CHAPTER 4
207-A SOUTH RETENTION BASINS (S-2-7) CLOSURE PLAN

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1 **TERMS**

ARARs	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
CAS	Chemical Abstracts Service
DOE	U.S. Department of Energy
DST	double-shell tank
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
GPS	global positioning system
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document* (DOE/RL-96-68)
HEIS	Hanford Environmental Information System
HHE	human health and the environment
IQRPE	Independent Qualified Registered Professional Engineer
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MTCA	"Model Toxics Control Act—Cleanup" (WAC 173-340)
N/A	not applicable
NRB	North Retention Basin
OU	operable unit
PQL	practical quantitation limit
QA	quality assurance
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RI	remedial investigation
SAF	Sampling Authorization Form
SAP	sampling and analysis plan
SEPA	State Environmental Policy Act
SRB	South Retention Basin
TA	Temporary Authorization
TPA	Tri-Party Agreement
TSD	treatment, storage, and/or disposal
VSP	Visual Sample Plan

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4.1 INTRODUCTION

The purpose of this plan is to describe the closure process for the 207-A South Retention Basins Closure Unit Group 5, hereinafter called 207-A South Retention Basins (207-A SRB). This closure process will include the demolition and removal of the 207-A SRB and soil sampling to verify soils meet clean closure standards.

The 207-A SRB, consists of three inactive storage cells, which are classified as surface impoundments. The 207-A SRB was used for storage of 242-A Evaporator process condensate for sampling and analysis before the condensate was discharged to the 216-A-37-1 Crib for disposal to the soil column. The 207-A SRB began storage operations in 1977. 242-A Evaporator discharge to the 207-A SRB was terminated on April 12, 1989, and it has been inactive since that date. Because the 242-A Evaporator process condensate was designated as dangerous waste under Washington Administrative Code (WAC) 173-303, a *Dangerous Waste Permit Application Part A Form*, for the 207-A SRB, hereinafter called the Part A, was submitted to the Washington State Department of Ecology (Ecology) in 1988 with the latest revision on January 27, 2016. The Part A is located in Chapter 1.0 of Closure Unit Group 5. Figure 1 provides a timeline that summarizes the operations and regulatory milestone associated with the 207-A SRB. Operations milestones are shown below the timeline, and regulatory milestones are shown above the timeline (Figure 1).

The dangerous wastes, including the dangerous waste components of any mixed waste, in the 242-A Evaporator Process Condensate are regulated under the applicable *Resource Conservation and Recovery Act of 1976* (RCRA) final status standards in 40 CFR 264. Authority to apply RCRA standards and regulations is provided to the State of Washington through the Hazardous Waste Management Act (HWMA) Chapter 70.105 Revised Code of Washington (RCW), and implemented through the Dangerous Waste Regulations, Chapter 173-303 Washington Administrative Code. The radionuclides in the mixed waste may include "source, special nuclear, and byproduct materials" as defined in the *Atomic Energy Act of 1954* (AEA). The AEA states that these radionuclide materials are regulated at U.S. Department of Energy (USDOE) facilities exclusively by USDOE, acting pursuant to its AEA authority. These radionuclide materials are not hazardous/dangerous wastes and, therefore, are not subject to regulation by the State of Washington under RCRA and HWMA.

4.1.1. Physical Description

The 207-A SRB is located in the 200 East Area (Figure 2) directly east of the 242-A Evaporator. The 207-A SRB, also known as Process Condensate Basins 1, 2, and 3 (i.e., PC-1, PC-2, and PC-3), began operations in March 1977. The 207-A SRB consists of three separate open liquid effluent storage cells constructed of concrete that operated as surface impoundments. Figure 3 provides a simplified diagram of the 207-A SRB.

The overall surface dimension of the 207-A SRB is 39.6 meters (130 ft) by 27.7 meters (91 ft) which includes a 1.2 meter (4 ft) wide dike around the perimeter of the 207-A SRB and between the storage cells. Each of the three storage cells had a 264,979 L (70,000 gal) design capacity for a total capacity of 794,937 L (210,000 gal). Each storage cell is approximately 11.6 meters (38 ft) wide by 25.3 meters (83 ft) long at the top with walls having a 2:1 slope downward for 4.3 meters (14 ft) to a bottom that is 16.8 m (55 ft) long, 3.0 m (10 ft) wide bottom. The cross section of the storage cells is thus generally trapezoidal in shape, with the bottom of each cell sloping toward a drain located at the north end of the cell. (The drain is about 0.6 m (2 ft) from the north end of the floor mid-way across the width). The drain lines from the storage cells go into a pump pit (valve box) to the north of the 207-A SRB. The discharge line to the 216-A-37-1 Crib exits from the west side of the pump pit and then turns south and runs along the west side of the 207-A SRB. The inlet to each storage cell enters via the center of the north wall about 0.5 m (1.5 ft) above the floor. The storage cells are 2.1 m (7 ft) deep having 1.5 meters (5 ft) of liquid capacity and 0.6 meters (2 ft) of freeboard. Initially a Hypalon® liner provided liquid retention in the storage cells. In 1982 concrete walls and floors were placed over the liner and provided with an elastomeric coating to minimize the process condensate from potentially penetrating the concrete.

Per drawing H-2-90783, a pump pit (also described as a control box or diversion box) is situated approximately halfway between the 207-A SRB and the 207-A North Retention Basin (207-A NRB). This pump pit controlled the flow and discharge of process condensate from the 242-A Evaporator to the 207-A SRB and the flow and discharge of steam condensate from the 242-A Evaporator to the 207-A NRB. The pump pit also controlled the discharge of process condensate from the 207-A SRB to the 216-A-37-1 Crib. The piping running between the pump pit and the 207-A SRB storage cells is part of the 207-A SRB dangerous waste management unit (treatment, storage, and disposal unit [TSD]). Piping from the 242-A Evaporator to the pump pit, piping running between the pump pit and the 207-A NRB, and piping running out from the pump pit to the 216-A-37-1 crib, are not part of the 207-A SRB.

Construction details shown on drawings H-2-90783 and H-2-90784 indicate that the liner and concrete were integrated to avoid preferential pathways to the soil column.

The construction of the 207-A SRB was done as follows (per instructions on drawings H-2-90783 and H-2-90784):

- The site was excavated to the appropriate grade and a Hypalon® liner was installed. A berm was created around the outer edge of the basins. Backfill was placed as required where excavations were done for piping associated with the basins. Where pipng entered or exited the basins, the liner was cut to allow the piping to pass through, but was repaired to create a seal around the penetration.
- Concrete was poured to create the sides and bottoms of the basins. The joints between the concrete were filled with a self-expanding cork meeting specifications HH-F-34F, Type II, Class C.
- Waterstops consisting of 6-inch dumbbells of styrene butadiene rubber were placed in joints in the concrete to prevent the passage of water.
- The surface of the concrete was cleaned and sandblasted when the concrete had cured. A two-part elastomeric coating was placed on the sides and bottoms of the basins.

This method of construction provides integration of the liner, concrete, and elastomeric membrane to create a structure which is designed to avoid preferential pathways to the soil column. The 207-A SRB unit group boundary, (shown on the Part A as the “TSD Unit Boundary”), was established as the exterior walls of the concrete basin structure.

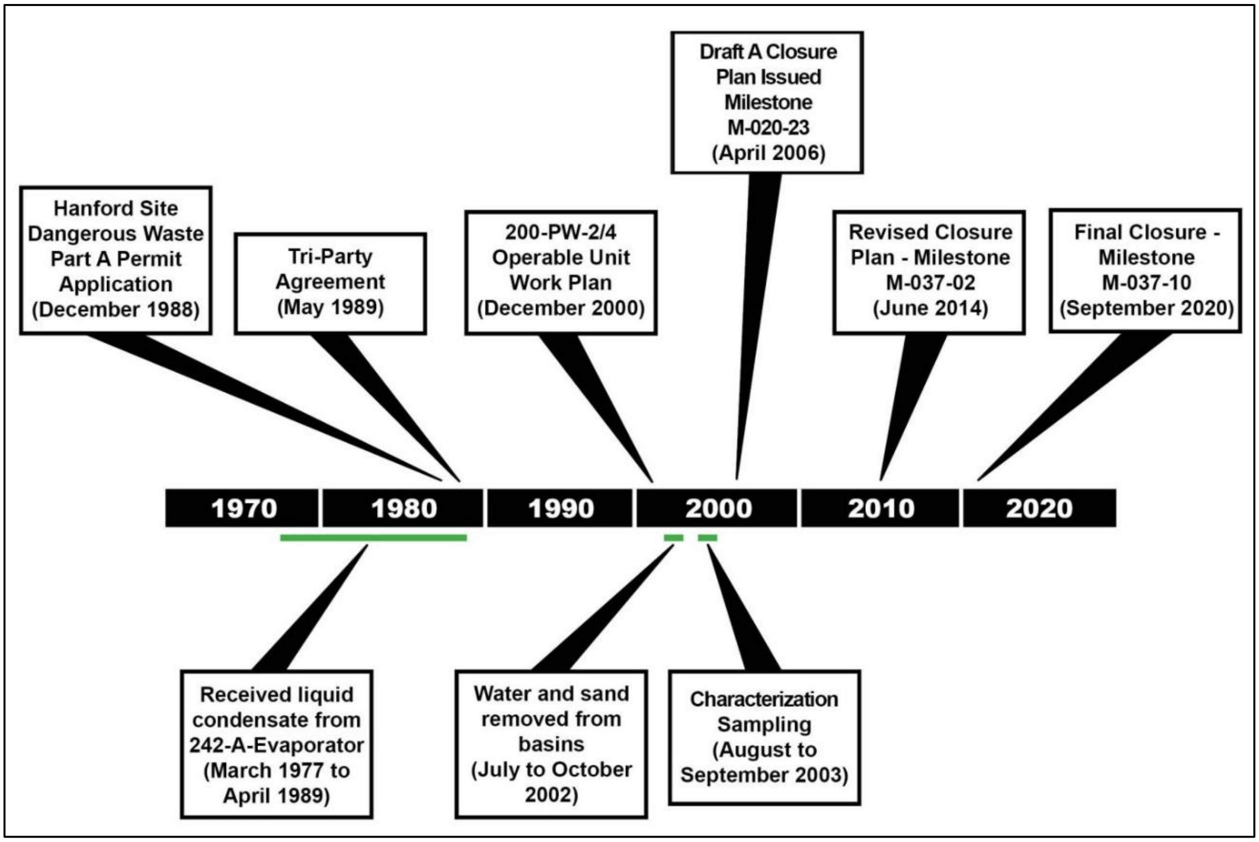

Figure 1. Timeline for the 207-A South Retention Basins

4.1.2. Process Information

The 207-A SRB storage cells operated as a surface impoundments for temporary storage of 242-A Evaporator process condensate, while the condensate awaited sampling and analysis. Waste was pumped from the 242-A Evaporator through transfer piping to the 207-A SRB. Waste generally was stored in the storage cells only long enough to obtain sample results for process control. The pumps located at a pump pit between the 207-A NRB and the 207-A SRB were used to transfer the stored effluent to the 216-A-37-1 Crib for disposal to the soil column. No waste treatment or disposal occurred at the 207-A SRB.

Waste processed by the 242-A Evaporator is received from the double-shell tank (DST) system as an aqueous, mixed waste solution. Slurry and process condensate are the two aqueous mixed waste streams generated at the 242-A Evaporator. The slurry is returned to the DST system. The process condensate is condensed vapor from the evaporation process. Between March 1977 and April 1989, process condensate was transferred to the 207-A SRB for temporary storage and sampling before it was disposed to the soil column via the 216-A-37-1 Crib.

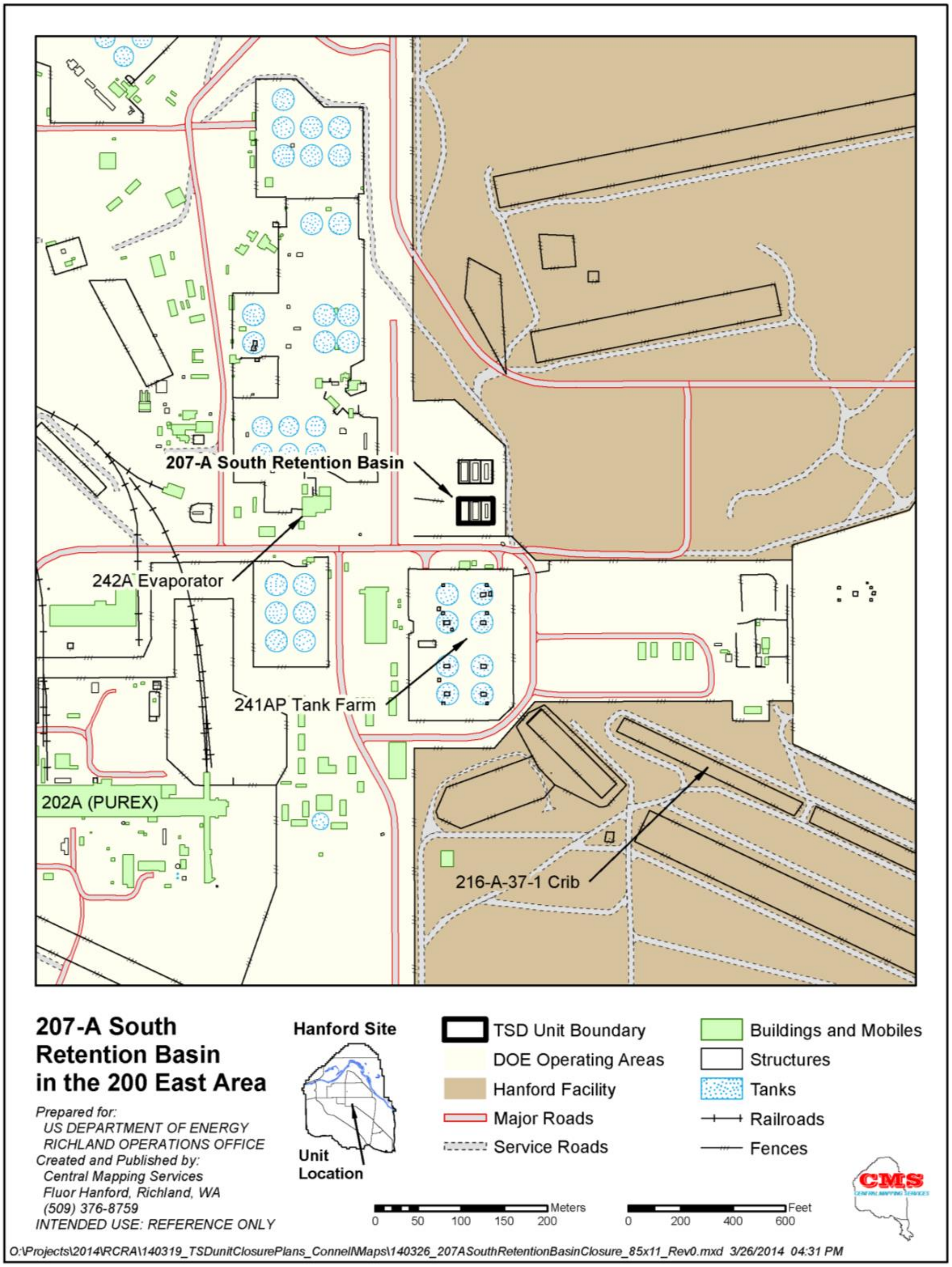

Figure 2. 207-A South Retention Basins in the 200 East Area

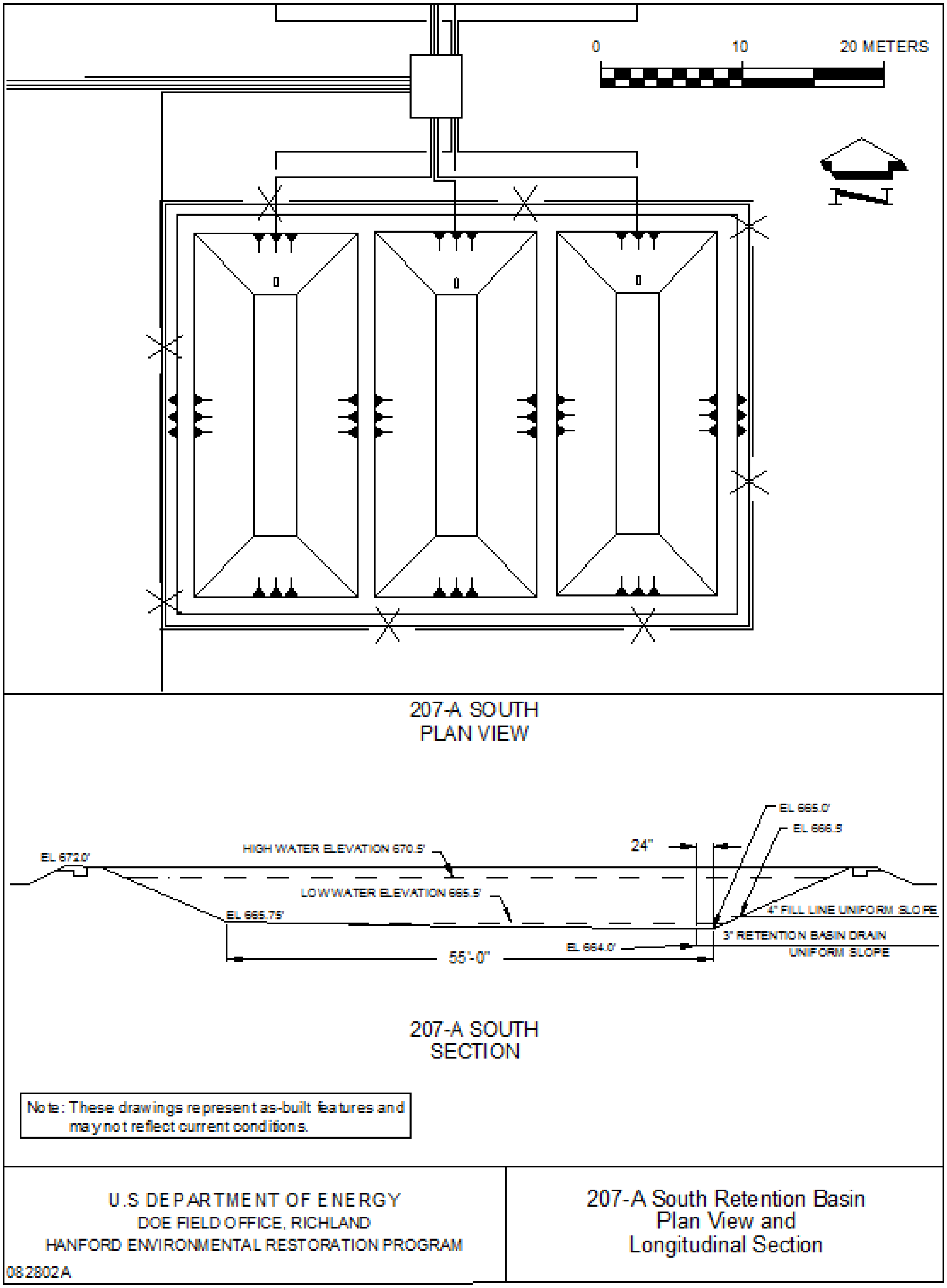

Figure 3. Simplified Diagram of the 207-A South Retention Basins

4.1.3. Waste Inventory and Characteristics

The 207-A SRB operated from 1977 to 1989. The total quantity of process condensate waste onsite at any one time was limited to the combined design capacity of the storage cells of approximately 794,937 L (210,000 gal). The total volume of process condensate the 207-A SRB received for temporary storage was 377,000,000 L (99,590,000 gal) of evaporator condensate (DOE/RL-98-28, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program*).

The process condensate is an aqueous, mixed waste solution containing trace amounts of dissolved cations and anions, such as sodium, potassium, aluminum, hydroxides, nitrates, and nitrites with radionuclides (WHC-EP-0342, Addendum 15, *242-A Evaporator Process Condensate Stream-Specific Report*). The 242-A Evaporator process condensate is regulated as mixed waste (WAC 173-303-040, "Definitions") is derived from a waste containing spent halogenated and nonhalogenated solvents (WAC 173-303, dangerous waste codes F001, F002, F003, F004, and F005), and for the toxicity of ammonia (WT02, state-only toxic dangerous waste). The 207-A SRB constituents associated with these dangerous waste codes include ammonia, acetone, *m*-cresol, *o*-cresol, *p*-cresol, and methylene chloride.

4.1.4. Security Information

The 207-A SRB is located in the 200 East Area and, therefore, security information pertaining to the 200 Areas applies to this unit group. Both the Hanford Site and the 200 East Area are fenced. The 207-A SRB is located in a chained-off area. Changes to security are expected to occur during the course of 207-A SRB closure activities, and includes changing the chained-off area to a roped off area, additional signs (i.e., radiological area warning signs), entry restriction, and other items as needed. Radiological area warning signs and danger signs will be posted during demolition and excavation activities. Security measures will remain in place that limit entry to authorized personnel and that preclude unknowing access by unauthorized individuals until closure of the 207-A SRB.

4.2 GROUNDWATER MONITORING

This closure plan proposes clean closure of the 207-A SRB. If clean closure is not achieved, a groundwater monitoring plan will be submitted within 90 days after the determination that the 207-A SRB cannot be clean closed, as required by WAC 173-303-610(8)(a).

4.3 CLOSURE PERFORMANCE STANDARDS

The standards for closure of the 207-A SRB are in accordance with the requirements of the Tri-Party Agreement (TPA) Action Plan (Ecology et al. 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*). As required by WAC 173-303 and the TPA Action Plan (Ecology et al. 1989b), Section 6.3.1, clean closure must demonstrate that treatment, storage, or disposal (TSD) unit operations did not adversely affect soil. The closure performance standards of WAC 173-303-610(2)(a)(i) through (iii) require the owner or operator of a dangerous waste management facility to close the facility in a manner that will accomplish the following objectives:

(a)(i) Minimizes the need for further maintenance;

(a)(ii) Controls, minimizes, or eliminates to the extent necessary to protect human health and the environment, post-closure escape of dangerous waste, dangerous constituents, leachate, contaminated runoff, or dangerous waste decomposition products to the ground, surface water, groundwater, or the atmosphere; and

(a)(iii) Returns the land to the appearance and use of surrounding land areas to the degree possible given the nature of the previous dangerous waste activity.

WAC 173-303-610(2)(b)(i) requires that for clean closure of soil the numeric cleanup levels calculated using unrestricted use exposure assumptions according to WAC 173-340, "Model Toxics Control Act—Cleanup," hereinafter called MTCA, cleanup regulations be achieved. For this closure, the numeric cleanup levels for soil concentrations protective of human health, WAC 173-340-740, the associated requirements for soil concentration protective of groundwater, WAC 173-340-747, and for soil concentration protective of ecology, WAC 173-340-7490 will be considered. The cleanup levels selected are identified in Table 4 in the shaded column (Closure Performance Standards).

According to WAC 173-303-610(2)(b)(ii), all structures, equipment, bases, liners, etc., clean closure standards will be set by the Ecology on a case-by-case basis in accordance with the closure performance standards of WAC 173-303-610(2)(a)(ii) and in a manner that minimizes or eliminates post-closure escape of dangerous waste. Clean closure of the 207-A SRB structures and liner will be achieved by removal.

Clean closure will eliminate the need for future post-closure inspections, monitoring, and maintenance. After clean closure, appearance of the land will be consistent with future land-use determinations for adjacent portions of the 200 Areas as an industrial-exclusive portion of the Hanford Site. This land use is consistent with the formal determination made for this portion of the 200 Area as described in 64 FR 61615, "Record of Decision: Hanford Comprehensive Land-Use Plan Environmental Impact Statement (HCP EIS)."

4.4 CLOSURE STRATEGY

The proposed clean closure determination for 207-A SRB is partially based on review of the operational history, operating records, waste management records, and a visual inspection of the 207-A SRB area. The 207-A SRB has not operated since 1989. Since that time routine surveillance inspections have been performed. Wind-blown debris, such as tumbleweeds, is removed on a periodic basis from the 207-A SRB storage cells. Rainfall and snowmelt accumulate in the storage cells and evaporate. After nearly 40 years since construction, small portions of the Hypalon® liner have been exposed and small areas of the elastomeric coating have degraded.

Based on these reviews, 207-A SRB is a candidate for clean closure under WAC 173-303, and verification sampling will be performed. Sampling and analysis activities were developed using the results of the records review and visual inspection (EPA/240/R-02/005, *Guidance on Choosing a Sampling Design for Environmental Data Collection* [EPA QA/G-5S] and Ecology Publication 94-111, *Guidance for Clean Closure of Dangerous Waste Units and Facilities*) and will be conducted via a sampling and analysis plan (SAP) (Section 4.6.1). The objective of the sampling described in this document is to determine if MTCA Method B unrestricted land use standards for soil will be met after 207-A SRB storage cell removal, and demonstration of meeting clean closure standards of the soil underneath the storage cells.

4.4.1. Previous Closure Activities

To preclude any further influent to the 207-A SRB, and in support of closure, the 207-A SRB was physically isolated from receipt of 242-A Evaporator process condensate effluent in 1989. Operations at the 242-A Evaporator were halted in 1989 to begin facility upgrades to allow waste to be transferred to the Liquid Effluent Retention Facility basins for storage and treatment at the 200 Areas Effluent Treatment Facility

The 207-A SRB was included as part of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* remedial investigation (RI) for 200-PW-2/4 Operable Unit (OU). Characterization activities consisting of borehole drilling, geophysical logging, field screening, and sampling and analysis of concrete cores and borehole soils were performed in 2003. In total, 27 soil samples and 9 concrete samples, plus required duplicate and blank samples were collected for analysis from the three 207-A SRB concrete storage cells. These activities were performed to identify the nature and extent of any chemical and radiological contamination in vadose zone soil underlying the 207-A SRB, in support of OU remedial

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decision making and dangerous waste management unit closure. The RI was conducted in accordance with the SAP contained in Appendix B of DOE/RL-2000-60, *Uranium-Rich/General Process Condensate and Process Waste Group Operable Units RI/FS Work Plan and RCRA TSD Unit Sampling Plan Includes: 200-PW-2 and 200-PW-4 Operable Units*. Data collected from the 207-A SRB storage cells are presented in the RI report (DOE/RL-2004-25, *Remedial Investigation Report for the 200-PW-2 Uranium-Rich Process Waste Group and the 200-PW-4 General Process Condensate Group Operable Units*, Appendix B and Section 7.2.2.2). Work plan sampling and analysis requirements for the 207-A SRB characterization were determined through a data quality objectives process documented in CP-14176, *Remedial Investigation Data Quality Objectives Summary Report for the 200-PW-4 Operable Unit*. A data review supports the decision to clean close the 207-A SRB by removal of the storage cells.

4.4.2. Clean Closure Strategy

The 207-A SRB will be clean closed by removing the storage cells and up to 1 m (3 ft) of soil beneath and adjacent to the cells, which will meet the requirements of WAC 173-303-610(2)(b)(ii). In accordance with WAC 173-303-610(2)(b)(i), the clean closure levels for soil will be the numeric cleanup levels calculated using unrestricted use exposure assumptions according to MTCA. These numeric cleanup levels will be developed using the MTCA Method B unrestricted land use standards current at the time of closure as of the effective date of the closure plan approval. Applicable cleanup levels consider carcinogens, noncarcinogens, groundwater protection, and ecological indicator values and are contained in Table 5. Ecological based cleanup levels will be calculated only in the event of a release, per WAC 173-340-7490(2).

Sampling and analysis will be performed to verify clean closure for the soil (Section 6, "Soil Verification Sampling and Analysis"). Both random and focused sampling strategies will be used. Focused sampling will entail choosing sampling locations based on where concrete joints are located, and where cracks in the elastomeric coating warrant sampling. Should sampling and analysis of the 207-A SRB indicate contamination at concentrations greater than the MTCA Method B unrestricted land use standards, additional soil removal will be performed underneath the storage cell floors to meet clean closure standards. If it is determined that clean closure cannot be achieved through additional soil removal, this closure plan will be modified to address landfill closure requirements in WAC 173-303-665, and a post-closure plan will be submitted, in accordance with Permit Condition V.5.B.5 and WAC 173-303-830.

For closure strategy purposes, the null hypothesis will be used to support the basis for clean closure. A null hypothesis is generally assumed true until evidence indicates otherwise. The null hypothesis, as defined in MTCA (WAC 173-340-200, "Definitions), is that the concentrations of contaminants of potential concern (COPCs) soil is assumed to be greater than unrestricted use cleanup levels, commonly called MTCA Method B cleanup levels. Therefore, the closure site is presumed to be contaminated (i.e., there has been a release from the unit). Rejection of the null hypothesis means sampling and analysis results of the closure site indicated the soil contains contamination levels below the MTCA Method B cleanup levels. Sampling and analysis will be used to determine whether the null hypothesis can be rejected, thereby confirming the underlying soil meets the closure performance standards.

4.5 CLOSURE ACTIVITIES

Clean closure of the 207-A SRB will include the following activities:

- 207-A SRB demolition and disposal (Section 4.5.1)
- Waste management (Section 4.5.2)
- Air emission controls (Section 4.5.3)
- Health and safety requirements (Section 4.5.4)

- Cultural and ecological resources (Section 4.5.5)
- Soil verification sampling and analysis (Section 4.6)

4.5.1. 207-A SRB Demolition and Disposal

Demolition of the 207-A SRB will include removal of the concrete storage cells, Hypalon® liner, and piping between the 207-A SRB and the pump pit. The majority of the demolition will require the use of heavy equipment (e.g., excavator with various attachments) to demolish the structure. Other standard industry or conventional demolition practices also may be used (e.g., hydraulic shears with steel shear jaws, concrete pulverizer jaws, or breaker jaws). Selection of demolition methods will be based on the structural elements to be demolished, remaining contamination, location, and integrity of the structure. Water may be used to control dust generated from demolition activities. The amount of water used will be minimized to prevent ponding and runoff. While unlikely, other controls such as portable ventilation filter units, HEPA-filtered vacuum cleaners, greenhouses, and/or fogging agents may be used. Additional storm water run-on and run-off controls may be implemented, as needed. The following demolition activities presume that the waste will be disposed in the Hanford Environmental Restoration Disposal Facility (ERDF), as discussed in Section 4.5.2. If for some reason the waste is not disposed of at ERDF, then waste will disposed of at a dangerous waste management unit authorized for disposal such as Trenches 31 and 34 in the 218-W-5 Burial Grounds.

4.5.1.1. Mobilization and Site Preparation

Demolition mobilization and site preparation include the activities necessary for field setup and closure action implementation. This includes obtaining field crew resources, equipment, materials, and performing field job site activities (e.g., site assessments and map development, providing worker support infrastructure, waste management areas, and other site preparation as required). Global positioning system (GPS) coordinates will be taken to ensure that after removal of the 207-A SRB storage cells, the grid for the verification sampling may be laid out (Section 4.6). Other prework tasks may include installing barriers and postings, site walk downs, completion of pre-demolition reviews, and equipment testing.

4.5.1.2. 207-A SRB Storage Cell Walls Demolition

The 207-A SRB storage cell walls will be rubblized. The demolition will occur most likely from north to south, removing concrete debris accordingly with no set pattern or amount removed. The rubblized debris from the walls and engineered fill material (per H-2-90783) from the 207-A SRB will be loaded into ERDF cans (roll-on/roll-off containers) for disposal at ERDF. A typical ERDF can is made of metal and is 20 feet long, 8 feet wide, and 5 feet tall. ERDF cans are typically covered with a tight fitting heavy duty tarp that is secured at multiple points for transport. While no liquid is expected to be in the storage cells prior to demolition, if present the liquid will be removed, characterized, containerized, and shipped for disposal to a permitted dangerous waste management unit.

4.5.1.3. Miscellaneous Piping and Soil

Piping runs that supported operations in the 207-A SRB storage cells will be removed between the 207-A SRB storage cell walls to the south wall of the pump pit. The pump pit is located approximately halfway between the 207-A SRB storage cells and the 207-A NRB storage cells. Piping running between the 207-A SRB storage cells and the pump pit will be removed at the south wall of the pump pit, and the holes left in the pump pit wall by the piping removal will be filled. Piping between the 242-A Evaporator to the pump pit and from the pump pit to the 216-A-37-1 Crib are not part of 207-A SRB and will not be removed as part of these closure activities.

The sides of the 207-A SRB excavation will be properly sloped to prevent cave-ins. The soil around the storage cells will be placed in ERDF containers and sent immediately to ERDF or staged at less than

90-day accumulation areas. If soil is stockpiled prior to loading, the soil will be sprayed with fixatives to eliminate wind blowing the soil. Any contaminated piping will have a fixative applied inside, as needed, prior to removal for disposal.

4.5.1.4. 207-A SRB Storage Cell Floors

The 207-A SRB storage cell floors are made of concrete and will be rubblized. Front-end loaders and excavators will load the rubble and remaining engineered fill material into ERDF cans. Based on drawing H-2-90783, the engineered fill consists of various materials: well graded sand, three inches of 2 inch minus pit run gravel, and organic-free dirt with cobbles no greater than 8 inches in diameter, compacted in up to one foot lifts. Based on the 207-A SRB footprint of 40 m (130 ft) long, 27.7 m (91 ft) wide, and 2.1 m (7 ft) deep, the final excavation footprint will be approximately 42.6 m (140 ft) long, 30.8 m (101 ft) wide, and 3 m (10 ft) deep. As discussed previously, additional soil removal may be performed underneath the 207-A SRB storage cell floors if deemed necessary to meet clean closure standards.

4.5.1.5. Decontamination

Decontamination of the 207-A SRB storage cells prior to demolition and removal is not planned based on previous operational history and concrete sampling results.

4.5.1.6. Completion Criteria

The demolition is considered complete after all waste debris has been removed to a nominal 1 m (3 ft) below the basin 207-A SRB floor, piping between the 207-A SRB storage cells and the pump pit disposed of at ERDF, the bottom of the excavation is sampled, and results documented. If sampling results identify contaminated soils, these soils will be excavated and additional sampling will be completed to confirm contaminated soils have been removed. If the sample results verify the soil meets the cleanup criteria, the 207-A SRB excavation footprint will be backfilled and returned to the appearance and use of surrounding land areas to the degree possible given the nature of the previous dangerous waste activity. Backfilling is anticipated to be completed in such a manner as to not unduly hinder future remediation in the immediate vicinity of the 207-A SRB, should remediation be necessary. Backfilling will be completed in such a manner as to mitigate potential construction safety hazards.

4.5.2. Waste Management

A variety of waste streams may be generated under this closure plan and will be in solid form. Some of the waste may be determined to be potentially dangerous or mixed waste. The generator and storage requirements of WAC 173-303-200, "Accumulating Dangerous Waste On-Site," will be followed.

Wastes generated through implementation of this closure plan will be disposed at ERDF or an approved RCRA TSD unit/dangerous waste management unit. ERDF is the preferred waste disposal facility. Waste is expected to meet the ERDF waste acceptance criteria (WCH-191, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*) as is. Waste volume reduction practices, such as minimizing cross-contamination during the demolition and excavation, or segregation of clean materials from contaminated materials, will be implemented where feasible.

Waste management activities include waste characterization, designation, staging, packaging, handling, marking, labeling, segregation, storage, transportation, treatment, and disposal and are briefly described in the following subsections.

4.5.2.1. Projected Waste Streams

One or all of the following solid waste streams are anticipated to be generated during the closure and may fall into any combination of these categories: nondangerous/nonradioactive, radioactive, mixed, hazardous, dangerous, suspect radioactive, suspect dangerous, and suspect mixed:

- Concrete, liner, and associated debris

- Hypalon® liner
- Soils
- Miscellaneous waste (e.g., rubber, glass, paper, personal protective equipment, cloth, plastic, and metal)
- Equipment and construction materials

4.5.2.1.1. Hazardous/Dangerous Waste, Low-Level Waste, and Mixed Waste Management

These wastes will be packaged, stored, and transported to prevent dispersion and public exposure. Waste specific storage and packaging requirements will comply with WAC 173-303 requirements, as applicable.

4.5.2.1.2. Solid Waste Management

Solid waste, such as personal protection equipment, step-off pad waste, will be managed per the action memorandum for the nonradiological and radiological contaminants present or suspected to be present (DOE-RL-2015-51). Miscellaneous solid waste that has contacted suspect dangerous or suspect mixed waste will be treated as such. Field screening will be used to segregate radioactive waste from nonradioactive waste. Waste is also screened to provide radiological information for shipping and disposal at ERDF. Container(s) will be properly marked and labeled Mixed waste may be staged at a USDOE designated less than 90 day waste container storage area. Miscellaneous solid waste will be dispositioned based on waste characterization information, consistent with disposal options in the action memorandum (DOE-RL-2015-51).

4.5.2.2. Waste Management and Characterization

Dangerous, low-level, and mixed wastes will be packaged, stored, and transported to prevent dispersion and personnel exposure. Waste specific storage and packaging requirements will comply with WAC 173-303 requirements, as applicable. Miscellaneous solid waste will be managed as appropriate for the nonradiological and radiological contaminants present or suspected to be present. Miscellaneous solid waste that has contacted suspect dangerous or suspect mixed waste will be treated as such. Field screening will be used to segregate radioactive waste from nonradioactive waste. Container(s) will be properly marked and labeled. The containers will be segregated, as appropriate, and either shipped directly to ERDF or staged at a USDOE-designated 90-day waste container storage area. Non-bulk solid waste will be dispositioned based on waste characterization information.

Waste generated through implementation of this closure plan will be characterized in accordance with the waste acceptance criteria of the receiving facility. Characterization is performed using a variety of information that includes, but is not limited to, process knowledge, historical analytical data, sampling and analysis data, and radiological and chemical screening.

Waste characterization information for managing the demolition waste as dangerous/mixed waste is based on the historical information on 207-A SRB operations, the Part A, and previous characterization information.

4.5.2.3. Waste Handling, Storage, and Packaging

Marking, labeling, segregating, and staging of waste containers will be performed or directed by the waste specialist. If waste containers cannot be shipped directly to the disposal site, wastes may be stored at Hanford Facility dangerous waste management units that are permitted to operate as container storage areas until disposal. Dangerous/mixed waste may also be accumulated in accordance with the generator requirements of WAC 173-303-200.

4.5.2.3.1. Hazardous/Dangerous Waste, Low-Level Waste, and Mixed Waste Management

These wastes are anticipated to be packaged, stored, and transported in ERDF cans to prevent dispersion and public exposure. Waste specific storage and packaging requirements will comply with WAC 173-303 requirements, as applicable.

4.5.2.3.2. Miscellaneous Waste Management

Miscellaneous waste, such as personal protection equipment, step-off pad waste, will be managed as appropriate for the nonradiological and radiological contaminants present or suspected to be present. Miscellaneous solid waste that has contacted suspect dangerous or suspect mixed waste will be treated as such. Field screening may be used to segregate radioactive waste from nonradioactive waste. Waste is also screened to provide radiological information for shipping and disposal at ERDF. Container(s) will be properly marked and labeled. Mixed waste may be staged at a USDOE designated less than 90 day waste container storage area. Miscellaneous waste will be dispositioned based on waste characterization information.

4.5.2.3.3. Management of Bulk Waste

The preferred management of the 207-A SRB storage cell materials is in bulk form. Bulk waste will be placed in ERDF cans for eventual disposal at ERDF or other approved RCRA dangerous waste management units. ERDF cans will be temporarily staged in an area adjacent to the 207-A SRB or may be stored for up to 90 days in an approved less than 90 day storage area.

Bulk containers will be covered when waste is not being added or removed. Lightweight material (e.g., plastic and paper) will be bagged, if appropriate, prior to placement in ERDF. ERDF cans are closed with a tight cover after filling. ERDF cans will be closed prior to transportation of dangerous or mixed waste generated by closure.

To facilitate the loading of concrete debris and soil into ERDF cans, the concrete debris and soil may be placed on the ground, adjacent to the 207-A SRB excavation footprint, to gather enough material for filling the bulk containers. Once the management of bulk waste has been completed, samples will be taken from the surface soil where the concrete debris and soil were placed. Analytical results from these samples will be directly compared to cleanup levels. If an exceedance of the cleanup levels is identified, additional soil removal will be completed until cleanup levels are met.

Additionally, a fixative will be applied to the demolition site and any loose soil as needed, to help control dust as well as radiological and nonradiological contaminants.

4.5.2.3.4. Management of Waste Containers

Any non-bulk waste generated will be placed in a 55 gallon drum(s). Non-bulk containers or packages of waste requiring tracking (e.g., hazardous/dangerous and mixed) will be assigned a unique tracking number by a waste specialist.

Waste containers are inspected before use to ensure container integrity. The containers will be temporarily stored/staged in a suitable area adjacent to the 207-A SRB or may be staged for up to 90 days at an approved storage area. Containers awaiting analytical results will be marked and labeled, based on process knowledge and historical concrete and soil sampling data. Weekly inspections of the containers will be performed at the less than 90 day storage areas, if needed, to document the integrity, container marking/labeling, physical container placement, staging/accumulation area boundaries/identification/warning signs, and signs of any potential leakage. Non-bulk waste containers showing signs of deterioration will be identified during container inspection and overpacked or repackaged, as necessary.

Waste containers will remain closed, except during packaging and waste inspection activities, once they are staged.

4.5.2.3.5. Waste Profile

Prior to initiating closure activities, waste anticipated to be generated will meet the ERDF acceptance criteria. Though not expected, if waste profiling changes to the waste-tracking form needed to occur, the following activities would be completed:

- Field-screening measurements may be used to obtain data to adjust the waste-tracking form.
- The waste profile may be adjusted to include new waste codes (if necessary) based on new data determined by either in-process field-screening methods oranalytical laboratory analysis. Any designation for a new waste code would require revision and resubmittal of the Part A form to include the new waste code.

4.5.2.3.6. Final Waste Disposal

Dangerous, mixed, and radioactive waste generated through implementation of the closure plan will be dispositioned at ERDF. ERDF is the preferred disposal location for waste meeting ERDF waste acceptance criteria, as it is engineered to meet appropriate RCRA technological requirements for landfills as described in the ERDF record of decision (EPA, 1995, *Record of Decision, U.S. DOE Hanford Environmental Restoration Disposal Facility, Hanford Site, Benton County, Washington*).

4.5.2.3.7. Waste Disposal Records

Original onsite waste tracking forms will be sent to ERDF with each container shipped. Original sample reports and a copy of the original onsite waste tracking form for each ERDF container will be retained and forwarded to the assigned waste specialist for inclusion in the project file following final waste disposition.

4.5.2.4. Waste Treatment

Typical treatment of waste from demolition activities (e.g., grouting, macroencapsulation, solidification, separation, size reduction, and/or repackaging) is not expected to be needed, based on available information. If treatment at the point of generation is deemed necessary to provide safe transport, meet waste disposal facility waste acceptance criteria, and/or address land disposal restriction requirements, such treatment may be conducted in accordance with ERDF requirements (DOE/RL-2015-51, Rev. 0). Residuals from treatment of waste originating from activities addressed in this closure plan can be disposed at ERDF, providing the treatment residuals meet ERDF waste acceptance criteria.

4.5.2.5. Waste Minimization and Recycling

Waste minimization practices will be followed to the extent technically and economically feasible during waste management. Introduction of clean materials into a contamination area, as well as contamination of clean materials, will be minimized to the extent practicable. Emphasis will be placed on source reduction to eliminate or minimize the volume of waste generated. Materials released offsite for disposal/recycle (e.g. residuals from analysis of samples) will conform to the receiving facility’s acceptance criteria.

4.5.3. Air Emissions

There is no expectation that substantial emissions of criteria and toxic air pollutants will result from demolition activities. No bulk processing chemicals are known to be present at the 207-A SRB. Relatively small amounts of radiological contaminant fixing agents could be introduced into the 207-A SRB to support closure. These are commercially available products that are used throughout the Hanford Site on a daily basis.

Reasonable precautions will be taken to minimize visible dust emissions from active structural demolition with standard emission control techniques. Active excavations shall use water or crusting agents (e.g., Soil-Sement®) as approved for dust control. Water usage for dust control will be minimized to protect against potential contaminant migration. Crusting agents or fixatives will be applied to any disturbed portion of the contamination area that will be inactive for more than 24 hours. Material to be disposed at ERDF will also comply with the moisture content and other applicable requirements of the ERDF waste acceptance criteria (WCH-191). Dust fixative is applied to the demolition and excavation site when potential concerns arise about health issues or the spread of contamination.

Airborne emissions associated with these closure activities will be minimized by the use of appropriate work controls. Airborne releases of contaminants during these closure activities will be controlled in accordance with USDOE radiation control and substantive air pollution control standards in order to maintain emissions of air pollutants at the Hanford Site to as low as reasonably achievable levels.

Minimal operations associated with greater than 100°C (212°F) deactivation methods (e.g., welding, laser cutting) will be expected. The applicability of WAC 173-400-110 ("General Regulations for Air Pollution Sources," "New Source Review (NSR) for Sources and Portable Sources") and WAC 173-460 ("Controls for New Sources of Toxic Air Pollutants") was evaluated. The proposed activity does not meet the definitions of establishment of a new source (under WAC 173-400-030, "Definitions", or modification (WAC 173-400-030[44]); therefore, the new source review requirements of WAC 173-400-100 are not applicable. WAC 173-460 is not an applicable chapter because these activities do not meet definitions of new toxic air pollutant source.

4.5.4. Health and Safety Requirements

Closure will be performed in a manner to ensure the safety of personnel and the surrounding environment. Qualified personnel will perform any necessary closure activities in compliance with established safety and environmental procedures. Personnel will be equipped with appropriate personal protective equipment. Qualified personnel will be trained in applicable safety and environmental procedures and have appropriate training and experience in sampling activities. Field operations will be performed in accordance with applicable health and safety requirements. If an emergency would occur, the on-call Building Emergency Director will be notified, and the requirements associated with DOE/RL-94-02, *Hanford Emergency Management Plan*, will be implemented.

The Permittees have instituted training or qualification programs to meet training requirements imposed by regulations, USDOE orders, and national standards such as those published by the American National Standards Institute/American Society of Mechanical Engineers. For example, the environmental, safety, and health training program provides workers with the knowledge and skills necessary to execute assigned duties safely. The Hanford Facility RCRA Permit, Attachment 5, describes specific requirements for the Hanford Facility Personnel Training program. The Permittees will comply with the training matrix shown in Table 1, which provides training requirements for Hanford Facility personnel associated with 207-A SRB.

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Table 1. Training Matrix for the 207-A SRB DWMU

	Training Category[a]			
Permit Attachment 5 Training Category	General Hanford Facility Training	Contingency Plan Training	Emergency Coordinator Training	Operations Training
207-A SRB Closure Unit DWTP Implementing Plan	Orientation Program	Emergency Response (Contingency Plan)	Emergency Coordinator Training	General Waste Management and Closure Support
Job Title/Position				
NCO	X	X		X[a]
Operations Supervisor	X	X	X	X[b]
ECO	X			X[b]
Waste Service Provider	X			X[b]
Sampler	X			X[b]

a. Refer to the LLBG Trenches 31-34-94 DWTP for a complete description of coursework in each training category.

b. Training received is commensurate with the duties performed. Individuals in this category who do not perform these duties are not required to receive this training.

DWMU = dangerous waste management unit
DWTP = dangerous waste training plan
ECO = environmental compliance officer
LLBG = low-level burial ground
NCO = nuclear chemical operator

Project-specific safety training addressed explicitly to the project and the day's activity will include the following:

- Training will provide the knowledge and skills needed for sampling personnel to perform work safely and in accordance with quality assurance (QA) requirements.
- Samplers are required to be qualified in the type of sampling being performed in the field.

Pre-job briefings will be performed to evaluate activities and associated hazards by considering the following factors:

- Objective of the activities
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Environment in which the job will be performed
- Facility where the job will be performed
- Equipment and material required
- Safety protocols applicable to the job
- Training requirements for individuals assigned to perform the work
- Level of management control
- Proximity of emergency contacts

Training records are maintained for each employee in an electronic training record database. The Permittees training organization maintains the training records system.

4.5.5. State Environmental Policy Act and Cultural and Ecological Resources

Cultural and ecological resource reviews were performed in support of the closure plan activities to identify any potential impacts. The cultural and ecological resource reviews were conducted in accordance with USDOE requirements. Per memorandum dated June 25, 2015, no potential impacts are anticipated, as long as memorandum recommendations are followed. However, if changes are warranted during field work, an appropriate mitigation action plan will be developed and implemented.

A State Environmental Policy Act (SEPA) (RCW 43.21C, "State Environmental Policy") checklist was prepared. SEPA (RCW 43.21C) requires the environmental effects of a proposal be evaluated before decisions are made by Ecology. The purpose of this checklist is to provide information to help identify impacts for the action, in this case closure of the 207-A SRB, and to reduce or avoid impacts from this action. Ecology reviewed the submission and made a determination of non-significance (DNS).

4.6 SOIL VERIFICATION SAMPLING AND ANALYSIS

Sampling and analysis of the soil will be conducted to confirm that clean closure levels in the soil have been achieved. The SAP summarizes the sampling design used and associated assumptions based on the knowledge of the 207-A SRB. The sampling design includes input parameters used to determine the number and location of samples.

4.6.1. Closure Sampling and Analysis Plan

All sampling and analysis will be performed in accordance with the sampling and quality standards established in this closure SAP. The closure SAP details sampling and analysis procedures in accordance with SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*; the American Society for Testing and Materials (ASTM) *Annual Book of ASTM Standards*; and applicable U.S. Environmental Protection Agency (EPA) guidance. Sampling and analysis activities will meet applicable requirements of SW-846, ASTM standards, EPA-approved methods, and DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD). This SAP was also developed using Ecology Publication 94-111, Section 7.0, "Sampling and Analysis for Clean Closure," and EPA/240/R-02/005 (EPA QA/G-5S).

4.6.1.1. Target Analytes

The Part A and effluent records for discharges to the 207-A SRB storage cells were reviewed. This information identified the federal and state waste codes of the liquid effluent discharged to the storage cells. The identified waste codes were the basis for the list of target analytes for analysis in this SAP. Table 2 details the waste codes listed for the storage cells and the target analyte associated with that waste code.

4.6.1.2. Verification Sampling Schedule

Verification closure sampling and analysis will be performed in accordance with the closure plan schedule in Section 8, "Schedule for Closure."

4.6.1.3. Sample Management

The Permittees are responsible for planning, coordinating, sampling, preparing, packaging, and shipping samples to the laboratory.

4.6.2. Sampling Design

The objective of sampling the soil underneath the 207-A SRB storage cells is to obtain analytical data to confirm that the soil does not have contaminants that exceed the MTCA Method B clean closure performance standards.

This SAP used Ecology Publication 94-111, Section 7.0, "Sampling and Analysis for Clean Closure," to determine the type of sampling design that will be used to demonstrate clean closure. When designing the sampling plan, both focused and area-wide (grid) sampling methods were considered. Ecology Publication 94-111, Section 7.2.1, identifies area-wide sampling as appropriate when the spatial distribution of contamination at or from the closure unit is uncertain. Ecology Publication 94-111, Section 7.3, "Sampling to Determine or Confirm Clean Closure," identifies the area-wide sampling approach as generally appropriate for sampling to determine or confirm that clean closure levels are achieved. Focused sampling, as identified in Section 7.2.2 of Ecology Publication 94-111, is selective sampling of areas where contamination is expected or releases have been documented. Based on the records review and visual inspection performed for the storage cells, both the area-wide sampling approach and focused sampling of concrete seams at the wall and floor joints were determined appropriate for verification of clean closure. Sampling for carbon tetrachloride and chloroform will occur if the Hypalon® liner is observed to be degraded at the time of removal. These analyses will not be sampled for in soil if the Hypalon® liner is observed to be in good condition at the time of removal (see Section 4.6.2.7 for documentation requirement related to field observations).

Table 2. Target Analyte List

Target Analyte (Waste Code)	CAS Number*
m-Cresol (F004)	108-39-4
p-Cresol (F004)	106-44-5
o-Cresol (F004)	95-48-7
Acetone (F003) (U002)	67-64-1
Methylene Chloride (F001) (F002)	75-09-2
Carbon tetrachloride **	56-23-5
Chloroform **	67-66-3

*CAS = Chemical Abstracts Service

** If required

Area-Wide (Grid) Sampling. In grid sampling, samples are collected at regularly spaced intervals over space or time. An initial location or time is chosen at random, and the remaining sampling locations are defined so that locations are at regular intervals over an area (grid). Grid sampling is used to search for hot spots and to infer means, percentiles, or other parameters. It is useful for estimating spatial patterns or trends over time. This design provides a practical method for designating sample locations and ensures uniform coverage of a site, unit, or process.

Focused Sampling. Focused sampling involves selective sampling of areas where contamination is expected or releases have been documented. Focused sampling should be conducted in addition to grid sampling where there is evidence of leaks or spins or potential for a dangerous waste constituent to migrate. Focused sampling could involve linear sampling along a drainage way, boundary, or other linear dimension.

The quantity and location of the area-wide samples was determined using the Visual Sample Plan (VSP) software (PNNL, 2001). VSP, a tool used throughout Washington State and nationally, statistically determines the quantity of samples required to accept or reject the null hypothesis based on input parameters specific to the 207-A SRB.

Both parametric and nonparametric equations rely on assumptions about the data population. Typically, however, nonparametric equations require fewer assumptions and allow for more uncertainty about the distribution of data. Alternatively, if the parametric assumptions are valid, the required number of samples is usually less than if a nonparametric equation were used. For soils underneath the 207-A SRB storage cells, the data assumptions were largely based on information obtained from a grouping of similar waste sites with the same type of constituents. To determine the parameters for this closure plan, the parameters from the 200-MG-1 waste sites in the SAP document DOE/RL-2009-60, *Sampling and Analysis Plan for Selected 200-MG-1 Operable Unit Waste Sites*, were evaluated, deemed appropriate, and used for the input parameters for soil in this closure plan. The VSP parameter inputs and the basis for those inputs are detailed in Table 3.

The decision rule for demonstrating compliance with the MTCA Method B clean closure level has three parts (referred to as the 3-part test per WAC 173-340-740(7)(e)):

- The upper one sided ninety-five percent confidence limit on the true mean soil concentration shall be less than the MTCA Method B soil cleanup level.
- No sample concentration can be more than twice the cleanup level.
- Less than 10 percent of the samples can exceed the cleanup level.

Using a nonparametric test and the input parameters identified in Table 3, VSP calculated a minimum of 20 samples are required to reject the null hypotheses with 95 percent confidence and ensure that soil would not be mistakenly determined as clean per the clean closure standards. For using the VSP software, the null hypothesis is to compare a site mean to a fixed threshold. Data will be evaluated to ensure that less than 10 percent of the individual values do not exceed the MTCA Method B clean closure performance standards and that no values are more than twice the cleanup level.

Sample locations were determined using the area-wide grid with a random start sampling method run in the VSP software. Statistical analyses of systematically collected data are valid if a random start to the grid is used. The 207-A SRB anticipated sampling area dimensions were entered into VSP to determine the locations of samples. The triangular grid sampling layout was determined to have an even distribution over the entire soil sampling area, providing the most representative data set. The choice of a triangular grid sampling layout required one additional sample location in order to complete the grid over the sample area, resulting in 20 samples. The 20 samples will be taken from the node locations indicated by the VSP results (Appendix A) and will be assigned sample location identifications and sample numbers using the Hanford Environmental Information System (HEIS). The southeast corner of the 207-A SRB excavation is considered the (0,0) point of the sampling location map in Appendix A.

The first node location was chosen at random by the VSP software, and the subsequent 19 sample locations were assigned by the VSP software using a triangular grid sampling layout. Supporting documentation and the sampling grid map automatically generated by the VSP software are provided in Appendix A.

For focused sampling at the concrete expansion joints in the 207-A SRB storage cell floors, professional judgment was used to determine the number of sample locations. VSP did not include the focus sampling locations because they are biased and would skew the randomness of the VSP locations. Three sample locations for each 207-A SRB storage cell floor were determined to be sufficient to support the overall sampling approach. GPS coordinates will be taken to determine the locations of these sample sites in the expansion joints. Once the storage cells are removed, these locations will be sampled in conjunction with the VSP result sample locations. Focused samples will also be collected at locations where there is evidence of potential leaks such as discoloration or staining. Evaluation of the results of focused sampling will be performed by direct comparison to the closure standard without applying any statistical tests. Additional cleanup (e.g. removal of soil) will be performed at the focused sample locations that exceed the cleanup standard.

4.6.2.1. Sampling Methods and Handling

For purposes of this SAP, soil surface is defined as the exposed layer once the 207-A SRB storage cells have been removed. The sample matrix will consist of soil collected in pre-cleaned sample containers taken at a depth of 0 to 15.24 cm (0 to 6 in.) below ground surface. Grab samples will be collected in the soil remaining after removal of the 207-A SRB. The sample matrix could consist of native soil, engineered fill, or a combination of the two materials. Sampling of the subsurface (sampling up to 4.6 m [15 ft] below surface) was evaluated. However, based on the results of the records review and no identified dangerous waste releases, subsurface sampling is deemed unnecessary beyond the planned sampling of the exposed surface layer after removal of the storage cells and up to 1 m (3 ft) of soil beneath and adjacent to the cells.

Once the soil is sampled, the sampled media will be screened to remove material larger than approximately 2 mm (0.08 in.) in diameter. Removal of material larger than approximately 2 mm (0.08 in.) in diameter will allow for a larger surface area to volume ratio and be more likely to identify any potential contamination in the sample. Grab samples will be collected into containers at the chosen node sample locations. To ensure sample and data usability, sampling will be performed in accordance with established sampling practices, procedures, and requirements pertaining to sample collection, collection equipment, and sample handling.

Table 3. Visual Sample Plan Parameter Inputs

Parameter	Value	Basis
Primary Objective of the Sampling Design	Compare a site mean or median to a fixed threshold	Reject the null hypothesis.
Type of Sampling Design	Nonparametric	Data are not assumed to be normally distributed.
Working Null Hypothesis	The mean value at the site exceeds the threshold (MTCA Method B closure performance standards).	The null hypothesis assumes that the site is contaminated, requiring the sampling and analysis to demonstrate through statistical analysis that the site is clean.
Area-Wide Grid Sampling Pattern	Triangular	A triangular pattern provided an even distribution of sample locations over the 207-A SRB storage cells.
Standard deviation (S)	0.45	This is the assumed standard deviation value relative to a unit action level for the sampling area. The value of 0.45 is conservative, based on consideration of past verification sampling. MARSSIM suggests 0.30 as a starting point; however, 0.45 has been selected to be more conservative. (Number of samples calculated increases with higher standard deviation values relative to a unit action level.)
Delta (Δ)	0.40	This is the width of the gray region. It is a user-defined value relative to a unit action level. The value of 0.40 is a value that balances unnecessary remediation cost with sampling cost.
Alpha (α)	5%	This is the acceptable error of deciding a dirty site is clean when the true mean is equal to the Action Level. It is a maximum error rate since dirty sites with a true mean above the Action Level will be easier to detect. A value of 5% was chosen as a practical balance between health risks and sampling cost.

Table 3. Visual Sample Plan Parameter Inputs

Parameter	Value	Basis
Beta (β)	20%	This is the acceptable error of deciding a clean site is dirty when the true mean is at the lower bound of the gray region. A value of 20% was chosen during the data quality objectives process as a practical balance between unnecessary remediation cost and sampling cost.
MARSSIM sampling overage	20%	MARSSIM suggests that the number of samples should be increased by at least 20% to account for missing or unusable data and uncertainty in the calculated value of *n*.

Reference: EPA 402-R-97-016, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*.

MTCA = "Model Toxics Control Act—Cleanup" (WAC 173-340)

Sample container, preservation, and holding time requirements are specified in Table 4 for soil samples. These requirements are in accordance with the analytical method specified. The final container type and volumes will be identified on the Sampling Authorization Form (SAF) and the chain-of-custody form.

Table 4. Sample Preservation, Container, and Holding Time for Soil Samples.

Target Analyte	Method	Analysis/Analytes	Preservation Requirement	Holding Time	Bottle Type
Acetone Methylene chloride Carbon Tetrachloride* Chloroform*	EPA 8260	Volatile Organic Analytes	Cool ~4°C	14 days	Glass
m-cresol *p*-cresol *o*-cresol	EPA 8270	Semivolatile Organic Compound	Cool ~4°C	14/40 days	Amber Glass

Notes: For the four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Third Edition Final Update IV-B.*

* *If required.*

Level I EPA pre-cleaned sample containers will be used for samples collected for chemical analysis. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting analytical detection limits.

The sample location, depth, and corresponding HEIS numbers will be documented in the sampler's field logbook. A custody seal (e.g., evidence tape) will be affixed to each sample container and/or sample collection package in such a way as to indicate potential tampering.

Each sample container will be labeled with the following information on firmly affixed, water resistant labels:

- SAF and form number
- HEIS number
- Sample collection date and time
- Sampler identification
- Analysis required
- Preservation method (if applicable)

Sample records must include the following information:

- Analysis required
- Sample location
- Matrix (e.g., water or soil)

Sample custody will be maintained in accordance with existing Hanford Site protocols to ensure maintenance of sample integrity throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained.

All waste (including unexpected waste) generated by sampling activities will be managed in accordance with WAC 173-303 and applicable or relevant and appropriate requirements (ARARs) incorporated via the action memorandum, DOE/RL-2015-51.

4.6.2.2. Analytical Methods

All analyses and testing will be performed consistent with this closure plan, laboratory analytical procedures, and HASQARD (DOE/RL-96-68). The approved laboratory must achieve the lowest practical quantitation limits (PQLs) consistent with the selected analytical method to confirm clean closure levels.

Analytical methods and performance requirements associated with the target analytes are outlined in Table 5.

Table 5. Soil Analytical Performance Requirements

CAS Number	Analyte	Analytical Method	Closure Performance Standard[a] (mg/kg)			Practical Quantitation Limit (mg/kg)	Accuracy Req't (Percent Recovery)[b]	Precision Req't (Relative Percent Difference)[b]
			Carcinogen	Non-carcinogen	Protection of Groundwater			
108-39-4	*m*-cresol	SW-846 Method 8270	N/A	4000	N/A	0.66	±30	±30
95-48-7	*o*-cresol	SW-846 Method 8270	N/A	4000	2.33	0.33	±30	±30
106-44-5	*p*-cresol	SW-846 Method 8270	N/A	8000	N/A	0.33	±30	±30
75-09-2	Methylene Chloride	SW-846 Method 8260	500	480	0.0215[c]	0.005	±30	±30
67-64-1	Acetone	SW-846 Method 8260	N/A	72,000	28.9	0.02	±30	±30
56-23-5	Carbon Tetrachloride*	SW-846 Method 8260	14.3	320	0.0416	0.005	±30	±30
67-66-3	Chloroform*	SW-846 Method 8260	32.3	800	0.0736[c]	0.005	±30	±30

Source: *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B.*

a. Closure performance standards are the numeric cleanup levels calculated using unrestricted use exposure assumptions according to "Model Toxics Control Act—Cleanup" (MTCA) regulations (WAC 173-340-740, "Unrestricted Land Use Soil Cleanup Standards;" WAC 173-340-747, "Deriving Soil Concentrations for Groundwater Protection;" and WAC 173-340-7490, "Terrestrial Ecological Evaluation Procedures," through -7494, "Priority Contaminants of Ecological Concern"). These numeric cleanup levels will be calculated according to MTCA Method B (unrestricted use standards). Where both carcinogen and noncarcinogen performance standards are available, the lowest value will be used.

b. Accuracy criteria for associated batch matrix spike percent recoveries. Evaluation based on statistical control of laboratory control samples is also performed. Precision criteria for batch laboratory replicate matrix spike analyses or replicate sample analyses.

c. More stringent of standard MTCA Method B cleanup value for unrestricted land use between soil protective of groundwater with vadose at 25°C and soil protective of groundwater with vadose at 13°C.

CAS = Chemical Abstracts Service

N/A = not applicable

mg/kg = milligrams per kilogram

* = If required.

4.6.2.3. Quality Control

Quality control (QC) procedures must be followed in the field and laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability. Field QC will include the following samples:

- Collection of full trip blank
- Field transfer blank
- Equipment rinsate blank

- Field duplicate samples
- Field split samples

Laboratory QC samples estimate the precision and bias of the analytical data. Field and laboratory QC samples are summarized in Table 6.

Data verification, data validation, and data quality assessment will include both the primary samples and quality control samples.

Table 6. Project Quality Control Sampling Summary

Quality Control Sample Type	Frequency	Characteristics Evaluated
Field Quality Control		
Full Trip Blank	One per 20 samples per media sampled.	Contamination from containers or transportation
Equipment Rinsate Blank	As needed. If only disposable equipment is used, then an equipment blank is not required. Otherwise, one per 20 samples per media[a].	Adequacy of sampling equipment decontamination and contamination from nondedicated equipment
Field Duplicate Sample	One per batch[h], 20 samples maximum of each media sampled (soil samples[b]).	Precision, including sampling and analytical variability
Field Split Sample	As needed. When needed, the minimum is one per analytical method, per media sampled, for analyses performed where detection limit and precision and accuracy criteria have been defined in the Performance Requirements tables.	Precision, including sampling, analytical, and interlaboratory
Laboratory Quality Control[h]		
Method Blanks	1 per batch[h]	Laboratory contamination
Lab Duplicates	[c]	Laboratory reproducibility and precision
Matrix Spikes	[c]	Matrix effect/laboratory accuracy
Matrix Spike Duplicates	[c]	Laboratory reproducibility, accuracy, and precision
Surrogates	[c]	Recovery/yield
Tracers	[c]	Recovery/yield
Laboratory Control Samples	1 per batch[h]	Evaluate laboratory accuracy
Performance Evaluation Parameters[d]	Annual	Evaluate laboratory accuracy

Table 6. Project Quality Control Sampling Summary

Quality Control Sample Type	Frequency	Characteristics Evaluated
Double-Blind Standards	Quarterly[e]	Evaluate laboratory accuracy
Audit/Assessment	Annually[f] or every 3 years[g]	Evaluate overall laboratory performance and operations

a. Whenever a new type of nondedicated equipment is used, an equipment blank shall be collected every time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination procedure for the nondedicated equipment.

b. Soil grab samples are exempted from duplicate sampling.

c. As defined in the laboratory contract or quality assurance plan and/or analysis procedures.

d. Nationally recognized program, such as USDOE Mixed Analyte Performance Evaluation Program or Environmental Resource Associates.

e. Soil matrix double-blind standards are submitted by request of Analytical Services.

f. USDOE Quality Systems for Analytical Services requires annual audit of commercial laboratories.

g. DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD), does not define a frequency for assessment of onsite laboratories. Three year evaluated supplier list requirement is typically applied.

h. Batching across projects is allowed for similar matrices.

USDOE = U.S. Department of Energy

4.6.2.4. Data Verification

Analytical results will be received from the laboratory, loaded into a database (i.e. HEIS), and verified. Verification includes, but is not limited to, the following items:

- Amount of data requested matches the amount of data received (number of samples for requested methods of analytes).
- Procedures and methods used.
- Documentation/deliverables are complete.
- Hard copy and electronic versions of the data are identical.
- Data seem reasonable, based on analytical methodologies and lab report.

4.6.2.5. Data Validation and Assessment

Data validation is performed by a third party of five percent of the results. The laboratory supplies contract laboratory program equivalent analytical data packages intended to support data validation by the third party. The laboratory submits data packages that are supported by QC test results and raw data.

Controls are in place to preserve the data sent to the validators and allow only additions to be made, not changes to the raw data.

The format and requirements for data validation activities are based upon the most current version of USEPA-540-R-08-01, *National Functional Guidelines for Superfund Organic Methods Data Review* (OSWER 9240.1-48), and USEPA-540-R-10-011, *National Functional Guidelines for Inorganic Superfund Data Review* (OSWER 9240.1-51). Five percent of the results will undergo Level C validation, as defined by the validation guidelines.

4.6.2.6. Verification of VSP Input Parameters

Analytical data from VSP sampling will be entered back into the VSP software as required. If all the analytical data for a particular analyte are nondetect, verification of VSP input parameters is not required for that analyte. The VSP software uses the analytical data to determine if the user input parameters were estimated appropriately. Once analytical data are entered into the VSP software validation module, VSP will calculate the true standard deviation and determine whether the null hypothesis can be rejected. If the calculated standard deviation is smaller than the estimated user input standard deviation, no additional sampling will be required. If the calculated standard deviation is larger than the estimated standard deviation, additional sampling may be required. Verification of the null hypothesis through VSP will determine if the mean value of the site analytical data supports rejection of the null hypothesis (Section 6.2). These statistical methods are only applicable to grid samples. Documentation of the results of the VSP validation process will be provided as part of the closure report for meeting clean closure requirements.

4.6.2.7. Documents and Records

The Project Manager is responsible for ensuring that the SAP included in this closure plan is being followed by field personnel. Changes to the SAP in this closure plan which would affect the data needs, will be submitted as a permit modification in accordance with WAC 173-303-610(3)(b) by USDOE to Ecology.

Logbooks are required for field activities. A logbook must be identified with a unique project name and number. The individual(s) responsible for logbooks will be identified in the front of the logbook and only authorized persons may make entries in logbooks. Logbooks will be signed by the field manager, supervisor, cognizant scientist/engineer, or other responsible individual. Logbooks will be permanently bound, waterproof, and ruled with sequentially numbered pages. Pages will not be removed from logbooks for any reason. Entries will be made in indelible ink. Corrections will be made by marking through the erroneous data with a single line, entering the correct data, and initialing and dating the changes. The logbooks used in these activities are record documents.

The project manager is responsible for ensuring that a project file is properly maintained. The project file will contain the records or references to their storage locations. The following items will be included in the project file, as appropriate:

- Field logbooks or operational records
- Data forms (especially those that are not part of the field logbook)
- GPS data
- Chain-of-custody forms
- Sample receipt records
- Inspection or assessment reports and corrective action reports
- Interim progress reports
- Final reports
- Laboratory data packages
- Verification and validation reports
- Documentation of the condition of the Hypalon® liner at the time of removal

The laboratory is responsible for maintaining, and having available upon request, the following items:

- Analytical logbook
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Instrument calibration information
- Training records for employees, as they relate to analytical methods
- Laboratory state accreditation records

- Laboratory audit records

Records may be stored in either electronic or hard copy format. Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes to ensure the accuracy and retrievability of stored records. Records required by the TPA (Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*) will be managed in accordance with the requirements therein.

4.6.2.8. Revisions to the Sampling and Analysis Plan and Constituents to Be Analyzed

Ecology will be notified of all changes requiring deviation from the SAP in the Closure Plan. If changes to the SAP are necessary due to unexpected events during closure that will affect sampling or analysis, the Permittees will notify Ecology to discuss the changes and how they will be addressed. Depending on the nature of the deviation, Ecology will make a decision to document the changes in the field notebooks covering the closure activities and in the closure certification package, or will require a permit modification. If a permit modification is required, a revision to this SAP will be submitted no later than 30 days after the unexpected event as a permit modification as required in WAC 173-303-610(3)(b)(iii) and WAC 173-303-830, "Dangerous Waste Regulations," "Permit Changes."

4.7 CLOSURE PLAN MODIFICATION

If contaminated soil is identified as a result of clean closure verification sampling activities (i.e., samples indicate contamination above clean closure standards), the nature and extent of contamination will be evaluated. The excavation will remain open until analytical results indicate that cleanup levels have been met. The primary option will be additional excavation to remove contaminated soil, as identified by analytical results. However, it may not be possible to remove or decontaminate all dangerous waste and dangerous waste residues, contaminated containment system components (liners, etc.), contaminated soils, and structures and equipment contaminated with dangerous waste, and manage all as dangerous waste. In this case, a permit modification request will be submitted to Ecology to modify the closure plan. The permit modification request will address landfill requirements per WAC 173-303-665 and specific landfill requirements for a surface impoundment per WAC 173-303-650(6) should any contaminated soils be left in place.

4.8 SCHEDULE FOR CLOSURE

Table 7 describes the primary and secondary closure activities and the expected duration of activities. 207-A SRB removal, verification sampling, and analysis activities are anticipated to be completed within 180 days after Ecology's approval of the permit modification incorporating this closure plan, or after Ecology issues a Temporary Authorization (TA) to begin closure activities. Ecology can also issue an one-time 180-day extension to the TA should closure activities continue beyond the initial 180-day period, per WAC 173-303-830. During the course of these final closure activities, if an unexpected event should arise, a permit modification request to amend the closure plan will be submitted to Ecology for approval no more than 30 days after the unexpected event, in accordance with WAC 173-303-610(3)(b).

Table 7. Closure Activity Description

Primary Activity	Secondary Activity	Expected Duration
207-A SRB structure demolition and disposal • Demolish concrete structure and liner(s) • Rubblize concrete • Load rubble/debris/soil into ERDF Cans • Transport to ERDF • Dispose of into ERDF	Verify sampling and analysis of soil for clean closure levels • Prepare sample grid • Take samples • Analyze samples • Validate data • Analyze data	180 days
Same as above	Same as above	Up to an additional 180 days
Closure Activities Complete		
Prepare closure documentation and obtain Independent Qualified Registered Professional Engineer certification	Transmit closure certification to Ecology	60 days
ERDF = Environmental Restoration Disposal Facility		

4.9 CERTIFICATION OF CLOSURE

In accordance with WAC 173-303-610(6), USDOE will submit a certification of closure to Ecology. Both USDOE and the co-operator identified on the Part A will sign the certification of closure, and an Independent Qualified Registered Professional Engineer (IQRPE) will certify that the unit has been closed in accordance with the approved closure plan.

An IQRPE will be retained to provide certification of the closure, as required by WAC 173-303-610(6). The engineer will be responsible for observing field activities and reviewing documents associated with closure of 207-A SRB. At a minimum, field activities and documents reviewed would include the following:

- Review of the 207-A SRB storage cells visual inspection.
- Review of sampling procedures and results.
- Observe and/or review of sampling activities.
- Observe and/or review contaminated environmental debris removal (as applicable).
- Verify that locations of samples are as specified in the SAP.

The engineer will record his or her observations and reviews in a written report that will be retained in the operating record. The resulting report will be used to develop the clean closure certification, which will then be provided to Ecology. Documentation supporting certification by the IQRPE will be placed in the Administrative Record.

Documentation supporting closure certification will be placed in the Administrative Record and will be provided to Ecology. At a minimum, the following documentation and information supporting closure certification will be included:

1. Field notes and photographs related to closure activities.
2. Description of minor deviations from approved closure plan and their justifications.

3. Documentation of removal and final disposition of all dangerous wastes and waste residues, including contaminated media, debris, and any treated residuals.
4. Documentation that decontamination procedures were followed and decontamination standards achieved.
5. All laboratory and/or field data, including sampling procedures and locations, QA/QC samples, chain-of-custody procedures, and required sample measurements.
6. Documentation that sample result data were input into the VSP validation module and report the results of the validation process.
7. Final summary report from the IQRPE, itemizing all data reviewed and including analytical results used to determine a final closure status.

4.10 POST-CLOSURE PLAN

The closure strategy is clean closure. If the 207-A SRB cannot be clean closed, a contingent plan, a post-closure plan and groundwater monitoring plan must be submitted to Ecology within 90 days of the determination that the unit cannot be clean closed.

4.11 AMENDMENT OF CLOSURE PLAN

As required by WAC 173-303-610(3)(b)(iii), the closure plan will be amended if changes to closure activities require modification of the approved closure plan. The revised closure plan will be submitted to Ecology within 30 days of the determination that the unit cannot be clean closed.

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APPENDIX A

SYSTEMATIC SAMPLING LOCATIONS FOR COMPARING A MEDIAN WITH A FIXED THRESHOLD (NONPARAMETRIC - MARSSIM)

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APPENDIX A
SYSTEMATIC SAMPLING LOCATIONS FOR COMPARING A MEDIAN WITH A FIXED THRESHOLD (NONPARAMETRIC - MARSSIM)

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Terms

LBGR	lower bound of gray region
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
VSP	Visual Sample Plan

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A1 SUMMARY

This report summarizes the sampling design used and associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil or groundwater) and how to analyze the samples (e.g., in situ or fixed laboratory) are addressed in other sections of the sampling plan.

Table A-1 summarizes the sampling design developed. Figure A-1 shows sampling locations in the field, and Table A-2 lists sampling location coordinates.

Table A-1. Summary of Sampling Design

Primary Objective of Design	Compare a site mean or median to a fixed threshold
Type of Sampling Design	Nonparametric
Sample Placement (Location) in the Field	Systematic with a random start location
Working (Null) Hypothesis	The median (mean) value at the site exceeds the threshold
Formula for Calculating Number of Sampling Locations	Sign test (MARSSIM version)
Calculated Total Number of Samples	20
Number of Samples on Map[a]	20
Number of Selected Sample Areas[b]	1
Specified Sampling Area[c]	1,313.6 m^2 (14,140.00 ft^2)
Size of Grid/Area of Grid Cell[d]	28.5722 m/707 m^2 (93.7 ft/7,610 ft^2)
Grid Pattern	Triangular

Reference: EPA 402-R-97-016, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*.

a. This number may differ from the calculated number because of grid edge effects, adding judgment samples, or selecting or unselecting sample areas.

b. The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.

c. The sampling area is the total surface area of the selected colored sample areas on the map of the site.

d. Size of grid/area of grid cell gives the linear and square dimensions of the grid used to systematically place samples.

e. Including measurement analyses and fixed overhead costs.

A1.1 Primary Sampling Objective

The primary purpose of sampling at this site is to compare a site median or mean value with a fixed threshold. The working hypothesis (or null hypothesis) is that the median (mean) value at the site is equal to or exceeds the threshold. The alternative hypothesis is that the median (mean) value is less than the threshold. Visual Sample Plan (VSP) calculates the number of samples required to reject the null hypothesis in favor of the alternative one, given a selected sampling approach and inputs to the associated equation.

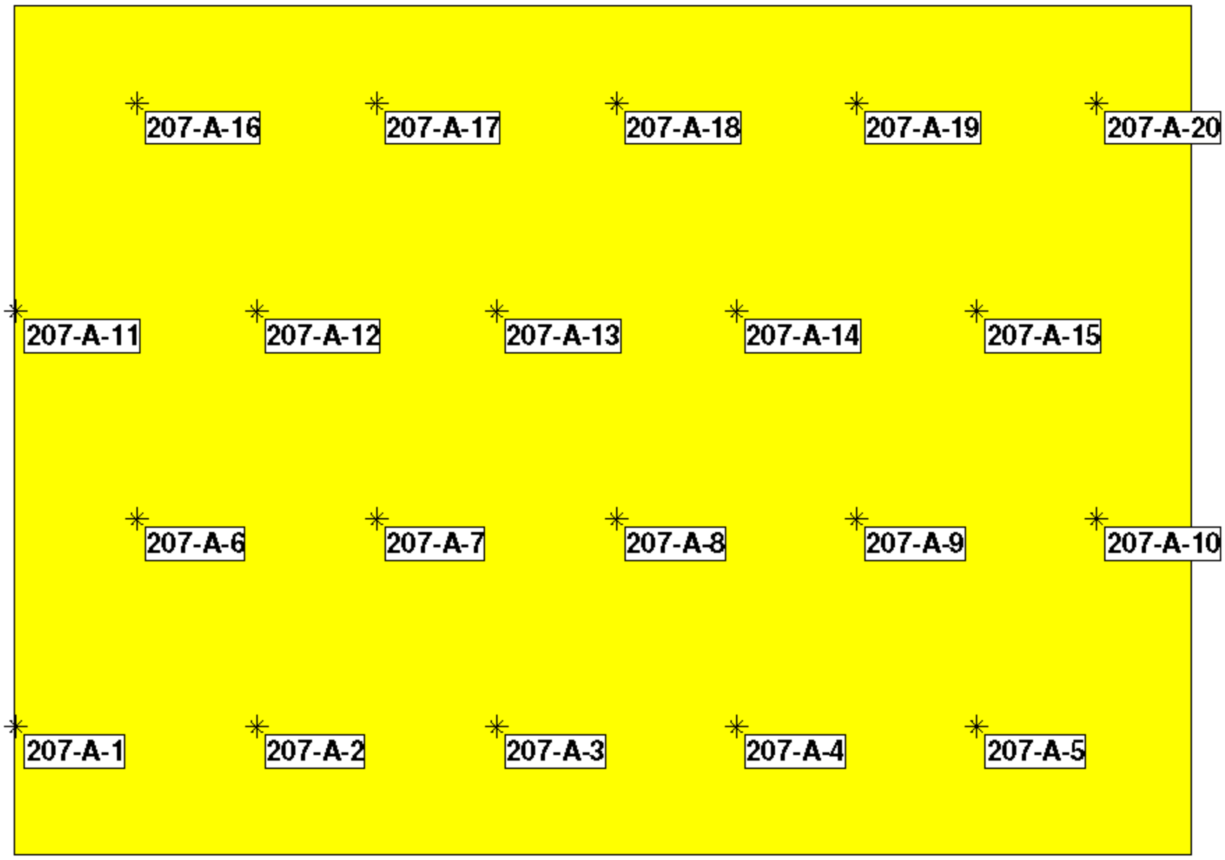


Figure A-1. Sampling Grid

Table A-2. X and Y Coordinates			
Area: 207-A South Retention Basin			
X Coordinate	**Y Coordinate**	**Label**	**Type**
0.2535	15.1433	207-A-1	Systematic
28.8257	15.1433	207-A-2	Systematic
57.3980	15.1433	207-A-3	Systematic
85.9702	15.1433	207-A-4	Systematic
114.5425	15.1433	207-A-5	Systematic
14.5396	39.8876	207-A-6	Systematic
43.1119	39.8876	207-A-7	Systematic
71.6841	39.8876	207-A-8	Systematic
100.2564	39.8876	207-A-9	Systematic
128.8286	39.8876	207-A-10	Systematic
0.2535	64.6318	207-A-11	Systematic
28.8257	64.6318	207-A-12	Systematic
57.3980	64.6318	207-A-13	Systematic
85.9702	64.6318	207-A-14	Systematic

Table A-2. X and Y Coordinates			
Area: 207-A South Retention Basin			
X Coordinate	**Y Coordinate**	**Label**	**Type**
114.5425	64.6318	207-A-15	Systematic
14.5396	89.3761	207-A-16	Systematic
43.1119	89.3761	207-A-17	Systematic
71.6841	89.3761	207-A-18	Systematic
100.2564	89.3761	207-A-19	Systematic
128.8286	89.3761	207-A-20	Systematic

A1.2 Selected Sampling Approach

A nonparametric systematic sampling approach with a random start was used to determine the number of samples and to specify sampling locations. A nonparametric formula was chosen because the conceptual model and historical information (e.g., historical data from this site or a very similar site) indicate that typical parametric assumptions may not be true.

Both parametric and nonparametric equations rely on assumptions about the population. Typically, however, nonparametric equations require fewer assumptions and allow for more uncertainty about the statistical distribution of values at the site. The trade-off is that if the parametric assumptions are valid, the required number of samples is usually less than if a nonparametric equation were used.

Locating the sample points over a systematic grid with a random start ensures spatial coverage of the site. Statistical analyses of systematically collected data are valid if a random start to the grid is used. One disadvantage of systematically collected samples is that spatial variability or patterns may not be discovered if the grid spacing is large relative to the spatial patterns.

A1.3 Number Of Total Samples: Calculation Equation And Inputs

The equation used to calculate the number of samples is based on a sign test (PNNL-13450, *Visual Sample Plan (VSP) Models and Code Verification*). For this site, the null hypothesis is rejected in favor of the alternative one if the median (mean) is sufficiently smaller than the threshold. The number of samples to collect is calculated so that if the inputs to the equation are true, the calculated number of samples will cause the null hypothesis to be rejected.

The following formula is used to calculate the number of samples:

$$n = \frac{(Z_{1-\alpha} + Z_{1-\beta})}{4(SignP - 0.5)^2}$$

where:

$$SignP = \Phi(\frac{\Delta}{S_{total}})$$

Φ (z) = is the cumulative standard normal distribution on (-•,z) (see PNNL-13450 for details)

n = is the number of samples

S_{total} = is the estimated standard deviation of the measured values including analytical error

Δ = is the width of the gray region

α = is the acceptable probability of incorrectly concluding the site median (mean) is less than the threshold β = is the acceptable probability of incorrectly concluding the site median (mean) exceeds the threshold

$Z_{1-\beta}$ = is the value of the standard normal distribution such that the proportion of the distribution less than Z_{1-a} is 1- α

$Z_{1-\beta}$ = is the value of the standard normal distribution such that the proportion of the distribution less than Z_{1-b} is 1- β

Note: MARSSIM suggests that the number of samples should be increased by at least 20 percent to account for missing or unusable data and uncertainty in the calculated value of n. VSP allows a user supplied percent overage as discussed in EPA 402-R-97-016, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, p. 5-33).

The input values that result in the calculated number of sampling locations are provided in Table A-3.

Table A-3. Input Values

Analyte	N[a]	Parameter					
		S	Δ	α	β	$Z_{1-\alpha}$ [b]	$Z_{1-\beta}$ [c]
Analyte 1	20	0.45	0.4	0.05	0.2	1.64485	0.841621

Reference: EPA 402-R-97-016, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*.

a. The final number of samples has been increased by the MARSSIM average of 20%.

b. This value is automatically calculated by VSP based upon the user defined value of a.

c. This value is automatically calculated by VSP based upon the user defined value of b.

VSP = Visual Sample Plan

Figure A-2 is a performance goal diagram, described in EPA/240/B-06/001, *Guidance on Systematic Planning Using the Data Quality Objectives Process* (QA/G-4). It shows the probability of concluding the sample area is dirty on the vertical axis versus a range of possible true median (mean) values for the site on the horizontal axis. This graph contains all of the inputs to the number of samples equation and pictorially represents the calculation.

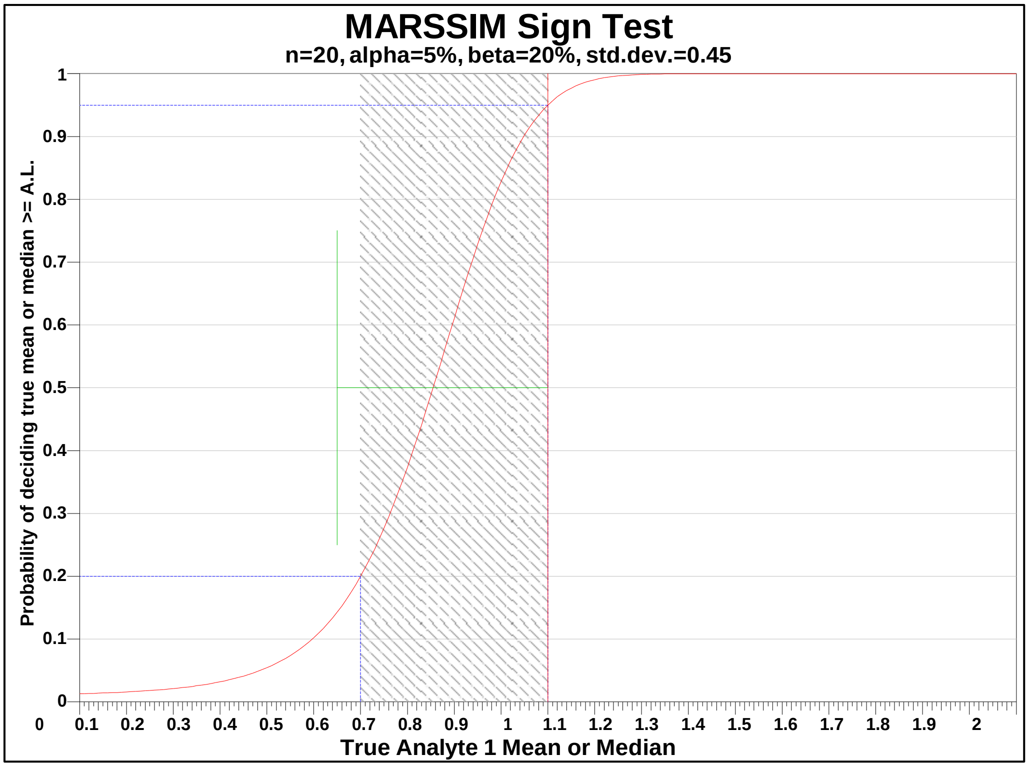
The red vertical line is shown at the threshold (action limit) on the horizontal axis. The width of the gray shaded area is equal to D; the upper horizontal dashed blue line is positioned at 1-a on the vertical axis; the lower horizontal dashed blue line is positioned at b on the vertical axis. The vertical green line is positioned at one standard deviation below the threshold. The shape of the red curve corresponds to the estimates of variability. The calculated number of samples results in the curve that passes through the lower bound of D at b and the upper bound of D at 1-a. If any of the inputs change, the number of samples that result in the correct curve changes.

A1.4 Statistical Assumptions

The following assumptions are associated with the formulas for computing the number of samples:

- Computed sign test statistic is normally distributed.
- Variance estimate (S^2) is reasonable and representative of the population being sampled.
- Population values are not spatially or temporally correlated.
- Sampling locations will be selected probabilistically.

The first three assumptions will be assessed in a post-data collection analysis. The last assumption is valid because the gridded sample locations were selected based on a random start.



Reference: EPA 402-R-97-016, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM).*

Figure A-2. MARSSIM Sign Test

A1.5 Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the standard deviation, lower bound of gray region (percent of action level), beta (percent), probability of mistakenly concluding that m > action level and alpha (percent), probability of mistakenly concluding that m < action level. Table A-4 shows the results of this analysis.

A1.6 Recommended Data Analysis Activities

Post data collection activities generally follow those outlined in EPA/240/B-06/002, *Data Quality Assessment: A Reviewer's Guide* (EPA QA/G-9R). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

Table A-4. Sensitivity Analysis

Action Level (Threshold)=1		Number of Samples					
		a=5		a=10		a=15	
		S=0.9	S=0.45	S=0.9	S=0.45	S=0.9	S=0.45
LBGR=90	b=15	1,103	280	825	209	659	167
	b=20	948	240	692	176	542	138
	b=25	826	209	587	149	449	114
LBGR=80	b=15	280	75	209	56	167	45
	b=20	240	64	176	47	138	36
	b=25	209	56	149	40	114	30
LBGR=70	b=15	128	36	95	27	77	22
	b=20	110	32	81	23	63	18
	b=25	95	27	69	20	52	15

a = alpha (%), probability of mistakenly concluding that m <action level
b = beta (%), probability of mistakenly concluding that m >action level
LBGR = lower bound of gray region (% of action level)
S = standard deviation

Because the primary objective of sampling for this site is to compare the site median (mean) value with a threshold value, data will be assessed in this context. Assuming that the data are adequate, at least one statistical test will be performed to compare the data and threshold of interest. Results of exploratory and quantitative assessments of the data will be reported, along with conclusions that may be supported by them[1].

A2 REFERENCES

EPA/240/B-06/001, 2006, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/QUALITY/qs-docs/g4-final.pdf.

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EPA 402-R-97-016, 2000, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, Rev. 1, U.S. Environmental Protection Agency, U.S. Department of Energy, U.S. Department of Defense, and U.S. Nuclear Regulatory Commission, Washington, D.C. Available at: http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1575/r1/ml003761445-chpt1-5.pdf.

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[1] This report was automatically produced by Visual Sample Plan (VSP) software version 7.2. This design was last modified 4/22/2015 9:36:49 AM. The report contents may have been modified or reformatted by end user of software.