

This document was prepared in conjunction with work accomplished under Contract No. DE-AC09-96SR18500 with the U.S. Department of Energy.

This work was prepared under an agreement with and funded by the U.S. Government. Neither the U. S. Government or its employees, nor any of its contractors, subcontractors or their employees, makes any express or implied: 1. warranty or assumes any legal liability for the accuracy, completeness, or for the use or results of such use of any information, product, or process disclosed; or 2. representation that such use or results of such use would not infringe privately owned rights; or 3. endorsement or recommendation of any specifically identified commercial product, process, or service. Any views and opinions of authors expressed in this work do not necessarily state or reflect those of the United States Government, or its contractors, or subcontractors.

United States Department of Energy

Savannah River Site

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

ERD-EN-2007-0064

June 2007

**Prepared by:
Washington Savannah River Company, LLC
Savannah River Site
Aiken, SC 29808**



Prepared for the U. S. Department of Energy Under Contract No. DE-AC09-96SR18500

SUMMARY PAOU ASH BASIN ECOLOGICAL UNCERTAINTY EVALUATION

Arsenic and selenium were tentatively identified as ecological RCOCs for the PAOU Ash Basin (PAOU Post-Characterization/Problem Identification Scoping Meeting, March 2007).

Core Team agreed to consider eliminating these constituents as RCOCs based on a revised uncertainty discussion. The ecological risk tables and revised text (in its entirety) for the PAOU Ash Basin are provided in the Supplemental Information Package for the FS Scoping Meeting (June 2007).

Arsenic and selenium have been traditionally carried through as ecological RCOCs (D-Area Ash Basin, A-Area Ash Pile).

Uncertainty factors common to both arsenic and selenium

- The area does not appear stressed and is naturally revegetating
- There are no low pH issues at this waste unit
- Although the HQ is slightly greater than one, the risk calculation is conservative and likely overestimates actual risk (TRV used in the risk calculation is based on a soluble chemical form administered in a laboratory via drinking water rather than insoluble forms typically found in the environment)
- Bioavailability is low in soil media (binds to soil particles and is unavailable for uptake by ecological receptors at 100% of the measured concentration)

Arsenic

LOAEL-based HQs greater than one are apparent for the shrew (insectivorous mammals). The HQ exceedence for the shrew is just barely over the threshold value of one (HQ = 1.3). There are no other receptors that have a HQ > 1.

Therefore, the potential for adverse ecological impact at the community level is negligible.

Worm HQ	Shrew HQ (LOAEL)	Mouse HQ (LOAEL)	Raccoon HQ (LOAEL)	Robin HQ (LOAEL)	Hawk HQ (LOAEL)
<1	1.3	<1	<1	<1	<1

Selenium

LOAEL-based HQs greater than one are apparent for the shrew (insectivorous mammals) and robin (omnivorous birds) receptors (HQ = 7.9 and 5.2, respectively).

The potential for adverse ecological impact at the community level is negligible.

Worm HQ	Shrew HQ (LOAEL)	Mouse HQ (LOAEL)	Raccoon HQ (LOAEL)	Robin HQ (LOAEL)	Hawk HQ (LOAEL)
<1	7.9	<1	<1	5.2	<1

In addition, only the maximum sample result (18.6 mg/kg) at the PAOU exceeds the maximum concentration in SRS soils. In other words, seventeen of eighteen results are less than 12.2 mg/kg, the maximum result in SRS soils.

SUPPLEMENTAL INFORMATION PACKAGE FOR

PAOU FS SCOPING MEETING

ECOLOGICAL RISK ASSESSMENT

(FOR THE PAOU ASH BASIN PORTION ONLY)

(note arsenic and selenium discussions; previously identified as ecological RCOCs)

APPENDIX Y

ECOLOGICAL RISK ASSESSMENT

Y.1 Introduction

The streamlined ecological risk evaluation for the P-Area Operable Unit (PAOU) consists of steps designed to provide a scientifically based and defensible assessment of exposure and hazard to ecological resources that will support a risk management decision regarding site remediation. These steps include an identification and refinement of the constituents of potential concern (COPCs). Steps beyond the COPC refinement process are required only for sites for which the need for further ecological risk evaluation is determined. The evaluation will assist in making a risk management decision regarding whether remediation from an ecological perspective is warranted, or if the site should proceed to further ecological evaluations for remedy development.

This evaluation implements a streamlined approach that uses lookup tables to estimate risk. Ecological thresholds (ETs) are risk-based tools developed by SRS that can be used to evaluate and clean up contaminated sites. ETs are chemical concentrations that correspond to a fixed level of risk, i.e., hazard quotient (HQ) = 1. Derivation of the ETs is simply a rearrangement of the standard risk calculation. However, instead of using the exposure point concentration to solve for a risk number, the risk number is set to the threshold value and the concentration term is solved for. ETs are based on pathways and receptors for which generally accepted methods, models, and assumptions have been developed (WSRC 2006b). The *Ecological Thresholds for Soil* (WSRC 2004) technical justification document identifies the ecological thresholds for soil invertebrates, mammals and birds used in this evaluation.

Y.2 Ecological Risk Assessment Process

The ecological evaluation checklist presented in the RI Work Plan for the PAOU (WSRC 2006a) provides a description of the ecological setting for the PAOU. Based on the conclusions documented in the checklist and agreements made with the Core Team during work plan scoping, an ecological risk evaluation is not warranted for much of the PAOU. This is due mainly to lack of habitat (industrial setting) and/or conceptual model considerations (e.g., contamination at depth). In these instances the exposure pathways are not complete and there is negligible potential for contaminant exposure to ecological receptors.

Y.2.1 ESV Screening

The ecological effects evaluation identifies the potential for adverse ecological effects based on conservative assumptions. The most conservative value (i.e., lowest soil concentration) between the *Ecological Screening Values* protocol (WSRC 2006b) and the NOAEL-based ET (WSRC 2004) was used to conduct the screening level assessment. The screening level exposure estimate process is outlined below:

- Compare unit maximum concentration to ESV concentration for the 0-1 and 1-4 ft intervals.
- Compare unit maximum concentration (0-1 ft and 1-4 ft) of the naturally occurring (nonanthropogenic) constituents to 2X SRS background concentration (WSRC 2006c; 0-1 ft, Appendix B-1; 1-4 ft, Appendix B-2).
- Constituents exceeding the ESV and background screen are carried forward to Step Y.2.2.

Y.2.2. Risk Estimate

Because of the conservative assumptions used during the initial risk screen, some of the constituents identified for further evaluation might pose acceptable levels of risk to ecological receptors. The method

used to further refine ecological COPCs based on food chain modeling and calculation of evaluation -level HQs is described below:

$$\text{Hazard Quotient (HQ)} = [\text{maximum, RME or average}] / [\text{ET}] \text{ (NOAEL-based or LOAEL-based).}$$

Y.2.3 Refinement of Constituents of Potential Concern

A recommendation of whether or not a COPC should be carried forward for further remedial evaluation is based on a thorough analysis of each COPC. The uncertainty discussion is provided per the *Constituents of Concern Refinement Process Protocol* (WSRC 2006b). SRS soil background concentrations used in this section were obtained from Appendix B-2 of the *Background Soils Statistical Summary Report* (cWSRC 2006c).

Results of the ESV screening (Step Y.2.1.) evaluation-level risk calculations (Step Y.2.2), and the refinement of COPC analysis (Step Y.2.3) are provided below for each waste unit.

P-Area Ash Basin (188-0P)

Table 1 identifies the ecological COPCs based on ESV screening at the P-Area Ash Basin (188-0P) surface ash (0-1 ft): aluminum, arsenic, barium, beryllium, chromium, copper, iron, lead, selenium, vanadium, zinc, phenol, acenaphthene, acenaphthylene, anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene, toluene, trichloroethylene, and 2,3,7,8-tetrachlorodibenzodioxin (TCDD). Note that for dioxins and furans, neither ESVs nor ETs have been calculated. The screening values used in this evaluation was obtained from *Preliminary Remediation Goals for Ecological Endpoints* (USDOE 1997) with toxicity equivalency factors applied (EPA 2003).

The subsurface ash 1-4 ft interval was not sampled because the material is assumed to be homogeneous. Therefore, the ecological risk evaluation conclusion for the 0-1 ft interval will automatically be applied to the 1-4 ft interval.

Evaluation-level HQ risk calculations are provided in the following tables for this subunit: Table 2 (maximum concentration – surface ash), Table 3 (RME concentration - surface ash), Table 4 (average concentration - ash soil). Constituents identified as COPCs in the surface interval include: aluminum, arsenic, barium, chromium, copper, lead, selenium, vanadium, zinc, acenaphthene, acenaphthylene, anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene, and 2,3,7,8-TCDD.

In this ecological risk assessment, average unit concentrations are given more significance than maximum (and RME) concentrations since the ecological receptors under consideration are not sedentary and their exposure will be over a larger area than that encountered at a single sampling location. The exception to the assumption of non-sedentary behavior is soil invertebrates. However, this is offset by the fact that the soil invertebrate endpoint is established at the community level, and effects caused by a maximum concentration at a single location would not cause community-level impacts. Therefore, the lines-of-evidence discussion is only presented for the mammalian or avian receptors in the cases where either the $HQ_{\text{avg-NOAEL}}$ or $HQ_{\text{avg-LOAEL}}$ exceeds one (Table 4). The uncertainty (lines-of-evidence) discussion is provided per the *Constituents of Concern Refinement Process Protocol* (WSRC 2006b).

The range of HQs for all receptors are presented in tabular format for each constituent. For the receptors that have a home range greater than the size of the waste unit (i.e., raccoon and hawk), a unit foraging factor (UFF) is applied to further refine the HQ calculation. The HQs based on a UFF are presented in parenthesis.

Aluminum

Aluminum was identified as a COPC in surface ash based on the risk estimates presented below. LOAEL-based HQs that are greater than one are apparent for the shrew (insectivorous mammals), mouse (herbivorous mammals) raccoon (omnivorous mammals) and robin (omnivorous birds) receptors.

Surface Ash

Worm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
--	584	58	27	2.7	102 (14)	10.2 (1.4)	10.1	1.0	<1 (<1)	<1 (<1)

In surface ash, aluminum was detected in 18 of 18 samples, with 4 samples being j-flagged. Concentrations ranged from 2,150 mg/kg to 36,500 mg/kg, with an average concentration of 9,648 mg/kg. The 95% UCL on the mean is 12,787 mg/kg.

Aluminum is a naturally-occurring constituent that is ubiquitous in SRS soils. Maximum concentrations in SRS soils (WSRC 2006c) is 23,700 mg/kg and mean concentration is 6,697 mg/kg. Unit-specific background concentrations range from 2,990 mg/kg to 48,900 mg/kg.

Aluminum has many uses in construction and industry, and is a component of some of the known process chemicals at SRS. Aluminum is ubiquitous in terrestrial and aquatic environments as it is a fundamental component of geologic material.

Aluminum is not recommended for further evaluation as a refined ECO COC in surface (or subsurface) ash for the following reasons:

- Concentrations are consistent with SRS background levels.
- Aluminum is naturally occurring and widespread in SRS soils.
- Bioavailability is low in soil media.
- Potential for adverse ecological impact at the community level is negligible.

Arsenic

Arsenic was identified as a COPC in surface ash based on the risk estimates presented below. LOAEL-based HQs that are greater than one are apparent for the shrew (insectivorous mammals).

Surface Ash

Worm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<1	13	1.3	1.2	<1	2.9 (<1)	<1 (<1)	<1	<1	<1 (<1)	<1 (<1)

In surface ash, arsenic was detected in 18 of 18 samples, with 4 samples being j-flagged. Concentrations ranged from 4.55 mg/kg to 59.7 mg/kg, with an average concentration of 20.4 mg/kg. The 95% UCL on the mean is 27.0 mg/kg.

Arsenic is a naturally-occurring constituent that is common in SRS soils. Maximum concentrations in SRS soils (WSRC 2006c) is 22.9 mg/kg and mean concentration is 2.2 mg/kg. Unit-specific background concentrations range from 0.94 mg/kg to 9.65 mg/kg.

Arsenic is a known by-product of coal combustion. Its presence at this unit is expected given the large amount of ash present. Ecological risk assessments at other ash/coal basins at the SRS have identified

arsenic as a RCOC. In those instances there was little to no vegetation on the unit and it was visually obvious that the medium did not provide productive substrate in which to establish ecological communities. The landscape was obviously stressed.

This is not the circumstance at the PAOU Ash Basin. There are no obvious signs of stress and it appears that the vegetation is successfully regenerating. In addition, there are no low pH issues associated with coal reject material at this waste unit.

The shrew (insectivorous mammals) is the only receptor that a LOAEL-based HQ exceeds one. The calculated HQ is 1.3. The HQs for the shrew's prey (earthworm) and predators (raccoon, hawk) are less than one. Due to uncertainties in the assessment process, HQs slightly greater than 1 may indicate a potential for risk when it is possible that there is no risk. The conservative assumptions used in the evaluation are expected to overestimate, rather than underestimate, the potential for a particular constituent to pose risk. By overestimating the risk calculation, the actual deleterious risk effects is likely to be less than indicated by the HQ.

In addition, the laboratory-derived TRV used in the HQ calculations are based on an administration of a soluble chemical form in drinking water rather than the insoluble forms typically encountered in the environment. Arsenic binds to soil particles and is unavailable for uptake by ecological receptors at 100% of the measured concentration. Therefore the potential for ecological risk is likely overestimated, particularly for inorganic constituents such as arsenic.

Arsenic is not recommended for further evaluation as an ecological RCOC in the surface (and subsurface) ash for the following reasons:

- The HQ exceedence for the shrew is just barely over the threshold value of one (HQ = 1.3).
- There are no other receptors which exceed an HQ of one.
- The area does not appear stressed and is naturally revegetating.
- There are no low pH issues at this waste unit.
- The risk calculation is conservative and likely overestimates actual risk.
- Bioavailability is low in soil media.
- Potential for adverse ecological impact at the community level is negligible.

Chromium

Chromium was identified as a COPC in surface ash based on the risk estimates presented below. There are no LOAEL-based HQs that are greater than one for any receptor.

Surface Ash

Worm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<1	<1	<1	<1	<1	<1 (<1)	<1 (<1)	2.5	<1	<1 (<1)	<1 (<1)

In surface ash, chromium was detected in 18 of 18 samples, with 4 samples being j-flagged. Concentrations ranged from 2.69 mg/kg to 32.4 mg/kg, with an average concentration of 11.6 mg/kg. The 95% UCL on the mean is 14.5 mg/kg.

Chromium is a naturally-occurring constituent that is ubiquitous in SRS soils. Maximum concentrations in SRS soils (WSRC 2006c) is 54.3 mg/kg and mean concentration is 11.4 mg/kg. Unit-specific background concentrations range from 2.38 mg/kg to 37 mg/kg.

Chromium tends to be concentrated in well-weathered soils associated with ferric iron phases. It is used widely for increasing the durability of metals (chrome-steel or stainless steel) and for chrome plating of other metals. It is a known component of the process waste stream at SRS.

Chromium is not recommended for further evaluation as a refined ECO COC in surface (or subsurface) ash for the following reasons:

- Concentrations are consistent with SRS background levels.
- Chromium is naturally occurring and widespread in SRS soils.
- No LOAEL-based HQs are greater than one for any receptor.
- Potential for adverse ecological impact at the community level is negligible.

Lead

Lead was identified as a COPC in surface ash based on the risk estimates presented below. There are no LOAEL-based HQs that are greater than one for any receptor.

Surface Ash

Worm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<1	<1	<1	<1	<1	<1 (<1)	<1 (<1)	5.5	<1	<1 (<1)	<1 (<1)

In surface ash, lead was detected in 18 of 18 samples, with 5 samples being j-flagged. Concentrations ranged from 3.14 mg/kg to 33.1 mg/kg, with an average concentration of 10.9 mg/kg. The 95% UCL on the mean is 15.5 mg/kg.

Lead is a naturally-occurring constituent that is ubiquitous in SRS soils. Maximum concentrations in SRS soils (WSRC 2006c) is 26.6 mg/kg and mean concentration is 5.41 mg/kg. Unit-specific background concentrations range from 1.75 mg/kg to 9.2 mg/kg.

Lead is used in producing ammunition, machinery equipment, building materials, storage tanks, and process vessels. Its presence at the unit is not inconsistent with the historical use of SRS.

Lead is not recommended for further evaluation as a refined ECO COC in surface (or subsurface) ash for the following reasons:

- Concentrations are consistent (slightly higher) with SRS background levels.
- Lead is naturally occurring and widespread in SRS soils.
- No LOAEL-based HQs are greater than one for any receptor.
- Potential for adverse ecological impact at the community level is negligible.

Selenium

Selenium was identified as a COPC in surface ash based on the risk estimates presented below. LOAEL-based HQs that are greater than one are apparent for the shrew (insectivorous mammals) and robin (omnivorous birds) receptors.

Surface Ash

Worm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<1	13	7.9	<1	<1	1.3 <1	<1 <1	10.4	5.2	<1 (<1)	<1 (<1)

In surface ash, selenium was detected in 18 of 18 samples, with 6 samples being j-flagged. Concentrations ranged from 1.02 mg/kg to 18.6 mg/kg, with an average concentration of 5.5 mg/kg. The 95% UCL on the mean is 7.8 mg/kg.

Selenium is a naturally-occurring constituent that is common in SRS soils. Maximum concentrations in SRS soils (WSRC 2006c) is 12.2 mg/kg and mean concentration is 1.9 mg/kg. Unit-specific background concentrations range from ND to 8.04 mg/kg.

Only the maximum sample result (18.6 mg/kg) at the PAOU exceeds the maximum concentration in SRS soils. In other words, seventeen of eighteen results are less than 12.2 mg/kg, the maximum result in SRS soils.

Selenium is a known by-product of coal combustion. Its presence at this unit is expected given the large amount of ash present. Ecological risk assessments at other ash/coal basins at the SRS have identified selenium as a RCOC. In those instances there was little to no vegetation at the unit and it was visually obvious that the medium did not provide productive substrate in which to establish ecological communities. The landscape was obviously stressed.

This is not the circumstance at the PAOU Ash Basin. There are no obvious signs of stress and it appears that the vegetation is successfully regenerating. There are no low pH issues associated with coal reject material at this waste unit.

The shrew (insectivorous mammal, HQ = 7.9) and the robin (insectivorous bird, HQ = 5.2) are the only receptors that a LOAEL-based HQ exceeds one. The HQs for their prey (earthworm) and predators (raccoon, hawk) are less than one. Due to uncertainties in the assessment process, HQs slightly greater than 1 may indicate a potential for risk when it is possible that there is no risk. The conservative assumptions used in the evaluation are expected to overestimate, rather than underestimate, the potential for a particular constituent to pose risk. By overestimating the risk calculation, the actual deleterious risk effects is likely to be less than indicated by the HQ.

In addition, the laboratory-derived TRV used in the HQ calculations are based on an administration of a soluble chemical form in drinking water rather than the insoluble forms typically encountered in the environment. Selenium binds to soil particles and is unavailable for uptake by ecological receptors at 100% of the measured concentration. Therefore the potential for ecological risk is likely overestimated, particularly for inorganic constituents such as selenium.

Selenium is not recommended for further evaluation as an ecological RCOC in the surface (and subsurface) ash for the following reasons:

- Only 1/18 sample results are above the range found in SRS soils.
- The area does not appear stressed and is naturally revegetating.
- There are no pH issues at this waste unit.
- The risk calculations are conservative and likely overestimate actual risk.
- Although the HQ calculations for the shrew and robin are above one, the risk for their prey and predators are less than one.
- Bioavailability is low in soil media.
- Potential for adverse ecological impact at the community level is negligible.

Vanadium

Vanadium was identified as a COPC in surface ash based on the risk estimates presented below. LOAEL-based HQs that are greater than one are apparent in surface soil for the shrew (insectivorous mammals) receptor.

Surface Ash

Worm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
--	19	1.9	<1	<1	2.9	<1	<1	<1	<1	<1

					<1	<1			<1	<1
--	--	--	--	--	----	----	--	--	----	----

In surface ash, vanadium was detected in 18 of 18 samples, with 4 samples being j-flagged. Concentrations ranged from 8.38 mg/kg to 68.4 mg/kg, with an average concentration of 26.8 mg/kg. The 95% UCL on the mean is 33.1 mg/kg.

Vanadium is a naturally-occurring constituent that is ubiquitous in SRS soils. Maximum concentrations in SRS soils (WSRC 2006c) is 104 mg/kg and mean concentration is 29 mg/kg. Unit-specific background concentrations range from 3.65 mg/kg to 85.3 mg/kg.

Vanadium is not recommended for further evaluation as a refined ECO COC in surface (or subsurface) ash for the following reasons:

- Concentrations are consistent with SRS background levels.
- Vanadium is naturally occurring and widespread in SRS soils.
- Potential for adverse ecological impact at the community level is negligible.

Zinc

Zinc was identified as a COPC in surface ash based on the risk estimates presented below. There are no LOAEL-based HQs that are greater than one for any receptor.

Surface Ash

Worm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<1	<1	<1	<1	<1	<1	<1	2.8	<1	<1	<1
					<1	<1			<1	<1

In surface ash, zinc was detected in 18 of 18 samples, with 4 samples being j-flagged. Concentrations ranged from 3.53 mg/kg to 69.1 mg/kg, with an average concentration of 18.6 mg/kg. The 95% UCL on the mean is 25.5 mg/kg.

Zinc is a naturally-occurring constituent that is ubiquitous in SRS soils. Maximum concentrations in SRS soils (WSRC 2006c) is 20.7 mg/kg and mean concentration is 3.7 mg/kg. Unit-specific background concentrations range from 3.01 mg/kg to 11.1 mg/kg.

Zinc and its compounds are found in the earth's crust and are present in most rocks, certain minerals, and some carbonate sediments. Zinc has wide commercial and industrial uses. Its presence at the unit is not inconsistent with the historical use of SRS and P-Area.

Zinc is not recommended for further evaluation as a refined ECO COC in surface (or subsurface) ash for the following reasons:

- Zinc is naturally occurring and widespread in SRS soils.
- No LOAEL-based HQs are greater than one for any receptor.
- Potential for adverse ecological impact at the community level is negligible.

Acenaphthene

Acenaphthene was identified as a COPC in surface ash based on the risk estimates presented below. A toxicity reference value (TRV) for avian receptors is not identified in the *Terrestrial Toxicity Reference Values* protocol (WSRC 2006b). The TRVs used to calculate the HQs in this evaluation were obtained through a review of scientific literature (USEPA 1999). There are no LOAEL-based HQs that are greater than one for any receptor.

Surface Ash

Worm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<1	<1	<1	<1	<1	<1 (<1)	<1 (<1)	1.5	<1	<1 (<1)	<1 (<1)

In surface ash, acenaphthene was detected in 1 of 7 samples, with 1 sample being j-flagged. Concentrations ranged from ND to 0.0079 mg/kg, with an average concentration of 0.0025 mg/kg. The 95% UCL on the mean is 0.0064 mg/kg.

There are no SRS background or unit-specific background results for acenaphthene.

Acenaphthene is a PAH that is formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances. It can also be found in substances such as crude oil, coal par pitch, creosote, roofing tar and asphalt. Its presence at the unit is not inconsistent with the historical use of the unit.

Acenaphthene is not recommended for further evaluation as a refined ECO COC in surface (or subsurface) ash for the following reasons:

- No LOAEL-based HQs are greater than one for any receptor.
- Potential for adverse ecological impact at the community level is negligible.
- Frequency of detection is low.

Acenaphthalene

Acenaphthalene was identified as a COPC in surface ash based on the risk estimates presented below. A toxicity reference value (TRV) for avian receptors is not identified in the *Terrestrial Toxicity Reference Values* protocol (WSRC 2006b). The TRVs used to calculate the HQs in this evaluation were obtained through a review of scientific literature (USEPA 1999). There are no LOAEL-based HQs that are greater than one for any receptor.

Surface Ash

Worm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<1	<1	<1	<1	<1	<1 (<1)	<1 (<1)	1.9	<1	<1 (<1)	<1 (<1)

In surface ash, acenaphthalene was detected in 2 of 7 samples, with 2 samples being j-flagged. Concentrations ranged from ND to 0.0096 mg/kg, with an average concentration of 0.0031 mg/kg. The 95% UCL on the mean is 0.0076 mg/kg.

There are no SRS background or unit-specific background results for acenaphthalene.

Acenaphthalene is a PAH that is formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances. It can also be found in substances such as crude oil, coal par pitch, creosote, roofing tar and asphalt. Its presence at the unit is not inconsistent with the historical use of the unit.

Acenaphthalene is not recommended for further evaluation as a refined ECO COC in surface (or subsurface) ash for the following reasons:

- No LOAEL-based HQs are greater than one for any receptor.

- Potential for adverse ecological impact at the community level is negligible.
- Frequency of detection is low.

Anthracene

Anthracene was identified as a COPC in surface ash based on the risk estimates presented below. A toxicity reference value (TRV) for avian receptors is not identified in the *Terrestrial Toxicity Reference Values* protocol (WSRC 2006b). The TRVs used to calculate the HQs in this evaluation were obtained through a review of scientific literature (USEPA 1999). There are no LOAEL-based HQs that are greater than one for any receptor.

Surface Ash

Worm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<1	<1	<1	<1	<1	<1 (<1)	<1 (<1)	1.5	<1	<1 (<1)	<1 (<1)

In surface ash, anthracene was detected in 2 of 7 samples, with 1 sample being j-flagged. Concentrations ranged from ND to 0.0048 mg/kg, with an average concentration of 0.0025 mg/kg. The 95% UCL on the mean is 0.0044 mg/kg.

There are no SRS background or unit-specific background results for acenaphthalene.

Anthracene is a PAH that is formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances. It can also be found in substances such as crude oil, coal par pitch, creosote, roofing tar and asphalt. Its presence at the unit is not inconsistent with the historical use of the unit.

Anthracene is not recommended for further evaluation as a refined ECO COC in surface (or subsurface) ash for the following reasons:

- No LOAEL-based HQs are greater than one for any receptor.
- Potential for adverse ecological impact at the community level is negligible.
- Frequency of detection is low.

Benzo(b)fluoranthene

Benzo(b)fluoranthene was identified as a COPC in surface ash based on the risk estimates presented below. A toxicity reference value (TRV) for avian receptors is not identified in the *Terrestrial Toxicity Reference Values* protocol (WSRC 2006b). The TRVs used to calculate the HQs in this evaluation were obtained through a review of scientific literature (USEPA 1999). There are no LOAEL-based HQs that are greater than one for any receptor.

Surface Ash

Worm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<1	<1	<1	<1	<1	<1 (<1)	<1 (<1)	7.1	<1	<1 (<1)	<1 (<1)

In surface ash, benzo(b)fluoranthene was detected in 4 of 7 samples, with 3 samples being j-flagged. Concentrations ranged from ND to 0.021 mg/kg, with an average concentration of 0.0116 mg/kg. The 95% UCL on the mean is 0.0174 mg/kg.

SRS background concentrations (WSRC 2006c) range from ND to 0.0574 mg/kg with an average concentration of 0.0195 mg/kg.

Benzo(b)fluoranthene is a PAH that is formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances. It can also be found in substances such as crude oil, coal par pitch, creosote, roofing tar and asphalt. Its presence at the unit is not inconsistent with the historical use of the unit.

Benzo(b)fluoranthene is not recommended for further evaluation as a refined ECO COC in surface (or subsurface) ash for the following reasons:

- No LOAEL-based HQs are greater than one for any receptor.
- Potential for adverse ecological impact at the community level is negligible.
- High percentage of j-qualified results.

Benzo(k)fluoranthene

Benzo(k)fluoranthene was identified as a COPC in surface ash based on the risk estimates presented below. A TRV for avian receptors is not identified in the *Terrestrial Toxicity Reference Values* protocol (WSRC 2006b). The TRVs used to calculate the HQs in this evaluation were obtained through a review of scientific literature (USEPA 1999). There are no LOAEL-based HQs that are greater than one for any receptor.

Surface Ash

Worm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<1	<1	<1	<1	<1	<1 (<1)	<1 (<1)	2.3	<1	<1 (<1)	<1 (<1)

In surface ash, benzo(k)fluoranthene was detected in 2 of 7 samples, with 0 samples being j-flagged. Concentrations ranged from ND to 0.01 mg/kg, with an average concentration of 0.0039 mg/kg. The 95% UCL on the mean is 0.0083 mg/kg.

There are no SRS background or unit-specific background results for benzo(k)fluoranthene.

Benzo(k)fluoranthene is a PAH that is formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances. It can also be found in substances such as crude oil, coal par pitch, creosote, roofing tar and asphalt. Its presence at the unit is not inconsistent with the historical use of the unit.

Benzo(k)fluoranthene is not recommended for further evaluation as a refined ECO COC in surface (or subsurface) ash for the following reasons:

- No LOAEL-based HQs are greater than one for any receptor.
- Potential for adverse ecological impact at the community level is negligible.
- Low frequency of detections.

Benzo(a)pyrene

Benzo(a)pyrene was identified as a COPC in surface ash based on the risk estimates presented below. A TRV for avian receptors is not identified in the *Terrestrial Toxicity Reference Values* protocol (WSRC 2006b). The TRVs used to calculate the HQs in this evaluation were obtained through a review of scientific literature (USEPA 1999). There are no LOAEL-based HQs that are greater than one for any receptor.

Surface Ash

Worm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<1	<1	<1	<1	<1	<1 (<1)	<1 (<1)	1.5	<1	<1 (<1)	<1 (<1)

In surface ash, benzo(a)pyrene was detected in 7 of 7 samples, with 4 samples being j-flagged. Concentrations ranged from 0.0091 mg/kg to 0.022 mg/kg, with an average concentration of 0.0173 mg/kg. The 95% UCL on the mean is 0.021 mg/kg.

SRS background concentrations (WSRC 2006c) range from ND to 0.00766 mg/kg with an average concentration of 0.0124 mg/kg.

Benzo(a)pyrene is not recommended for further evaluation as a refined ECO COC in surface ash for the following reasons:

Benzo(a)pyrene is a PAH that is formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances. It can also be found in substances such as crude oil, coal par pitch, creosote, roofing tar and asphalt. Its presence at the unit is not inconsistent with the historical use of the unit.

Benzo(a)pyrene is not recommended for further evaluation as a refined ECO COC in surface (or subsurface) ash for the following reasons:

- No LOAEL-based HQs are greater than one for any receptor.
- Potential for adverse ecological impact at the community level is negligible.

Fluoranthene

Fluoranthene was identified as a COPC in surface ash based on the risk estimates presented below. A TRV for avian receptors is not identified in the *Terrestrial Toxicity Reference Values* protocol (WSRC 2006b). The TRVs used to calculate the HQs in this evaluation were obtained through a review of scientific literature (USEPA 1999). There are no LOAEL-based HQs that are greater than one for any receptor.

Surface Ash

Worm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<1	<1	<1	<1	<1	<1 (<1)	<1 (<1)	6.8	<1	<1 (<1)	<1 (<1)

In surface ash, fluoranthene was detected in 6 of 7 samples, with 4 samples being j-flagged. Concentrations ranged from ND to 0.028 mg/kg, with an average concentration of 0.011 mg/kg. The 95% UCL on the mean is 0.017 mg/kg.

There are no SRS background or unit-specific background results for fluoranthene.

Fluoranthene is a PAH that is formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances. It can also be found in substances such as crude oil, coal par pitch, creosote, roofing tar and asphalt. Its presence at the unit is not inconsistent with the historical use of the unit.

Fluoranthene is not recommended for further evaluation as a refined ECO COC in surface (or subsurface) ash for the following reasons:

- No LOAEL-based HQs are greater than one for any receptor.
- Potential for adverse ecological impact at the community level is negligible.
- High percentage j-qualified values.

Fluorene

Fluorene was identified as a COPC in surface ash based on the risk estimates presented below. A TRV for avian receptors is not identified in the *Terrestrial Toxicity Reference Values* protocol (WSRC 2006b). The TRVs used to calculate the HQs in this evaluation were obtained through a review of scientific literature (USEPA 1999). There are no LOAEL-based HQs that are greater than one for any receptor.

Surface Ash

Worm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<1	<1	<1	<1	<1	<1 (<1)	<1 (<1)	2.5	<1	<1 (<1)	<1 (<1)

In surface ash, fluorene was detected in 4 of 7 samples, with 3 samples being j-flagged. Concentrations ranged from ND to 0.0079 mg/kg, with an average concentration of 0.0041 mg/kg. The 95% UCL on the mean is 0.0058 mg/kg.

There are no SRS background or unit-specific background results for fluorene.

Fluorene is a PAH that is formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances. It can also be found in substances such as crude oil, coal par pitch, creosote, roofing tar and asphalt. Its presence at the unit is not inconsistent with the historical use of the unit.

Fluorene is not recommended for further evaluation as a refined ECO COC in surface ash (or subsurface) for the following reasons:

- No LOAEL-based HQs are greater than one for any receptor.
- Potential for adverse ecological impact at the community level is negligible.
- High percentage j-qualified values.

Naphthalene

Naphthalene was identified as a COPC in surface ash based on the risk estimates presented below. A TRV for avian receptors is not identified in the *Terrestrial Toxicity Reference Values* protocol (WSRC 2006b). The TRVs used to calculate the HQs in this evaluation were obtained through a review of scientific literature (USEPA 1999). TRVs are not available for all individual PAHs. The TRV used in the risk calculation for naphthalene is a surrogate for high molecular weight PAHs. Naphthalene is considered a low molecular weight PAH. This introduces an element of uncertainty into the calculation. LOAEL-based HQs that are greater than one are apparent for the robin (omnivorous birds).

Surface Ash

Worm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<1	<1	<1	<1	<1	<1 (<1)	<1 (<1)	17	1.7	<1 (<1)	<1 (<1)

In surface ash, naphthalene was detected in 7 of 7 samples, with 4 samples being j-flagged. Concentrations ranged from 0.0071 mg/kg to 0.045 mg/kg, with an average concentration of 0.0287 mg/kg. The 95% UCL on the mean is 0.038 mg/kg.

There are no SRS background or unit-specific background results for naphthalene.

Naphthalene is a PAH that is formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances. It can also be found in substances such as crude oil, coal par pitch, creosote, roofing tar and asphalt. Its presence at the unit is not inconsistent with the historical use of the unit.

The robin (insectivorous bird) is the only receptor that a LOAEL-based HQ exceeds one. The calculated HQ is 1.7. Due to uncertainties in the assessment process, HQs slightly greater than 1 may indicate a potential for risk when it is possible that there is no risk. The conservative assumptions used in the risk evaluation are expected to overestimate, rather than underestimate, the potential for a particular constituent to pose risk. By overestimating the risk calculation, the deleterious risk effects is likely to be less than indicated by the hazard quotient.

In addition, the laboratory analyzed the PAHs using two analytical methods (EPA8270C and EPA8270C SIM). Therefore results were reported in duplicate or, in many instances, in triplicate. The data used in this evaluation used the highest concentration reported (i.e., most conservative) for each sample location regardless of the analytical method used. Therefore the analytical results used in the calculation is be biased high.

Naphthalene is not recommended for further evaluation as a refined ECO COC in surface (or subsurface) ash for the following reasons:

- The HQ exceedence for the robin (insectivorous birds) is just barely over the traditional threshold value of one (HQ = 1.7)
- There are no other receptors which exceed an HQ of one.
- The risk calculation is conservative and likely overestimates the risk.
- A surrogate TRV value was used in the calculation, which likely overestimates the risk.
- The most conservative (highest) analytical results were used in the evaluation, which may overestimate the risk
- Potential for adverse ecological impact at the community level is negligible.

Phenanthrene

Phenanthrene was identified as a COPC in surface ash based on the risk estimates presented below. A TRV for avian receptors is not identified in the *Terrestrial Toxicity Reference Values* protocol (WSRC 2006b). The TRVs used to calculate the HQs in this evaluation were obtained through a review of scientific literature (USEPA 1999). TRVs are not available for all individual PAHs. The TRV used in the risk calculation for phenanthrene is a surrogate for high molecular weight PAHs. Phenanthrene is considered a low molecular weight PAH. This introduces an element of uncertainty into the calculation. LOAEL-based HQs that are greater than one are apparent for the robin (omnivorous birds).

Surface Ash

Worm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<1	<1	<1	<1	<1	<1	<1	26.2	2.6	<1	<1
					(<1)	(<1)			(<1)	(<1)

In surface ash, phenanthrene was detected in 7 of 7 samples, with 4 samples being j-flagged. Concentrations ranged from 0.0084 mg/kg to 0.062 mg/kg, with an average concentration of 0.043 mg/kg. The 95% UCL on the mean is 0.0567 mg/kg.

There are no SRS background or unit-specific background results for phenanthrene.

Phenanthrene is a PAH that is formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances. It can also be found in substances such as crude oil, coal par pitch, creosote, roofing tar and asphalt. Its presence at the unit is not inconsistent with the historical use of the unit.

The robin (insectivorous bird) is the only receptor that a LOAEL-based HQ exceeds one. The calculated HQ is 2.6. Due to uncertainties in the assessment process, HQs slightly greater than 1 may indicate a potential for risk when it is possible that there is no risk. The conservative assumptions used in the risk evaluation are expected to overestimate, rather than underestimate, the potential for a particular constituent to pose risk. By overestimating the risk calculation, the deleterious risk effects is likely to be less than indicated by the hazard quotient.

In addition, the laboratory analyzed the PAHs using two analytical methods (EPA8270C and EPA8270C SIM). Therefore, the results were reported in duplicate or, in many instances, in triplicate. The data used in this evaluation used the highest concentration reported (i.e., most conservative) for each sample location regardless of the analytical method used. Therefore the analytical results used in the calculation is biased high.

Phenanthrene is not recommended for further evaluation as a refined ECO COC in surface (or subsurface) ash for the following reasons:

- The HQ exceedence for the robin (insectivorous birds) is just barely over the traditional threshold value of one (HQ = 1.7)
- There are no other receptors which exceed an HQ of one.
- The risk calculation is conservative and likely overestimates the risk.
- A surrogate TRV value was used in the calculation, which likely overestimates the risk.
- The most conservative (highest) analytical results were used in the evaluation, which may overestimate the risk
- Potential for adverse ecological impact at the community level is negligible.

Pyrene

Pyrene was identified as a COPC in surface ash based on the risk estimates presented below. A TRV for avian receptors is not identified in the *Terrestrial Toxicity Reference Values* protocol (WSRC 2006b). The TRVs used to calculate the HQs in this evaluation were obtained through a review of scientific literature (USEPA 1999). There are no LOAEL-based HQs that are greater than one for any receptor.

Surface Ash

Worm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<1	<1	<1	<1	<1	<1 (<1)	<1 (<1)	8.2	<1	<1 (<1)	<1 (<1)

In surface ash, pyrene was detected in 6 of 7 samples, with 3 samples being j-flagged. Concentrations ranged from ND mg/kg to 0.026 mg/kg, with an average concentration of 0.014 mg/kg. The 95% UCL on the mean is 0.019 mg/kg.

There are no SRS background or unit-specific background results for pyrene.

Pyrene is a PAH that is formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances. It can also be found in substances such as crude oil, coal par pitch, creosote, roofing tar and asphalt. Its presence at the unit is not inconsistent with the historical use of the unit.

Pyrene is not recommended for further evaluation as a refined ECO COC in surface (or subsurface) ash for the following reasons:

- No LOAEL-based HQs are greater than one for any receptor.
- Potential for adverse ecological impact at the community level is negligible.

2,3,7,8-TCDD

2,3,7,8-TCDD was identified as a COPC in surface ash based on the risk estimates provided below. ETs for this constituent have not been calculated by SRS. The ET used in this HQ calculations was obtained through a review of the scientific literature (USDOE 1997). Note that the PRG for the woodcock was used as a surrogate for the robin. LOAEL-based HQs that are greater than one are apparent for the shrew (insectivorous mammal).

Surface Ash

Worm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ*		Hawk HQ	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
--	14	1.4	2.0	<1	--	--	<1	<1	<1	<1
									(<1)	(<1)

In surface ash, 2,3,7,8-TCDD was detected in 7 of 7 samples, with 6 samples being j-flagged. Concentrations ranged from 0.00000081 mg/kg to 0.00001 mg/kg, with an average concentration of 0.0000049 mg/kg. The 95% UCL on the mean is 0.00000687 mg/kg.

There are no SRS background or unit-specific background results for 2,3,7,8-TCDD.

2,3,7,8-TCDD does not occur naturally nor is it intentionally manufactured by any industry, although it can be produced inadvertently in small amounts as an impurity during the manufacture of certain herbicides and germicides and has been detected in products of incineration of municipal and industrial wastes.

The shrew (insectivorous mammal) is the only receptor that a LOAEL-based HQ exceeds one. The calculated HQ is 1.4. Due to uncertainties in the assessment process, HQs slightly greater than 1 may indicate a potential for risk when it is possible that there is no risk. The conservative assumptions used in the risk evaluation are expected to overestimate, rather than underestimate, the potential for a particular constituent to pose risk. By overestimating the risk calculation, the deleterious risk effects is likely to be less than indicated by the hazard quotient.

In addition, 6 of the sample results were j-flagged; of these 5 were nj-flagged. J qualified means that the result is abnormally uncertain, while "nj" means that the analyte identification is even more uncertain. Use of a high amount of J (and nj) qualified data presents an additional uncertainty in the risk evaluation.

2,3,7,8-TCDD is not recommended for further evaluation as a refined ECO COC in surface (or subsurface) ash for the following reasons:

- The HQ exceedence for the shrew (insectivorous mammals) is just barely over the traditional threshold value of one (HQ = 1.4)
- There are no other receptors which exceed an HQ of one.
- The risk calculation is conservative and likely overestimates the risk.
- There is a high percentage of j and nj qualified data that was used in the risk evaluation.

- Potential for adverse ecological impact at the community level is negligible.

Conclusion: There are no ECO RCOCs for the P-Area Ash Basin (188-0P).

Y.3 References

USDOE, 1997. *Preliminary Remediation Goals for Ecological Endpoints*. ES/ER/TM-162/R2, United States Department of Energy.

USEPA, 1999. *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities*. Draft. EPA530-D-99-001A, United States Environmental Protection Agency, Office of Solid Waste and Emergency Response.

USEPA, 2003. *Framework for Application for the Toxicity Equivalence Methodology for Polychlorinated Dioxins, Furans and Biphenyls in Ecological Risk Assessment*. EPA/630/P-03/002A, Draft. United States Environmental Protection Agency.

WSRC, 2004. *Ecological Thresholds (ETs) for Soils*, Rev. 0, Westinghouse Savannah River Company.

WSRC, 2006a. *Remedial Investigation Work Plan for P-Area Operable Unit*, Rev. 1.1, WSRC-RP-2005-4081, Washington Savannah River Company, September.

WSRC, 2006b. *Environmental Restoration Division Regulatory Document Handbook*, Rev. 16, ERD-AG-003, Washington Savannah River Company, September.

WSRC, 2006c. *Background Soils Statistical Summary Report for Savannah River Site*, Rev. 1, ERD-EN-2005-0223, Washington Savannah River Company, October.

Table Y-1. Ecological Screening for Surface Ash (0-1 ft) at the P-Area Ash Basin

Constituent	Detected Maximum Concentration ¹	ESV ²	ESV Screen		Background Screen		COPC ^{9,6}
			Screening Level HQ ³	HQ > 1?	2X Average Background ⁴	Exceed Background? ⁵	
Inorganics (mg/kg)							
Aluminum	3.65E+04	1.65E+01	2210.2	YES	1.05E+04	YES	YES
Antimony	2.60E+00	1.17E+00	2.2	YES	2.69E+00	No	No
Arsenic	5.97E+01	1.54E+00	38.9	YES	4.28E+00	YES	YES
Barium	4.07E+02	6.05E+01	6.7	YES	3.91E+01	YES	YES
Beryllium	3.81E+00	1.10E+00	3.5	YES	2.89E-01	YES	YES
Cadmium	3.16E-01	1.09E-01	2.9	YES	4.83E-01	No	No
Calcium	1.81E+04	Nutrient ⁷	--	No	4.76E+02	--	No
Chromium	3.24E+01	4.59E+00	7.1	YES	1.54E+01	YES	YES
Cobalt	1.23E+01	2.00E+01	< 1	No	1.55E+00	--	No
Copper	7.13E+01	4.00E+01	1.8	YES	4.34E+00	YES	YES
Cyanide	4.63E-01	9.00E-01	< 1	No	ND	--	No
Iron	2.89E+04	2.00E+02	144.5	YES	1.27E+04	YES	YES
Lead	3.31E+01	1.98E+00	16.7	YES	1.03E+01	YES	YES
Magnesium	2.54E+03	Nutrient ⁷	--	No	2.75E+02	--	No
Manganese	1.35E+02	1.00E+02	1.4	YES	1.53E+02	No	No
Mercury	1.45E-01	3.00E-01	< 1	No	7.10E-02	--	No
Nickel	2.16E+01	3.00E+01	< 1	No	3.48E+00	--	No
Potassium	2.22E+03	Nutrient ⁷	--	No	2.16E+02	--	No
Selenium	1.86E+01	4.24E-01	43.9	YES	2.99E+00	YES	YES
Silver	1.12E+00	2.00E+00	< 1	No	7.28E-01	--	No
Sodium	4.49E+02	Nutrient ⁷	--	No	4.02E+01	--	No
Thallium	2.65E+00	1.24E-02	213.2	YES	3.12E+00	No	No
Vanadium	6.84E+01	1.44E+00	47.3	YES	3.91E+01	YES	YES
Zinc	6.91E+01	6.59E+00	10.5	YES	9.47E+00	YES	YES
Semivolatiles (mg/kg)							
Acenaphthene	7.90E-03	1.65E-03	4.8	YES	ND	--	YES
Acenaphthylene	9.60E-03	1.65E-03	5.8	YES	ND	--	YES
Anthracene	4.80E-03	1.65E-03	2.9	YES	ND	--	YES
Benzo(a)anthracene	2.40E-02	9.29E-02	< 1	No	ND	--	No
Benzo(b)fluoranthene	2.10E-02	1.65E-03	12.8	YES	ND	--	YES
Benzo(k)fluoranthene	1.00E-02	1.65E-03	6.1	YES	ND	--	YES
Benzo(a)pyrene	2.20E-02	1.18E-02	1.9	YES	ND	--	YES
Chrysene	1.90E-02	1.18E-02	1.6	YES	ND	--	YES
Dibenzo(a,h)anthracene	7.90E-03	4.58E-02	< 1	No	ND	--	No
Fluoranthene	2.80E-02	1.65E-03	17.0	YES	ND	--	YES
Fluorene	7.90E-03	1.65E-03	4.8	YES	ND	--	YES
2-Methylnaphthalene	8.10E-02	9.48E+01	< 1	No	ND	--	No
Naphthalene	4.50E-02	1.65E-03	27.3	YES	ND	--	YES
Phenanthrene	6.20E-02	1.65E-03	37.7	YES	ND	--	YES
Phenol	3.10E-01	2.00E-02	15.5	YES	ND	--	YES
Pyrene	2.60E-02	1.65E-03	15.8	YES	ND	--	YES
Volatiles (mg/kg)							
Acetone	6.50E-01	9.48E+01	< 1	No	ND	--	No
Carbon disulfide	3.30E-03	1.62E+01	< 1	No	ND	--	No
Chloroform	3.60E-03	1.42E+02	< 1	No	ND	--	No
Methyl acetate	3.30E-01	9.48E+01	< 1	No	ND	--	No
Methyl ethyl ketone	4.80E-02	1.68E+04	< 1	No	ND	--	No
Tetrachloroethene	2.10E-03	1.00E-02	< 1	No	ND	--	No
Toluene	8.70E-02	5.00E-02	1.7	YES	ND	--	YES
Trichloroethene (TCE)	2.70E-03	1.00E-03	2.7	YES	ND	--	YES
Dioxins/Furans⁸ (mg/kg)							
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	5.10E-06	3.15E-04	< 1	No	ND	--	No
1,2,3,7,8-Pentachlorodibenzene-p-furan	2.00E-07	6.30E-05	< 1	No	ND	--	No
2,3,7,8-Tetrachlorodibenzodioxin	1.00E-05	3.15E-06	3.2	YES	ND	--	YES
2,3,7,8-Tetrachlorodibenzofuran	7.50E-07	3.15E-05	< 1	No	ND	--	No
Heptachlorodibenzo-p-dioxins	9.90E-06	3.15E-04	< 1	No	ND	--	No
Octachlorodibenzo-p-dioxin	7.10E-05	3.15E-02	< 1	No	ND	--	No
Pentachlorodibenzo-p-dioxins	1.10E-06	3.15E-06	< 1	No	ND	--	No
Tetrachlorodibenzo-p-furans	4.40E-06	3.15E-05	< 1	No	ND	--	No

1 - Maximum detected concentration from the 0-1 ft ash interval.

2 - The Ecological Screening Value (ESV) is the lesser of the value in the ESV protocol (WSRC 2006) and the NOAEL-based ET (WSRC 2004).

3 - The screening level HQ is determined by dividing the maximum concentration by the ESV.

4 - Background screening values obtained from *Background Soils Statistical Summary Report for Savannah River Site*, ERD-EN-2005-0223, Rev. 1, 10/06, Appendix B-1. Constituents not detected in background samples are designated by ND.

5 - Background screen performed only for anthropogenic inorganic constituents.

6 - Constituents are identified as COPCs if the maximum detected concentration exceeds the ecological screening value and the 2X average background concentration.

7 - Calcium, magnesium, potassium, and sodium are essential nutrients and are not identified as COPCs.

8 - For dioxins and furans, neither ESVs nor ETs have been calculated. Screening values obtained from *Preliminary Remediation Goals for Ecological Endpoints* (USDOE 1997) with toxicity equivalency factors applied (EPA 2003).

Table Y-2. Maximum Concentration Hazard Quotient Evaluation for the P-Area Ash Basin Surface Ash (0-1 ft)

Constituent	Maximum Concentration (mg/kg)	Earthworm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
			NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<i>Inorganics</i>												
Aluminum	3.65E+04	--	2210	221	102	10.2	386	39	38	3.8	<1	<1
Arsenic	5.97E+01	<1	39	3.9	3.4	<1	8.6	<1	<1	<1	<1	<1
Barium	4.07E+02	--	6.7	1.7	1.0	<1	1.7	<1	<1	<1	<1	<1
Beryllium	3.81E+00	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Chromium	3.24E+01	1.0	<1	<1	<1	<1	<1	<1	7.1	1.4	<1	<1
Copper	7.13E+01	1.4	1.0	<1	<1	<1	<1	<1	<1	<1	<1	<1
Iron	2.89E+04	--	--	--	--	--	--	--	--	--	--	--
Lead	3.31E+01	<1	1.3	<1	<1	<1	<1	<1	17	1.7	<1	<1
Selenium	1.86E+01	<1	44	27	<1	<1	4.2	2.6	35	18	<1	<1
Vanadium	6.84E+01	--	47	4.7	1.8	<1	7.3	<1	1.1	<1	<1	<1
Zinc	6.91E+01	<1	<1	<1	<1	<1	<1	<1	10	1.2	<1	<1
<i>Semivolatiles</i>												
Phenol	3.10E-01	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Acenaphthene	7.90E-03	<1	<1	<1	<1	<1	<1	<1	4.8	<1	<1	<1
Acenaphthylene	9.60E-03	<1	<1	<1	<1	<1	<1	<1	5.8	<1	<1	<1
Anthracene	4.80E-03	<1	<1	<1	<1	<1	<1	<1	2.9	<1	<1	<1
Benzo(b)fluoranthene	2.10E-02	<1	<1	<1	<1	<1	<1	<1	13	1.3	<1	<1
Benzo(k)fluoranthene	1.00E-02	<1	<1	<1	<1	<1	<1	<1	6.1	<1	<1	<1
Benzo(a)pyrene	2.20E-02	<1	<1	<1	<1	<1	<1	<1	1.9	<1	<1	<1
Chrysene	1.90E-02	<1	<1	<1	<1	<1	<1	<1	1.6	<1	<1	<1
Fluoranthene	2.80E-02	<1	<1	<1	<1	<1	<1	<1	17	1.7	<1	<1
Fluorene	7.90E-03	<1	<1	<1	<1	<1	<1	<1	4.8	<1	<1	<1
Naphthalene	4.50E-02	<1	<1	<1	<1	<1	<1	<1	27	2.7	<1	<1
Phenanthrene	6.20E-02	<1	<1	<1	<1	<1	<1	<1	38	3.8	<1	<1
Pyrene	2.60E-02	<1	<1	<1	<1	<1	<1	<1	16	1.6	<1	<1
<i>Volatiles</i>												
Toluene	8.70E-02	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Trichloroethene (TCE)	2.70E-03	--	<1	<1	<1	<1	<1	<1	--	--	--	--
<i>Dioxins/Furans</i>												
2,3,7,8 TCDD	1.00E-05	--	32	3.2	4.5	<1	--	--	6.3	<1	<1	<1

Table Y-3. Reasonable Maximum Exposure Concentration Hazard Quotient Evaluation for the P-Area Ash Basin Surface Ash (0-1 ft)

Constituent	RME Concentration (mg/kg)	Earthworm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
			NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<i>Inorganics</i>												
Aluminum	1.28E+04	--	774	77	36	3.6	135	14	13	1.3	<1	<1
Arsenic	2.70E+01	<1	18	1.8	1.6	<1	3.9	<1	<1	<1	<1	<1
Barium	2.40E+02	--	4.0	1.0	<1	<1	1.0	<1	<1	<1	<1	<1
Beryllium	2.31E+00	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Chromium	1.45E+01	<1	<1	<1	<1	<1	<1	<1	3.2	<1	<1	<1
Copper	3.92E+01	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Iron	1.42E+04	--	--	--	--	--	--	--	--	--	--	--
Lead	1.55E+01	<1	<1	<1	<1	<1	<1	<1	7.8	<1	<1	<1
Selenium	7.84E+00	<1	18	11	<1	<1	1.8	1.1	15	7.4	<1	<1
Vanadium	3.31E+01	--	23	2.3	<1	<1	3.5	<1	<1	<1	<1	<1
Zinc	2.55E+01	<1	<1	<1	<1	<1	<1	<1	3.9	<1	<1	<1
<i>Semivolatiles</i>												
Phenol	3.10E-01	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Acenaphthene	6.44E-03	<1	<1	<1	<1	<1	<1	<1	3.9	<1	<1	<1
Acenaphthylene	7.61E-03	<1	<1	<1	<1	<1	<1	<1	4.6	<1	<1	<1
Anthracene	4.44E-03	<1	<1	<1	<1	<1	<1	<1	2.7	<1	<1	<1
Benzo(b)fluoranthene	1.75E-02	<1	<1	<1	<1	<1	<1	<1	11	1.1	<1	<1
Benzo(k)fluoranthene	8.31E-03	<1	<1	<1	<1	<1	<1	<1	5.0	<1	<1	<1
Benzo(a)pyrene	2.08E-02	<1	<1	<1	<1	<1	<1	<1	1.8	<1	<1	<1
Chrysene	1.51E-02	<1	<1	<1	<1	<1	<1	<1	1.3	<1	<1	<1
Fluoranthene	1.73E-02	<1	<1	<1	<1	<1	<1	<1	11	1.1	<1	<1
Fluorene	5.88E-03	<1	<1	<1	<1	<1	<1	<1	3.6	<1	<1	<1
Naphthalene	3.80E-02	<1	<1	<1	<1	<1	<1	<1	23	2.3	<1	<1
Phenanthrene	5.67E-02	<1	<1	<1	<1	<1	<1	<1	34	3.4	<1	<1
Pyrene	1.95E-02	<1	<1	<1	<1	<1	<1	<1	12	1.2	<1	<1
<i>Volatiles</i>												
Toluene	8.70E-02	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Trichloroethene (TCE)	1.75E-03	--	<1	<1	<1	<1	<1	<1	--	--	--	--
<i>Dioxins/Furans</i>												
2,3,7,8- TCDD	6.87E-06	--	22	2.2	3.1	<1	--	--	4.3	<1	<1	<1

Table Y-4. Average Concentration Hazard Quotient Evaluation for the P-Area Ash Basin Surface Ash (0-1 ft)

Constituent	Average Concentration (mg/kg)	Earthworm HQ	Shrew HQ		Mouse HQ		Raccoon HQ		Robin HQ		Hawk HQ	
			NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<i>Inorganics</i>												
Aluminum	9.65E+03	--	584	58	27	2.7	102	10.2	10	1.0	<1	<1
Arsenic	2.04E+01	<1	13	1.3	1.2	<1	2.9	<1	<1	<1	<1	<1
Barium	2.04E+02	--	3.4	<1	<1	<1	<1	<1	<1	<1	<1	<1
Beryllium	1.94E+00	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Chromium	1.16E+01	<1	<1	<1	<1	<1	<1	<1	2.5	<1	<1	<1
Copper	3.08E+01	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Iron	1.12E+04	--	--	--	--	--	--	--	--	--	--	--
Lead	1.09E+01	<1	<1	<1	<1	<1	<1	<1	5.5	<1	<1	<1
Selenium	5.52E+00	<1	13	7.9	<1	<1	1.3	<1	10.4	5.2	<1	<1
Vanadium	2.68E+01	--	19	1.9	<1	<1	2.9	<1	<1	<1	<1	<1
Zinc	1.86E+01	<1	<1	<1	<1	<1	<1	<1	2.8	<1	<1	<1
<i>Semivolatiles</i>												
Phenol	5.45E-02	<1	<1	<1	<1	<1	<1	<1	--	--	--	--
Acenaphthene	2.48E-03	<1	<1	<1	<1	<1	<1	<1	1.5	<1	<1	<1
Acenaphthylene	3.15E-03	<1	<1	<1	<1	<1	<1	<1	1.9	<1	<1	<1
Anthracene	2.53E-03	<1	<1	<1	<1	<1	<1	<1	1.5	<1	<1	<1
Benzo(b)fluoranthene	1.17E-02	<1	<1	<1	<1	<1	<1	<1	7.1	<1	<1	<1
Benzo(k)fluoranthene	3.86E-03	<1	<1	<1	<1	<1	<1	<1	2.3	<1	<1	<1
Benzo(a)pyrene	1.73E-02	<1	<1	<1	<1	<1	<1	<1	1.5	<1	<1	<1
Chrysene	1.06E-02	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Fluoranthene	1.11E-02	<1	<1	<1	<1	<1	<1	<1	6.8	<1	<1	<1
Fluorene	4.06E-03	<1	<1	<1	<1	<1	<1	<1	2.5	<1	<1	<1
Naphthalene	2.87E-02	<1	<1	<1	<1	<1	<1	<1	17	1.7	<1	<1
Phenanthrene	4.31E-02	<1	<1	<1	<1	<1	<1	<1	26	2.6	<1	<1
Pyrene	1.35E-02	<1	<1	<1	<1	<1	<1	<1	8.2	<1	<1	<1
<i>Volatiles</i>												
Toluene	6.17E-02	--	<1	<1	<1	<1	<1	<1	--	--	--	--
Trichloroethene (TCE)	1.01E-03	--	<1	<1	<1	<1	<1	<1	--	--	--	--
<i>Dioxins/Furans</i>												
2,3,7,8-TCDD	4.49E-06	--	14	1.4	2.0	<1	--	--	<1	<1	<1	<1

United States Department of Energy

Savannah River Site

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

March 2007

**Prepared by:
Washington Savannah River Company, LLC
Savannah River Site
Aiken, SC 29808**



Table of Contents

1.0	P-Area Operable Unit	3
2.0	Unit Assessment.....	4
2.1	Southern Vadose Zone Investigative Unit	4
2.1.1	PSA 5: Two Localized Areas in the Southwestern Part of P Area	7
2.2	P-Area Ash Basin Investigative Unit.....	7
2.2.1	Ash Basin	11
2.2.2	P007 Outfall	11
2.3	Cooling Water System Investigative Unit	12
2.3.1	Potential Release from P-Area Reactor Cooling System.....	14
2.4	Northern Vadose Zone Investigative Unit	14
2.4.1	Potential Source Area 2	17
2.4.2	Potential Source Area 3B.....	17
2.5	P-Reactor Investigative Unit.....	18
2.5.1	Potential Release from P-Area Disassembly Basin	22
2.5.2	P-Area Reactor Area Cask Car Railroad Tracks as Abandoned.....	22
2.5.3	P-Area Process Sewer Lines as Abandoned	23
2.5.4	Reactor Building (105-P).....	23
2.5.5	PSA 1: Emergency Cooling Water Retention Basin (904-86G).....	23
2.5.6	PSA 3A: Area near the Northern End of the Reactor Building	24
2.5.7	PSA 4: Area east of the Reactor Building	24
2.6	Other – P007 and P02 Outfalls	24
2.6.1	P02 Outfall	25
3.0	Summary	25

List of Figures

Figure 1: Location of P Area	26
Figure 2: Location of FFA OUs and Reactor Building.....	27
Figure 3: Location of PSAs.....	28
Figure 4: Location of Investigative Units	29
Figure 5: Sampling Locations in the Southern Vadose Zone Investigative Unit	30
Figure 6: Background Sampling Locations at the PAOU.....	31
Figure 7: Sampling Locations in the Ash Basin Investigative Unit.....	32
Figure 8: 1974 Photograph of Ash Basin.....	33
Figure 9: 1982 Photograph of Ash Basin.....	34
Figure 10: Ash Thickness at the Ash Basin	35
Figure 11: Sampling Locations in the Cooling Water System Investigative Unit.....	36
Figure 12: Sampling Locations in the Northern Vadose Zone Investigative Unit	37
Figure 13: Sampling Locations in the P-Reactor Investigative Unit	38
Figure 14: Sampling Locations in Railroad Tracks High Contamination Area the P- Reactor Investigative Unit	39
Figure 15: Sampling Locations at the P007 and P02 Outfalls	40
Figure 16: Impacted Areas at the PAOU	41

List of Tables

Table 1: Issues Addressed Through Characterization and Data Analysis	42
Table 2: Summary of Sampling Activities.....	43

1.0 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 Operable Units [OUs]), the Site Evaluation (SE) Program investigations, reactor process documents, gamma over-flight surveys, and pre-Work Plan characterization for the PRGW OU.

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

Federal Facility Agreement Operable Units

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).

Potential Source Areas

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.

Deactivation and Decommissioning Structures

The category is comprised of the Reactor Building (105-P) and its ancillary structures (Engine Houses [108-1P and 108-2P]). In situ decommissioning is anticipated for the Reactor Building (105-P) based on agreements with the FFA parties and is subject to completion of a CERCLA Record of Decision (ROD) for the selected end-state.

Based on the locations of the FFA OUs, PSAs, and facilities that comprise the PAOU, these eleven subunits were grouped into the following five IUs (Figure 4 and Table 1):

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

Groundwater is not included as part of the PAOU, however groundwater samples were collected to support vadose zone data evaluation. The groundwater will be addressed by the P-Reactor Groundwater OU.

Table 1 identifies the IUs and associated subunit(s) that comprise the PAOU. The table also denotes the issue(s) (surficial risk, contaminant migration, and/or PTSM) that was addressed through PAOU characterization and data analysis. Table 2 presents a summary of sampling activities that were performed in support of the data quality objectives that were identified for each IU.

2.0 Unit Assessment

A comprehensive approach was implemented to address potential impact to the environment, human health, and ecological receptors at the PAOU. Overall, soil-gas samples were collected from 69 locations, groundwater samples were collected from 138 locations, soil samples were collected from 136 locations, gravel samples were collected from eight locations, and ash samples were collected from 19 locations.

2.1 Southern Vadose Zone Investigative Unit

The Southern Vadose Zone Investigative Unit consists of approximately 40 acres south of the reactor inner-fence line. This IU comprises two localized areas in the southwestern part of P Area (PSA 5) (Figure 4). Further review of the sewer system identified a section of process sewer lines (PSLs) that cross into this IU.

The investigation was conducted in two localized areas delineated by previous direct push technology (DPT) groundwater data at PSA 5 and main junctions/manholes of the PSLs (Figure 5). The objectives of the characterization within this IU are as follows:

- If there are elevated soil-gas data for trichloroethene (TCE) (> 76 ppmv) and tetrachloroethene (PCE) (> 20.5 ppmv), soil samples will be collected to quantify volatile organic compound (VOC) soil concentrations;
- Determine nature and extent of VOC contamination in subsurface soils (if applicable);
- Collect a groundwater sample at select locations to determine local impact to groundwater; and
- Collect PAOU background surface soil samples.

Background surface soil samples were collected from three sampling locations located at unimpacted areas around P Area (Figure 6).

Only contaminant migration and PTSM are issues to be addressed through data collection and analysis for the subunits identified within this IU as releases to the environment would have occurred at depth and not from surface release (Table 1).

Sampling Approach

Soil-Gas

Soil-gas sampling was conducted at 12 locations to discern the presence of VOCs in the vadose zone that might be the source to the slightly elevated PCE groundwater concentrations (Figure 5). Soil-gas samples were collected every 1.5 m (5 ft), starting at 3 m (10 ft) down to 12.2 m (40 ft). The initial plan to collect soil-gas at 13.7 m (45 ft) was precluded by the high water table at that sample depth. The saturated sediments prevented adequate flow of soil-gas for sampling; therefore, soil-gas sampling was terminated at 12.2 m (40 ft). Field measurements consisting of carbon dioxide, TCE, and PCE concentrations were collected at each sample depth. Each soil-gas sample was analyzed for VOCs.

If soil-gas data indicate tetrachloroethene (PCE) or trichloroethene (TCE) concentrations greater than the established trigger levels, depth-discrete 0.3 m (1 ft) soil sampling at 1.8 m (6 ft) down to 14.6 m (48 ft) would be performed. Each soil sample will be analyzed for a subset of TCL VOCs.

Soil

Subsurface soil sampling was performed at two sampling locations at the identified PSLs that cross into the IU (Figure 5 and Table 2).

Each soil sample was analyzed for TAL inorganics, gross alpha, and nonvolatile beta. Radionuclide speciation would be performed in the event the trigger level of 20 and 50 pCi/g for gross alpha or nonvolatile beta were exceeded, respectively.

Groundwater

Groundwater samples were collected at 21 locations from the top of the upper UTRA (Figure 5). Groundwater samples were analyzed for TCL VOCs, gross alpha, nonvolatile beta, and tritium. Radionuclide speciation would be performed in the event the trigger level of 15 and 50 pCi/L for gross alpha or nonvolatile beta were exceeded, respectively.

Data Evaluation

Soil-Gas

A total of 82 soil-gas field measurements were collected for tetrachloroethene (PCE) and trichloroethene (TCE). PCE and TCE were detected at low concentrations (1.2 and 0.4 ppmv, respectively). The field data did not indicate the presence of VOC contamination within the vadose zone. None of the field measurements for PCE and TCE were greater than the trigger levels.

A total of 81 laboratory analyses were performed on soil-gas samples collected for VOCs. The primary contaminants of interest, PCE and TCE were not determined in any of the samples. Trichlorofluoromethane was determined in a quarter of the samples. The laboratory data supports the field data in that no VOC source(s) was determined in the IU that would contribute to the localized PCE concentrations in the groundwater.

Soil-gas data did not indicate the presence of VOC contamination within the vadose zone.

Soil

Review of the soil-gas data did not exceed trigger levels nor did the data indicate elevated levels that would support additional characterization. Therefore, no depth-discrete soil samples to define the extent of VOC contamination were identified or collected.

However, soil sampling was conducted at two locations associated with the PSLs (Figure 5). Two soil samples exceeded the 20 pCi/g trigger level for gross alpha and one sample exceeded the 50 pCi/g trigger level for nonvolatile beta. These exceedances were from the same sampling location but at different sampling depths.

Data evaluation of soil samples collected from the two locations determined the presence of 19 inorganics and 15 radionuclides. No man-made radionuclides were determined in the speciated samples. Further screening of the data against 2X average SRS background values determined five inorganics and three radionuclides to be unit-specific constituents (USCs).

Inorganic concentrations are consistent with background soil levels, naturally occurring, and widespread in SRS soils. Radionuclides determined in the soil samples are also naturally occurring, widespread, and commonly found in SRS soils.

Because this is a subsurface soil unit, human health and ecological risk is not applicable but further evaluation was performed to determine if contaminant migration or PTSM refined constituents of concern (RCOCs) were present (Table 1).

Groundwater

A total of 44 analyses were performed for VOCs and a total of 22 analyses were performed for radionuclides. Three of the 22 groundwater samples were analyzed for alpha speciation and one groundwater sample was analyzed for gamma speciation as the trigger levels for gross alpha and nonvolatile beta in the groundwater sample were exceeded. No man-made radionuclides, except for tritium, were detected in the groundwater. Two VOCs and five radionuclides were determined to exceed maximum concentration limits (MCLs) or preliminary remediation goals (PRGs).

The elevated levels of inorganics and radionuclides are attributed to turbid samples that are associated with CPT sampling activities and are not indicative of a groundwater problem.

Principal Threat Source Material Evaluation

An evaluation was performed on soils data collected to support characterization of the PSLs to determine if principal threat source material (PTSM) exists. As an outcome of this evaluation, it was determined there are no PTSM constituents associated with the PSLs.

Contaminant Migration Evaluation

An evaluation was performed on soils data to determine if constituents in the soil near the PSLs would impact local groundwater. No constituents were identified as contaminant migration RCOCs.

2.1.1 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 concentration levels of PCE in the groundwater exceed the MCL (5 µg/) (Figure 3). These areas were delineated by previous DPT groundwater investigations but there is no defined groundwater plume. These localized groundwater areas are not located near any known facilities. No VOCs were determined in the area. Groundwater data at one location exhibited elevated PCE slightly above MCL in one of three analyses performed on two samples collected. No PCE was detected in groundwater samples collected around this location.

Problems Warranting Action

- There is no soil contamination related to these subunits. However, there are contaminated pipelines present in the subsurface within this investigative unit (See Section 5.5.3).

2.2 P-Area Ash Basin Investigative Unit

The P-Area Ash Basin Investigative Unit consists of approximately 26 acres in and around the P-Area Ash Basin (188-0P) (Figure 4). The ash basin and the P007 outfall are the subunits identified in this IU.

The boundary of the study is the interior of the ash basin and surrounding area (Figure 7). Any ash and coal reject material found exterior to the ash basin will be managed according to the selected remedy. The objectives of the characterization are as follows:

- Determine the presence of pooled water within the basin;
- Determine the depth of the ash within the basin;
- Determine the presence of coal reject material within the ash;
- Determine nature and extent of contamination, if coal reject material is determined to be present;
- Determine nature and extent of contamination in pooled water (if present) and ash material;
- Determine the presence of ash and/or coal reject material on the exterior of the ash basin; and
- Collect a groundwater sample at select locations to determine local impact to groundwater.

Sampling Approach

Ash Thickness

Nineteen locations were sited in and around the ash basin to determine the thickness of the ash and determine the presence of coal rejects (Figure 7).

Surface Soil/Ash

Samples were collected from seven sampling locations within the ash basin from 0 to 0.3 m (0 to 1 ft), 12 locations were sited exterior to the basin, and four within the P007 outfall (Figure 7). It is assumed that the composition of the ash is homogeneous; therefore, no depth-discrete ash samples were collected.

Each ash sample collected from within the ash basin was analyzed for TCL organics, TAL inorganics, TCL polyaromatic hydrocarbons (PAHs), dioxins/furans, sulfate, nitrate as nitrogen, total organic carbon, gross alpha, nonvolatile beta, and alpha and gamma speciation. For the samples collected exterior to the basin, each sample was analyzed for TAL inorganics, gross alpha, and nonvolatile beta. Radionuclide speciation was performed on ash samples that exceeded the trigger level of 20 and 50 pCi/g for gross alpha or nonvolatile beta, respectively.

Subsurface Basin Soil

Three subsurface soil samples were collected at the interface of the ash and the ash basin bottom to ascertain potential impact to subsurface soils from contaminants leaching from the ash (Figure 7). Each sample was analyzed for TCL organics, TAL inorganics, TCL polyaromatic hydrocarbons (PAHs), dioxins/furans, sulfate, nitrate as nitrogen, total organic carbon, gross alpha, nonvolatile beta, and alpha and gamma speciation.

Surface Water

A walk down of the ash basin was conducted to determine if there was any standing or pooling of water in sufficient quantity within the basin.

Groundwater Samples

Three groundwater sampling locations were sited within the ash basin. Each groundwater sampling location coincided with surface ash and subsurface basin soil sampling locations (Figure 7).

Each groundwater sample was analyzed for TCL organics, TAL inorganics, TCL PAHs, dioxins/furans, sulfate, nitrate as nitrogen, total organic carbon, gross alpha, nonvolatile beta, and tritium. No radionuclide speciation was performed since the triggers of 15 or 50 pCi/L for gross alpha and nonvolatile beta were not exceeded, respectively.

Data Evaluation

A review of historical photographs since 1951 to 2004 was performed to determine distribution of ash within the basin. During years of 1973-74, ash within the P-Area Ash Basin was removed and placed around the perimeter of the basin and to the north along the access road that led to the basin. As seen in the 1974 aerial photograph, there is a significant ash deposit to the northeast of the basin as a result of this effort (Figure 8). The 1982 aerial photograph depicts the extent of ash redistribution as it extends to the west and north along the access road that leads to the ash basin (Figure 9).

Hand-augering was performed at 26 locations to verify the presence and thickness of the ash within and around the basin. The thickness of the ash exterior to the basin varied from less than 0.3 m (1 ft) to greater than 3 m (10 ft) (Figure 10). The ash deposits tend to be thicker around the basin berm; to the west and south. Four of the 26 locations are located within a discharge drainage area for the P007 outfall. Ash was found to be within a wooded area just south of the discharge channel.

Ash deposits within the basin are primarily the thickest near the sluice line discharge point within the basin (Figure 10). This area also accounts for the majority of the ash deposits within the basin. The largest amount of ash found in the basin was determined to be 3.4 m (11 ft) thick at sampling location PASH001. Most of the ash basin contains approximately 0.3 m (1 ft) of ash on the basin bottom; except near the sluice line discharge point (sampling locations PASH-001 and -002).

Further document investigation identified a 2001 topographic survey that was conducted within the interior of the basin. An estimate of approximately 30,173 m³ (39,465 yds³) of ash was determined to be present within the basin. Confirmation of the 2001 survey was conducted during sampling of the seven locations within the basin (Figure 10).

Visual inspection of the ash deposits within the basin indicate partially burned coal material near the sluice line in addition to ash. Throughout most of the ash basin, ash is the primary deposit

with no presence of unburned or partially burned coal. Visual inspection of ash deposits exterior to the basin indicates a mix of partially burned coal and ash.

Surface Soil/Ash

Surface ash samples were collected from 19 sampling locations (Figure 7). Of the 19 sampling locations, seven were located within the basin and one was located in the P007 outfall. Surface soil samples were collected from three locations within the P007 outfall. Four samples (all ash) exceeded the gross alpha trigger level. One sample (ash) located in the P007 outfall exceeded the trigger levels for gross alpha and nonvolatile beta.

Cesium-137 was determined in ash samples collected from the basin and surrounding area. The presence of this radionuclide can be attributed to fallout. However, elevated activities for cesium-137 and cobalt-60 were determined in an ash sample collected from the P007 outfall. The presence of these radionuclides is principally from the release of contaminated process water from the disassembly basin area to this outfall and not as a result of fallout.

Data evaluation of ash samples collected from the 22 locations determined the presence of six dioxins/furans, 26 inorganics, 22 radionuclides, 16 SVOCs, and eight VOCs constituents. Further screening of the data against 2X average SRS background values determined six dioxins/furans, 23 inorganics, 21 radionuclides, 13 SVOCs, and eight VOCs constituents.

Subsurface Basin Soil

Subsurface basin soil samples were collected from three sampling locations within the ash basin (Figure 7). One subsurface basin soil sample was collected from the location that contained the thickest ash deposit (>11 ft) and nearest the sluice line discharge. This location not only contained ash but also partially burned coal. The remaining two subsurface basin soil samples were collected from ash sampling locations within the basin.

Data evaluation of the subsurface basin soil samples collected determined the presence of seven dioxins/furans, 24 inorganics, 16 radionuclides, eight SVOCs, and one VOC constituents. Further screening of the data against 2X average SRS background values determined six dioxins/furans, ten inorganics, two radionuclides, six SVOCs, and one VOC constituents.

Surface Water

No pooled water was present during a walk down of the basin; therefore, no samples were collected.

Groundwater

During groundwater sampling of the three locations within the basin, field pH measurements were taken and determined to be between 4.85 and 5.18 from the three groundwater sampling locations. Depth to water was determined to be approximately 7.0 to 7.6 m (23 to 25 ft) below basin bottom.

Screening of the data against MCLs or PRGs determined two polynuclear aromatic hydrocarbons (PAHs). The PAH exceedances are attributable to the turbidity characteristic of the cone penetrometer technology (CPT) water collection method. Solid matter is captured during CPT water sample collection and reflects the PAHs sorbed to fine sediments since PAHs have very low solubility and high sorption. None of the groundwater samples exceeded the gross alpha or nonvolatile beta trigger level; therefore, no radionuclide speciation was performed. No other constituent was found to have exceeded either a MCL or PRG.

Human Health and Ecological Risk Assessment

Arsenic, cesium-137 (+D), cobalt-60, potassium-40, radium-226 (+D), radium-228 (+D), thorium-228 (+D), and uranium-238 (+D) are present at concentrations that pose a risk greater than 1E-06 to a future industrial worker in surface ash. Arsenic and selenium are present at concentrations that pose an unacceptable risk to ecological receptors in surface and subsurface ash.

Principal Threat Source Material Evaluation

An evaluation was performed on data collected to support characterization of the ash basin to determine if PTSM exists. As an outcome of this evaluation, it was determined there are no PTSM constituents.

Contaminant Migration Evaluation

An evaluation was performed on soils data to determine if constituents in the soil would impact local groundwater. No constituents were identified as contaminant migration RCOs.

2.2.1 Ash Basin

The subunit contains elevated concentrations of natural occurring metals (arsenic) and radionuclides contained with the ash/partially burned coal deposits within and exterior to the basin as a result of combustion of coal for power in support of facility operations. Cesium-137 was determined to be present in the ash samples; however, the activities are low and are attributed to fallout.

Problems Warranting Action

- Arsenic, potassium-40, radium-226 (+D), radium-228 (+D), thorium-228 (+D), and uranium-238 (+D) are present in surface ash that exceeds 1E-06 risk levels (total media risk = 2.5E-04) to the industrial worker.
- Arsenic (HQ=1.3 [shrew]) and selenium (HQ=7.9 [shrew] and HQ=5.2 [robin]) exist in surface ash that exceeds an HQ of 1 for ecological receptors.

2.2.2 P007 Outfall

Gamma overflight data indicate a localized area of elevated gamma activity in the P007 outfall. Sampling did determine elevated activities of cesium-137 and cobalt-60 at one sampling

location. The possible source of the material is from process sewer line discharges that originate from the disassembly basin area.

Problems Warranting Action

- Radiological (Cs-137 [+D], Co-60, K-40, Ra-226 [+D], U-238 [+D]) and inorganic (As) constituents are present in surface ash and exceed 1×10^{-6} risk levels (5.7E-04) to the industrial worker.
- Inorganic (metal) constituents in surface soil that exceed an HQ of 1 (TBD) for ecological receptors.

2.3 Cooling Water System Investigative Unit

The Cooling Water System Investigative Unit consists of approximately 12.5 acres around the Cooling Water Reservoir (186-P) and Cooling Water Pump House (190-P) (Figure 2 and Figure 3). The following subunits have been grouped under the Cooling Water System Investigative Unit:

- Potential Release from the P-Area Reactor Cooling System (186/190-P); and
- P-Area Process Sewer Lines as Abandoned

The Potential Release from the P-Area Reactor Cooling System (186/190-P) is contained entirely within the Cooling Water System Investigative Unit, while only portions of the P-Area Process Sewer Lines as Abandoned exist within the Cooling Water Investigative Unit. These pipelines may be interrelated with any potential subsurface releases from the P-Area Reactor Cooling System (186/190-P).

The investigation was exterior of the P-Area Reactor Cooling System (186/190-P) and those PSLs that cross into the IU. The principal risk is associated with contaminants that may be present in surface soils that would affect human and ecological receptors. The objectives of the characterization within this IU are as follows:

- Determine nature and extent of contamination in surface and subsurface soils; and
- Collect a groundwater sample at select locations to determine local impact to groundwater.

As a result of the intermittent overflows, there is the potential for surficial risk and contaminant migration for the P-Area Reactor Cooling System. PTSM is not an issue as the releases would not have resulted in an accumulation of contaminants (Table 1). Contaminant migration and PTSM are issues to be addressed for the PSLs since release to the environment would have resulted in subsurface release. Each of these issues will be addressed through data collection and analysis.

Sampling Approach

Soil Sampling

Soil samples were collected from 15 locations and analyzed for TAL inorganics, gross alpha and nonvolatile beta (Figure 11 and Table 2).

Radionuclide speciation was performed on samples if the trigger levels of 20 or 50 pCi/g for gross alpha and nonvolatile beta were exceeded, respectively.

Groundwater Sampling

Groundwater samples were collected from fifteen locations (Figure 11). Each sample was analyzed for TAL metals, TCL VOCs, gross alpha, nonvolatile beta, and tritium. Radionuclide speciation was performed in the event the trigger level of 15 and 50 pCi/L for gross alpha or nonvolatile beta was exceeded, respectively.

Data Evaluation

Soil

Fifteen locations were sited in the Cooling Water System IU (186/190-P) of which 12 were located principally around the P-Area Reactor Water Cooling Basins (186-P) and Cooling Water Pump House (190-P) (Figure 11). Three sampling locations were located at PSL junctions or manholes that crossed into the IU. A total of 103 soil samples were collected with 97 samples collected from around the P-Area Reactor Water Cooling Basins (186-P) and Cooling Water Pump House (190-P). The remaining 16 soil samples were collected from three soil sampling locations along the PSLs.

Data evaluation of soil samples collected from the 15 locations determined the presence of 23 inorganic and 17 radionuclide constituents. Five soil samples exceeded the soil trigger for gross alpha and one soil sample exceeded the soil trigger for nonvolatile beta. Neptunium-237 was detected in one of six samples but at very low activities (0.0624 pCi/g). No other man-made radionuclides were detected. Further screening of the data against 2X average SRS background values determined 16 inorganics and 12 radionuclides to be USCs.

Inorganic concentrations are consistent with background soil levels, naturally occurring, and widespread in SRS soils. Radionuclides determined in the soil samples are also naturally occurring, widespread, and commonly found in SRS soils.

Groundwater

A total of 17 analyses were performed for inorganics. A total of 28 analyses were performed for VOCs. A total of 16 analyses were performed for radionuclides. Only one groundwater sampling location exceeded trigger levels for gross alpha and nonvolatile beta. Therefore, an alpha and gamma speciation was performed to discern specific radionuclides. No man-made radionuclides, except for tritium, were detected in the groundwater.

Screening of the data against MCLs or PRGs determined seven inorganics, two VOCs, and five radionuclides.

The elevated levels of inorganics and radionuclides are attributed to turbid samples that are associated with CPT sampling activities and are not indicative of a groundwater problem. The presence of VOCs in groundwater samples collected is not associated with potential release(s) from the subunits within this IU. This IU is located downgradient of an existing VOC source area located in the Northern Vadose Zone and P-Reactor IUs.

Human Health and Ecological Risk Assessment

A human health and ecological risk assessment was performed for the Potential Release from P-Reactor Cooling Water System subunit. Constituents exceeding 1E-06 risk to industrial worker and HQ >1 to ecological receptors were eliminated in uncertainty evaluation.

Principal Threat Source Material Evaluation

An evaluation was performed on soils data collected to support characterization of the PSLs to determine if PTSM exists. As an outcome of this evaluation, it was determined there are no PTSM constituents associated with the PSLs.

Contaminant Migration Evaluation

An evaluation was performed on soils data to determine if constituents in the soil would impact local groundwater at the Potential Release from P-Reactor Cooling Water System subunit. No constituents were identified as contaminant migration RCOCs.

2.3.1 Potential Release from P-Area Reactor Cooling System

The primary concern associated with this subunit is associated with impact to surface soils and impact to subsurface soils and groundwater from intermittent overflow from the cooling water basins. Investigation of the area did not determine the presence of contamination.

Problems Warranting Action

- There is no soil contamination related to these subunits. However, there are contaminated pipelines present in the subsurface within this investigative unit (See Section 5.5.3).

2.4 Northern Vadose Zone Investigative Unit

The Northern Vadose Zone Investigative Unit consists of approximately 14 acres north of the reactor inner-fence line (Figure 4). There are three subunits contained within the Northern Vadose Zone Investigative Unit (Figure 2 and Figure 3):

- P-Area Process Sewer Lines as Abandoned;
- PSA 2: Area around the Cooling Water Effluent Sumps (107-P/107-1P); and

- PSA 3B: Area west of the Administrative/Maintenance slab.

The boundary of the study will be in an area exterior to the Cooling Water Effluent Sumps (107-P/107-1P) for PSA 2 and an area west and exterior to the Administrative/Maintenance slab for PSA 3B. Where PSLs cross into the IU, samples will be collected at pipeline junctions and near manholes and sumps. The objectives of the characterization are as follows:

- If there are elevated soil-gas data for TCE (> 76 ppmv) and PCE (> 20.5 ppmv), soil samples will be collected to quantify VOC soil concentrations.
- Determine nature and extent of contamination in subsurface soils around the effluent sumps and pipelines; and
- Collect a groundwater sample to determine local impact to groundwater

Background surface soil samples were collected from three sampling locations located at unimpacted areas around P Area (Figure 5 and Table 2).

Only contaminant migration and PTSM are issues to be addressed through data collection and analysis for the subunits identified within this IU as releases to the environment would have occurred at depth and not from surface release (Table 1).

Soil-Gas

Soil-gas samples were collected every 1.5 m (5 ft) starting at 3 m (10 ft) down to 12.2 m (40 ft) from 19 sampling locations (Figure 12). Field measurements consisting of carbon dioxide, TCE, and PCE concentrations were collected at each sample depth. Each soil-gas sample was analyzed for VOCs.

Soil

A total of 23 soil sampling locations were sited at the three subunits (Figure 12). Of the 23 sampling locations, 13 were associated with VOC subsurface soil sampling at PSA 3B based on soil-gas data. The remaining ten were associated with subsurface soil sampling at the PSLs and PSA 2 (Figure 12). Radionuclide speciation was performed on samples if the trigger levels of 20 or 50 pCi/g for gross alpha and nonvolatile beta were exceeded, respectively.

Subsurface soil samples collected from PSA 3B were continuously sampled on 0.3 m (1 ft) increments starting at various depths depending on distance from the source area and the soil-gas results. Subsurface soil samples were collected from PSA 2 and the PSLs.

Groundwater

Groundwater samples were collected at the top of the upper UTRA at 42 sampling locations (Figure 12). Each groundwater sample was analyzed for TCL VOCs, TAL inorganics, gross alpha, nonvolatile beta, and tritium. Radionuclide speciation was performed in the event the trigger level of 15 and 50 pCi/L for gross alpha or nonvolatile beta were exceeded, respectively.

Physical Characteristics

Four geotechnical samples were collected at one location within PSA 3B (Figure 12). Each sample was analyzed for soil moisture, total organic carbon, Atterburg limits, bulk density, hydraulic conductivity, specific gravity, and conductivity.

Data Evaluation

Soil-Gas

A total of 137 field measurements were collected for PCE and TCE. PCE and TCE were detected with PCE determined to exceed the trigger level in eight samples from three sampling locations.

A total of 121 analyses were performed on soil-gas samples collected for VOCs. PCE and trichlorofluoromethane were determined in samples collected. TCE was not detected. Six samples exceeded the trigger level of 20.5 ppmv at the three locations that were also identified from the field measurements.

Soil

A total of 347 VOC analyses from 13 sampling locations were performed on samples collected from PSA 3B. Data evaluation of the soil samples determined the presence of ten organic constituents. None of the ten detected organic constituents have corresponding background data to determine if the maximum concentration exceeds the 2X SRS average background concentration. Therefore, all ten organic constituents were retained as USCs.

A total of 37 TAL inorganic analyses from 10 sampling locations were performed on samples collected from PSA 2 and the PSLs. Data evaluation of samples collected from the ten sampling locations determined the presence of 21 inorganic constituents. A total of 38 analyses were performed for radionuclides. Gross alpha and nonvolatile beta were detected in samples collected. No radionuclide speciation was performed on soil samples collected from PSA 2 and the PSLs. Further screening of the data against 2X average SRS background values determined ten inorganics and one radionuclide to be USCs.

Inorganic concentrations are consistent with background soil levels, naturally occurring, and widespread in SRS soils. Radionuclides determined in the soil samples are also naturally occurring, widespread, and commonly found in SRS soils.

Groundwater

A total of 25, 70, and 42 analyses were performed for inorganics, VOCs, and radionuclides. Six groundwater locations exceeded the trigger level for gross alpha (15 pCi/L) and two locations exceeded the trigger level for nonvolatile beta (50 pCi/L). Therefore, alpha and gamma speciations were performed to discern specific radionuclides. No man-made radionuclides, except for tritium, were detected in the groundwater. The elevated levels of inorganics and

radionuclides are attributed to turbid samples that are associated with CPT sampling activities and are not indicative of a groundwater problem.

Screening of the data against MCLs or PRGs determined nine inorganics, five VOCs, and seven radionuclides.

Principal Threat Source Material Evaluation

An evaluation was performed on soils data collected to support characterization of PSA 2 and the PSLs to determine if PTSM exists. As an outcome of this evaluation, it was determined there are no PTSM constituents.

Contaminant Migration Evaluation

An evaluation was performed on soils data to determine if constituents in the soil would impact local groundwater. No constituents were identified as contaminant migration RCOCs. However, for PSA 3B the sampling approach was to define the extent of contamination from the source area and as such the data collected do not indicate the maximum concentrations from the source area. Therefore, data collected from the FY05 sampling event in support of the P-Reactor Groundwater OU will be used to refine the contaminant migration evaluation. The data collected during this field investigation focused on the source areas to define the source.

2.4.1 Potential Source Area 2

The concern with this PSA is associated with elevated gross alpha and nonvolatile beta activities in the groundwater near the cooling water effluent sumps that are located in this PSA. No speciation was performed on the previously collected groundwater samples. Therefore, sampling was performed in this PSA to determine impact to subsurface soils and groundwater that might have occurred from potential release(s) from the sumps or PSLs that are located in this PSA. Investigation of area did not indicate the presence of man-made radionuclides or other contaminants in the soil. Groundwater sampling to speciate groundwater samples did not determine the presence of contamination.

Problems Warranting Action

- There is no soil contamination related to these subunits. However, there are contaminated pipelines present in the subsurface within this investigative unit (See Section 5.5.3).

2.4.2 Potential Source Area 3B

Previous investigations determined the presence of a VOC source area (primarily PCE) in an area west of the administration/maintenance slab as a result of previous operations and maintenance activities in this area. The investigation of the area confirmed the presence of VOC soil contamination in the area. The concern with this PSA is the presence of VOCs in subsurface soils that are impacting local groundwater.

Problems Warranting Action

- The vadose zone has residual levels of VOCs (principal contaminant PCE 1.35 mg/kg) that are migrating to the groundwater at levels that exceed the MCL.

2.5 P-Reactor Investigative Unit

The following subunits are grouped under the P-Reactor Investigative Unit (Figure 2 and Figure 3):

- 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 including the Spill on 3/15/79 of 5500 Gallons of Contaminated Water;
- 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.

The P-Reactor IU consists of approximately 16.6 acres within the reactor inner fence line. Due to the proximity and congestion of utilities related to the Reactor Building (105-P) (P-Area Disassembly Basin, PSLs, and ancillary structures are inter-related), it is impractical to determine which subunit may have been an actual source area for groundwater contamination. The reactor inner fence line is the boundary for this IU, with the exception of PSA-1. Samples were collected around the exterior of the Reactor Building, at pipeline junctions, near manholes and sumps, and outside the 1,892,500 liter (500,000 gallon) tank within the Emergency Cooling Water Retention Basin. Additionally, all railroad tracks within P Area are included as part of the IU to assess impact to the environment. The objectives of the sampling plan are as follows:

- Perform radiological survey of railroad tracks, cross ties, and up to 1.8 m (6 ft) on either side of all railroad tracks within the P Area fence;
- Determine nature and extent of contamination in surface soils identified from radiological surveys, as appropriate;
- Determine nature and extent of contamination in surface soils within a defined high contamination area (HCA);
- Determine nature and extent of contamination in subsurface soils;
- Determine the presence of VOCs within subsurface soils; and
- Collect a groundwater sample at select locations to determine local impact to groundwater.

Sampling Approach

Radiological Survey

A radiological survey was conducted on all existing railroad tracks within the P Area facility fence. The survey was performed to 1.8 m (6 ft) to either side of the railroad tracks. In addition, remnants of the railroad tracks that lead to the coal burning powerhouse were also surveyed. This section of railroad track and cross ties was removed earlier and centrally staged in the southern part of P Area.

Soil-Gas

Soil-gas samples were collected every 1.5 m (5 ft) starting at 3 m (10 ft) down to 12.2 m (40 ft) from 36 sampling locations (Figure 13). Twenty of the 36 sampling locations were located in PSA 3A. The remaining 16 sampling locations were located in PSA 4. Field measurements consisting of carbon dioxide, TCE, and PCE concentrations were collected at each sample depth. Each soil-gas sample was analyzed for VOCs.

Soil

Sixty-eight soil sampling locations were sited within the P-Reactor IU to address potential impacts to the environment from multiple sources (Figure 13).

Surface Soil

Of the 68 sampling locations, surface soil samples 0 to 0.3 m (0 to 1 ft) and 0.3 m to 1.2 m (1 to 4 ft) were collected from 23 locations to support human health and ecological risk assessment and were analyzed for TAL inorganics, gross alpha, and nonvolatile beta. Of the 23 locations, eight locations were sampled for gravel from the railroad bed and wood from cross ties at the HCA on the railroad tracks near the Reactor Building (105-P) and were analyzed by ISOCS for radionuclides (Figure 14).

Subsurface Soil

Subsurface soils were collected from 48 sampling locations to determine nature and extent and support PTSM and contaminant migration evaluations and were analyzed, depending on which subunit, for TCL VOCs, TAL inorganics, gross alpha, and nonvolatile beta. Subsurface soil sampling was performed at the following OUs and depths (Table 2):

PSAs 3A and 4

- VOCs only: 0.3 m (1 ft) increments starting at various depths depending on distance from the source area and the soil-gas results

PSLs, P-Area Cask Car Railroad Tracks, and Potential Release from the P-Area Disassembly Basin

- 1.2 to 1.8 m (4 to 6 ft)

- 2.4 to 3.0 m (8 to 10 ft)
- 5.5 to 6.1 m (18 to 20 ft)
- 6.7 to 7.3 m (22 to 24 ft)
- 8.5 to 9.1 m (28 to 30 ft)
- 11.6 to 12.2 m (38 to 40 ft)
- 12.0 to 12.8 m (40 to 42 ft)
- 14.0 to 14.6 m (46 to 48 ft)

Radionuclide speciation was performed on samples if the trigger levels of 20 or 50 pCi/g for gross alpha and nonvolatile beta were exceeded, respectively.

Groundwater

Groundwater samples were collected at the top of the upper UTRA at 58 sampling locations within the IU (Figure 13). Each groundwater sample will be analyzed for TCL VOCs, TAL inorganics, gross alpha, nonvolatile beta, and tritium. Radionuclide speciation was performed on samples if the trigger levels of 15 or 50 pCi/L for gross alpha and nonvolatile beta were exceeded, respectively.

Physical Characteristics

Four geotechnical samples were collected from one location in PSA3A (Figure 13). Each sample was analyzed for soil moisture, total organic carbon, Atterburg limits, bulk density, hydraulic conductivity, specific gravity, and conductivity.

Data Evaluation

The following data discussion pertaining to the nature and extent of contamination within the P-Reactor IU is discussed holistically in lieu of presenting the data on a subunit by subunit basis. This is due to the complexity and inter-relationship of the subunits to one another. In certain instances, data are presented for a particular subunit based on the outcome of the work performed.

Radiological Survey

As an outcome of the survey, no radiological contamination was found. Therefore, no sampling was performed on the railroad tracks except for the already identified HCA on the railroad tracks near the Reactor Building (105-P).

Soil-Gas

A total of 250 field measurements were collected for PCE and TCE. PCE and TCE concentrations were determined in field measurements. TCE exceeded the trigger level of 76 ppmv in nine measurements from two sampling locations at PSA 3A. No measurements from PSA 4 exceeded the PCE or TCE trigger values.

A total of 244 analyses were performed on soil-gas samples collected for VOCs. PCE, TCE, cis-1,2-dichloroethylene, and trichlorofluoromethane were determined in the samples collected. TCE exceeded the trigger level of 76 ppmv in 4 samples from the same two sampling locations as determined from the soil-gas field measurements at PSA 3A. No samples from PSA 4 exceeded the PCE or TCE trigger values.

Soil/Gravel

Overall, a total of 225 inorganic, 226 radionuclide, and 482 organic analyses from 68 sampling locations were performed. Data evaluation of the soil samples determined the presence of 22 inorganics, 20 radionuclides, and 19 organic constituents.

Eight soil samples at various depths collected from six locations around the Reactor Building (105-P) exceeded the trigger level for gross alpha or nonvolatile beta. Alpha speciation was performed on four of the samples. Gamma speciation was performed on four of the samples. No man-made radionuclides were detected in the soil.

Sixteen gravel samples collected from the HCA on the railroad tracks near the Reactor Building (105-P) were speciated using ISOCS. Naturally occurring radionuclides along with cesium-137 and cobalt-60 were detected in gravel samples collected from the HCA.

In addition to the two locations that were determined to exceed the TCE soil-gas trigger level, 14 locations were also sampled and analyzed for VOCs. The highest VOCs were determined in PSA 3A. VOCs were determined at shallow depths in a localized southern area in PSA 4 near an old abandoned diesel tank and disassembly basin. No VOCs were determined at depth associated with this localized VOC contamination.

Screening of the data against 2X average SRS background values determined 15 inorganic, 16 radionuclide, and 19 organic as USCs.

Inorganic concentrations are consistent with background soil levels, naturally occurring, and widespread in SRS soils. Radionuclides determined in soil samples are also naturally occurring, widespread, and commonly found in SRS soils. Except for cesium-137 and cobalt-60, radionuclides determined in gravel samples are naturally occurring.

Groundwater

A total of 41 analyses were performed for inorganics, 102 analyses were performed for VOCs, and 59 analyses were performed for radionuclides. Nine groundwater locations exceeded the trigger level for gross alpha (15 pCi/L) and two locations exceeded the trigger level for nonvolatile beta (50 pCi/L). Therefore, alpha and gamma speciation was performed to discern specific radionuclides. No man-made radionuclides, except for tritium, were detected in the groundwater. Screening of the data against MCLs or PRGs determined ten inorganics, five VOCs, and nine radionuclides.

The elevated levels of inorganics and radionuclides are attributed to turbid samples that are associated with CPT sampling activities and are not indicative of a groundwater problem.

Human Health and Ecological Risk Assessment

The two following subunits were evaluated for human health and ecological risk (PSA 1 only):

- Potential Source Area 1: Emergency Cooling Water Retention Basin; and
- HCA on Cask Car Railroad Tracks

Through data evaluation, no risk to human health and ecological receptors was determined for PSA 1. However, risk exists greater than $1E-06$ for the HCA on the Cask Car Railroad Tracks. Cesium-137 and cobalt-60 are the primary human health RCOCs at this subunit with a total combined risk of $5.6E-03$.

Principal Threat Source Material Evaluation

Cesium-137 is present at concentrations indicative of PTSM in surface soil/gravel (risk = $1.8E-02$) at the HCA on the Cask Car Railroad Tracks.

Contaminant Migration Evaluation

An evaluation was performed on soils data to determine if constituents in the soil would impact local groundwater. No constituents were identified as contaminant migration RCOCs. However, for PSA 3A the sampling approach was to define the extent of contamination from the source area and as such the data collected do not indicate the maximum concentrations from the source area. Therefore, data collected from the FY05 sampling event in support of the P-Reactor Groundwater OU will be used to refine the contaminant migration evaluation. The data collected during this field investigation focused on the source areas to define the source.

2.5.1 Potential Release from P-Area Disassembly Basin

The investigation of this subunit pertained to spills/releases that may have occurred exterior to the basin via process sewer lines, tank transfers, discharges to the seepage basins, and overflow of weirs. Incidental leaks from piping and equipment exterior to the basin 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 that houses the basin did not indicate the presence of man-made radiological constituents in the soil.

Problems Warranting Action

- There is no soil contamination related to these subunits. However, there are contaminated pipelines present in the subsurface within this investigative unit (See Section 5.5.3).

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

The investigation of this OU pertained to incidental leaks from the cask cars that may have affected surface soil with tritium and other radiological constituents. The principal impact to the environment is associated with an identified HCA along the railroad tracks where contaminated water leaked from cask cars onto the railroad tracks, cross ties, and railroad bed (gravel).

Contamination was determined to be present on the gravel and cross ties. No contamination was determined in the soil beneath the railroad bed (gravel) or laterally off the tracks.

Problems Warranting Action

- Cesium-137 (+D) (risk=5.6E-03) and cobalt-60 (risk=9.9-06) are present in surface gravel/cross ties that exceeds 1E-06 risk levels (total media risk=5.6E-03) to the industrial worker at the HCA.
- Cesium-137 (+D) (risk=1.8E-02) is present in the gravel/cross tie at concentrations that exceeds PTSM levels.

2.5.3 P-Area Process Sewer Lines as Abandoned

Subsurface soils were sampled around and below the PSLs and no contamination were determined as a result of a release from the PSLs and the Spill on 03/15/79 of 5500 Gallons of Contaminated Water, NBN. However, there is a potential for a release from the lines and there is fixed contamination (i.e., cesium-137 and cobalt-60) present within the PSLs. Due to the difficulty in accessing the lines, there is a potential for PTSM to be present within the lines.

Problems Warranting Action

- The PSLs are a conduit for surface water discharge.
- Based on process knowledge and data from other Reactor Areas (R- and C-Area), it is assumed that fixed radiological contamination is present within the PSLs which could be released to the environment and/or accessed in the future.

2.5.4 Reactor Building (105-P)

As agreed upon with Area Completion Team, work associated with the Reactor Building (105-P) will be conducted in a phased approach. Scoping of the Reactor Building (105-P) is currently underway.

Problems Warranting Action

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

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

The soil located around the 1,892,500 liter (500,000-gallon) contaminated-water storage tank within the retention basin was sampled to determine if there was impact to surface soils associated with previous water transfer activities from the tank to the nearby seepage basins. There is a potential for leaks to have occurred from the tank to the basins that would impact surface soils. As a result of the investigation, no contamination was determined in the soil.

Problems Warranting Action

- None

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

Previous investigations determined the presence of a VOC source area (primarily TCE) in an area north of the Reactor Building (105-P) as a result of previous operations and maintenance activities in this area. The investigation of the area confirmed the presence of VOC soil contamination in the area. The concern with this PSA is the presence of VOCs in subsurface soils that are impacting local groundwater.

Problems Warranting Action

- VOC contamination are present in the vadose zone at concentrations up to 12.5 mg/kg (TCE) and are continuing as a source to groundwater contamination exceeding the MCLs.
- VOC contamination in the vadose zone may pose a risk to vapor intrusion for future resident.

2.5.7 PSA 4: Area east of the Reactor Building

Previous groundwater investigations indicated the presence of VOCs in the groundwater east of the Reactor Building (105-P). However, no data were available to determine if a source was present that was or has contributed to the groundwater contamination. As a result of the investigation, no VOC source area was determined or the presence of VOC contamination. A localized area with elevated VOCs at shallow depths was determined near an old abandoned diesel tank, however, no soil contamination was determined at depth or in the groundwater. The presence of the VOCs in the groundwater can be attributed to the fluctuation of the shallow water table, existing VOC source areas, and radial groundwater flow from the reactor area.

Problems Warranting Action

- None

2.6 Other – P007 and P02 Outfalls

Based on gamma overflight data, two areas outside of P Area indicated elevated radioactivity in surface soils. These two areas coincide with the P007 outfall to the south and the P02 outfall to the northeast of P Area (Figure 15).

Since the P007 outfall area contains ash and is co-located with ash deposits exterior to the ash basin, data collection activities associated with the P007 outfall were included with the human health and ecological risk assessment and PTSM and contaminant migration evaluations for the Ash Basin IU (See Section 5.2).

Data Evaluation

Data evaluation of surface soil samples collected from the four P02 outfall sampling locations determined ten inorganics and two radionuclides to be USCs.

2.6.1 P02 Outfall

Gamma overflight data indicate a localized area of elevated gamma activity in the upper reaches of the P02 outfall. Investigation of the area did not adequately determine the presence of radionuclides. Field survey equipment (i.e., NaI) indicates elevated radionuclide activities above background within the area.

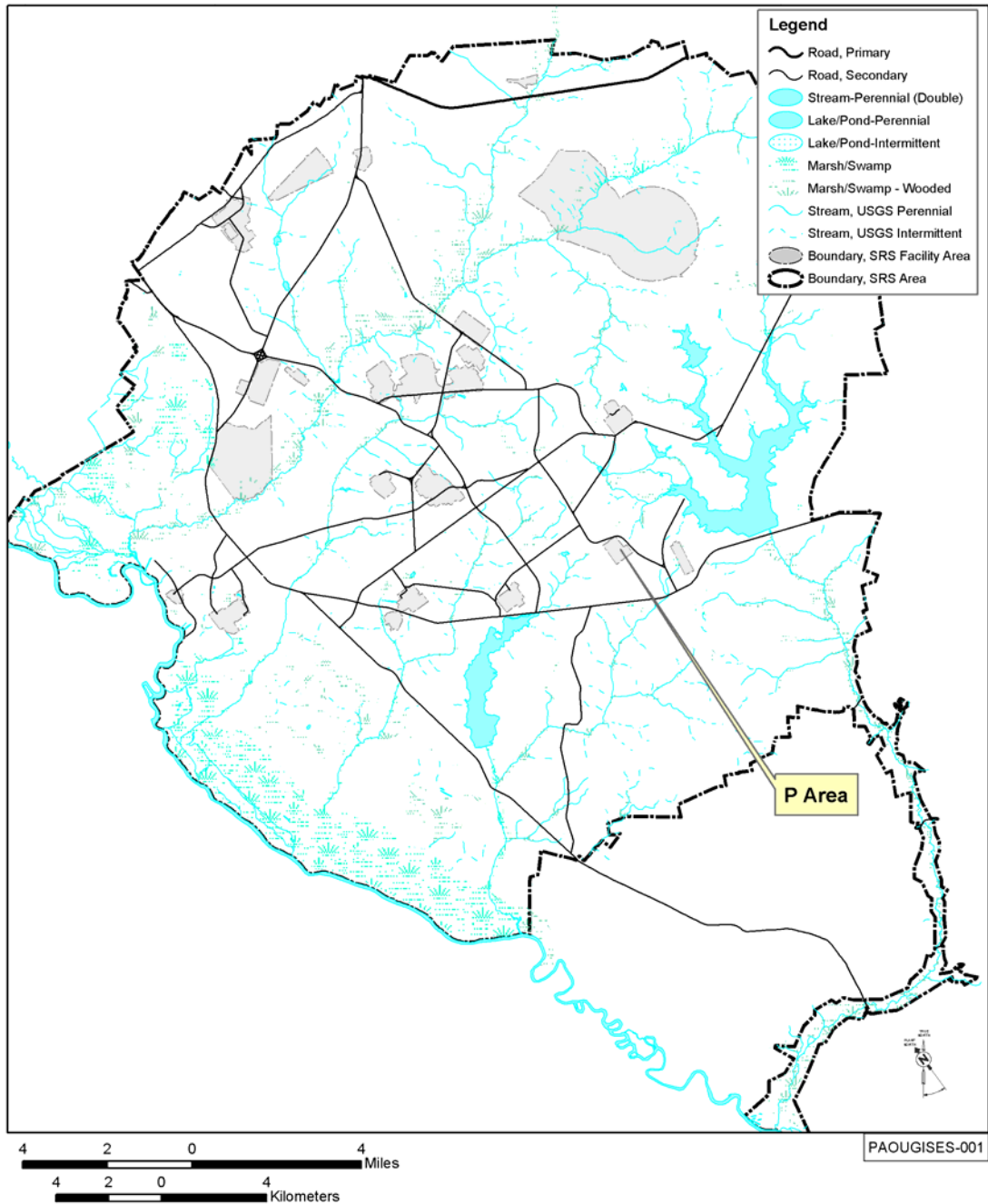
Problems Warranting Action

- Radiological constituents may be present in surface soil and may exceed 1×10^{-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.

3.0 Summary

As an outcome the PAOU field investigation and data evaluations, the following subunits have been identified that are either a risk to human health and ecological receptors, contain constituents that exceed PTSM values, or may be impacting groundwater (Figure 16):

Investigative Unit	Subunit	Constituent(s)	Driver	Size of Area
Ash Basin	Ash Basin and P007 Outfall	Metals, Radionuclides	risk to human health/ ecological receptors	10.5 ha (26 ac); varying ash thickness
Northern Vadose Zone	PSA 3B	VOCs (PCE)	groundwater impact	0.27 ha (0.68 ac); 3-13.7m (10-45 ft) bls
Reactor	PSA 3A	VOCs (TCE)	groundwater impact	0.48 ha (1.17 ac); 2-13.7m (6-45 ft) bls
	High Contamination Area	Radionuclides (Cs-137, Co-60)	risk to human health, PTSM	45 m ³ (59 yds ³); 6.1x12.2x0.3m (20x40x1 ft)
Outfalls	P007 & P02	Radionuclides (both) Arsenic (P007)	risk to human health/ ecological receptors	P007 0.36 ha (0.9 ac); P02 0.07 ha (0.16 ac)



Disclaimer:

This product was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.

Location of P Area at the Savannah River Site

Projection: Universal Transverse Mercator
 Datum: North American Datum 1927
 Zone: 17

To place on the North American Datum 1983, move the projection line 13 meters south and 15 meters west.

Figure 1: Location of P Area

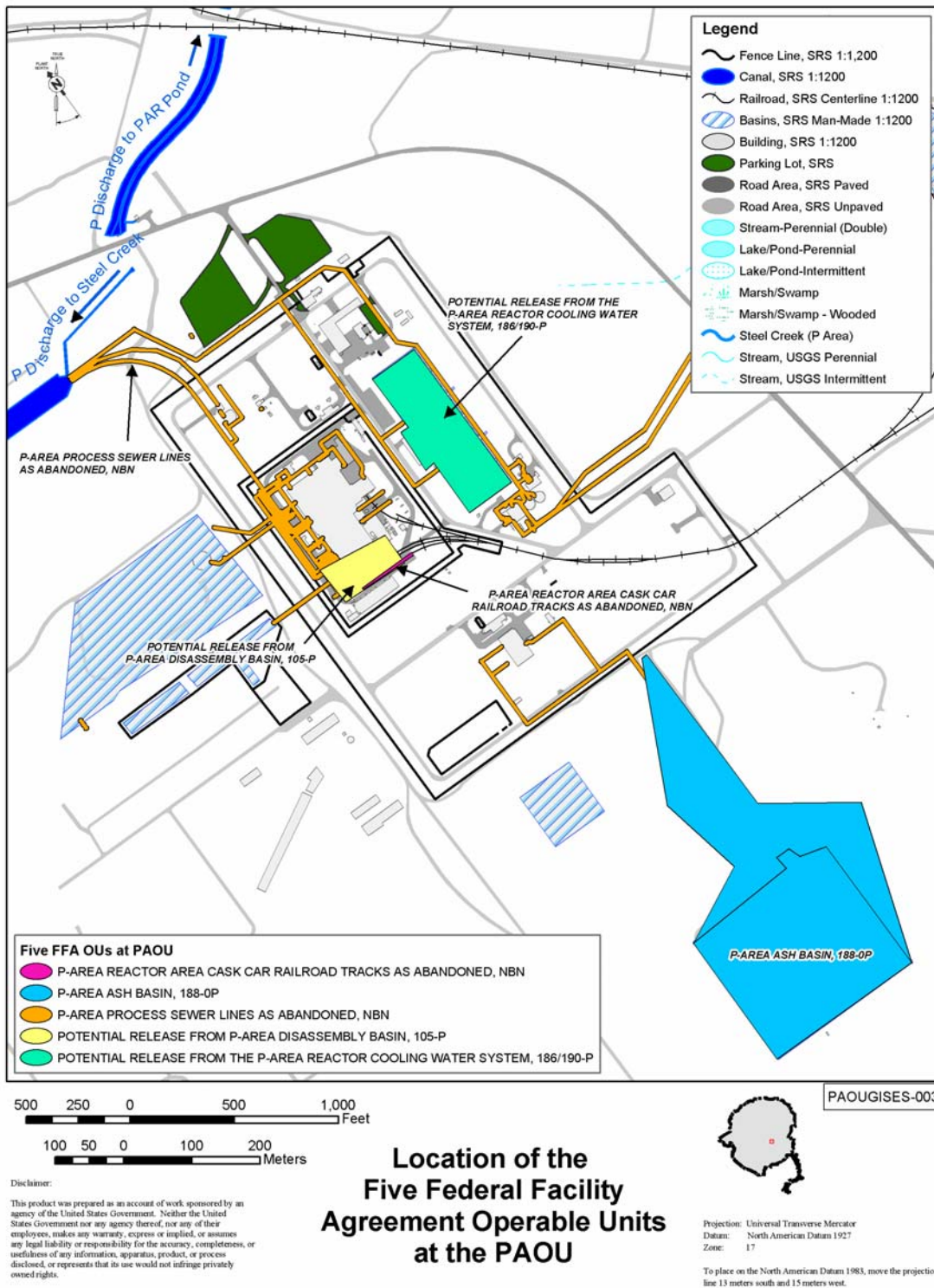
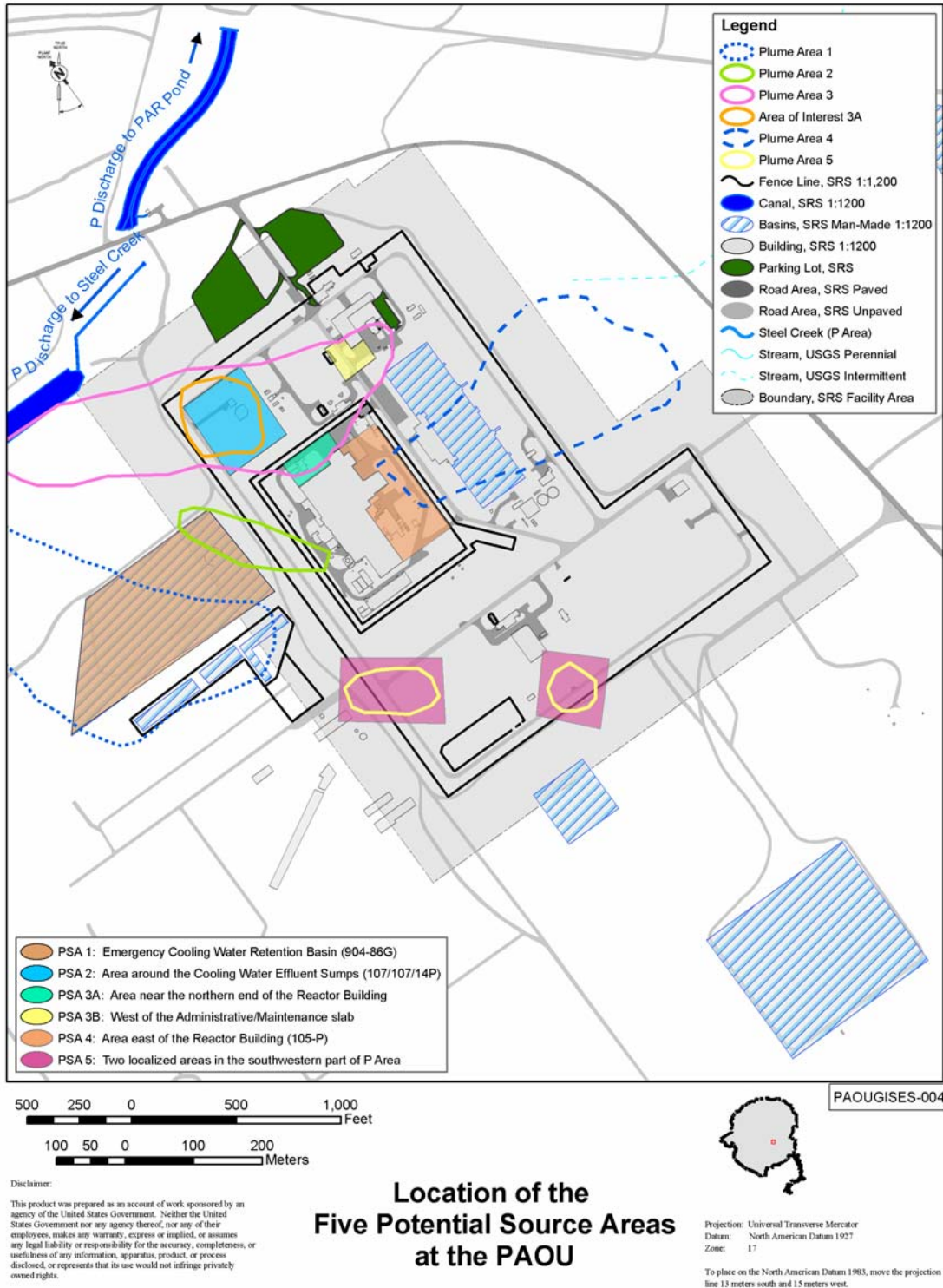


Figure 2: Location of FFA OUs and Reactor Building



Location of the Five Potential Source Areas at the PAOU

Figure 3: Location of PSAs

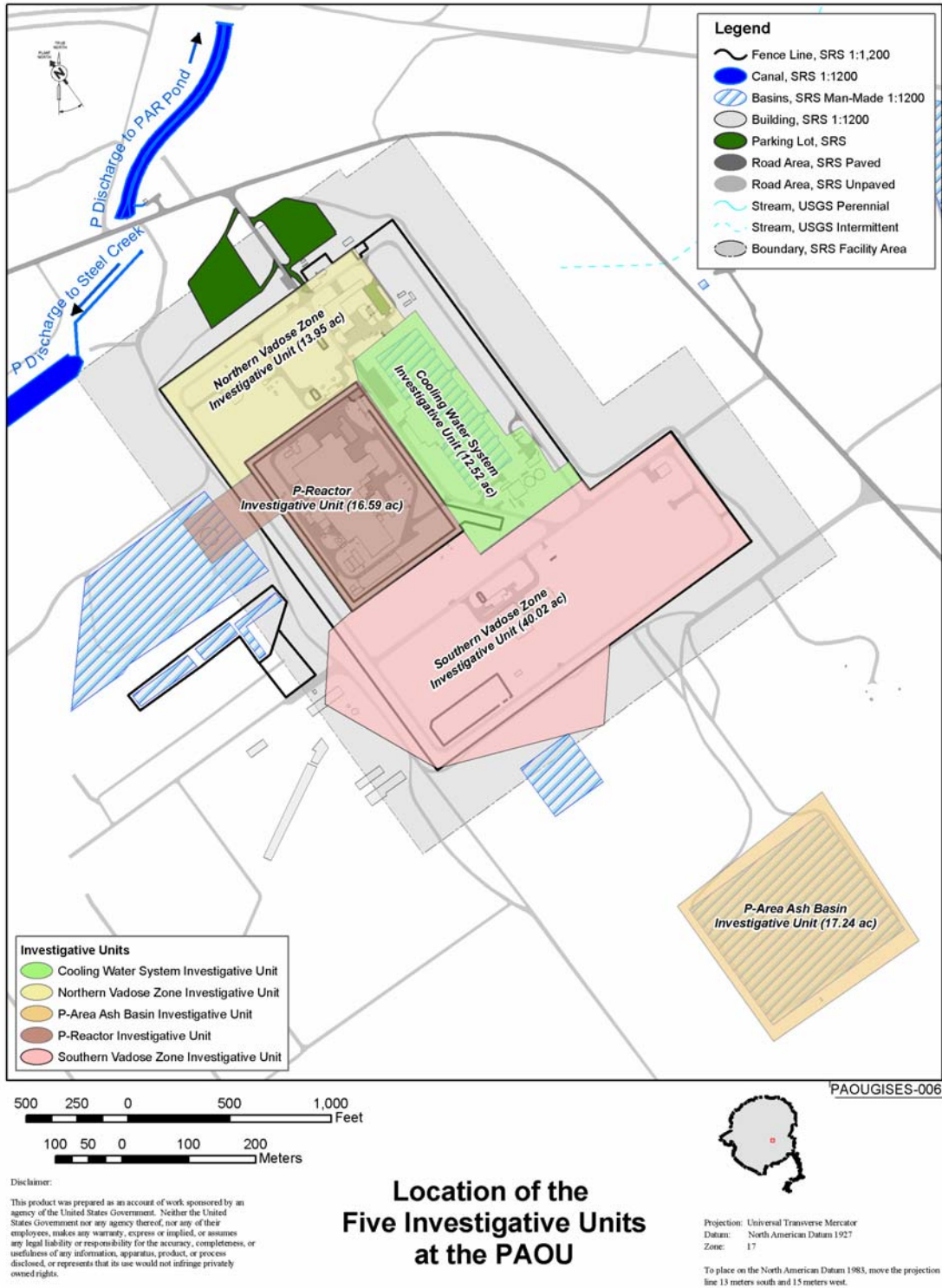


Figure 4: Location of Investigative Units

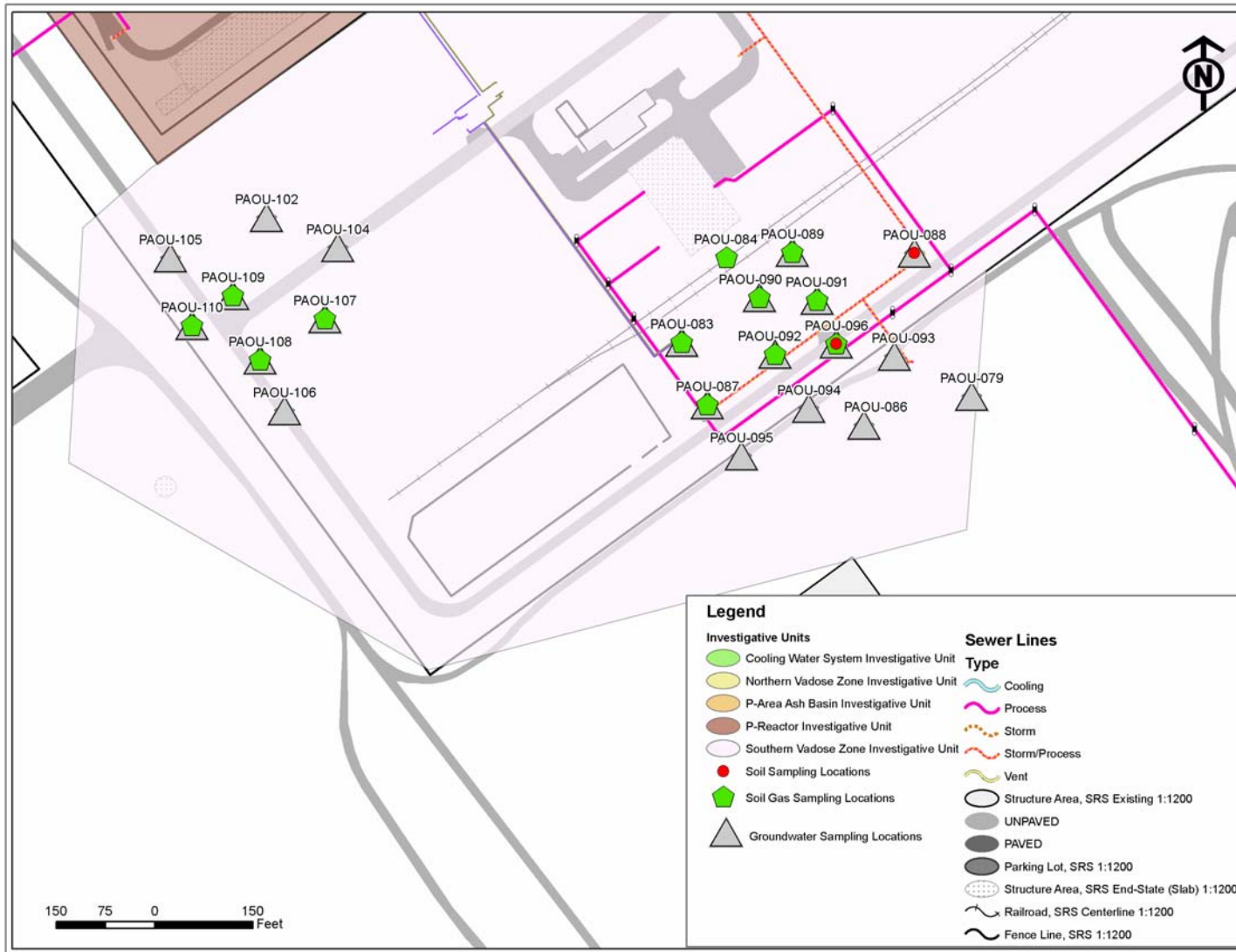


Figure 5: Sampling Locations in the Southern Vadose Zone Investigative Unit

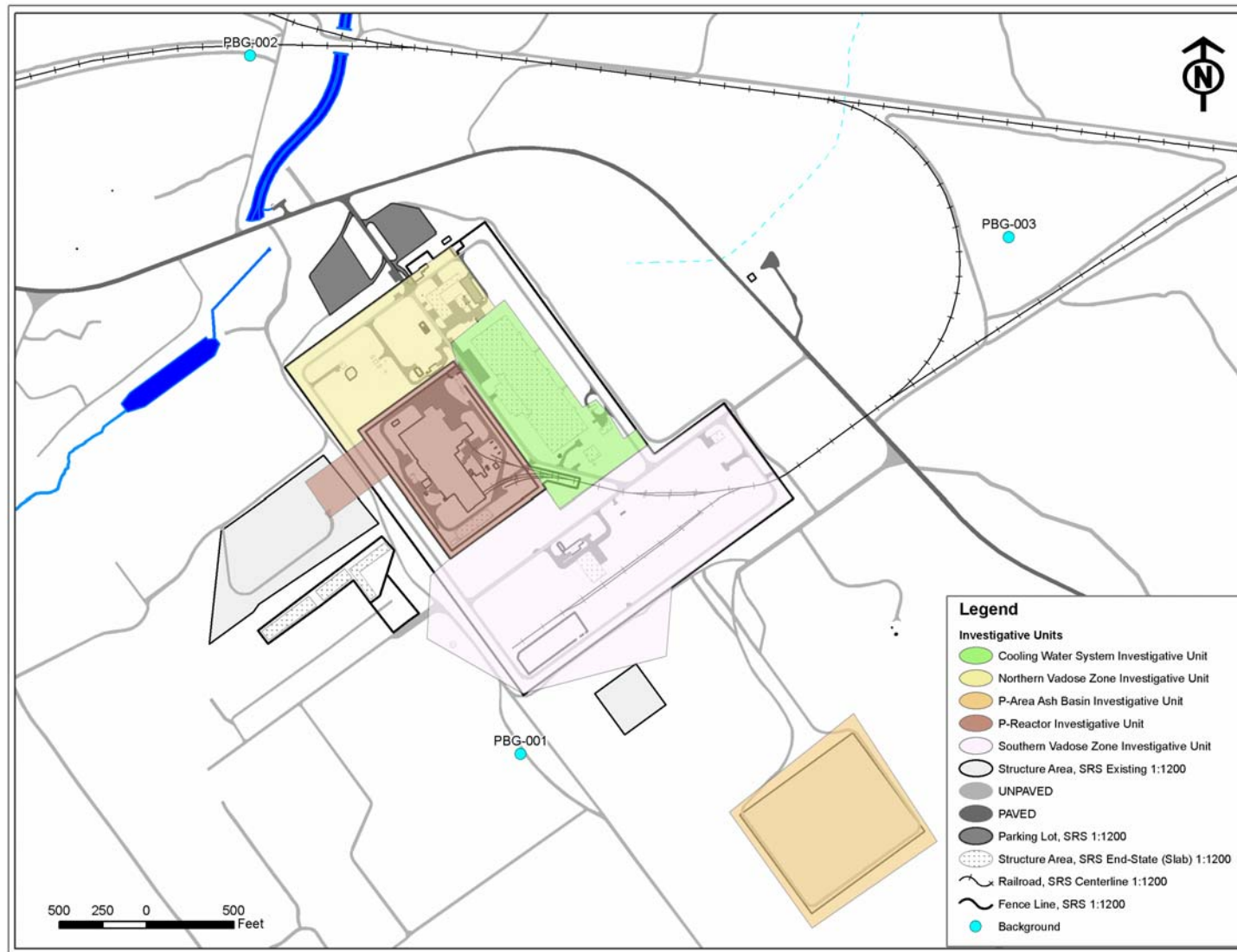


Figure 6: Background Sampling Locations at the PAOU

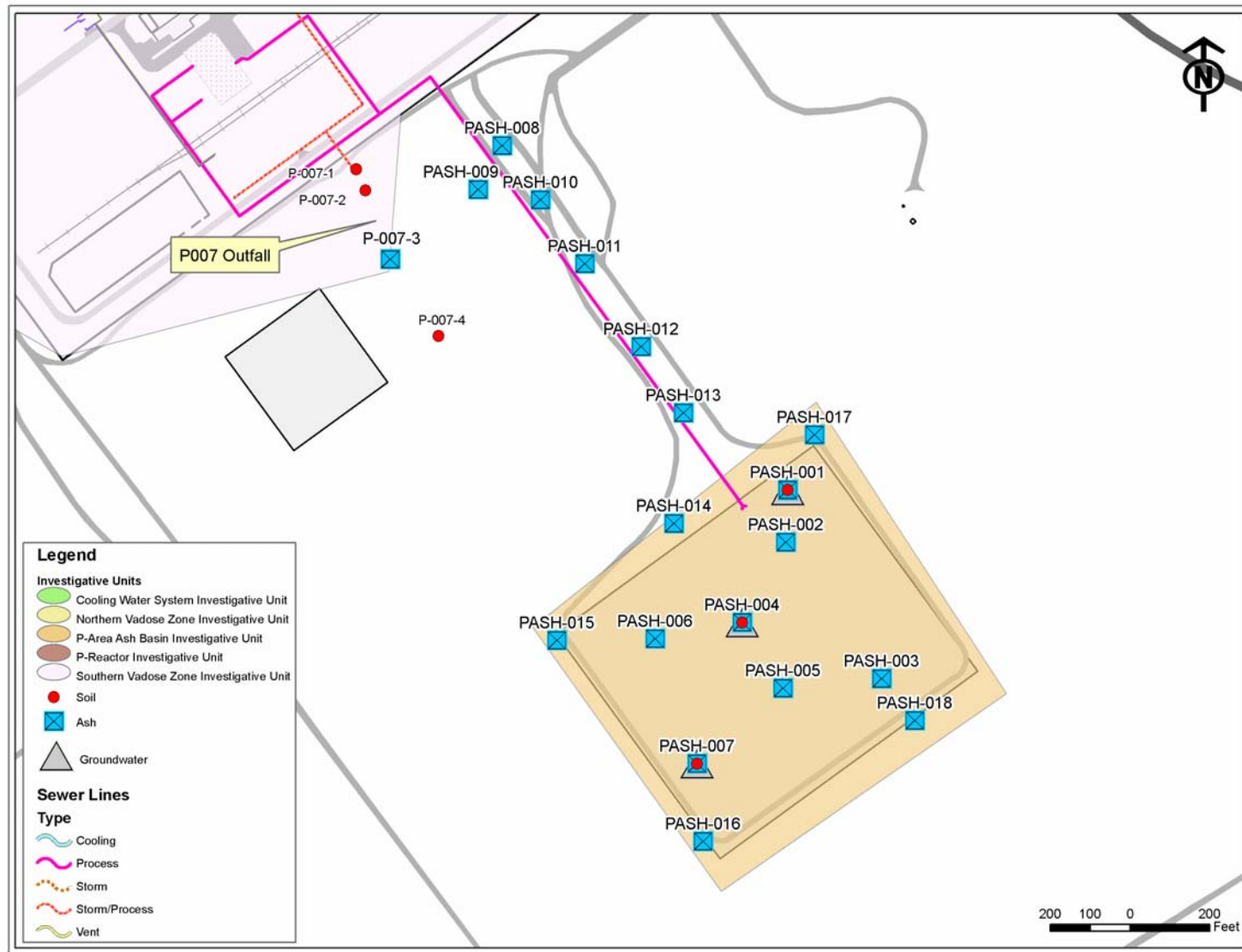


Figure 7: Sampling Locations in the Ash Basin Investigative Unit



Figure 8: 1974 Photograph of Ash Basin



Figure 9: 1982 Photograph of Ash Basin

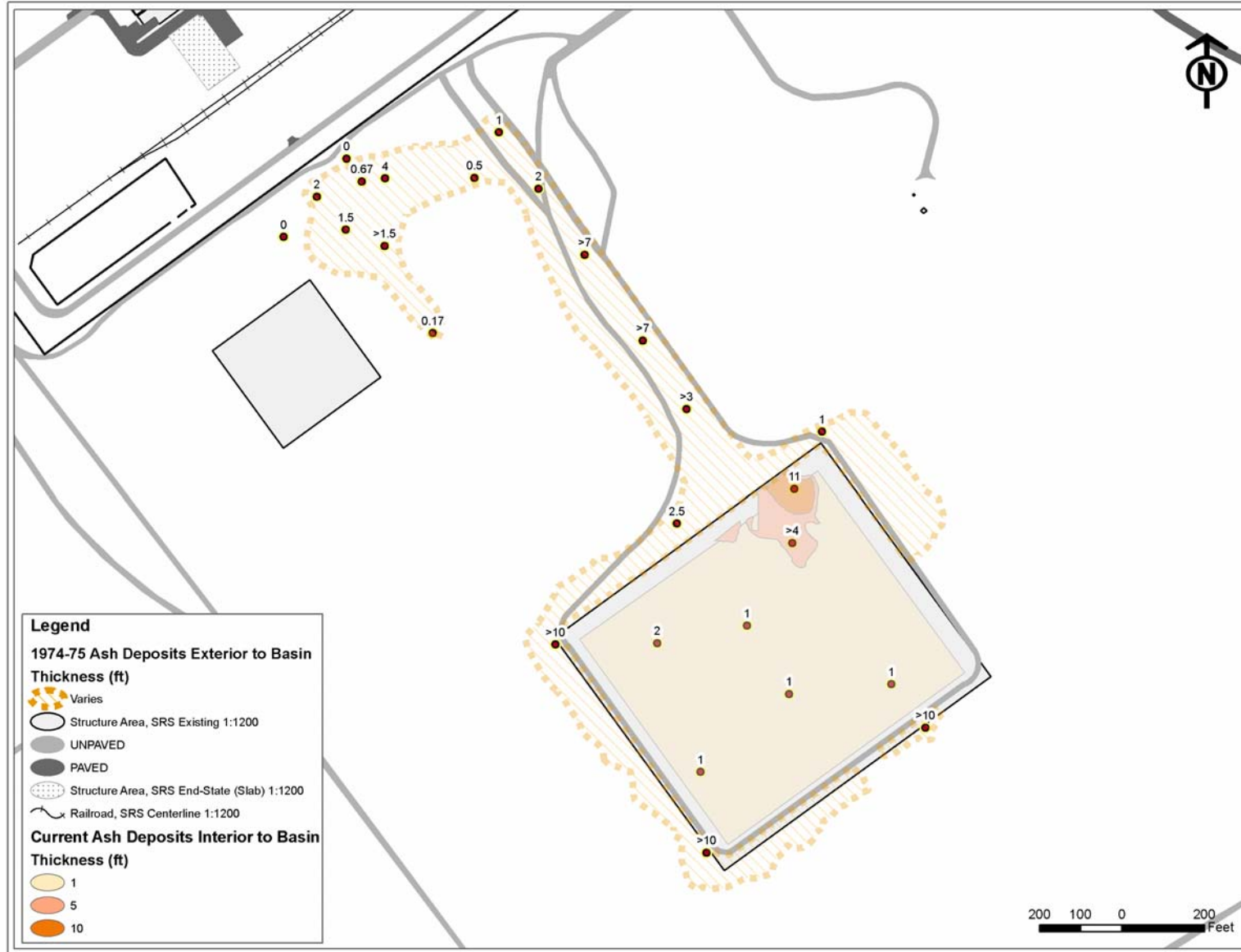


Figure 10: Ash Thickness at the Ash Basin

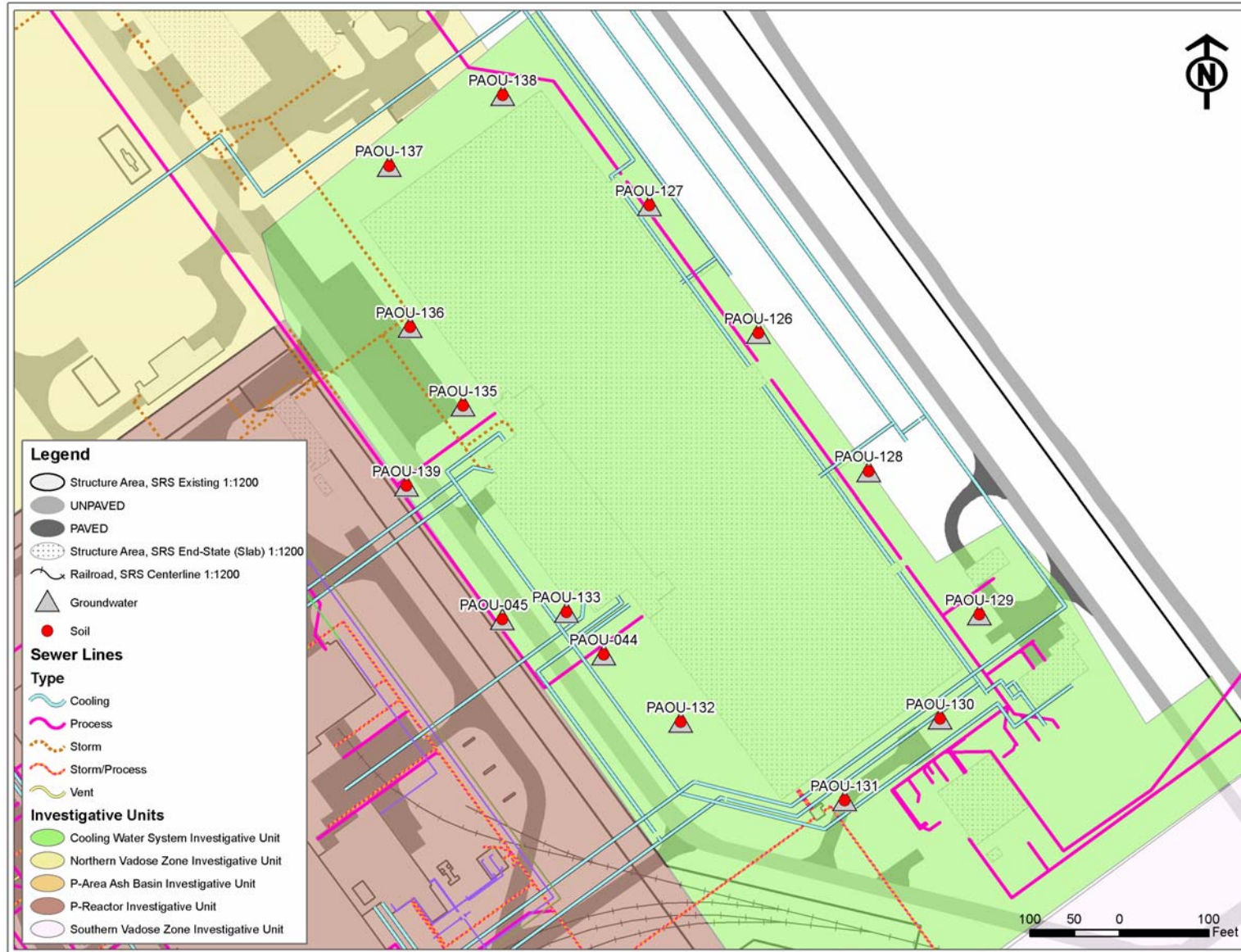


Figure 11: Sampling Locations in the Cooling Water System Investigative Unit

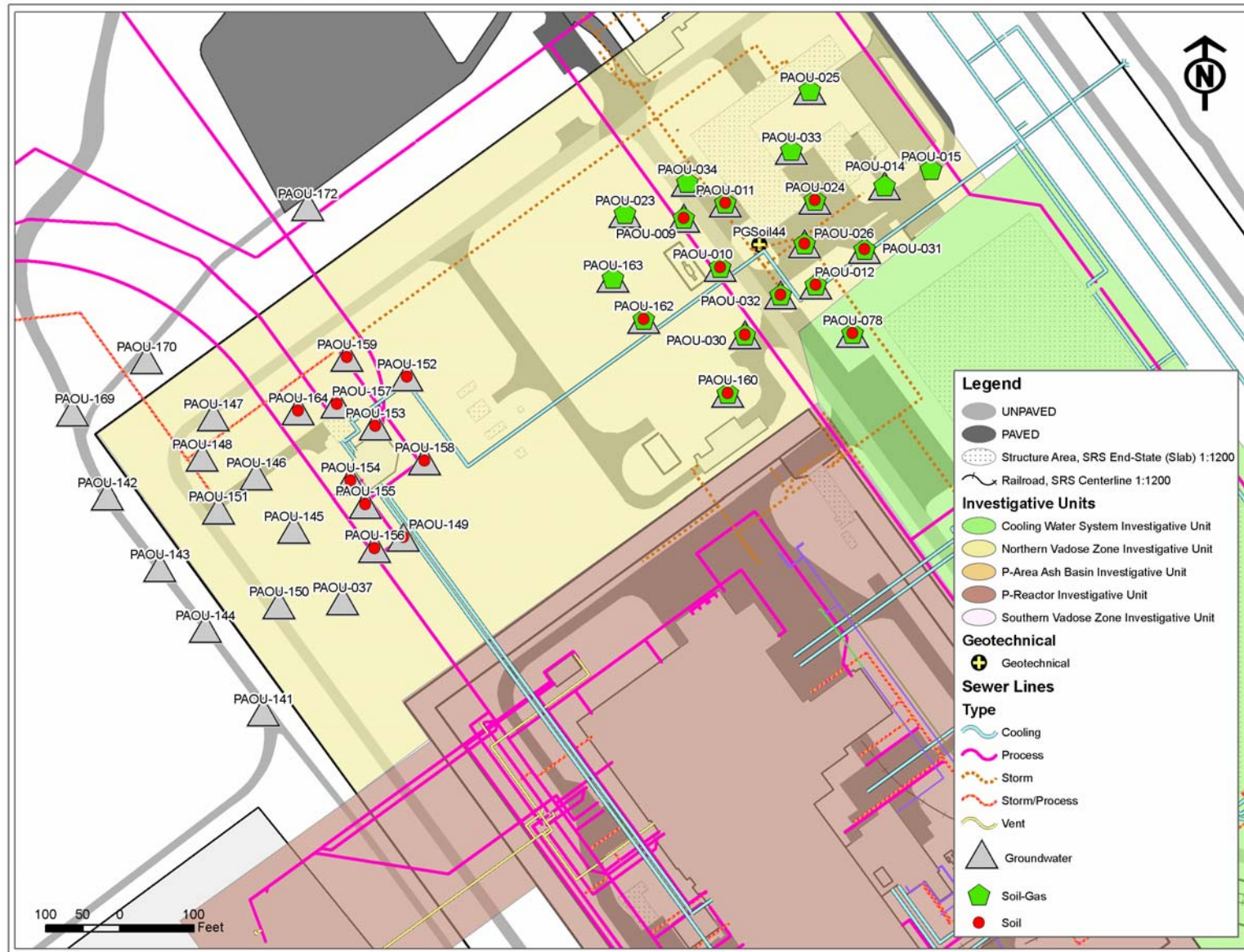


Figure 12: Sampling Locations in the Northern Vadose Zone Investigative Unit

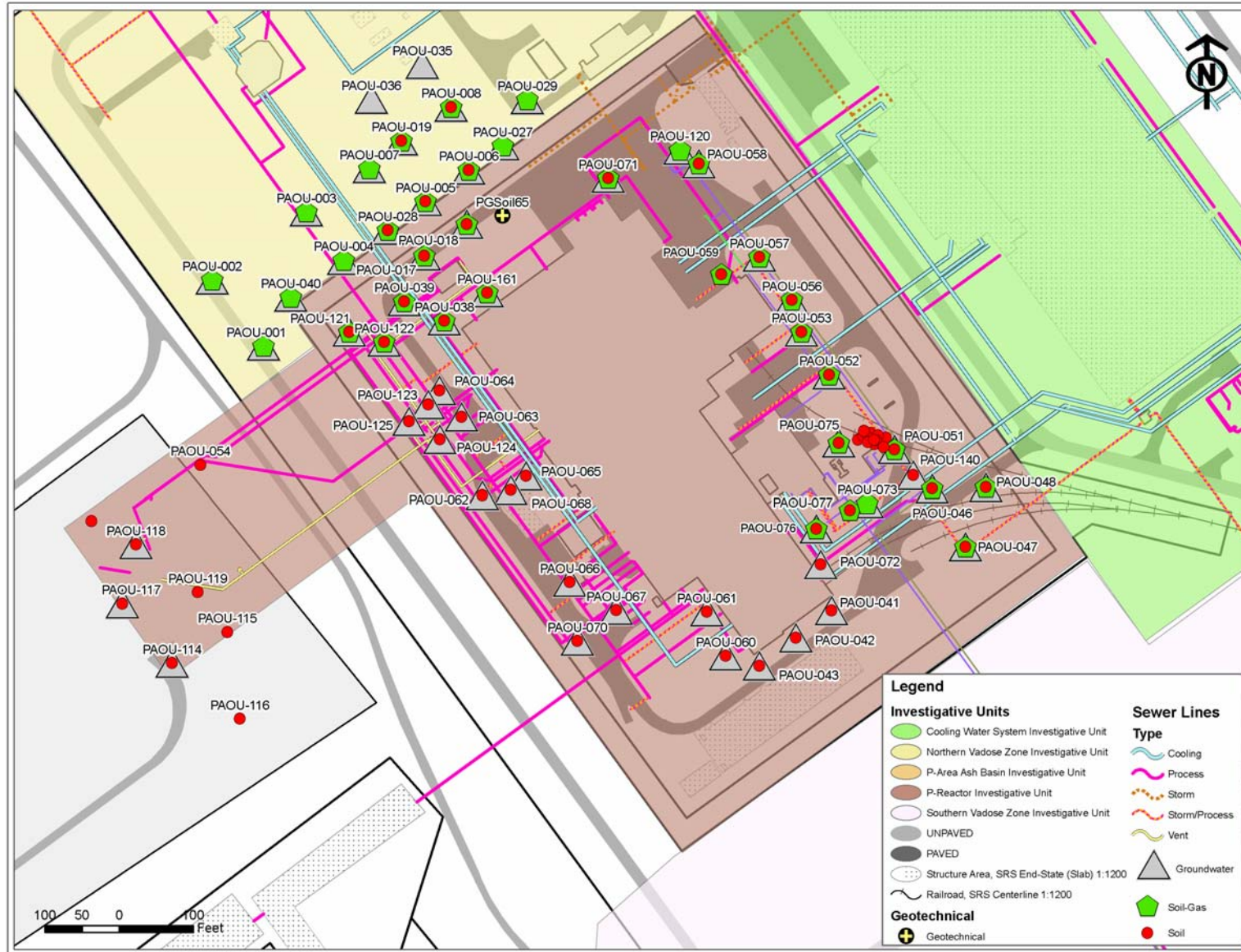


Figure 13: Sampling Locations in the P-Reactor Investigative Unit

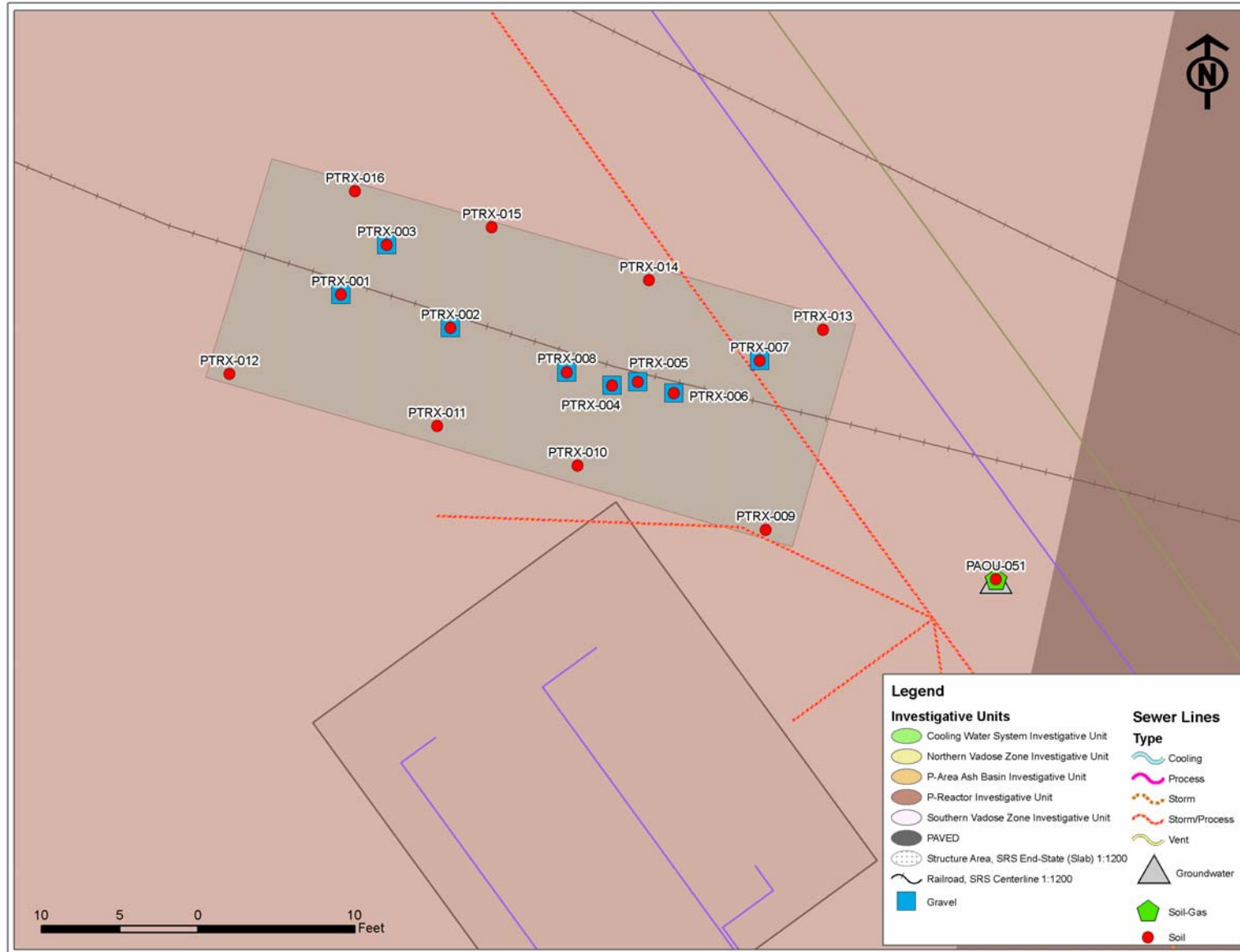


Figure 14: Sampling Locations in Railroad Tracks High Contamination Area the P-Reactor Investigative Unit

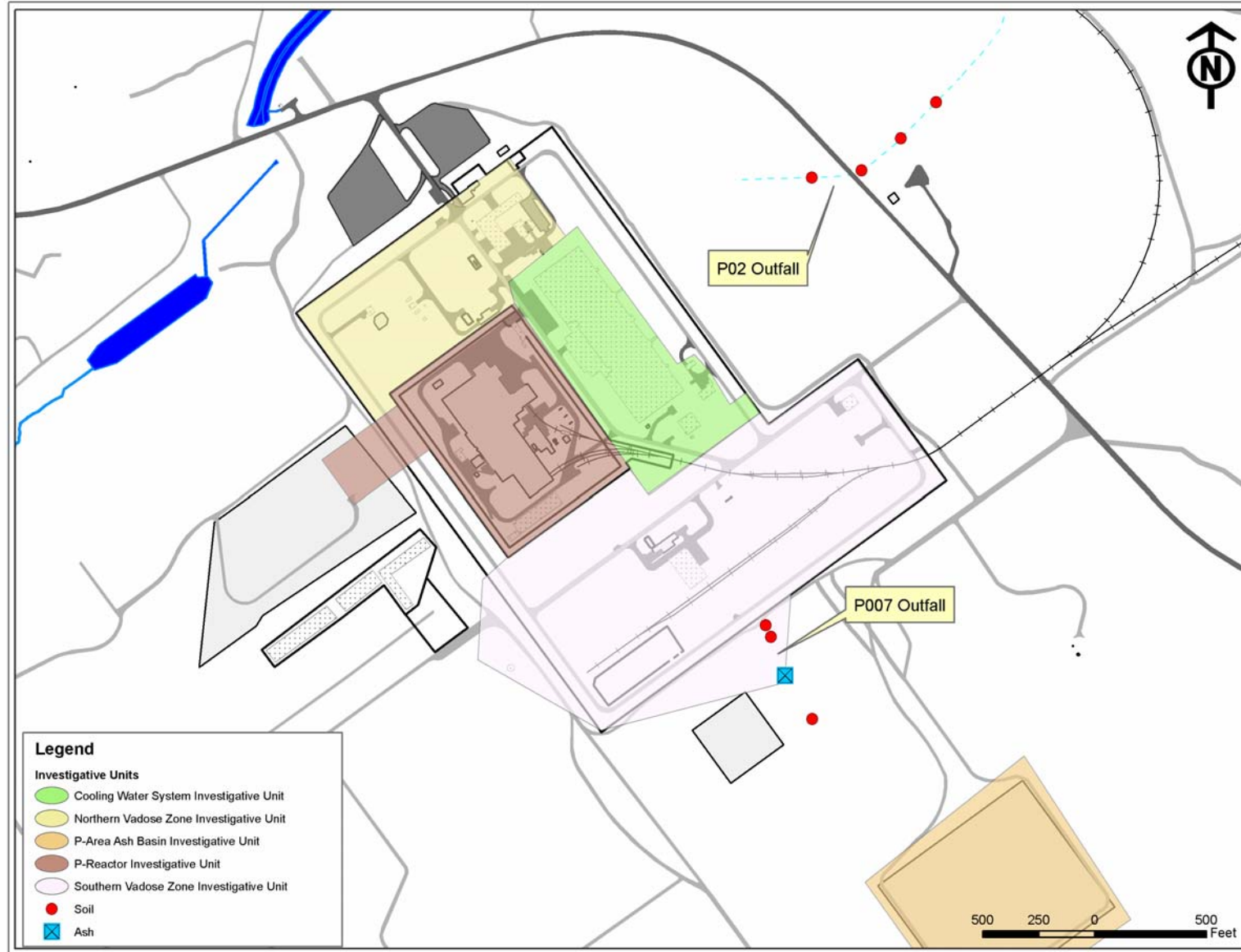


Figure 15: Sampling Locations at the P007 and P02 Outfalls

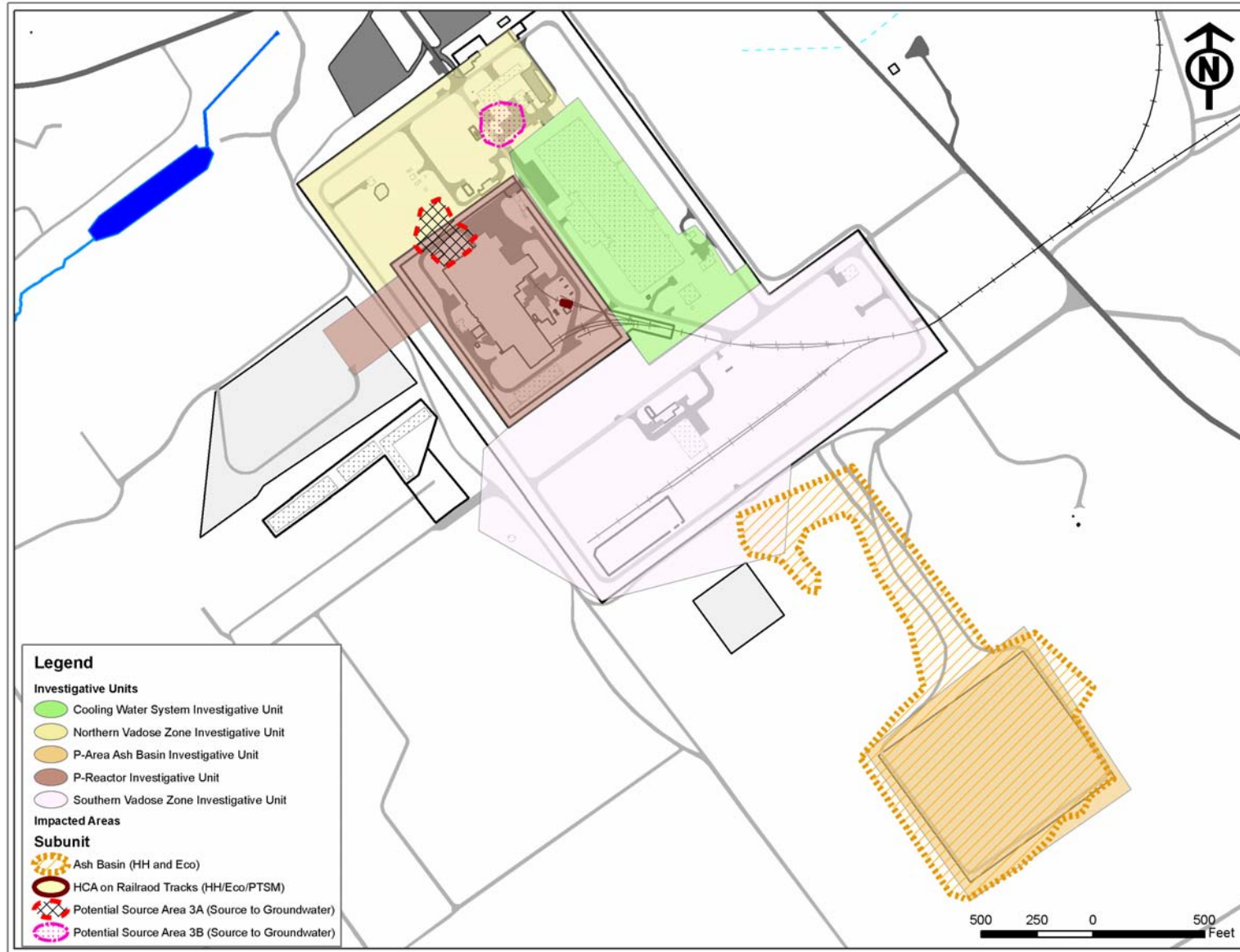


Figure 16: Impacted Areas at the PAOU

Table 1: Issues Addressed Through Characterization and Data Analysis

Investigative Unit	Subunit	Issues Addressed by Data Analysis			
		Human Health	Ecological	PTSM ⁽¹⁾	Contaminant Migration ⁽²⁾
Southern Vadose Zone	Potential Source Area (PSA) 5				X
	Process Sewer Lines (PSL) as Abandoned			X	X
Ash Basin	Ash Basin	X	X	X	X
Cooling Water System	Potential Release from P-Reactor Cooling Water System (186/190-P)	X	X		X
	PSL			X	X
Northern Vadose Zone	PSA 2			X	X
	PSA 3B				X
	PSL			X	X
P-Reactor	PSA 1	X	X		
	PSA 3A				X
	PSA 4				X
	Potential Release from the P-Area Disassembly Basin (105-P)			X	X
	PSL			X	X
	P-Area Cask Car Railroad Tracks	X		X	X

X - denotes data analysis performed for the identified issue as described in the Rev 1.1 P-Area Operable Unit Work Plan (WSRC-RP-2005-4081).

(1) PTSM based on toxicity using risk $\geq 1E-03$ (carcinogens) or hazard index ≥ 10 (noncarcinogens) for the future industrial worker

(2) Contaminant migration was performed on the mobility of the constituents as it related to groundwater impact

Table 2: Summary of Sampling Activities

Investigative Unit	Subunit	Media Sampled					Analyses Performed					Other Activities Performed	Primary Source	Driver	Sampling Objectives	Sampling Performed	
		Soil-Gas	Surface Soil	Gravel	Subsurface Soil	Groundwater	Soil-Gas	Surface Soil	Gravel	Subsurface Soil	Groundwater						
P-Reactor*	Potential Release from P-Area Disassembly Basin (105-P)				X	X				3, 6, 7 ^(a)	1 ^(c) , 3, 6, 7 ^(a)		Release of water from leaks and spills around the exterior of the basin into subsurface soils	Subsurface (>4ft) (contaminant migration and principal threat source material [PTSM])	Determine nature and extent of contamination in subsurface soils and collection of groundwater samples	-6 sampling locations exterior of the basin -Sampling depths of 28-30, 38-40, 46-48 ft bls -Groundwater samples at 6 locations	
P-Reactor*	P-Area Reactor Cask Car Railroad Tracks (NBN)		X (if above background levels)	X (HCA)		X			3, 6, 7 ^(a)	10	1 ^(c) , 3, 6, 7 ^(a)	All existing railroad tracks to be radiologically surveyed	Release of cooling water containing irradiated fuel and target assemblies from Cask Cars	Surface (human health)	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 -No sampling performed as result of survey -16 surface sampling locations with depths of 0-1 and 1-4 ft bls in HCA -4 subsurface sampling locations with sample depths 4-6, 8-10, 18-20, 22-24, 28-30, 40-42 ft bls	
P-Reactor*	P-Area Process Sewer Lines As Abandoned (NBN)				X	X					3, 6, 7 ^(a)	1 ^(c) , 3, 6, 7 ^(a)	Release from pipelines and the lines themselves	Subsurface (>4ft) (contaminant migration and PTSM)	Nature and extent of contamination in subsurface soils	-28 locations along the PSLs -Sampling depths of 4-6, 8-10, 18-20, 22-24, 28-30, 40-42 ft bls	
P-Reactor, Cooling Water System, Northern Vadose Zone, Southern Vadose Zone	P-Area Process Sewer Lines As Abandoned (NBN)				X	X					3, 6, 7 ^(a)	1 ^(c) , 3, 6, 7 ^(a)	Release from pipelines and the lines themselves	Subsurface (>4ft) (contaminant migration and PTSM)	Nature and extent of contamination in subsurface soils	-43 locations along the PSLs (see each IU) -Varying sampling depths depending on depth of lines -At most locations sampling was conducted at 4-6, 8-10, 18-20, 22-24, 28-30, 40-42 ft bls	
P-Reactor	PSA 1: Emergency Cooling Water Retention Basin (904-86G)		X			X					3, 6, 7 ^(a)	1 ^(c) , 3, 6, 7 ^(a)	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	-7 sampling locations within basin near tank -Sampling depths of 0-1 and 1-4 ft bls -Groundwater samples at 3 locations	
P-Reactor*	PSA 3A: Area near the northern end of the reactor building	X			X	X	1 ^(c)				1 ^{(b)(c)}	1 ^(c) , 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 20 locations @ depths 10, 15, 20, 25, 30, 35, 40 -Soil sampling at 11 soil-gas locations on 1 ft increments -Groundwater samples at 22 locations -4 Geotechnical samples at one location @ depths of 15-17, 30.5-32.5, 40.3-42.7, 51.3-53.6	
P-Reactor*	PSA 4: Area east of the Reactor Building (105-P)	X			X	X	1 ^(c)				1 ^{(b)(c)}	1 ^(c) , 3, 6, 7 ^(a)	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 sampling at 16 locations @ depths 10, 15, 20, 25, 30, 35, 40 -Soil sampling at 4 soil-gas locations on 1 ft increments -Groundwater samples at 16 locations	
Cooling Water System	Potential Release from P-Area Reactor Water Cooling System (186/190-P)		X		X	X				3, 6, 7 ^(a)	3, 6, 7 ^(a)	1 ^(c) , 3, 6, 7 ^(a)	Release of Savannah River 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	-12 sampling locations exterior of the basin -Sampling depths of 0-1, 1-4, 10-12, 20-22, 28-30, 38-40, 46-48 ft bls at CWS -3 sampling locations along PSLs @ sample depths of 4-6, 8-10, 18-20, 22-24, 28-30, 40-42 ft bls -Groundwater samples at 15 locations	
P-Area Ash Basin	P-Area Ash Basin (188-0P)		X		X	X			2, 3, 4, 5, 6, 7 ^(a) , 8		2, 3, 4, 5, 6, 7 ^(a) , 8	2, 3, 4, 5, 6, 7 ^(a) , 8, 9	Ash thickness to be determined. Visually inspect for coal reject material. Visually inspect for ash /coal reject material on the exterior of the ash basin.	Deposition of Ash material from the P-Area Reactor Powerhouse. Ash to be treated as "soil".	Surface (human health and ecological) PTSM	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 (if present), ash material, and subsurface soil, and collection of groundwater samples	-7 sampling locations within basin -12 locations exterior to basin -0 - 1 ft sampling interval (assume homogeneity of ash) -ash thickness determined to vary -Groundwater samples at 3 locations -Subsurface soil samples at 3 locations at interface of ash and ash basin bottom -No depth-discrete ash samples collected -No surface water present

Table 2: Summary of Sampling Activities continued

Investigative Unit	Subunit	Media Sampled					Analyses Performed					Other Activities Performed	Primary Source	Driver	Sampling Objectives	Sampling Performed	
		Soil-Gas	Surface Soil	Gravel	Subsurface Soil	Groundwater	Soil-Gas	Surface Soil	Gravel	Subsurface Soil	Groundwater						
Northern Vadose Zone	PSA 2: Area around the Cooling Water Effluent Sumps (107/107-1P)		X ^(a)		X	X		2, 3, 4, 5, 6, 7 ^(a) , 8 ^(d)			3, 6, 7 ^(a)	1 ^(c) , 3, 6	Background surface soil samples to be collected outside P Area fence line and at unimpacted areas to define background soil concentrations	Spills and leaks from process-related activities and maintenance and infiltration/percolation from subsurface units	Subsurface (>4ft) (contaminant migration and PTSM)	Determine nature and extent of contamination in subsurface soils near sumps and collection of groundwater samples	-Subsurface soil sampling at 10 locations around sumps and PSLs -Sampling depths of 20-22, 28-30, 38-40, and 46-48 ft bls -Groundwater sampling at 24 locations
Northern Vadose Zone	PSA 3B: West of the Administrative/Maintenance slab	X	X ^(a)		X	X		1 ^(c)			1 ^{(b)(c)}	1 ^(c) , 6	Background surface soil samples to be collected outside P Area fence line and at unimpacted areas to define background soil concentrations	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 @ 19 locations @ depths of 10, 15, 20, 25, 30, 35, 40 -Soil sampling @ 13 locations on 1 ft increments to 45 ft bls -Groundwater sampling at 18 locations -4 Geotechnical samples from one location @ depths of 19-20.5, 25-27, 34-36, 49-51 -Background soils collected from 3 locations (0-1, 1-4 ft bls)
Southern Vadose Zone	PSA 5: Two localized areas in the southwestern part of P Area & PSLs	X	X ^(a)		X	X		1 ^(c)			3, 6, 7 ^(a)	1 ^(c) , 6, 7 ^(a)	Background surface soil samples to be collected outside P Area fence line and at unimpacted areas to define background soil concentrations	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 @ 12 locations @ depths of 10, 15, 20, 25, 30, 35, 40 -No VOC Soil sampling -Subsurface soil sampling at two locations assoc. with PSLs @ depths of 4-6, 8-10, 22-24, 28-30, 40-42 -Groundwater samples collected from 21 locations -Background soils collected from 3 locations (0-1, 1-4 ft)
Outfalls	P02 and P007 Outfalls		X					3, 6 ^(a)						Surface release from PSLs	Surface (human health and ecological)	Determine nature and extent of contamination in surface soils	-Surface soil sampling performed at 4 locations within each outfall -sampling depth from 0-1 ft

* Sampling locations within the P-Reactor IU address impacts from multiple subunits due to inter-relation

NOTES for Media Sampled
(a) surface soil collected at 3 background locations outside the P Area fence line and at unimpacted areas for determination of P Area background soil concentrations.

NOTES for Analyses Performed
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 (tritium not analyzed in soil matrix)
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
10 - In situ Object Counting System (ISOCs) (K40, Cs137, Co60, Bi212, Bi214, Pb212, Pb214, Ac, 228, U235)
* groundwater samples to be collected via DPT. This method limits the amount of water to be collected. If triggers are exceeded and speciation is needed, resampling will be conducted.
(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
(d) analysis for background soils only