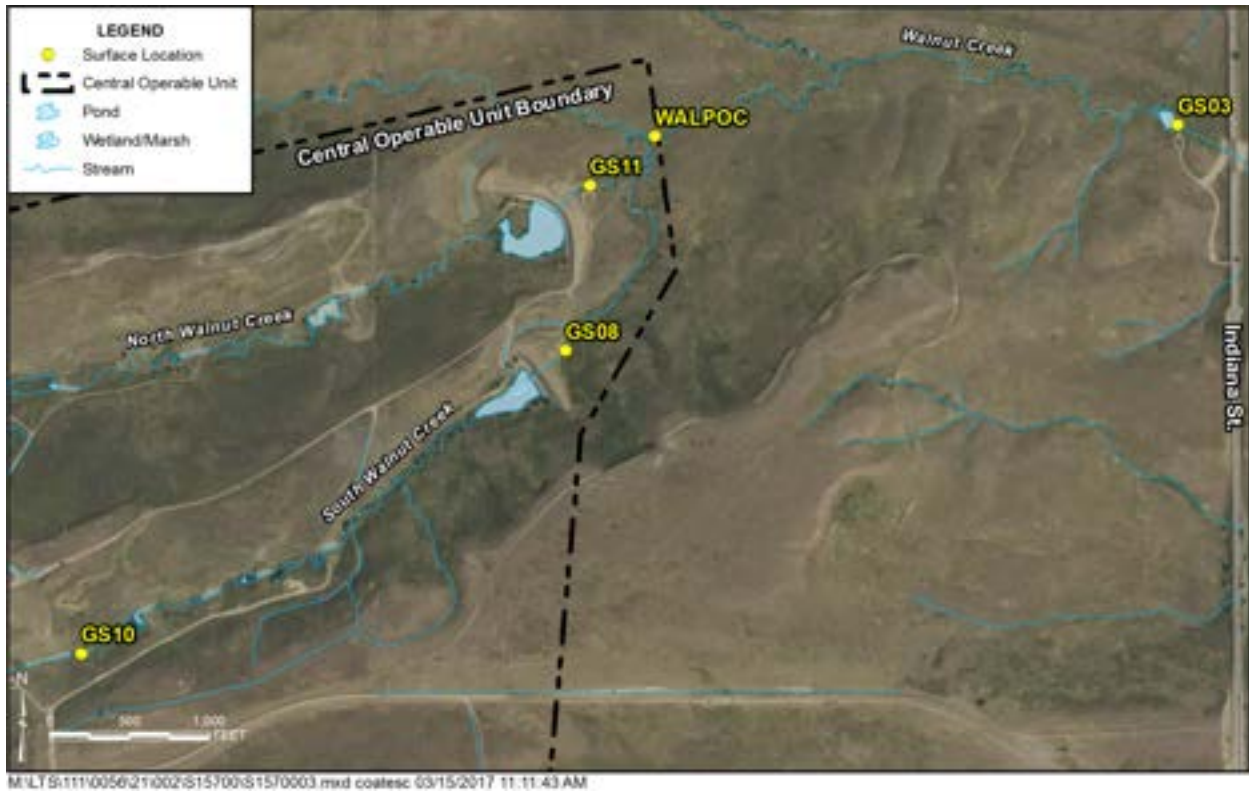
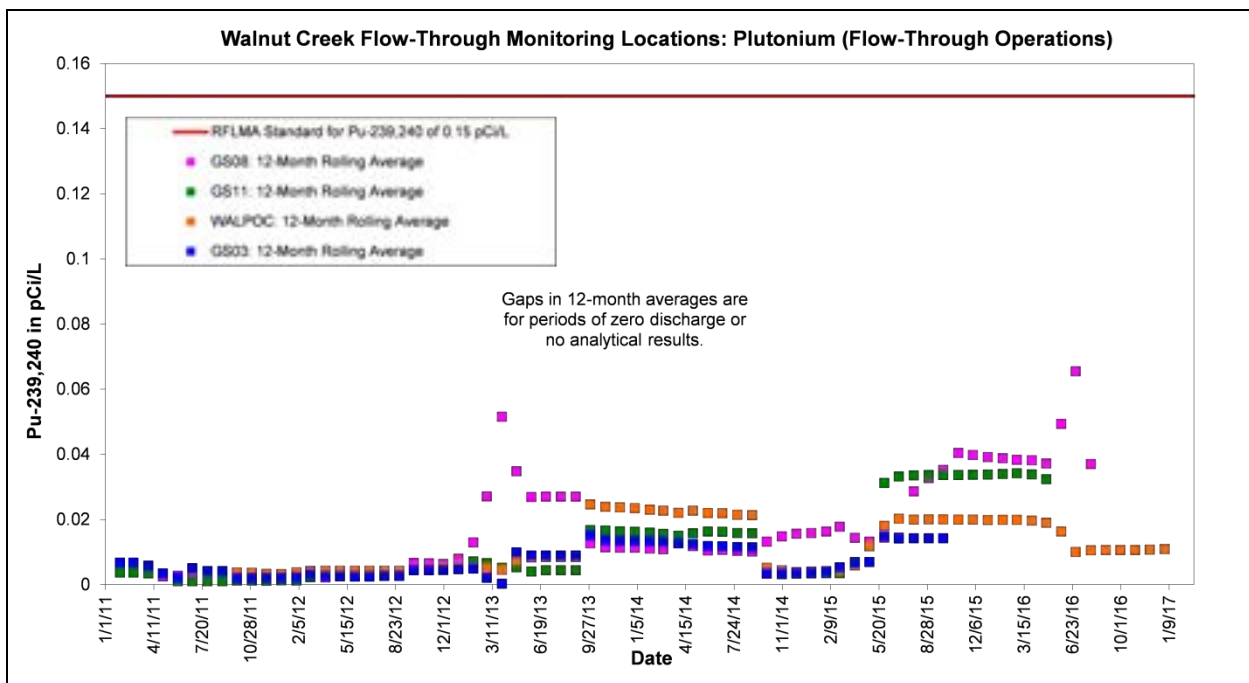


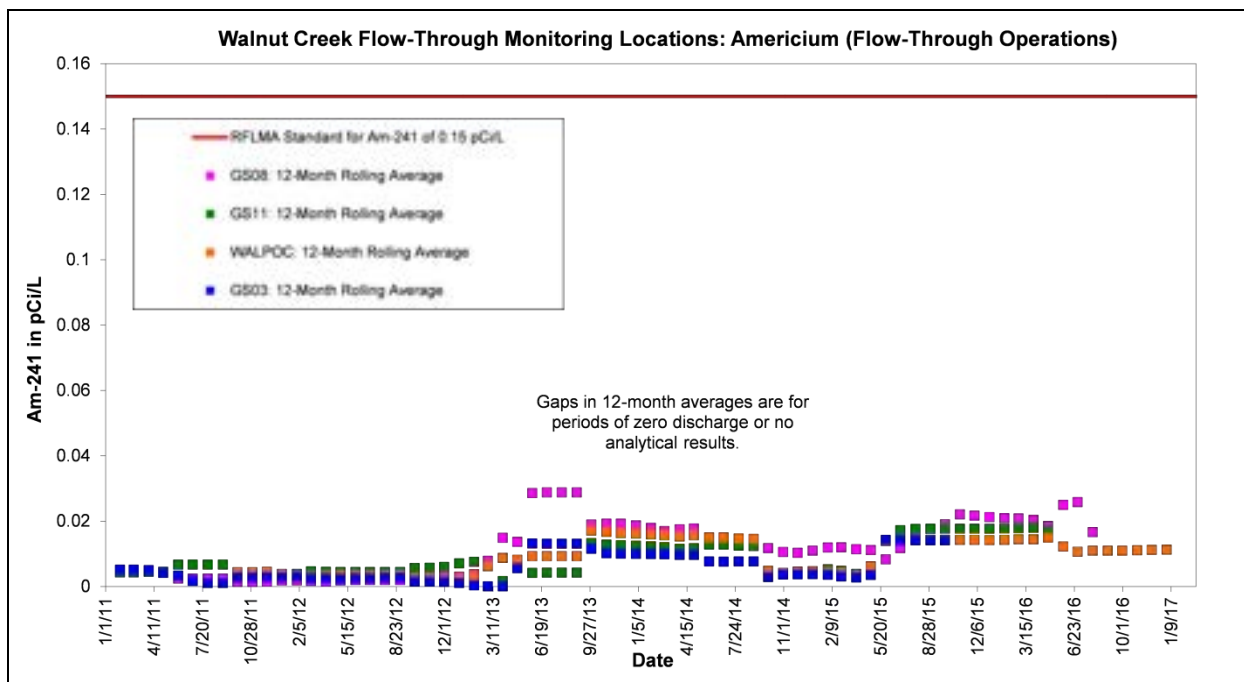
Figure E-9. GS10 and Associated Monitoring Locations



**Note:**

Values for 12-month averages for locations GS08 and GS11 are shown here relative to 0.15 pCi/L for comparison purposes only.

Figure E-10. Average Plutonium Activities at Locations Downstream of Location GS10



**Note:**

Values for 12-month averages for locations GS08 and GS11 are shown here relative to 0.15 pCi/L for comparison purposes only.

Figure E-11. Average Americium Activities at Locations Downstream of Location GS10

**E1.2.1.2 SW027**

Surface water monitoring location SW027 is the POE at the eastern (downstream) end of the South Interceptor Ditch (SID), upstream of WOMPOC (Figure E-12). Figure E-13 presents the 12-month rolling average Pu and Am data for SW027 from site closure in 2005 through 2016.

The 12-month rolling average for plutonium at SW027 (0.16 pCi/L) initially exceeded the RFLMA surface water standard of 0.15 pCi/L in April 2010 (CR 2010-06). Following consultation, mitigating actions were completed in December 2010, which included reseeding and installation of additional erosion controls in the SID drainage area (DOE 2010). These efforts were an attempt to reduce the movement of residual Pu in soil from the 903 Pad/Lip Area and into the SID. The 2006 RI/FS acknowledged that remaining concentrations of Pu in soil from this area, while below the soil cleanup action level, could result in the exceedance of surface water quality standards should Pu be transported through soil erosion (DOE 2010). Inspection of the area and evaluation of upstream and downstream data did not identify any new plutonium source. The concentration of plutonium during this time frame at WOMPOC, downstream of SW027, did not exceed the RFLMA standard. Additional detail regarding evaluation of Pu at SW027 is found in the 2011 annual report (DOE 2012). No samples were collected at SW027 from October 2010 until February 2013, due to lack of surface water flow. All SW027 samples collected in 2013 were below the RFLMA standards for Am and Pu (Figure E-13); no composite samples were collected in 2014 due to lack of flow. Location SW027 was dry until March 2015, when sampling resumed.

A reportable condition for plutonium with a 12-month rolling average of 0.22 pCi/L was documented shortly after sampling resumed in April 2015 (CR 2015-05). The 12-month rolling average for Am subsequently exceeded the standard in June 2015. Following consultation, additional measures were implemented to enhance the vegetation and erosion controls implemented in 2010 and 2011. These measures were mostly completed by August 2015 and included the addition of straw wattles, GeoRidge berms, and woodstraw in the SID drainage area; installation of additional erosion matting and GeoRidge berms in the SID was completed in March 2016. The 12-month rolling averages for Pu at SW027 continued to exceed the RFLMA standard through the end of this FYR period. Americium concentrations continued to exceed the RFLMA standard until June 2016; since June 2016 and through the end of this FYR period Am has been below the standard.



Figure E-12. SW027 and Associated Monitoring Locations

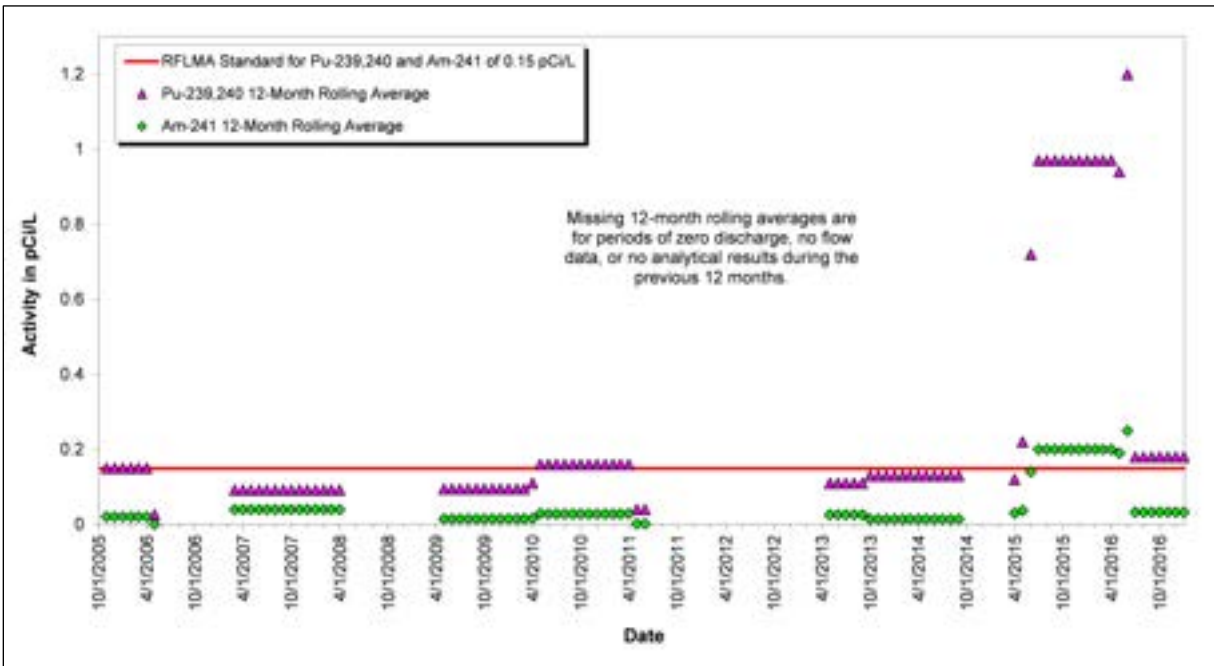


Figure E-13. Volume-Weighted 12-Month Rolling Average Plutonium and Americium Activities at Location SW027: Post-Closure Period Ending CY 2016

### E1.2.2 Performance Monitoring Locations

Performance monitoring locations are downstream of specific remedies (Figure E-2) and are used to determine the short- and long-term effectiveness of these remedies where known contaminants may affect surface water. The results of monitoring at these locations are discussed in the sections indicated below. The performance monitoring locations are as follows:

- NNG01, which monitors surface water downstream of the PLF and PLFTS (see Section 6.1.4.1)
- GS13, which monitors surface water downstream of the SPPTS (see Section E1.1.2.2)
- GS10, which monitors surface water downstream of the MSPTS (see Section E1.2.1.1)
- POM2, which monitors surface water downstream of the ETPTS (see Section E1.1.2.3)
- GS05, which monitors surface water upstream of the OLF (see Section 6.1.4.2)
- GS59, which monitors surface water downstream of the OLF (see Section 6.1.4.2)



## E2.0 References

DOE (U.S. Department of Energy), 2010. Letter from S.R. Surovchak, LM Site Manager, to C. Spreng, RFLMA Project Coordinator, regarding *Status Report of Steps Taken Regarding Monitoring Results at Surface Water Point of Evaluation (POE) SW027*, August 31.

DOE (U.S. Department of Energy), 2012. *Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats, Colorado, Site, Calendar Year 2011*, LMS/RFS/S08568, Office of Legacy Management, April.

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DOE (U.S. Department of Energy), 2014. *Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Colorado, Site, Calendar Year 2013*, LMS/RFS/S11432, Office of Legacy Management, April.

DOE (U.S. Department of Energy), 2015. *Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats, Colorado, Site, Calendar Year 2014*, LMS/RFS/S12421, Office of Legacy Management, April.

DOE (U.S. Department of Energy), 2016. *Rocky Flats Site Annual Report of Site Surveillance and Maintenance Activities, Calendar Year 2015*, LMS/RFS/S13696, Office of Legacy Management, April.

DOE, EPA, and CDPHE (U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment), 2006. *Corrective Action Decision/Record of Decision for Rocky Flats Plant (USDOE) Peripheral Operable Unit and Central Operable Unit, Jefferson and Boulder Counties, Colorado*, September.

Wright Water Engineers, Inc., 2015. *Evaluation of Water Quality Variability for Uranium and Other Selected Parameters in Walnut Creek at the Rocky Flats Site*, Rev. 1, September.

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## **Appendix F**

### **Documents Reviewed**

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**The following documents were reviewed as part of the FYR process to form the basis of the technical assessment of remedy protectiveness in the Central Operable Unit.**

*Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats, Colorado, Site, Calendar Year 2012*, LMS/RFS/S09641, U.S. Department of Energy Office of Legacy Management, April 2013.

*Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats, Colorado, Site, Calendar Year 2013*, LMS/RFS/S11432, U.S. Department of Energy Office of Legacy Management, April 2014.

*Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats, Colorado, Site, Calendar Year 2014*, LMS/RFS/S12421, U.S. Department of Energy Office of Legacy Management, April 2015.

*Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Site, Colorado, Calendar Year 2015*, LMS/RFS/S13696, U.S. Department of Energy Office of Legacy Management, April 2016.

*Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Site, Colorado, Calendar Year 2016*, LMS/RFS/S15402, U.S. Department of Energy Office of Legacy Management, April 2017.

*Corrective Action Decision/Record of Decision for Rocky Flats Plant (USDOE) Peripheral Operable Unit and Central Operable Unit, Jefferson and Boulder Counties, Colorado*, U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment, September 2006.

*Corrective Action Decision/Record of Decision Amendment for Rocky Flats Plant (USDOE) Peripheral Operable Unit and Central Operable Unit*, U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment, September 2011.

*Environmental Covenant Between DOE and CDPHE Pursuant to §25-15-321, Colorado Revised Statutes*, November 2011.

*First Five-Year Review Report for Rocky Flats Environmental Technology Site, Golden, Colorado*, Rocky Flats Field Office, Golden, Colorado, July 2002.

*Original Landfill Monitoring and Maintenance Plan*, LMS/RFS/S05516, U.S. Department of Energy Office of Legacy Management, September 2009.

*Present Landfill Monitoring and Maintenance Plan and Post-Closure Plan* U.S. Department of Energy Rocky Flats, Colorado, Site, LMS/RFS/S03965, U.S. Department of Energy Office of Legacy Management, December 2014.

*RCRA Facility Investigation-Remedial Investigation/Corrective Measures Study-Feasibility Study Report for the Rocky Flats Environmental Technology Site*, June 2006.

*Rocky Flats Legacy Management Agreement*, U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment, March 2007.

*Rocky Flats, Colorado, Site Quarterly Report of Site Surveillance and Maintenance Activities, First Quarter Calendar Year 2012*, LMS/RFS/S09187, U.S. Department of Energy Office of Legacy Management, July 2012.

*Rocky Flats, Colorado, Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, Second Quarter Calendar Year 2012*, LMS/RFS/S09930, U.S. Department of Energy Office of Legacy Management, October 2012.

*Rocky Flats Site, Colorado, Site Quarterly Report of Site Surveillance and Maintenance Activities, Third Quarter Calendar Year 2012*, LMS/RFS/S09514, U.S. Department of Energy Office of Legacy Management, January 2013.

*Rocky Flats, Colorado Site, Quarterly Report of Site Surveillance and Maintenance Activities, First Quarter Calendar Year 2013*, LMS/RFS/S10368, U.S. Department of Energy Office of Legacy Management, July 2013.

*Rocky Flats, Colorado, Site Quarterly Report of Site Surveillance and Maintenance Activities, Second Quarter Calendar Year 2013*, LMS/RFS/S10694, U.S. Department of Energy Office of Legacy Management, October 2013.

*Rocky Flats, Colorado, Site Quarterly Report of Site Surveillance and Maintenance Activities, Third Quarter Calendar Year 2013*, LMS/RFS/S11334, U.S. Department of Energy Office of Legacy Management, January 2014.

*Rocky Flats, Colorado, Site Quarterly Report of Site Surveillance and Maintenance Activities, First Quarter Calendar Year 2014*, LMS/RFS/S11979, U.S. Department of Energy Office of Legacy Management, July 2014.

*Rocky Flats, Colorado, Site Quarterly Report of Site Surveillance and Maintenance Activities, Second Quarter Calendar Year 2014*, LMS/RFS/S12195, U.S. Department of Energy Office of Legacy Management, October 2014.

*Rocky Flats, Colorado, Site Quarterly Report of Site Surveillance and Maintenance Activities, Third Quarter Calendar Year 2014*, LMS/RFS/S12555, U.S. Department of Energy Office of Legacy Management, January 2015.

*Rocky Flats, Colorado, Site Quarterly Report of Site Surveillance and Maintenance Activities, First Quarter Calendar Year 2015*, LMS/RFS/S13091, U.S. Department of Energy Office of Legacy Management, July 2015.

*Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, Second Quarter Calendar Year 2015*, LMS/RFS/S13352, U.S. Department of Energy Office of Legacy Management, October 2015.

*Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, Third Quarter Calendar Year 2015*, LMS/RFS/S13687, U.S. Department of Energy Office of Legacy Management, January 2016.

*Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, First Quarter Calendar Year 2016*, LMS/RFS/S14430, U.S. Department of Energy Office of Legacy Management, July 2016.

*Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, Second Quarter Calendar Year 2016*, LMS/RFS/S14793, U.S. Department of Energy Office of Legacy Management, October 2016.

*Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, Third Quarter Calendar Year 2016*, LMS/RFS/S15209, U.S. Department of Energy Office of Legacy Management, January 2017.

*Second Five-Year Review Report for the Rocky Flats Site Jefferson and Boulder Counties, Colorado*, DOE-LM/1504-2007, U.S. Department of Energy Office of Legacy Management, September 2007.

*Third Five-Year Review Report for the Rocky Flats Site Jefferson and Boulder Counties, Colorado*, LMS/RFS/S07693, U.S. Department of Energy Office of Legacy Management, July 2012.

**The following articles and reports were also reviewed in response to stakeholder input provided on the FYR.**

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Biello, D., 2006. "Colloids in Russia: Have Plutonium, Will Travel," *Scientific American*, October 26.

Hei, T.K., L.-J. Wu, S.-X. Liu, D. Vannais, C.A. Waldren, and G. Randers-Pehrson. 1997. "Mutagenic effects of a single and exact number of  $\alpha$  particles in mammalian cells," *Proceedings of the National Academy of Sciences* 94:3765–3770.

Heller, A., 2011. "Plutonium Hitches a Ride on Subsurface Particles," *Science & Technology Review*, Lawrence Livermore National Laboratory, October/November, pp. 16–18.

Johnson C.J., R.R. Tidball, and R.C. Severson, 1976. "Plutonium hazard in respirable dust on the surface of soil," *Science* 193:488–490.

Kaiser-Hill Co., LLC, 2000. *Report on Soil Erosion and Surface Water Sediment Transport Modeling for the Actinide Migration Evaluation at the Rocky Flats Environmental Technology Site*, 00-RF-01823/DOE-00-03258, August, p. 51.

Kersting, A.B., D.W. Eford, D.L. Finnegan, D.J. Rokop, D.K. Smith, and J.L. Thompson, 1999. "Migration of plutonium in ground water at the Nevada Test Site," *Nature* 397:56–59.

Makhijani, A., and S. Gopal, 2001. "Setting Cleanup Standards to Protect Future Generations: The Scientific Basis of the Subsistence Farmer Scenario and Its Application to the Estimation of Radionuclide Soil Action Levels for Rocky Flats," Institute for Energy and Environmental Research, Takoma Park, MD, December.

National Research Council, 2006. *Health Risks from Exposure to Low Levels of Ionizing Radiation BEIR VII, Phase 2*. Committee to Assess Health Risks from Exposure to Low Levels of Ionizing Radiation, National Academies Press, Washington, D.C., p. 246.

Novikov, A.P., S.N. Kalmykov, S. Utsunomiya, R.C. Ewing, F. Horreard, A. Merkulov, S.B. Clark, V.V. Tkachev, and B.F. Myasoedov, 2006. "Colloid Transport of Plutonium in the Far-Field of the Mayak Production Association, Russia," *Science* 314:638–641.

Satterfield, T., and J. Levin, 2002. *Risk Communication, Fugitive Values, and the Problem of Tradeoffs at Rocky Flats*, A Report for the U.S. Department of Energy Low-Dose Radiation Research Program, December 6, pp. 14–15.



## **Appendix G**

### **Site Inspection Checklist**

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EPA guidance (EPA 2001) indicates that the FYR should include a recent site inspection (generally, within the last nine months). The objective of this inspection is to visually confirm and document the conditions of the remedy, the site, and the surrounding area. An annual inspection of the site is required by the *Rocky Flats Legacy Management Agreement* (RFLMA) Attachment 2. The annual site inspection of the Central Operable Unit (COU) was conducted on March 16, 2017 and focused on the following:

- Evidence of significant erosion in the COU and evaluation of the proximity of significant erosion to subsurface features. This monitoring includes visual observation for precursor evidence of significant erosion (e.g., cracks, rills, slumping, subsidence, and sediment deposition).
- The effectiveness of institutional controls (ICs), as determined by any evidence of violation.
- Evidence of adverse biological conditions, such as unexpected morbidity or mortality, observed during the inspection and monitoring activities.

As part of the IC inspection, the presence of the Environmental Covenant in the Administrative Record and in Jefferson County records was verified on March 16, 2017. This Environmental Covenant has been in effect for this FYR period, however, it was superseded in early April 2017 by the Notice of Environmental Use Restrictions (see Section 3.3.2 of this fourth FYR report). During the annual inspection, marker flags were placed at locations where required follow-up by subject matter experts. Several areas had evidence of erosion and possible depressions, which were minor and very limited in area. Site field operations subject matter experts visited the areas to determine if any observations were significant or required repairs and collect trash/debris. No evidence of violations of ICs or physical controls was observed, and no adverse biological conditions were noted. The annual site inspection notes and site maps indicating the areas surveyed are provided following the FYR Site Inspection Checklist. The Five-Year Review Site Inspection Checklist below was completed by reviewing site monitoring and inspection records for this FYR period and discussing checklist items with site staff.

Inspections of the engineered remedy components, such as landfill covers and groundwater treatment systems, are conducted regularly at a frequency established in RFLMA. These components were not inspected specifically during the March 16 annual site inspection. Instead, the most recent routine and weather-related inspections of these components were considered in completing the FYR Site Inspection Checklist below. Thus, observations from the annual site inspection and the results of RFLMA routine and weather-related inspections are used in combination to satisfy the FYR site inspection requirement.

The remedy in the COU also includes physical controls (signs placed along the COU boundary), which are inspected quarterly (four times a year). The most recent sign inspection was performed on January 31, 2017; all required signs were present and in good condition.

## March 16, 2017 Annual Site Inspection Team Roster

<b>Name</b>	<b>Title</b>	<b>Affiliation</b>
Vera Moritz	RFLMA Project Coordinator	EPA Region 8
Steven Merritt	Industrial Hygienist/Radiation Coordinator	EPA Region 8
Carl Spreng	RFLMA Project Coordinator	CDPHE
Scott Surovchek	DOE-LM Site Manager	DOE-LM
Jeffrey Murl	DOE-LM Site Manager	DOE-LM
Joyce Chavez	DOE-LM Asset Management	DOE-LM
Linda Kaiser	LMS Site Manager	DOE-LMS contractor
Anya Palmieri	Groundwater Sampling Lead	DOE-LMS contractor
Chuck Brown	Groundwater Treatment Operations	DOE-LMS contractor
Jeff Walters	Groundwater Treatment Systems Lead	DOE-LMS contractor
Michelle Hanson	Project Coordinator	DOE-LMS contractor
Jody Nelson	Ecology Lead	DOE-LMS contractor
Patrick Boulas	Groundwater Treatment Operations	DOE-LMS contractor
Dana Santi	Technical Support	DOE-LMS contractor
John Boylan	Groundwater Lead	DOE-LMS contractor
Ryan Uzdienski	Surface Water Sampling Lead	DOE-LMS contractor
Jeremy Wehner	Landfill Project Manager	DOE-LMS contractor
David Ward	Environmental Compliance Lead	DOE-LMS contractor
Alan Smith	Site Operations Manager	DOE-LMS contractor
LM = Office of Legacy Management		
LMS = Legacy Management Support		



3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency EPA Region 8 RFLMA  
 Contact VEGA MORITZ PROJECT COORDINATOR VARIOUS\* 303-312-6981  
 Name Title Date Phone no.  
 Problems; suggestions;  Report attached \_\_\_\_\_

Agency CDPHE RFLMA  
 Contact CARL SPRENG PROJECT COORDINATOR VARIOUS 303-692-3358  
 Name Title Date Phone no.  
 Problems; suggestions;  Report attached \_\_\_\_\_

Agency CDPHE RFLMA  
 Contact LINDSAY MASTERS PROJECT COORDINATOR VARIOUS 303-692-3310  
 Name Title Date Phone no.  
 Problems; suggestions;  Report attached \_\_\_\_\_

Agency \_\_\_\_\_  
 Contact \_\_\_\_\_  
 Name Title Date Phone no.  
 Problems; suggestions;  Report attached \_\_\_\_\_

4. **Other interviews (optional)**  Report attached.

DOE-LM contractor involved in site monitoring, and inspections also provided input for the FYR site inspection.

\* Interaction with RFLMA PROJECT COORDINATORS regarding site conditions is not limited to the annual site inspections, but is continuous through the RFLMA consultative process.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply) *			
1.	<b>O&amp;M Documents</b> <input checked="" type="checkbox"/> O&M manual <input checked="" type="checkbox"/> As-built drawings <input checked="" type="checkbox"/> Maintenance logs Remarks <i>Some O&amp;M manuals and as-built drawings are being updated as a result of system modifications.</i>	<input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A <input type="checkbox"/> N/A <input type="checkbox"/> N/A
2.	<b>Site-Specific Health and Safety Plan</b> <input checked="" type="checkbox"/> Contingency plan/emergency response plan Remarks <i>Site is governed by DCE-LM-wide safety and health manual and emergency response plans.</i>	<input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A <input type="checkbox"/> N/A
3.	<b>O&amp;M and OSHA Training Records</b> Remarks _____	<input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A
4.	<b>Permits and Service Agreements</b> <input type="checkbox"/> Air discharge permit <input type="checkbox"/> Effluent discharge <input type="checkbox"/> Waste disposal, POTW <input checked="" type="checkbox"/> Other permits <i>USEWS</i> Remarks <i>Effluent discharge is monitored IAW RFLMA (federal facilities agreement)</i>	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input type="checkbox"/> N/A
5.	<b>Gas-Generation Records</b> Remarks _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
6.	<b>Settlement Monument Records</b> Remarks _____	<input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A
7.	<b>Groundwater Monitoring Records</b> Remarks <i>Surface water monitoring records are also readily available and up-to-date.</i>	<input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A
8.	<b>Leachate Extraction Records</b> Remarks _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A
9.	<b>Discharge Compliance Records</b> <input type="checkbox"/> Air <input checked="" type="checkbox"/> Water (effluent) Remarks <i>Effluent discharge monitored at COU boundary POCs.</i>	<input type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A <input type="checkbox"/> N/A
10.	<b>Daily Access/Security Logs</b> Remarks _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A

\* Documents discussed in this section are generally kept in LMS contractor office, not on-site, unless they are required to be available on-site.

IV. O&M COSTS																																																			
1.	<b>O&amp;M Organization</b> <input type="checkbox"/> State in-house <input type="checkbox"/> Contractor for State <input type="checkbox"/> PRP in-house <input type="checkbox"/> Contractor for PRP <input type="checkbox"/> Federal Facility in-house <input type="checkbox"/> Contractor for Federal Facility <input type="checkbox"/> Other _____ _____																																																		
2.	<b>O&amp;M Cost Records</b> <input type="checkbox"/> Readily available <input type="checkbox"/> Up to date <input type="checkbox"/> Funding mechanism/agreement in place Original O&M cost estimate _____ <input type="checkbox"/> Breakdown attached  Total annual cost by year for review period if available  <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;">From _____</td> <td style="width: 15%;">To _____</td> <td style="width: 15%; text-align: center;">_____</td> <td style="width: 15%; text-align: center;">Total cost</td> <td style="width: 40%;"><input type="checkbox"/> Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td style="text-align: center;">_____</td> <td></td> <td></td> </tr> <tr> <td>From _____</td> <td>To _____</td> <td style="text-align: center;">_____</td> <td style="text-align: center;">Total cost</td> <td><input type="checkbox"/> Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td style="text-align: center;">_____</td> <td></td> <td></td> </tr> <tr> <td>From _____</td> <td>To _____</td> <td style="text-align: center;">_____</td> <td style="text-align: center;">Total cost</td> <td><input type="checkbox"/> Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td style="text-align: center;">_____</td> <td></td> <td></td> </tr> <tr> <td>From _____</td> <td>To _____</td> <td style="text-align: center;">_____</td> <td style="text-align: center;">Total cost</td> <td><input type="checkbox"/> Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td style="text-align: center;">_____</td> <td></td> <td></td> </tr> <tr> <td>From _____</td> <td>To _____</td> <td style="text-align: center;">_____</td> <td style="text-align: center;">Total cost</td> <td><input type="checkbox"/> Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td style="text-align: center;">_____</td> <td></td> <td></td> </tr> </table>	From _____	To _____	_____	Total cost	<input type="checkbox"/> Breakdown attached	Date	Date	_____			From _____	To _____	_____	Total cost	<input type="checkbox"/> Breakdown attached	Date	Date	_____			From _____	To _____	_____	Total cost	<input type="checkbox"/> Breakdown attached	Date	Date	_____			From _____	To _____	_____	Total cost	<input type="checkbox"/> Breakdown attached	Date	Date	_____			From _____	To _____	_____	Total cost	<input type="checkbox"/> Breakdown attached	Date	Date	_____		
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3.	<b>Unanticipated or Unusually High O&amp;M Costs During Review Period</b> Describe costs and reasons: _____ _____ _____ _____ _____																																																		
V. ACCESS AND INSTITUTIONAL CONTROLS <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A																																																			
<b>A. Fencing</b>																																																			
1.	<b>Fencing damaged</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Gates secured <input checked="" type="checkbox"/> N/A Remarks _____ _____																																																		
<b>B. Other Access Restrictions</b>																																																			
1.	<b>Signs and other security measures</b> <input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A Remarks <u>In good condition and inspected quarterly.</u> _____																																																		

\* See Section 6.1.5 for discussion of O&M costs in this fourth FYR report.



<b>C. Institutional Controls (ICs)</b>			
1.	<b>Implementation and enforcement</b>		
	Site conditions imply ICs not properly implemented	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No <input type="checkbox"/> N/A
	Site conditions imply ICs not being fully enforced	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No <input type="checkbox"/> N/A
	Type of monitoring (e.g., self-reporting, drive by)	<u>ON-SITE VISITS</u>	
	Frequency	<u>most work days</u>	
	Responsible party/agency	<u>DOE-LM</u>	
	Contact	<u>SCOTT SUROVICHAK</u>	<u>DOE-LM SITE MGR.</u>
	Name	Title	Date <u>N/A</u> Phone no. <u>720-377-9682</u>
	Reporting is up-to-date	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	Reports are verified by the lead agency	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	Specific requirements in deed or decision documents have been met	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	Violations have been reported	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
	Other problems or suggestions:	<input type="checkbox"/> Report attached	
	_____		
	_____		
	_____		
2.	<b>Adequacy</b>	<input checked="" type="checkbox"/> ICs are adequate	<input type="checkbox"/> ICs are inadequate <input type="checkbox"/> N/A
	Remarks	<u>ICs are enforceable by the state of Colorado via the</u> <u>Notice of Environmental Use Restrictions filed with the</u> <u>local county.</u>	
<b>D. General</b>			
1.	<b>Vandalism/trespassing</b>	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> No vandalism evident
	Remarks	_____	
2.	<b>Land use changes on site</b>	<input checked="" type="checkbox"/> N/A	
	Remarks	_____	
3.	<b>Land use changes off site</b>	<input checked="" type="checkbox"/> N/A	
	Remarks	_____	
<b>VI. GENERAL SITE CONDITIONS</b>			
<b>A. Roads</b> <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A			
1.	<b>Roads damaged</b>	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Roads adequate <input type="checkbox"/> N/A
	Remarks	_____	

<b>B. Other Site Conditions</b>			
Remarks _____			
_____			
_____			
_____			
_____			
_____			
_____			
<b>VII. LANDFILL COVERS</b> <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A <i>OLF &amp; PLF *</i>			
<b>A. Landfill Surface</b>			
1.	<b>Settlement (Low spots)</b> Areal extent _____ Remarks _____	<input type="checkbox"/> Location shown on site map Depth _____	<input type="checkbox"/> Settlement not evident
Inspections are performed periodically per the Landfill U & M Plans. See corresponding inspection checklists and reports in site records and annual site reports.			
2.	<b>Cracks</b> Lengths _____ Widths _____ Depths _____ Remarks _____	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Cracking not evident
See remarks in VII A.1.			
3.	<b>Erosion</b> Areal extent _____ Remarks _____	<input type="checkbox"/> Location shown on site map Depth _____	<input type="checkbox"/> Erosion not evident
See remarks in VII A.1.			
4.	<b>Holes</b> Areal extent _____ Remarks _____	<input type="checkbox"/> Location shown on site map Depth _____	<input checked="" type="checkbox"/> Holes not evident
5.	<b>Vegetative Cover</b> <input type="checkbox"/> Grass <input type="checkbox"/> Cover properly established <input type="checkbox"/> No signs of stress <input type="checkbox"/> Trees/Shrubs (indicate size and locations on a diagram) Remarks _____	Vegetation cover meets success criteria except for areas that have recently been disturbed.	
6.	<b>Alternative Cover (armored rock, concrete, etc.)</b> Remarks _____	<input checked="" type="checkbox"/> N/A	
7.	<b>Bulges</b> Areal extent _____ Remarks _____	<input type="checkbox"/> Location shown on site map Height _____	<input type="checkbox"/> Bulges not evident
See remarks in VII A.1.			

\* The March 2017 OLF inspection report and the first quarter (March 2017) PLF inspection report are attached.

8.	<b>Wet Areas/Water Damage</b>	<input type="checkbox"/> Wet areas/water damage not evident	
	<input type="checkbox"/> Wet areas	<input type="checkbox"/> Location shown on site map	Areal extent _____
	<input type="checkbox"/> Ponding	<input type="checkbox"/> Location shown on site map	Areal extent _____
	<input type="checkbox"/> Seeps	<input type="checkbox"/> Location shown on site map	Areal extent _____
	<input type="checkbox"/> Soft subgrade	<input type="checkbox"/> Location shown on site map	Areal extent _____
	Remarks	<i>See remarks in VII A.1.</i>	
9.	<b>Slope Instability</b>	<input type="checkbox"/> Slides	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of slope instability
	Areal extent _____		
	Remarks	<i>See remarks in VII A.1.</i>	
<b>B. Benches</b> <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A			
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)			
1.	<b>Flows Bypass Bench</b>	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> N/A or okay
	Remarks _____		
2.	<b>Bench Breached</b>	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> N/A or okay
	Remarks _____		
3.	<b>Bench Overtopped</b>	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> N/A or okay
	Remarks _____		
<b>C. Letdown Channels</b> <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A <i>at OLF</i>			
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)			
1.	<b>Settlement</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of settlement
	Areal extent _____	Depth _____	
	Remarks	<i>See remarks in VII A.1 and attached OLF inspection report.</i>	
2.	<b>Material Degradation</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of degradation
	Material type _____	Areal extent _____	
	Remarks	<i>See remarks in VII A.1 and attached OLF inspection report.</i>	
3.	<b>Erosion</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of erosion
	Areal extent _____	Depth _____	
	Remarks	<i>See remarks in VII A.1 and attached OLF inspection report.</i>	

4.	<b>Undercutting</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of undercutting
	Areal extent _____	Depth _____	
	Remarks <i>See remarks in VII A.1 and attached OLF inspection report.</i>		
5.	<b>Obstructions</b>	Type _____	<input type="checkbox"/> No obstructions
	<input type="checkbox"/> Location shown on site map	Areal extent _____	
	Size _____		
	Remarks <i>See remarks in VII A.1 and attached OLF inspection report.</i>		
6.	<b>Excessive Vegetative Growth</b>	Type _____	
	<input type="checkbox"/> No evidence of excessive growth		
	<input type="checkbox"/> Vegetation in channels does not obstruct flow		
	<input type="checkbox"/> Location shown on site map	Areal extent _____	
	Remarks <i>See remarks in VII A.1 and attached OLF inspection report.</i>		
<b>D. Cover Penetrations</b> <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A			
1.	<b>Gas Vents</b>	<input type="checkbox"/> Active <input checked="" type="checkbox"/> Passive	
	<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled <input checked="" type="checkbox"/> Good condition
	<input type="checkbox"/> Evidence of leakage at penetration	<input type="checkbox"/> Needs Maintenance	
	<input type="checkbox"/> N/A		
	Remarks _____		
2.	<b>Gas Monitoring Probes</b>	<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning
	<input type="checkbox"/> Evidence of leakage at penetration	<input type="checkbox"/> Routinely sampled	<input type="checkbox"/> Good condition
		<input type="checkbox"/> Needs Maintenance	<input checked="" type="checkbox"/> N/A
	Remarks _____		
3.	<b>Monitoring Wells (within surface area of landfill)</b>	<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning
	<input type="checkbox"/> Evidence of leakage at penetration	<input type="checkbox"/> Routinely sampled	<input type="checkbox"/> Good condition
		<input type="checkbox"/> Needs Maintenance	<input checked="" type="checkbox"/> N/A
	Remarks _____		
4.	<b>Leachate Extraction Wells</b>	<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning
	<input type="checkbox"/> Evidence of leakage at penetration	<input type="checkbox"/> Routinely sampled	<input type="checkbox"/> Good condition
		<input type="checkbox"/> Needs Maintenance	<input checked="" type="checkbox"/> N/A
	Remarks _____		
5.	<b>Settlement Monuments</b>	<input checked="" type="checkbox"/> Located	<input checked="" type="checkbox"/> Routinely surveyed
	<input type="checkbox"/> N/A		
	Remarks _____		

<b>E. Gas Collection and Treatment</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1.	<b>Gas Treatment Facilities</b> <input type="checkbox"/> Flaring <input type="checkbox"/> Thermal destruction <input type="checkbox"/> Collection for reuse <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____		
2.	<b>Gas Collection Wells, Manifolds and Piping</b> <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____		
3.	<b>Gas Monitoring Facilities (e.g., gas monitoring of adjacent homes or buildings)</b> <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A Remarks _____		
<b>F. Cover Drainage Layer</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1.	<b>Outlet Pipes Inspected</b> Remarks _____	<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A
2.	<b>Outlet Rock Inspected</b> Remarks _____	<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A
<b>G. Detention/Sedimentation Ponds</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1.	<b>Siltation</b> Areal extent _____ Depth _____ <input type="checkbox"/> Siltation not evident Remarks _____		<input type="checkbox"/> N/A
2.	<b>Erosion</b> Areal extent _____ Depth _____ <input type="checkbox"/> Erosion not evident Remarks _____		
3.	<b>Outlet Works</b> Remarks _____	<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A
4.	<b>Dam</b> Remarks _____	<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A

<b>H. Retaining Walls</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1.	<b>Deformations</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Deformation not evident
	Horizontal displacement _____	Vertical displacement _____	
	Rotational displacement _____		
	Remarks _____		
2.	<b>Degradation</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Degradation not evident
	Remarks _____		
<b>I. Perimeter Ditches/Off-Site Discharge</b>		<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A
1.	<b>Siltation</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Siltation not evident
	Areal extent _____	Depth _____	
	Remarks <u>See remarks in VII A.1.</u>		
2.	<b>Vegetative Growth</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> N/A
	<input type="checkbox"/> Vegetation does not impede flow		
	Areal extent _____	Type _____	
	Remarks <u>See remarks in VII A.1.</u>		
3.	<b>Erosion</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Erosion not evident
	Areal extent _____	Depth _____	
	Remarks <u>See remarks in VII A.1.</u>		
4.	<b>Discharge Structure</b>	<input type="checkbox"/> Functioning	<input checked="" type="checkbox"/> N/A
	Remarks _____		
<b>VIII. VERTICAL BARRIER WALLS</b>		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1.	<b>Settlement</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Settlement not evident
	Areal extent _____	Depth _____	
	Remarks _____		
2.	<b>Performance Monitoring</b>	Type of monitoring _____	
	<input type="checkbox"/> Performance not monitored		
	Frequency _____	<input type="checkbox"/> Evidence of breaching	
	Head differential _____		
	Remarks _____		

<b>IX. GROUNDWATER/SURFACE WATER REMEDIES</b> <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A	
<b>A. Groundwater Extraction Wells, Pumps, and Pipelines</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
1.	<b>Pumps, Wellhead Plumbing, and Electrical</b> <input type="checkbox"/> Good condition <input type="checkbox"/> All required wells properly operating <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A Remarks _____ _____
2.	<b>Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances</b> <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____
3.	<b>Spare Parts and Equipment</b> <input type="checkbox"/> Readily available <input type="checkbox"/> Good condition <input type="checkbox"/> Requires upgrade <input type="checkbox"/> Needs to be provided Remarks _____ _____
<b>B. Surface Water Collection Structures, Pumps, and Pipelines</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
1.	<b>Collection Structures, Pumps, and Electrical</b> <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____
2.	<b>Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances</b> <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____
3.	<b>Spare Parts and Equipment</b> <input type="checkbox"/> Readily available <input type="checkbox"/> Good condition <input type="checkbox"/> Requires upgrade <input type="checkbox"/> Needs to be provided Remarks _____ _____

<b>C. Treatment System</b>		<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A	<i>only for groundwater.</i>
1.	<b>Treatment Train</b> (Check components that apply)	<input checked="" type="checkbox"/> Metals removal	<input type="checkbox"/> Oil/water separation	<input checked="" type="checkbox"/> Bioremediation
		<input checked="" type="checkbox"/> Air stripping	<input type="checkbox"/> Carbon adsorbers	
		<input type="checkbox"/> Filters		
		<input checked="" type="checkbox"/> Additive (e.g., chelation agent, flocculent)	<i>Carbon nutrient source</i>	
		<input type="checkbox"/> Others		
		<input checked="" type="checkbox"/> Good condition	<input type="checkbox"/> Needs Maintenance	
		<input checked="" type="checkbox"/> Sampling ports properly marked and functional		
		<input checked="" type="checkbox"/> Sampling/maintenance log displayed and up to date		
		<input checked="" type="checkbox"/> Equipment properly identified		
		<input checked="" type="checkbox"/> Quantity of groundwater treated annually	<i>3.3 MILLION GALLONS (Average annual volume treated from 2012-2016)</i>	
		<input type="checkbox"/> Quantity of surface water treated annually	<i>N/A</i>	
	Remarks	<i>Maximum treatability studies are ongoing in 4 systems</i>		
2.	<b>Electrical Enclosures and Panels</b> (properly rated and functional)	<input type="checkbox"/> N/A	<input checked="" type="checkbox"/> Good condition	<input type="checkbox"/> Needs Maintenance
	Remarks			
3.	<b>Tanks, Vaults, Storage Vessels</b>	<input type="checkbox"/> N/A	<input checked="" type="checkbox"/> Good condition	<input type="checkbox"/> Proper secondary containment <input type="checkbox"/> Needs Maintenance
	Remarks			
4.	<b>Discharge Structure and Appurtenances</b>	<input type="checkbox"/> N/A	<input checked="" type="checkbox"/> Good condition	<input type="checkbox"/> Needs Maintenance
	Remarks			
5.	<b>Treatment Building(s)</b>	<input type="checkbox"/> N/A	<input checked="" type="checkbox"/> Good condition (esp. roof and doorways)	<input type="checkbox"/> Needs repair
		<input checked="" type="checkbox"/> Chemicals and equipment properly stored		
	Remarks			
6.	<b>Monitoring Wells</b> (pump and treatment remedy)	<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition
		<input type="checkbox"/> All required wells located	<input type="checkbox"/> Needs Maintenance	<input checked="" type="checkbox"/> N/A
	Remarks			
<b>D. Monitoring Data</b> - <i>for surface water and groundwater.</i>				
1.	Monitoring Data	<input checked="" type="checkbox"/> Is routinely submitted on time	<input checked="" type="checkbox"/> Is of acceptable quality	
2.	Monitoring data suggests:	<i>N/A</i>		
		<input type="checkbox"/> Groundwater plume is effectively contained	<input type="checkbox"/> Contaminant concentrations are declining	



<b>D. Monitored Natural Attenuation</b>			
1.	<b>Monitoring Wells</b> (natural attenuation remedy)	<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning
		<input type="checkbox"/> All required wells located	<input type="checkbox"/> Needs Maintenance
	Remarks _____	<input type="checkbox"/> Routinely sampled	<input type="checkbox"/> Good condition
			<input checked="" type="checkbox"/> N/A
<b>X. OTHER REMEDIES</b>			
If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.			
<b>XI. OVERALL OBSERVATIONS</b>			
<b>A. Implementation of the Remedy</b>			
Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).			
<p style="text-align: center;"><i>See Section 6.1 of this fourth FYR report.</i></p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>			
<b>B. Adequacy of O&amp;M</b>			
Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.			
<p style="text-align: center;"><i>See Section 6.1.5 of this fourth FYR report.</i></p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>			

**C. Early Indicators of Potential Remedy Problems**

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.

*See Section 6.1.5 of this fourth FYR report.*

**D. Opportunities for Optimization**

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

*See Section 6.1.4.3 of this fourth FYR report.*

## Present Landfill– Monitoring and Maintenance Plan Inspection Form

Inspector: Patrick Boulas Date: 3/13/17 Time: 13:30 Reviewed by: Jeremy Wehner

Temperature: 50 deg F Weather conditions: Partly Cloudy Review date: 3/27/17

Meteorological station location: Rocky Flats Meteorological Station

Subsidence/Consolidation					
Region	Evidence of cracks	Evidence of depressions	Evidence of sinkholes	Evidence of ponding	Other (Describe below)
Top cover– West	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Top cover– East	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Cover side slope– North	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Cover side slope– South	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
East face slope– North	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
East face slope– South	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
East face slope– Central	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
East face slope– North Seep*	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Settlement plates and side slope monitoring points to be inspected for integrity. During year 1, they will be surveyed quarterly, and annually thereafter.			Integrity intact <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		

\*Area of seep is outside of landfill cover and east of the cover anchor trench

Maintenance required, comments, photo log: No maintenance necessary.

Present Landfill – Monitoring and Maintenance Plan Inspection Form (continued)

Slope Stability				
Region	Evidence of cracks	Evidence of block or circular failure	Evidence of seeps	Other (Describe below)
Cover side slope– North	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Cover side slope– South	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Perimeter channel outer slope– North	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Perimeter channel outer slope– South	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
East face slope– North	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
East face slope– South	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
East face slope–Central	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
East face slope–North seep*	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	

\*Area of seep is outside of landfill cover and east of the cover anchor trench

Maintenance required, comments, photo log: The soil was damp but no flow was visible in the east face slope - north seep.

Present Landfill – Monitoring and Maintenance Plan Inspection Form (continued)

Soil Cover				
Region	Evidence of deposition or erosion	Evidence of erosion rills or gullies	Evidence of burrowing animals	Other (Describe below)
Top of cover–West	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Top of cover–East	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Cover side slope–North	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Cover side slope–South	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
East face slope–North	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
East face slope–South	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
East face slope–Central	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Area where east slope central meets east slope–North	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Area where east slope central meets east slope–South	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
	<b>Vent caps in place and secure</b>	<b>Standpipes in good condition</b>	<b>Birds or insects in vent caps</b>	
Cover–barometric vents	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	

Maintenance required, comments, photo log: No maintenance necessary.

Present Landfill – Monitoring and Maintenance Plan Inspection Form (continued)

Seep Treatment System			
Region	Evidence of plugging, obstructions, or excess debris	Evidence of cracks or deterioration	Other (describe below)
GWIS inlet pipes	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Strip drain inlet pipe	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
North manhole outlet pipe	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
South manhole outlet pipe	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Treatment unit	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Treatment unit outlet pipe	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
North manhole	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
South manhole	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Treatment unit grating	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	

Maintenance required, comments, photo log: No maintenance necessary. The new grout at the north and south manholes is in good condition.

Present Landfill – Monitoring and Maintenance Plan Inspection Form (continued)

Stormwater Management Structures								
Structure	Evidence of excessive erosion, gulying, scour, or undermining	Evidence of settlement subsidence or depressions	Evidence of breaching or bank failure	Evidence of burrowing animals	Evidence of sediment build-up or other blockage	Evidence of lining deterioration holes, rips, or separations	Evidence of lining displacement	
Diversion berm	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Vegetation lines perimeter channel–North	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Vegetation lined perimeter channel–South	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Riprap lined perimeter channel	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
C350 lined east face	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
East face riprap channel–North	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
East face riprap channel–South	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	

Other deficiencies: N/A

Maintenance required, comments, photo log: No maintenance necessary.

**Present Landfill – Monitoring and Maintenance Plan Inspection Form (continued)**

**Stormwater Management Structures (continued)**

**OUTFALLS**

Check each structure for excessive erosion and sediment depth. If sediment depth is compromising the design characteristics, remove sediment.

Structure	Condition and sediment depth
Diversion Berm Outfall–North	No issue
Diversion Berm Outfall–South	No issue
Culvert 1 outfall	No issue
Culvert 2 outfall	No issue
South culvert outfall	No issue

**CULVERTS**

Check each structure for blockage, surrounding conditions, breaching, sediment build-up, and inlet/outlet conditions.

Structure	Condition
Culvert 1	No issue
Culvert 2	No issue
South Culvert	No issue

Maintenance required, comments, photo log: No maintenance necessary.



Contractor to U.S. Department of Energy Office of Legacy Management

Present Landfill – Monitoring and Maintenance Plan Inspection Form (continued)

"Run-On" Erosion Control	
Area	Adversely affecting PLF
Run-on into perimeter channel–North	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Comment:
Run-on into perimeter channel–South	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Comment:
Natural drainage fed by culvert 1	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Comment:
Natural drainage fed by northeast perimeter channel	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Comment:
Natural drainage fed by riprap	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Comment:

Maintenance required, comments, photo log: No maintenance necessary.

**Present Landfill – Monitoring and Maintenance Plan Inspection Form (continued)**

**Institutional Controls**

Item	
Evidence of excavation(s) of cover and immediate vicinity of cover?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Comment:
Evidence of construction of roads, trails, on cover or buildings?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Comment:
Evidence of unauthorized entry?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Comment:
Evidence of drilling, wells or use of groundwater?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Comment:
Disruption or damage of seep treatment system?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Comment:
Damage or removal of any signage or groundwater monitoring wells?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Comment:

Other deficiencies, photo log: N/A

Contractor to U.S. Department of Energy Office of Legacy Management

Present Landfill – Monitoring and Maintenance Plan Inspection Form (continued)

Action Items				
Deficiency	Date noted	Action	Date completed	Comments
No Deficiencies	3/13/2017			

Inspector signature: 

Date: 3/14/17

Reviewer signature: 

Date: 3/27/2017



PLF Looking Northwest at the East Face Slope, with PLFTS on right



PLF Looking West at the Cover Side Slope – North



PLF Looking Northwest at the Top Cover – West

Attachment 1: March 2017  
Monthly Report of the Original Landfill Inspection at the Rocky Flats Site

The monthly inspection of the Original Landfill (OLF) at the Rocky Flats Site, Colorado, was completed on March 22, 2017. The weather was sunny and clear during the inspection. The Rocky Flats Site Meteorological Tower recorded 0.08 inches of precipitation at the site between this inspection and the prior inspection of February 22, 2017. The National Renewable Energy Laboratory M2 tower, adjacent to the northwest corner of the site, recorded 0.30 inches during the same time period using a heated rain gauge.

Figure 1 provides the approximate locations where each of the inspection photographs were taken on the OLF (as shown in Figures 2–7).

No new signs of movement were observed on the OLF (Figure 2). No new cracks since the time of the previous inspection have been observed. Regions that show cracks that were backfilled are no longer checkmarked on the inspection form. Items that are checkmarked are from previous cracks that cannot be backfilled with hand tools. A description is included with information about the checkmarked items. The most notable cracks in 2016, southeast of Berm 5 starting just below Seep 2/3, were repaired during the September 2016 minor regrading (Figure 3), and since then, no signs of cracking or movement have been observed.

The construction of the OLF temporary groundwater intercept system started on March 14, 2017. At the time of inspection, the gravity drain line was in place and connected to the East Subsurface Drain (ESSD) (Figure 4). During the inspection, a subcontractor was flushing water through the ESSD lines and repairing the erosion control mat near the ESSD that had blown away. Weekly inspection of the ESSD and ESSD outfall has not resulted in the discovery of any visible water flowing out of the pipes; however, the ESSD outfall was damp. Erosion-control is in good condition, and most of the minor damage occurring from wildlife and high winds has been repaired (Figure 5). Staking the drainage pipe at more frequent intervals has reduced movement caused by high winds and is expected to increase the life of the drainage pipe. The revegetation of recently disturbed areas on the OLF is managed and monitored under the *Erosion Control Plan for Rocky Flats Property Central Operable Unit* (DOE 2007)<sup>1</sup> and under the sitewide vegetation and revegetation plans.

Seep 8A had the highest flow of the seeps at approximately 2 gallons per minute (gpm). Seep 2/3 was flowing less than 1 gpm and Seep 7 was damp. Seep 9 and Seep 4 had pockets of water with no visible flow. A wet area was discovered, about 30 feet north of the Seep 2/3 drainage outfall, flowing at approximately 1 gpm (Figure 6). The wet area appears to be from water in the East Perimeter Channel (EPC) that percolates through the EPC side slope instead of

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<sup>1</sup> DOE (U.S. Department of Energy), 2007. *Erosion Control Plan for Rocky Flats Property Central Operable Unit*, DOE-LM/1497-2007, Office of Legacy Management, Rocky Flats Environmental Technology Site, July.

towards the EPC outfall. This water then continues to run south along the Seep 2/3 drainage pipe, creating pockets of water and damp soil running to Woman Creek (Figure 7). The Seep 2/3 drainage pipe was moved so that the drainage outfall would discharge in the EPC, in an effort to reduce the amount of water at the wet area. The wet area will be monitored to determine the effects of moving the Seep 2/3 drainage pipe, and to observe whether it is being fed by surface or subsurface sources. No ground movement has been observed in this area since the previous inspection. The rest of the historic seep locations on the OLF were dry at the time of inspection.

Summary

No new ground movement of the OLF cover was observed during the inspection. Minor corrugated drainage pipe damage behind Berm 7 was repaired. A wet area was discovered that appears to shortcut the EPC outfall to Woman Creek. The inspection forms are filled out to represent current conditions at the OLF. Repaired items will no longer be checkmarked as evidence unless further action is warranted.

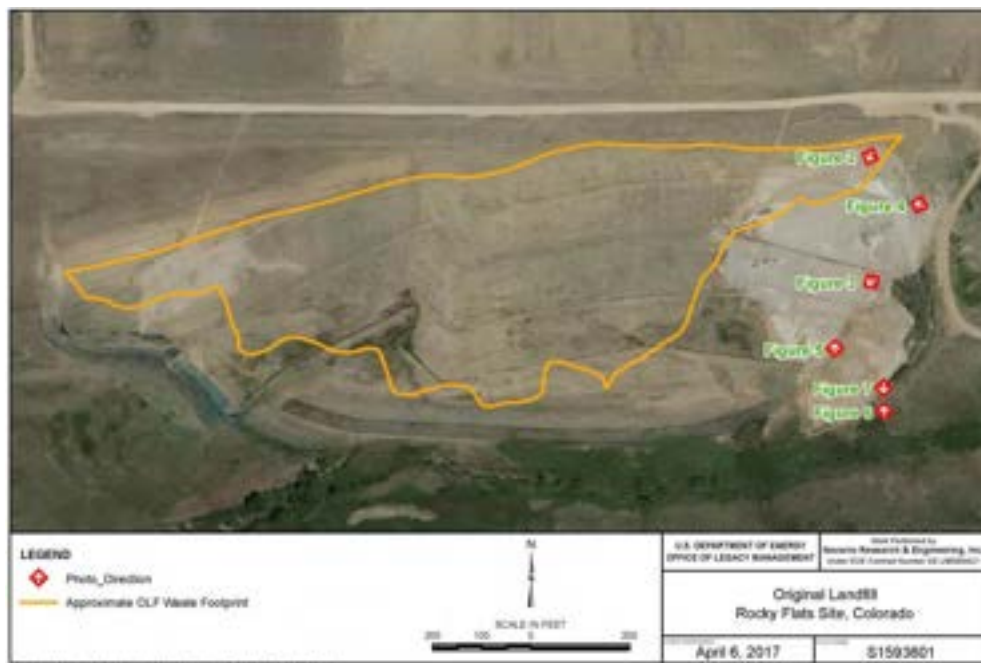


Figure 1. Location and Direction of Each of the Photographs Referred to in this Report (Figures 2–7), Rocky Flats Site OLF





Figure 2. Looking South at Berm 4 and the New Above-Ground Drain Pipe Running from the OLF Groundwater Intercept System to the ESSD



Figure 3. Looking West, Just East of Berm 6



Figure 4. Looking West, at Berm 4 and the Gravity Drain Line Connection to the ESDD



Figure 5. Standing on Berm 7 Looking North to Berm 6



Figure 6. Standing Below the Seep 2/3 Drainage Outfall Looking North at the Wet Area Discovered (estimated outline in blue)



Figure 7. Standing Above the Seep 2/3 Drainage Outfall Looking South at the Wet Area Discovered

## Original Landfill – Monitoring and Maintenance Plan Inspection Form

Inspector: Patrick Boulas Date: 3/22/17 Time: 11:30 AM Reviewed by: Jeremy Wehner

Temperature: 56 DEG F Weather conditions: Sunny Review date: 4/3/2017

### Subsidence/Consolidation

Region	Evidence of cracks	Evidence of depressions	Evidence of sink holes	Evidence of ponding	Other (Describe below)
Top cover–West	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Top cover– East	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Buttress fill	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Diversion Berm 1	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Diversion Berm 2	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Diversion Berm 3	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Diversion Berm 4	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Salt stain
Diversion Berm 5	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Salt stain
Diversion Berm 6	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Diversion Berm 7	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	

Settlement plates—inspection integrity. Intact  Yes  No

Maintenance required, comments, and/or photo log: No new movement observed at the Original Landfill (OLF). The Rocky Flats Site Meteorological Tower recorded 0.08 inches of precipitation since the last monthly report. The National Renewable Energy Laboratory M2 tower, adjacent to the northwest corner of the site, recorded 0.30 inches during the same time period using a heated rain gauge. No new cracks were observed.

Original Landfill – Monitoring And Maintenance Plan Inspection Form (continued)

Slope Stability				
Region	Evidence of cracks	Evidence of seeps	Evidence of block or circular failure	Other (Describe below)
Cover– West	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Cover– East	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Buttress fill side slope	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
West perimeter channel side slopes	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
East perimeter channel side slopes	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Wet area found near Seep 2/3 drainage outfall
Cover seeps (if present)	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	

Maintenance required, comments, and/or photo log: East Perimeter Channel (EPC) had no visible flow, but mud and pockets of water were present throughout the channel. Seep 8A had the highest flow of the seeps at approximately 2 gallons per minute (gpm). Seep 2/3 was flowing at less than 1 gpm and Seep 7 was damp. Seep 9 and Seep 4 had pockets of water but no visible flow. A wet area was discovered about 30 feet north of the Seep 2/3 drainage outfall. The source of the wet area is not clear at this time. The wet area is running south along the Seep 2/3 drainage pipe and has pockets of water and damp soil leading to Woman Creek. No ground movement has been observed in this area since the discovery of the wet area. The Seep 2/3 drainage pipe was moved to the EPC and the wet area will be monitored to determine if it is being fed by surface or subsurface sources, and any effects will be recorded.

Original Landfill – Monitoring And Maintenance Plan Inspection Form (continued)

Soil Cover

Region	Evidence of deposition or erosion	Evidence of erosion rills or gullies	Evidence of burrowing animals	Other (Describe below)
Cover– West	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Cover– East	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Buttress fill	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Buttress fill side slope	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	

Maintenance required, comments, and/or photo log: N/A

Original Landfill – Monitoring And Maintenance Plan Inspection Form (continued)

Vegetation				
Region	Condition of grass	Unwanted vegetation present*	Percentage of grass versus bare ground	Percentage of unwanted vegetation
Cover– West	See Comments	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Cover– East	See Comments	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Diversion Berm 1	See Comments	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Diversion Berm 2	See Comments	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Diversion Berm 3	See Comments	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Diversion Berm 4	See Comments	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Diversion Berm 5	See Comments	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Diversion Berm 6	See Comments	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Diversion Berm 7	See Comments	<input type="checkbox"/> Yes <input type="checkbox"/> No		
West perimeter channel	See Comments	<input type="checkbox"/> Yes <input type="checkbox"/> No		
East perimeter channel	See Comments	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Upper buttress fill side slope	See Comments	<input type="checkbox"/> Yes <input type="checkbox"/> No		
Lower buttress fill side slope	See Comments	<input type="checkbox"/> Yes <input type="checkbox"/> No		

\*Unwanted vegetation includes weeds and "woody vegetation." Woody vegetation within the original landfill (OLF) waste footprint must be removed. Other locations must be evaluated per section 3.5 of the Original Landfill Monitoring and Maintenance Plan.

Maintenance required, comments, and/or photo log: Vegetation inspection is no longer required by Rocky Flats Legacy Management Agreement. New areas of disturbance are addressed under the site wide revegetation plan, "Erosion Control Plan for Rocky Flats Property Central Operable Unit."

Original Landfill – Monitoring And Maintenance Plan Inspection Form (continued)

Stormwater Management Structures										
Channels										
Structure	Evidence of excessive erosion, gully, scour, or undermining		Evidence of settlement, subsidence, or depressions		Evidence of breaching or bank failure		Evidence of burrowing animals		Evidence of sediment build-up or other blockage	
Diversion Berm 1	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Diversion Berm 2	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Diversion Berm 3	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Diversion Berm 4	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Diversion Berm 5	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Diversion Berm 6	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Diversion Berm 7	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Temporary check dams*	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
West perimeter channel	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
East perimeter channel	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No

\*Check dams may be removed after vegetation is established.

Other deficiencies: None

Maintenance required, comments, and/or photo log: The damaged corrugated drainage pipe behind Berm 7 was repaired.



**Original Landfill – Monitoring And Maintenance Plan Inspection Form (continued)**

**Stormwater Management Structures (continued)**

**Outfalls**

Check each structure for excessive erosion and sediment depth. If sediment depth is compromising the design characteristics, remove sediment.

Structure	Condition and sediment depth
Diversion Berm Outfall 1	No issues
Diversion Berm Outfall 2	No issues
Diversion Berm Outfall 3	No issues
Diversion Berm Outfall 4	No issues
Diversion Berm Outfall 5	No issues
Diversion Berm Outfall 6	No issues
Diversion Berm Outfall 7	No issues
West perimeter channel outfall	No issues, dry, no flow
East perimeter channel outfall	Muddy with pockets of water, no visible flow
French drain outfall (SID)	Dry, no flow

Other deficiencies: None

Maintenance required, comments, and/or photo log: No new erosion or sediment buildup. There were mud and pockets of water at the EPC outfall. The East Subsurface Drain (ESSD) outfall had no flow but the ESSD outfall channel was damp in the weekly inspections leading up to the monthly inspection. At the time of the monthly inspection, the ESSD lines were being flushed with water per the subcontractor's punch list and water was observed at the outfall.

Original Landfill – Monitoring And Maintenance Plan Inspection Form (continued)

“Run-On” Control	
Area	Adversely affecting OLF
North of the original landfill	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Comment:
West of the west perimeter channel	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Comment:
East of the east perimeter channel	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Comment:
North of Woman Creek	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Comment:

Maintenance required: N/A

Original Landfill – Monitoring And Maintenance Plan Inspection Form (continued)

Institutional Controls	
Item	
Evidence of excavation(s) of cover and immediate vicinity of cover?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Comment:
Evidence of construction of roads, trails, or buildings on cover?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Comment:
Evidence of drilling of wells or use of groundwater?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Comment:
Damage or removal of any signage or groundwater monitoring wells?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Comment:

Other deficiencies and/or photo log: The 2017 OLF Temporary Groundwater Intercept System described in CR 2017-01 has two wells that have been drilled just upgradient of the OLF cover and outside the OLF boundary.

Original Landfill – Monitoring And Maintenance Plan Inspection Form (continued)

Action Items				
Deficiency	Date noted	Action	Date completed	Comments
Drainage pipe behind Berm 7 was damaged	3/22/17	Drainage pipe was repaired with new coupler and taped	3/22/17	
Erosion-control mat disturbed south of berm 7	3/22/17	Restaked erosion control mat, ecologist was notified	3/22/17	

Inspector signature: 

Date: 4/12/2017

Reviewer signature: 

Date: 4/12/2017

## **Appendix H**

### **Changes to Applicable, Relevant, and Appropriate Requirements**

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ARAR <sup>1</sup>		Change	Impact to Remedy	Revision Reference	Contact Record	Effective Date
Stormwater Permit for Construction Activities	40 CFR 122.26	Issuance of the 2017 NPDES Construction General Permit (CGP) to replace 2012 CGP.  (The new CGP has not been issued yet and is expected in Feb. 2017. FYR report will be updated when issued.)	None. Remedy protectiveness is not impacted because all activities subject to this ARAR, such as construction work to maintain the landfills covers and groundwater treatment systems, are conducted in accordance with the CGP substantive requirements.	Fill in with FR notice.	None	
General Permits	40 CFR 122.28	Issuance of Final 2016 NPDES Pesticide General Permit (PGP) to replace 2011 PGP.	None. Remedy protectiveness is not impacted because all activities subject to this ARAR, such as application of pesticides near onsite streams, are conducted in accordance with the PGP substantive requirements.	81 FR 75816	None	10/31/16
Permits for Dredged or Fill Material; Discharges of Dredged or Fill Material into Waters of the United States	33 CFR 323	Availability of the National Wetland Plant List, which is used to determine whether the hydrophytic vegetation parameter is met when conducting wetland determinations under the CWA.	None. Remedy protectiveness is not impacted because all activities subject to this ARAR, such as construction or maintenance at the landfills or monitoring locations, are conducted in accordance with wetlands delineation criteria.	81 FR 22580	None	05/01/16
		Notice announcing the withdrawal of the March 25, 2014 interpretive letter regarding the applicability of the exemption from permitting to discharges of dredged material associated with certain agricultural conservation practices provided under section 404(f)(1)(A) of the CWA.	None. This letter did not effect a change in the regulation, but clarified interpretation of the regulation. As such, it's withdrawal does not impact the remedy or protectiveness, since any actions taken with regard to dredged/fill material would be compliant with applicable regulations.	80 FR 6705	None	01/29/15
		Revision of definition of "Waters of the United States" in light of the U.S. Supreme Court cases.	None. This revision narrows definition of "waters of the state" and does not impact remedy protectiveness.	80 FR 37053	None	06/29/15
Colorado Basic Standards and Methodologies for Surface Water; Basic Standards Applicable to Surface Waters of the State	5 CCR 1002-31.11	Revisions and additions to basic standards for volatile organic compounds	None. Numeric standards for Carbon tetrachloride and Tetrachloroethene slightly increased from previous standards. The standard for <i>cis</i> -1,2-dichloroethene was changed to a concentration range, with the previous standard at the top of the range.	5 CCR 1002-31.51 (Statement of Basis)	2012-03	01/31/13
Classification and Numeric Standards South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin; Classification Tables	5 CCR 1002-38.6	Revisions to site-specific standards for Big Dry Creek segments 4a, 4b, and 5 of the South Platte River Basin	None. Revisions included addition of Cr III(chronic) standard = 50 ug/L (T) for all segments with Water Supply use (5 CCR 1002-38.90(P)); addition of Cadmium, Lead, and Nickel standards for Water Supply uses of Big Dry Creek segments 2, 4a, 4b, 5, 6, and 7 (5 CCR 1002-38.90(Q)) .	5 CCR 1002-38.90 (Statement of Basis)	None	12/31/15
Colorado Noxious Weed Act	CRS 35-5.5-101 et seq.	Revisions to noxious weed lists and weed management plans.	None. Weeds are controlled in accordance with the RF integrated vegetation management approach, which is part of site maintenance activities. These amendments to the noxious weed lists and management plans do not impact remedy protectiveness.	8 CCR 1206-2	None	09/30/12; 03/30/14; 12/30/14; 12/30/15

ARAR <sup>1</sup>		Change	Impact to Remedy	Revision Reference	Contact Record	Effective Date
DOE Compliance with Floodplain/Wetlands Environmental Review Requirements	10 CFR 1022	Additions and modifications to Base Flood Elevations (BFEs), base flood depths, Special Flood Hazard Area (SFHA) boundaries or zone designations, or the regulatory floodway in Jefferson County, Colorado	None. These modifications are issued by FEMA and relate to flood hazard determinations; they do not alter the floodplain ARAR itself. However, FEMA is one of many resources that may be used to support flood hazard determinations required by the regulation (e.g., for new construction projects on site).	81 FR 66983	None	09/29/16
Colorado Air Permits	Not an ARAR in CAD/ROD	Air Pollutant Emissions Notice requirements	None. Since the last FYR, the passive groundwater treatments systems at two locations were reconfigured to allow treatment of groundwater from both locations at a single commercial air stripper. Because the air stripper releases VOCs to the air, the applicability of state air emissions regulations was evaluated. The calculated air emissions for the air stripper were determined to be below the regulatory threshold, thus an emissions notification to the regulator was not required, nor was an air permit.	5 CCR 1001-5 (Regulation 3, Part A II.B.3)	2014-01	

<sup>1</sup> From Table 21 in *Corrective Action Decision/Record of Decision for Rocky Flats Plant (USDOE)*, September 2006, unless otherwise noted.



## **Appendix I**

### **Responses to Stakeholder Input on the FYR**

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## Responses to Stakeholder Input on the Five-Year Review

As summarized in Section 5.1 of this fourth five-year review (FYR) report, the public received notification of the start of the FYR process in June 2016. On June 6, 2016, LM discussed the upcoming FYR during a presentation at the Rocky Flats Stewardship Council (RFSC) meeting. On June 10, 2016, written notice of the start of the FYR was emailed to the community notice distribution list. On June 13, 2016, this notice was posted to the U.S. Department of Energy Office of Legacy Management website. In response to inquiries for additional information on the FYR process, an update on the FYR was posted to the LM website on November 9, 2016, and provided via email to the community notice distribution list on November 11, 2016.

The scope of this fourth FYR report is the Central Operable Unit (COU). This fourth FYR report evaluated changes to toxicity factors and other risk parameters in relation to the unlimited use and unrestricted exposure (UU/UE) determination for the Rocky Flats National Wildlife Refuge (the Peripheral OU [POU]) and OU3, offsite areas (see Appendix C). Some of the input received from stakeholders concerned topics that are not related to remedy implementation or performance at the COU or are outside the scope of this FYR. As such, these topics are not addressed in this appendix. Stakeholder input was grouped into general topics, where possible, to streamline the response process. The following table provides a summary of input received from the public and corresponding responses. Input that did not readily fit into one of the groups identified in the first column of the table below is addressed at the end of the table.

Group Topic	Input Summary	Response
A. FYR Process	<p>Input was received related to the FYR process, as follows:</p> <ol style="list-style-type: none"> <li>1. Public comment period for the FYR report.</li> <li>2. Scope of the FYR.</li> <li>3. Federal agency responsibilities and potential conflicts of interest.</li> </ol>	<ol style="list-style-type: none"> <li>1. <i>Public comment period for the FYR report.</i> The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) does not require formal public comment on the FYR report; it only requires that the public be notified of the start of the FYR process and of the availability of the final FYR report (EPA 2001). Interested stakeholders were notified of the start of the FYR at a June 2016 RFSC meeting, via email, and through notices posted on the LM website. The public was invited to submit questions and other input to the email address provided in the notice and listed on the LM website. A notice when the final FYR report is issued will be distributed in the same manner as the initial FYR notice. As always, DOE accepts input from the public during RFSC meetings, in response to quarterly and annual reports and presentations, in response to contact records, and through other means of contact (formal or informal).</li> <li>2. <i>Scope of the FYR.</i> Federal environmental law (CERCLA) requires that a FYR be conducted for sites where hazardous substances, pollutants, or contaminants remain above levels that allow for UU/UE: If DOE "selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, [DOE] shall review such remedial action no less often than each 5 years after the initiation of such remedial action..." (CERCLA Section 121(c)). The COU meets this condition, and therefore, CERCLA requires that a FYR be completed for the COU every 5 years. The remaining operable units associated with the former Rocky Flats Plant (the POU [now the Rocky Flats National Wildlife Refuge, the "Refuge"] and OU3) were determined to meet UU/UE conditions in 2007 and were deleted from the National Priorities List (NPL) (Vol. 72 Fed. Reg. 29276). Therefore, a FYR is not required for the POU or OU3. This fourth FYR report evaluated changes to toxicity factors and other risk parameters for these two operable units to determine if the UU/UE designation is still valid (see Appendix C).</li> <li>3. <i>Federal agency responsibilities and potential conflicts of interest.</i> The U.S. Environmental Protection Agency (EPA) is not responsible for conducting FYRs at federal NPL sites. CERCLA Section 120 allows, and Executive Order 12580 directs, the federal department with control of the site to serve as the lead agency for the FYR with EPA providing oversight. However, EPA retains final authority to make or concur with protectiveness determinations (EPA 2001). For the COU, LM is considered the lead agency and completes the FYR; EPA will either concur with the lead agency protectiveness determination or provide independent findings. CERCLA does not require that an independent authority, other than EPA, evaluate the protectiveness of the remedy.</li> </ol>
B. Accelerated Cleanup	<p>The protocols and cleanup standards applied during accelerated actions at the RFP were insufficient, and the cleanup was incomplete.</p>	<p>The former Rocky Flats Plant (RFP) was investigated and remedies were selected in compliance with the Rocky Flats Cleanup Agreement (RFCA), which served as both a federal facilities agreement under CERCLA and a consent order under the Colorado Hazardous Waste Act. This agreement was signed by DOE, EPA, and the Colorado Department of Public Health and Environment (CDPHE) in 1996. The RFCA prescribed an accelerated closure process based on applicable environmental regulations and close consultation among the agencies. For example, the surface soil action levels in the agreement were calculated using protective methodologies based on a lifetime excess cancer risk of 1 in 100,000 for a wildlife refuge worker. For comparison, the normal lifetime cancer risk in the United States is approximately 1 in 3. When exceeded, these action levels triggered removal actions. Plutonium was one of the primary contaminants of concern in surface soil at the former RFP; for plutonium, a 1 in 100,000 carcinogenic risk was calculated to be equivalent to 116 pCi/g of plutonium in soil. After discussions with community officials, DOE, EPA, and CDPHE further reduced the surface soil action level for plutonium to 50 pCi/g. Following remediation, residual plutonium concentrations in surface soil were below regulatory standards.</p> <p>The final remedy in the Corrective Action Decision/Record of Decision (CAD/ROD) was based on the Remedial Investigation/Feasibility Study (RI/FS) Report, which included a comprehensive risk assessment that evaluated both human and ecological risks. The remedy chosen in the 2006 CAD/ROD conformed to state and federal environmental regulations. As stated in the CAD/ROD, the selected remedy consists of institutional and physical controls with surface water and groundwater monitoring, including ongoing treatment of groundwater at the existing groundwater treatment systems and landfill cover maintenance at the two landfills.</p>

Group Topic	Input Summary	Response
C. Land Use Assumptions and Exposure Scenarios	<p>The adequacy of remedies at Rocky Flats is limited by specific land use assumptions that are no longer valid. Specific concerns include:</p> <ul style="list-style-type: none"> <li>-To justify deletion of the areas now constituting the Wildlife Refuge from CERCLA [oversight], assumptions were made about the lack of soil disturbance and human exposures that are now very questionable given plans for a DOE-funded visitor center, trail construction as part of the Greenway project, and future highway construction.</li> <li>-Other human receptors such as construction workers building highways or bike paths, or volunteers working on trails and other maintenance activities, were never considered, and no such exposures have been formally evaluated.</li> <li>-New exposure pathways now exist that have never been evaluated due to changes in land use and the 100-year flooding event.</li> <li>-There is no data or other information sufficient to establish that the current remedies are adequate to protect human health in the face of the planned land use changes or the impacts of the flooding event. The five-year review must recommend either a reevaluation of the remedies to address these issues or call for a halt to the land use changes.</li> <li>-Significant changes in circumstances, including burgeoning housing developments adjacent to the site and proposed increased public access to the Refuge, have rendered the COU remedy's physical and institutional controls obsolete and ineffective.</li> </ul>	<p>The land use for the COU remains consistent with that stated in the CAD/ROD: land ownership is expected to remain with the United States government and LM will manage the COU for remedy-related purposes.</p> <p>Lands that constitute the POU and OU3 were determined to be suitable for any use (i.e., UU/UE). This means that there are no restrictions on the use of the POU or OU3 offsite areas and they may be used for any activity (i.e., under any exposure scenario). As a result, changes in land use will not affect the UU/UE determination. That determination was based on risk assumptions for Wildlife Refuge Worker and Wildlife Refuge Visitor scenarios as well as comparisons of environmental sampling data with preliminary remediation goal (PRG) values (<math>1 \times 10^{-6}</math> risk) calculated for a Rural Resident scenario (CAD/ROD 2006).</p> <p>The impacts of the severe weather events experienced during this FYR period are discussed in relation to remedy protectiveness in Sections 6.1.3.1, 6.1.4.2, and 6.3 of this FYR report.</p>

Group Topic	Input Summary	Response
D. Additional Monitoring	<p>1. Conduct air/dust monitoring within the COU.</p> <p>2. Conduct air/dust monitoring and soil sampling within the Rocky Flats National Wildlife Refuge.</p> <p>3. How can you know whether air and soil conditions have changed if there is no monitoring?</p>	<p>1. <i>Conduct air/dust monitoring within the COU.</i> Monitoring of air contaminants was not required by the CAD/ROD as part of the final remedy for the COU because substantial, relevant data on air quality at and near the former RFP had been gathered previously. Ambient air monitoring began when the RFP began operating in 1952; large-scale, continuous ambient air monitoring began in 1971. DOE conducted both effluent monitoring (e.g., measuring stack and building air contaminant emissions) and ambient air monitoring to demonstrate regulatory compliance as well as to monitor fugitive particulate radionuclide emissions from decommissioning, remediation, and demolition operations. CDPHE also operated an ambient particulate radionuclide air-monitoring network inside the RFP boundary and a network of five ambient nonradioactive pollutant air monitors at the site perimeter. During closure, DOE and the regulatory agencies monitored air quality around demolition and cleanup activities to ensure that air quality standards and radiation limits for workers and the public were not exceeded.</p> <p>In 1989, federal regulations were issued for the protection of the public from radioactive air emissions from DOE facilities (40 <i>Code of Federal Regulations</i> 61, Subpart H). These regulations, the "National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities" (Rad-NESHAP), limit annual dose to any member of the public to 10 millirem per year (mrem/year) through the air pathway. The dose from radionuclide air emissions (plutonium, americium, and uranium) at the RFP never exceeded this limit. In fact, based on historical ambient air monitoring, annual dose to the public during both RFP operation and closure was consistently less than 3% of the annual standard. This includes the period of active demolition and remediation at the site, when the highest levels of dust emissions would have been generated. During site cleanup, the maximum radiation dose from the site to any member of the public through the air pathway was less than 1 mrem/year. For comparison, 1 mrem/year is comparable to the dose received from traveling 1000 miles by plane or watching television. To put this in context, the average annual dose to a person in the United States due to all sources is 620 mrem, including both natural sources of radiation and medical tests.</p> <p>With completion of accelerated actions in 2005, all point sources of radioactive air emissions (e.g., building stacks and vents) had been eliminated and nonpoint (diffuse) sources had been significantly reduced by remediation of contaminated soil. Subsequent revegetation of all disturbed areas further stabilized soils and reduced diffuse source emissions. The CAD/ROD acknowledged that the resuspension of residual radioactive contaminants attached to surface soil particles would remain a potential source of ongoing air emissions at the site (DOE, EPA, CDPHE 2006). However, air dispersion modeling conducted during and following accelerated actions concluded that the resulting dose to a member of the public from these diffuse sources would still be much less than the 10 mrem/year standard (DOE 2006). The CAD/ROD concluded, "With completion of all accelerated actions and the attendant removal of all historical air emissions sources except for wind erosion of the minor, remnant contamination in surface soils, future air emissions from the site will be less than those in the past" (and past emissions were consistently less than 3% of the standard). After demonstrating that the Rad-NESHAP limit was not exceeded for many years before, during, and after site cleanup, DOE sampling was terminated in 2007; CDPHE discontinued air monitoring in 2005. Current site conditions in the COU are protective of the public, and air/dust monitoring is unnecessary.</p> <p>2. <i>Conduct air/dust monitoring and soil sampling within the Rocky Flats National Wildlife Refuge.</i> Lands that comprise the Refuge, also known as the POU, were determined to be suitable for any use. That is, they meet the criteria for UU/UE, and there are no restrictions on the use of the Refuge lands. Air monitoring is not required on the Refuge based on the years of monitoring data collected at the former RFP (within the COU and POU), as summarized in response No. 1 above. Soil data collection is not required because the data available at the time of the final remedy decision showed that contaminant levels in soils in the POU were below risk-based regulatory levels that would have required remediation or restrictions. Therefore, site conditions on the Refuge are protective of the public, and air/dust or soil monitoring is not necessary.</p> <p>3. <i>How can you know whether air and soil conditions have changed if there is no monitoring?</i> Ongoing surface water monitoring serves as an indicator of remobilization of contaminants from surface soils, as discussed in Sections E1.2.1.1 and E1.2.1.2 of this fourth FYR report. In addition, the establishment of mature vegetation and lack of major soil erosion reduces the probability of any residual contaminants entering the air or being removed from the soil.</p>

Group Topic	Input Summary	Response
E. Question A	<p>Based on point of compliance (POC)/point of evaluation (POE) exceedances of <i>Rocky Flats Legacy Management Agreement</i> (RFLMA) standards and Original Landfill (OLF) slumping, LM cannot state that the remedy is functioning as intended by the decision document. Specific concerns include:</p> <ol style="list-style-type: none"> <li>1. Uranium exceedance at Walnut Creek POC (WALPOC).</li> <li>2. OLF slumping.</li> <li>3. Data are inadequate to determine protectiveness.</li> <li>4. The water sampling protocol is limited by flawed assumptions and weather-related failures.</li> <li>5. DOE is collecting insufficient or incorrect data to support permanent resolution of remedy failures.</li> <li>6. Only a "Short-Term Protective" finding is appropriate.</li> </ol>	<p>Section 6.1 of this fourth FYR discusses Question A, "Is the remedy functioning as intended by the decision documents?" On the basis of this FYR evaluation, the remedy is functioning as intended by the CAD/ROD. Institutional and physical controls are in place and effective, required groundwater and surface water monitoring is ongoing and supports achievement of remedial action objectives (RAOs) in the long term, and operation and maintenance (O&amp;M) of remedy components at the OLF, PLF, and groundwater treatment systems is ongoing and supports achievement of RAOs in the long term.</p> <ol style="list-style-type: none"> <li>1. <i>Uranium exceedance at WALPOC.</i> The reportable conditions at the POEs and POCs during this FYR period and how they relate to the protectiveness of the remedy are discussed in Sections E1.2.1 and 6.1.3.1, respectively. LM acknowledges that this is the first time uranium standards at WALPOC have been exceeded since closure of the former RFP. As a result, a comprehensive evaluation of these conditions was conducted (see Section 6.1.3.1). Remedy performance is evaluated using several other indicators as outlined in the RFLMA, to include surface water monitoring results from locations upstream of POCs, groundwater monitoring results, landfill inspection results, treatment system operation and maintenance, performance monitoring results, and observations during inspections. The evaluation of POC and POE exceedances and any subsequent corrective actions are addressed through the RFLMA consultative process. The RFLMA parties (DOE EPA, CDPHE) have agreed that based on the data evaluated to date, corrective actions are not warranted to address the uranium exceedance at WALPOC. Monitoring data is reported in the quarterly and annual RFLMA reports and discussed with the public at the quarterly RFSC meetings.</li> <li>2. <i>OLF slumping.</i> Discrete areas of the OLF are slumping. This slumping is being addressed as part of ongoing landfill maintenance activities, which are part of the selected remedy in the CAD/ROD. Specifically, the CAD/ROD requires continued operation and maintenance of engineered structures, such as the landfill covers and groundwater treatment systems. Refer to Section 6.1.4.2 of this fourth FYR report for a discussion of the OLF in relation to protectiveness.</li> <li>3. <i>Data are inadequate to determine protectiveness.</i> The media (surface water and groundwater) to be monitored at the former RFP following closure were determined in the 2006 CAD/ROD, based on the results of the RI/FS. Monitoring frequency and sample analyses are prescribed by the RFLMA. Monitoring data are important in the evaluation of site protectiveness and are reviewed in conjunction with other information to determine whether the remedy is protective. Other such information includes the results of monthly and weather-related landfill inspections, groundwater treatment system operation and maintenance monitoring, observations during annual sitewide inspections, and effectiveness of institutional and physical controls.</li> <li>4. <i>The water sampling protocol is limited by flawed assumptions and weather-related failures.</i> The surface water monitoring network is a robust and sophisticated system that collects automated, flow-paced composite samples. This system design allows for the collection of samples that represent water quality over a period of time (as opposed to a single point in time), based on how much water is flowing through the system. Following the 2013 flood event, the surface water monitoring system was enhanced to reduce sampling interruptions during extreme weather events (see Group I response below).</li> <li>5. <i>DOE is collecting insufficient or incorrect data to support permanent resolution of remedy failures.</i> Based on the evaluation of remedy performance completed for this FYR, the remedy is functioning as intended by the CAD/ROD and is protective of human health and the environment (see Section 8.0 of this fourth FYR report). This conclusion is based on several sources of information, such as groundwater and surface water routine monitoring data, site inspections, treatment system operation and maintenance, and other data collected to evaluate specific conditions. The RFLMA consultative process provides the mechanism for the identification of data needs and allows for the collection of additional information to support evaluation of site conditions (e.g., OLF slumping, POC exceedances). For example, DOE has contracted two independent geotechnical studies of the slumping at the OLF (see Section 6.1.4.2 of this fourth FYR report) and a comprehensive study of uranium in the Walnut Creek drainage (see Section 6.1.3.1) to better understand these site conditions.</li> <li>6. See Section 8.0 of this fourth FYR report regarding the protectiveness statement and rationale.</li> </ol>

Group Topic	Input Summary	Response
F. Question B	<p>1. What is the trigger for remedial action objective (RAO) revision?</p> <p>2. How do you know if exposure mechanisms have changed?</p> <p>3. Question B must be answered negatively because exposure assumptions are no longer valid.</p>	<p>Section 6.2 of this FYR discusses Question B, "Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?" On the basis of the evaluation presented in this FYR report, the exposure assumptions, toxicity levels, cleanup levels, and RAOs used at the time of the remedy are still valid, and revision of the RAOs is not necessary.</p> <p>1. <i>What is the trigger for RAO revision?</i> As stated in EPA guidance (EPA 2001), the FYR should include an evaluation of remedy performance and RAOs to determine if the RAOs are being met. Depending on the outcome of this evaluation, it may be necessary to modify the RAOs, modify the remedy, or conduct further response actions. The fact that a RAO is not currently being met, however, does not necessarily compel action. For example, the 2006 CAD/ROD acknowledged that residual concentrations of VOCs in groundwater in some areas "are likely to persist in the environment at Rocky Flats for decades to hundreds of years" (DOE, EPA, CDPHE 2006). The CAD/ROD recognized that the Groundwater RAO 2 (see Table 4 of this fourth FYR report) may not be achieved for some time. Nevertheless, the remedy currently remains protective because active groundwater treatment systems continue to reduce contaminants entering surface water, and institutional controls restrict the use of groundwater and prohibit the construction of buildings, thereby controlling exposure.</p> <p>2. <i>How do you know if exposure mechanisms have changed?</i> Lands that constitute the POU and OU3 were determined to be suitable for UU/UE in 2007. For the POU, this determination was based on risk assumptions for the Wildlife Refuge Worker and Wildlife Refuge Visitor scenarios as well as comparisons of environmental sampling data with preliminary remediation goal (PRG) values (<math>1 \times 10^{-6}</math> risk) calculated for a Rural Resident scenario. For OU3, the UU/UE determination was based on a residential exposure scenario. The UU/UE determination means that the POU and OU3 lands are protective of human health and the environment even if exposure mechanisms (or pathways) change. Changes to exposure mechanisms/pathways in the COU are evaluated during the FYR process through direct observation of site conditions (e.g., evidence of unauthorized access, vandalism) and monitoring and effectiveness of institutional controls (see Sections 3.3.2 and 6.1.1 of this fourth FYR report).</p> <p>3. See response to C. Land Use Assumptions and Exposure Scenarios group topic.</p>
G. Question C	<p>The Comprehensive Five-Year Review Guidance in Section 4.0 specifically calls out natural disasters, such as a 100-year flood event, as requiring an affirmative answer to Question C from the EPA Guidance. This makes further evaluation of the adequacy of the remedy in light of the flooding event a necessary outcome of this five-year review.</p>	<p>Section 6.3 of this FYR discusses Question C, "Has any other information come to light that could call into question the protectiveness of the remedy?" No other information collected during this FYR period has called into question the protectiveness of the remedy.</p> <p>The EPA FYR guidance provides examples of situations that should be considered in the FYR to answer Question C. This question need only be answered in the affirmative if the protectiveness of the remedy has been called into question. The former RFP experienced two severe weather events during this FYR period, which are discussed in relation to remedy protectiveness in Sections 6.1.3.1, 6.1.4.2, and 6.3 of this fourth FYR report.</p>
H. Groundwater Treatment Systems	<p>The continued exceedances of RFLMA standards by effluent from the Solar Ponds Plume Treatment System (SPPTS) calls into question the effectiveness of this groundwater treatment system.</p>	<p>Refer to Section E1.1.2.2 (SPPTS) of this fourth FYR report for a discussion of remedy performance at this treatment system in relation to protectiveness. Monitoring data associated with the groundwater treatment systems provide valuable information to support the evaluation of remedy performance. The effluent data from these treatment systems are considered in conjunction with routine monitoring data, inspection results, and institutional controls to evaluate the protectiveness of the remedy.</p>

Group Topic	Input Summary	Response
I. Flooding	<p>1. The 2013 flood event incapacitated surface water monitoring equipment to the point that the quantity of contaminants that migrated off the COU is unknown.</p> <p>2. No sediment sampling has been done to investigate contaminant migration off the COU. Increased exposures to radioactive materials in sediment or groundwater mobilized during flooding events have not been evaluated.</p>	<p>1. <i>The 2013 flood event incapacitated surface water monitoring equipment to the point that LM does not know the quantity of contaminants that migrated off the COU.</i> The COU experienced very high flows during the second week of September 2013. In some cases, the high flows and debris caused damage to the automated sampling equipment, resulting in temporary interruptions in composite sampling. At almost all locations, the unanticipated runoff volumes caused flow-paced composite bottles to fill before personnel could safely replace them with empty bottles. Access to various areas of the COU was unsafe and restricted by local authorities during certain periods.</p> <p>At the Woman Creek POC (WOMPOC), although sampling was interrupted for 22 hours and 10 minutes, 326 grab samples were collected from late on 9/11/2013 through 9/13/2013. Similarly, at the most-downstream Walnut Creek POC (GS03), although sampling was interrupted for 7 hours and 8 minutes, 469 grab samples were collected from 9/12/2013 through 9/13/2013. Monitoring data both before and after the sampling interruptions, from numerous locations in the COU, coupled with the fact that the majority of the runoff originated offsite, do not suggest that high contaminant concentrations occurred.</p> <p>DOE has since made improvements to the surface water monitoring systems to minimize sampling interruption during extreme, low-probability weather events. Secondary automated samplers have been installed at each POC to provide backup sample volume capacity. In the event of extreme flows resulting in the premature filling of the primary sampler, the secondary sampler will automatically begin to collect samples, ensuring extended sampling until personnel can access the site.</p> <p>Surface water samples collected for RFLMA monitoring are not filtered prior to analysis. Therefore, these sample results represent the combination of contaminants detected in the dissolved fraction of the water and contaminants detected in the suspended solids portion of the water. While sediment sampling is not required as part of the remedy in the COU, surface water sample results provide an indication of the concentration of contaminants associated with sediment that could settle out in the streambed.</p> <p>The surface water remedial action objective (RAO) is "meet surface water quality standards, which are the Colorado Water Quality Control Commission surface water standards". The surface water standards are concentration-based values, and surface water monitoring sample concentrations are measured so they may be compared to these standards. The total quantity (mass) of contaminants is not measured directly by routine monitoring activities.</p> <p>2. <i>No sediment sampling has been done to investigate contaminant migration off the COU. Increased exposures to radioactive materials in sediment or groundwater mobilized during flooding events have not been evaluated.</i> Surface water samples collected for RFLMA monitoring are not filtered prior to analysis. Therefore, these sample results represent the combination of contaminants detected in the dissolved fraction of the water and contaminants detected in the suspended solids portion of the water. While sediment sampling is not required as part of the remedy in the COU, surface water sample results provide an indication of the concentration of contaminants associated with sediment that could settle out in the streambed.</p> <p>Surface water exiting the COU via Woman Creek is ultimately captured in the Woman Creek Reservoir, which is part of the Standley Lake Protection Project. The reservoir was constructed in the mid-1990s by the City of Westminster, with the objective of protecting Standley Lake (a drinking water source) from contaminated stormwater runoff. Water entering Woman Creek Reservoir is held for 90 days, treated if necessary, and tested for quality before being released (<a href="http://www.ci.westminster.co.us/ExploreWestminster/OpenSpace/OpenSpaceAreas/WestminsterLandofLakes/WomanCreekReservoir">http://www.ci.westminster.co.us/ExploreWestminster/OpenSpace/OpenSpaceAreas/WestminsterLandofLakes/WomanCreekReservoir</a>). From the reservoir, the water is pumped to the northeast into Walnut Creek, altogether avoiding Standley Lake. Sediment in Woman Creek Reservoir is periodically sampled by the Woman Creek Reservoir Authority; the most recent report of sampling results was published in May 2014.</p>
J. OLF	<p>1. Continue monthly inspections of the OLF and require additional monitoring of up-gradient groundwater levels.</p> <p>2. Highly toxic polychlorinated biphenyls (PCBs) are being air-stripped from groundwater into the environment, mainly in the OLF.</p>	<p>1. <i>Continue monthly inspections of the OLF and require additional monitoring of up-gradient groundwater levels.</i> The current monthly inspection frequency for the OLF is mandated by RFLMA and cannot be changed unless authorized by the RFLMA parties. In addition to the monthly inspections, the OLF is also inspected following extreme weather events as required by RFLMA. The monitoring of groundwater levels upgradient of the OLF is conducted to support and inform evaluation of OLF conditions and will continue at the discretion of LM.</p> <p>2. <i>Highly toxic PCBs are being air-stripped from groundwater into the environment, mainly in the OLF.</i> This statement is incorrect. There is no air-stripping treatment occurring at the OLF. There is no PCB treatment occurring at the OLF or anywhere in the COU. PCBs are not contaminants of concern in the groundwater contaminant plumes in the COU. Air stripping is used for the treatment of volatile organic compounds (i.e., chemicals that evaporate readily) in groundwater from the East Trenches and Mound Site contaminant plumes (see Section 6.1.4.3 of this fourth FYR report).</p>
K. PLF	<p>The fourth FYR should include a clearly defined corrective action plan to address ongoing water quality issues at the Present Landfill (PLF).</p>	<p>Refer to Section 6.1.4.1 of this fourth FYR report for discussion of monitoring results at the PLF. The RFLMA consultative process has been triggered by PLF treatment system effluent monitoring results during this FYR period. However, the RFLMA parties have not required corrective action in response, since downstream surface water quality has not been impacted.</p> <p>The determination of whether a corrective action (mitigation) plan is necessary to address site conditions is made by the RFLMA parties through the RFLMA consultative process. Although the FYR report may identify issues and make recommendations based on the results of the technical assessment, any necessary action plans would be developed independent of the FYR process. Therefore, it is not appropriate to include corrective action plans in the FYR report. The RFLMA consultative process allows for the more timely identification, evaluation, and ongoing mitigation of issues in contrast to the FYR process, which occurs every 5 years.</p>
L. Literature Cited	<p>Several articles and reports were cited in the input received from stakeholders. These citations were associated with input related to various topics including implementation of accelerated actions, burrowing animals, dust sampling, plutonium migration, and risk.</p>	<p>These documents, including but not limited to those listed in Appendix D, "Documents Reviewed," were reviewed and do not affect the conclusions of this FYR.</p>



Individual Input		Response
M. Uranium maximum contaminant level (MCL)	The CERCLA review should not make references to the current EPA drinking water standard for uranium since the drinking water standard does not apply to the site.	LM acknowledges that the uranium MCL is not applicable to the COU; the MCL is a nationwide health-based standard applicable to public water supply systems. Comparison of uranium concentrations to the drinking water standard in the FYR report is included simply to offer perspective on the quality of surface water at the COU boundary.
N. Hazardous Waste	The Resource Conservation and Recovery Act (RCRA) permit for the Rocky Flats Site is limited to Hazardous Waste Generator. The last documented biennial report was in 2005. Yet LM currently utilizes erosion-control materials (wattles, air stripping and matting) to mitigate the migration of contaminants of concern. LM has not documented the sample analysis of such media, filed any RCRA biennial reports, nor provided regulatory authority to treat, store, or dispose of the contaminants of concern at the Rocky Flats Site.	The RFP previously held a RCRA permit as a hazardous waste treatment, storage, and disposal facility (TSD) and was required to submit biennial hazardous waste generator reports in accordance with 40 CFR 264.75. The RCRA permit was terminated in 2006. LM rarely generates hazardous waste in the conduct of legacy management activities and as a small, or very small, quantity generator is exempt from generator biennial reporting requirements. Sample results associated with wastes generated at the site are documented in project files and are provided to the disposal facilities that receive wastes from the site.  As a previous TSD facility, LM is required to submit a biennial report in accordance with Section 3016 of RCRA. This report, <i>Inventory of Federal Hazardous Waste Activities at Formerly Owned or Operated Federal Facilities</i> , includes a description of the location of the facility and the amount, nature, and toxicity of the hazardous waste at the site. The most recent Section 3016 biennial report was filed in 2016.
O. FYR Report	This is only the second CERCLA Five-Year Review since the final physical and regulatory closure occurred at the Site in 2006.	Under CERCLA, the trigger for the first FYR was the signing of the CAD/ROD for OU3 in 1997 (that is, the selection of the remedial action). The first FYR report evaluated data from 1997–2001. The site was closed at the end of 2005. The second FYR report evaluated data from 2002–2006, which included 1 year of post-closure data. The third FYR report evaluated data from 2007–2011 and was the first review to include 5 continuous years of post-closure data. This fourth FYR report evaluated data from 2012–2016 and is the second report to include 5 continuous years of post-closure data.
P. Quarterly Technical Meetings	Recommend continuation of the Quarterly Technical Meetings and request that they occur 4 months after RFLMA technical documents are released.	LM will coordinate with interested stakeholders regarding meeting frequency and timing, as requested.

**References:**

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 120 (42 USC 9620, “Federal Facilities”) and Section 121(c), (42 USC 9621(c), “Cleanup Standards.”)

DOE (U.S. Department of Energy), 2006. *RCRA Facility Investigation – Remedial Investigation/Corrective Measures Study – Feasibility Study Report for the Rocky Flats Environmental Technology Site*, prepared by Kaiser-Hill Company, LLC for the U.S. Department of Energy, June.

DOE, EPA, and CDPHE (U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment), 2006. *Corrective Action Decision/Record of Decision for Rocky Flats Plant (USDOE) Peripheral Operable Unit and Central Operable Unit, Jefferson and Boulder Counties, Colorado*, September.

EPA (U.S. Environmental Protection Agency), 2001. *Comprehensive Five-Year Review Guidance*, EPA 540-R-01-007, Office of Emergency and Remedial Response, June.  
Executive Order 12580, *Superfund Implementation*, 23 January, 1987.

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