2.0 Site Operations and Maintenance

2.1 Annual Site Inspection

Evidence of significant erosion and IC violations must be inspected for annually, in accordance with RFLMA Attachment 2, Sections 5.3.4 and 5.3.6. The 2014 inspection was conducted on March 25, 2014, and reported in the Rocky Flats Site Quarterly Report of Site Surveillance and Maintenance Activities, First Quarter Calendar Year 2014 (DOE 2014d).

The following condition categories were monitored during the inspection:

- Evidence of significant erosion in the COU and evaluation of the proximity of significant erosion to subsurface features in RFLMA Attachment 2, Figures 3 and 4. This monitoring included visual observation for precursor evidence of significant erosion (e.g., cracks, rills, slumping, subsidence, sediment deposition).
- The effectiveness of 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 Environmental Covenant’s presence in the Administrative Record and in Jefferson County records was verified. This verification is required annually. In addition, physical controls (signs placed along the COU fence) were also inspected.

Marker flags were placed where conditions showed evidence of the three condition categories listed above, to track their location for follow-up by Site subject matter experts. Several areas were noted as having evidence of erosion and possible depressions, which were minor and very limited in area. The inspection forms and maps are included in the quarterly report for the first quarter of CY 2014 (DOE 2014d).

Most inspection observations were related to metal debris on the surface or trash that was either picked up or marked for subsequent removal and pickup. Rocky Flats field operations subject matter experts subsequently visited the areas to determine if any observations were significant or required repairs and to collect debris. All items were closed out in the Site Observation Log.

No evidence of violations of ICs or physical controls was observed.

No adverse biological conditions were noted during the inspection.

2.2 Pond Operations

Three constructed ponds collect and manage surface-water runoff at the Site. The ponds are A-4 in North Walnut Creek, B-5 in South Walnut Creek, and C-2 near and alongside of Woman Creek. Ponds A-4, B-5, and C-2 are referred to as “terminal ponds” because they were the farthest downstream ponds in their respective drainages, but now they are the only constructed ponds in those drainages. All three terminal ponds were operated in a flow-through configuration for all of CY 2014.
Routine dam inspections, pond-level measurements, and piezometer measurements were performed as scheduled during the year. Annual dam mowing and vegetation removal was completed in October. Annual monument-movement surveys were performed as scheduled in June. Semiannual inclinometer readings were performed as scheduled in June; the December readings were not taken until February 2015.

In compliance with the State of Colorado Rules and Regulations for Dam Safety and Dam Construction, a registered professional engineer periodically conducts a formal dam safety inspection for Dams A-4, B-5, and C-2.

2.3 Landfills

The annual report of the results of inspections, monitoring data, and maintenance activities for the PLF and OLF is provided below.

2.3.1 Present Landfill

The PLF consists of an approximately 22-acre engineered RCRA Subtitle C–compliant cover over a former sanitary and construction debris landfill. A diversion channel surrounds the landfill and diverts storm water runoff away from the landfill to No Name Gulch. The landfill has a passive seep interception and treatment system (the Present Landfill Treatment System [PLFTS]) installed to treat landfill seep water and Groundwater Intercept System (GWIS) water that discharges into the former Landfill Pond area. A passive gas extraction system is also built into the landfill to let subsurface gas vent to the atmosphere.

Subsidence and consolidation at the PLF is monitored by visually inspecting the surface of the landfill cover for cracks, depressions, heaving, and sinkholes. The landfill final construction site conditions are used as a baseline for comparisons made during Site inspections. In addition to the visual inspection, settlement monuments are used to evaluate the actual settlement at these specific locations compared to the expected settlement calculated in the final design. Nine settlement monuments were installed across the top of the landfill cap, and an additional six monuments are located on the east face of the landfill. The monuments were monitored quarterly for the first year and annually thereafter.

Inspections and monitoring tasks follow the format and protocol established in the PLF M&M Plan and include groundwater and surface-water monitoring, as well as monitoring subsidence and consolidation, slope stability, soil cover, storm-water management structures, and erosion in surrounding features. This monitoring is conducted so that corrective actions can be taken in a timely manner. Monthly inspections were initiated in October 2005. Quarterly inspections were initiated in the fourth quarter of CY 2007 as described in RFLMA Contact Record 2007-08.

The PLF Monitoring and Maintenance Plan and Post-Closure Plan was revised and issued in December 2014. Contact Records 2007-08 and 2014-03 provide the basis in accordance with RFLMA for this change. Changes to the plan include:

- Updates to reflect the PLF dam breach and removal of the East Landfill Pond
- Updates to discontinue quantitative vegetation monitoring because vegetation cover requirements have been met (in the future, vegetation will be monitored under the site vegetation monitoring program)
- Updating sample location East Landfill Pond to NNG01
2.3.1.1 Inspection Results

Four quarterly inspections were performed at the PLF in CY 2014. The inspection process followed the format and protocol established in the PLF M&M Plan. No significant problems were observed during these inspections. The fourth quarter inspection was performed December 3, 2014. No issues were noted. Appendix C contains the landfill inspection forms for the fourth quarter of CY 2014; earlier 2014 inspection forms are included in the applicable quarterly reports.

PLF area surface-water and groundwater monitoring, and operation of the PLFTS, is covered in those respective sections of this report.

2.3.1.2 Slumps

On February 13, 2007, a slump was discovered on the south-facing hillside just east of the PLF. The slump is not on the PLF, and engineering review determined that it does not impact the PLF cover. The slump was likely caused by heavy snow conditions and influenced by the post-closure lower water levels in the Landfill Pond. Therefore, regrading the slump is not necessary; however, deep-rooted plants were planted in the slump area to promote stabilization. There were no significant changes to the slumping area in CY 2014.

2.3.1.3 Settlement Monuments

The annual survey was completed in December 2014. Results of the settlement monument survey indicate that settling at each monument does not exceed expected settlement calculated in the final design and therefore does not trigger any maintenance activity under the PLF M&M Plan.

2.3.2 Original Landfill

The OLF consists of an approximately 20-acre soil cover over a former solid sanitary and construction debris landfill. The final cover consists of a 2-foot-thick Rocky Flats Alluvium soil cover that was constructed over both a regraded surface and a buttress fill and then revegetated. The original surface was regraded to provide a consistent slope. A 20-foot-high, 1,000-foot-long soil mass buttress was placed at the toe of the landfill. Erosion is controlled by a series of diversion berms that carry storm-water runoff away from the cover to channels on the east and west perimeter of the cover.

The OLF is inspected monthly in accordance with the OLF M&M Plan (DOE 2009a).

2.3.2.1 Inspection Results

Twelve monthly inspections were performed at the OLF in CY 2014. The inspection process followed the format and protocol established in the OLF M&M Plan. During the first quarter of CY 2014, cracking and slumping were noted on the east side of the East Perimeter Channel (EPC), outside of the landfill boundary. Cracks were filled as required by the M&M Plan. During the second and third quarters, this slumping continued to move very gradually, but no new cracks were noted. Similarly, no cracking was noted in the fourth quarter.
Appendix C contains the landfill inspection forms for the fourth quarter of CY 2014; earlier 2014 inspections forms are included in the applicable quarterly reports. Inspections during the fourth quarter were performed on October 30, November 24, and December 10.

In late October, approximately eight burrowing-animal holes were observed adjacent to the EPC between Berms 6 and 7. Two additional holes were observed in December. The holes are small and show no signs of recent activity. They are located outside of the waste footprint and will continue to be monitored to ensure that they do not expand in size or in quantity. At this time the holes do not pose an immediate threat to the integrity of the OLF.

OLF area surface-water and groundwater monitoring is covered in those respective sections of this report.

2.3.2.2 Settlement Monuments

The settlement monuments were surveyed in March, June, September, and December 2014. Survey data indicate that settling at each monument does not exceed expected settling calculated in the final design and therefore does not trigger any maintenance activity under the OLF M&M Plan.

2.3.2.3 Geotechnical Evaluation

DOE requested a geotechnical engineering review and evaluation of documents, design concepts, and mitigation procedures related to the OLF. The purpose of the review was to evaluate previous design decisions and provide professional opinions on whether the current course of action (performing localized and low-impact maintenance when evidence of localized instability is observed) remains the best alternative. The review did not identify factors, conditions, or changes in conditions that suggest the current approach is any less valid now than when implemented. The evaluation report is included in the 2014 third quarter report (DOE 2015).

2.3.2.4 Precipitation Response Repairs

Slumping and cracking were observed on the eastern part of the OLF cover in the vicinity of Berm 4 and the EPC following the unusually high precipitation received in September 2013. DOE notified CDPHE and EPA on September 17, 2013, that a reportable condition had been identified at the OLF. DOE, CDPHE, and EPA personnel toured the area on September 18 to start the consultative process to develop a proposed course of action. Contact Record 2013-02 documents the initial mitigating actions and the path forward to address the reportable condition. CDPHE approved this contact record on October 21, 2013. Repairs to the slumping and cracking areas were completed in September 2013 as reported in the third quarter report for CY 2013. The areas where repairs were completed were inspected weekly as a precautionary measure to help ensure that any new slumping or cracking could be addressed in a timely manner.

A project to address slope stability in the EPC and surrounding area was originally scheduled for completion in December 2013 but was rescheduled to the summer of 2014 because the soil was either frozen or too wet to complete the project. The proposed modifications are described and approved in Contact Record 2013-03, “Soil Disturbance Review Plan (SDRP) for Regrading the
East Perimeter Channel (EPC) and Associated Diversion Berms at the Original Landfill (OLF).” CDPHE approved Contact Record 2013-03 on December 4, 2013. Because of the additional movement in the EPC and continued minor cracking within the landfill area, DOE reevaluated the approved design before implementation. Changes to the approved designed are documented in Contact Record 2014-09. Construction began in October 2014 and was completed in mid-January 2015.

2.3.2.5 Other Maintenance

The OLF M&M Plan also requires periodic evaluation of the height of the berms on the face of the OLF to ensure that the channels can carry the required volume of storm-water runoff. A technical memorandum from the geotechnical subcontractor (see 2013 Annual Report [DOE 2014c]), dated December 19, 2013, provides information on the data analysis and tabulates new minimum berm heights (in contrast to those that were previously calculated using more generic Colorado Front Range data). At a December 5, 2013, meeting, the RFLMA Parties reviewed this memorandum and agreed that OLF berm height maintenance can be based on the new calculated minimum berm heights. On July 21 and 22, 2014, the berms were regraded where necessary to restore the appropriate berm height, using the new approved criteria, and to repair damaged berm outfalls. These activities are considered “maintenance action activities” under the OLF M&M Plan.

2.3.2.6 Inclinometers

Seven inclinometers were installed in boreholes at the OLF in 2008 as part of the geotechnical investigation (Figure 1).

Movement of the inclinometers has been monitored approximately monthly since installation. During the fourth quarter CY 2014, the inclinometers were monitored on October 30, November 28, and December (January 6, 2015). (The December 2014 monitoring was postponed because of poor weather and was conducted in early January instead.)

Inclinometers deflect based on lateral movement of the ground in which the inclinometer is located and can deflect enough to cause the inclinometer tube to break. Should an inclinometer tube break, then it provides monitoring data only to the broken point. Inclinometer monitoring data provide information on localized soil movement and serve to focus periodic inspections of the soil cover surface on signs of potential instability, such as cracking, vertical displacement, and slumping. A deflection of more than 1 inch is used as a trigger for evaluation of the data by a qualified geotechnical engineer. The engineer determines the significance of the deflection in relation to recommendations for maintenance or repairs to address potential instability in accordance with the OLF M&M Plan (DOE 2009a).

During 2014, deflection of more than 1 inch was observed at inclinometer Tt-5 (82508I) in May, following a period of high precipitation. The data was reviewed by the consulting company Tetra Tech. Very little movement was recorded by inclinometer Tt-6 (82608I), which is located approximately 75 feet downslope of Tt-5. This suggests that the movement was localized.

Inclinometer Tt-2 (82208I) showed additional movement in the A-axis direction of approximately 2 inches between April 2013 and November 28, 2014; however, approximately
1.5 inches of the movement occurred in 2013. Movement of 0.6 inch was recorded on the B-axis during the same time interval. Appendix E contains the *Technical Memorandum Regarding Instrumentation and Monitoring at the Rocky Flats OLF*, which discusses the findings noted above.

The conclusion of the data review is that recommendations made in the 2008 geotechnical investigation and the Tetra Tech Technical Memorandum (2008) remain valid. The instrumentation indicates that instability is caused by one or more weak layers in the shallow subsurface, and movement is exacerbated by precipitation events and elevated water levels. Slope stability modeling indicates that, on a large scale, the overall slope is stable.

### 2.4 Groundwater Plume Treatment Systems Maintenance

Rocky Flats utilizes four groundwater treatment systems designed to reduce contaminant load before the water is discharged. The four systems are the Mound Site Plume Treatment System (MSPTS), the East Trenches Plume Treatment System (ETPTS), the Solar Ponds Plume Treatment System (SPPTS), and the PLFTS. Each of these was designed and installed to passively collect and treat groundwater. Before the Site closed, only the SPPTS had been modified to include an active—i.e., powered—component. However, since Site closure, additional active components have been required in order to meet the more stringent post-closure treatment objectives. Additional active components were initially added only to the SPPTS. In 2011 the MSPTS received active components, and in early 2013 those MSPTS active components were bolstered and similar components were installed at the ETPTS. In 2014 the ETPTS was reconfigured to incorporate a fully active treatment approach. (The ETPTS Reconfiguration Project is described in greater detail in Section 3.1.5.3.) Only the PLFTS remains fully passive.

This section focuses on the maintenance and operation of the MSPTS, the ETPTS, and the SPPTS during CY 2014. Additional information is provided in the previous quarterly reports from 2014 (DOE 2014d, 2014e, 2015).

Details of the monitoring of the treatment systems, including the PLFTS, are presented in Section 3.1.2.8, and interpretations related to system operation and the corresponding contaminant plumes are provided in Section 3.1.5.3.
2.4.1 Mound Site Plume Treatment System

The MSPTS treated groundwater throughout the year. Maintenance activities were conducted as necessary and small adjustments were made in CY 2014.

2.4.1.1 Flow Configuration

MSPTS flows are measured using two flow meters located in a configuration vault between the two treatment cells that contain zero-valent iron (ZVI). Untreated groundwater is piped into this vault, where it is then directed to the desired treatment cell(s) for treatment. The flow configuration through the treatment cells remained in a “parallel upflow” configuration throughout the year. In this configuration, the influent that is piped into the configuration vault is then split among two pipes, with approximately half the flow directed upward through the media in treatment Cell 1 and the other half upward through the media in Cell 2. The flow to each treatment cell is measured by a flow meter in the vault. After flowing through the media, treated groundwater from each treatment cell is piped back to the flow configuration vault, where it is combined. The combined flow then enters the effluent manhole, which is located just east of treatment Cell 2. This treatment cell effluent is then processed by an air stripper installed within this manhole. (This air stripper operates via spray aeration, and was designed and built by Rocky Flats staff. More information is provided in Section 3.1.5.3 and in recent annual reports, especially DOE 2013a and 2014c.) Effluent from this manhole is discharged to a small, subsurface vertical French drain and then to the larger subsurface discharge gallery.

2.4.1.2 Revisions of System Components

One slight modification was made to the MSPTS during 2014. In February, the air stripper nozzle configuration was revised from 10 smaller-orifice nozzles to a single larger one. Routine maintenance—i.e., cleaning the nozzles—was required frequently and represented a fairly labor-intensive activity, so changing to a single nozzle helped to reduce maintenance requirements. Refer to Section 3.1.5.3 for a discussion of air stripper and overall MSPTS treatment effectiveness.

2.4.1.3 Maintenance

MSPTS maintenance in CY 2014 consisted primarily of routine activities such as flushing or otherwise removing biological growth and clayey iron oxide/oxyhydroxide accumulations from system components (primarily the air stripper pump, but also the air stripper spray nozzle/nozzles, effluent manhole, and various pipes), skimming accumulations of biological growth off the surface of the water in the two treatment cells, and cleaning flow meters and water-level transducers. In addition, on a couple of occasions when accumulated snow did not melt off quickly enough, snow was cleared off the solar panels.

The powered fans for the air stripper malfunctioned in January 2014. Air stripping in the effluent manhole is still effective without this component, but it is enhanced when powered ventilation is present. All four fans were replaced.

The display on the flow meter monitoring Cell 1 began to malfunction in late July, leading to replacement of this meter in August 2014.
2.4.1.4 Operation

Operational activities are conducted to gather data, optimize performance, and control various treatment system functions. Routine activities in CY 2014 included controlling and adjusting flow through the treatment system, recording flow and pressure data, measuring water levels, and inspecting system components. The flow adjustments were typically made to balance flow rates through each of the two treatment cells so that residence times for the water in each cell would be approximately equivalent. In addition, the system was shut off intermittently (generally by closing the valve that controls influent flow from the groundwater intercept trench) to allow regular system maintenance to be conducted (e.g., cleaning the air stripper pump).

For additional information on treatment system monitoring and performance, refer to Section 3.1.5.

2.4.2 East Trenches Plume Treatment System

The ETPTS treated groundwater throughout the year. Maintenance activities were conducted as necessary. The ETPTS Reconfiguration Project, the design of which was launched in 2013, began construction in 2014 and was nearly complete by year’s end. (Refer to Section 3.1.5.3 for additional information on this work.) Various configuration changes were implemented to support this project, as summarized below.

2.4.2.1 Flow Configuration

For most of 2014, ETPTS flows were measured using flow meters located in the “metering vault” adjacent to the two treatment cells. The flow configuration was controlled in a second vault (the “flow configuration vault”) located between these two cells. This layout was revised with elimination of the metering vault as part of the Reconfiguration Project, as discussed in greater detail in Section 3.1.5.3.

Over the course of the year, the flow configuration at the ETPTS was changed on several occasions. For the first part of the year through July, flow proceeded through the air stripper within the influent manhole, then to the metering and flow configuration vaults. The flow was split in this latter vault and directed via “parallel upflow” through the two ZVI-containing treatment cells. Following treatment, flow was routed back to the flow configuration vault, recombined into a single pipe, and the treated effluent was routed through the effluent manhole and to the discharge gallery. Valves were occasionally adjusted to balance flows between the two cells so that each would provide a fairly equivalent residence time for water within the treatment media. This was less feasible starting in June 2014, as it appeared the influent distribution gallery in the bottom of Cell 2 was becoming clogged and would require extreme measures to clear (e.g., forcing concentrated acid through the lines to dissolve the clog if it was due to accumulations of scale and other hard-water-related precipitates). As the system was to be reconfigured soon, best efforts were made to achieve flow through both treatment cells but no extreme measures were undertaken.

In August 2014, the ETPTS Reconfiguration Project began. The first major task was to remove the ZVI from the treatment cells. Dewatering the cells began in mid-July in preparation for the
project, and eventually both treatment cells were taken offline. From that point through the end of the year, intercepted groundwater was processed by the air stripper in the influent manhole, and then bypassed the treatment cells and was routed to the effluent manhole. This air stripper was shut off occasionally for maintenance (cleaning), and also was de-energized while some of the modifications required to complete the reconfiguration were underway. Whenever feasible during those periods, water was stored in the groundwater intercept trench until the air stripper was reactivated, and then flow was allowed to exit to the discharge gallery. However, over the course of the Reconfiguration Project there were several instances in which the air stripper was not active but flow needed to be released. For the approximately 15.5 hours total during which this occurred, flow was directed from the influent manhole to the effluent manhole.

2.4.2.2 Revisions of System Components

The ETPTS Reconfiguration Project was a focal point of activities in 2014. The objective of this project was to eliminate ZVI—and its associated high costs, need for periodic labor-intensive replacement, and the resulting wastes—from the ETPTS and achieve complete treatment using only a solar/battery-powered air stripper. ZVI alone has never consistently treated water to meet the RFLMA Table 1 values. The addition in 2013 of the air stripper in the influent manhole improved treatment substantially, but by this time the ZVI installed in 2009 was losing its treatment effectiveness. The ETPTS Reconfiguration Project was completed in January 2015. Refer to Section 3.1.5.3 for additional information on this project and a summary of early data and treatment effectiveness.

System components were changed on occasion throughout the first part of the year, before the Reconfiguration Project began. These activities focused on the influent manhole air stripper and were completed to evaluate and optimize treatment and maintenance. The original submersible pump, which operated using a centrifugal approach, had been replaced in November 2013 with two helical pumps that operated at lower flow rates but cumulatively produced equivalent flow. (Refer to the 2013 Annual Report [DOE 2014c] for an extended discussion of the original ETPTS air stripper, including operation and maintenance needs and activities.) Different nozzle assemblies and orientations were tested, to assess (for example) differences that might be attributed to the nozzle(s) spraying vertically upwards from the bottom of the manhole, or downwards from the top. The average flow rate through the pumps remained approximately 22 gallons per minute (gpm) for most of the year, with two primary exceptions: first, as the various air stripper components gradually clogged with scale, that flow rate decreased; and second, one of the pumps malfunctioned in November and from then until the Reconfiguration Project was completed a single pump operated the air stripper.

2.4.2.3 Maintenance

Maintenance in 2014 at the ETPTS continued to focus on issues related to hard-water scale in the air stripper and related components, and was both laborious and frequent. (See related discussion in the 2013 Annual Report [DOE 2014c], Sections 2.4.2, and the ETPTS portion of Section 3.1.5.) Routine maintenance activities included removing this scale—via the use of acid to dissolve the precipitates, as well as various brushes and tools to scrape parts—and flushing biological growth from piping, cleaning flow meters, cleaning water-level transducers, and cleaning or replacing filters. The air stripper hose required reattachment to the pump once, and this line needed to be repaired on another occasion.
The data logger for the ETPTS required maintenance in 2014, to install a new battery and eventually to reconfigure it to operate off the ETPTS solar/battery power facility. During these efforts, components such as the flow meters were deactivated and were then reactivated at completion of the electrical work. After the ETPTS Reconfiguration Project began, the data logger and flow meter (only one was needed at this point) were again set up to operate on separate batteries.

2.4.2.4 Operation

Operational activities are conducted to gather data, optimize performance, and control various treatment system functions. Routine activities during 2014 included controlling flow through the air stripper, modifying the nozzle configuration in the air stripper, recording flow and pressure data, measuring water levels, inspecting system components, and adjusting flows. Additionally, parts were replaced as needed (such as the air release valve in Cell 2) to ensure smooth operation of the various components.

The air stripper was shut off intermittently throughout the year for maintenance and adjustment. Flow through the treatment cells was shut off in early August to allow the ZVI media to drain prior to removal. The next time flow was directed to the former treatment cells—now the influent and effluent tanks for the air stripper—was at the end of the ETPTS Reconfiguration Project in January 2015, when treatment media was no longer a component of the ETPTS. However, the air stripper in the influent manhole remained active throughout this project (except during short intervals when it was de-energized to support construction activities). It was permanently de-energized in early January 2015.

Refer to Section 3.1.5.3 for additional information on the ETPTS Reconfiguration Project and on treatment system monitoring and performance.

2.4.3 Solar Ponds Plume Treatment System

The SPPTS treated groundwater throughout the year. Maintenance activities were performed periodically, and some operational adjustments and configuration changes were made in CY 2014.

2.4.3.1 Flow Configuration

SPPTS flows are measured using several flow meters, some of which are dedicated to specific components within the system. Total system flows are monitored by (1) a flow meter located on the influent line before water enters any treatment component and (2) a flow meter on the effluent line in a vault near the Solar Ponds Plume (SPP) Discharge Gallery. These are informally referred to as SPIN and SPOUT flows, respectively (from the associated monitoring location names, SPIN for SPPTS influent, and SPOUT for SPPTS effluent). The flow of groundwater that is pumped from the Phase I Interceptor Trench System Sump (ITSS) over a distance of approximately 420 feet to the SPIN influent collection sump is also measured, as are flows directed through certain test components (including each Phase III cell and the microcells).
SPPTS influent is therefore a mixture of water from the ITSS (which empties into the SPIN collection well) and water from the original groundwater intercept trench. These commingled waters are routed from SPIN through the small SPIN vault and then through a second vault (the metering vault). Within this metering vault, the influent flow is divided among the various components of the system for treatment and to support ongoing tests. The majority of this groundwater passes through the metering vault and enters the ZVI-filled Phase II treatment cell a few feet to the west, through which it moves in an upflow configuration. This water then flows by gravity to original treatment Cells 1 and 2, located in the large concrete structure. A portion of the groundwater from the Phase II cell is pumped in timed pulses back through the metering vault, where this water is split among two lines, dosed with liquid carbon, and then routed into the two Phase III pilot-scale lagoons located just north of the metering vault. These Cell A and Cell B lagoons are supporting nitrate treatment tests. (Refer to Section 3.1.5 for a more detailed discussion of these lagoons.) Effluent from these lagoons flows by gravity to original treatment Cells 1 and 2.

A portion of the groundwater entering the metering vault is diverted before entering the Phase II cell, flowing instead to the ongoing microcell tests, which are designed to evaluate a compact, simpler, and more efficient way to treat uranium (Section 3.1.5). Effluent from these tests also flows by gravity to the original treatment cells.

Groundwater from the Phase II cell, the Phase III lagoons, and the microcells flows to the original treatment Cells 1 and 2. The treated effluent flows by gravity from the original treatment cell structure, through the effluent manhole, and then approximately 420 feet to the east where it is piped through the effluent vault (i.e., within which is the SPPTS effluent sampling location known as SPOUT). As noted above, a flow meter located in this vault measures the effluent flow rate. From here, effluent flows to the subsurface discharge gallery.

The general flow configuration did not change throughout the year. However, additional piping was installed to support future testing of microcells downstream of the pilot-scale lagoons—i.e., using water that has been treated to remove nitrate. Prior to beginning pilot-scale field testing, a series of bench tests will be completed to explore different approaches to clarifying lagoon effluent, which contains abundant residual carbon and biomass that would otherwise clog microcells quickly. See Section 3.1.5 for more information on this topic.

### 2.4.3.2 Revisions of System Components

Minor upgrades were installed at a few locations within the SPPTS in CY 2014. Most notable was the addition of plumbing to allow testing of microcells using lagoon effluent, as noted above. When this line is in use, plans are for effluent from the pilot-scale lagoons to flow through the carbon storage vault to a holding tank, from which it will be pumped through a microcell and then routed to the original treatment cells.

Microcells were replaced when they were no longer effective, either due to reduced flow or treatment effectiveness. The operational duration of each microcell varied from several days to more than three weeks. See Section 3.1.5.3 for additional discussion of microcells and microcell testing.
2.4.3.3 Maintenance

SPPTS maintenance in CY 2014 included routine activities as well as special efforts focusing on the solar/battery power facility and associated electronics, and on flow through the concrete structure containing the two original treatment cells (informally referred to as “the big box”).

Routine activities included inspecting the various components, cleaning flow meters and lines, calibrating liquid carbon dosing pumps, cleaning temperature sensors and water-level transducers, and refilling the liquid carbon tank. Several times throughout the year, especially after heavy snow or rain, groundwater levels in the immediate area rose to the point that the open-bottom vaults became flooded. This water was pumped out of the vaults and into the original concrete treatment structure, sometimes daily, to protect system components. The rate of infiltration was high enough on a few occasions to activate an automated shut-off switch, shutting down the entire treatment system. Water was usually pumped out and the system restarted within 24 hours.

The power and electrical components were evaluated and related work was performed for two main reasons. First, the evolution of the treatment experiments performed at the SPPTS led to some electrical components no longer being needed and a general need to simplify the wiring. Second, the system began to suffer power failures in early September 2014. The batteries were initially reconfigured as a temporary measure, and in October were replaced. The balance of the electrical work was completed in October and November. During the course of this work, the main influent pump (“SPIN”) and the Phase I ITSS pump were shut off to allow the electrical work to be conducted safely.

As has been the case in previous years, standing water was present on the surface of the overburden in the big box for part of the year. The high flow rates in the first part of the year, which were related to the heavy precipitation in September 2013, required the SPPTS to process higher flows to keep up. The variably clogged lines within the treatment cells in the big box caused water to back up and flow from a weep hole drilled in Riser 1, the vent riser attached to the Cell 1 influent distribution gallery. When flowing, water from this weep hole saturated the overburden and led to a puddle forming over this material. Although this puddle essentially acted as another lagoon and so provided some beneficial effects, several efforts were conducted to improve flows through the treatment cells beneath this overburden material. These included physically surging the water within each of the four risers, similar to the process used to develop a monitoring well to remove fines and improve flows; perforating the overburden; and video-inspecting and jetting the lines.

Surging the risers provided immediate improvements in flow and was performed numerous times throughout the year. Four PVC vent risers (4-inch pipes) protrude from the media and overburden in the big box. Each of these connects to either an influent distribution pipe or an effluent pipe within one of the two treatment cells. Surging the water within helped clear out accumulations of biomass and any other material (silts, clays, and precipitates) that might be hampering flow through the cells. These efforts were consistently beneficial, but were very labor-intensive and the degree of success varied. On one occasion the results suggested flow might be short-circuiting the treatment cells entirely, leading to tracer tests focusing on the big box.
A series of two tracer tests was performed on the original treatment cells in summer 2014. The first tracer test evaluated whether flow was bypassing these treatment cells entirely, and determined this was not the case. The second tracer test evaluated whether flow was bypassing original Cell 2, and determined that it was. The valve was reconfigured accordingly. However, drainage of the big box did not improve following this valve adjustment.

A working hypothesis for why water was pooling on the surface in the big box had been developed over the past few years. Because effluent from the pilot-scale Phase III cells drains to Cell 1, any excess carbon fed to these pilot-scale cells would be available to bacteria within Cell 1; in addition, this lagoon effluent contains abundant bacteria. This could lead to an increase in biomass within the media and Cell 1 distribution gallery. This problem was recognized as early as 2010; at that time, attempts were made to address it using biocides (see Section 2.5.3 of the 2010 Annual Report [DOE 2011]). Those attempts undoubtedly helped to kill bacteria in the Cell 1 media and overburden surrounding the influent distribution gallery in this cell, but the clogged conditions remained because the now-dead biomass could not be removed. The distribution gallery piping is surrounded by overburden material comprising wood chips, mulch, and soil, beneath which is a non-woven fabric layer that separates the overburden from the underlying treatment media (in Cell 1, this is 90 percent sawdust and 10 percent ZVI). Therefore, the overburden, media, fabric, and pipes each may be clogged to some degree. Furthermore, if gases generated through consumption of the carbon in the Cell 1 media, overburden, and Phase III effluent cannot escape due to these clogged conditions, those trapped gases can exacerbate the clogged conditions. One way to address such a condition would be to perforate the overburden, fabric, and media to allow water to flow into the media and any trapped gases to escape.

Two rounds of “overburden perforation” were performed in early September and late October 2014. Threaded steel Geoprobe rods, approximately 3 inches in diameter and equipped with a solid point, were pushed vertically downward through the material using a mini-excavator. In the first round, at least 25 holes were pushed down through the overburden, fabric, and uppermost media, focusing on the western portion of Cell 1 but avoiding the main influent feed lines through the northwestern corner of the concrete wall. In the second round, at least 50 holes were pushed through this material, focusing on both Cell 1 and Cell 2.

Results of these perforation efforts were positive, but short-lived. The holes confirmed gases are trapped at depth in these materials, and one of the holes continued to offgas for many weeks. Flows increased dramatically, but the holes were allowed to collapse and seal themselves—no PVC casings, for example, were installed in these holes to keep them open. It was hoped that the perforations would provide sufficient flow paths over a longer term to allow water to flow through and gases to escape, but within a matter of days to weeks the flows had decreased to pre-perforation conditions.

A plumbing company was contracted in October to perform video inspection of the lines within the big box. The first company was not equipped to complete all the required activities—most particularly, to provide recorded video of the results, and to follow the initial inspection with jetting of the lines and repeated video inspection—and a second firm was contracted and provided the necessary service. Results of the inspection were inconclusive, and the jetting was unsuccessful. The influent distribution gallery in Cell 1 could not be accessed due to the numerous 90-degree angles in the piping and the series of laterals that branch off the main line,
and the water was so cloudy within this influent line that video could not clearly indicate the conditions of the pipe. However, this indirectly suggests that the materials surrounding the piping are clogged, and the piping itself may also be clogged. Because of the Cell 1 influent pipe configuration, the jetting tools could not access the portions that might benefit the most from this action. The other lines—Cell 1 effluent, and Cell 2 influent and effluent—were relatively clear by comparison, and jetting appeared at least somewhat beneficial, from a visual (video) perspective. Even so, flow through the big box was not significantly affected by this plumbing work.

Site technical staff is evaluating the path forward for this treatment system for both an overall system reconfiguration and a short-term maintenance effort. Testing over the last several years has been conducted to identify and test treatment technologies and processes that would allow the system to more effectively treat nitrate and uranium with a secondary goal of reducing operation and maintenance requirements. The constraints of very low flows, high nitrate concentrations, and no access to electric line power severely restrict the types of technology that can be used at the site. However, the microcell and lagoon testing currently in progress show promise for implementation in the overall reconfiguration within the next few years.

Options for a short-term maintenance effort to increase flow through the Cells 1 and 2 media are also being evaluated. As stated above, several techniques have been implemented but have provided only short-term results. Because the testing to support the overall reconfiguration is not yet complete, staff is now looking at options for a more extensive interim project that would improve system performance in the short term.

### 2.4.3.4 Operation

Operational activities are conducted to gather data, optimize performance, and control various treatment system functions. Routine activities during CY 2014 included starting, stopping, and adjusting the rate of flow through the treatment system and its various components; recording flow, temperature, and pressure data; and measuring water levels. In addition, test microcells were removed after they clogged or data indicated they were not treating adequately, and new microcells were installed in their place. Several different forms of microcell media, typically comprising various grain sizes of ZVI and in some cases mixed with sawdust, were tested over the course of the year. Section 3.1.5 provides summary information on the SPPTS performance and the different tests.

Changes to flow rates most often focused on the SPIN pump, which delivers influent to all treatment components. The flow rate was typically increased to draw down the water present in the groundwater intercept trench, or was decreased to retain a nominal amount of water in the trench. On occasion it was curtailed entirely to support maintenance activities (such as the electrical work described above). Flows to microcells and to Phase III Cells A and B were also adjusted on occasion. The average rate of pumping from ITSS was also adjusted to manage the water level in this sump.

For additional information on treatment system monitoring and performance, refer to Section 3.1.5.
2.5 Sign Inspection

“U.S. Department of Energy - No Trespassing” signs are required to be posted at intervals around the perimeter of the COU to notify persons that they are at the boundary of the COU. Signs listing the use restrictions (ICs) and providing contact information are also required to be posted at access points to the COU. The signs are required as physical controls of the remedy, are inspected quarterly, and are maintained by repairing or replacing them as needed. Physical controls protect the engineered components of the remedy, including landfill covers, groundwater treatment systems, and monitoring equipment, which are also inspected routinely during monitoring and maintenance activities.

The signs were inspected quarterly during CY 2014 as required. A few signs were added or replaced as needed. Some of the DOE logo stickers on the signs have begun to fade and will be replaced with new stickers in 2015.

2.6 Erosion Control and Revegetation

The existing erosion controls are maintained and repaired to protect the bare soil areas until the vegetation can stabilize the soil. Areas lacking sufficient vegetation cover are assessed and typically reseeded. In some cases, soil amendments are added to help establish the native vegetation. Additional information on the revegetation activities conducted at the Site during 2014 is provided in Section 3.2.

2.6.1 Erosion Control

Maintenance, repair, replacement, and monitoring of the Site erosion control features continued as needed through 2014. Assessing the erosion control is especially important following high-wind events that are common at the Site and after significant precipitation events. Repairs in 2014 included re-staking (or weighting with rocks) wattles or erosion blankets that had loosened. The Erosion Control Plan for the Rocky Flats Property Central Operable Unit (DOE 2007a) was followed for various projects conducted in 2014. The plan addresses the regulatory approach, monitoring inspections, and applicability and scope of erosion control activities at the Site. It outlines the responsibilities, BMPs, and implementation aspects for erosion control activities before, during, and after projects.