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Savannah River Site

Scoping Summary for the P-Area Operable Unit (U)

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KEY CHANGES TO SCOPING SUMMARY		
Date	***Section***	***Description of Change***
1 Dec. 2005	All	Complete rewrite.
2 Dec. 2005	3.0	Industrial land use scenario was selected as the baseline risk assessment exposure scenario.
	4.3.1	Additional text was added to determine that a limited number of surface soil samples will be collected to supplement gamma overflight data near the disassembly basin.
	4.3.2	Additional text was added stating that surface soil samples will be collected in the HCA.
	4.3.3	A clarification was added to the uncertainty section that soil sampling/analysis will be performed at pipeline junctions and sumps and that PTSM protocols will be used for data evaluation.
	4.3.4	Text “to be determined” was added to the Problems Warranting Action as it is uncertain at this time to what action(s) is appropriate for the Reactor Building.
	4.3.7	Text was added to the second paragraph describing the maximum DPT TCE concentrations in the groundwater in PSA 4.
	4.4.1	Text was added to clarify that the Scope of the Problem Warranting Action includes the soil exterior to the Cooling Water Basins and Pump House.
	4.4.1	A new uncertainty was added that discusses the uncertainty to whether or not contamination is present in the soil that would exceed contaminant migration criteria and that this uncertainty will be managed through soil sampling/analysis and evaluation using contaminant migration protocol.
	4.5.1	A new uncertainty was added that discusses the uncertainty to whether or not contamination is present in the soil that would exceed contaminant migration and PTSM criteria and that this uncertainty will be managed through soil sampling/analysis and evaluation using contaminant migration and PTSM protocols.
	4.6.2	Clarification was added to the second paragraph in that based on sump design and process history, it is unlikely that the sumps overflowed or that leaching occurred through the sumps.

		Additional text was added to the proposed sampling plan that collection of unit specific background soil samples is subject to approval of the SRS background soil protocol.
		The word "subsurface" was added to the first bullet under Problems Warranting Action.
		The acronym PTSM was added to the Uncertainty section to address the potential for contaminants to exceed contaminant migration and PTSM screening target levels.
	4.6.3	Additional text was added to the proposed sampling plan that collection of unit specific background soil samples is subject to approval of the SRS background soil protocol.
	4.7.1	Additional text was added to the proposed sampling plan that collection of unit specific background soil samples is subject to approval of the SRS background soil protocol.

RECORD OF KEY AGREEMENTS	
Date	***Description of Agreement***
2 Nov. 2005	The end state of the Reactor Building (105-P) will most likely be situ decommissioning. The project team should evaluate the building as a consolidation unit. The land use is non-residential and the industrial worker scenario will apply to risk assessments.
2 Dec. 2005	The core team agreed to a revised submittal date for the rev. 0 RI Work Plan for the PAOU until 3/2/2006. WSRC/DOE will submit an extension request for the new submittal date.
	The core team agreed to a phased Work Plan for the PAOU. This phased approach will include subsequent scoping associated with the process sewer lines and Reactor Building.
	The core team agreed to a standing meeting on the last Wednesday of each month as a way of communicating status and issues concerning the PAOU. The first call-in will be January 25, 2006.
	The core team agreed to submittal of a modified Area Closure RI Work Plan for P Area. It was also agreed that no modified table of contents will be submitted for review prior to submittal of the modified Work Plan.

1.0 Project Phase

This scoping summary supports development of the P-Area Operable Unit (PAOU) work plan which will be submitted by 12/31/2005. This work plan will be constructed as a phased approach in that there will be job tasks which can only be implemented subsequent to the completion of other tasks. Subsequent phases associated with the work plan will be included in this scoping summary as the project evolves. The objectives of this scoping meeting are for the Core Team to (1) agree on the subunits and investigative units in the PAOU, (2) agree on the problems warranting action on the subunits within the PAOU work plan, and (3) agree on the data quality objectives and the sampling strategy for the OU.

On November 1, 2005 an Area Completion Team meeting was held to discuss the integration of the 105-P reactor facility into the P-Area Operable Unit. All core team members concurred that the hardened Reactor Building (105-P) would be included within the RI/FS process for area completion. SRS will ensure that the CERCLA nine criteria are evaluated to guide final decisions on this facility. The team also concluded that the hardened facility would remain basically intact and could be utilized for consolidation of P Area wastes. Early stakeholder involvement is needed to determine the final end state of the Reactor Building (105-P) and multiple public meetings are expected. A stakeholder involvement plan will be developed to guide the public participation process.

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2.0 Background

P Area is located in south-central SRS (Figure 1). P-Area Reactor was started up in February 1954 and placed in shutdown in 1991. The primary sources of radioactive contamination in P Area are fission products and tritium, both of which were by-products of operation of the P-Reactor. In addition, solvents, which were used to clean fuel and targets, are a source of non-radioactive contamination.

The PAOU comprises (1) Federal Facility Agreement (FFA) Operable Units (OUs), (2) the Reactor Building (105-P) and ancillary structures, (3) potential (vadose zone) source areas (PSAs) to the groundwater as identified during P-Area Reactor Groundwater (PRGW) OU pre-work plan characterizations, and (4) any other releases subsequently identified. The ancillary structures to be included with the Reactor Building (105-P) are limited to those listed in Section 4.1.4. Groundwater in P Area is not included in the PAOU. However, a limited groundwater investigation will be performed to support identification of potential vadose zone source areas to be addressed as part of the PAOU. Figure 2 and Figure 3 illustrate the units to be investigated.

3.0 Land Use

The end state for the Reactor Building (105-P) is anticipated to be *in situ* decommissioning. No current or projected future development of P Area is planned. There are no identified area(s) or structures that may be subjected to historical usage. However, an industrial land use scenario is selected as the baseline risk assessment exposure scenario for the protection of human health and

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the environment as designated in the Land Use Control Assurance Plan (LUCAP). There is no current or projected future use of the groundwater as a drinking water source.

4.0 P-Area Operable Unit

Based on process history and previous investigations that have been performed in and around P Area, a general understanding of the potential contaminants, contaminant sources, and contaminant behavior is known. This knowledge was developed from waste unit investigations (RCRA/CERCLA OUs), the Site Evaluation (SE) Program investigations, reactor process documents, gamma over-flight surveys, and pre-Work Plan characterization for the PRGW OU.

Final Records of Decisions have been issued for four OUs in P Area: P-Area Burning/Rubble Pit; P-Area Coal Pile Runoff Basin; P-Area Bingham Pump Outage Pits; and the P-Area Reactor Seepage Basins. Investigations performed as part of the SE Program were primarily related to historic spills. No problems warranting action were identified during the SE investigations and no remedial actions were required. Completed SE units in P Area have been determined to require no further action (NFA).

Groundwater investigation is being used to detect any continuous sources of groundwater contamination that have not been previously identified as historical RCRA/CERCLA waste units or ongoing releases from any of the remaining P Area facilities. The groundwater data is also being used to track any groundwater plumes back to a surface or subsurface source, if needed. In addition, gamma over-flight surveys are being reviewed to provide a cursory overview of potential surficial soil contamination. Overall, the over-flight surveys do not reflect a gamma signature on the ground surface indicating there may be no surficial soil risk from radioactivity within the P Area perimeter.

A prospective contaminant migration analysis has been completed and reveals only a limited number of contaminants that have the potential to migrate to groundwater in less than 1,000 years at concentrations that will exceed maximum contaminant levels (MCLs) in the aquifer. Therefore, a degree of understanding exists as to which P Area subunits pose a contaminant migration hazard.

Because P Area sits on a topographic high, groundwater in P Area flows in a radial pattern away from P Area. The groundwater investigation has identified possibly five contaminant plumes of volatile organic compounds (VOCs) and/or tritium in the area (Figure 3). Plume 1 is a large tritium plume that extends to the northwest from the P-Area Reactor Seepage Basins. Plume 2 is a smaller tritium plume that extends to the northwest from within the reactor area. Plume 3 is a VOC and tritium plume that emanates from north of the reactor area and extends to the west. Plumes 1, 2, and 3 are commingled and extend to Steel Creek where tritium is detected in exceedance of the MCL (20 pCi/mL). TCE has also been detected in the headwaters of Steel Creek in exceedance of the MCL (5 µg/L). The primary VOCs in Plume 3 are trichloroethylene (TCE) and tetrachloroethylene (PCE). Plume 4 is a VOC and tritium plume that extends to the northeast from the eastern side of the reactor area. TCE is the primary VOC contaminant in Plume 4. A possible fifth plume (Plume 5) is located south of the reactor area. CPT sampling has identified PCE as a potential groundwater contaminant although a plume has not been defined.

4.1 Subunits

To evaluate the impact to the environment from various former operating facilities and remaining FFA OUs at P Area, investigations have been grouped into the three following categories: 1) FFA OUs; 2) Deactivation and Decommissioning (D&D) Structures; and 3) PSAs.

Federal Facility Agreement (FFA) OUs

The FFA OUs category identifies those OUs that have yet to be investigated per the FFA (Figure 2). Those OUs include the following:

- P-Area Ash Basin (188-0P);
- Potential Release from P-Area Reactor Water Cooling System (186/190-P);
- Potential Release from P-Area Disassembly Basin (105-P);
- P-Area Process Sewer Lines As Abandoned (NBN) (which includes the Spill on 03/15/79 of 5500 Gallons of Contaminated Water, NBN); and
- P-Area Cask Car Railroad Tracks as Abandoned (NBN).

Deactivation and Decommissioning (D&D) Structures

Draft Appendix K of the FFA comprises twenty structures located in P Area that are to be decommissioned and were evaluated for inclusion in the PAOU (Figure 4 and Table 1). To date, ten structures have been evaluated, and eight more evaluations are planned. In addition, two structures (107-P and 152-7P) were dismantled as removal activities without Facility Decommissioning Evaluations (FDE) being prepared. Of the ten facilities already evaluated, five were evaluated to be Simple Models and five were evaluated to be Integrated Sampling Models (ISM). The five ISM facilities include the following:

- Sodium Hypochlorite Tank Storage (186-1P);
- Filter and Softener Plant (183-2P);
- Clarification Facility (183-4P);
- Cooling Water Pump House (190-P); and
- Chemical Feed Facility (607-22P).

Based on a combination of process knowledge, historical information, data from similar facilities, and verification walkdowns, it was determined that no radioactive or hazardous constituents (except for building materials) contaminants are associated with three of the five ISM structures. These three ISM structures were treated as simple model facilities. Based on regulator comments, additional characterization was performed at the Filter and Softener Plant (183-2P) and Clarification Facility (183-4P). As an outcome of this additional characterization, there is no evidence of spills or releases from these structures. Therefore, no further investigation or evaluation is proposed on the completed five ISM facilities.

Of the remaining eight structures to be evaluated, FDEs will be conducted at a later date. Five of the eight structures yet to be evaluated are likely to be Simple Models. The remaining three structures, Reactor Building (105-P) and its ancillary structures (Engine Houses [108-1P and 108-2P]), will most likely not be categorized as Simple Models and are included for evaluation in the work plan. The likely end state for the Reactor Building (105-P) is *in situ* disposal.

Potential Source Areas (PSAs)

PSAs have been identified in and around P Area by previous groundwater pre-work plan characterizations associated with the PRGW OU. As a result of data reviews, five areas were identified as PSAs to the groundwater (Figure 3). These PSAs result from spills and releases associated with facility operations and are not necessarily related to a particular FFA OU or D&D structure. The following five PSAs are as follows:

- PSA 1: Emergency Cooling Water Retention Basin (904-86G);
- PSA 2: Area around the Cooling Water Effluent Sumps (107-P/107-1P);
- PSA 3A: Area near the northern end of the Reactor Building (105-P);
- PSA 3B: Area west of the Administrative/Maintenance slab;
- PSA 4: Area east of the Reactor Building (105-P); and
- PSA 5: Two localized areas in the southwestern part of P Area.

PSA 3 is subdivided into two areas because both contribute to the same VOC groundwater plume but are located in two different areas within P Area (Figure 3). The first area, PSA 3A, is located in an area north of the Reactor Building (105-P), where TCE is the primary contaminant. The second area, PSA 3B, is located near the Administration/Maintenance slab where PCE is the primary contaminant. Previous groundwater investigations indicate these areas to be potential continuing source areas to the TCE/PCE groundwater plumes. Recent soil investigations at these areas confirm the presence of elevated levels of TCE and PCE.

4.2 Investigative Units

Based on the locations of the FFA operable units and facilities that comprise the PAOU, in addition to the preliminary understanding of groundwater contamination in P Area, the aforementioned subunits will be grouped into the following investigative units (Figure 5 and Table 2):

- P-Reactor Investigative Unit;
- Cooling Water System Investigative Unit;
- P-Area Ash Basin Investigative Unit;
- Northern Vadose Zone Investigative Unit; and
- Southern Vadose Zone Investigative Unit.

For the PAOU, most of the identified subunits are associated with subsurface contamination. For this reason, investigative units are designed to identify problems warranting action from a

contaminant migration and principal threat source material (PTSM) perspective, rather than surficial risk, and the specific groupings of subunits are not necessarily defined by the receptor exposure.

The following sections discuss each of the investigative units in more detail. In addition, for each investigative unit, the appropriate subunit in that investigative unit is also discussed.

4.3 P-Reactor Investigative Unit

The P-Reactor Investigative Unit consists of approximately 16.6 acres within the reactor inner fence line (Figure 5). The following subunits have been grouped under the P-Reactor Investigative Unit (Table 2):

- Potential Release from the P-Area Disassembly Basin;
- P-Area Reactor Area Cask Car Railroad Tracks as Abandoned;
- P-Area Process Sewer Lines as Abandoned (portions);
- P-Reactor Building (105-P) and ancillary structures; and
- PSAs 1, 3A, and 4.

The primary facility within the P-Reactor Investigative Unit is the Reactor Building (105-P). The expected end state for the Reactor Building (105-P) is *in situ* decommissioning. The level of effort required for facility deactivation will be addressed through future Core Team discussions and stakeholder involvement.

Previous groundwater investigations have identified a tritium plume west (PSA 1) west of the Reactor Investigative Unit and a tritium/VOC plume to the north (PSA 3A) and east (PSA 4) (Figure 3). Source area investigations have identified the P-Area Reactor Seepage Basins as a primary source for the western plume. Additional sources for the northern and eastern plumes appear to emanate from within the Reactor Investigative Unit (PSA-3A and PSA-4). Additionally, PSA-1, which is located outside the Reactor inner fence line near the P-Area Emergency Cooling Water Retention Basin (904-86G), will be investigated as part of the Reactor Investigative Unit. A process sewer line from the Reactor Building (105-P) extends to a contaminated water storage tank in this basin, and while it never received water during an emergency event, the tank has received waste water.

There does not appear to be a surficial risk associated with the P-Reactor Investigative Unit based on the gamma over-flight survey. However, existing soil data will be used to assess the surficial risk assessment for the investigative unit.

Because many of the processes related to the Reactor Building (105-P), including the P-Area Disassembly Basin and the process sewer lines, are inter-related, it is impractical to determine which subunit may have been an actual source area for groundwater contamination. Subsurface sampling will be performed within the investigative unit to support a P-Reactor Investigative Unit contaminant migration analysis. The subsurface investigation will include sampling points to address the Potential Release from the P-Area Disassembly Basin, the P-Area Process Sewer

Lines as Abandoned, and potential source areas north (PSA-3A) and east (PSA-4) of the Reactor Building (105-P).

The following sections provide details pertaining to the subunits listed for the P-Reactor Investigative Unit.

4.3.1 Potential Release from P-Area Disassembly Basin

The P-Area Disassembly Basin is a concrete-lined basin that ranges in depth from 5.2 m (17 ft) below grade to 9.1 m (30 ft) below grade. The full-pool capacity of the basin is 18,250 m^3 (4.82 million gallons); as of March 2005, the basin was 96% full, containing approximately 17,034 m^3 (4.1 million gallons) of water and miscellaneous irradiated scrap (chains, buckets, hangers, lights, plastic, hand tools, harps, etc).

The P Reactor was shut down in 1991, and all irradiated fuel assemblies and target material were subsequently removed from the disassembly basin. The basin and other infrastructure associated with reactor operations are maintained in accordance with applicable safety basis requirements.

The disassembly basin is divided into several discrete but contiguous areas used for different fuel handling processes, including storage, cooling, disassembly, and preparation for transport (Figure 6). Irradiated fuel and target assemblies were discharged from the reactor to the water-filled Vertical Tube Storage area, where short-lived radionuclides were allowed to decay. In the Machine Basin, the assemblies were sawed, disassembled, cropped to fit into bundles, and placed in metal baskets for storage in the Horizontal Storage and Bucket Storage areas. Prepared shipments were transferred into shipping casks in the Transfer Bay, and then transported to one of the F or H Separations Areas via the cask car railroad tracks.

As soon as the fuel and targets were fully withdrawn from the reactor vessel, they were rinsed with light water in the discharge machine to remove 30 to 50% of the remaining film coating of heavy water moderator before placement in the disassembly basin. Other components (control rods, instrument rods, miscellaneous components, etc.) discharged from the reactor were not rinsed prior to placing in the disassembly basin. The tritium contamination in the disassembly basin water and sludge is from the small amounts of moderator that was transferred with the fuel, targets, and other components when discharged from the reactor. The other radionuclide contamination present within the disassembly basin water and sludge is from the corrosion of the irradiated and activated components that were stored in the basin.

The disassembly basin radionuclide inventory consists of irradiated reactor components, mixed radionuclides in the sediment in the bottom of the basin, and tritium and radionuclides in the basin water. There are approximately 4.1 million gallons of water and approximately 4,380 ft^3 of sediment present in basin. The latest sampling of the basin water and sediment conducted in 2004 determined that tritium accounts for over 99% of the curies in the water and over 61% in the sediment. The primary contaminants in the disassembly basin water are tritium (~2.9E8 pCi/L), cesium-137 (~5.9E4 pCi/L), and strontium-90 (~1.73E4 pCi/L) and in the sediment are tritium (3.03E6 pCi/g), cesium-137 (4.02E4 pCi/g), and plutonium-238 (7.17E5 pCi/g). Other radionuclides present in the sediment that account for most of the remaining 39% of the curies are nickel-63 (22%), cobalt-60 (4.9%), plutonium-238 (2.99%), cesium-137 (2.278%), carbon-14

(2%), plutonium-241 (1.3%), and strontium-90 (0.245%). Table 3 and Table 4 summarize the mean concentration for each radionuclide in the basin water and sediment, respectively. The curie content of the liquids and the sediment in the disassembly basin is 4.95E3 Ci and 57.5 Ci, respectively, for a total curie content of 5.0E3 Ci.

The primary source of contamination associated with the disassembly basin is contaminated water that may have been released from process piping or equipment in connection with the basin. These potential releases may have resulted in subsurface soil contamination (Figure 7). There is no surficial soil expression of overflow or large leaks from the disassembly basin based on the gamma over-flight survey.

Incidental leaks from external basin piping and equipment may have released tritium, other radiological constituents, and metals to subsurface soil. However, previous soil sampling investigations (conducted around the exterior of the Reactor Building (105-P), where the basin is located) indicate no radiological constituents in exceedance of regulatory limits. In addition, aerial radiological survey and existing soil data do not indicate the presence of radionuclides in shallow and subsurface soil surrounding the basin exterior. Furthermore since tritium is an excellent tracer, groundwater monitoring data can be used to determine if the disassembly basin is leaking or has ever leaked by comparing tritium concentrations of groundwater to tritium concentrations in the disassembly basin. Groundwater data from nearby shallow wells (PDB wells series) do not indicate a release of basin water to the subsurface. Tritium is present in the groundwater near the basin at a maximum concentration of 3.9E4 pCi/L compared to ~2.9E8 pCi/L of tritium in the disassembly basin. No other readily mobile fission products (iodine, technetium, strontium) that are present in disassembly basin liquid are present in the groundwater. Additionally, water levels within the basin have been and remain static.

The disassembly basin and disassembly basin water and sediment will be dispositioned in conjunction with the Reactor Building (105-P). Final disposition of the disassembly basin and disassembly basin water and sediment will be managed in parallel with the PAOU and should not interfere with the PAOU schedule.

Proposed sampling will entail subsurface soil sampling outside the Reactor Building (105-P) where the disassembly basin is located (Figure 8). To supplement the gamma overflight data, a limited number of surface soil samples will be collected, as well. Table 5 summarizes the sampling strategy for this subunit. Each sample will be analyzed for TAL inorganics, radionuclide indicators (gross alpha and nonvolatile beta emitters), and tritium. In the event the trigger levels for gross alpha activity (20 pCi/g) and nonvolatile beta activity (50 pCi/g) are exceeded, radionuclide speciation will be performed. A minimum of 5 to 30 locations are planned for this subunit. Groundwater samples will also be collected at select locations and analyzed for TCL VOCs, radionuclide indicators, and tritium. In the event trigger levels for gross alpha activity (15 pCi/L) and nonvolatile beta activity (50 pCi/L) are exceeded, radionuclide speciation will be performed.

Problems Warranting Action

- Radiological constituents may be present in subsurface soil, could leach to groundwater, and could cause an exceedance above MCL levels in less than 1,000 years.

- Radiological constituents may be present in subsurface soil and could exceed the PTSM criteria of $1x10^{-3}$ risk to the industrial worker.

Remedial Action Objectives

- Reduce leaching of radiological constituents to groundwater at levels that exceed the MCLs.
- Prevent exposure to soil contamination that exceeds the PTSM criteria.

Scope of Problem Warranting Action

- The scope of the problem is limited to the soil around the perimeter of the disassembly basin (0.9 acres).

Likely Response Actions

- Institutional Controls
- Cover
- Excavation of contaminated soil

Uncertainty

- It is uncertain if contamination exists in soils that would exceed PTSM criteria or contaminant migration screening target levels. This uncertainty affects whether a problem warranting action exists that would require a response action. This uncertainty will be addressed by soil sampling/analysis and by further evaluation using the PTSM and contaminant migration protocols.

4.3.2 P-Area Reactor Area Cask Car Railroad Tracks as Abandoned

The P-Area Reactor Area Cask Car Railroad Tracks as Abandoned is identified as an area south of the disassembly basin that extends from the western reactor fence line back to the end of a railroad spur. For the purpose of the work plan and to meet the intent of area closure at P Area, all existing railroad tracks within the P Area perimeter fence will be addressed as part of this FFA OU (Figure 2).

Radiological material from the disassembly basin was transferred into metal casks inside the Reactor Building (105-P). The casks were loaded onto railroad cars inside the building and were routinely parked in various locations within P Area while awaiting transfer to the Separation Areas. When the railroad cars were exposed to rain, radiological materials may have been washed from the outside of the casks onto the ground surface. Surface soils adjacent to the P-Area Reactor Area Cask Car Railroad Tracks as Abandoned may be contaminated with radiological constituents from Reactor operations.

No characterization has been conducted specific to the cask car railroad tracks. Incidental leaks from the cask cars may have impacted surface soil with tritium and other radiological constituents. These potential releases may have resulted in surface soil contamination (Figure 9).

There is one area on the tracks that is designated as a high contamination area. However, the current gamma over-flight survey does not show a gamma signature present in this area which would be indicative of a historical tritium spill or release. No other radiological areas on or around the tracks are identified (Figure 8) based on current radiological and gamma over-flight surveys.

Proposed sampling will entail a radiological survey of the track area and up to 6 ft either side of the tracks (Figure 8). If areas above radiological background are determined, surface soil sampling will be conducted. The high contamination area will also be radiologically surveyed (Figure 8). Surface soil samples will be collected in the HCA and analyzed for TAL inorganics and radionuclide indicators. In the event the trigger levels for gross alpha activity (20 pCi/g) and nonvolatile beta activity (50 pCi/g) are exceeded, radionuclide speciation will be performed. A minimum of 5 to 20 locations are planned for this subunit. A groundwater sample will also be collected at select locations and analyzed for TCL VOCs, radionuclide indicators, and tritium. Table 5 summarizes the sampling strategy for this subunit.

Problems Warranting Action

- Radiological constituents may be present in surface soil and may exceed $1x10^{-6}$ risk levels to the industrial worker.

Remedial Action Objectives

- Prevent industrial worker exposure to contaminated surface soil.

Scope of Problem Warranting Action

- Existing railroad tracks within the P Area perimeter fence will be investigated to determine the presence of surface contamination.

Likely Response Actions

- Institutional Controls
- Cover
- Excavation

Uncertainty

- It is uncertain if contamination exists in surface soils that would exceed industrial worker screening target levels. This uncertainty impacts whether a problem warranting action

exists that would require a response action. This uncertainty will be addressed through soil sampling/analysis and further evaluation using the human health risk protocols.

4.3.3 P-Area Process Sewer Lines as Abandoned

The process sewer lines are defined as those lines that received contaminated process water discharges from the Reactor Building (105-P) and are primarily located to the west of the Reactor Building (105-P). The majority of the process sewer lines are associated with the P-Reactor Investigative Unit. Reactor cooling water lines, fire water lines, and water treatment lines from the Reactor Cooling Water System (186/190-P) and water treatment facilities (183-2/183-4P) are not considered as part of the process sewer lines and will not be characterized. These lines never received direct discharges from the Reactor Building (105-P) nor came in direct contact with process equipment. As such, these lines are not considered to be contaminated or potential sources to the groundwater. The process sewer lines that did receive contaminated discharges are comprised of carbon steel, vary in size and depth below land surface, and in some respect, are interconnected. Generally, primary cooling water was directed to Steel Creek or PAR Pond via the Cooling Water Effluent Sumps (107-P/107-1P). In some cases, cooling water was redirected to the Cooling Water Reservoir (186-P) as makeup water. Waste water from the disassembly basin was sent to the seepage basins or the discharge canals. The seepage basin lines have been removed as part of the P-Area Reactor Seepage Basins closure.

The process sewers consist of underground piping systems designed to transport water that had the potential for coming in contact with process water (deuterium [D_2O] moderator). The process sewers collected cooling water from sumps in the Reactor Building (105-P), purification system steam condensate tanks, cooling water off of condensers for the purification system, and seal coolant effluent from the Bingham Pump seals. The process sewers discharged to the Cooling Water Effluent Sumps (107-1P sump, which overflowed to the 107-P sump), and subsequently to the discharge canal. Secondary cooling water flow through the heat exchangers was in excess of 400 ft^3 per second (approximately 3,000 gallons/second) which would have been sufficient to dilute and flush any sediments potentially contaminated with radionuclides from these lines.

No characterization has been conducted specifically for the process sewer lines. Incidental leaks from subsurface process sewer piping and equipment may have released metals, tritium, and other radiological constituents into soil. Depth of the process sewer lines vary from a depth of approximately 1.2 m (4 ft) near the Reactor Building (105-P) to 3.0 m (10 ft) near the Cooling Water Effluent Sumps (107-P/107-1P). The process sewer lines may have fixed and/or transferable radioactive contamination. Potential releases from the process sewer lines may have resulted in subsurface soil contamination at depths greater than four feet (Figure 10). However, previous site evaluation investigations have been conducted at known spills of reactor waste water associated with the process sewer lines. These SE investigations determined that there was no impact to the environment due to the release of reactor waste water. No constituents were detected above their respective risk-based concentration and no radionuclide activities exceeded risk-based activities or background levels for SRS soils. The release of reactor waste water at

these SE units is a good indicator of what can and cannot be expected in terms of specific contaminants that might be present and the breadth of contamination.

Data from previous investigations and from existing monitoring wells indicate the presence of VOCs and tritium in groundwater. VOCs would not be sourced from the process sewer lines since VOCs were a poison to the reactor. The process sewer lines are located throughout P Area and lie within two groundwater plume areas (Figure 3). As VOC and tritium groundwater contamination is present upgradient of the process sewer lines, it is unlikely any releases from this subunit may have contributed to these plumes.

Proposed sampling will entail subsurface soil sampling at pipeline junctions and sumps. A review of existing drawings in conjunction with process knowledge on the usage of the process sewer lines will be performed to determine areas of investigation. Sampling will also be conducted in sumps where water and/or sediment are present (Figure 8). Table 5 summarizes the sampling strategy for this subunit. Each sample will be analyzed for TAL inorganics, radionuclide indicators (gross alpha and nonvolatile beta emitters), and tritium. In the event the trigger levels for gross alpha activity (20 pCi/g) and nonvolatile beta activity (50 pCi/g) are exceeded, radionuclide speciation will be performed. A minimum of 5 to 20 locations are planned for this subunit. A groundwater sample will also be collected at select locations and analyzed for TCL VOCs, radionuclide indicators, and tritium. In the event trigger levels for gross alpha activity (15 pCi/L) and nonvolatile beta activity (50 pCi/L) are exceeded, radionuclide speciation will be performed.

Problems Warranting Action

- Radiological constituents may be present in subsurface soil (> 4 ft), and could exceed PTSM criteria of $1x10^{-3}$ industrial risk levels.
- Radiological constituents may be present in subsurface soil (> 4 ft), could leach to groundwater, and could cause an exceedance of MCLs in less than 1000 years.
- The process sewer lines may contain contamination above the PTSM criteria of $1x10^{-3}$ industrial risk levels.

Remedial Action Objectives

- Prevent human exposure to radiological constituents in subsurface soils and/or process sewer lines that exceed $1x10^{-3}$ industrial risk levels.
- Reduce leaching of radiological constituents in subsurface soil to groundwater at levels that exceed MCLs.

Scope of Problem Warranting Action

- Identification of whether problems exists warranting action will be determined through further investigation/characterization of soil analysis at pipeline junctions and sumps.

Likely Response Actions

- Institutional controls
- Soil Cover
- Excavation of soil and/or pipeline
- Intruder barrier
- Grouting of pipeline

Uncertainty

- The scope of the process sewer lines to be investigated under this work plan is uncertain because not all of the process sewer lines may have conveyed contaminated liquid. This uncertainty affects the design of a characterization plan for the process sewer lines. The uncertainty will be resolved through review of the operational history of P Area and agreement by the core team on the scope of the process sewer lines requiring further characterization.
- It is uncertain if contamination exists in subsurface soils that would exceed PTSM criteria or contaminant migration screening target levels. This uncertainty impacts whether a problem warranting action exists that would require a response action. This uncertainty will be addressed through soil sampling/analysis and further evaluation using the PTSM and contaminant migration protocols.
- There is uncertainty if fixed contamination or PTSM exists within the process sewer lines. This uncertainty impacts whether a problem warranting action exists that would require a response action. This uncertainty will be addressed through soil sampling/analysis at pipeline junctions and sumps and further evaluation using the PTSM protocols.

Deleted: and contaminant migration

4.3.4 Reactor Building (105-P)

This subunit includes the Reactor Building (105-P), including ancillary structures. Ancillary structures associated with the Reactor Building (105-P) include:

- Disassembly Basin and ancillary facilities (Process Water Storage Tank [106-P] and Purge Water Storage Basin [109-P]); and
- Engine Houses (108-1P and 108-2P).

The disassembly basin is contained within the hardened Reactor Building (105-P) while the Process Water Storage Tank (106-P) and Purge Water Storage Basin (109-P) are located external to the disassembly basin. The two engines houses (108-1P and 108-2P) are attached externally to the Reactor Building (105-P). Primary access to the engine houses is through the lower level of the Reactor Building (105-P).

The Reactor Building (105-P) is a massive reinforced concrete structure of nuclear blast resistant design, with multiple levels over 39.6 m (130 ft) above and 12.2 m (40 ft) below ground surface.

The subsurface footprint of the building is not the same as the ground level footprint. Walls, floors, and roofing of the building vary between approximately 1.4 to over 2.1 m (4.5 to over 7.0 ft) in thickness of reinforced concrete. For example, the floor and the roof of the disassembly basin vary between 1.5 to 2.3 m (5 to 7.5 ft) and 0.7 to 1.5 m (2.5 to 5 ft) thick, respectively. The facility is structurally sound; however, there is evidence of rainwater ingressions. Since shutdown of the reactor in 1991, some of the reusable equipment and materials have been removed from the building. The reactor has been defueled, all fissile materials have been removed, and no bulk storage of moderator (heavy water) remains in any of the P Area buildings. Because electricity to the facility was disconnected, the ventilation system does not operate to circulate air throughout the building. With the absence of fresh air, there is an accumulation of moisture within the building which in turn has contributed to stale air, condensation, and mold. There is also evidence of peeling paint, which may contain lead and PCBs. There are no chemicals present within the Reactor Building (105-P).

Semi-annual inspections are performed on the sumps inside the Reactor Building (105-P). Some areas within the Reactor Building (105-P) require regulated access because of the remaining low levels of radioactivity and transferable contamination in various rooms. There is no indication of compromise to structural integrity, and from periodic radiological surveys, there is no indication of migration of radioactive contamination.

The following text provides additional information regarding known hazards for each of the four process areas of the Reactor Building (105-P). Figure 11 depicts a summary of known hazards within the four process areas of the Reactor Building (105-P).

Process Area

The process area houses the reactor vessel that was embedded in the floor of the Process Room. The reactor tank contains irradiated aluminum and stainless steel reactor components such as sleeve housings, plenum plugs, semi-permanent sleeves, muffs, septifoils, safety rod thimbles, automatic incident action rods, thermocouple rods, and spargers. The irradiated components are in solid form and the contaminants on the irradiated components have no credible release mechanism.

Disassembly Basin

The disassembly basin no longer contains irradiated fuel assemblies. The basin is divided by walls into seven interconnected, water-filled smaller basins (Figure 6). A description on the usage for each of the seven smaller basins is as follows:

- Vertical tube storage – used to cool reactor fuel;
- Machine basin – used to disassemble and handle fuel from the vertical tube storage basin;
- Emergency basin – used to segregate and contain damaged assemblies in harps;
- Dry cave basin – used to process control rods;
- Inspection basin – used for developmental work and was small and isolable;

- Horizontal bundle and bucket storage basin – used to store fuel and target tube bundles prior to shipping from the machine basin; and
- Shipping transfer basin (pits) – used to place fuel and target tube bundles into shipping casks.

The basin contains approximately 1.55E7 L (4.1 million gallons) of radiologically contaminated water and approximately 124 m^3 (4,380 ft^3) of radiologically contaminated sediment. The basin also contains an unspecified quantity of debris and equipment remnants.

The Process Water Storage Tank (106-P) is an underground concrete storage tank (3.28E5 L [86,850 gallons]) designed to contain process water used in the operation of P-Area Reactor. The Process Water Storage Tank (106-P) received water from the disassembly basin that was circulated through sand filters and water from a settler tank that was used to receive back wash from the sand filters. The contents of the tank were transferred to the P-Area Reactor Seepage Basins.

The Purge Water Storage Basin (109-P) is an underground concrete storage tank (3.42E4 L [9,050 gallons]) designed to contain deionized purge water from the reactor shield system. The contents of the basin were discharged to the disassembly basin after short-lived radionuclides were allowed to decay.

Purification Area

The Purification Area provides storage for the process (moderator) water deionizers. There are eleven spent process water deionizers constructed of stainless steel, each containing approximately 30 cubic feet of resins. The resins contain approximately 146 Ci of chemically bonded mixed radionuclides. The deionizers have been dedeuterized with light water and, in addition, oil dry has been added to some of the deionizers to absorb residual moisture after the light water was drained. The only credible release of radionuclides is a fire or explosion due to build up of hydrogen gas, which is considered unlikely. The deionizers are to be dispositioned through the SRS waste management program.

Assembly Area

Three sealed containers of radioactive sources are stored in a confined area and do not pose a release to the environment since they are in a solid metallic form. The only credible release of radionuclides is a fire or explosion due to build up of hydrogen gas, which is considered unlikely.

Miscellaneous Areas of the Reactor Building

Three moderator (heavy water) storage tanks located in the -40 ft level have been emptied and it is estimated that approximately three gallons of contaminated moderator (heavy water) is present in the heel of each tank. The general areas of the Reactor Building (105-P) for the most part have been laid up, de-energized, and drained of radioactive and chemical hazards. Even though the systems have been drained and dried, residual liquids and non-releasable contaminants may be present in these drained systems.

The engine houses were constructed with and connected to the Reactor Building (105-P) at the -20 ft elevation. The 108-1P and 108-2P engine houses provided back-up emergency power for the reactor. The equipment has been removed from service and some equipment has been removed.

Figure 12 illustrates the conceptual site model for the Reactor Building (105-P) and ancillary structures. No characterization is proposed; however, further scoping to determine what additional evaluation(s) will be undertaken to support the end state is planned with subsequent stakeholder involvement.

Problems Warranting Action

- To be determined - Unclear definition of *in situ* end state, and whether further characterization/investigation will be necessary.

Remedial Action Objectives

- To be determined.

Scope of Problem Warranting Action

- To be determined.

Likely Response Actions

- *In situ* Decommissioning

Uncertainty

- USDOE acknowledges that the approach to evaluating and integrating the reactor into the area operable unit decision making process is not yet finalized. This will be managed in parallel and should not interfere with the scoping of soil sites and building remnants.

4.3.5 PSA 1: Emergency Cooling Water Retention Basin (904-86G)

This PSA is primarily associated with the Emergency Cooling Water Retention Basin (904-86G) (Figure 13). It is a 190 million L (50 million gal) earthen basin that was constructed during the 1960's as part of the emergency cooling system. The basin was designed to contain contaminated water that would accumulate in the event of a loss-of-cooling or loss-of-circulation accident. The basin never received discharges from an emergency event.

In the late 1970's, a 1,892,500-L (500,000-gal) contaminated-water storage tank was added to the retention basin. The purpose of the tank was to collect light- or heavy-water process water leaks that were pumped from beneath the reactor. By design, when this tank became full, additional water would overflow to the cooling water retention basin. The tank never received water from the reactor building during an emergency event. However, the tank routinely receives rainwater inleakage via the joints associated with the underground process sewer line piping. There is residual water in the tank.

Limited groundwater data have been collected around the perimeter of the basin. Tritium is the primary groundwater contaminant; no fission products have been detected in the groundwater. No soil or groundwater sampling has been conducted within the basin or near the tank (Figure 13). Groundwater contamination is present beneath this area which is adjacent and down gradient to the P-Reactor Seepage Basins, a known tritium source to groundwater. The primary source to the existing groundwater contamination is associated with the P-Area Reactor Seepage Basins. However, it is unknown what contribution, if any, this subunit may have had to the existing groundwater plume. There is no surficial expression of radiological contamination based on the gamma over-flight survey.

Proposed sampling will entail surface soil sampling within the retention basin near the tank (Figure 14). Table 5 summarizes the sampling strategy for this subunit. Each sample will be analyzed for TAL inorganics, radionuclide indicators (gross alpha and nonvolatile beta emitters), and tritium. In the event the trigger levels for gross alpha activity (20 pCi/g) and nonvolatile beta activity (50 pCi/g) are exceeded, radionuclide speciation will be performed. A minimum of 5 to 20 locations are planned for this subunit. A groundwater sample will also be collected at select locations and analyzed for TCL VOCs, radionuclide indicators, and tritium. In the event trigger levels for gross alpha activity (15 pCi/L) and nonvolatile beta activity (50 pCi/L) are exceeded, radionuclide speciation will be performed.

Problems Warranting Action

- Radiological and inorganic (metal) constituents in surface soil may exceed $1x10^{-6}$ risk levels to the industrial worker.
- Radiological and inorganic (metal) constituents in surface and subsurface soil may exceed an HQ of 1 for ecological receptors.
- Radiological and inorganic (metal) constituents may be present in surface and subsurface soils, may leach to groundwater, and may cause an exceedance of MCLs in less than 1000 years.

Remedial Action Objectives

- Prevent industrial worker exposure to contaminated surface soil.
- Prevent ecological exposure to contaminated surface and subsurface soils.
- Reduce leaching of constituents to groundwater at levels that exceed the MCLs.

Scope of Problem Warranting Action

- The scope of the problem is the soil in the area around the tank.

Deleted: limited to

Deleted: (0.1 acres)

Likely Response Actions

- Institutional Controls
- Excavate
- Cover
- Evaluate the tank for disposition

Uncertainty

- The tank contains residual water that may be contaminated and has the potential to leach to the aquifer. This uncertainty affects the problem definition. This uncertainty can be resolved by sampling the water within the tank and surrounding surface soil.
- It is uncertain if contamination exists in surface and subsurface soils that would exceed industrial worker or ecological screening target levels. This uncertainty affects whether a problem warranting action exists that would require a response action. This uncertainty will be addressed by screening and by further evaluation using the human health risk and ecological risk protocols.
- It is uncertain if contamination exists in subsurface soils that would exceed contaminant migration screening target levels. This uncertainty affects whether a problem warranting action exists that would require a response action. This uncertainty will be addressed through soil sampling/analysis and further evaluation using the contaminant migration protocol.

4.3.6 PSA 3A: Area near the Northern End of the Reactor Building

Previous soil-gas and soil investigations at PSA 3A have indicated that TCE is the primary VOC present in the soil. The highest VOC concentrations are exhibited in an area outside the northern end of the Reactor Building (105-P) (Figure 3). In particular, the highest TCE concentration exhibited in the soil was 12.5 mg/kg, at a location, near a storm water sewer line.

Groundwater data from previous investigations and existing groundwater monitoring wells indicate the presence of VOCs and tritium. Maximum TCE concentrations exhibited in the groundwater were determined to be 35 mg/L in an area further north of PSA 3A. The maximum

TCE concentration exhibited in the groundwater at PSA 3A is 8.7 mg/L. Releases within PSA 3A have resulted in subsurface soil contamination and are contributing to the existing VOC groundwater plume (Figure 13).

Proposed sampling will entail subsurface soil-gas sampling at a minimum of 5 to 50 locations with samples collected every 1.5 m (5 ft) starting at a depth of 3 m (10 ft) (Figure 14). Each sample will be analyzed for VOCs. Based on the outcome of the soil-gas sampling, select soil-gas locations will be identified and soil samples collected. Soil samples will be collected starting at 3 m (10 ft) and collected every 0.3 m (1ft) down to a depth of 14.6 m (48 ft). Each sample will be analyzed for VOCs. Groundwater samples will be collected at a select number of sampling locations and analyzed for VOCs, radionuclide indicators, and tritium. Table 5 summarizes the sampling strategy for this subunit. Geotechnical samples that can be used to support future remedial actions are also planned at selected locations.

Problems Warranting Action

- VOC contamination is present in the vadose zone and can act as a continuing source of groundwater contamination exceeding the MCL (5.0 ug/L).

Remedial Action Objectives

- Reduce leaching of VOCs from the vadose zone to groundwater at levels that exceed the MCL.

Scope of Problem Warranting Action

- To be determined through additional characterization.

Likely Response Actions

- Institutional Controls
- SVE
- Subsurface Heating (Electrical Resistance Heating [ERH], Steam, etc)
- Bioremediation
- Excavation and Removal

Uncertainty

- Sufficient characterization has not been completed to determine the extent of vadose contamination. This uncertainty will be resolved by additional sampling during the characterization.
- It is uncertain if contamination exists in subsurface soils that would exceed contaminant migration screening target levels. This uncertainty affects whether a problem warranting action exists that would require a response action. This uncertainty will be addressed

through soil sampling/analysis and further evaluation using the contaminant migration protocol.

4.3.7 PSA 4: Area east of the Reactor Building

This PSA is located in an area on the eastern side of the Reactor Building (105-P). Previous groundwater investigations in this area indicate that the area around the eastern side of the Reactor Building (105-P) may be a source for the TCE/tritium groundwater plume. No source investigation has been conducted in this area (Figure 3).

Releases within PSA 4 may have resulted in subsurface soil contamination and may be contributing to the existing TCE/tritium groundwater plume (Figure 13). Maximum DPT TCE concentrations and tritium activities exhibited in the plume are 18.6 µg/L and 235 pCi/mL, respectively.

Deleted: NOTE: *Add groundwater data.*

Inserted: NOTE: *Add groundwater data.*

Proposed sampling will entail subsurface soil-gas sampling at a minimum of 5 to 50 locations with samples collected every 1.5 m (5 ft) starting at a depth of 3 m (10 ft) (Figure 14). Each sample will be analyzed for VOCs. Based on the outcome of the soil-gas sampling, select soil-gas locations will be identified and soil samples collected. Soil samples will be collected starting at 3 m (10 ft) and collected every 0.3 m (1ft) down to a depth of 14.6 m (48 ft). Each sample will be analyzed for VOCs. Groundwater samples will be collected at a select number of sampling locations and analyzed for VOCs, radionuclide indicators, and tritium. In the event trigger levels for gross alpha activity (15 pCi/L) and nonvolatile beta activity (50 pCi/L) are exceeded, radionuclide speciation will be performed. Table 5 summarizes the sampling strategy for this subunit. Geotechnical samples that can be used to support a future remedial actions are also planned at selected locations.

Problems Warranting Action

- TCE contamination may be present in the vadose zone and may act as a continuing source of groundwater contamination exceeding the MCL (5.0 ug/L).

Remedial Action Objectives

- Reduce leaching of TCE from the vadose zone to groundwater at levels that exceed the MCL.

Scope of Problem Warranting Action

- To be determined through further investigation/characterization.

Likely Response Actions

- Institutional Controls
- SVE

- Subsurface Heating (ERH, Steam, etc)
- Bioremediation
- Excavation and Removal

Uncertainty

- Sufficient characterization has not been completed to determine if the source of TCE is continuing or depleted. This uncertainty affects whether a problem warranting action exists in the vadose zone. This uncertainty will be resolved by additional sampling during the characterization.
- There is uncertainty if contamination exists in subsurface soils that would exceed contaminant migration screening target levels. This uncertainty affects whether a problem warranting action exists that would require a response action. This uncertainty will be addressed through soil sampling/analysis and further evaluation using the contaminant migration protocol.

4.4 Cooling Water System Investigative Unit

The Cooling Water System Investigative Unit consists of approximately 12.5 acres around the 186-P Cooling Water Reservoir (186-P) and Cooling Water Pump House (190-P). There is one RCRA/CERCLA waste unit that is contained entirely within the Cooling Water System Investigative Unit (Table 2):

- Potential Release from the P-Area Reactor Cooling System (186/190-P); and

Portions of the P-Area Process Sewer Lines as Abandoned OU may exist within the Cooling Water Investigative Unit. Piping layout drawings are currently being reviewed to determine the use of the pipelines present in the Cooling Water System Investigative Unit.

The facilities within the Cooling Water System Investigative Unit include: the Cooling Water Reservoir (186-P); Filter and Softener Plant (183-2P); Clarification Plant (183-4P); Sodium Hypochlorite Tank Storage (186-1P); and the Cooling Water Pump House (190-P). The Cooling Water Reservoir (186-P) was decommissioned as a Simple Model through the FDE process. The 183-2P, 183-4P, 186-1P, and 190-P facilities were decommissioned as ISMs. Facilities completed as ISMs typically require additional evaluation. However, final confirmatory sampling was not required for any of these facilities and each was treated as a Simple Model facilities. The basis for this decision was that each of these facilities was involved in the water treatment for P Area. The contaminants of interest were water treatment chemicals, such as chlorine and sodium hypochlorite. No problems warranting action exist for these facilities and no additional evaluation was required.

4.4.1 Potential Release from P-Area Reactor Cooling Water System (186/190-P)

The P-Area Reactor Cooling Water System is comprised of the P-Area Reactor Cooling Water Reservoir (186-P) and the P-Area Cooling Water Pump House (190-P) (Figure 2). The P-Area

Reactor Cooling Reservoir is also commonly referred to as the P-Area concrete lakes or the P-Area cooling water basins. The reservoir consists of three basins (total capacity of 25-million gallons), which were used to supply cooling water to the reactor. The Cooling Water Pump House (190-P) housed the pumps that moved water from the basins to the reactor. Cooling water was received primarily from two sources: 1) PAR Pond and 2) makeup water from the Savannah River. In some cases, cooling water from reactor discharge was diverted back to the basins from the Cooling Water Effluent Sump (107-P).

Water flowed by gravity from the basin to the suction well, and then by suction to the pumps in the Cooling Water Pump House (190-P). The pumps in turn pumped water to the non-contact heat exchangers in the Reactor Building (105-P). These heat exchangers sometimes leaked minute quantities of radioactively contaminated heavy water (deuterium oxide) to the cooling water.

From the Reactor Building (105-P), discharge water flowed to the Cooling Water Effluent Sump (107-P). During normal operation and mild weather, the water flowed by gravity from the Cooling Water Effluent Sump (107-P) to the P-Area Discharge Canal back into PAR Pond. During normal operations and cold weather, the Cooling Water Effluent Sump (107-P) pumped some of the water back to the Cooling Water Reservoir (186-P) to maintain water temperature. During periods of cold weather, temperature of the water in the Cooling Water Reservoir (186-P) would drop due to the addition of cold water from the Savannah River or PAR Pond. If the temperature dropped too much, then the cooling water would cause the heavy water (in the reactor's cooling loop) to freeze (NOTE: Cooling water and heavy water have slightly different freezing points). To compensate for this drop in temperature, the Cooling Water Pump House (190-P) pumped a mixture of recycled water and PAR Pond/Savannah River water to the Reactor Building (105-P).

The Cooling Water Reservoir (186-P) was decommissioned, with concurrence from EPA and DHEC, using the Simple Model. Residual river sediment was sampled in the basins. Data indicated that the sediment contained inorganics and trace amounts of radionuclides. However, the results of the sampling indicated that the material did not exceed any RCRA characteristic waste thresholds and did not exceed any radiological control posting thresholds. The primary source of contamination is attributed to naturally occurring radionuclides and fallout from the suspended sediments collected with the cooling water received from PAR Pond and the Savannah River.

The Cooling Water Pump House (190-P) was determined by the D&D project, with the concurrence of EPA and DHEC, to meet the criteria of decommissioning according to the Integrated Sampling Model. Following decommissioning, it was determined to not require final verification sampling.

This subunit pertains to a potential release(s) of cooling water from the basins to surface soils. Operational process knowledge indicate the basins have overflowed when pumps inadvertently shutdown in the Cooling Water Pump House (190-P). No data exist to indicate where the release(s) may have occurred. Process knowledge and review of historical documents indicate that water from the Savannah River is known to be contaminated with mercury and that sediment in PAR Pond contains cesium-137. The reservoir was recently drained (Spring 2004) and

currently contains no water. The bottom surface is covered by several inches of sediment in two of the three chambers. Residual river sediment was sampled in the basins. The results of the sampling indicated that the material does not exceed any RCRA characteristic waste thresholds and/or any radiological control posting thresholds.

No soils data exist around this subunit. Sources of tritium and TCE in the groundwater are also detected upgradient of this subunit (PSA 4) and therefore, it is unlikely this subunit is a source to this groundwater contamination (Figure 3).

The principal risk is associated with contaminants that may be present in surface soils that would affect human and ecological receptors (Figure 15). The expansion joints were filled with a lead material. Past inspections have indicated that this material is missing at most of the joint locations. In addition, frequent cleaning of the basin bottom was conducted to remove sediment and oysters from the basin when it was drained for maintenance. This continual cleaning could have also removed some of the expansion joint material.

Proposed sampling will entail surface and subsurface soil sampling around the subunit (Figure 8). Table 5 summarizes the sampling strategy for this subunit. Each sample will be analyzed for TAL-inorganics and radionuclide indicators (gross alpha and nonvolatile beta emitters). In the event the trigger levels for gross alpha activity (20 pCi/g) and nonvolatile beta activity (50 pCi/g) are exceeded, radionuclide speciation will be performed. A minimum of 5 to 30 locations are planned for this subunit. A groundwater sample will also be collected a select locations and analyzed for TCL VOCs, TAL inorganics, radionuclide indicators, and tritium.

Problems Warranting Action

- Inorganic and radiological constituents may be present in surface soil and may exceed $1x10^{-6}$ risk levels to the industrial worker.
- Inorganic and radiological constituents may be present in surface and subsurface soil and may exceed an HQ of 1 for ecological receptors.

Remedial Action Objectives

- Prevent industrial worker exposure to contaminated surface soil.
- Prevent ecological exposure to contaminated surface and subsurface soils.

Scope of Problem Warranting Action

- The scope of this problem includes the soil exterior to the area of the Cooling Water Basins/Pump House. This subunit does not include the piping system.

Deleted: in

Deleted: (12.5 acres)

Likely Response Actions

- Institutional Controls
- Cover

- Excavation of contaminated soil

Uncertainty

- It is uncertain if contamination exists in surface and subsurface soils that would exceed industrial worker or ecological screening target levels. This uncertainty affects whether a problem warranting action exists that would require a response action. This uncertainty will be addressed through soil sampling/analysis and further evaluation using the human health risk and ecological risk protocols.
- It is uncertain if there are contaminants in soils that would exceed contaminant migration criteria. This uncertainty affects whether a problem warranting action exists that would require a response action. This uncertainty will be managed through soil sampling/analysis and further evaluation using the contaminant migration protocol.

4.4.2 P-Area Process Sewer Lines as Abandoned (portions)

A limited portion of the process sewer lines is included within this investigative unit. This investigative unit also encompasses pipelines associated with the cooling water system. A review of all piping systems will be performed to identify process related sewer lines. Section 4.1.3 discusses the proposed sampling strategy, Problems Warranting Action, Remedial Action Objectives, Scope of Problem Warranting Action, Likely Response Actions, and Uncertainty associated with the process sewer lines.

4.5 P-Area Ash Basin Investigative Unit

The P-Area Ash Basin Investigative Unit consists of approximately 17.2 acres around the P-Area Ash Basin (188-0P) (Figure 5). The ash basin is the only subunit in this investigative unit (Table 2).

Prior investigations at other SRS ash basins and ash piles have identified arsenic and coal-related radionuclides as human health constituents of concern (COCs). The contaminants associated with ash are typically not mobile and do not qualify as contaminant migration COCs. This immobility has also been suggested by a prospective contaminant migration analysis that has been performed for the PAOU. However, in instances where coal reject material is present, water migrating through the ash may be acidified by sulfuric acid created from sulfides in the coal and soil-pore water, and may then dissolve the metals within the ash. Coal rejects are materials that could not be pulverized such as hard coal, quartz, and iron sulfides (pyrite), or materials that were not of sufficient quality to be burned. There is no indication that the P-Area Ash Basin ever received coal rejects.

4.5.1 P-Area Ash Basin (188-0P)

The P-Area Ash Basin is an unlined, earthen containment basin that received ash sluice water from P-Area powerhouse (Figure 2). It is operated under an Industrial Wastewater Permit #7292.

Since startup in 1951, the P-Area Ash Basin (188-P) has been in service to receive flyash and bottom flyash from the P-Area powerhouse. Ash disposal in P Area ended in 1990, but the P-Area Ash Basin still received process/wash water. Coal ash typically contains metals such as arsenic, cadmium, chromium, lead, mercury, selenium, and naturally occurring radionuclides. Since the coal was mined in a different region of the country, the concentrations of these constituents may be considerably different from background concentrations. The solubility of trace elements in coal ash depends on the coal source, combustion, and chemical properties of rainfall and runoff (especially the pH because many of the metals are more soluble at low pH). Metals can leach into groundwater and contaminate surface water from coal and ash pile runoff or overflow from a basin.

Due to the lack of operations and maintenance actions since the early 1990s, the ash basin has been naturally revegetated by various grasses, shrubs, and trees.

No recent characterization has been conducted at the ash basin to determine impact to the environment. Limited sampling was conducted in 1983 and 1984. EP Toxicity was performed on the samples with no exceedances of regulatory limits. The depth of the ash within the basin and whether or not coal reject material is present within the ash are data needs. No groundwater characterization has been performed near the basin nor are groundwater monitoring wells installed near enough to the basin to determine if groundwater has been affected. However, as a point of comparison at another SRS ash basin, groundwater at the K-Area Ash Basin has been monitored quarterly by a network of wells. Overall, no impact to the groundwater has been observed at the K-Area Ash Basin. Ash disposal sites are specifically exempt from RCRA regulations.

Potential releases from ash deposition may have resulted in surface and subsurface soil contamination and subsequent leaching to groundwater (Figure 16). Based on investigation of other SRS Ash Piles/Basins, potential contaminants include metals and coal-related radionuclides. This contamination may be of concern to human and/or ecological receptors.

Proposed sampling will entail surface soil sampling of the ash within the basin (Figure 8). Table 5 summarizes the sampling strategy for this subunit. Each sample will be analyzed for TCL/TAL, dioxins/furans, sulfate, nitrate-nitrite as nitrogen, total organic carbon, radionuclide indicators (gross alpha and nonvolatile beta emitters), and tritium. In the event the trigger levels for gross alpha activity (20 pCi/g) and nonvolatile beta activity (50 pCi/g) are exceeded, radionuclide speciation will be performed. A minimum of 5 to 20 locations are planned for this subunit. A groundwater sample will also be collected a select locations and analyzed for pH, TCL VOCs, TAL metals, radionuclide indicators, and tritium. In the event trigger levels for gross alpha activity (15 pCi/L) and nonvolatile beta activity (50 pCi/L) are exceeded, radionuclide speciation will be performed.

At select locations, the thickness of the ash will be determined and a visual inspection of the ash will be conducted to determine the presence of coal reject material. Depth-discrete ash sampling will only be conducted if groundwater samples indicate a low groundwater pH. In addition, a walkdown of the basin will be conducted to determine if surface water is present. If surface water is present, samples will be collected and analyzed for the same list of constituents as with the ash samples.

Problems Warranting Action

- Inorganic, SVOC, and ash-related radiological constituents may exist in surface soil and may exceed $1x10^{-6}$ risk levels to the industrial worker.
- Inorganic, SVOC, and ash-related radiological constituents may exist in surface soil may exceed an HQ of 1 for ecological receptors.

Remedial Action Objectives

- Prevent industrial worker exposure to contaminated surface soil.
- Prevent ecological exposure to contaminated surface and subsurface soils.

Scope of Problem Warranting Action

- The scope of the problem is the ash contained within the basin (12.8 acres).

Likely Response Actions

- Institutional Controls
- Cover
- Excavation action (Remove ash to solid waste disposal facility, resource recovery, or incineration)

Uncertainty

- It is uncertain if contamination exists in surface soils that would exceed industrial worker or ecological screening target levels. This uncertainty affects whether a problem warranting action exists that would require a response action. This uncertainty will be addressed through soil sampling/analysis and further evaluation using the human health risk and ecological risk protocols.
- It is uncertain if surface water is present in the basin that presents a problem warranting action. This uncertainty will be managed by sampling of surface water (if present) during characterization.
- It is uncertain if there are contaminants in soils that would exceed PTSM or contaminant migration criteria. This uncertainty affects whether a problem warranting action exists that would require a response action. This uncertainty will be managed through soil sampling/analysis and further evaluation using the contaminant migration and PTSM protocols.

4.6 Northern Vadose Zone Investigative Unit

The Northern Vadose Zone Investigative Unit consists of approximately 14 acres north of the reactor inner-fence line (Figure 5). There are three subunits contained within the Northern Vadose Zone Investigative Unit (Table 2):

- P-Area Process Sewer Lines as Abandoned (portions);
- PSA 2: Area around the Cooling Water Effluent Sumps (107-P/107-1P); and
- PSA 3B: Area west of the Administrative/Maintenance slab.

Piping layout drawings are currently being reviewed to determine the use of the pipelines present in the Northern Vadose Zone Investigative Unit.

Each of the facilities within the Northern Vadose Zone Investigative Unit has undergone, or will undergo decommissioning. Based on the FDE process there are two Simple Model facilities: the Administrative and Maintenance Building (704-P) and the Equalization Basin (607-24P). One facility has been classified as an Integrated Sampling Model: the Chemical Feed Facility (607-22P). The 607-22P facility contained water-quality process chemicals that consisted of soda ash, calcium hypochlorite, and sodium hypochlorite. No confirmatory sampling was required for the 607-22P facility.

Three facilities within the Northern Vadose Zone Investigative Unit have not been evaluated through the FDE process: the Area Gatehouse and Patrol Headquarters (701-1P); a Primary Substation (151-1P); and the Cooling Water Effluent Sump (107-P).

Previous groundwater investigations have identified a tritium/VOC plume that emanates from within the Northern Vadose Zone Investigative Unit. Groundwater investigations have identified an area around the Cooling Water Effluent Sump (107-P) as a potential source to the plume (PSA-2). Investigation of the 107 Cooling Water Effluent Sumps will also include investigation of the process sewer lines. An additional source appears to emanate from the area west of the Administrative/Maintenance slab (PSA-3B).

There does not appear to be a surficial risk issue related to the Northern Vadose Zone Investigative Unit. Surface sampling will be performed to determine investigative unit-specific background concentrations.

4.6.1 P-Area Process Sewer Line as Abandoned (portions)

A limited portion of the process sewer lines are included within this investigative unit the sewer lines extends from the P-Reactor fence to the discharge canals. Section 4.1.3 discusses the proposed sampling strategy, Problems Warranting Action, Remedial Action Objectives, Scope of Problem Warranting Action, Likely Response Actions, and Uncertainty associated with the process sewer lines.

4.6.2 PSA 2: Area around the Cooling Water Effluent Sumps (107-P/107-1P)

PSA 2 is located in the area around the Cooling Water Effluent Sumps (107-P/107-1P) which received cooling water effluent discharges from the Reactor Building (105-P) (Figure 3). Previous groundwater data collected via DPT methods near these sumps indicate localized elevated activities for gross alpha and nonvolatile beta emitters above the MCL of 15 and 50 pCi/L, respectively. However, these elevated levels could be caused by naturally occurring radionuclides present in suspended sediment in the CPT groundwater samples which are unfiltered and often turbid. Tritium can also interfere with nonvolatile beta analyses.

No soil samples have been collected near the Cooling Water Effluent Sumps nor have water and sediment samples been collected from the sumps. Based on sump design and process history, it is unlikely that the sumps overflowed or leaching occurred through the sumps into subsurface soils. It is also unknown if the localized groundwater contamination originates from the sumps or upgradient of the sumps. In addition, there are no groundwater monitoring wells in the area to provide long-term monitoring or to provide confirmation of the previously collected DPT groundwater samples.

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Potential releases from the Cooling Water Effluent Sumps may have resulted in subsurface soil contamination and subsequent leaching to groundwater (Figure 13). Potential contaminants based on process history may include metals and radionuclides.

Characterization of the Cooling Water Effluent Sumps (107-P/107-1P) will be performed as part of the process sewer lines investigation as outlined in section 4.1.3. The proposed characterization for PSA 2 pertains to subsurface soils and groundwater in the vicinity of the sumps. Characterization activities associated with the process sewer lines and PSA 2 will be used in conjunction to determine the source to the groundwater contamination.

Proposed sampling will entail subsurface soil sampling around the Cooling Water Effluent Sumps (Figure 14). Surface soil background samples will also be collected. The collection of unit specific background surface soil samples is subject to approval of the SRS background soil protocol. Table 5 summarizes the sampling strategy for this subunit. Each sample will be analyzed for TAL inorganics (metals), radionuclide indicators (gross alpha and nonvolatile beta emitters), and tritium. In the event the trigger levels for gross alpha activity (20 pCi/g) and nonvolatile beta activity (50 pCi/g) are exceeded, radionuclide speciation will be performed. A minimum of 5 to 20 locations are planned for this subunit. A groundwater sample will also be collected a select locations and analyzed for TCL VOCs, TAL inorganics (metals), radionuclide indicators, and tritium. In the event the trigger levels for gross alpha activity (15 pCi/L) and nonvolatile beta activity (50 pCi/L) are exceeded, radionuclide speciation will be performed.

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Inserted: *NOTE: Add statement about bkg study.*

Problems Warranting Action

- Radiological constituents may be present in subsurface soil and may exceed PTSM criteria of $1x10^{-3}$ industrial risk.
- Radiological constituents may be present in subsurface soils may leach to groundwater, and may exceed MCLs in less than 1000 years.

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Remedial Action Objectives

- Prevent human exposure to radiological constituents in subsurface soils that exceed PTSM criteria.
- Reduce or mitigate leaching of radiological constituents in subsurface soil at levels that would exceed groundwater MCLs.

Scope of Problem Warranting Action

- To be determined during further investigation.

Likely Response Actions

- Institutional Controls
- Cover
- Excavation

Uncertainty

- It is uncertain if contamination exists in subsurface soils that would exceed contaminant migration and PTSM screening target levels. This uncertainty affects whether a problem warranting action exists that would require a response action. This uncertainty will be addressed through soil sampling/analysis and further evaluation using the contaminant migration and PTSM protocols.

4.6.3 PSA 3B: Area West of the Administrative/Maintenance Slab

Previous soil-gas and soil investigations at PSA 3B have indicated that PCE is the primary VOC present in the soil. The highest PCE concentrations are exhibited in an area west of the Administrative/Maintenance slab (Figure 3). In particular, the highest PCE concentration exhibited in the soil was 1.4 mg/kg, in a sample near a storm water sewer line.

Groundwater data from previous investigations and from existing groundwater monitoring wells indicate the presence of VOCs and tritium. Maximum PCE concentrations in the groundwater were determined to be 2.5 mg/L.

Releases within PSA 3B have resulted in subsurface soil contamination which is contributing to the existing VOC groundwater plume (Figure 13).

Proposed sampling will entail subsurface soil-gas sampling at a minimum of 5 to 50 locations with samples collected every 1.5 m (5 ft) starting at a depth of 3 m (10 ft) (Figure 14). Each sample will be analyzed for VOCs. Based on the outcome of the soil-gas sampling, select soil-gas locations will be identified and soil samples collected. Soil samples will be collected starting at 3 m (10 ft) and collected every 0.3 m (1ft) down to a depth of 14.6 m (48 ft). Each sample will be analyzed for VOCs. Surface soil background samples will also be collected. The collection of unit specific background surface soil samples is subject to approval of the SRS background soil protocol. Groundwater samples will be collected at a select number of sampling locations and analyzed for VOCs, radionuclide indicators, and tritium. Table 5 summarizes the sampling strategy for this subunit. Geotechnical samples that can be used to support a future remedial actions are also planned at selected locations.

Problems Warranting Action

- VOC contamination is present in the vadose zone and can act as a continuing source of groundwater contamination exceeding the MCL (5.0 ug/L).

Remedial Action Objectives

- Reduce VOCs in the vadose zone to levels that will not exceed the MCL in groundwater.

Scope of Problem Warranting Action

- To be determined through additional characterization.

Likely Response Actions

- Institutional Controls
- SVE
- Electrical Resistance Heating
- Enhanced Bioremediation

Uncertainty

- Sufficient characterization has not been completed to determine the extent of vadose contamination. This uncertainty will be resolved by additional sampling during the characterization.
- It is uncertain if sufficient contaminant concentrations exist in subsurface soils to exceed contaminant migration screening target levels. This uncertainty affects whether a problem warranting action exists that would require a response action. This uncertainty will be addressed through soil sampling/analysis and further evaluation using the contaminant migration protocol.

4.7 Southern Vadose Zone Investigative Unit

The Southern Vadose Zone Investigative Unit consists of approximately 40.0 acres south of the reactor inner-fence line. There are no RCRA/CERCLA waste units contained within the Southern Vadose Zone Investigative Unit (Table 2). However, this investigative unit is comprises two localized areas in the southwestern part of P Area (PSA 5) (Figure 3).

There are two facilities within the Southern Vadose Zone Investigative Unit that will undergo decommissioning: Primary Substation (151-2P) and the Heavy Water Storage Facility (105-13P).

Previous groundwater investigation has identified a potential VOC plume within the Southern Vadose Zone Investigative Unit at an area designated as PSA 5. There does not appear to be a surficial risk issue related to the Southern Vadose Zone Investigative Unit. Surface sampling will be performed to determine unit-specific background concentrations.

4.7.1 PSA 5: Two localized areas in the southwestern part of P Area

This area focuses on two small areas in the southwestern part of P Area where low levels of PCE in the groundwater exceed the MCL (5 μg/L) (Figure 3). These areas were delineated by previous DPT groundwater investigations. These localized groundwater areas are not located near any known facilities.

Releases within PSA 5 may have resulted in subsurface soil contamination and may be leaching to the groundwater (Figure 13).

Proposed sampling will entail subsurface soil-gas sampling at a minimum of 5 to 50 locations with samples collected every 1.5 m (5 ft) starting at a depth of 3 m (10 ft) (Figure 14). Each sample will be analyzed for VOCs. Based on the outcome of the soil-gas sampling, select soil-gas locations will be identified and soil samples collected. Soil samples will be collected starting at 3 m (10 ft) and collected every 0.3 m (1ft) down to a depth of 14.6 m (48 ft). Each sample will be analyzed for VOCs. Surface soil background samples will also be collected. The collection of unit specific background surface soil samples is subject to approval of the SRS background soil protocol. Groundwater samples will be collected at a select number of sampling locations and analyzed for VOCs, radionuclide indicators, and tritium. Table 5 summarizes the sampling strategy for this subunit.

Problems Warranting Action

- PCE contamination may be present in the vadose zone and may act as a continuing source of groundwater contamination in exceeding the MCL (5.0 ug/L).

Remedial Action Objectives

- Reduce PCE concentrations in the vadose zone to levels that will not exceed the MCL in groundwater.

Scope of Problem Warranting Action

- To be determined.

Likely Response Actions

- Institutional Controls
- SVE

Uncertainty

- Uncertainty is associated with the identification of any source for these localized groundwater plume areas and whether the PCE concentrations are indicative of a long-term groundwater problem or an artifact from sampling and analytical activities.

Sufficient characterization has not been completed to determine if the source of PCE is continuing or depleted. This uncertainty affects the scope of the problem warranting action. This uncertainty will be resolved by additional sampling during the characterization.

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- It is uncertain if contamination exists in subsurface soils that would exceed contaminant migration screening target levels. This uncertainty affects whether a problem warranting action exists that would require a response action. This uncertainty will be addressed through soil sampling/analysis and further evaluation using the contaminant migration protocol.

5.0 Operable Unit Strategy

The PAOU Work Plan is proposed to be submitted by 3/2/2006. The project team proposes to submit a focused work plan to facilitate starting characterization as soon as possible.

A groundwater monitoring strategy will be discussed in conjunction with the post-characterization scoping meeting.

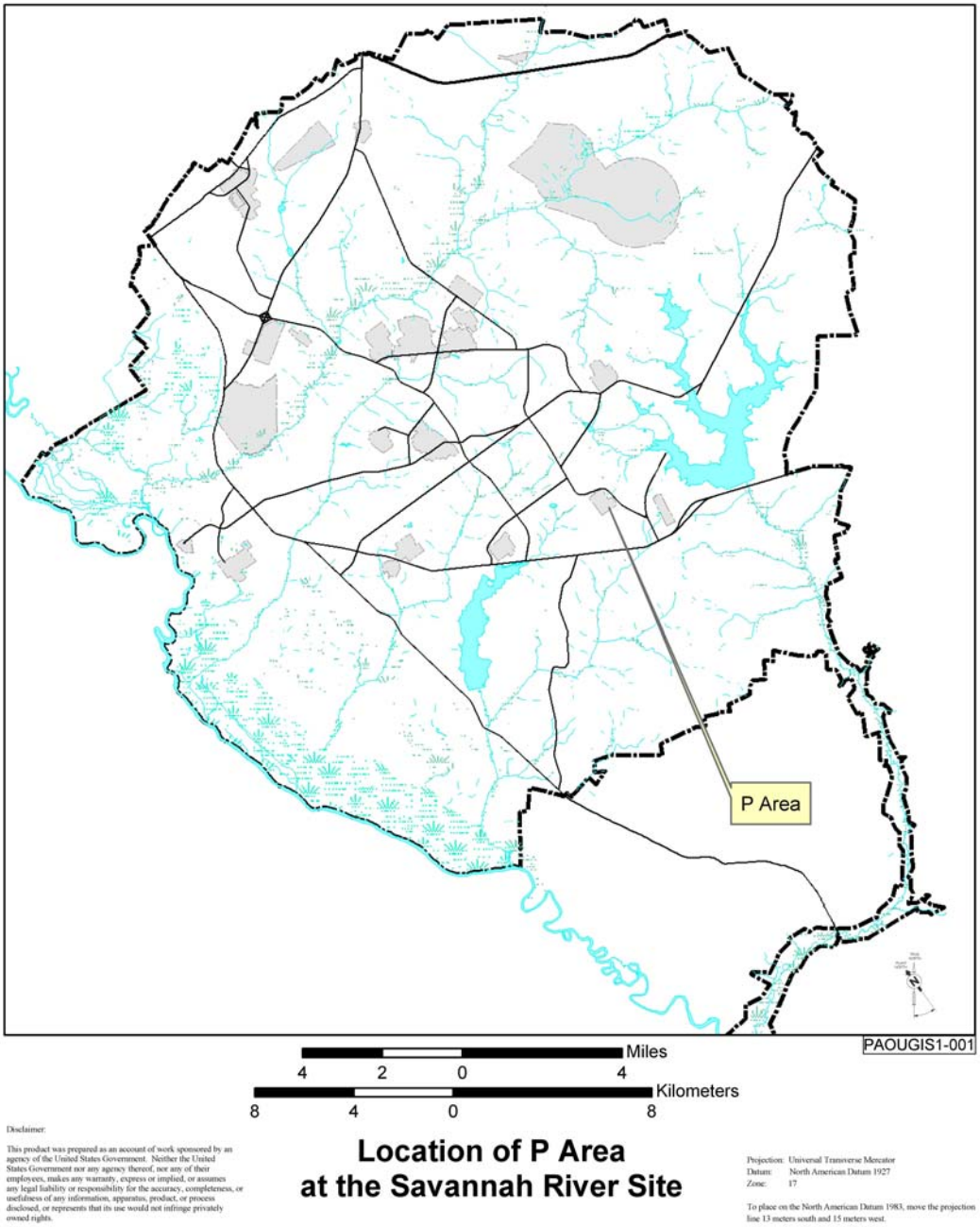

Figure 1: Location of P Area

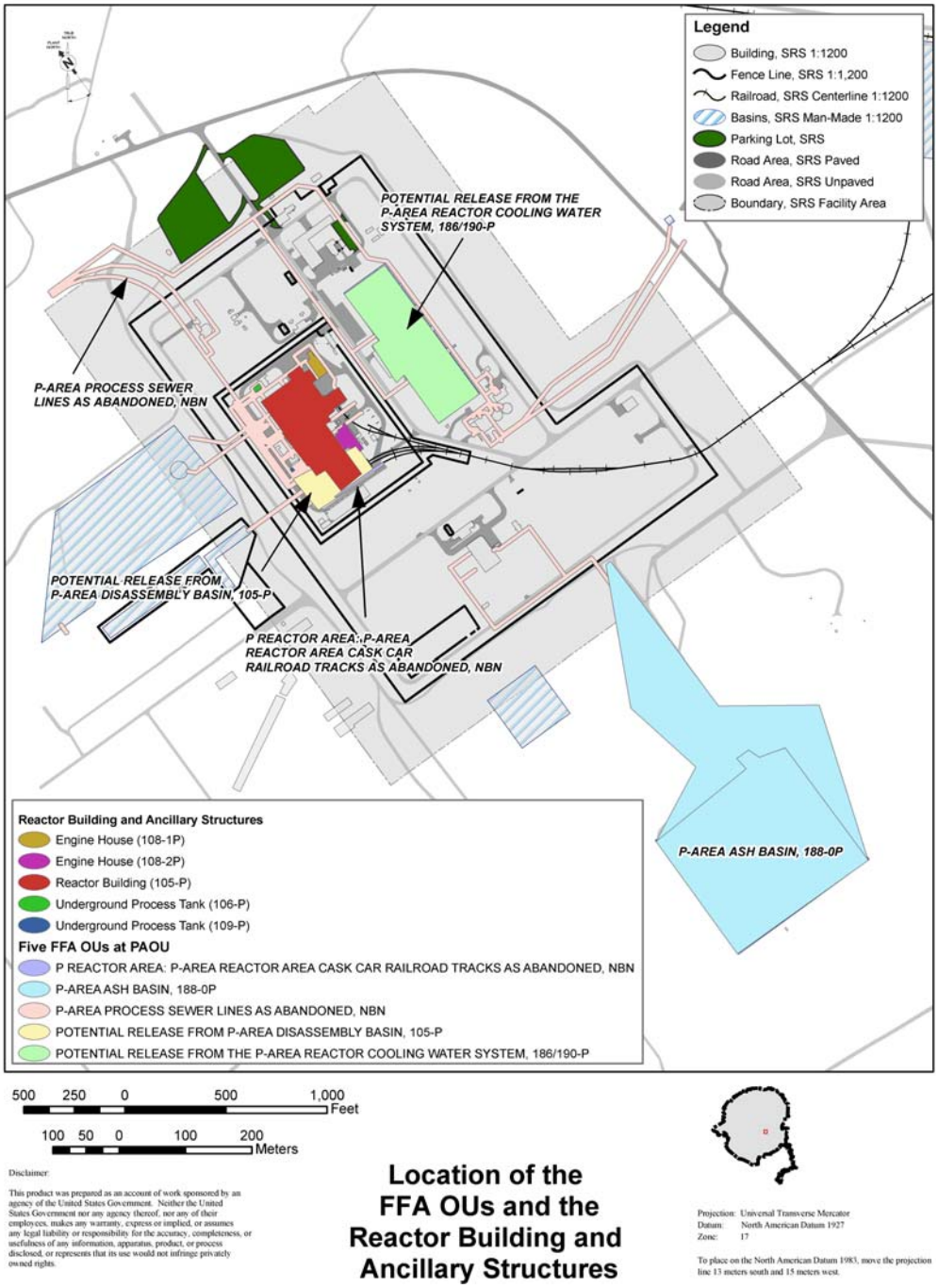

Figure 2: Location of FFA OUs and Reactor Building

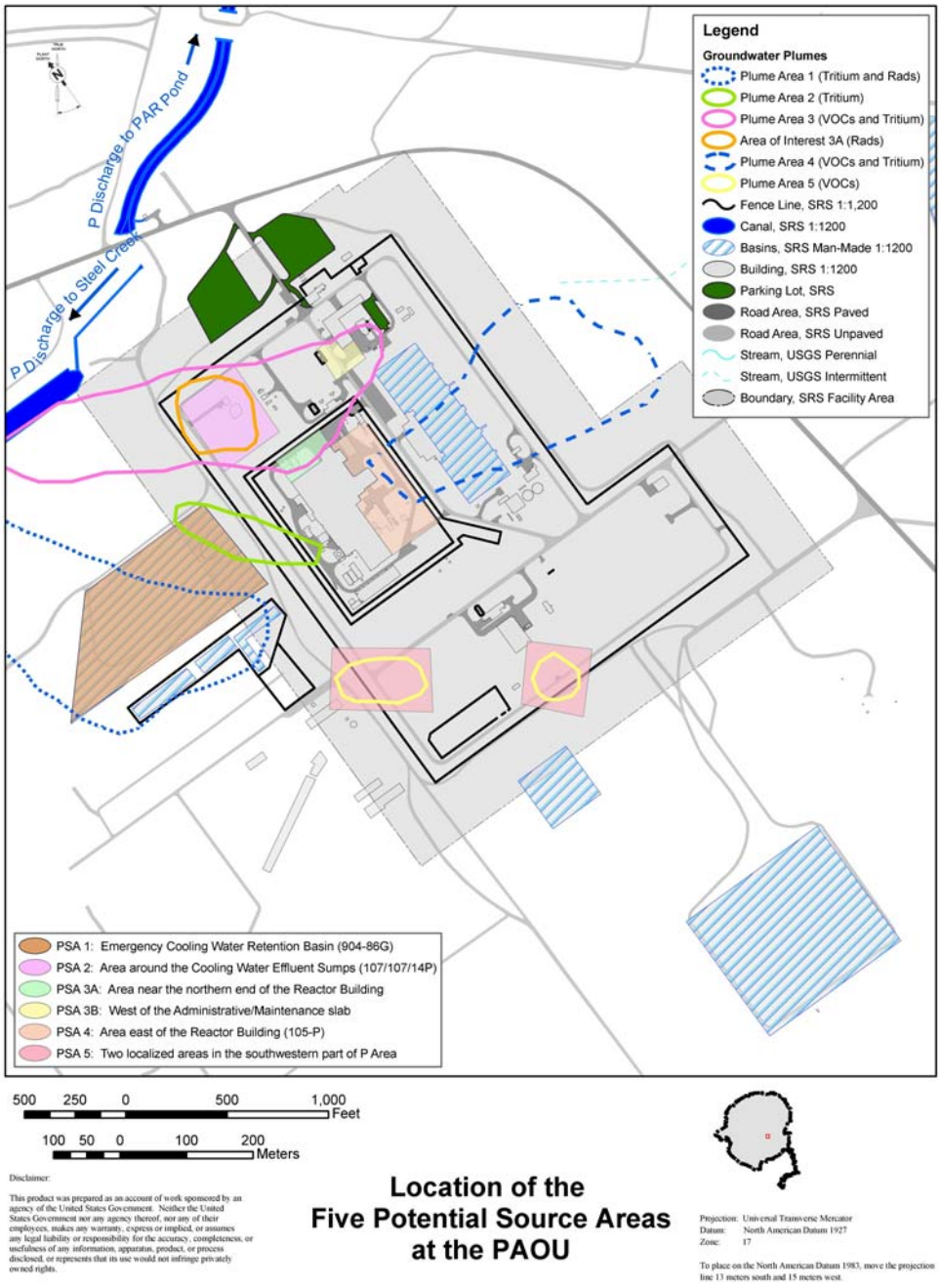

Figure 3: Location of PSAs

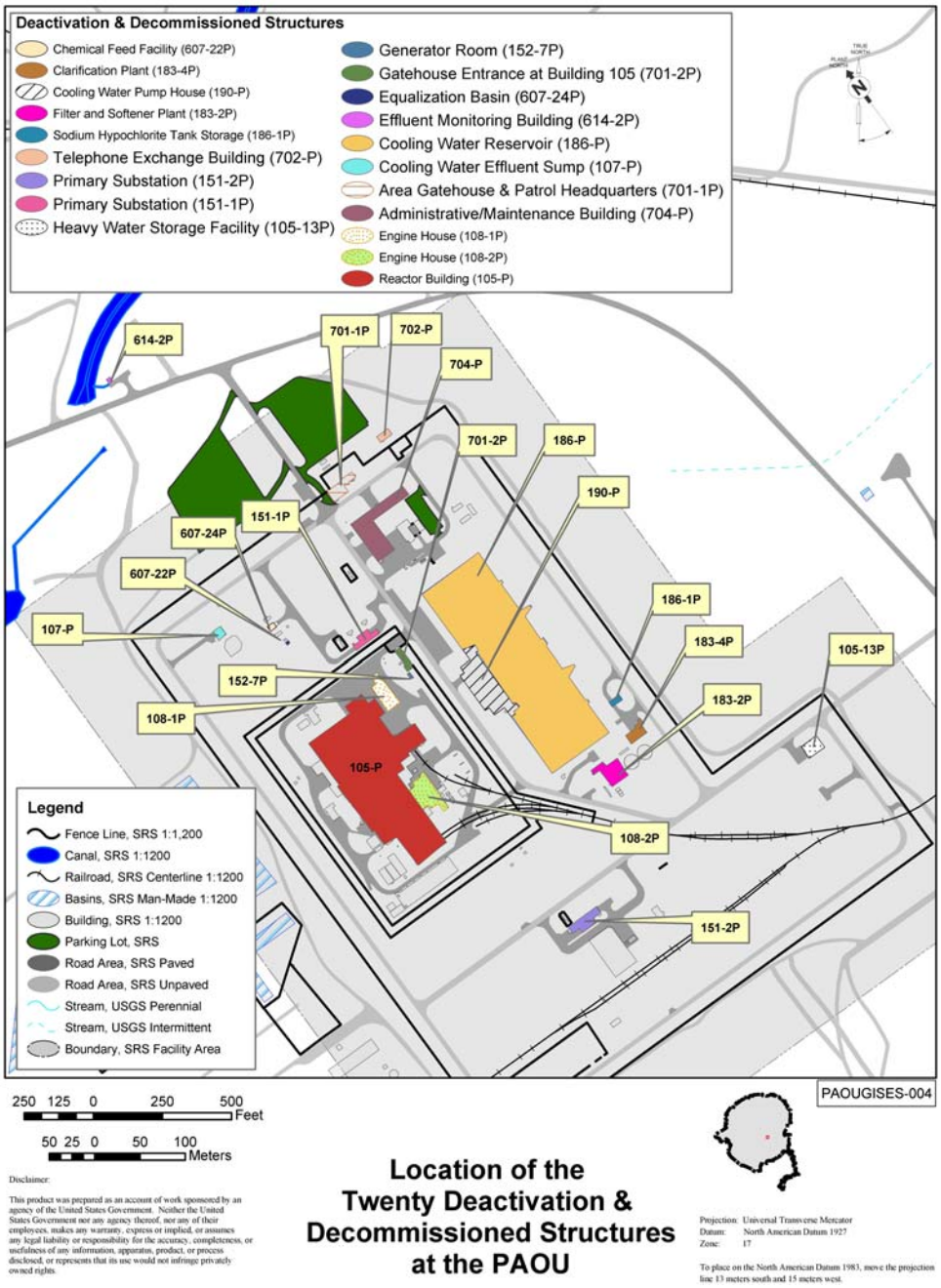

Figure 4: Location of the 20 D&D Structures

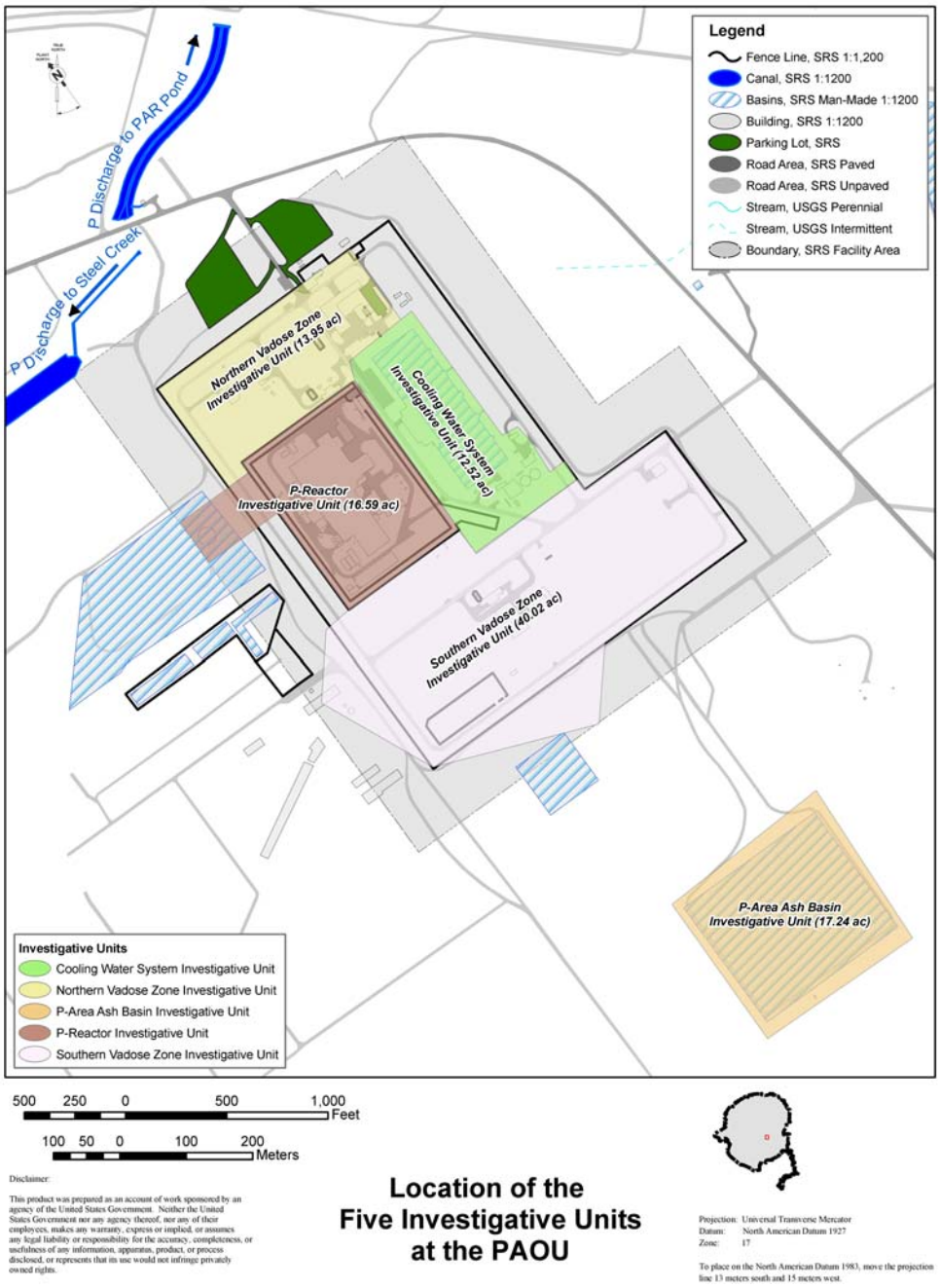

Figure 5: Location of Investigative Units

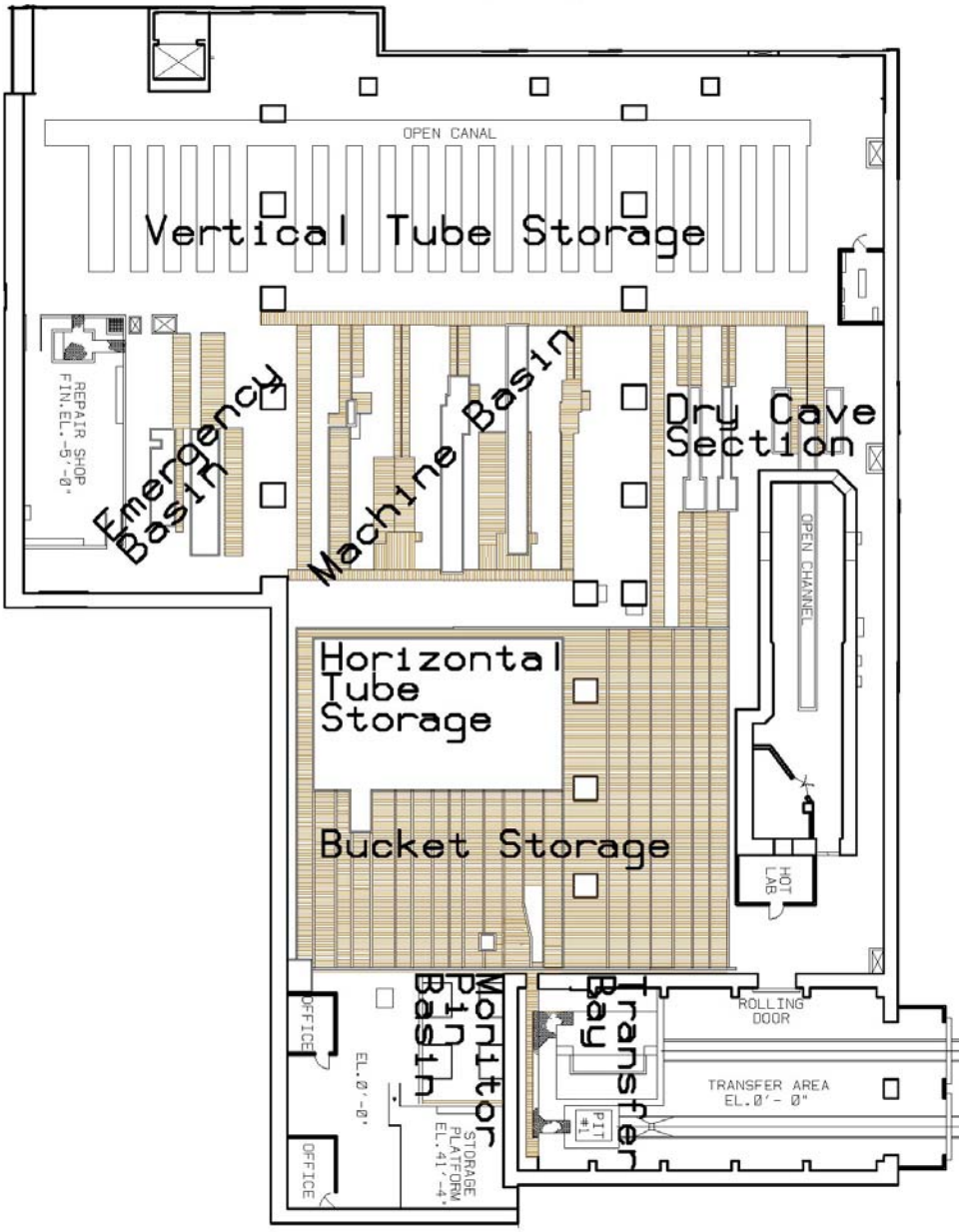

Figure 6: Disassembly Basin Layout

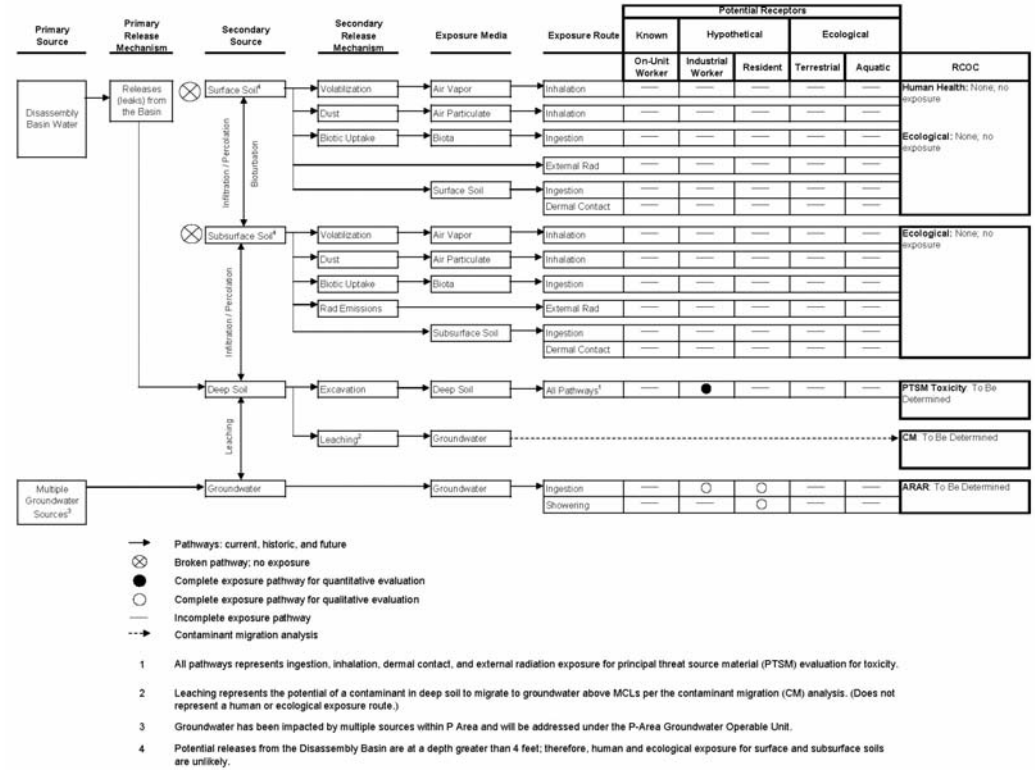

Figure 7: Conceptual Site Model for the Potential Release from the Disassembly Basin

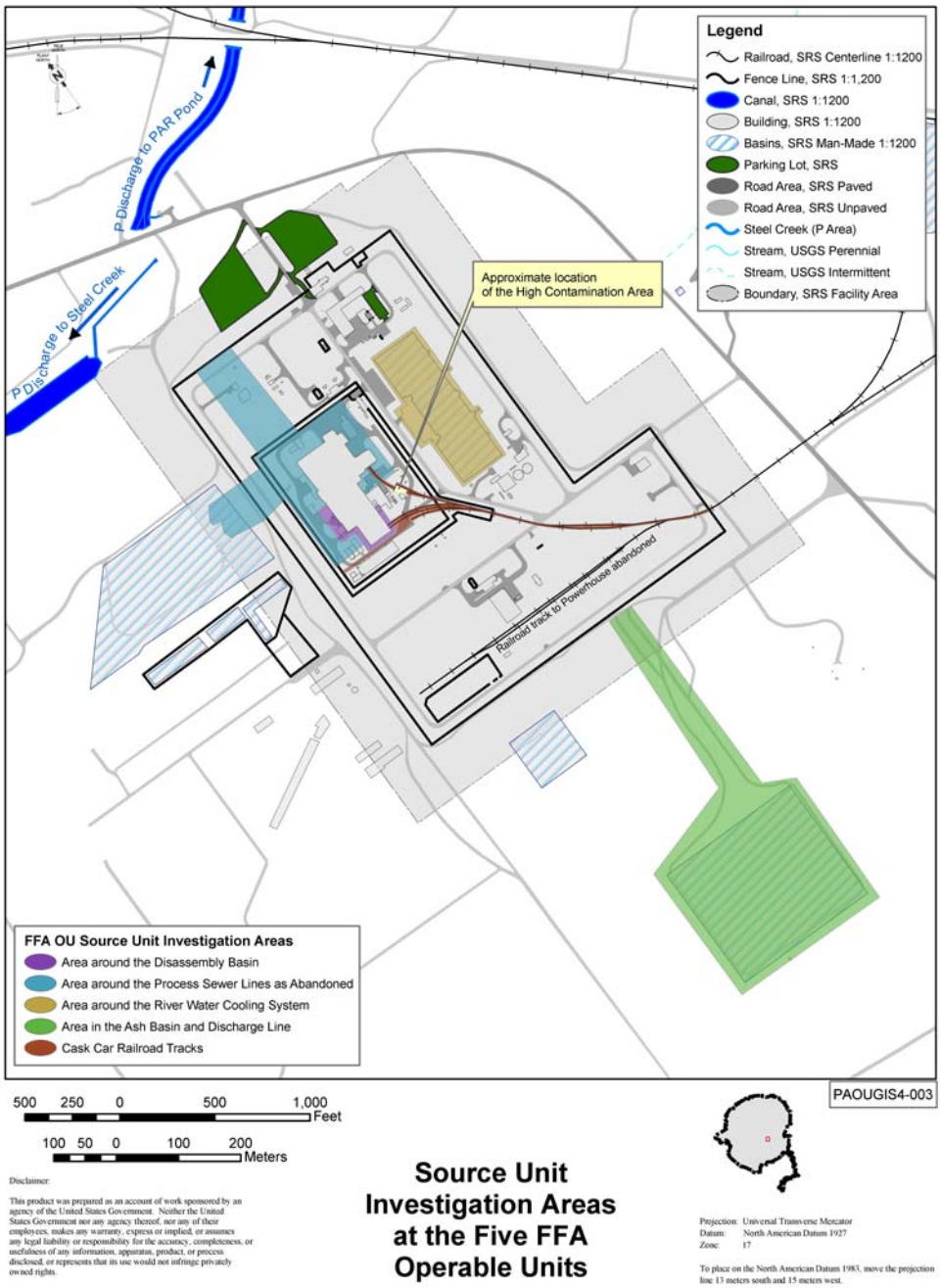

Figure 8: Location of the FFA OU Sampling Areas

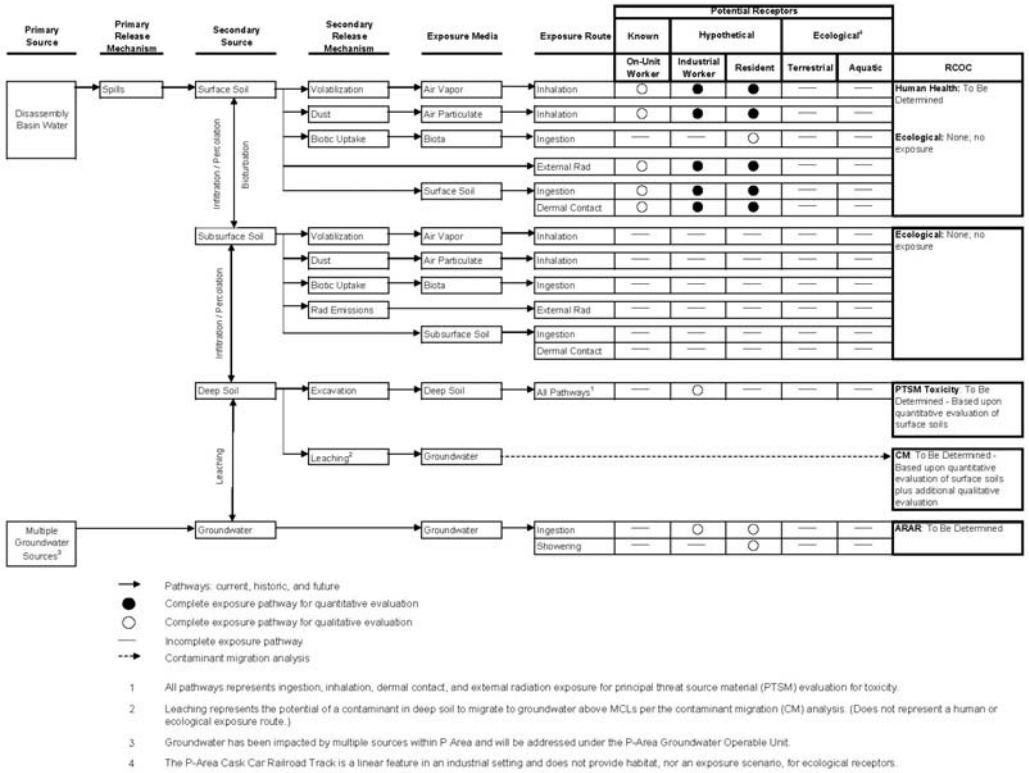

Figure 9: Conceptual Site Model for the Cask Car Railroad Tracks

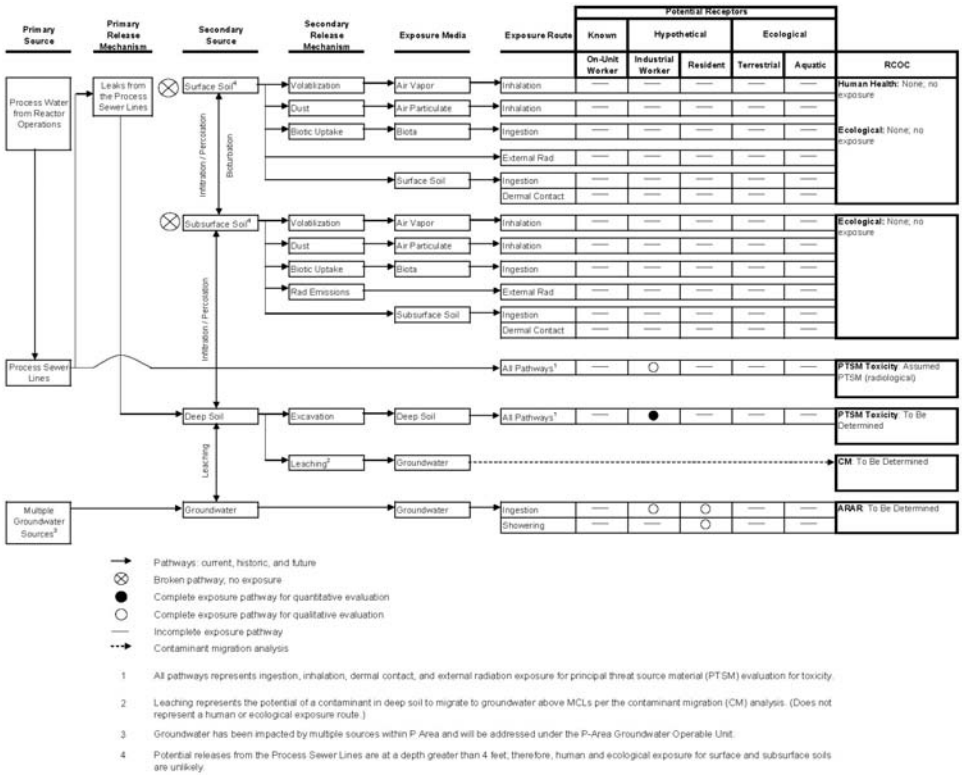

Figure 10: Conceptual Site Model for the Process Sewer Lines as Abandoned

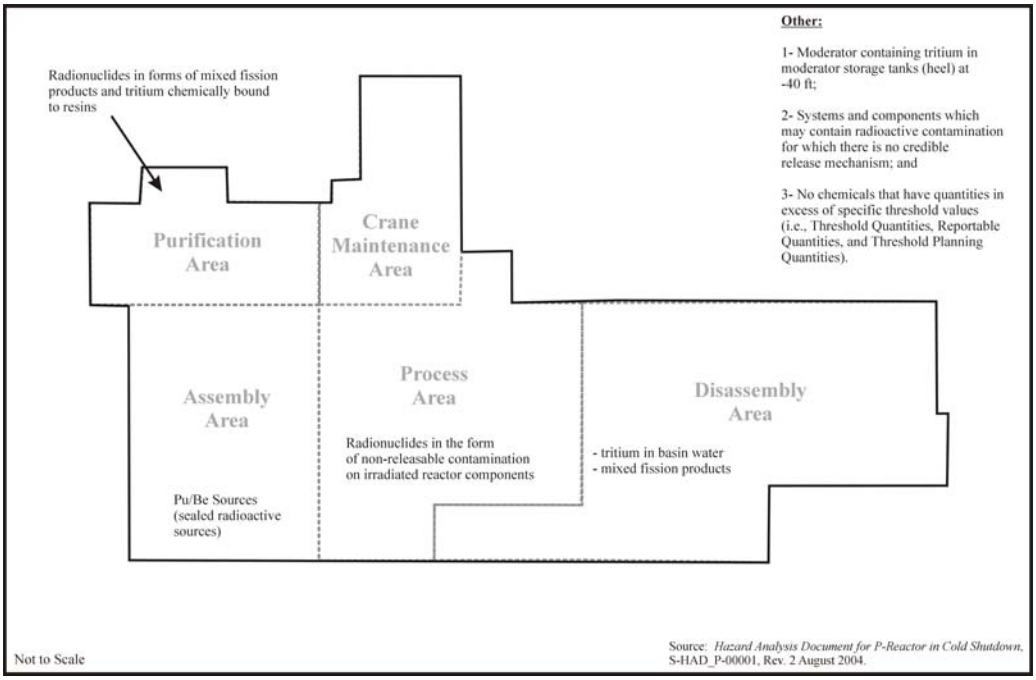

Figure 11: P-Reactor Hazard Assessment

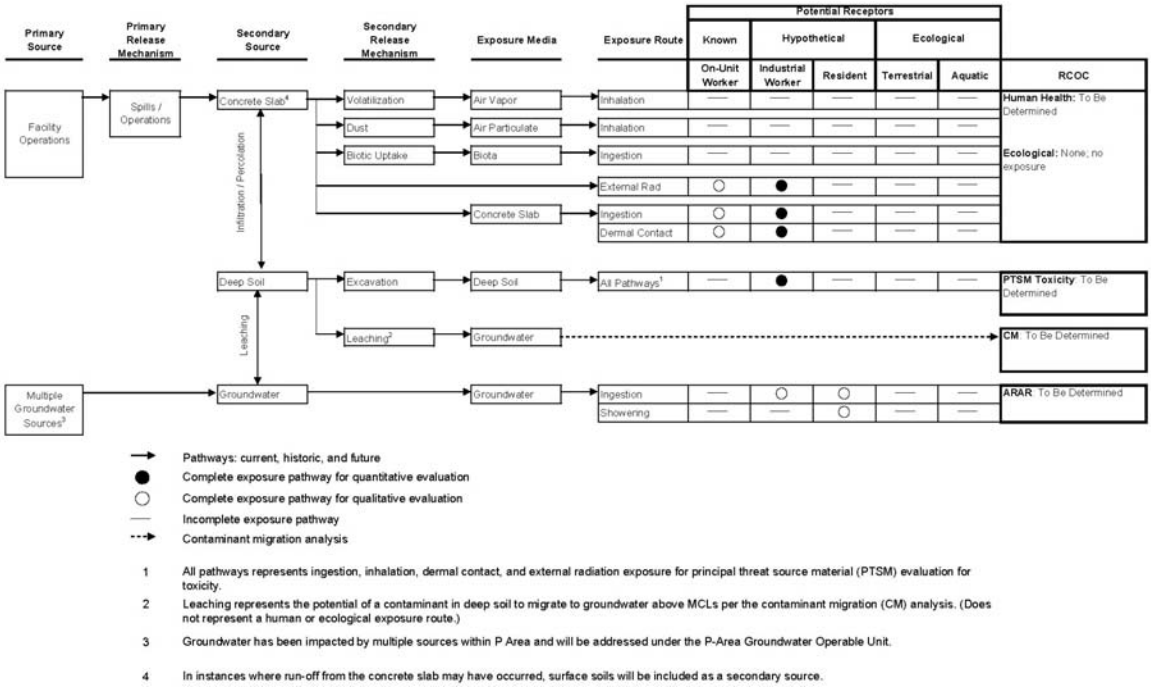

Figure 12: Conceptual Site Model for the Reactor Building

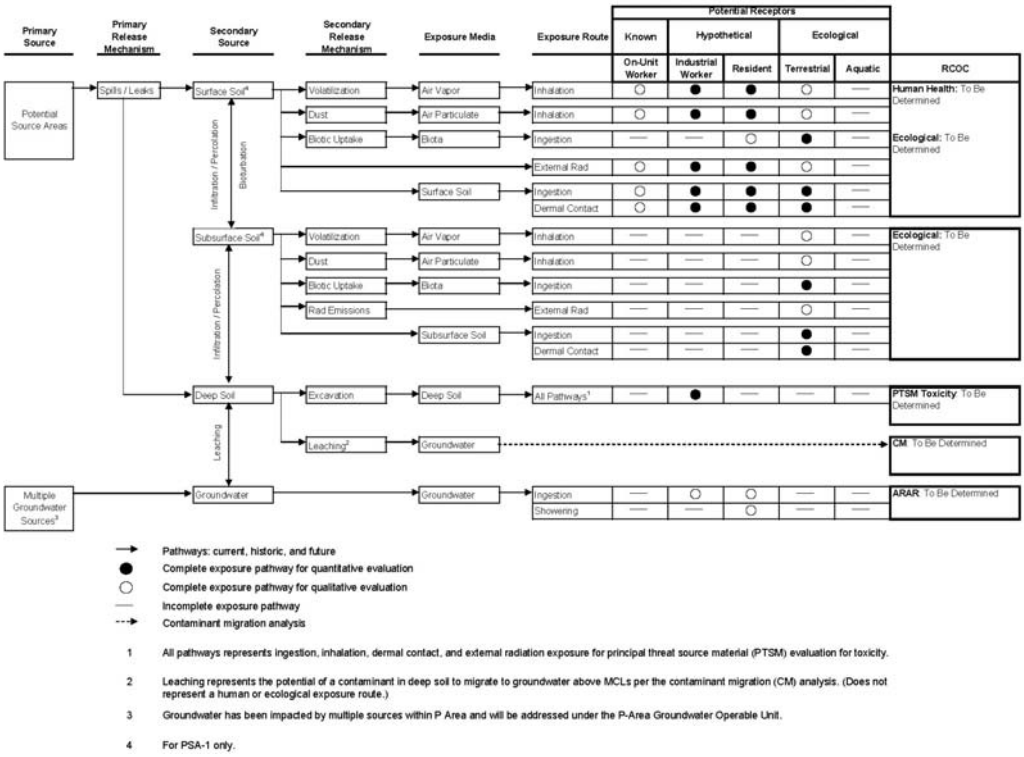

Figure 13: Conceptual Site Model for the Potential Source Areas

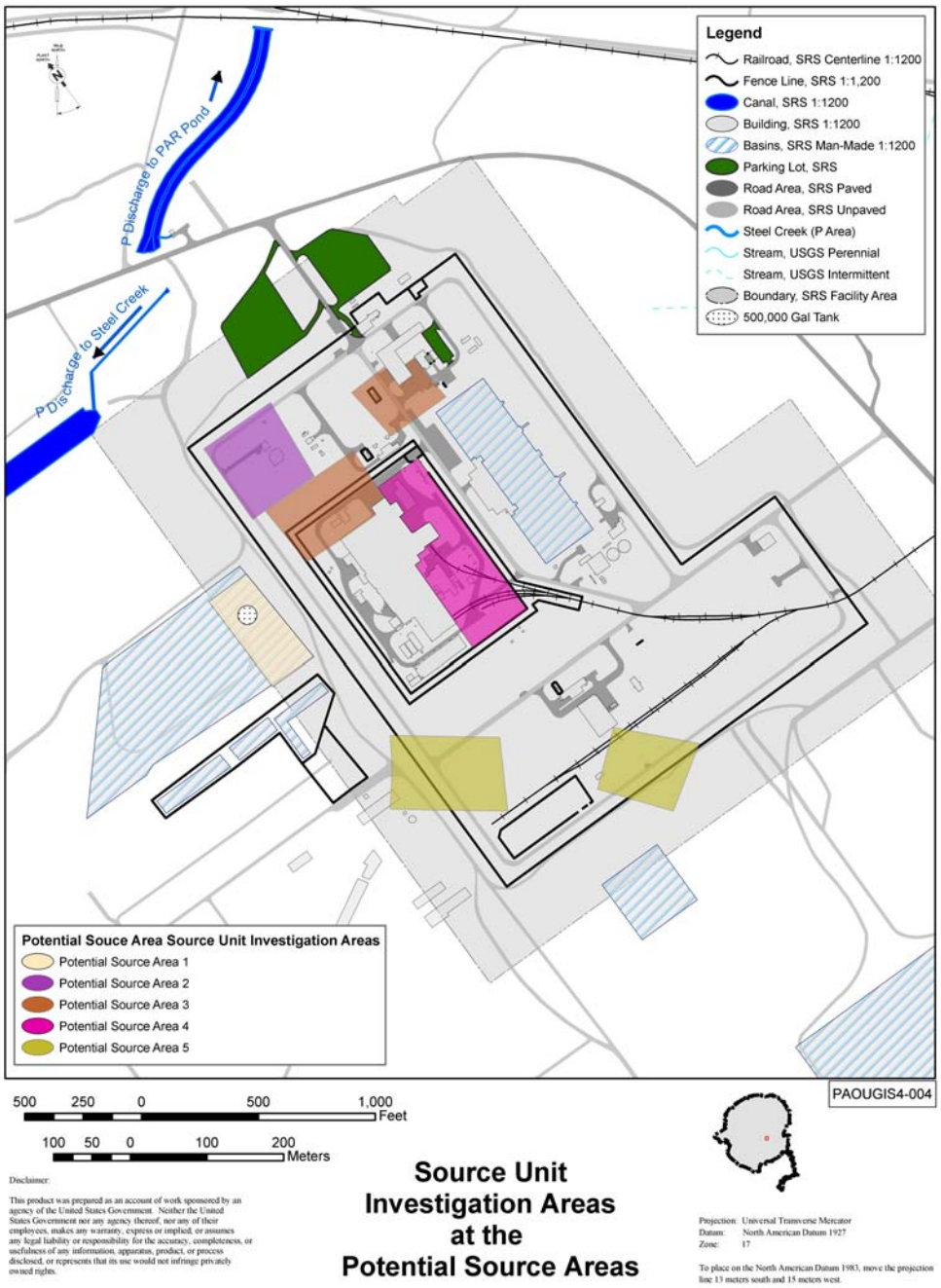

Figure 14: PSA Sampling Areas

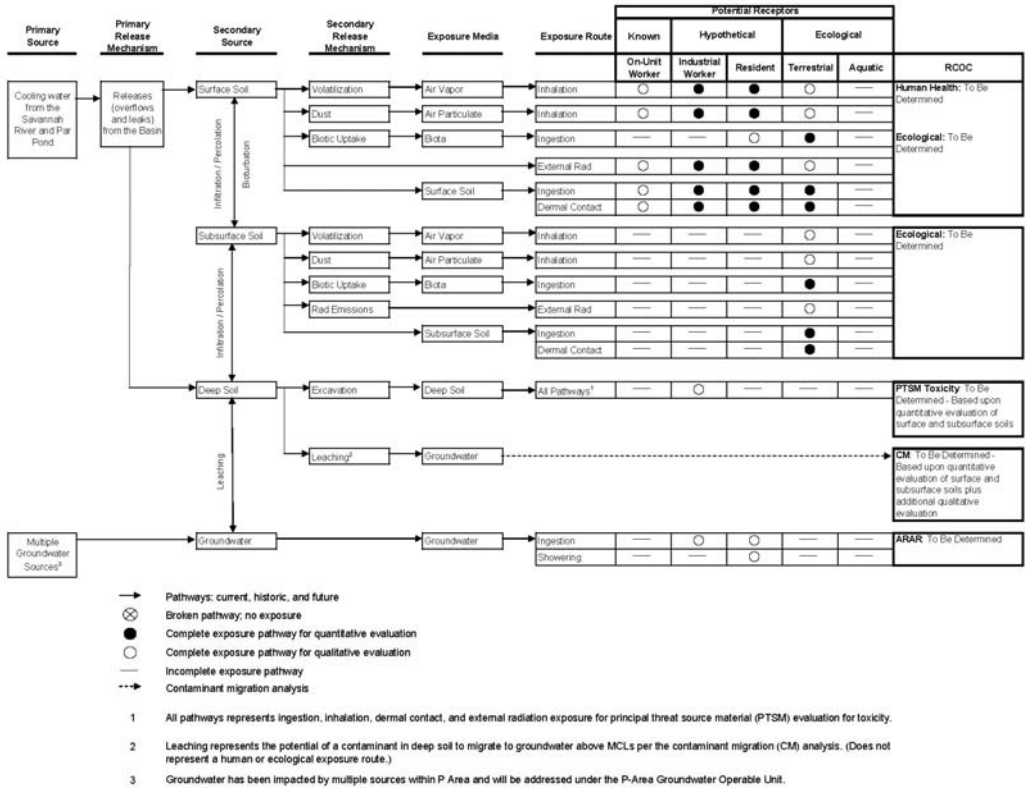

Figure 15: Conceptual Site Model for the Reactor Cooling Water System

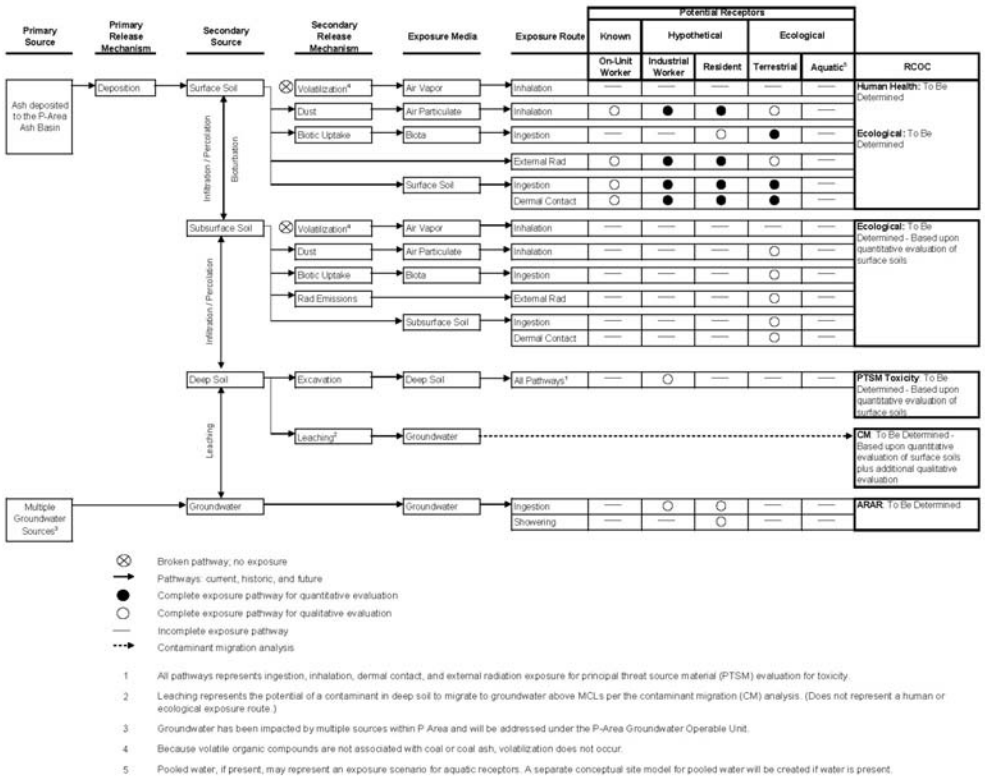

Figure 16: Conceptual Site Model for the Ash Basin

Table 1: List of the 20 D&D Structures

Structure Name	Model	Decommissioned Date
Adminstration and Service Building (704-P)	Simple Model	complete
Cooling Water Pump House (190-P)	Integrated Sampling Model	complete
Cooling Water Reservoir (186-P)	Simple Model	complete
Effluent Monitoring Building	Simple Model	complete
Gatehouse Entrance for 105-P Building (701-2P)	Simple Model	complete
Generator Room (152-7P)	(1)	complete
Cooling Water Effluent Sump (107-P)	(2)	complete
Chemical Feed Facility (607-22P)	Integrated Sampling Model	FY2006
Clarification Facility (183-4P)	Integrated Sampling Model	FY2006
Equalization Basin (607-24P)	Simple Model	FY2006
Filter and Softener Plant (183-2P)	Integrated Sampling Model	FY2006
Sodium Hypochlorite Tank Storage (186-1P)	Integrated Sampling Model	FY2006
Area Gatehouse & Patrol Headquarters (701-1P)	TBD	post FY2006
Engine Houses (108-1P and 108-2P)	TBD	post FY2006
Heavy Water Storage Facility (105-13P)	TBD	post FY2006
Primary Substations (151-1/151-2P)	TBD	post FY2006
Reactor Building (105-P)	TBD	post FY2006
Telephone Exchange and Services Building (702-P)	TBD	post FY2006

(1) Structure removed as an unit and sent to salvage for sale as an asset. Therefore, no Facility Decommissioning Evaluation (FDE) conducted.

(2) Project involves simple equipment dismantlement and removal. Sump to be assessed by PAOU characterization.

Table 2: Summary of Investigative Units with Identified Subunits

INVESTIGATIVE UNIT:	REACTOR INVESTIGATIVE UNIT	COOLING WATER SYSTEM INVESTIGATIVE UNIT	NORTHERN V. INVESTIGA		
FFA Operable Units:	▪ Potential Release from the P-Area Disassembly Basin ▪ P-Area Reactor Cask Car Railroad Tracks as Abandoned ▪ P-Area Process Sewer Lines as Abandoned (portions)	▪ Potential Release from the P-Area Reactor Cooling Water System ▪ P-Area Process Sewer Lines as Abandoned (portions)	▪ P-Area Proces Abandoned (p		
Simple Model Facilities:	▪ Gatehouse Entrance at Building 105-P, 701-2P	▪ Cooling Water Reservoir, 186-P	▪ Administrative Maintenance E ▪ Equalization B		
Integrated Sampling Model Facilities:		▪ Filter and Softener Plant, 183-2P ▪ Clarification Plant, 183-4P ▪ Sodium Hypochlorite Tank Storage, 186-1P ▪ Cooling Water Pump House, 190-P	▪ Chemical Fee 22P		
Other Facilities / To Be Determined:	▪ Reactor Building, 105-P (including the Process Water Storage Tank, 106-P and the Purge Water Storage Basin, 109-P ▪ Engine Houses, 108-1P and 108-2P ▪ Generator Room, 157-2P		▪ Area Gatehou Headquarters, ▪ Primary Substa ▪ Cooling Water 107-P		
Potential Source Areas:	▪ Area around the water storage tank in the Emergency Cooling Water Retention Basin, PSA-1 ▪ Area north of the Reactor Building, PSA-3A ▪ Area west of the Reactor Building, PSA-4		▪ Area around Water Effluen -1P, PSA-2 ▪ Area west of PSA-3B		

The above text has been highlighted to indicate the FFA operable units, facilities that comprise the PAOU, and the PSAs that comprise the in

Table 3: Disassembly Basin Aqueous Curie Content and Concentrations Compared to MCLs

Radionuclide	Half-Life	Ci*	Percent	Mean Concentration (pCi/L)	MCL (pCi/L)	>MCL (in basin)	Present in Groundwater
Americium-241	432.7y	8.25E-06	0.000%	4.82E-01	15	NO	NO
Americium-243	7370y	8.40E-06	0.000%	4.92E-01	15	NO	NO
Antimony-124	60.2d	1.21E-03	0.000%	7.08E+01	60	YES	NO
Antimony-125	2.758y	2.78E-03	0.000%	1.96E+02	300	NO	NO
Carbon-14	5714y	1.64E-02	0.000%	9.54E+02	2000	NO	NO
Cesium-134	2.065y	1.23E-03	0.000%	7.20E+01	80	NO	NO
Cesium-137	30.07y	1.01E+00	0.020%	5.89E+04	200	YES	NO
Cobalt-60	5.271y	2.34E-03	0.000%	1.37E+02	100	YES	NO
Iodine-129	1.57E7y	7.18E-05	0.000%	4.19E+00	1	YES	NO
Neptunium-237	2.14E6y	1.75E-05	0.000%	1.02E+00	15	NO	NO
Plutonium-238	87.7y	5.16E-04	0.000%	3.30E+01	15	YES	NO
Plutonium-239/240	2.4E4y	5.68E-05	0.000%	3.33E+00	15	NO	NO
Plutonium-241	14.4y	1.11E-03	0.000%	8.14E+01	27.1	YES	NO
Selenium-79	6.5E5y	9.71E-04	0.000%	5.68E+01	6.53	YES	NO
Strontium-90	28.78y	2.96E-01	0.006%	1.73E+04	8	YES	NO
Technetium-99	2.13E5y	3.44E-04	0.000%	2.01E+01	900	NO	NO
Tritium (H-3)	12.32y	4.95E+03	99.973%	2.72E+08	20000	YES	YES
Uranium-233/234	2.45E5y	2.55E-05	0.000%	1.49E+00	10	NO	NO
Uranium-235/236	7.04E8y	6.28E-06	0.000%	3.68E-01	0.47	NO	NO
Uranium-238	4.47E9y	1.46E-05	0.000%	8.53E-01	10	NO	NO
Total Uranium		6.97E-05	0.000%	4.08E+00	20.47	NO	NO
Total Curies		4.95E+03	100.00%				

*Curie estimates based on 4.1 million gallons of liquid in basin.

Source: Modified from WSRC, *Building 105-P Disassembly Basin Liquid and Sediment Sample Results* , WSRC-RP-2004-4543, Rev. 1 Jan. 2005

Table 4: Disassembly Basin Sediment Curie Content and Concentrations Compared to Soil Screening Levels

Radionuclide	Half-Life	Ci*	Percent	Mean Concentration (pCi/g)	Soil Screening Level (pCi/g)	Mean Travel Time (years)	Contaminant Migration Concern
Actinium-228	6.15h	1.16E-02	0.020%	1.40E+03	>1.00E+10	2.59E+04	NO
Amercium-241	432.7y	4.56E-02	0.079%	3.71E+04	6.61E+04	5.77E+03	NO
Amercium-243	7.37E3y	2.11E-02	0.037%	2.47E+03	10.9	5.77E+03	NO
Antimony-124	60.2d	4.50E-03	0.008%	2.98E+02	>1.00E+10	>100,000	NO
Antimony-125	2.758y	4.57E-03	0.008%	1.14E+03	>1.00E+10	>100,000	NO
Barium-133	10.7y	1.24E-03	0.002%	1.33E+02	NC	2.37E+03	NO
Californium-249	350y	1.19E-03	0.002%	1.41E+02	NC	NC	NA
Californium-251	900y	1.06E-02	0.018%	5.35E+02	NC	NC	NA
Carbon-14	5714y	1.18E+00	2.052%	1.80E+05	1.96E+02	1.16E+03	NO
Cerium-141	32.5d	2.16E-03	0.004%	1.99E+02	NC	NC	NA
Cerium-144	284.6d	4.75E-03	0.008%	4.93E+02	NC	NC	NA
Cesium-134	2.065y	2.02E-03	0.004%	2.34E+02	>1.00E+10	2.88E+04	NO
Cesium-135	2.3E6y	3.65E-03	0.006%	4.41E+02	NA	2.88E+04	NO
Cesium-137	30.07y	1.31E+00	2.278%	6.00E+04	>1.00E+10	2.88E+04	NO
Cobalt-57	271.8d	8.23E-03	0.014%	8.76E+02	>1.00E+10	5.82E+02	NO
Cobalt-58	70.88d	1.75E-03	0.003%	1.95E+02	NC	5.82E+02	NA
Cobalt-60	5.271y	2.86E+00	4.972%	2.15E+05	>1.00E+10	5.82E+02	NO
Curium-243/244	29.1y	1.11E-02	0.019%	2.07E+03	>1.00E+10	>100,000	NO
Curium-245	8.50E3y	2.26E-02	0.039%	3.71E+03	4.14E+08	>100,000	NO
Curium-246	4.76E3y	3.58E-02	0.062%	6.14E+03	4.14E+08	>100,000	NO
Europium-152	13.54y	5.09E-03	0.009%	1.37E+03	>1.00E+10	1.41E+04	NO
Europium-154	8.593y	4.20E-02	0.073%	4.45E+03	>1.00E+10	1.41E+04	NO
Europium-155	4.75y	3.75E-03	0.007%	5.68E+02	>1.00E+10	1.41E+04	NO
Iodine-129	1.57E7y	1.90E-04	0.000%	2.38E+01	1.57E-02	2.13E+02	YES
Lead-212	10.64h	2.69E-03	0.005%	3.13E+02	NC	1.56E+04	NO
Manganese-54	312.1d	2.98E-03	0.005%	3.46E+02	>1.00E+10	2.89E+03	NO
Neptunium-237	2.14E6y	7.96E-04	0.001%	1.57E+02	8.69E-01	5.82E+02	YES
Neptunium-239	2.355d	4.07E-03	0.007%	5.49E+02	>1.00E+10	5.82E+02	NO
Nickel-59	7.6E4y	4.92E-02	0.086%	4.89E+03	NC	3.75E+03	NO
Nickel-63	100y	1.29E+01	22.428%	1.80E+06	>1.00E+10	3.75E+03	NO
Niobium-94	2.0E4y	3.16E-03	0.005%	3.45E+02	NC	NC	NA
Plutonium-238	87.7y	1.72E+00	2.990%	2.98E+05	>1.00E+10	5.77E+03	NO
Plutonium-239/240	2.4E4y	9.70E-02	0.169%	1.97E+04	7.51E+00	5.77E+03	NO
Plutonium-241	14.4y	7.65E-01	1.330%	1.35E+05	NC	5.77E+03	NO
Plutonium-242	3.75E5y	2.47E-03	0.004%	8.90E+02	NC	5.77E+03	NO
Potassium-40	1.27E9y	5.89E-03	0.010%	8.22E+02	NA	4.33E+03	NO
Promethium-144	360d	1.07E-03	0.002%	1.21E+02	NC	NC	NA
Promethium-146	5.53y	1.56E-03	0.003%	1.61E+02	NC	NC	NA
Ruthenium-103	39.27d	1.97E-03	0.003%	1.85E+02	NC	NC	NA
Ruthenium-106	1.020y	2.11E-02	0.037%	2.44E+03	NC	NC	NA
Selenium-79	6.5E5y	8.76E-02	0.152%	7.51E+03	NC	3.17E+03	NO
Sodium-22	2.604y	7.29E-03	0.013%	7.84E+02	NC	NC	NA
Strontium-90	28.78y	1.41E-01	0.245%	3.27E+04	2.23E+04	4.67E+02	YES
Technetium-99	2.13E5y	1.27E-03	0.002%	1.85E+02	52.1	1.15E+01	YES
Tin-113	115.1d	1.53E-03	0.003%	1.58E+02	NC	NC	NA
Tin-126	2.5E5y	3.16E-03	0.005%	5.96E+02	NC	NC	NA
Tritium (H-3)	12.32y	3.56E+01	61.895%	8.58E+06	NA	5.76E+00	YES
Uranium-233	1.592E5y	1.13E-03	0.002%	1.32E+02	NC	2.31E+03	NO
Uranium-234	2.46E5y	9.40E-04	0.002%	1.18E+02	1.71E+00	2.31E+03	NO
Uranium-235	7.04E8y	6.31E-05	0.000%	1.09E+01	8.50E+02	2.31E+03	NO
Uranium-236	2.342E7y	1.51E-04	0.000%	2.32E+01	NC	2.31E+03	NO
Uranium-238	4.47E9y	4.01E-04	0.001%	5.38E+01	1.70E+00	2.31E+03	NO
Yttrium-88	106.65d	6.27E-04	0.001%	7.35E+01	NC	NC	NA
Zinc-65	243.8d	6.11E-03	0.011%	5.20E+02	>1.00E+10	3.58E+03	NO
Zirconium-95	64.02d	2.92E-03	0.005%	3.29E+02	>1.00E+10	3.46E+04	NO
Total Uranium		4.90E-01	0.852%	1.21E+05	NA	2.31E+03	NO
Total Curies		5.75E+01	100.00%				

*Curie estimates based on 4380 ft^3 of sludge volume

NC= Not calculated.

NA= Not applicable.

Source: Modified from WSRC, *Building 105-P Disassembly Basin Liquid and Sediment Sample Results*, WSRC-RP-2004-4543, Rev. 1 Jan. 2005

Table 5: Sampling Matrix Table

		Media to be Sampled						Analytes of Interest										
Investigative Unit	Unit	Soil-Gas	Surface Soil	Subsurface Soil	Sediment	Surface Water	Groundwater	Soil-Gas	Surface Soil	Subsurface Soil	Sediment	Surface Water	Groundwater	Other	Primary Source	Risk	Sampling Objectives	Sampling Locations
	FFA OUs:																	
P-Area Ash Basin	P-Area Ash Basin (188-0P)		X			X[(a)]	X		2, 3, 4, 5, 6, 7[(d)], 8			2, 3, 4, 5, 6, 7[(d)], 8, 9	2, 3, 6, 7[(d)], 9	Ash thickness to be determined. Visually inspect for coal reject material.	Deposition of Ash material from the P-Area Reactor Powerhouse. Ash to be treated as "soil".	Surface (human health and ecological)	Determine the presence of surface water, the extent and depth of ash in basin, the presence of coal rejects, nature and extent of contamination in surface water and ash material, and collection of groundwater samples	-Minimum of 5 to 20 locations within the basin -0 - 1 ft interval (assume homogeneity of ash) -Groundwater samples at select locations -If pH of groundwater is acidic, depth-discrete ash samples will be collected -Surface water, if present
P-Reactor	Potential Release from P-Area Disassembly Basin (105-P)		X (limited)	X			X			3, 6, 7[(d)]			1[(d)], 6, 7[(d)]		Release of water from leaks and spills around the exterior of the basin into subsurface soils	Subsurface (>4ft) (contaminant migration)	Determine nature and extent of contamination in subsurface soils and collection of groundwater samples	-Minimum of 5 to 30 locations to the exterior of the basin -Sampling depths of 28 to 30, 38 to 40, 46-48 ft bls -Groundwater samples at select locations
Cooling Water System	Potential Release from P-Area Reactor Water Cooling System (188/190-P)		X	X			X		3, 6, 7[(d)]	3, 6, 7[(d)]			1[(d)], 3, 6		Release of SR and PAR Pond cooling water from overflow of the basin and leaks in basins and sump well	Surface (human health and ecological) and Subsurface (>4ft) (contaminant migration)	Determine nature and extent of contamination in surface and subsurface soils and collection of groundwater samples	-Minimum of 5 to 30 locations to the exterior of the basin -Sampling depths of 0 to 1, 1 to 4, 10 to 12, 20 to 22, 28 to 30, 38 to 40, 46-48 ft bls -Groundwater samples at select locations
P-Reactor, Cooling Water System, Northern Vadose Zone	P-Area Process Sewer Lines As Abandoned (NBN)			X	X[(b)]	X[(b)]	X			3, 6, 7[(d)]	3, 6, 7[(d)]	3, 6, 7[(d)]	1[(d)], 6, 7[(d)]		Release from pipelines and the lines themselves	Subsurface (>4ft) (contaminant migration)	Determine the presence of water or sediment in sumps, nature of contamination in water or sediment in sumps, evaluate integrity of the lines, and nature and extent of contamination in subsurface soils	-Minimum of 5 to 50 locations near the PSLs -Sampling of sumps, if water or sediment present -Sampling depths of 4 to 6, 8 to 10, 18 to 20, 22 to 24, 28 to 30 ft bls
P-Reactor	P-Area Reactor Cask Car Railroad Tracks (NBN)		X				X		3, 6, 7[(d)]				1[(d)], 6, 7[(d)]	All existing railroad tracks to be radiologically surveyed	Release of cooling water containing irradiated fuel and target assemblies from Cask Cars	Surface (human health and ecological)	Perform radiological survey of tracks, cross ties, and up to 6 ft to either side of tracks and determine nature and extent of contamination in surface soils from radiological surveys and subsurface soils from within the HCA	-Radiological survey -Sampling depths of 0 to 1 and 1 to 4 ft bls
	Potential Source Areas:																	
P-Reactor	PSA 1: Emergency Cooling Water Retention Basin (904-86G)		X				X		3, 6, 7[(d)]				1[(d)], 3, 6, 7[(d)]		Spills and leaks from process-related activities and maintenance and infiltration/percolation from subsurface units	Surface (human health and ecological)	Determine nature and extent of contamination in surface soils near tank and collection of groundwater samples	-Minimum of 5 to 20 locations within basin near tank -Sampling depths of 0 to 1 and 1 to 4 ft bls -Groundwater samples at select locations
Northern Vadose Zone	PSA 2: Area around the Cooling Water Effluent Sumps (107/107-1P)		X[(b)]	X	(c)	(c)	X		2, 3, 4, 5, 6, 7, 8	3, 6, 7[(d)]			1[(d)], 3, 6, 7[(d)]	Background surface soil samples will be collected to define background soil concentrations for the Exposure Unit	Spills and leaks from process-related activities and maintenance and infiltration/percolation from subsurface units	Subsurface (>4ft) (contaminant migration)	Determine nature and extent of contamination in subsurface soils near sumps and collection of groundwater samples	-Minimum of 5 to 20 locations around the sumps -Sampling depths of 20 to 22, 28 to 30, 38 to 40, and 46 to 48 ft bls -Groundwater samples at select locations -Select number of surface soil sampling locations for background soil concentrations
P-Reactor	PSA 3A: Area near the northern end of the reactor building	X		X			X	1[(e)]		1[(e)(c)]			1[(d)], 6		Spills and leaks from process-related activities and maintenance and infiltration/percolation from subsurface units	Subsurface (>4ft) (contaminant migration)	Determine the presence of VOCs in subsurface soils, nature and extent of contamination in subsurface soils, and collection of groundwater samples	-Soil-Gas at a minimum of 5 to 50 locations -Soil sampling at select soil-gas locations -Groundwater samples at select locations -Geotechnical samples
Northern Vadose Zone	PSA 3B: West of the Administrative/Maintenance slab	X	X[(b)]	X			X	1[(e)]	2, 3, 4, 5, 6, 7, 8	1[(e)(c)]			1[(d)], 6	Background surface soil samples will be collected to define background soil concentrations for the Exposure Unit	Spills and leaks from process-related activities and maintenance and infiltration/percolation from subsurface units	Subsurface (>4ft) (contaminant migration)	Determine the presence of VOCs in subsurface soils, nature and extent of contamination in subsurface soils, and collection of groundwater samples	-Soil-Gas at a minimum of 5 to 50 locations -Soil sampling at select soil-gas locations -Groundwater samples at select locations -Geotechnical samples -Select number of surface soil sampling locations for background soil concentrations
P-Reactor	PSA 4: Area east of the Reactor Building (105-P)	X		X			X	1[(e)]		1[(e)(c)]			1[(d)], 3, 6, 7[(d)]		Spills and leaks from process-related activities and maintenance and infiltration/percolation from subsurface units	Subsurface (>4ft) (contaminant migration)	Determine the presence of VOCs in subsurface soils, nature and extent of contamination in subsurface soils, and collection of groundwater samples	-Soil-Gas at a minimum of 5 to 50 locations -Soil sampling at select soil-gas locations -Groundwater samples at select locations -Geotechnical samples
Southern Vadose Zone	PSA 5: Two localized areas in the southwestern part of P Area	X	X[(b)]	X			X	1[(e)]	2, 3, 4, 5, 6, 7, 8	1[(e)(c)]			1[(d)], 6	Background surface soil samples will be collected to define background soil concentrations for the Exposure Unit	Spills and leaks from process-related activities and maintenance and infiltration/percolation from subsurface units	Subsurface (>4ft) (contaminant migration)	Determine the presence of VOCs in subsurface soils, nature and extent of contamination in subsurface soils, and collection of groundwater samples	-Soil-Gas at a minimum of 5 to 50 locations -Soil sampling at select soil-gas locations -Groundwater samples at select locations -Select number of surface soil sampling locations for background soil concentrations

NOTES for Media to be Sampled

(a) if surface water is present, a sample(s) will be collected
(b) if water and sediment are present, a sample(s) will be collected
(c) sampling of the Cooling Water Effluent Sumps (107/107-1P) will be performed under investigation of the P-Area Process Sewer Lines as Abandoned
(d) surface soil are to be collected at a limited number of background locations within the Investigative Unit for determination of background soil concentrations.

NOTES for Analytes of Interest

1 - TCL VOCs
2 - TCL organics (SVOCs, VOCs, pesticides, PCBs)
3 - TAL inorganics
4 - TCL PAHs
5 - dioxin/furans
6 - gross alpha, nonvolatile beta, and tritium
7 - alpha and beta radionuclide speciation with select gamma emitters
8 - sulfate, nitrate-nitrite as nitrogen, total organic carbon
9 - field parameters: pH, conductivity, turbidity, temperature

(a) contingent analyses based on exceeding triggers for gross alpha (20 pCi/g) or nonvolatile beta (50 pCi/g) in soil and 15 pCi/L for gross alpha or 50 pCi/L for nonvolatile beta in surface water.
(b) if soil-gas results determine elevated VOC soil-gas concentrations, soil samples will be collected to quantify VOC soil concentrations
(c) a subset of the TCL VOC analysis to include only TCE, PCE, carbon tetrachloride, benzene, 1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethylene, chloroform, cis-1,2-dichloroethylene, dichloromethane, ethylbenzene, m,p-xylene, o-xylene, toluene, trans-1,2-dichloroethylene, and trichlorofluoromethane