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FY2019 Performance Assessment Annual Review for the E-Area Low-Level Waste Facility

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March 2020

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EXECUTIVE SUMMARY

The Savannah River Site (SRS) E-Area Low-Level Waste Facility (ELLWF) consists of six types of disposal units described in the Performance Assessment (PA) (WSRC, 2008): Low Activity Waste Vault (LAWV), Intermediate Level Vault (ILV), Trenches [Slit Trenches (STs), Engineered Trenches (ETs), and Component-in-Grout (CIG) Trenches], and Naval Reactor Component Disposal Areas (NRCDAs). The ELLWF is a part of the Solid Waste Management Facility (SWMF). SWMF is managed and operated by the SRS Management and Operations prime contractor, Savannah River Nuclear Solutions (SRNS). Within SRNS, the Solid Waste Management (SWM) organization is responsible for operating the SWMF, and the Savannah River National Laboratory (SRNL) is the technical agency responsible for preparing and maintaining the PA. SWMF operations have been performed at SRS since 1952. The mission of the SWMF is to provide storage, processing, disposal, and shipment of radioactive, hazardous, and mixed waste. The SWMF is committed to treat, store, and dispose of these waste products in a manner that protects the environment and the health and safety of the facility worker, the co-located worker, and the offsite general public. Wastes handled in the SWMF include low level waste, transuranic waste, hazardous waste, Toxic Substances Control Act waste, and mixed waste (containing both hazardous and radioactive constituents).

SRS low-level waste management at ELLWF is regulated under Department of Energy (DOE) Order 435.1 (DOE 1999a) and is authorized under a Disposal Authorization Statement (DAS) as a federal permit. The original DAS was issued by Department of Energy-Headquarters (DOE-HQ) on September 28, 1999 (DOE 1999b) for the operation of the ELLWF and the Saltstone Disposal Facility. Those portions of that DAS applicable to the ELLWF were superseded by Revision 1 of the DAS on July 15, 2008 (DOE 2008a). The 2008 PA and 2008 DAS were officially implemented by the facility on October 31, 2008 and are the authorization documents for this Fiscal Year (FY) 2019 Annual Review.

Approximately 4,600 cubic meters of low-level waste were disposed into ELLWF disposal units during FY2019. All disposal units remain in conformance with their disposal limits. There have been no significant changes to the documents making up the Radioactive Waste Management Basis (RWMB). The Component-in-Grout trench cover was damaged by a storm and will be replaced. Inspections of all other trench covers did not find any major issues. Vadose zone monitoring results show that 8 of 83 sampled action-level lysimeters have tritium concentrations exceeding their administrative limits; one less lysimeter was sampled in FY2019 than FY2018 because the lysimeter was dry and it could not be sampled. Monitoring of vault and trench sump water showed that all samples were below administrative limits.

New groundwater flow predictions resulted in the initiation of a Special Analysis (SA) (Hamm et al., 2018), and measures have been introduced to maintain assurance that performance objectives will continue to be met (see Table 2-1). The number of proposed changes to data, models and operational plans for the ELLWF since the 2008 PA are enough to warrant a revision. Therefore, a revision to the PA is in preparation and is scheduled to be submitted LFRG in FY2022.

The FY2019 PA Annual Review for the ELLWF affirms that the disposal facility continued to operate within the bounds of the current PA and Composite Analysis (CA) baseline and satisfied all the requirements, conditions, and limitations identified in the 2008 DAS (DOE 2008a), RWMB (McGill, 2018), and ELLWF Waste Acceptance Criteria (SRS-1S). This annual review affirms that the supporting studies performed in FY2019 do not alter the conclusions of the ELLWF PA (WSRC, 2008) and that there is a reasonable expectation that the ELLWF will meet the performance objectives delineated in DOE Order 435.1.

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LIST OF ABBREVIATIONS

AL	Action Level
AP	All-Pathways
CA	Composite Analysis
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CIG	Components-in-Grout
DAS	Disposal Authorization Statement
DOE-HQ	Department of Energy – Headquarters
DOE-SR	Department of Energy – Savannah River
dpm	disintegrations per minute
DRF	Dose Release Factor
ELLWF	E-Area Low-Level Waste Facility
ET	Engineered Trench
FY	Fiscal Year
GSA	General Separations Areas
GW	Groundwater
HELP	Hydrologic Evaluation of Landfill Performance
ILV	Intermediate Level (Waste) Vault
L	liter
LAWV	Low Activity Waste Vault
LFRG	Low-Level Waste Disposal Facility Federal Review Group
LLW	Low-Level Waste
m^3	cubic meters
mL	milliliter
MWMF	Mixed Waste Management Facility
N/A	Not Applicable
NRCDA	Naval Reactor Component Disposal Area
PA	Performance Assessment
PARC	Performance Assessment Review Committee
pCi	picocuries
PEST	Parameter ESTimation software
PO	Performance Objective
QA	Quality Assurance
RWMB	Radioactive Waste Management Basis
SA	Special Analysis

SCDHEC	South Carolina Department of Health and Environmental Control
SOF	Sum-of-Fractions
SRNL	Savannah River National Laboratory
SRNS	Savannah River Nuclear Solutions
SRS	Savannah River Site
ST	Slit Trench
SWM	Solid Waste Management
SWMF	Solid Waste Management Facility
UCAQE	Unreviewed Composite Analysis Question Evaluation
UDQE	Unreviewed Disposal Question Evaluation
WAC	Waste Acceptance Criteria
WITS	Waste Information Tracking System

1.0 Facility Background/History

The Savannah River Site (SRS) E-Area Low-Level Waste Facility (ELLWF) consists of six types of disposal units described in the Performance Assessment (PA) (WSRC 2008): Low Activity Waste Vault (LAWV), Intermediate Level Vault (ILV), Trenches [Slit Trenches (STs), Engineered Trenches (ETs), and Component-in-Grout (CIG) Trenches, and Naval Reactor Component Disposal Areas (NRCDAs). This annual review evaluates the adequacy of the approved 2008 ELLWF PA, along with the Special Analyses (SAs) approved since the PA was issued, the 2008 Disposal Authorization Statement (DAS) (DOE 2008a), and ELLWF Waste Acceptance Criteria (SRS-1S). The review also verifies that the Fiscal Year (FY) 2019 low-level waste (LLW) disposal operations were conducted within the bounds of the PA/SA baseline and the DAS. Important factors considered in this review include waste receipts, results from monitoring, research and development (R&D) programs, and the adequacy of controls derived from the PA/SA baseline.

SRS low-level waste management at ELLWF is regulated under Department of Energy (DOE) Order 435.1 (DOE 1999a) and is authorized under a DAS as a federal permit. The original DAS was issued by Department of Energy-Headquarters (DOE-HQ) on September 28, 1999 (DOE 1999b) for the operation of the ELLWF and the Saltstone Disposal Facility (SDF). Those portions of that DAS applicable to the ELLWF were superseded by Revision 1 of the DAS on July 15, 2008 (DOE 2008a). The 2008 PA and 2008 DAS were officially implemented by the facility on October 31, 2008 and are the authorization documents for this FY2018 Annual Review.

The ELLWF is a part of the Solid Waste Management Facility (SWMF). SWMF is managed and operated by the SRS Maintenance and Operations prime contractor, Savannah River Nuclear Solutions (SRNS). Within SRNS, the Solid Waste Management (SWM) organization is responsible for operating the SWMF, and the Savannah River National Laboratory (SRNL) is the technical agency responsible for preparing and maintaining the PA. SWMF operations have been performed at SRS for over 60 years. The mission of the SWMF is to provide storage, processing, and shipment of radioactive, hazardous, and mixed waste. The SWMF is committed to treat, store, and dispose of these waste products in such a manner that the health and safety of the facility worker, the co-located worker, the offsite general public, and the environment are protected. Wastes handled in the SWMF include low level waste, transuranic waste, hazardous waste, Toxic Substances Control Act waste, and mixed waste (containing both hazardous and radioactive constituents). The SWMF consists of E-Area and a portion of H-Area within SRS. The majority of the SWMF processes, including ELLWF, are located in the E-Area, which is near the center of SRS.

2.0 Changes Potentially Affecting the PA, CA, DAS OR RWMB

Many of the research and development tasks summarized in recent Annual Reviews (Hiergesell et al., 2016; Crapse et al., 2017; Hang et al., 2018; Kubilius et al., 2019a) as well as in this report, have been in preparation for the revision of the 2008 PA (WSRC, 2008). The DOE requires that the PA demonstrate a reasonable expectation that LLW disposal will meet the radiological performance objectives/measures established in DOE Order 435.1. A revision to the PA was started in January 2019.

PA/CA. There were no Unreviewed Disposal Question Evaluations (UDQE) or Unreviewed Composite Analysis Question Evaluations (UCAQE) completed in FY2019. In March 2018, Savannah River National Laboratory (SRNL notified SWM of new information that could potentially impact groundwater (GW) disposal limits and possibly require temporary protective measures (Crowley, 2018). GW flow directions in the ELLWF STs, ETs, and the LAWV had notably changed in the new 2018 General Separations Area (GSA) flow model (Flach, 2019). The 2018 GSA flow model had been updated using 20 years of new hydrologic field data and model calibration methods that employed mathematical optimization software. It was later determined that the primary reason for the change in GW flow directions was due to the influence of low permeability caps that had been placed over the Old Burial Grounds and the Low-Level Radioactive

Waste Disposal Facility. Updated flow directions in the model produce a higher degree of plume overlap for disposal units (DU's) in the southeastern portion of E-Area than had been predicted in the 2008 E LLWF PA. SWM and SRNL outlined the scope for this Special Analysis (SA) and proposed a set of interim measures (IM's) to protect trench operations from exceeding Performance Objectives (PO's) during the preparation of this SA, both of which were approved by the SWM Performance Assessment Review Committee (PARC) (Mooneyhan, 2018). The following new models and updated key PA datasets were employed in the SA:

- updated GSA flow model (Flach, 2019),
- new conceptual closure cap design (SRNS 2016a and 2016b),
- updated infiltration estimates (Dyer and Flach 2018),
- new trench model (Danielson 2019, Dyer 2017),
- latest geochemical parameters (Kaplan 2016a and 2016b, SRNL 2018a),
- updated hydraulic parameters (SRNL 2018c), and
- new dose model based on updated radionuclide-dose parameters and dose methodology (Smith et al. 2015 and Smith 2015, SRNL 2018b).

These updated models and datasets are being evaluated as part of the ongoing PA revision. Specific information for this identified change is described in Section 3.0 and Table 2-1

DAS. SRS continued to conduct ELLWF disposals in accordance with requirements, conditions and limitations set out in the DAS. No baseline document listed in the DAS required revisions in FY2019. LLW disposal facility designs and operational practices continue to conform to the conceptual models used in the PA. Secondary issues identified in the Low-Level Waste Disposal Facility Federal Review Group (LFRG) review team report (DOE, 2008b) have been closed and improvements are to be addressed in the next PA. Thus, this annual review affirms the continued adequacy of the DAS in FY2019.

RWMB. The Radioactive Waste Management Basis (RWMB), as updated and approved by Department of Energy – Savannah River (DOE-SR), is adequate for providing the waste controls, processes, and procedures to define the conditions under which the facility may operate with respect to low-level radioactive waste. The RWMB was updated in 2018 (McGill, 2018) to ensure that it is consistent with facility operations and the radioactive waste management order. SA SRNL-STI-2018-00624 (Hamm et. al., 2018) was added to the FY2019 RWMB with expected approval in FY2020. SWMF inventory database limits were changed to implement the operating restrictions as noted in Table 2-1. The LFRG Site Member reviewed the SA and the Field Element Manager issued approval.

Table 2-1. Potential Changes Affecting the PA, CA, DAS or RWMB.

Disposal Facility/Unit	UDQE /UCAQE or Change control process identification number	Change, Discovery, Proposed Action, New Information description	Evaluation Results	Special Analysis number	PA, CA, DAS, or RWMB Impacts
ELLWF: ST05-ST07, ST14-ST21, ET01, ET02, and LAWV	N/A	GW flow directions in the ELLWF Trenches and the LAWV have notably changed in the new 2018 GSA flow model	• Lower limit of 2% of the trench area on non-crushable containers is imposed on ET02 and ST14 through ST21. No additional non-crushable containers should be disposed in ST06 or ST07. • Prohibit opening of any new trenches south of ST14 (i.e., ST15 through ST21) prior to completion and approval of the next PA revision. • ST06 and ST07 should not be reactivated to receive additional waste prior to completion and approval of the next PA revision. • SWM can continue to use the current Waste Information Tracking System (WITS) inventory limits for the DU's that were the subject of this analysis and be confident that the DOE O 435.1 GW protection requirement and GW PO's will not be exceeded.	SRNL-STI-2018-00624 (Hamm et. al., 2018)	The results of this SA provide increased confidence that the planned PA revision will produce acceptable GW limits

3.0 Cumulative Effects of Changes

The number of proposed changes to data, models and operational plans for the ELLWF since the 2008 PA are enough to warrant a revision. Therefore, a revision to the PA utilizing the new models and updated key PA datasets described in Section 2.0 is in preparation and is scheduled to be submitted to LFRG in FY2022.

There was only one SA performed in FY2019 as discussed in Section 2.0. The SA was approved by PARC (Germain, 2019) and DOE-SR (DOE-SR, 2019) and was reviewed by the DOE-SR LFRG Site Member. The following conclusions were reached:

- SWM will need to apply the new operational constraints imposed by the SA (see Table 2-1) to ensure that disposal operations are protected. SWM should also update the SWM key inputs and assumptions database.

- The SA demonstrated a sizeable amount of operating margin with respect to performance objectives given the restrictions on trench operations listed in Table 2-1.

- SWM can continue to operate at their current limits in their active disposal units subject to the operational constraints in Table 2-1 until the ongoing PA revision is completed and approved and be confident that DOE O 435.1 PO's and GW protection requirements will not be exceeded. These constraints are implemented, in either procedures or other applicable means, by an Implementation Plan that will be formally approved in FY2020.

4.0 Waste Receipts

Waste acceptance criteria for disposal of LLW at the ELLWF are found in Chapter 5 of the 1S SRS Radioactive Waste Requirements Manual. Chapter 5 identifies the specific Waste Acceptance Criteria (WAC) by waste form, general Waste Information Tracking System (WITS) limits, and a LLW disposal unit decision tree. This LLW WAC procedure is periodically reviewed and updated (SRS-1S, 2014).

As required by the WAC (SRS-1S, 2014), waste generators must fill out a waste stream characterization form for each waste stream and forward it to SWM for approval prior to shipping. This characterization form includes the waste type and description. SWM reviews the characterization form for compliance with the WAC. Currently, there are over 2,000 approved waste streams in WITS with approximately 127 approved waste streams active as of the end of FY2019. All waste types received in the E-Area disposal units were included and analyzed in the PA or supporting SAs (prior to FY2019).

The disposed radionuclide and volumetric inventories in FY2019 (between 9/28/18 and 9/30/19) were compared against the applicable PA/SA-limits for each of the LLW disposal units in ELLWF and met performance objectives. These disposal units included the E-Area Vaults (LAWV, Intermediate Level Vault (ILV)), disposal trenches (STs, ETs, and Component-in-Grout (CIG) trenches), and the Naval Reactor Component Disposal Areas (NRCDAs).

The radionuclide inventory limits calculated in the PA/SA are implemented in the WAC. Disposed inventory is tracked as fractions of the individual radionuclide limits in WITS. The sum of these fractions for each disposal unit is controlled to less than or equal to one to ensure compliance with each PA performance measure's limit. SWM typically operates most low-level waste facilities with a 0.95 sum of fractions (SOF) administrative limit. The SOFs for disposed radionuclide inventories for all disposal units are less than one.

Because of waste minimization and volume reduction programs at SRS, future inventory estimates indicate that only a single LAWV and a single ILV will be needed for low-level radioactive waste disposal over the operational period (i.e., no new vaults need to be constructed). After 25 years of LAWV operation, approximately 32% of the available volume is filled with waste that contains approximately 13% of the allowable radionuclide inventory. After 25 years of ILV operation, approximately 58% of the available volume in the nine cells is filled with waste that contains approximately 10% of the allowable radionuclide inventory. Neither vault is projected to be filled to 100% capacity during the planned operational period.

Table 4-1 provides the volume disposed of in FY2019, PA-estimated disposal capacity, percent filled, limiting SOFs for the selected performance measures, and the PA/Composite Analysis (CA) impact as of 9/30/19 for each DU. Plume overlap among units has been taken into account in calculating final limits. Thus, if individual DU's are compliant the overall facility is as well. For all ELLWF units, the groundwater beta-gamma performance measure is the controlling pathway at various time intervals depending on the disposal unit. Dose impact was calculated using the most limiting SOF and the corresponding performance objective. The dose associated with each disposal unit is below the performance objective limit.

Table 4-1. Waste Receipts.

Disposal Unit	Volume Disposed During FY2019 (m^3)	PA-Estimated Disposal Capacity (m^3)	Percent Filled FY2019 (%)	Sum of Fractions	PA/CA Impact (mrem/yr)
LAWV	136	30,600	32	0.13	0.52 of 4
ILV	14	4,284	58	0.09	0.36 of 4
ST 1 (closed)	0	14,264	100	0.85	3.40 of 4
ST 2 (closed)	0	15,560	100	0.87	3.48 of 4
ST 3 (closed)	0	16,953	100	0.89	3.56 of 4
ST 4 (closed)	0	19,193	100	0.99	3.96 of 4
ST 5 (closed)	0	28,125	100	0.99	3.96 of 4
ST 6	0	23,000	91	0.82	3.28 of 4
ST 7	0	15,900	66	0.56	2.24 of 4
ST 8	0	16,275	95	0.89	3.56 of 4
ST 9	633	21,000	93	0.84	3.36 of 4
ST 14	884	19,500	74	0.52	2.08 of 4
ET 1 (closed)	0	35,660	100	0.87	3.48 of 4
ET 2	344	35,500	78	0.68	2.72 of 4
ET 3	2,779	27,000	75	0.54	2.16 of 4
NRCDA (643-7E) (closed)	0	701	100	0.44	1.76 of 4
NRCDA (643-26E)	-102[1]	6,000	12	0.03	0.12 of 4
CIG 1	0	6,500	28	0.03	0.12 of 4

[1]Volume decreased in FY2019 due to containers being relocated to ET 3 for disposal

5.0 Monitoring

The E-Area Performance Monitoring Program ensures that the monitoring results from the vadose zone, sump water, soil cover, stormwater runoff covers, and vaults are evaluated and that they meet the ELLWF performance objectives. The monitoring program is implemented in accordance with DOE Manual 435.1 (DOE 1999a) and its objectives are to: 1) monitor trends in performance, 2) evaluate whether a facility is operating and behaving as expected and predicted by the PA, 3) evaluate the conservativeness of the PA conclusions, 4) provide input for refining the PA and building integrity in the PA analyses, and 5) provide a means to evaluate the potential for future regulatory exceedances. A summary of the monitoring performed for the ELLWF is provided in Table 5-1, and the performance modeling results that differ from expected behavior are given in Table 5-2. The PA Monitoring Plan was last revised in 2012 (Millings, 2012) and a revision is planned to be completed in FY2021 to further evaluate the exceedance of the action levels and incorporate ET 3 monitoring as well as new information obtained during recent field characterization (Kubilius and Joyce, 2018).

5.1 <u>Vadose Zone Monitoring</u>

Groundwater in the vadose zone beneath the ELLWF undergoes semiannual performance monitoring to verify that tritium concentrations are not high enough to cause saturated zone groundwater to exceed the tritium maximum concentration limit outside the facility. Measured vadose zone tritium concentrations are compared to administrative limits, which were established in the ELLWF Monitoring Plan (Millings, 2012) and are based on PA predictions (WSRC, 2008). The administrative limit for a given trench is 25% of the tritium concentration in the vadose zone which, if it occurred beneath the entire areal footprint of the trench, would cause groundwater tritium concentrations at the 100-meter boundary to reach the maximum concentration limit. The vadose zone monitoring program employs a series of about 300 active lysimeters, which are grouped into 99 lysimeter clusters. In 90 of the clusters, one lysimeter is designated as an "action-level lysimeter" (Halverson and Millings, 2017). This is usually the deepest (i.e., closest to the water table) active lysimeter in the cluster. Tritium concentrations in action-level lysimeters are compared to the administrative limits.

Nine lysimeter clusters do not have an action-level lysimeter; one cluster (MWMF-VL-1) is a "background" cluster not associated with a trench, and eight clusters have no active lysimeter at an appropriate elevation: one at ET 1(VL-23), two at ET 2 (ET2-VL-4, ET2-VL-8), one at ST 1 (VL-3A), two at ST 2 (ST2-VL-1, ST2-VL-6), one at ST 3 (ST3-VL-7) and one at ST 8 (ST8-VL-3). These nine clusters are still sampled, and the results are reviewed for notable changes.

In FY2019, samples were collected at 83 of the 90 action-level lysimeters. The other seven lysimeters were dry for both fall and spring sampling periods. Analytical results in FY2019 were at or below administrative limits at 75 of the 83 sampled action-level lysimeters. Table 5-2 provides a summary of FY2019 tritium data for each of the action-level lysimeters above administrative limits (where the PA Expected Behavior is the administrative limit for that DU). Table 5-3 provides summary data for all action-level lysimeters. Tritium concentrations in eight action-level lysimeters exceeded administrative limits: two at ET 1, one each at ET 2, ST 1, ST 4, ST 7, ST8, and ST 14 (locations shown in Figure 5-1). Another ET 1 action-level lysimeter, at VL-22, had exceeded administrative limits in FY2016, but has been dry since and could not be sampled. ET2-VL-5 was above the administrative limit in FY2018 but was dry during FY2019 and could not be sampled.

An analytical result that is greater than the administrative limit does not indicate that groundwater concentrations will exceed the Environmental Protection Agency drinking water standard (SRS groundwater protection requirement) at the compliance point. The administrative limit would have to be simultaneously exceeded by a factor of four over a significant portion of the trench in several of the deepest lysimeters (closest to the aquifer) before there would be a risk of exceeding drinking water standards. When an action-level is exceeded, data are reviewed to establish temporal trends and to evaluate depth and geographic occurrence (Millings, 2012). A graded hierarchal approach is used to evaluate the collected data versus projected results from the PA. The graded approach may consist of additional sampling, testing, and research studies implemented through the PA/CA maintenance program. All action-level lysimeters which exceeded their administrative limits in FY2019 or earlier are discussed individually below.

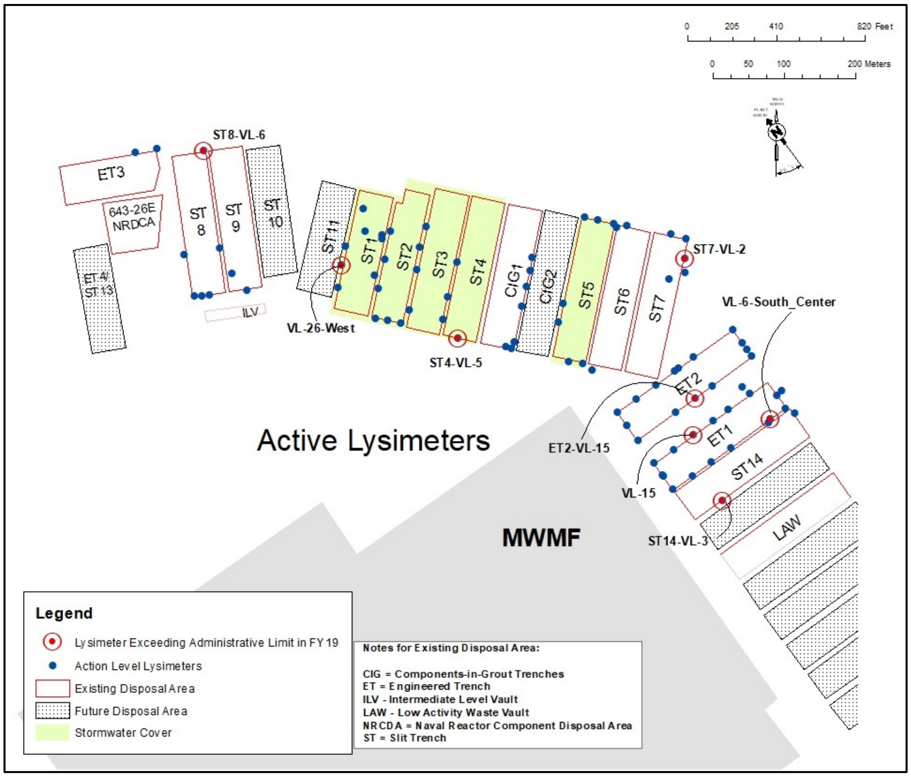

Figure 5-1. Layout showing disposal units, current action-level lysimeters, locations of administrative limit exceedances, and stormwater runoff covers.

5.1.1 Engineered Trench 1

There are 17 action-level lysimeters associated with Engineered Trench 1 (ET 1). Of these 17 lysimeters, three were dry during both FY2019 sampling events. Samples were collected from 14 action-level lysimeters during either or both FY2019 sampling events. Two of the 14 action-level lysimeters sampled in FY2019 exceeded the tritium concentration administrative limit of 101 pCi/mL: those in clusters VL-6-South Center (VL-6-SC) and VL-15. In addition, the action-level lysimeter at VL-22 was dry in FY2019, but its most recent sample (FY2018) exceeded the administrative limit.

VL-6-SC. The action-level lysimeter first exceeded the tritium administrative limit in FY2014, with a result of 502 pCi/mL, representing a substantial increase from 58 pCi/mL obtained in the previous sampling event. This prompted a detailed data review for VL-6-SC including disposal records, local hydrogeology, and rainfall data (Millings et al., 2014). Nothing remarkable was found in these data that could definitively explain the elevated tritium concentrations in VL-6-SC. Since 2014, concentrations in the action-level lysimeter have been generally decreasing, reaching 312 pCi/mL in spring 2019. However, concentrations in the shallow lysimeter at VL-6-SC have been increasing since 2015. Even though the shallow lysimeter was dry during both FY2019 sampling events, the increasing trend suggests the tritium concentration in the action level (AL) lysimeter may increase in the future. At the time of the 2014 review, concentrations in the adjacent lysimeters (VL-7 and VL-23) were at or near background. As of spring 2019, VL-7 remains at background whereas the tritium concentration in the action level lysimeter at VL-23 has trended upward.

VL-15. The AL lysimeter had its first exceedance in FY2012, with its concentration increasing from 40 to 158 pCi/mL. It has exceeded the administrative limit in every sampling since then. The tritium concentration rose to a maximum of 1163 pCi/mL in fall 2015. After a period of decline, the tritium concentration rose to 1113 pCi/mL in spring 2019. A similar trend was observed in the shallower lysimeter where tritium concentrations initially increased, declined, and subsequently increased again. The most recent data shows that tritium concentrations in the shallower lysimeter are declining again. It appears that tritium concentrations in the AL lysimeter follow the same pattern as the shallower lysimeter but are lagged and slightly reduced.

VL-22. The AL lysimeter was dry during FY2019; it was last successfully sampled in spring 2016. At that time, its tritium concentration was 289 pCi/mL, representing an increase from 246 pCi/mL a year earlier. Shallow lysimeters at VL-22 are elevated, but on a decreasing trend.

As a result of the exceedances noted for the ET 1 sampling locations, a study was undertaken to assess whether the elevated concentrations challenged the PA conclusions (Flach and Whiteside, 2016). Because ET 1 and ET 2 were analyzed together in the 2008 PA, they were evaluated together in this study. The 2008 PA model conservatively assumed hypothetical waste disposal timing and distribution based on both trenches opening and being filled simultaneously. In reality, the average disposal dates for ET 1 and ET 2 differ by more than eight years, which will result in some plume separation. Because the as-disposed-of waste condition for ET 1 and ET 2 were different than assumed in the PA, the model was revised to reflect the actual disposal conditions. The results of the study showed that simulated and vadose zone plume concentrations are reasonably consistent and that the phased operation of ET 1 and ET 2 is likely to ensure that performance objectives are met. This conclusion was later confirmed by the Special Analysis of the impact of the updated GSA flow model on E-Area groundwater performance (Hamm et al. 2018)

5.1.2 Engineered Trench 2

There are 15 AL lysimeters associated with Engineered Trench 2 (ET 2). Of these 15 lysimeters, one was dry during both FY2019 sampling events. Samples were collected from 14 AL lysimeters during either or both FY2019 sampling events. One of the 14 AL lysimeters, ET2-VL-15, exceeded the tritium concentration administrative limit of 101 pCi/mL. In addition, the AL lysimeter at ET2-VL-5 was dry in FY2019, but its most recent sample (FY2018) exceeded the administrative limit.

ET2-VL-5. This AL lysimeter first exceeded the tritium administrative limit in spring 2017, with a result of 178 pCi/mL. It increased again in both fall 2017 and spring 2018. The spring 2018 concentration of 2822 pCi/mL is the highest level of any AL lysimeter at ELLWF to date. The shallow lysimeter in this cluster reached a maximum in fall 2016, and it has been declining since. Because concentrations at these two lysimeters follow a similar trend, the concentration at ET2-VL-5 may also decrease over time. However, ET2-VL-5 was dry during both FY2019 sampling events. As part of normal operations, the operational soil cover over the waste was extended beyond ET2-VL-5 in FY2019. This action will reduce infiltration and funneling of water in the vicinity of ET2-VL-5.

ET2-VL-15. Tritium concentrations at this AL lysimeter have been increasing since 2015. It first exceeded the administrative limit in spring of 2018 with a concentration of 189 pCi/mL. The tritium concentration continued to increase in FY2019, with a result of 221 pCi/mL. Concentrations in shallow lysimeters in this cluster are elevated but have generally been declining since 2016. This suggests that concentrations at the AL lysimeter may also begin to decrease in the future. As with ET2-VL-5, the operational soil cover was extended beyond this lysimeter location during FY2019.

5.1.3 Slit Trench 1

In FY2019, one of the eight AL lysimeters, VL-26-West, exceeded the tritium concentration administrative limit of 61 pCi/mL. Additionally, a second lysimeter, AT-6, exceeded the limit in FY2017, but has not since. However, in FY2019, the tritium concentration in AT-6 was 60.6 pCi/mL, which is slightly less than the administrative limit.

VL-26-West. This AL lysimeter was the first at ELLWF to exceed its administrative limit. This lysimeter was installed in 2003 and the first AL exceedance was in spring 2008 with a result of 67 pCi/mL. The tritium concentration increased gradually through 2017 reaching 515 pCi/mL. Since 2017, the concentration has been relatively steady. The spring 2019 result was 518 pCi/mL. The lysimeter above the AL lysimeter is also elevated, but tritium concentrations there have been declining since 2013. The decreasing trend in the shallower lysimeter suggests that concentrations in the AL lysimeter have plateaued and may decrease in the future. Previous investigations into VL-26-West have included additional sampling events, reviews of geology and disposal history (Millings, 2009), modeling (Smith, 2010), and a field study (Millings, et al., 2010). Data from these studies indicate that the tritium emanating from ST1 near VL-26-West is localized and should have no discernable effect on groundwater near the trench.

AT-6. The tritium concentration in the AL lysimeter at AT-6 rose gradually from about 2011, and it exceeded the administrative limit in fall 2016 with a concentration of 76 pCi/mL. Since fall 2016, tritium concentrations have hovered around the administrative limit of 61 pCi/mL. In spring 2019, the tritium concentration was 60.7 pCi/mL which is slightly less than the administrative limit of 61 pCi/mL. The tritium concentrations in the shallow lysimeters at AT-6 are generally trending downward. This suggests the tritium concentration in the action level lysimeter may begin to trend downward.

5.1.4 Slit Trench 4

ST4-VL-5. One of the two AL lysimeters in Slit Trench 4, ST4-VL-5, exceeded its tritium concentration administrative limit (61 pCi/mL) in FY2019. This AL lysimeter had elevated tritium levels when installed in 2008, and concentrations have increased since then. It has exceeded the administrative limit continuously since fall 2011. In spring 2019, the concentration was 103 pCi/mL. Concentrations in shallow lysimeters within the cluster are elevated but have been gradually trending downward since spiking in 2009. Tritium data from this cluster will continue to be monitored as part of the vadose zone program.

5.1.5 Slit Trench 7

ST7-VL-2. One of the six AL lysimeters in Slit Trench 7, ST7-VL-2, exceeded its tritium concentration administrative limit (61 pCi/mL) in FY2019. This AL lysimeter slightly exceeded the administrative limit in FY2010 and FY2011, then was below it for several years. Beginning in FY2017, it has been above the administrative limit for each sampling event and reached a peak of 425.6 pCi/mL in fall 2017. Since fall 2017, the tritium concentration in this lysimeter has been decreasing with a concentration of 343 pCi/mL in fall 2019. Shallow lysimeters in the cluster are at area background levels (~5-10 pCi/mL). Tritium data from this cluster will continue to be monitored as part of the vadose zone program.

5.1.6 Slit Trench 8

ST8-VL-6. One of the five AL lysimeters in Slit Trench 8, ST8-VL-6, exceeded its tritium concentration administrative limit (46.9 pCi/mL) in FY2019, with a concentration of 60.8 pCi/mL (spring 2019). This lysimeter first exceeded the administrative limit in FY2018. The shallow lysimeter at this cluster is elevated but the tritium concentration appears to be reaching a plateau. Therefore, the concentration in the AL lysimeter may also plateau in the future. Tritium data from this cluster will continue to be monitored as part of the vadose zone program.

5.1.7 Slit Trench 14

ST14-VL-3. One of the three AL lysimeters in Slit Trench 14, ST14-VL-3, exceeded its tritium concentration administrative limit (64 pCi/mL) in FY2019 with a concentration of 125 pCi/mL (spring 2019). This lysimeter was installed in 2016, and it has been sampled five times. It exceeded the limit in the four most recent sampling events. The lysimeter immediately above the AL lysimeter is near background but the shallowest lysimeter in the cluster has been trending upwards. Tritium data from this cluster will continue to be monitored as part of the vadose zone program.

5.2 Trench Cover Monitoring

Inspections of the soil cover over filled sections of operating STs are conducted on a quarterly basis per procedure SW15.6-INP-SWF-03 (SWM, 2019a). A few localized depressions and erosion areas were noted in these inspections. SWM addressed each area of concern with grading equipment and soil fill.

Inspections of the CIG storm water runoff cover are performed on a quarterly basis (SWM, 2019a). Four inspections were conducted in FY2019. There was damage to the cover due to a hurricane that came through the area in October 2018. The cover is anticipated to be replaced with the same material as the original storm water runoff cover in December 2019. The cover damage is not expected to impact PA assumptions as the limits were calculated with and without a cover; the lower of the two being used in the WAC.

Inspections of the Slit Trench water barriers are performed quarterly (SWM, 2019a). Ongoing maintenance issues were addressed with concrete fasteners. A few concrete fasteners for the stainless-steel anchor strips had been found to be broken off at the head of the fasteners. These fasteners were replaced with more durable concrete anchors. In addition, SWM has continued to monitor two depressions that had formed underneath the covers due to subsidence of the waste in FY2012. One depression is approximately ten feet in diameter and the other depression is approximately five feet in diameter. Both are up to approximately eighteen inches deep. The FY2019 inspections determined that these two depressions had not changed in size or in depth. The covers were still intact with no fatigue issues above these two depression areas. SWM will continue to monitor these depressions for changes in conditions.

5.3 Vault Concrete Monitoring

Inspection of the LAWV walls was last performed in October 2018 (FY2019) by procedure 724-EAV-50 (SWM, 2018) which showed no significant cracking or degradation beyond what was assumed for the PA. This inspection is performed every two years.

5.4 Sump Water Monitoring

Water samples are taken from the vaults (LAWV and ILV) and engineered trench sumps. SWM monitors the vault sumps through procedure SW15.1-SOP-LLS-01 (SWM, 2019b) and the ET 2 sump through procedure SW15.1-SOP-ESUMP-02 (SWM, 2017). These procedures provide instructions for sampling and pumping the vaults and ET 2 sumps. The sumps are checked for liquid levels and if liquid level thresholds are exceeded then the contents are sampled for evaluation against the administrative limits (SWM, 2019b and SWM, 2017) and dispositioned accordingly. All FY2019 samples were below administrative limits.

5.5 Surface Water Compliance Monitoring

SRS conducts scheduled compliance monitoring of surface water at several locations downstream of ELLWF, per DOE Order 458.1 (DOE 2011) and the CA monitoring plan (Crapse et al 2011). Results and projected radiation doses to the public are published in the SRS Annual Environmental Report and are compared to CA predictions in the CA annual reviews (Kubilius et al., 2019b). The most recent predicted maximum dose to a member of the public, via the liquid pathways (includes doses from drinking water, fish, and invertebrates consumption, recreational activities, and irrigation) at locations below ELLWF, is published in the 2018 Annual Environmental Report (SRNS, 2019) and shown in Table 5-4. This value is 0.19 mrem/yr, which is far below the DOE 458.1 dose limit of 100 mrem/yr.

Table 5-1. Current PA Monitoring Summary.

Area	Monitoring Location	Sampling Frequency	Radionuclide / Other Substance	Administrative Limits
Vadose Zone	Beneath and adjacent to the trenches	Twice per year	Tritium	East ST – 63.8 pCi/mL Center ST – 61.2 pCi/mL West ST – 46.9 pCi/mL ET 1 & 2 – 101.3 pCi/mL ET 3 – 43.7 pCi/mL[1] CIG – 29.6 pCi/mL
Sump Water	Vault Sumps	Prior to pumping when threshold liquid levels are exceeded	Gross Alpha	1.35E+3 pCi/L (or ≥ 3.0 dpm/mL)
			Nonvolatile Beta	7.20E+3 pCi/L (or ≥ 16.0 dpm/mL)
			Tritium	8.0E+8 pCi/L (or ≥ 1.78E+6 dpm/mL)
	Engineered Trench 2 Sump	Prior to pumping when threshold liquid levels are exceeded	Gross Alpha	1.35E+3 pCi/L (or ≥ 3.0 dpm/mL)
			Nonvolatile Beta	7.20E+3 pCi/L (or ≥ 16.0 dpm/mL)
Groundwater	Not monitored by ELLWF because there is an existing tritium plume beneath parts of ELLWF that is from a different facility which monitors and reports on the groundwater per a RCRA permit. [2]			
Vault Concrete	Inspections of vaults; subsidence inspections	Every two years	N/A	N/A
Trench Cover Monitoring	Inspections of trench covers	Four times a year	N/A	N/A

[1] Calculated using peak fraction flux of 0.125 Ci/yr per Ci disposed (Hamm et al., 2013) and inventory limit of 4.2 Ci for the disposal unit (Butcher, 2017).
[2] Monitored and reported in accordance with the Office of Environmental Quality Control Bureau of Land and Waste Management Hazardous and Mixed Waste Permit SC1 890 008 989 (SCDHEC, 2014).

Table 5-2. Performance Monitoring.

Disposal Facility/Unit	Monitoring Purpose	Monitoring Results[1]	PA Expected Behavior (Below)	Action Taken	PA/CA Impacts
ELLWF Engineered Trench 1 VL-6	Radionuclide Transport	• 312 pCi/mL • Concentrations in the action-level lysimeter are trending **downward**. The lysimeter above the action level lysimeter was dry in 2019 but shows an **increasing** trend. This suggests the concentration in the action level lysimeter may increase in the future. See Section 5.1.1	101.3 pCi/mL	Will continue to monitor this location as part of vadose zone monitoring program.	Expect PO's to be met
ELLWF Engineered Trench 1 VL-15	Radionuclide Transport	• 1113 pCi/mL • Concentrations in the action-level lysimeter have fluctuated. Upper lysimeters are **elevated** but the lysimeter immediately above the action level lysimeter has generally trended **downward** in recent sampling events. See Section 5.1.1	101.3 pCi/mL	Will continue to monitor this location as part of vadose zone monitoring program.	Expect PO's to be met
ELLWF Engineered Trench 2 ET2-VL-15	Radionuclide Transport	• 221 pCi/mL • Concentrations in the action-level lysimeter are trending **upward**. See Section 5.1.2	101.3 pCi/mL	Operational soil cover was extended past ET2-VL-5 and ET2-VL-15 during FY2019. This should reduce infiltration and eliminate funneling of rainwater near the lysimeters.	Expect PO's to be met
ELLWF Slit Trench 1 VL-26-West	Radionuclide Transport	• 518 pCi/mL • Concentrations in the action-level lysimeter appear to have **plateaued**. The tritium concentration in the lysimeter above the action-level lysimeter has been trending **downward**. This suggests the concentration in the action-level lysimeter may begin to **decline** in the future. See Section 5.1.3	61.2 pCi/mL	Will continue to monitor this location as part of vadose zone monitoring program.	Expect PO's to be met

Disposal Facility/Unit	Monitoring Purpose	Monitoring Results[1]	PA Expected Behavior (Below)	Action Taken	PA/CA Impacts
ELLWF Slit Trench 4 ST4-VL-5	Radionuclide Transport	• 103 pCi/mL • Concentrations in the action-level lysimeter have been slowly trending **upward** but may be reaching a **plateau**. The tritium concentration in the shallow lysimeter is also elevated but has trended **downward** since the fall of 2009. See Section 5.1.4	61.2 pCi/mL	Will continue to monitor this location as part of vadose zone monitoring program.	Expect PO's to be met
ELLWF Slit Trench 7 ST7-VL-2	Radionuclide Transport	• 343 pCi/mL • After spiking in fall 2017, concentrations have been trending **downward**. See Section 5.1.5	61.2 pCi/mL	Will continue to monitor this location as part of vadose zone monitoring program.	Expect PO's to be met
ELLWF Slit Trench 8 ST8-VL-6	Radionuclide Transport	• 61 pCi/mL • Concentrations in the action-level lysimeter are trending **upward** but may be reaching a **plateau**. Although elevated, the tritium concentration in the shallow lysimeter has also **plateaued**. See Section 5.1.6	46.9 pCi/mL	Will continue to monitor this location as part of vadose zone monitoring program.	Expect PO's to be met
ELLWF Slit Trench 14 ST14-VL-3	Radionuclide Transport	• 125 pCi/mL • Concentrations in the action-level lysimeter are **elevated** but the lysimeter above is at **background**. See Section 5.1.7	63.8 pCi/mL	Will continue to monitor this location as part of vadose zone monitoring program.	Expect PO's to be met

[1]Trends discussed in more depth within the text

Table 5-3 Summary FY2019 Tritium Data (pCi/mL) for Action-Level Lysimeters.

	FY2019 Sampling Events	
Well ID (Elevation in ft msl)	Fall +	Spring +
CIG Trench (Administrative Limit = 29.6 pCi/mL)		
CIG1-VL-1 (236)	10	11
CIG1-VL-2 (237)	3	3
CIG1-VL-3 (233)	6	5
CIG1-VL-4 (232)	8	8
CIG1-VL-5 (238)	3	3
VL-30-End (240)	4	4
VL-31 (241)	*	4
Engineered Trench 1 (Administrative Limit = 101.3 pCi/mL		
AT-22-East (233)	4	3
AT-23-North (237)	2	2
VL-6-South_Center (233)	286	312
VL-7-SE_Corner (235.7)	10	10
VL-8-East_Center (234.9)	50	45
VL-10-North_Center (233)	13	11
VL-13 (237)	7	7
VL-14 (239)	*	*
VL-15 (235)	1099	1113
VL-16 (235)	*	5
VL-17 (238)	53	53
VL-18 (234)	*	6
VL-18-Auger (234)	*	3
VL-19 (238)	*	3
VL-20 (243)	5	4
VL-21 (239)	*	*
VL-22 (241)	*	*
Engineered Trench 2 (Administrative Limit = 101.3 pCi/mL		
ET2-VL-1 (242)	4	4
ET2-VL-2 (242)	4	5
ET2-VL-3 (245)	3	3
ET2-VL-5 (247)	*	*
ET2-VL-6 (244)	26	9
ET2-VL-7 (245)	21	15
ET2-VL-9 (242)	5	3
ET2-VL-10 (242)	7	3
ET2-VL-11 (246)	8	4
ET2-VL-12 (240)	5	5
ET2-VL-14 (240)	6	18
ET2-VL-15 (247)	*	221
ET2-VL-16 (242)	2	2
ET2-VL-18 (242)	5	5
ET2-VL-19 (248)	6	6
Engineered Trench 3 (Administrative Limit = 43.7 pCi/mL)		
ET3-VL-1 (221)	2	2
ET3-VL-2 (226)	1	2
Slit Trench 1 (Administrative Limit = 61.2 pCi/mL)		
AT-5 (226)	*	*
AT-6 (227)	58	61
AT-8 (232)	*	4
ST1-VL-1 (245)	4	4
VL-2 (225)	6	7
VL-25-West (246)	2	2
VL-26-West (245)	508	518
VL-27-West (245)	5	5

	FY2019 Sampling Events	
Well ID (Elevation in ft msl)	Fall +	Spring +
Slit Trench 2 (Administrative Limit = 61.2 pCi/mL)		
ST2-VL-4 (232)	3	4
ST2-VL-7 (231)	14	12
ST2-VL-8 (240)	3	*
VL-32 (231)	*	3
VL-33 (229)	5	4
VL-34 (227)	5	4
VL-35 (227)	3	*
Slit Trench 3 (Administrative Limit = 61.2 pCi/mL)		
ST3-VL-4 (234)	19	19
ST3-VL-5 (236)	20	21
ST3-VL-8 (238)	4	4
ST3-VL-10 (240)	4	3
ST3-VL-12 (243)	*	*
Slit Trench 4 (Administrative Limit = 61.2 pCi/mL)		
ST4-VL-5 (238)	98	103
ST4-VL-8 (239)	3	3
Slit Trench 5 (Administrative Limit = 61.2 pCi/mL)		
ST5-VL-1 (237)	5	6
ST5-VL-2 (252)	4	3
ST5-VL-5 (239)	4	3
ST5-VL-6 (244)	3	3
ST5-VL-11 (237)	3	2
ST5-VL-12 (231)	2	1
ST5-VL-13 (236)	3	3
Slit Trench 6 (Administrative Limit = 61.2 pCi/mL)		
ST6-VL-1 (233)	2	2
ST6-VL-2 (241)	3	3
ST6-VL-3 (235)	2	3
Slit Trench 7 (Administrative Limit = 61.2 pCi/mL)		
ST7-VL-1 (233.5)	2	2
ST7-VL-2 (231.7)	343	258
ST7-VL-3 (232)	3	2
ST7-VL-4 (232)	4	4
ST7-VL-5 (229)	2	2
ST7-VL-6 (229)	2	2
Slit Trench 8 (Administrative Limit = 46.9 pCi/mL)		
ST8-VL-1 (235.5)	4	4
ST8-VL-2 (227)	2	3
ST8-VL-4 (230)	2	2
ST8-VL-5 (229)	2	2
ST8-VL-6 (238)	56	61
Slit Trench 9 (Administrative Limit = 46.9 pCi/mL)		
ST9-VL-1 (239)	2	2
ST9-VL-2 (229)	*	*
ST9-VL-3 (240)	3	3
Slit Trench 14 (Administrative Limit = 63.8 pCi/mL)		
ST14-VL-1 (240)	4	5
ST14-VL-2 (239)	7	10
ST14-VL-3 (237)	93	125

+ All data in pCi/mL
* Yielded no sample
Pink shading = Exceeds Adminstrative Limit

Table 5-4. Compliance Monitoring.

Disposal Facility/Unit	Monitoring Type	Monitoring Results & Trends	Performance Objective Measure or other Regulatory Limit	Action Level	Action Taken	PA/CA Impacts
ELLWF	Surface Water	0.19 mrem	<100 mrem	NA	None	None

5.6 Monitoring Conclusions

The majority of action-level lysimeter locations, approximately 90%, remained below administrative limits in FY2019. A majority of the action level lysimeters would need to reach, with some exceeding, their administrative limit in order to exceed a groundwater performance objective or measure. Because administrative limits are set at 1/4th the concentration predicted to result in an exceedance in the groundwater, the remaining eight action level lysimeters spread over 7 trenches are not expected to result in an exceedance at the 100-m POA. The source of these exceedances in the overlying waste zone and potential impacts have been previously evaluated (Halverson and Millings, 2017; Hang et al., 2018; Kubilius et al., 2019a) and trends in these wells continue to be monitored.

Trench cover and vault concrete monitoring in FY2019 revealed minor defects (cover – depressions, erosion areas, fasteners; concrete – shallow, passive cracking) not affecting the structural integrity or expected performance of these barriers. In some cases, repairs have been made (i.e., trench cover concrete fasteners). In other cases, conditions will continue to be monitored for progression of existing defects or new defects.

Finally, sump water samples were all found to be below administrative limits before being discharged. Impacts from surface waters down steam from the E-Area LLWF (UTRC, SR) continue to fall well below DOE public dose limits based on annual compliance monitoring.

6.0 Research and Development

In FY2019, the SRNL Environmental Restoration Technology Section produced multiple technical reports and memoranda supporting ELLWF annual PA maintenance, SWM Operations & Engineering, PA Test & Research, and PA Revision Development. Table 6-1 lists a summary of this work where the designation “To Be Determined” indicates the PA impact will be evaluated in the next PA revision.

Table 6-1. Research and Development Activities.

Document Number	Results	PA/CA Impact
SRNS-RP-2019-00002, Rev. 0	**Annual PA-CA Maintenance** The FY2018 PA Annual Review for the ELLWF (Kubilius et al., 2019a) affirms that the disposal facility continued to operate within the bounds of the current PA baseline and satisfied all the requirements, conditions, and limitations identified in the DAS. The number of proposed changes to data, models, and operational plans that are used as input to the E-Area PA suggest the need for a new PA revision.	None
N/A	**Software Purchases** The two primary calculational software packages for PA work are PORFLOW and GoldSim. Annual renewals were completed for both. One of the historical limitations of SRNL's PORFLOW licensing was the restriction on the number of active licenses or open "seats" available to modelers at any one time which hampered work progress. Following discussions with the vendor, a change to an unlimited site license was granted which greatly improves modeler productivity. SRNL reassessed the number of up-to-date GoldSim® licenses that are needed for supporting PA work and brought 2 network license seats up-to-date and extended into 2020 as well as upgraded the 2-desktop license with the distributed processing module to allow Monte Carlo simulations to run on multiple processors.	None
SRNL-STI-2019-00145, Rev. 0	**Software QA Updates** Twenty software applications to be used in the next PA revision were surveyed for compliance with SRS 1Q Manual, Procedure QAP 20-1, Software Quality Assurance (SRS, 2018). Several actions are noted as being needed to complete software QA documentation or bring current documentation up to date. This list will be updated as future software needs are identified or actions completed. (Hang, 2019)	None
SRNL-STI-2018-00681, Rev. 0	**Recommended Strategy for Implementing PORFLOW Subsidence Infiltration Boundary Conditions** This technical memorandum summarizes a limited-in-scope sensitivity analysis that addresses uncertainty in the conservatism of blending infiltration rates for use as input boundary conditions in PORFLOW vadose zone simulations as opposed to blending flux-to-the-water-table outputs for different subsidence infiltration scenarios, as has been done historically. Results indicate that blending infiltration rates for different subsidence infiltration scenarios is a more conservative implementation of subsidence. (Danielson, 2019)	To Be Determined
SRNL-STI-2019-00205, Rev. 0	**Confirmation of Disposal Unit Footprints for use in E-Area Performance Assessment Revision** This technical memorandum confirms and or adjusts the corner coordinates laid out for DUs. The confirmed final corner coordinates of each DU footprint in the next PA are listed. (Hamm, 2019)	To Be Determined

Document Number	Results	PA/CA Impact
SRNL-STI-2019-00009, Rev. 0	**Review of Cementitious Materials Development and Application to Support DOE-EM Missions: Waste Treatment, Conditioning, Containment Structures, Tank Closures, Facility Decommissioning, Environmental Restoration, and Structural Assessments** This document explores how/where cementitious materials are used for multiple waste applications and provides a review of how cementitious materials have been used across the DOE complex. The various approaches, formulations, processing techniques and disposal paths are discussed along with the requirements that drove the various cementitious systems and techniques used. (Lorier and Langton, 2019)	None
SRNS-RP-2018-01123, Rev. 0	**Optimization of Groundwater Monitoring Program at the ELLWF** This report describes results of a saturated zone characterization campaign which was conducted in 2017, and proposes changes to the ELLWF PA Monitoring Plan, including: 1) reducing the frequency of vadose zone lysimeter sampling from semi-annually, to annually, 2) omitting sampling of about 40 (of 300) lysimeters, that are deemed unnecessary, 3) installing up to eight new performance monitoring wells in the saturated zone downgradient of ET 1 and 2 and ST 1; and 4) considering future compliance monitoring at surface water stations in Upper Three Runs or Crouch Branch. (Kubilius and Joyce, 2018)	To Be Determined
SRNL-STI-2018-00633, Rev. 0	**Proposed NRCDA Groundwater Pathway Conceptual Model** This report documents SRNL's evaluation of updated Naval Reactor waste container and inventory projections and proposes a NRCDA GW pathway modeling approach for the next ELLWF PA. (Wohlwend and Butcher, 2018)	To Be Determined
SRNL-STI-2015-00056, Rev. 1	**Dose Calculation Methodology and Data for Solid Waste Performance Assessment and Composite Analysis at the Savannah River Site** This report provides a detailed description of the methodology developed to perform dose calculations for ELLWF Facility PAs and SRS CAs. (Smith et al., 2019)	To Be Determined
SRNL-STI-2018-00643, Rev. 0	**Updated Groundwater Flow Simulations of the Savannah River Site General Separations Area** The groundwater flow model supporting PAs and CAs at SRS was significantly revised in 2016 and 2017 using new hydrostratigraphic surfaces, updated well water level calibration targets, and semi-automated model calibration with the PEST optimization code. This model is referred to as "GSA_2016". This report documents further refinement of the GSA_2016 model in 2018 to incorporate updates to model calibration targets, closure of the H-Area Ash Basin, construction of E-Area Slit Trench operational covers, and plume information from the Mixed Waste Management Facility and Low-Level Radioactive Waste Disposal Facility. Another objective was to lower hydraulic head residuals by adding another calibration zone. (Flach, 2019)	To Be Determined

All documents are PA development/maintenance activities and therefore do not require individual UDQEs.

7.0 Planned or Contemplated Changes

A PA revision is currently ongoing and is scheduled to be submitted to LFRG in FY2022. There are two additional monitoring and operations support activities that are planned to be started or completed in FY2020. Details are provided in Table 7-1. Action Level lysimeters at the ELLWF are experiencing an increasing number of administrative limit exceedances for tritium concentrations in vadose zone groundwater. Therefore, a revision to the PA Monitoring Plan (last revised in 2012 (Millings, 2012)) is planned to be completed in FY2021 to include monitoring in the saturated zone. However, the saturated zone near the ELLWF is already contaminated with tritium originating from the Mixed Waste Management Facility, which is upgradient of ELLWF. For an SZ monitoring program to be effective, it will be necessary to determine if the tritium originated from the Mixed Waste Management Facility, or the ELLWF (Kubilius and Joyce, 2018). The E-Area Maintenance Plan will be revised prior to the submittal of the next annual summary report pending available resources.

Table 7-1. Planned or Contemplated Changes.

Planned or contemplated change	Change Basis	PA/CA Impact	Schedule
Optimization of Groundwater Monitoring Program at the E-Area Low-Level Waste Facility	This report describes results of a saturated zone characterization campaign which was conducted in 2017, and proposes changes to the ELLWF PA Monitoring Plan, including: 1) reducing the frequency of vadose zone lysimeter sampling from semi-annually, to annually; 2) omitting sampling of about 40 (of 300) lysimeters, that are deemed unnecessary; 3) installing up to eight new performance monitoring wells in the saturated zone downgradient of ET 1 and 2 and ST 1; and 4) considering future compliance monitoring at surface water stations in Upper Three Runs or Crouch Branch. (Kubilius and Joyce, 2018)	Update to the monitoring plan	FY20-FY21
Tritium Release from a Production TPBAR Container-SWM support	SRNL is supporting SWM by researching historical analysis for evaluating potential impacts of a TPBAR cask non-conformance.	To Be Evaluated	FY20

8.0 Status of DAS Conditions, Key and Secondary Issues

All key and secondary issues from the LFRG review of the 2008 PA have been resolved and are understood to be closed with final DOE-HQ approval of the FY2014 Annual Review. Three issues were closed by committing to address the issues in the next PA and are listed in Table 8-1. This annual review affirms that the ELLWF has satisfied all the requirements, conditions and limitations identified in the DAS and that a revision to the DAS is not needed at this time.

Table 8-1. Status of DAS Conditions, Key and Secondary Issues

Disposal Facility/ Unit	Key/ Secondary Issue or DAS Condition number	Issue Description	Issue Closure Method	Disposition Documentation & Date Completed	PA, CA, DAS Impact or Status
ELLWF	7.2.3.2	Insufficient documentation of all components of the site model for the vadose and saturated zone (five specific items to be addressed)	Closed per DOE approval of FY2011 Annual Review	Items 1, 3, 4 and 5: *PORFLOW Qualification for use in E-Area Low-Level Waste Facility Performance Assessment*, (McDowell-Boyer and Flach, 2011)*, July 2011; Item 2: Information was included in App. G of the PA *GSA Model Improvements will be incorporated into the next revision of the PA.	Complete Pending PA Revision
ELLWF	7.2.4	Greater consistency is needed in the level of detail of technical approaches and results for each facility in Ch. 1-5 (recommend including figures and diagrams of the general technical approaches and calculational steps that led to performance measures and disposal limits). Evaluate information within App. A of Part B for relevance.	Closed per DOE approval of the FY2014 Annual Review.	All figures in the Appendices underwent a general review before the final PA was issued. The labeling on the specific figures referenced in the last paragraph of this issue was corrected in the final PA. These actions addressed the concerns about mislabeling. For the remaining details of this issue, re-examining and rewriting Chapters 1 through 5 of the PA in order to achieve greater consistency for all disposal units represent significant revision. As such, improvements will be incorporated into the next revision of the PA.	Complete Pending PA Revision
ELLWF	7.1.1	Additional sensitivity and uncertainty work required to increase confidence in the waste concentration limits and SOFs (through deterministic or probabilistic sensitivity and uncertainty analysis). In the near term, focus should be on components most likely to compromise Performance Objectives (the non-sorbing radionuclides disposed in STs and ETs).	Closed per DOE approval of FY2014 Annual Review.	This item was downgraded from a key issue to a secondary issue based on additional sensitivity analyses performed and documented in the final PA during the factual accuracy review. Additional work to improve the 1-D GoldSim ELLWF trench models, benchmark to PORFLOW, and update the S/U analysis was completed in 2010 with subcontractor support. The initial benchmarking report was updated in FY2013, *Benchmarking Exercises to Validate the Updated ELLWF GoldSim Trench Models*, SRNL-STI-2010-0737, Rev. 1, November 2013. (Taylor and Hiergesell, 2013) In 2014 SRNL prepared a report that compiles and summarizes the collective GoldSim trench model improvements, benchmarking work, and S/U analysis update, *Update to the Uncertainty Analysis for the E-Area Low-Level Waste Facility Trenches*, SRNL-STI-2013-00660, Rev. 0, May 2014. (Hiergesell & Taylor, 2014) These improvements will be incorporated into the next revision of the PA.	Complete Pending PA Revision

9.0 Certification of the Continued Adequacy of the PA, CA, DAS and RWMB

This annual review affirms that the disposal facility continued to operate within the bounds of the current PA and CA baseline and satisfied all the requirements, conditions, and limitations identified in the 2008 DAS (DOE 2008a), RWMB (McGill, 2018), and ELLWF Waste Acceptance Criteria (SRS-1S). This annual review affirms that the supporting studies performed in FY2019 do not alter the conclusions of the ELLWF PA (WSRC, 2008) and that there is a reasonable expectation that the ELLWF will meet the performance objectives delineated in DOE Order 435.1. New groundwater flow predictions resulted in the initiation of an SA (Hamm et al., 2018), and measures have been introduced to maintain assurance that performance objectives will continue to be met (see Table 2-1). The number of proposed changes to data, models and operational plans for the ELLWF since the 2008 PA were deemed sufficient to warrant a revision. A revised PA is in preparation and submittal is scheduled to occur in FY2022.

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