United States Department of Energy

Savannah River Site

Removal Site Evaluation Report / Engineering Evaluation /Cost Analysis (RSER/EE/CA) for the R-Area Operable Unit (RAOU) R-Area Process Sewer Line (RPSL) Combined Subunit (NBN) (U)

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Aiken, South Carolina

EXECUTIVE SUMMARY

The U.S. Department of Energy (USDOE) is proposing to perform a non-time critical removal (NTCR) action at the R-Area Process Sewer Lines (RPSLs) including the associated underground structures. The RPSLs is a subunit of the R-Area Operable Unit (RAOU). In December 1953, R-Reactor began operations. Shutdown of the R-Reactor occurred in 1964 due to reduced requirements for defense-related products. Immediately following the shutdown, the R-Reactor was de-fueled and all fissile materials removed. R-Reactor is now in cold shutdown with no capability of restart. The RAOU is listed as a Resource Conservation and Recovery Act (RCRA) 3004(u) Solid Waste Management Unit/Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) unit in Appendix C of the Federal Facility Agreement (FFA) for the Savannah River Site (SRS). The proposed removal action at the RPSLs is consistent with the overall closure strategy for the RAOU, as discussed with the U.S. Environmental Protection Agency (USEPA) and South Carolina Department of Health and Environmental Control (SCDHEC) in May 2009.

This Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis (RSER/EE/CA) addresses the removal actions associated with the RPSLs listed below:

- R-Area Process Sewer Lines as Abandoned (no building number [NBN])
- Cooling Water Effluent Sump (107-R)
- Purge Water Storage Basin (109-R)

(additional associated underground structures)

- Process Water Storage Tank (106-R)
- Septic Tank (607-1R)
- Outfall at R (904-1G)
- Manholes, catch basins, weirs and other miscellaneous access points

The RPSLs, Cooling Water Effluent Sump (107-R), Purge Water Storage Basin (109-R), Process Water Storage Tank (106-R), Septic Tank (607-1R), Outfall at R (904-1G), manholes, catch

basins, weirs and other miscellaneous access points are herein described as the "RPSLs Combined Subunit."

Problem Statement

The RPSLs consist of approximately 6.4 km (4 mi) of underground lines of various size and configuration throughout R Area. Only certain sections of this piping network that were directly associated with contaminated process water and moderator became radioactively contaminated during the period when the reactor was operating. From radiological surveys and process knowledge, it is known that some degree of contamination remains within certain sections of this buried piping. Radiological contamination (such as cesium-137 (+D) and cobalt-60) may be fixed within the pore spaces of the concrete or trapped in the rust and scale in these lines above principal threat source material (PTSM) thresholds. Any structures outside the Reactor Building (105-R) that came in contact with contaminated process water are also assumed to be contaminated with cobalt-60 and cesium-137 (+D). Review of the piping drawings and extensive field walkdowns have resulted in the identification of the associated underground structures, 35 manholes, catch basins, weirs and other miscellaneous access points that compose the RPSLs Combined Subunit.

Removal Action Scope and Objectives

The scope of the removal action is to remediate the RPSLs to prevent possible exposure of residual contamination inside the RPSLs and prevent the migration of contaminants from residual water in the Process Water Storage Tank (106-R).

The removal action objectives (RAOs) for the RPSLs Combined Subunit are

- Prevent industrial worker exposure to fixed radiation inside the main process sewer, Process Water Storage Tank (106-R), and Cooling Water Effluent Sump (107-R) that exceeds a 1.0E-06 risk for an industrial worker or PTSM levels.

- Prevent the migration of contaminants from residual water in the Process Water Storage Tank (106-R) to groundwater at concentrations exceeding regulatory standards (maximum contaminant levels [MCLs] or preliminary remediation goals [PRGs]).

Alternatives Evaluated

Alternatives that prevented access and prevented the migration of contaminants from residual water in the Process Water Storage Tank (106-R) RPSLs were considered (WSRC2008). The following three alternatives for the RPSLs Combined Subunit are evaluated in detail in this RSER/EE/CA:

- Alternative P-1: No Action
- Alternative P-2: Isolation/Plugging of RPSLs and Drainage System, Grouting of Manholes, Diversion Boxes, and Process Tanks, Select Removal of Process Equipment External to the R-Reactor Building (105-R), Sealing/Plugging of Outfalls, and Institutional Controls
- Alternative P-3 Intruder Barrier, Isolation, Plugging of RPSLs and Drainage System, Grouting of Manholes, Diversion Boxes, and Process Tanks, Select Removal of Process Equipment External to the R-Reactor Building (105-R), Sealing/Plugging of Outfalls, and Institutional Controls.

The table below summarizes the results from the alternative evaluation.

Alternative	Effectiveness	Implementability	Cost	Acceptance
Alternative P-1: No Action;	Low	NA	$ 0	Low
Alternative P-2: Isolation/Plugging of RPSLs and Drainage System, Grouting of Manholes, Diversion Boxes, and Process Tanks, Select Removal of Process Equipment External to the R-Reactor Building (105-R), Sealing/Plugging of Outfalls, and Institutional Controls	Medium	High	$2.69 M	High
Alternative P-3 Same as Alternative P-2 except that an intruder barrier would also be placed over an appropriate width of the R-Area RSLs to ensure limited access to the subsurface at that location.	High	Medium	$6.44 M	High

Preferred Removal Action Alternative

Alternative P-2 [Isolation/Plugging of RPSLs and Drainage System, Grouting of Manholes, Diversion Boxes, and Process Tanks, Select Removal of Process Equipment External to the R-Reactor Building (105-R), Sealing/Plugging of Outfalls, and Institutional Controls] has been identified as the preferred action. This alternative meets the RAOs, will not preclude any additional remediation of the RAOU, and is expected to be consistent with the final remedial actions proposed for the RAOU.

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LIST OF ACRONYMS AND ABBREVIATIONS

ARRA	American Recovery and Reinvestment Act
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
BRA	baseline risk assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cf	cubic feet
CFR	Code of Federal Regulations
cm	centimeter
CM	contaminant migration
CMS	Corrective Measures Study
COC	constituent of concern
Cs	cesium
+D	+D signifies daughter products
D&D	deactivation and decommissioning
DPFR	Decommissioning Project Final Report
EDE	effective dose equivalent
EE/CA	Engineering Evaluation/Cost Analysis
FFA	Federal Facility Agreement
FS	Feasibility Study
ft	feet
ft^3	cubic feet
ha	hectare
HHRA	human health risk assessment
IOU	Integrator Operable Unit
km	kilometer
km^2	square kilometer
lf	linear feet
LLC	Limited Liability Company
LLWF	Low-Level Waste Facility
lt	lot
LTR	Lower Three Runs
LUCIP	Land Use Implementation Plan
µg/L	microgram per liter
m	meter
m^3	cubic meter
MCL	maximum contaminant level
mi	mile
mi^2	square mile
mL	milliliter
mrem	millirem or one one-thousandth of a rem (1,000 mrem = 1 rem)
NBN	no building number
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act

LIST OF ACRONYMS AND ABBREVIATIONS *(Continued/End)*

NTCR	non-time critical removal
O&M	Operations and Maintenance
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
pCi	picocurie
PTSM	principal threat source material
RAOU	R-Area Operable Unit
RAO	removal action objective
RCOC	refined constituent of concern
RCRA	Resource Conservation and Recovery Act
rem	roentgen equivalent man (a unit of radiation dose)
RFI	RCRA Facility Investigation
RI	Remedial Investigation
RPSL	R-Area Process Sewer Line
RSER	Removal Site Evaluation Report
SB\PP	Statement of Basis/Proposed Plan
SCDHEC	South Carolina Department of Health and Environmental Control
SRNS	Savannah River Nuclear Solutions, LLC
SRS	Savannah River Site
TBC	to be considered
USDOE	U.S. Department of Energy
USEPA	U.S. Environmental Protection Agency
UTR	Upper Three Runs
WSRC	Washington Savannah River Company LLC (October 2005-present)
WSRC	Westinghouse Savannah River Company LLC (before October 2005)
yd	yard
yd^3	cubic yard

1.0 INTRODUCTION

The U.S. Department of Energy (USDOE) is proposing to perform a non-time critical removal (NTCR) action at the R-Area Operable Unit (RAOU). This Removal Site Evaluation Report /Engineering Evaluation/Cost Analysis (RSER/EE/CA) identifies the objectives of the removal action for the RAOU R-Area Process Sewer Lines (RPSLs) Combined Subunit, describes alternatives that address the potential threats from release of contaminants to the environment, and provides a vehicle for public comment in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) 300.415. The RPSLs Combined Subunit includes the following subunits, listed in the Federal Facilities Agreement (FFA) (1993), as well as additional associated underground structures:

- R-Area Process Sewer Lines as Abandoned (no building number [NBN])
- Cooling Water Effluent Sump (107-R)
- Purge Water Storage Basin (109-R)

(additional associated underground structures)

- Process Water Storage Tank (106-R)
- Septic Tank (607-1R)
- Outfall at R (904-1G)
- Manholes, catch basins, weirs and other miscellaneous access points

The RPSLs, the associated underground structures, manholes, catch basins, weirs and other miscellaneous access points are herein described as the "RPSLs Combined Subunit."

The Savannah River Site (SRS) encompasses 803 km^2 (310 mi^2) of land adjacent to the Savannah River, principally in Aiken and Barnwell counties of South Carolina. SRS is located approximately 40 km (25 mi) southeast of Augusta, Georgia, and 32 km (20 mi) south of Aiken, SC (Figure 1). SRS is owned by USDOE while Savannah River Nuclear Solutions, LLC (SRNS) provides management and operating services. SRS has historically produced tritium, plutonium, and other special nuclear materials for national defense. Chemical and radioactive wastes are by-products of nuclear material production processes. Hazardous substances, as

defined by Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), are present in the SRS environment.

The public is encouraged to comment on the alternatives presented in this RSER/EE/CA. Following the public comment period, an Action Memorandum will be prepared by USDOE and added to the SRS Administrative Record, which is accessible by the public. All responses to the public comments will be included in an Action Memorandum.

Copies of this RSER/EE/CA and the Administrative Record for SRS are available at the following locations:

U.S. Department of Energy
Public Reading Room
Gregg Graniteville Library
University of South Carolina-Aiken
171 University Parkway
Aiken, South Carolina 29801
(803) 641–3465

Thomas Cooper Library
Government Documents Department
University of South Carolina
Columbia, SC 29208
(803) 777–4866

Hard copies of this RSER/EE/CA are available at the following locations:

Reese Library
Augusta State University
2500 Walton Way
Augusta, GA 30910
(706) 737–1744

Asa H. Gordon Library
Savannah State University
Tompkins Road
Savannah, GA 31404
(912) 356–2183

To submit comments or request a public meeting during the public comment period, contact:

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2.0 SITE CHARACTERIZATION

2.1 R-Area Operable Unit Description and Regulatory Strategy

In December 1953, R-Reactor began operations. Shutdown of the R-Reactor occurred in 1964 due to reduced requirements for defense-related products. Immediately following the shutdown, the R-Reactor was de-fueled and all fissile materials removed. R-Reactor is now in cold shutdown with no capability of restart. The RAOU is listed as a Resource Conservation and Recovery Act (RCRA) 3004(u) Solid Waste Management Unit/CERCLA unit in Appendix C of the FFA (FFA 1993) for the SRS, and it is currently undergoing closure. A RCRA Facility Investigation/Remedial Investigation (RFI/RI) Report with Baseline Risk Assessment (BRA) and Corrective Measures Study/Feasibility Study (CMS/FS) for the RAOU has been approved by the U.S. Environmental Protection Agency (USEPA) and South Carolina Department of Health and Environmental Control (SCDHEC) (WSRC 2008a). This document, referred to herein as the RAOU Combined Document, describes the subunits included as part of the RAOU and the outcome of the RFI/RI/BRA/CMS/FS to determine impact to the environment.

The RAOU is one of the area operable units identified at SRS. The RAOU is located approximately 4.0 km (2.5 mi) northeast of the geographical center of SRS and approximately 7.2 km (4.5 mi) northwest of the nearest site boundary (see Figure 2).The administrative path for each of the RAOU subunits is shown in Figure 3. Four RSER/EE/CAs and a final Statement of Basis/Proposed Plan will be prepared for the RAOU subunits. The RSER/EE/CAs addresses the R-Area Reactor Building Complex, Reactor Disassembly Basin, R-Area Ash Basin and the RAOU RPSL Combined Subunit. During an interactive scoping process in May 2009, representatives from USDOE, USEPA, and SCDHEC agreed that the RPSLs Combined Subunit was identified as an NTCR action. This RSER/EE/CA addresses the actions associated with the RAOU RPSL Combined Subunit.

Subunit Description and Background

The RAOU RPSL Combined Subunit includes R-Area Process Sewer Lines as Abandoned (NBN), the Cooling Water Effluent Sump (107-R), the Purge Water Storage Basin (109-R), the Process Water Storage Tank (106-R), the Septic Tank (607-1R), the Outfall at R (904-1G), manholes, catch basins, weirs and other miscellaneous access points. It also includes portions of the R-Area storm sewer system(Figure 4).

The secondary cooling system was a collection of underground pipelines used to pumped large volumes of cooling water to the heat exchangers to control temperatures of the moderator water circulated from the reactor vessel primary cooling loop. There was also a series of underground process sewer lines that were used to dispose of contaminated waste water from within and around the building. These lines are composed of carbon steel. The reinforced-concrete stormwater collection systems on the south side and north side of the Reactor Building (105-R) are included in the RPSLs. The stormwater collection, a system on the south side, is directly interconnected by process sewer lines from the Disassembly Basin. The reinforced-concrete storm sewer on the north side of the Reactor Building (105-R) is known to be contaminated based on existing data and radiological postings; however, the specific source of the contamination is unknown.

A number of other underground piping systems, some also identified as process lines, supplied clean water to the R-Reactor Building (105-R) and other buildings in R Area not directly associated with the reactor process to include potable water, filtered and de-ionized water, fire protection, sanitary sewer, etc. All these latter systems are assumed to be uncontaminated and are not included in the waste unit. In total, there are approximately 6.4 km (4 mi) of buried piping in R Area. Only certain sections of this piping network that were directly associated with the process water became radioactively contaminated during the period when the reactor was operating. From radiological surveys, limited pipe crawler data, and process knowledge, it is known that some degree of contamination remains within certain sections of this buried piping.

The RPSL as Abandoned (NBN) subunit has been combined with the Process Water Storage Tank (106-R), the Cooling Water Effluent Sump (107-R), the Purge Water Storage Basin (109-R) and the Outfall at R (904-1G) subunits because they are interconnected and have similar process histories. The Septic Tank 607-1R is included because it is tied directly to the main process sewer line. It provides the first access point on the branch connection.

The Process Water Storage Tank (106-R) is a below-ground concrete tank, the bottom of which is 6.1 m below ground surface (bgs) (20 ft bgs) (Figure 5). It is located on the northeast end of the R-Reactor Building (105-R). The primary purpose of the design of the Process Water Storage Tank (106-R) was to contain the highly contaminated water that would be released during a loss of primary coolant accident however, such an incident never occurred. It was never used for this purpose. During normal reactor operations the Process Water Storage Tank (106-R) served other operational purposes that were associated with the various sumps such as the collection of rainwater infiltration.

The Cooling Water Effluent Sump (107-R) is a large in-ground concrete structure that extends to a depth of approximately 9.15 m (30 ft). This subunit also consists of the ground immediately surrounding the sump and the soils, which was investigated to determine potential past releases from the underground pipeline (Figure 6). The piping connects to the structure at varying depths to approximately 6.7 m (22 ft) bgs. The top of the structure is at ground level and resembles a concrete slab. The Cooling Water Effluent Sump (107-R) is connected to both the R-Reactor Building (105-R) and the Effluent Canal (Discharge Canal) by underground pipelines.

The Purge Water Storage Basin (109-R) received purged out-of-spec deionized water from the 105-R Reactor Vessel Shield system (Figure 7). It is essentially a concrete container that is predominantly below grade. The gross estimated volume is 33 m^3 (1,165 ft^3). The basin is designed with a series of baffles to slow the flow to the process sewer, allowing particles of short-lived radionuclides to settle and time to decay. Use of the basin was ceased, along with operation of the R Reactor, in 1964. The residual water and sludge were removed from the basin and filled with grout during deactivation and decommissioning (D&D) activities.

The Septic Tank (607-1R) received sanitary sewage from R Area. Based on process knowledge and P-Area data, no radiological contamination is associated with the sanitary sewer system (Figure 8). The Septic Tank (607-1R) is included because it is directly tied to a process sewer line and provides access to the contaminated RPSLs.

The outfall at R (904-1G) is located at the northern corner of the reactor area at the head of the Effluent Canal that flows northward to Pond A, Joyce Branch and then to PAR Pond (Figure 9). Radiologically contaminated water was discharged from the contaminated storm sewer line, the main process line from the Reactor Building (105-R), and the process line from Cooling Water Effluent Sump (107-R) to the Effluent Canal.

2.2 Previous Action

The Facility Decommissioning Evaluation identified in situ decommissioning, using the Integrated Sampling Models, for the Purge Water Storage Basin (109-R). USEPA concurrence for this decommissioning was received on June 5, 2006, and SCDHEC approval was received on July 14, 2006. The structure is essentially concrete and is predominantly below grade. Residual water and sludge was removed from the basin during D&D activities. A Decommissioning Project Final Report (DPFR) was submitted on August 9, 2006 (WSRC 2006).

2.3 Land Use

The RAOU RPSL Combined Subunit is in an area currently designated for industrial use. No current or projected future development of RAOU is planned. Future industrial land use will be controlled in accordance with the *Land Use Control Assurance Plan for the Savannah River Site* (WSRC 1999). An industrial land use scenario was selected as the BRA exposure scenario for the protection of human health and the environment (USDOE 1996). R-Reactor has been declared an excess facility by the USDOE Defense Programs Office.

2.4 Environmental Setting

In general, the SRS region has a temperate climate with relatively short, mild winters and long, hot, humid summers. Rainfall at the site tends to be evenly distributed throughout the year. The RAOU Work Plan (WSRC 2006a) summarizes climate conditions specific to R Area. Additional details concerning the weather patterns and climate conditions at SRS can be found in the "Site Characteristics" chapter of the *Generic Safety Analysis Report for SRS* (WSRC 1995).

SRS is situated on the Atlantic Coastal Plain, a wedge of unconsolidated and semi-consolidated sediments that thickens toward the southeast. The investigations into regional and SRS geology are summarized in the *Hydrogeologic Framework of West-Central South Carolina* (Aadland et al. 1995) and other reports (Fallaw and Price 1995; Price et al. 1988; Stieve and Stephenson 1995).

The RAOU is located predominantly in the Lower Three Runs (LTR) watershed. Although the northwestern portion of the RAOU is located in the Upper Three Runs (UTR) watershed, the RPSLs discharge points all drain to the LTR (Figure 10). Detailed descriptions of the floral and faunal species, biotic diversity, and hydrology of these watersheds are included in the UTR Integrator Operable Unit (IOU) Work Plan (WSRC 2003) and the LTR IOU Work Plan (WSRC 2002).

The soils in the immediate vicinity of R Area are classified as Udorthent (USDA 1990). Udorthent is a generic term that indicates that the natural soil weathering horizon has been disturbed or removed, usually by construction activity or erosion. Soil may be classified as Udorthent when either the top soil or disturbed soil is used for fill during grading for parking lots or to create level areas. Additional information can be found in the LTR IOU Work Plan (WSRC 2002), which summarizes the pedological assemblages and the distribution of various soil types specific to R Area.

The RAOU is predominantly an industrialized area and does not provide significant habitat to support ecological receptors for the majority of the subunits, including the R-Area RPSL

Combined Subunit. An ecological checklist for the RAOU was provided in the Work Plan (WSRC 2006a).

2.5 Nature and Extent of Contamination

Limited characterization data exists on the residual contamination levels present in most portions of the abandoned RPSLs Combined Subunit. Due to accessibility difficulties, the sewer lines investigated were predominantly the concrete storm sewers and a few steel process lines from purification. Because the main process sewer is constructed of carbon steel with welded joints, access is limited to two manholes located at the south side of the Reactor Building (105-R) and two inlet drains. The majority of the storm sewers lines exhibited internal radiation levels typical of the levels found in naturally occurring concrete. The one sample obtained from the main process sewer line exhibited elevated contamination levels. Sampling results from the residual water found in various sumps and drains associated with the process and storm sewer systems indicated that contamination levels for most constituents are not elevated over maximum contaminant levels (MCLs). In the contaminated storm sewers and in portions of the main process sewer fed by the inlet manholes, the natural flow of surface and rainwater has removed transferable contamination during the 40 years that have elapsed since the reactor ceased operations. Any residual contamination that remains is likely fixed in the surface of the pipe material (i.e., within the pores of the concrete or trapped within the rust and scale on the interior surface of the carbon steel lines). Subsurface soil and groundwater were sampled around and below the RPSLs Combined Subunit, and no contamination was determined as a result of a potential release from the RPSLs Combined Subunit. The RAOU Work Plan characterization (WSRC 2008b) focused on the soil surrounding the RPSLs, particularly near manholes, junction boxes, and process sewer line tie-ins, to determine if radionuclides and metals were present within the native soils (Figure 11 and 12).

The RPSLs Combined Subunit includes the RPSLs as Abandoned (NBN), the Process Water Storage Tank (106-R), the Cooling Water Effluent Sump (107-R), the Purge Water Storage Basin (109-R)), the Septic Tank (607-1R), the Outfall at R (904-1G), manholes, catch basins, weirs and other miscellaneous access points. Analyses for RPSLs Combined Subunit for the

RPSLs as Abandoned (NBN), the Process Water Storage Tank (106-R), the Cooling Water Effluent Sump (107-R), and the Purge Water Storage Basin (109-R) were performed and are contained in Appendix A of the RAOU Combined Document (WSRC 2008a).

The surface and subsurface soil samples collected around the RPSLs Combined Subunit had several naturally occurring radionuclides and inorganic constituents that have maximum concentrations exceeding two-times the SRS average soil background values; however, these constituents are still within the range of SRS maximum background soil values.

Tritium groundwater contamination was observed in the RPSLs Combined Subunit samples, but it is attributed to other sources rather than to the RPSLs Combined Subunit based on groundwater flow paths and tritium contaminant patterns. Elevated metal and radiological results from RPSLs Combined Subunit groundwater samples are attributed to high turbidity in the samples and naturally occurring elements in the sediments.

The soil and groundwater samples collected outside the Process Water Storage Tank (106-R) did not indicate any contamination/leaks from the Process Water Storage Tank (106-R). The shallow groundwater samples were below the detection limit for trichloroethylene, but the deeper groundwater samples were above the MCL (5 µg/L) for TCE, indicating an upgradient source instead of the Process Water Storage Tank (106-R). There is approximately 219 m^3 (7,740 ft^3) of water inside the Process Water Storage Tank (106-R), and approximately a 2.5-cm (1-in) layer of sediment/sludge on the bottom of the tank. A water sample from inside the Process Water Storage Tank (106-R) had a tritium concentration of 15,700 pCi/mL, which exceeds the MCL (20 pCi/mL). No other radionuclides, organic, or inorganic compounds exceeded MCLs. Analytical results from the sediment in the 106-R do not pose a risk to the groundwater based on the Tier 1 Contaminant Migration (CM) analysis and groundwater samples (WSRC 2008a).

None of the soil or groundwater samples indicated any contamination/leaks from the Cooling Water Effluent Sump (107-R). There is approximately 87.7 m^3 (3,097 ft^3) of water in the Cooling Water Effluent Sump (107-R), and no sediment/sludge on the bottom. The water sample collected from inside the Cooling Water Effluent Sump (107-R) did not exceed

groundwater regulatory limits (MCLs or preliminary remedial goals [PRGs]) for any contaminant. The Cooling Water Effluent Sump (107-R) is still in use and receives stormwater runoff as well as water from periodic dewatering of rainwater and/or groundwater, which has leakeded into the R-Reactor Building (105-R).

The Purge Water Storage Basin (109-R) soil and groundwater samples did not indicate radiological, inorganic, or organic contamination in the soil or groundwater outside the basin. Contaminants detected in surface soil surrounding the Purge Water Storage Basin (109-R) will be addressed within the scope of the Area on the North Side of 105-R Combined Subunit, which is part of the R-Reactor Disassembly Basin subunit. The D&D DPFR for the Purge Water Storage Basin (109-R) results indicate that the Purge Water Storage Basin (109-R) has principal threat source material (PTSM) levels of cobalt-60 in the concrete inside the basin as fixed contamination (WSRC 2006). It is highly probable that the RPSLs as Abandoned (NBN), which are connected to the Purge Water Storage Basin (109-R), will contain similar levels of contamination.

Human Health Risk Assessment

A quantitative human health risk assessment (HHRA) was not conducted, and no human health refined constituents of concern (RCOCs) were identified because the potential for human exposure at the ground surface is negligible, and any potential releases to the environment would have occurred at depth and not from surficial releases (i.e., incomplete exposure pathway).

Ecological Risk Assessment

A quantitative Ecological Risk Assessment was not conducted, and no ecological RCOCs were identified because the industrial setting does not provide suitable habitat for ecological receptors and the potential for wildlife exposure is negligible since any potential releases to the environment would have occurred at below grade and not from surface releases (i.e., incomplete exposure pathway).

Contaminant Migration

To determine if the RPSLs would impact the groundwater, a CM evaluation was performed using the maximum soil concentrations collected near the RPSLs. The Tier 1 CM Screen for the RPSLs Combined Subunit (RPSLs, 106-R, 107-R, and 109-R), presented in Appendix D-1 of the RAOU Combined Document, indicates that two analytes qualify as CM constituents of concern (COCs): arsenic and thallium. Both of these constituents are present in subunit soils at concentrations that are predicted to result in future groundwater contamination at a level exceeding their MCLs, with travel time to groundwater less than 1,000 years. However, the subunit concentrations of arsenic and thallium are comparable to SRS background levels for upland soils; therefore they were not retained as refined CM COCs.

Principal Threat Source Material Evaluation

Based on the quantitative PTSM evaluation provided in the RAOU Combined Document, no constituents have been identified as PTSM for the RPSLs Combined Subunit (RPSLs, 106-R, 107-R, and 109-R). This conclusion is based on an evaluation of the soils surrounding each of these subunits. However, characterization data exist on the residual contamination levels present in some portions of this subunit, in addition to process history, that indicate the residual contamination exceeds PTSM threshold levels fixed on the inside surfaces of the RPSLs (i.e., within the matrix material of the RPSLs) or trapped within the rust and scale on the surface of steel. Therefore, radionuclides are generically identified as PTSM RCOCs based on the qualitative evaluation presented in Appendix E of the Combined Document (WSRC 2008).

Conclusion

As an outcome of the RAOU characterization no analytes qualified as CM COCs; therefore, it was concluded that residual contaminants in native soils surrounding the RPSLs will not impact groundwater. Since some of these samples were collected from the location of a known pipe break, it is further assumed that residual cesium-137 (+D) and cobalt-60 in the pipes will not impact groundwater.

Based on process knowledge and data obtained during limited investigations conducted at C- and R-Reactor, there is a potential for cesium-137 (+D) and cobalt-60 to be present at PTSM levels (risk > 1.0E-3) fixed within the pipeline walls. A quantitative PTSM evaluation was performed on the RPSLs Combined Subunit because the RPSLs are assumed to contain PTSM based on 109-R fixed contamination data. In a Core Team meeting in May 2008, representatives from USDOE, USEPA and SCDHEC agreed that there is a potential for PTSM to be present within matrix material (pore spaces of the concrete or trapped in the rust and scale) of the lines. Therefore, there is a potential for receptor exposure from the RPSLs if the lines are accessed or if they are mechanically breached and brought to the surface.

Conceptual Site Model

For the RPSLs, there is an incomplete exposure pathway to the human receptor at the ground surface. In the conceptual site model, the surficial exposure pathway is considered incomplete (i.e., no exposure) since the potential for contaminant release is greater than 0.3 m (1 ft) bgs. No constituents have been identified as CM COCs or PTSM for the soil media that surround the RPSLs. However, access through the associated underground structures, manholes, weirs and other miscellaneous access points is possible, and the pipelines could potentially be excavated, exposing workers. The conceptual site model for the RPSLs subunit is shown in Figure 13.

The process sewer line investigations conducted at both C and R Areas indicate there is a potential for cesium-137 (+D) and cobalt-60 to be present at PTSM levels inside of the piping associated with the RPSLs. Therefore, the RPSLs will be managed as if they are known to contain PTSM.

3.0 Removal Action Scope and Objectives

The RPSLs consist of approximately 6.4 km (4 mi) of underground lines of various sizes and configuration throughout R Area. Only certain sections of this piping network that were directly associated with the process water became radioactively contaminated during the period when the reactor was operating. Review of the piping drawings and extensive field walkdowns have resulted in the identification of 35 manholes, miscellaneous and various underground structures

that are associated with the RPSLs. These structures outside the Reactor Building (105-R) that came in contact with the process water are assumed to be contaminated with cobalt-60 and cesium-137 (+D). Structures that fit this category include the Cooling Water Effluent Sump (107-R), the Purge Water Storage Basin (109-R), the Process Water Storage Tank (106-R), the Septic Tank (607-1R), the Outfall at R (904-1G), manholes, catch basins, weirs and other miscellaneous access points. The gross estimated volumes of the underground structures [Cooling Water Effluent Sump (107-R), the Process Water Storage Tank (106-R), the Septic Tank (607-1R)] are 676 m^3 [23,868 ft^3], 341 m^3 (12,042 ft^3) and 91 m^3 (3,213 ft^3)] respectively. The manholes, catch basins, weirs and other miscellaneous access points combined are estimated to be a total volume of 275 m^3 (9,693 ft^3).

The removal actions evaluated in this RSER/EE/CA eliminate access to the internal portions of the RPSLs Combined Subunit, which reduces receptor access to the RPSLs and the mobility of contaminants within the pipes but neither eliminates nor reduces the toxicity or volume of the contaminants. Radioactive contaminants are assumed to be present at PTSM levels, and this remedy would leave those substances in place. No sampling and analysis plan is associated with this action.

3.1 Justification for the Proposed Removal Action

USDOE, as lead agency, is mandated to take action to reduce the adverse effects of manmade contamination on human health and the environment. The NCP states that if the lead agency determines a release or potential release poses a threat to public health or welfare or the environment, the lead agency may take any appropriate removal action to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or threat of release. This determination should be based on the factors identified in 40 CFR Section 300.415(b)(2).

The RPSLs Combined Subunit (Figure 4) is a candidate for removal action because it is assumed to be contaminated with cesium-137 (+D) and cobalt-60 at levels representing PTSM. The elevated levels of radionuclides meet the criteria in 40 CFR Section 300.415(b)(2)*(iv)* needed to

mandate action. Radioactive contaminants are assumed to be present at PTSM levels in the RPSLs Combined Subunit, and these levels might pose a potential threat to human health.

3.2 Removal Action Objectives

The scope of the removal action is to remediate the RPSLs to prevent possible exposure of residual contamination inside the RPSLs and prevent the migration of contaminants from residual water in the Process Water Storage Tank (106-R).

The RAOs for the RPSLs Combined Subunit are

- Prevent industrial worker exposure to fixed radiological contamination inside the main process sewer, Process Water Storage Tank (106-R), and Cooling Water Effluent Sump (107-R) that exceeds a 1.0E-06 risk for an industrial worker or PTSM levels.

- Prevent the migration of contaminants from residual water in the Process Water Storage Tank (106-R) to groundwater at concentrations exceeding regulatory standards (MCLS or PRGs).

It is anticipated that the preferred land use for the RAOU will be industrial use. This remedy would leave radioactive contaminants in place that pose a potential future risk and will require land use restrictions for an indefinite period of time. Given the close proximity of the RPSLs Combined Subunit to the R-Reactor Building (105-R), a removal action goal based on industrial use is warranted. The residual risk of exposure to contaminated RPSLs Combined Subunit will be left in place and will be minimized by including the RPSLs Combined Subunit in the area that will be managed by institutional controls for the entire RAOU.

4.0 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES

In accordance with CERCLA, the following removal alternatives for the RPSLs Combined Subunit removal action were evaluated. Each of these alternatives was identified in the RAOU Combined Document (WSRC 2008a).

4.1 Alternative P-1: No Action

The No Action alternative is required by the NCP to serve as a baseline for comparison with other remediation alternatives. Under this alternative, no efforts would be made to control access, limit exposure, or reduce contaminant toxicity, mobility, or volume at the RPSLs subunit. Institutional controls and removal actions would not be implemented. This alternative is not effective in achieving the RAOs for the RPSLs Combined Subunit. The No Action alternative requires no construction and implementability is not a consideration. This alternative would leave the RPSLs subunit in its current condition with no additional controls.

4.2 Alternative P-2: Isolation Plugging of RPSLs and Drainage System, Grouting of Manholes, Diversion Boxes, and Process Tanks, Select Removal of Process Equipment External to the R-Reactor Building (105-R), Sealing/Plugging of Outfalls, and Institutional Controls.

This alternative entails the isolation/plugging of every process line that discharged contaminated process sewer water to the RPSLs from the Reactor Building (105-R). In addition, all accessible openings, including basins, manholes, weirs and outfall openings to the RPSLs outside the building, will be grouted, including 35 manholes, catch basins, weirs and other miscellaneous access points. Any residual water in the structures will be removed. The associated underground structures will be filled with concrete/grout to an elevation above all pipe openings and then brought to grade using structural fill, grout and/or concrete, as appropriate. The gross volumes of the underground structures [Cooling Water Effluent Sump (107-R), the Process Water Storage Tank (106-R), the Septic Tank (607-1R)], are 676 m^3 (23,868 ft^3), 341 m^3 (12,042 ft^3) and 91 m^3 (3,213 ft^3). The manholes, catch basins, weirs and other miscellaneous access points combined are estimated to be a total volume of 275 m^3 (9,693 ft^3). After being filled to the appropriate grade, a concrete slab will be poured over the remaining openings or the entire structure as appropriate. Any equipment (e.g., above grade vent piping, railings, miscellaneous pumps, etc.) external to the Reactor Building (105-R) associated with the RPSLs or the associated underground structures would be removed and appropriately dispositioned. All open lines at the outfalls would also be sealed and/or plugged. This alternative includes institutional controls to control access and protect the industrial worker during construction.

Alternative P-2 is consistent with remediation activities that will be conducted within the RAOU as a part of the R-Area closure. This alternative is specific for the RPSLs subunit and is not a final remedy for the entire RAOU; it is a remedy for this subunit only.

4.3 Alternative P-3: Intruder Barrier, Isolation, Plugging of RPSLs and Drainage System, Grouting of Manholes, Diversion Boxes, and Process Tanks, Select Removal of Process Equipment External to the R-Reactor Building (105-R), Sealing/Plugging of Outfalls, and Institutional Controls

This alternative is similar to Alternative P-2 except that an intruder barrier would also be placed over an appropriate width of the RPSLs subunit to ensure limited access to the subsurface along the pipelines. An intruder barrier would consist of a 15.24-cm (6-in) thick concrete barrier and would extend approximately 3.04 m (10 ft) on either side of the process sewer line. The extent of the barrier is shown in Figure 14, and results in approximately 2.1 ha (5.3 acres) of concrete coverage and additional grading. This alternative includes institutional controls to control access and protect the industrial worker during construction.

Alternative P-3 is consistent with the remediation activities that will be conducted within the RAOU as a part of the R-Area closure. This alternative is specific for the RPSLs subunit and is not a final remedy for the entire RAOU; it is a remedy for this subunit only.

5.0 ANALYSIS AND COMPARISON OF REMOVAL ACTION ALTERNATIVES

Three alternatives are presented in this RSER/EE/CA for evaluation. The No Action Alternative, Alternative P-1, must be evaluated as a baseline according to the NCP. In addition, Alternatives P-2 and P-3 will be evaluated in detail.

Guidance on conducting NTCR actions under CERCLA recommends that each alternative be reviewed against three broad criteria—effectiveness, implementability, and cost.

Regulatory acceptance and community acceptance are usually not known until after the comment periods. However, during the alternative analysis, a judgment as to acceptance may be included based on previous regulatory decisions or on public comment to other related documents. The

final impact of these modifying criteria can be assessed only after the comment period and after subsequent responses are developed.

5.1 Effectiveness

For an alternative to be effective, it must achieve specified objectives, must be compatible with the contaminant characteristics and unit conditions, and must be protective of human health and the environment in the long term. The alternative must also be effective in reducing short-term (during construction and implementation) risk to human health and the environment. In addition, each alternative should be effective in decreasing the inherent threats or risks associated with hazardous substances or media by reducing their toxicity, mobility, or volume through treatment. Permanence of the action is also considered. Alternatives that do not provide adequate protection of human health and the environment, or that do so to a much lesser extent than a comparable alternative, are screened out and not considered during the detailed analysis.

5.1.1 Alternative P-1: No Action

The Alternative P-1, No Action, does not meet the effectiveness criteria because the RAOs would not be met. Short-term effectiveness is not applicable for Alternative P-1 because it does not involve any construction-related activities that could endanger public communities or remedial workers or adversely affect the environment. This alternative does not contribute to a reduction of toxicity, mobility, or volume through treatment. The "No Action" Alternative would not reduce risks to human health or the environment. This alternative provides no long-term effectiveness and permanence.

5.1.2 Alternative P-2: Isolation/Plugging of RPSLs and Drainage System, Grouting of Manholes, Diversion Boxes, and Process Tanks, Select Removal of Process Equipment External to the R-Reactor Building (105-R), Sealing/Plugging of Outfalls, and Institutional Controls.

Alternative P-2 meets the effectiveness criteria. This alternative eliminates access to the internal portions of the RPSLs subunit, which reduces receptor access to the RPSLs and mobility of contaminants within the pipes, but neither eliminates nor reduces the toxicity or volume of the

contaminants. This alternative poses no significant risk to the community or on-unit workers. The greatest risk will be experienced by the remedial workers who are required to seal off the associated underground structures, manholes, weirs and other miscellaneous access points. This alternative, once completed and properly executed with institutional controls, will meet the RAOs. This alternative protects human health by preventing access to the pipelines and inlets to the structures, thereby eliminating the possible access and/or release of fixed contamination from within the pipelines to humans. Contamination within the pipelines would be sealed and would not be available for exposure unless the lines are mechanically breached. This alternative relies on institutional controls to prevent excavation of the RPSLs subunit.

Dewatering of the Process Water Storage Tank (106-R) will prevent contaminants present in the residual water in the tank from migrating to the groundwater. Eliminating access of the RPSLs and associated structures protects the future industrial worker from unacceptable exposure and prevents the spread of contamination. This alternative will comply with all applicable or relevant and appropriate requirements (ARARs) and is effective both long term and permanent. The removal action will be performed consistent with SRS safety and health procedures to ensure minimal impact to the remediation worker during implementation.

5.1.3 Alternative P-3: Intruder Barrier, Isolation, Plugging of RPSLs and Drainage System, Grouting of Manholes, Diversion Boxes, and Process Tanks, Select Removal of Process Equipment External to the R-Reactor Building (105-R), Sealing/Plugging of Outfalls, and Institutional Controls.

Alternative P-3 meets the effectiveness criteria as described for Alternative P-2 with additional protectiveness afforded by the intruder barrier. The intruder barrier would restrict access to the RPSLs by preventing mechanical breaching of the RPSLs, minimizing the risk of exposure to the inside of the pipes. Contamination with the pipelines would remain in the subsurface line as long as the lines are not mechanically breached.

Dewatering of the Process Water Storage Tank (106-R) will prevent the migration of contaminants to groundwater from the Process Water Storage Tank (106-R). Eliminating access to the RPSLs and associated structures protects the future industrial worker from unacceptable

exposure and prevents the spread of contamination. This alternative will comply with all ARARs and is effective both long term and permanent. The removal action will be performed consistent with SRS safety and health procedures to ensure minimal impact to the remediation worker during implementation.

5.2 Identification of ARARs

In accordance with the NCP [40 CFR 300.415(j)] and USDOE guidance, onsite removal actions conducted under CERCLA are required to meet ARARs "to the extent practicable, considering the exigencies of the situation." ARARs include only Federal and state environmental or facility citing laws or regulations; they do not include occupational safety or worker radiation protection requirements. Additionally, per 40 CFR 300.405(g)(3), other advisories, criteria, or guidance may be considered in determining remedies, the so-called "to-be-considered" (TBC) category.

Under Section 121 of CERCLA, any material remaining on site must reach a level or standard of control equal to that of any other applicable or relevant and appropriate standard or requirement promulgated under any Federal or more stringent state environmental statute. The term "promulgated" means that the requirement generally is applicable and legally enforceable. The ARAR concept is pertinent only to onsite actions; offsite actions must comply with all applicable Federal and state requirements. A requirement under other environmental laws may be either "applicable" or "relevant and appropriate," but not both. The first step in identifying ARARs is to determine if a requirement is applicable.

ARARs are identified for the RPSLs Combined Subunit NTCR action in Appendix A. This RSER/EE/CA does not propose to waive any ARARs. As previously stated, the final disposition of the entire RAOU will be addressed as part of the RAOU completion activities that are identified in the FFA (FFA 1993), a legally binding and enforceable tri-party agreement between USDOE and the two regulatory agencies (USEPA and SCDHEC).

Appendix A provides a summary of potential ARARs for the RPSLs Combined Subunit of the RAOU. The No Action Alternative would not achieve the ARARs. Under Alternatives P-2 and P-3, all ARARs would be achieved.

Consideration of National Environmental Policy Act Values

This RSER/EE/CA conforms to USDOE policy (i.e., DOE Order 451.1B, "National Environmental Policy Act Compliance Program") to incorporate National Environmental Policy Act (NEPA) values in USDOE CERCLA documents. The RAOU Combined Document has been developed and approved by USEPA and SCDHEC. NEPA values (e.g., the analysis of cumulative, off-site, ecological, and socioeconomic impacts of the proposed action) have been adequately addressed in the RAOU Combined Document. An HHRA has been performed as prescribed by USEPA risk assessment guidance and SRS protocols. CERCLA risk assessments and the associated remedial cleanup goals are protective of hypothetical future workers at the site, and thus are necessarily protective of offsite receptors. Any potential environmental releases resulting from implementation of the preferred alternative would be minimal and limited to the vicinity of the RPSLs Combined Subunit. Impacts beyond the SRS boundary would be negligible, ensuring that there are no environmental justice concerns associated with the proposed removal action.

As one of many cleanup actions being undertaken as part of the American Reinvestment and Recovery Act (ARRA) mission at SRS, implementation of either Alternative P-2 or P-3 would create a barrier between radioactive/hazardous contaminants and human or ecological receptors. Therefore, both Alternatives P-2 and P-3, which involve isolation/plugging of Reactor Building (105-R) RPSLs, would contribute cumulatively to reducing risk to site workers and the public. Additionally, the expenditure of funds for the proposed closure action for the RPSLs Combined Subunit, as a part of the ARRA mission at SRS, would contribute cumulatively to an overall positive economic impact within the site's region of influence. It would also represent progress toward the completion of the 515 waste units and 15 areas where environmental restoration work is required under the FFA at SRS.

Two structures in the scope of the RPSLs subunit closure, the Cooling Water Effluent Sump (107-R) and the Purge Water Storage Basin (109-R), are listed as historically significant as documented in SRS's *Cold War Built Environmental Cultural Resource Management Plan* (USDOE 2005). All actions required by the Cold War Historic Preservation Program have been

completed for the Cooling Water Effluent Sump (107-R) (SRNS 2009) and the Purge Water Storage Basin (109-R) (WSRC 2005). Implementation of the proposed removal action would have a negligible impact on SRS archaeological, cultural, or historical resources.

In summary, the cumulative impacts associated with the proposed removal action would be so small that their potential contribution to an overall cumulative effect on- or offsite would be negligible.

5.3 Implementability

Implementability of each alternative was assessed against the criteria below:

- Technical feasibility with regard to available techniques and demonstrated methods for accomplishing the proposed alternative;
- Administrative feasibility with regard to operations personnel and other resources to complete the alternative's implementation, including the availability of specific equipment and technical specialists;
- Regulatory acceptance of the preferred alternative; and
- Community acceptance of the preferred alternative. USDOE-Savannah River will provide for a public comment period, and comments concerning the proposed remedy will be incorporated into the comment responses and included with the Action Memorandum.

5.3.1 Alternative P-1: No Action

The No Action alternative is the current condition and, therefore, would not require any additional resources to implement. USEPA, SCDHEC and community acceptance of this alternative is unlikely because an exposure pathway to the contaminated RPSLs Combined Subunit would remain and contaminants at concentrations exceeding regulatory standards could migrate from the Process Water Storage Tank (106-R) to groundwater.

5.3.2 Alternative P-2: Isolation/Plugging of RPSLs and Drainage System, Grouting of Manholes, Diversion Boxes, and Process Tanks, Select Removal of Process Equipment External to the R-Reactor Building (105-R), Sealing/Plugging of Outfalls, and Institutional Controls.

This alternative could be implemented without major technical or administrative concerns. Personnel are readily available, and technologies for RPSLs Combined Subunit are well defined. Alternative P-2 would require approximately 13 months for completion. Community and regulator acceptance of this alternative is likely because the exposure pathway to the contaminated RPSLs Combined Subunit would be eliminated.

Should any radiological waste be generated by the removal action, it will be disposed of at the SRS E-Area Low-Level Waste Facility (LLWF). Any uncontaminated waste material generated will be disposed of at the solid waste landfill, which is located on USDOE property. Construction activities will comply with regulations to prevent sediment discharges to surface water and runoff. Measures will be taken to prevent the spread of contamination during construction activities. An air permit may be required to implement this activity if the use of generators is required.

5.3.3 Alternative P-3: Intruder Barrier, Isolation, Plugging of RPSLs and Drainage System, Grouting of Manholes, Diversion Boxes, and Process Tanks, Select Removal of Process Equipment External to the R-Reactor Building (105-R), Sealing/Plugging of Outfalls, and Institutional Controls.

This alternative could be implemented without major technical or administrative concerns. Personnel are readily available and technologies for the Alternative P-3 removal action are well defined but would require a significant amount of grading. Alternative P-3 would require approximately 18 months for completion. Community and regulator acceptance of this alternative is likely because the exposure pathway to the contaminated RPSLs Combined Subunit would be eliminated.

Should any radiological waste be generated by the removal action, it will be disposed of at the SRS E-Area LLWF. Any uncontaminated waste material generated will be disposed of at the

solid waste landfill, which is located on USDOE property. Construction activities will comply with regulations to prevent sediment discharges to surface water and runoff. Excavation of materials uses standard construction earth-moving equipment readily available at SRS. An air permit may be required to implement this activity if the use of generators is required.

5.4 Cost

Cost evaluations take into consideration capital costs and Operations and Maintenance (O&M) costs. These estimates are based on prior estimates, previous experience, and engineering judgment. Detailed cost estimates for Alternatives P-1, P-2, and P-3 are provided in Appendix A. A summary of the estimated costs for the three alternatives is presented in Section 5.5.

5.4.1 Alternative P-1: No Action

There are no present-worth costs estimated for Alternative P-1, No Action.

Estimated Total Cost $0

5.4.2 Alternative P-2: Isolation/Plugging of RPSLs and Drainage System, Grouting of Manholes, Diversion Boxes, and Process Tanks, Select Removal of Process Equipment External to the R-Reactor Building (105-R), Sealing/Plugging of Outfalls, and Institutional Controls

Construction costs for Alternative P-2 include isolation/plugging of Reactor Building (105-R) RPSLs, grouting of the associated underground structures, manholes/catch basins, weirs and other miscellaneous access points, select removal of process equipment (e.g., abovegrade vent piping, railings, miscellaneous pumps, etc.) external to the Reactor Building (105-R), sealing/plugging of outfalls, and institutional controls. O&M costs associated with this alternative include institutional controls to control access and protect the industrial worker during construction.

Estimated Present Worth Total Cost $2.69M

5.4.3 Alternative P-3: Intruder Barrier, Isolation, Plugging of RPSLs and Drainage System, Grouting of Manholes, Diversion Boxes, and Process Tanks, Select Removal of Process Equipment External to the R-Reactor Building (105-R), Sealing/Plugging of Outfalls, and Institutional Controls

Construction costs for Alternative P-3 are the same as for Alternative P-2 except that an intruder barrier would also be placed over an appropriate width of the RPSLs to ensure limited access to the subsurface at that location. O&M costs associated with this alternative include institutional controls to control access and protect the industrial worker during construction.

Estimated Present Worth Total Cost $6.44M

The costs shown for Alternatives P-2 and P-3 were revised from those costs shown in the RAOU Combined Document (WSRC 2008a). These changes are the result of the addition of the Septic Tank (607-1R), the refined unit price cost for grouting the Cooling Water Effluent Sump (107-R) Process Water Storage Tank (106-R) and Septic Tank (607-1R), and the refinement of the estimated quantities for the intruder barrier.

5.5 Comparison of Removal Action Alternatives

A detailed comparative analysis and ranking of the RPSLs subunit alternatives are provided in Appendix B. A summary of the comparative analysis is shown below:

Alternative	Effectiveness	Implementability	Cost	Acceptance
Alternative P-1: No Action	Low	NA	$ 0	Low
Alternative P-2: Isolation/Plugging of RPSLs and Drainage System, Grouting of Manholes, Diversion Boxes, and Process Tanks, Select Removal of Process Equipment External to the R-Reactor Building (105-R), Sealing/Plugging of Outfalls, and Institutional Controls	Medium	High	$2.69 M	High
Alternative P-3: Same as Alternative P-2 except that an intruder barrier would also be placed over an appropriate width of the RPSLs to ensure limited access to the subsurface at that location	High	Medium	$6.44 M	High

6.0 PREFERRED REMOVAL ACTION ALTERNATIVE

The preferred removal action for the RPSLs subunit is Alternative P-2: Isolation/Plugging of R-Reactor Building (105-R) RPSLs, Grouting of the associated Underground Structures, Manholes, weirs and other miscellaneous access points, Select Removal of Process Equipment (e.g., abovegrade vent piping, miscellaneous pumps, etc.) External to the R-Reactor Building (105-R), Sealing/Plugging of Outfalls, and Institutional Controls. This remedy meets the RAOs, providing the necessary effectiveness at significantly lower cost than Alternative P-3. The remedy is effective in the long term due to the isolation of potential PTSM from human exposure that it will provide. Remediation of this subunit by utilization of an NTCR action is an effective strategy for cost-effectively reducing obvious risks and accelerating area closure by initiating early actions while meeting necessary ARARs.

The waste streams generated as part of the selected alternative will be transported to the appropriate disposal facilities. The contaminated waste anticipated to be generated includes job control waste, personal protective equipment, and miscellaneous items. Radioactive contaminated waste will be characterized in accordance with USDOE requirements for disposal and will be sent to the SRS E-Area LLWF where CERCLA Off-Site Rules are approved. Prior to the transfer of these wastes to their final disposal facility, SRS will obtain an acceptability determination from the appropriate Regional Off-site Rule Coordinator for disposal of CERCLA waste.

This alternative will not preclude any additional remediation of the RAOU and is consistent with the current and future land use. Institutional controls to control access and protect the industrial worker will be in place during construction. Long-term land use controls, including institutional controls, will be addressed in the final action RAOU Land Use Control Implementation Plan (LUCIP). The approved LUCIP will establish implementation, monitoring, maintenance, reporting, and enforcement requirements for the unit.

Based on information currently available, the lead agency believes the Preferred Alternative provides the best balance of tradeoffs among the other alternatives with respect to the evaluation

criteria. USDOE expects the Preferred Alternative to satisfy the statutory requirements in CERCLA Section 121(b) to (1) be protective of human health and the environment, (2) comply with ARARs, (3) be cost-effective, (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable, and (5) satisfy the preference for treatment as a principal element to the extent practicable.

6.1 Preferred Alternative Implementation

The basin, tanks, sumps, and boxes will be dewatered. Any contaminated water will be managed at an SRS treatment facility (e.g., Effluent Treatment Facility). This work will be performed by SRNS per the project waste management plan.

Every process line that discharged contaminated process water to the RPSLs Combined Subunit from the Reactor Building (105-R) must be isolated and plugged.

All access points to the RPSLs Combined Subunit outside of Reactor Building (105-R) will be grouted, including all manholes, weirs and other miscellaneous access points.

Any process equipment (e.g., abovegrade vent piping, railings, miscellaneous pumps, covers, etc.) external to Reactor Building (105-R) that is associated with the RPSLs Combined Subunit will be removed and placed within an RPSLs Combined Subunit associated underground structure during the grouting process or transported to an approved facility.

All outfalls of the RPSLs Combined Subunit will be sealed/plugged.

For the Process Water Storage Tank (106-R) with an existing concrete cover the tank will be filled with grout up to the bottom of the existing cover. After it has cured, concrete will be poured in any remaining openings.

Cooling Water Effluent Sump (107-R), the structure will be filled with concrete/grout to an elevation above all pipe openings and then brought to grade using structural fill, grout and/or concrete. After being filled to the appropriate grade, concrete will be poured over the openings in the top of the structure.

7.0 IMPLEMENTATION SCHEDULE

This RSER/EE/CA will be submitted to USEPA and SCDHEC for review and comment. The RSER/EE/CA will be available for public comment following this review. The removal action schedule is presented below:

Submit Revision 0 RSER/EE/CA for Regulatory Comment	November 25, 2009
Submit Revision 1 RSER/EE/CA to Regulators	January 27, 2010
Submit Draft Action Memorandum for Regulatory Comment	February 7, 2010
Issue RSER/EE/CA for Public Comment	February 24, 2010
Submit Action Memorandum to Regulators	March 25, 2010
Anticipated removal action start of RSER/EE/CA activity	July 2010
Anticipated completion of RSER/EE/CA activity	August 2010
Anticipated closeout letter issued	September 2010

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9.0 GLOSSARY

Applicable or Relevant and Appropriate Requirement (ARAR): The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) require compliance with any promulgated standard requirements, criteria, or limitation under Federal and more stringent State environmental laws. Examples include the Clean Water Act, Endangered Species Act, etc.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA): A Federal law, known as Superfund passed in 1980, and reauthorized by the Superfund Amendments and Reauthorization Act (SARA) in 1986. The law authorizes the Federal government to respond directly to releases of hazardous substances that may endanger public health or the environment.

Core Team –Project Managers from EPA, SCDHEC, and DOE that are responsible for all decisions concerning the OU. The team meets on a as need basis from initial planning to the final approval of the decision document(s).

Curie (Ci): A unit of radioactivity that represents the amount of radioactivity associated with one gram of radium. To say that a sample of radioactive material exhibits one curie of radioactivity means that the element is disintegrating at the rate of 37 billion times per second.

Deactivation: The process of placing a facility in a stable and known condition including the removal of hazardous and radioactive materials to ensure adequate protection of the worker, public health and safety, and the environment, thereby limiting the long-term cost of surveillance and maintenance. Actions include the removal of fuel, draining and/or de-energizing nonessential systems, removal of stored radioactive and hazardous materials, and related actions. Deactivation does not include all decontamination necessary for the dismantlement and demolition phase of decommissioning, e.g., removal of contamination remaining in the fixed structures and equipment after deactivation.

Decommissioning: Decommissioning is inclusive of activities that take place after a facility has been deactivated and placed in an ongoing surveillance and maintenance program. Decommissioning can include decontamination and dismantlement. Decontamination encompasses the removal or reduction of radioactive or hazardous contamination from facilities. Dismantlement involves the disassembly or demolition, and removal, of any structure, system, or component and the interim or long-term disposal of waste materials in compliance with applicable requirements.

Executive Order 12580: An order entitled "Superfund Implementation" signed on January 23, 1987 by the President of the United States. This document delegates authority and responsibility to implement certain provisions of CERCLA to a number Federal departments (including the USDOE) and agencies.

Federal Facility Agreement (FFA): The legally binding agreement between regulatory agencies (USEPA and SCDHEC) and regulated entities (USDOE) that sets the standards and schedules for the comprehensive remediation of the SRS.

Low-Level Waste (LLW): Low-level radioactive waste is defined as any radioactive waste that does not belong in one of the following three categories for radioactive waste: high-level waste (spent nuclear fuel or the highly radioactive waste produced if spent fuel is reprocessed), uranium milling residues, and waste with greater than specified quantities of elements heavier than uranium. Low-level radioactive waste is generated at commercial facilities such as nuclear power plants, hospitals, and research institutions. It includes radioactive materials used in various processes as well as supplies and equipment that have been contaminated with radioactive materials.

Low-Level Waste Disposal Site: Low-level waste disposal occurs at facilities licensed by the Nuclear Regulatory Commission (NRC). The facilities must be designed, constructed, and operated to meet safety standards. The operator of the facility must also extensively characterize the site on which the facility is located and analyze how the facility will perform for thousands of years into the future.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP): The federal government's blueprint for responding to both oil spills and hazardous substance releases. The NCP is the result of our country's efforts to develop a national response capability and promote overall coordination among the hierarchy of responders and contingency plans.

Non-Time Critical Removal (NTCR) Action: This is a type of response action recognized by the USEPA as appropriate for addressing hazardous substance threats where a planning horizon of six months or more

is appropriate. Under an USEPA/USDOE agreement, USDOE uses a non-time critical removal action approach tailored for decommissioning USDOE facilities. That approach is comprised of: a threat assessment; identification, analysis, and documentation of decommissioning alternatives; opportunities for public participation in the decommissioning decision; and planning and performance of decommissioning activities.

Operations and Maintenance (O&M): These activities are conducted through-out the facility life cycle phase including when a facility is not operating and is not expected to operate again and continues until phased out during decommissioning. Activities include providing in a cost effective manner periodic inspections/surveillance and maintenance of structures, systems and equipment necessary for the satisfactory containment of contamination and protection of workers, the public and the environment.

Picocurie (pCi): One one-trillionth (1/1,000,000,000,000) of a curie.

Principal Threat Source Material (PTSM) – Source material(s) whose cumulative risk exceeds the toxicity threshold criteria for carcinogens (greater than 1E-03 industrial worker) or noncarcinogens (industrial worker hazard index [HI]) greater than 10). These source materials include containerized liquid wastes (e.g. drums) or non-aqueous phase liquids (NAPL) (e.g., perched dense NAPLs in the vadose zone), and highly toxic solid wastes such as polycyclic chlorinated biphenyl transformers or lead batteries.

Removal Action: When USDOE identifies a threat of exposure to, or migration of, hazardous substances that poses a risk to health, welfare, or the environment, USDOE is authorized by CERCLA to exercise removal action authority to implement an appropriate response to the risks posed. Activities that may be taken under CERCLA removal action authority include any activity that reduces risks or potential risks in a relatively short time frame and can be identified as appropriate with a relatively limited analysis of alternatives. Removal actions are not limited to immediate action, or action in response to an emergency. (See non-time critical removal action.

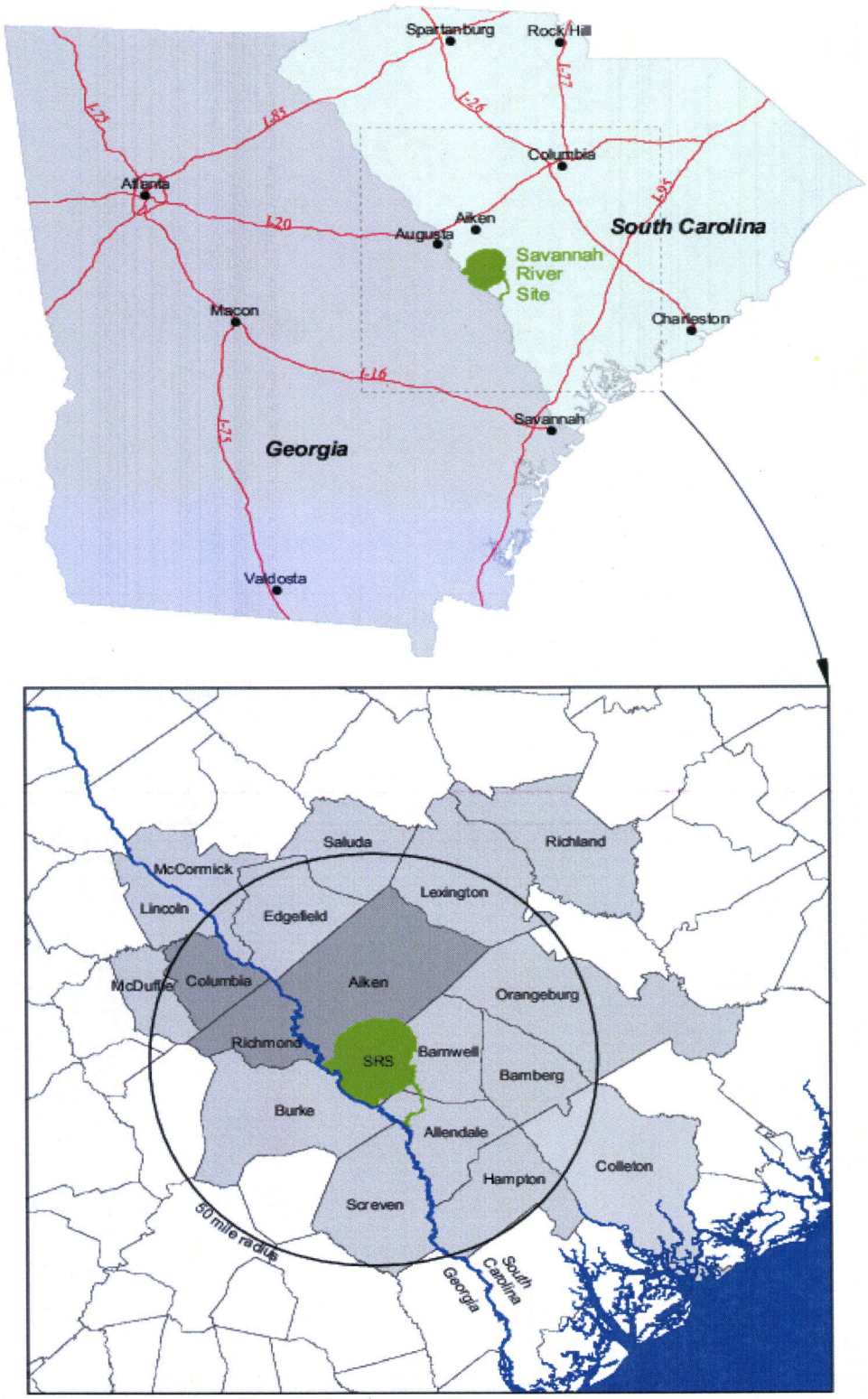

Figure 1. Geographic Proximity of the Savannah River Site

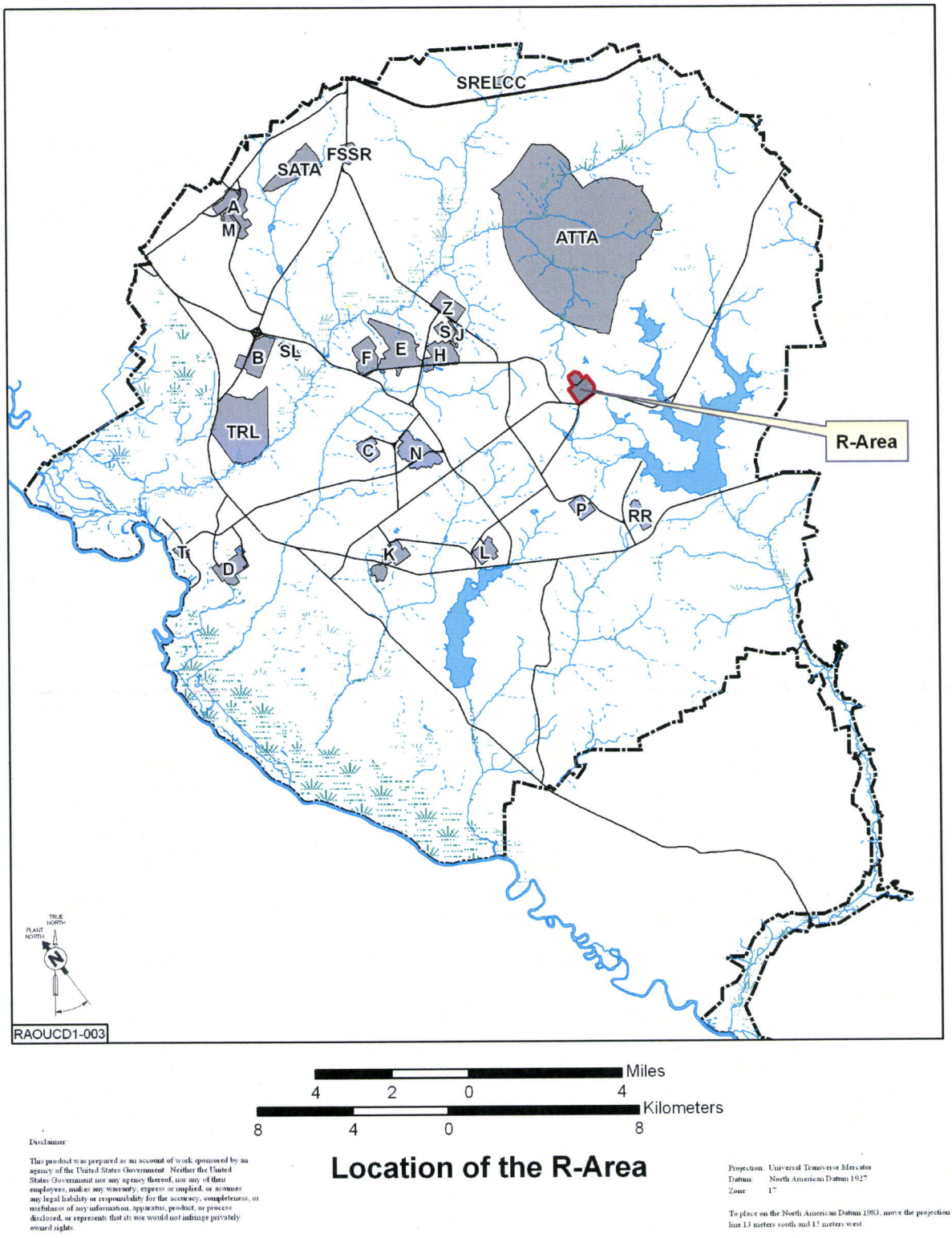

Figure 2. Relative Location of RAOU at the Savannah River Site

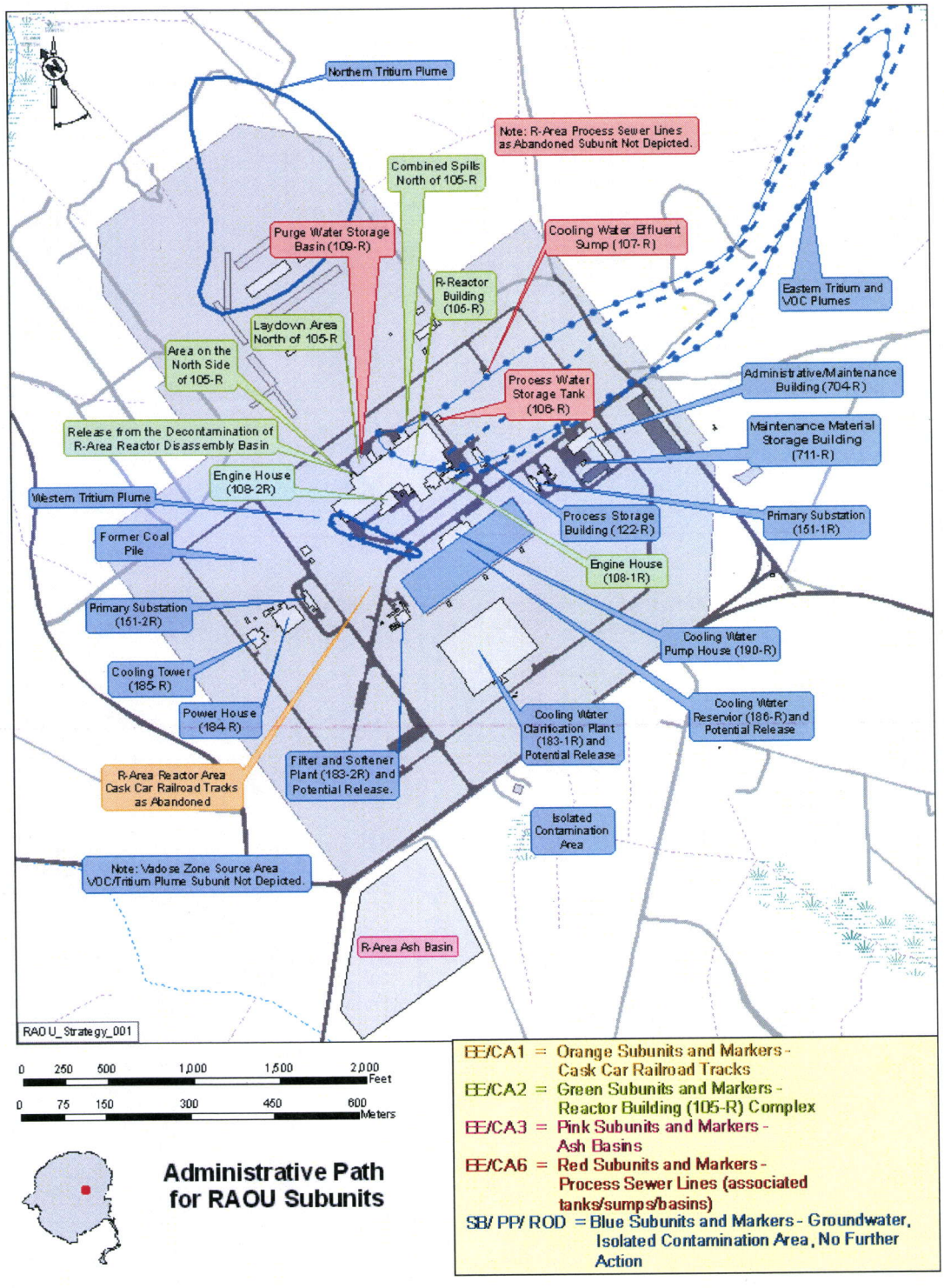

Figure 3. Administrative Path for the RAOU

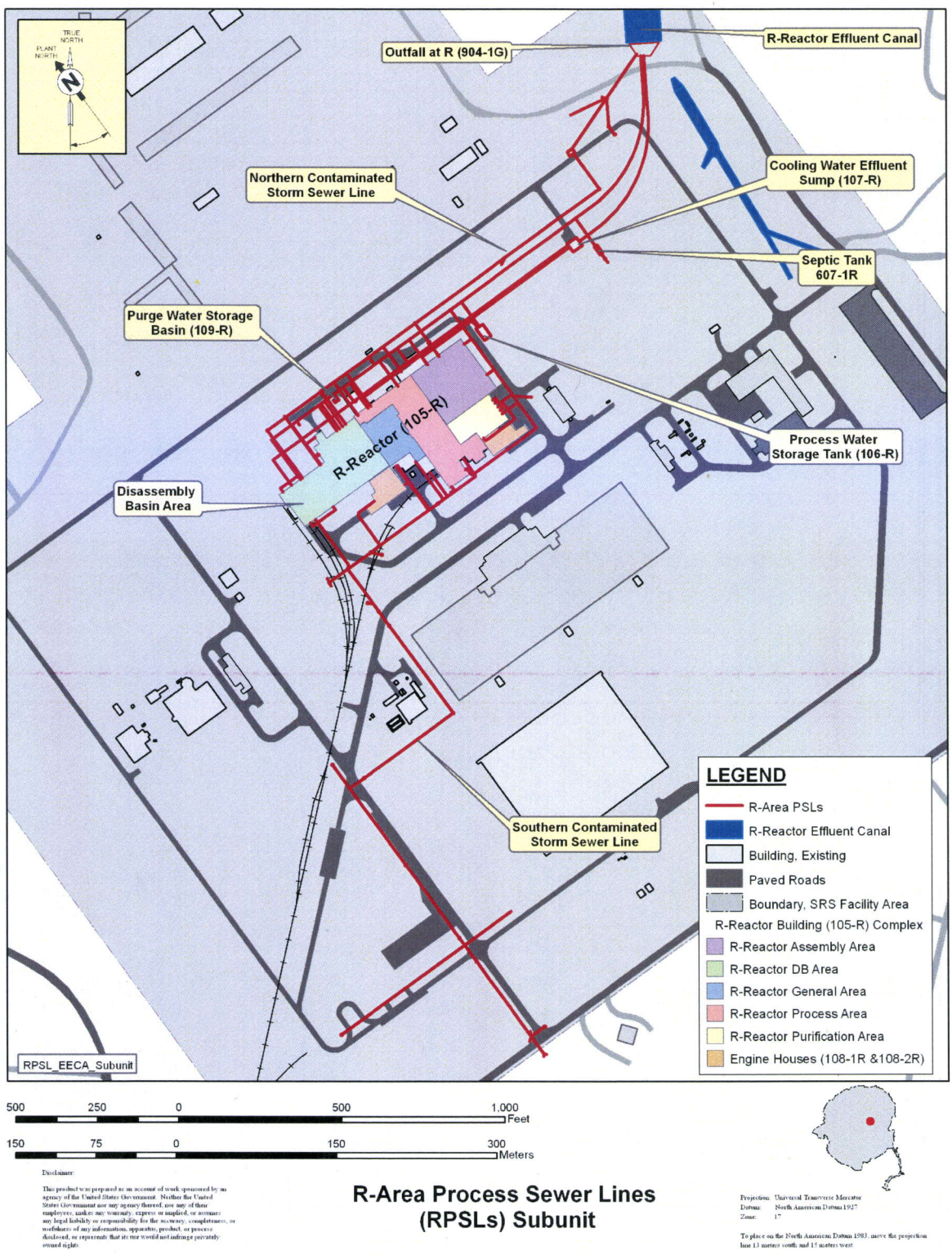

Figure 4. Location of the R-Area Process Sewer Combined Subunit

Figure 5. Process Water Storage Tank (106-R)

Figure 6. Cooling Water Effluent Sump (107-R)

Figure 7. Purge Water Storage Basin (109-R)

Figure 8. Access Manhole to Septic Tank (607-1R)

Figure 9. Outfall at R (904-1G)

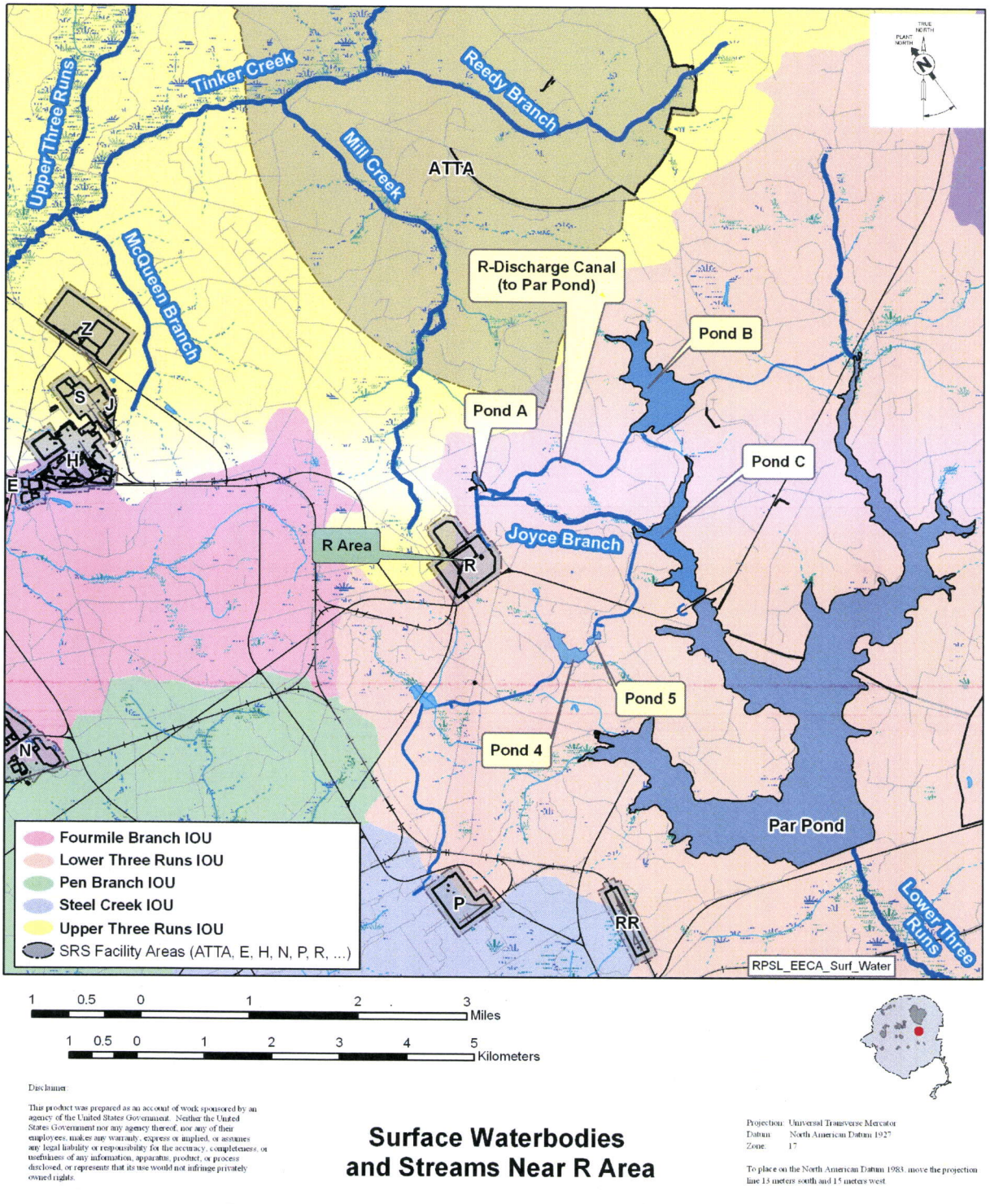

Figure 10. Surface Waterbodies and Streams Near R Area

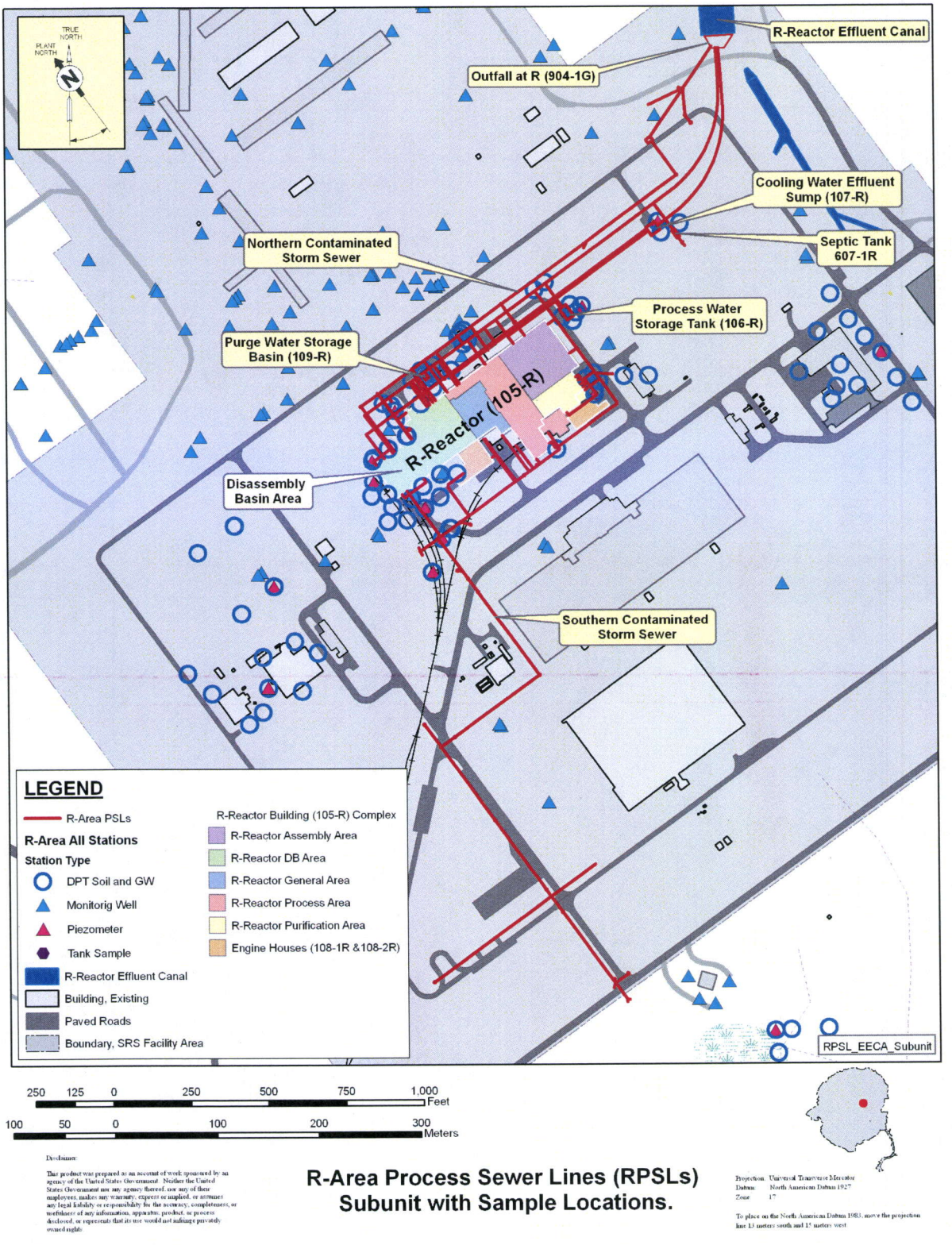

Figure 11. RPSL Sampling locations

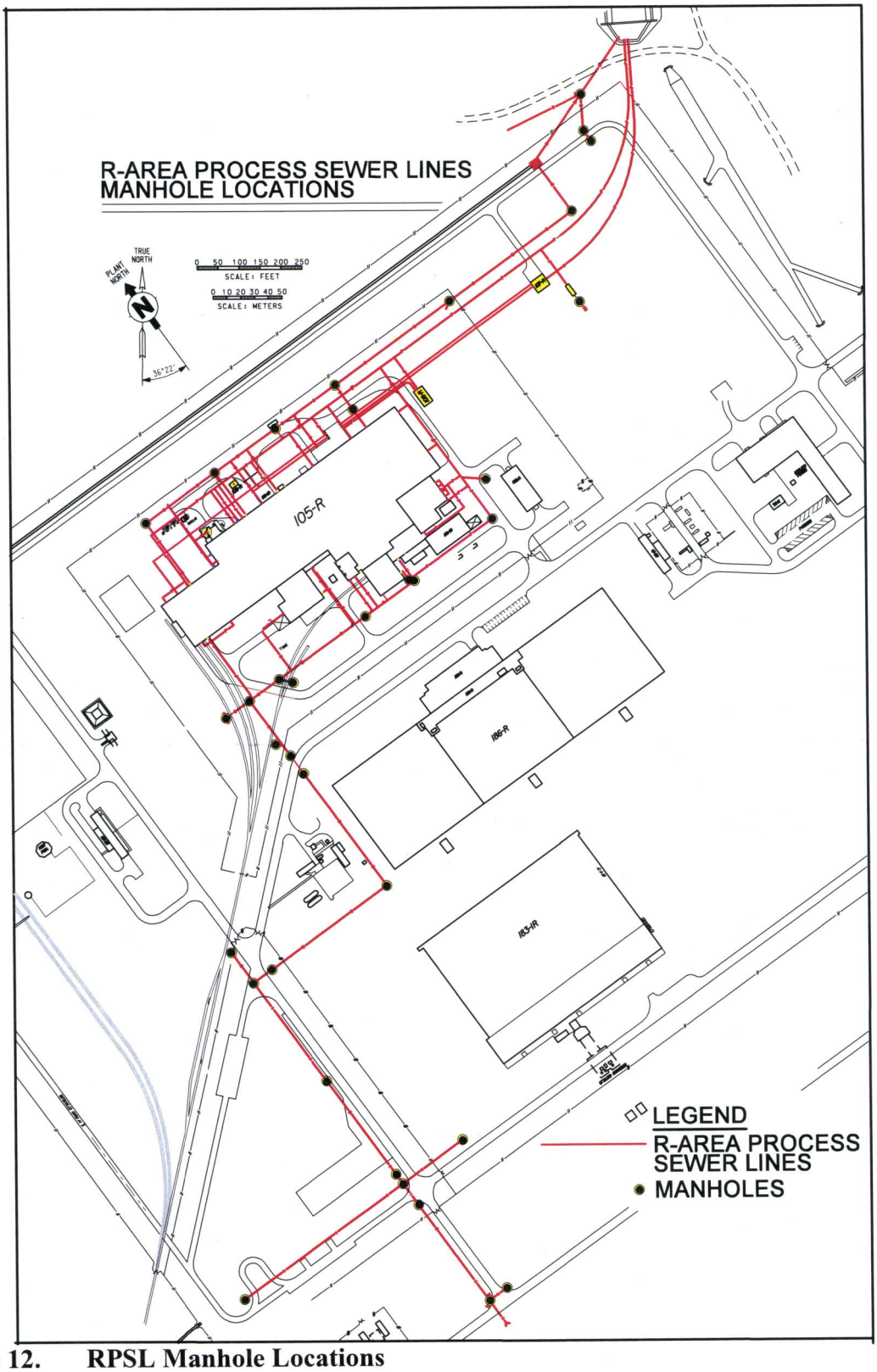

Figure 12. RPSL Manhole Locations

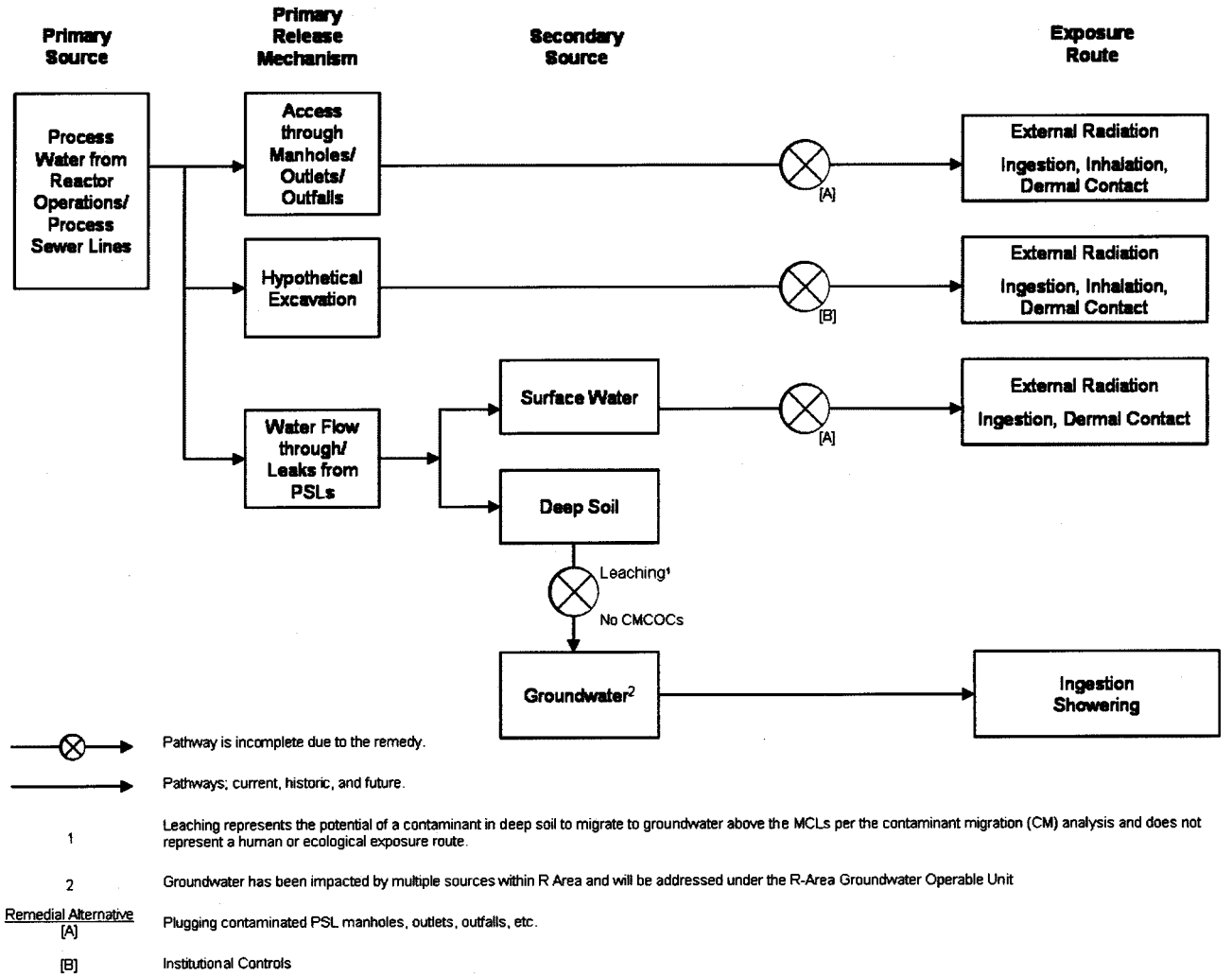

Figure 13. Conceptual Site Model of RPSLs Combined Subunit

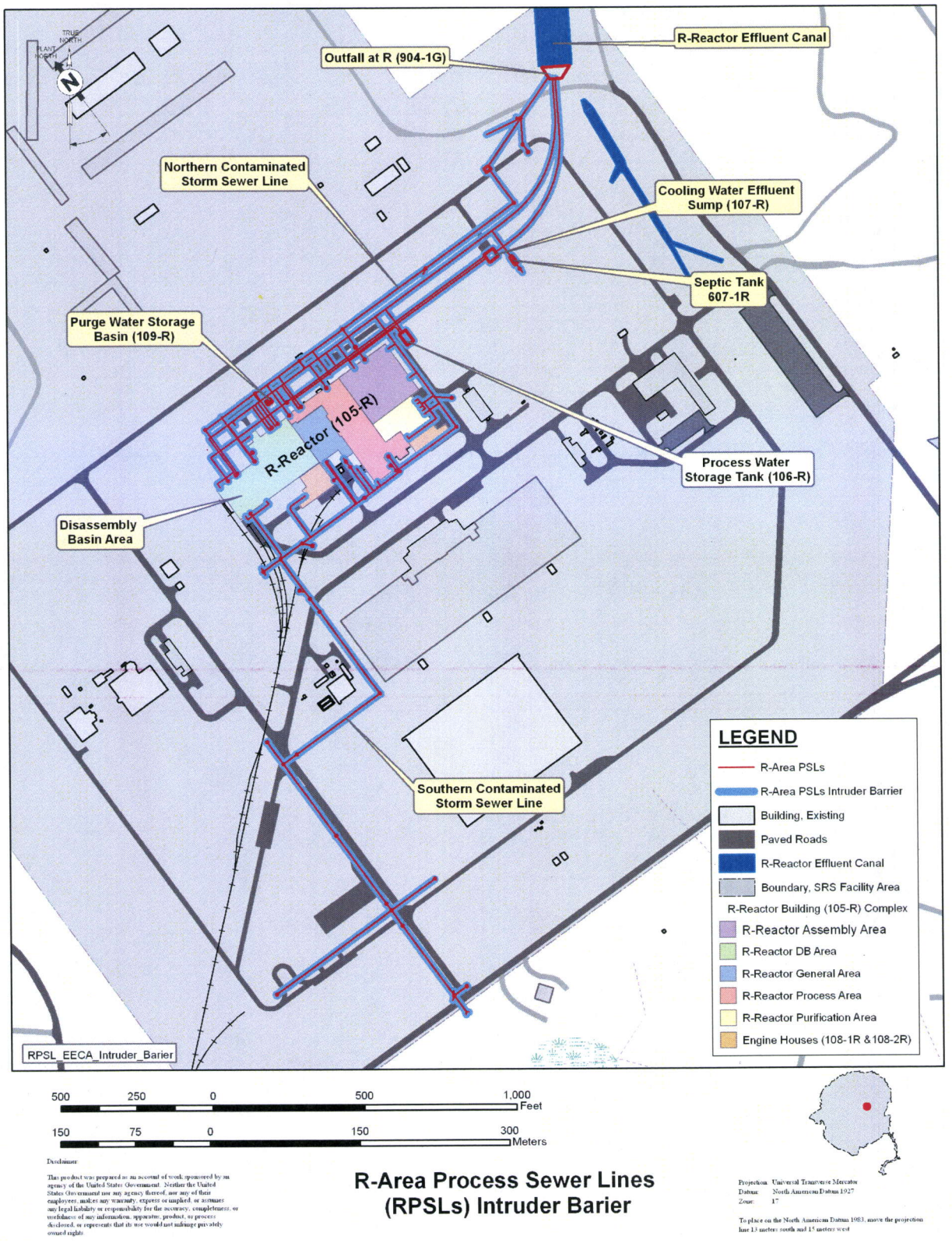

Figure 14. RPSLs Combined Subunit Intruder Barriers

APPENDIX A.

Potential ARARs and TBC Criteria for R-Area Process Sewer Line (RPSL) Combined Subunit (NBN)

Citation(s)	Status	Requirement Summary	Reason for Inclusion
Chemical Specific			
National Primary Drinking Water Regulations 40 CFR 141 SC R. 61-58 State Primary Drinking Water Regulations SC R. 61-68 Water Classification and Standards	Applicable	Establishes requirements and standards for chemicals and radionuclides to protect human health from the potential effects of drinking-water contamination. ***Establishes the State's official classified water uses for all waters of the State, establishes general rules and specific numeric and narrative criteria for protecting classified and existing water uses, and establishes procedures for classifying waters of the State.***	***The state of South Carolina classifies all groundwater and tributaries to the Savannah River as potential sources of drinking water, and mandates that potential drinking water sources must meet maximum contaminant levels. Any discharges of water to surface water must meet applicable surface water standards.***
Radiation Protection of the Public and the Environment DOE Order 5400.5	To Be Considered	Establishes standards and requirements for operations of the USDOE and USDOE contractors with respect to protection of members of the public and the environment against undue risk from radiation.	It is known that some degree of contamination remains within certain sections of the RPSLs. Establishes exposure limits to members of the public and the environment from DOE activities.
DOE Order 435.1	To Be Considered	Ensures that all USDOE radioactive waste is managed in a manner that protects the worker, public safety, and the environment.	Pumping of water, removal on misc. process equipment associated with the RPSLs Combined Subunit could generate radioactive waste that may have to be managed at a location other than R Area. Active SRS radioactive disposal facilities are authorized under this DOE Order.
The National Pollutant Discharge Elimination System SC R.61-9	Applicable	Requirements for permits and control of stormwater/wastewater discharges.	Any stormwater/wastewater discharges from demolition and remedial activities must meet permit conditions and standards established by state.

Citation(s)	Status	Requirement Summary	Reason for Inclusion
Chemical Specific			
USEPA OSWER Directive 9200.4-18 Establishment of Cleanup Levels for CERCLA sites with Radioactive Contamination	To Be Considered	Cleanups of radioactive contamination outside the risk range (in general, exceeding 15 mrem/yr Effective Dose Equivalent (EDE) which equates to approx. 3 x 10-4 increased lifetime risk) are not protective.	Radiological contamination (such as cesium-137 (+D) and cobalt-60) may be fixed within the pore spaces of the concrete or trapped in the rust and scale in these lines above principal threat source material (PTSM) thresholds. This action will eliminate exposure pathways. EPA policy establishing protective range for radionuclide cleanups at CERCLA sites. Mandates use of CERCLA risk range rather than dose limits established under other regulations.
South Carolina Air Pollution Control Standard SC R.61-62.1 and 62.5	Potentially Applicable	Identifies allowable air concentrations and permit requirements for air emissions of toxic criteria and air pollutants for new and existing sources. National ambient air quality standards for PM10 and PM2.5, carbon monoxide, lead, nitrogen dioxide, ozone and sulfur oxides.	Potentially applicable should diesel generators be required during construction.
Location-Specific			
National Historic Preservation Act 36 CFR 800, 36 CFR 79, 36 CFR 65	Applicable	Establishes a national registry of historic sites for preservation of historic and prehistoric resources.	109-R and 107-R are listed as historically significant. All Actions have been completed.
Control of Fugitive Particulate Matter 40 CFR 50.6 South Carolina Air Pollution Control Regulations and Standards SC 61-62.6 Control of Fugitive Particulate Matter	Applicable	Fugitive particulate material shall be controlled. Water, chemicals or other means required for control of dust in demolition or construction operations.	Gravel access /lay down areas may be required. These actions may require dust suppression if potential exists for particulate emissions.
Standards for Stormwater Management and Sediment Reduction SC R.72-300	Applicable	Stormwater management and sediment control plan for land disturbances.	Activities may require an erosion control plan to prevent environmental impacts from stormwater runoff.

Citation(s)	Status	Requirement Summary	Reason for Inclusion
Chemical Specific			
Solid Waste Management SC R.61-107.19 Solid Waste Landfills and Structural Fill, SC R. 61-107.258 Municipal Solid Waste Landfills	Applicable	Regulations governing disposal of nonhazardous solid waste.	Activities could generate solid waste requiring disposal. Disposal location dependent on specific requirements of the regulations and permit for each type of landfill.
USEPA OSWER Directive 9200.4-18 Establishment of Cleanup Levels for CERCLA sites with Radioactive Contamination	To Be Considered	Cleanups of radioactive contamination outside the risk range (in general, exceeding 15 mrem/yr EDE, which equates to approx. 3×10^{-4} increased lifetime risk) are not protective.	EPA policy establishing protective range for radionuclide cleanups at CERCLA sites. Mandates use of CERCLA risk range rather than dose limits established under other regulations.

APPENDIX B.

Detailed Cost Analysis
Alternative P-1: No Action

Alternative P-1 Process Sewer Lines
No Action
R Area OU
Savannah River Site

Item	Quantity	Units	Unit Cost	Total Cost	
Direct Capital Costs					
No Action					
Subtotal - Direct Capital Cost				$0	*
Mobilization/Demobilization	10% of subtotal direct capital			$0	*
Site Preparation/Site Restoration	10% of subtotal direct capital			$0	*
Total Direct Capital Cost	(sum of * items)			**$0**	
Indirect Capital Costs					
Engineering & Design	15% of direct capital			$0	
Project/Construction Management	25% of direct capital			$0	
Health & Safety	5% of direct capital			$0	
Overhead	30% of direct capital			$0	
Contingency	20% of direct capital			$0	
Total Indirect Capital Cost				**$0**	
Total Estimated Capital Cost				**$0**	
Direct O&M Costs	3.9% discount rate for costs > 30 years duration				
Annual Costs (Existing System during Post-ROD Design &	30 year O&M period			*Years 2008 - 2038*	
Subtotal - Annual Costs				$0	
Present Worth Annual Costs				$0	
Five Year Costs	0				
Remedy Review	0	ea	$15,000	$0	
Subtotal - Five Year O&M Costs				$0	
Present Worth Five Year Costs				$0	
Total Present Worth Direct O&M Cost				**$0**	
Indirect O&M Costs					
Project/Admin Management	40% of direct O&M			$0	
Health & Safety	10% of direct O&M			$0	
Overhead	30% of direct O&M			$0	
Contingency	15% of direct O&M			$0	
Total Present Worth Indirect O&M Cost				**$0**	
Total Estimated Present Worth O&M Cost				**$0**	
TOTAL ESTIMATED COST				**$0**	

There are no O&M or 5-year review costs for the No Action alternative, as per EPA-540-R-98-031 guidance.

Alternative P-2:
Isolation/Plugging of RPSLs and Drainage System, Grouting of Manholes, Diversion Boxes, and Process Tanks, Select Removal of Process Equipment External to the R-Reactor Building, Sealing/Plugging of Outfalls, and Institutional Controls

Alternative P-2 Process Sewer Lines
Isolation and Plugging Proccess Sewer Lines, Process Tanks and Institutional Controls
R Area OU
Savannah River Site

Item	Quantity	Units	Unit Cost	Total Cost	
Direct Capital Costs					
Isolation and Plugging Process Sewer Lines (Note 3)					
Isolate Process Sewer Lines (D&R Selected Components)	1	lt	$110,000	$110,000	
Plug Manhole Inverts and Grout Manholes	35	ea	$3,000	$105,000	
Plug Diversion Box / Sump Inverts and Grout	5	ea	$35,000	$175,000	
Isolate / Secure Outfalls (Animal Intrusion)	5	ea	$50,000	$250,000	
Grouting Process Tank 106-R (Note 3)	12096	cf	$10	$120,960	
Grouting Cooling Water Sump 107-R (Note 3)	23500	cf	$10	$235,000	
Grout Septic Tank 607-1R (Note 3)	3300	cf	$10	$33,000	
Stormwater Management	2500	lf	$25	$62,500	
Institutional Controls					
Posting of Warning Signs	20	ea	$50	$1,000	
Land Use Control Implementation Plan	1	ea	$5,000	$5,000	
Deed Restrictions	1	ea	$5,000	$5,000	
Subtotal - Direct Capital Cost				$1,102,460	*
Mobilization/Demobilization	10%	of subtotal direct capital		$110,246	*
Site Preparation/Site Restoration	10%	of subtotal direct capital		$110,246	*
Total Direct Capital Cost		(sum of * items)		**$1,322,952**	
Indirect Capital Costs					
Engineering & Design	18%	of direct capital		$238,131	
Project/Construction Management	25%	of direct capital		$330,738	
Health & Safety	10%	of direct capital		$132,295	
Overhead	30%	of direct capital		$396,886	
Contingency	20%	of direct capital		$264,590	
Total Indirect Capital Cost				**$1,362,641**	
Total Estimated Capital Cost				**$2,685,593**	
Direct O&M Costs	2.7%	discount rate for costs > 30 years duration[1]			
Annual Costs (Existing System during Post-ROD Design & Const)	2	years O&M		*Years 2010 - 2011*	
Access Controls	1	ea	$500	$500	
Subtotal - Annual Costs				$500	
Present Worth Annual Costs (.9% Discount Rate)				$987	
Annual Costs (Note 2)	30	years O&M		*Years 2012 - 2042*	
Access Controls	0	ea	$500	$0	
Annual Inspections / Maintenance	0	ea	$10,000	$0	
Subtotal - Annual Costs				$0	
Present Worth Annual Costs (2.7.% Discount Rate)				$0	
Five Year Costs (Note 2)	0				
Remedy Review	0	ea	$15,000	$0	
Subtotal - Five Year O&M Costs				$0	
Present Worth Five Year Costs				$0	
Total Present Worth Direct O&M Cost				**$987**	
Indirect O&M Costs					
Project/Admin Management	320%	of direct O&M		$3,157	
Overhead	30%	of direct O&M		$296	
Contingency	15%	of direct O&M		$148	
Total Present Worth Indirect O&M Cost				**$3,601**	
Total Estimated Present Worth O&M Cost				**$4,588**	
TOTAL ESTIMATED COST				**$2,690,181**	

1. Interest rate for costs with duration < 30 years (i.e., before 2039) is based on SRNS's August 25, 2009 Technical Memorandum ERTEC-2009-00004.
2. Long term land use controls, including institutional controls, will be addressed in the final action RAOU Land Use Control Implementation Plan (LUCIP)
3. Cost for dewatering are included in the unit cost.

Alternative P-3:
Intruder Barrier, Isolation, Plugging of RPSLs and Drainage System, Grouting of Manholes, Diversion Boxes, and Process Tanks, Select Removal of Process Equipment External to the R-Reactor Building (105-R), Sealing/Plugging of Outfalls, and Institutional Controls

Alternative P-3 - Process Sewer Lines
Isolation and Plugging Proccess Sewer Lines, Intruder Barrier and Institutional Controls
R Area OU
Savannah River Site

Item	Quantity	Units	Unit Cost	Total Cost	
Direct Capital Costs					
Isolation and Plugging Process Sewer Lines (Note 3)					
Isolate Process Sewer Lines (D&R Selected Components)	1	lt	$110,000	$110,000	
Plug Manhole Inverts and Grout Manholes	35	ea	$3,000	$105,000	
Plug Diversion Box / Sump Inverts and Grout	5	ea	$35,000	$175,000	
Isolate / Secure Outfalls (Animal Intrusion)	5	ea	$50,000	$250,000	
Grouting Process Tank 106-R (Note 3)	12096	cf	$10	$120,960	
Grouting Cooling Water Sump 107-R (Note 3)	23500	cf	$10	$235,000	
Grout Septic Tank 607-1R (Note 3)	3300	cf	$10	$33,000	
Intruder Barrier					
Technical Requirements	1	lt	$120,000	$120,000	
D&R Interferences	1	lt	$110,000	$110,000	
Prep Area for Intruder Barrier	23500	sy	$10	$235,000	
Install Intruder Barrier	23500	sy	$48	$1,128,000	
Stormwater Management	2500	lf	$25	$62,500	
Institutional Controls					
Posting of Warning Signs	20	ea	$50	$1,000	
Land Use Control Implementation Plan	1	ea	$5,000	$5,000	
Deed Restrictions	1	ea	$5,000	$5,000	
Subtotal - Direct Capital Cost				$2,695,460	*
Mobilization/Demobilization		10% of subtotal direct capital		$269,546	*
Site Preparation/Site Restoration		10% of subtotal direct capital		$269,546	*
Total Direct Capital Cost		(sum of * items)		**$3,234,552**	
Indirect Capital Costs					
Engineering & Design		14% of direct capital		$452,837	
Project/Construction Management		25% of direct capital		$808,638	
Health & Safety		10% of direct capital		$323,455	
Overhead		30% of direct capital		$970,366	
Contingency		20% of direct capital		$646,910	
Total Indirect Capital Cost				**$3,202,206**	
Total Estimated Capital Cost				**$6,436,758**	
Direct O&M Costs		2.7% discount rate for costs > 30 years duration[1]			
Annual Costs (Existing System during Post-ROD Design & Const)		2 years O&M		*Years 2010 - 2011*	
Access Controls	1	ea	$500	$500	
Subtotal - Annual Costs				$500	
Present Worth Annual Costs (.9% Discount Rate)				$969	
Annual Costs (Note 2)		30 years O&M		*Years 2012 - 2042*	
Access Controls	0	ea	$500	$0	
Annual Inspections / Maintenance	0	ea	$10,000	$0	
Subtotal - Annual Costs				$0	
Present Worth Annual Costs (2.7% Discount Rate)				$0	
Five Year Costs (Note 2)	0				
Remedy Review	0	ea	$15,000	$0	
Subtotal - Five Year O&M Costs				$0	
Present Worth Five Year Costs				$0	
Total Present Worth Direct O&M Cost				**$969**	
Indirect O&M Costs					
Project/Admin Management		320% of direct O&M		$3,102	
Overhead		30% of direct O&M		$291	
Contingency		15% of direct O&M		$145	
Total Present Worth Indirect O&M Cost				**$3,538**	
Total Estimated Present Worth O&M Cost				**$4,508**	
TOTAL ESTIMATED COST				**$6,441,266**	

1. Interest rate for costs with duration < 30 years (i.e., before 2039) is based on SRNS's August 25, 2009 Technical Memorandum ERTEC-2009-00004.
2. Long term land use controls, including institutional controls, will be addressed in the final action RAOU Land Use Control Implementation Plan (LUCIP)
3. Cost for dewatering are included in the unit cost.