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United States Department of Energy
Savannah River Site

Statement of Basis/Proposed Plan for the P-Area Burning/Rubble Pit (131-P) (U)

WSRC-RP-2000-4196

Revision 1

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SRS

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

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Document Certification Page

WSRC-RP-2000-4196, Rev. 1

SB/PP for the P-Area Burning/Rubble Pit (131-P) OU (U)

"I certify under the penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designated to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations."

Date: 2/13/02 Signature: [signature]
Michael A. Sabbe
Vice President and General Manager
Environmental Restoration Division
Westinghouse Savannah River Company
Co-operator for the U.S. Department of Energy

Date: 2/21/02 Signature: [signature]
Greg Rudy
Manager
U. S. Department of Energy
Savannah River Operations Office
Owner and Co-operator

Table of Contents

List of Figures

List of Tables

List of Appendices

List of Acronyms and Abbreviations

ARAR	applicable or relevant and appropriate requirement
bls	below land surface
BRA	Baseline Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
cm/sec	centimeters per second
CM RCOC	contaminant migration refined constituent of concern
CMI/RAIP	Corrective Measures Implementation/Remedial Action Implementation Plan
CMS	Corrective Measures Study
CPT	cone penetrometer technology
FFA	Federal Facility Agreement
FS	Feasibility Study
ft	feet
GRA	general response action
HI	hazard index
HQ	hazard quotient
IOU	integrator operable unit
LLC	Limited Liability Company
LUC	land use control
LUCAP	Land Use Control Assurance Plan
LUCIP	Land Use Control Implementation Plan
m	meter
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
NCP	National Oil and Hazardous Substances Contingency Plan
NPL	National Priorities List
O&M	operation and maintenance
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PBRP	P-Area Burning/Rubble Pit (131-P)
PCB	polychlorinated biphenyl
PTSM	principal threat source material
RAO	remedial action objective
RBC	risk-based concentration
RCOC	refined constituent of concern
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RFI	RCRA Facility Investigation
RG	remedial goal
RGO	remedial goal option
RI	Remedial Investigation
ROD	Record of Decision
SB/PP	Statement of Basis/Proposed Plan
SCDHEC	South Carolina Department of Health and Environmental Control
SCHWMR	South Carolina Hazardous Waste Management Regulations
SDWA	Safe Drinking Water Act
SRS	Savannah River Site
SVOC	semivolatile organic compound
TAL	target analyte list
TBC	to-be-considered

List of Acronyms and Abbreviations (Continued)

TCL	target compound list
μg/L	micrograms per liter
USC	United States Code
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WSRC	Westinghouse Savannah River Company LLC

I. INTRODUCTION AND BACKGROUND

Introduction

This Statement of Basis/Proposed Plan (SB/PP) is being issued by the United States Department of Energy (USDOE), which functions as the lead agency for Savannah River Site (SRS) remedial activities, with concurrence by the United States Environmental Protection Agency (USEPA) and the South Carolina Department of Health and Environmental Control (SCDHEC). The purpose of this SB/PP is to describe the preferred remedial alternatives for the P-Area Burning/Rubble Pit (131-P) (PBRP) Operable Unit (OU) and to provide for public involvement in the decision-making process. The PBRP OU is located at the SRS in Barnwell County, South Carolina (Figure 1).

The PBRP OU consists of five subunits: (1) PBRP, a single burning/rubble pit; (2) a small drainage ditch near PBRP; (3) a seepline located along an embankment of Steel Creek; (4) a segment of Steel Creek adjacent to the OU; and (5) groundwater in the water table aquifer. Figures 2 and 3 are photographs of the OU. Based on the findings of a unit investigation and assessment (WSRC 2001), only two subunits, PBRP and groundwater, require remedial action. Therefore, remedial alternatives were developed only for these subunits. No constituents warranting remedial action (refined constituents of concern [RCOCs]) are present at the ditch or seepline, so these subunits do not require any remedial action, and no remedial alternatives are proposed for them. Steel Creek has been impacted by an upgradient source of contamination. The contamination did not originate from PBRP; therefore no RCOCs are identified for this subunit. Surface water and sediment data from Steel Creek will be provided to the Integrated Operable Unit (IOU) program for use in evaluation of the Steel Creek IOU.

SRS manages certain waste materials that are regulated under the Resource Conservation and Recovery Act (RCRA), a comprehensive law requiring responsible management of hazardous waste. The PBRP is a solid waste management unit under RCRA Section 3004(u). SRS received a RCRA hazardous waste permit from SCDHEC which was most recently renewed on September 5, 1995 (SC1 890 008 989). Module IV of the Hazardous and Solid Waste Amendments portion of the RCRA permit mandates corrective action requirements for non-regulated solid waste management units subject to RCRA 3004(u).

On December 21, 1989, SRS was included on the National Priorities List (NPL). The inclusion created a need to integrate the established RCRA facility investigation (RFI) program with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) requirements to provide for a focused environmental program. In accordance with Section 120 of CERCLA 42 United States Code (USC) Section 9620, USDOE has negotiated a Federal Facility Agreement (FFA) (FFA 1993) with the USEPA and SCDHEC to coordinate remedial activities at SRS into one comprehensive strategy which fulfills these dual regulatory requirements. The FFA lists the PBRP as a RCRA/CERCLA unit requiring further evaluation using an investigation/assessment process that integrates and combines the RFI process with the CERCLA Remedial Investigation (RI) process to determine the actual or potential impact to human health and the

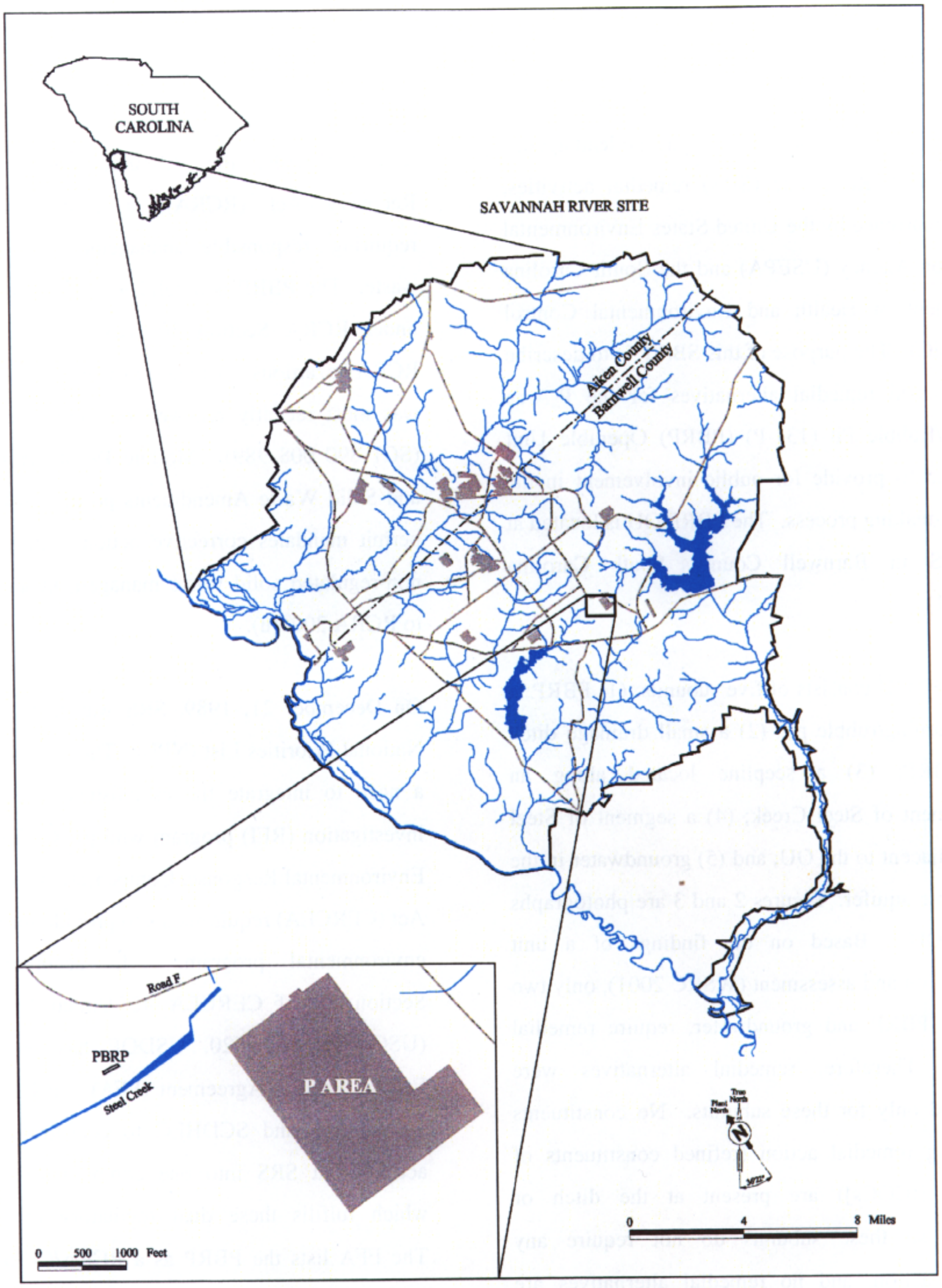

Figure 1. Location of PBRP OU at SRS

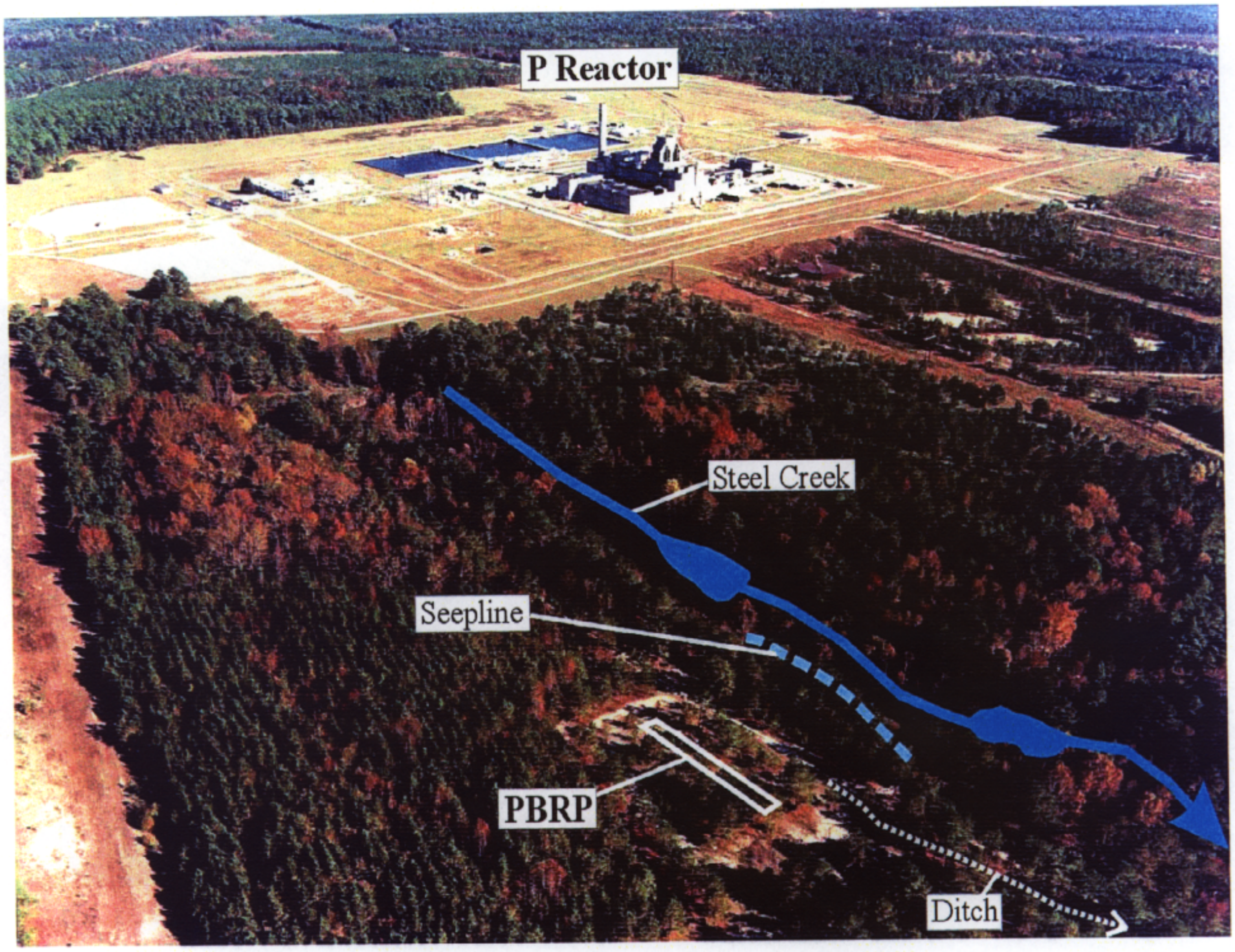

Figure 2. Oblique Aerial Photograph of PBRP OU

(looking southeast with P Area in background)

Figure 3. Ground-Level Photograph of PBRP

(looking southeast)

environment of releases of hazardous substances to the environment.

Both RCRA and CERCLA require that the public be given an opportunity to review and comment on the draft permit modification and proposed remedial alternatives. Public participation requirements are listed in South Carolina Hazardous Waste Management Regulations (SCHWMR) R.61-79.124 and Sections 113 and 117 of CERCLA, 42 USC Sections 9613 and 9617. These requirements include establishment of an Administrative Record File that documents the investigation and selection of remedial alternatives and allows for review and comment by the public regarding those alternatives (see Section II). The Administrative Record File must be established at or near the facility at issue. The SRS Public Involvement Plan (USDOE 1994) is designed to facilitate public involvement in the decision-making process for permitting, closure, and the selection of remedial alternatives. SCHWMR R.61-79.124 and Section 117(a) of CERCLA, as amended, require the advertisement of the draft permit modification and notice of any proposed remedial action and provide the public an opportunity to participate in the selection of the remedial action. A final permit modification will (1) include the final selection of remedial alternatives under RCRA, (2) be sought for the entire PBRP OU, and (3) include the necessary public involvement and regulatory approvals.

SCHWMR R.61-79.124 requires that a brief description and response to all significant comments be made available to the public as part of the RCRA Administrative Record. Community involvement in consideration of this evaluation of alternatives for the PBRP OU is strongly encouraged. All submitted comments will be reviewed and considered. Following the public comment period, a Responsiveness Summary will be prepared to address issues raised during the public comment period. The Responsiveness Summary will be made available with the final RCRA permit modification and the Record of Decision (ROD).

The final remedial decision will be made only after the public comment period has ended and all the comments have been received and considered. The final remedial decision under RCRA will be in the form of a final permit modification decision, which is made by SCDHEC. Selection of the remedial alternative that will satisfy the FFA requirements will be made by USDOE, in consultation with USEPA and SCDHEC. It is important to note that the final action(s) may be different from the preferred alternative discussed in this plan depending on new information or public comments. The alternative chosen will be protective of human health and the environment and comply with all federal and state laws.

Background

SRS occupies approximately 310 square miles of land adjacent to the Savannah River, principally in Aiken and Barnwell Counties of South Carolina. SRS is located approximately 25 miles southeast of Augusta, Georgia, and 20 miles south of Aiken, South Carolina.

SRS is owned by the USDOE. Management and operating services are provided by Westinghouse Savannah River Company LLC (Limited Liability

Company) (WSRC). SRS has historically produced tritium, plutonium, and other special nuclear materials for national defense. Chemical and radioactive wastes are byproducts of nuclear material production processes. Hazardous substances, as defined by CERCLA, are currently present in the environment at SRS.

II. COMMUNITY PARTICIPATION

There has been no public participation prior to issuance of this SB/PP. This SB/PP provides for community involvement through a document review process and a public comment period.

The FFA Administrative Record File, which contains the information pertaining to the selection of the response action, is available at the following locations:

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

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

Hard copies of the SB/PP are available at the following locations:

Reese Library
Augusta State University
2500 Walton Way
Augusta, Georgia 30910
(706) 737-1744

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

The RCRA Administrative Record File for SCDHEC is available for review by the public at the following locations:

The South Carolina Department of Health and Environmental Control
Bureau of Land and Waste Management
8901 Farrow Road
Columbia, South Carolina 29203
(803) 896-4000

Lower Savannah District Environmental Quality Control Office
206 Beaufort Street, Northeast
Aiken, South Carolina 29801
(803) 641-7670

The public will be notified of the public comment period through mailing of the *SRS Environmental Bulletin*, a newsletter sent to citizens in South Carolina and Georgia, and through notices in the *Aiken Standard*, the *Allendale Citizen Leader*, the *Augusta Chronicle*, the *Barnwell People-Sentinel*, and *The State* newspapers. The public comment period will also be announced on local radio stations.

USDOE will provide an opportunity for a public meeting during the public comment period if significant interest is expressed. The public will be notified of the date, time, and location. At the meeting, the proposed action will be discussed, and questions about the action will be answered.

To request a public meeting during the public comment period, to obtain more information concerning this document, or to submit written comments, contact one of the following:

Jim Moore
Westinghouse Savannah River Company
Public Involvement
Savannah River Site
Building 742-A
Aiken, South Carolina 29808
(800) 249-8155
jim02.moore@srs.gov

The South Carolina Department of Health and Environmental Control
Attn.: J. T. Litton, P.E., Director
Division of Waste Management
Bureau of Land and Waste Management
2600 Bull Street
Columbia, South Carolina 29201
(803) 896-4000

Following the public comment period, a ROD will be signed, and a final decision for the SRS RCRA permit modification will be issued. The ROD and RCRA permit modification will detail the remedial alternative chosen for this OU and include responses to oral and written comments received during the public comment period in the Responsiveness Summary.

III. OPERABLE UNIT BACKGROUND

Operable Unit History

The following sections address the five subunits of the PBRP OU.

PBRP

PBRP is a single, inactive burial pit approximately 200 ft long by 30 ft wide. The depth of the pit ranges from 8 ft below land surface (bls) in the western end to 11 ft bls in the eastern end.

From 1951 to 1973, PBRP was used for periodic burning of combustible materials. Disposal records of individual burials were not kept for this unit; however, information obtained from historical records and from characterization of similar burning/rubble pits at SRS indicate that materials such as wood, cardboard, paper, plastics, rubber, rags, oils and organic liquids of unknown origins were disposed of in the pit and burned on a monthly basis. In 1973, burning in open pits was discontinued at SRS, and a soil layer was placed over the pit contents. The pit continued to receive inert debris such as construction materials. When the pit reached capacity in 1978, the debris was covered with approximately 4 ft of clean soil to grade. No removal actions have been performed at the unit.

Characterization of PBRP was performed through a series of sampling events. Generally, the sampling locations of each successive event were selected based on review of data previously collected with the intent of targeting the areas exhibiting the highest levels of contamination.

Investigation of PBRP began in 1986 with a soil-gas survey that consisted of 24 soil-gas samples collected from locations in and around the pit. In 1988, soil sampling was performed to investigate the pit construction and contents. In 1991, a second soil-gas survey was performed at 10 locations within the backfill of the pit. In 1997, a ground penetrating radar survey was performed to produce a graphic profile of the subsurface. The survey was used to define the boundaries of the pit before further soil sampling was performed.

Phase I pre-Work Plan soil activities also began in 1997. Five soil borings were advanced through the entire depth of the pit (PBRP-01 through PBRP-05) (Figure 4). In each boring, samples were collected of the backfill, the soil among the debris within the pit, the soil at the base of the pit, and the soil below the base of the pit (Figure 5). In addition, four other borings were performed to determine the pit geometry, but no soil samples were collected. The soil samples were analyzed for target analyte list (TAL) inorganics, target compound list (TCL) semivolatile organic compounds (SVOCs), TCL volatile organic compound (VOCs), TCL pesticides/polychlorinated biphenyls (PCBs), dioxins/furans, and radionuclides.

The Phase II investigation began in 1998 with exploratory trenching at PBRP as part of standard characterization activities for burning/rubble pits at SRS. Soil and trapped water samples from the two trenches received definitive-level analysis for TAL inorganics, TCL SVOCs, TCL VOCs, TCL pesticides/PCBs, dioxins/furans, and radionuclides.

Phase II borings at the PBRP were advanced around the perimeter of the pit (Figure 4). Six perimeter borings (PBRP-11 through PBRP–16) were advanced to augment the data for the RFI/RI Report and Baseline Risk Assessment (BRA) and to determine if past operations at the unit and/or surface runoff from the PBRP had impacted the adjacent areas. The perimeter soil samples were analyzed for TAL inorganics, TCL SVOCs, TCL VOCs, TCL pesticides/PCBs, dioxins/furans, and radionuclides.

The unit investigation confirmed that miscellaneous inert debris remains buried in the pit. Soil contaminants within the pit include inorganics, SVOCs, VOCs, and PCBs. Soils around the perimeter of the pit are generally uncontaminated. However, there are a few places around the perimeter of the pit where low levels of unit-related contamination are present. Figures 4 and 5 illustrate the extent of contamination at PBRP.

Ditch

No waste was placed in the ditch (Figure 2). The ditch was assessed as part of this OU to determine if runoff and erosion from PBRP had impacted it.

The ditch was investigated in 1997. Two locations were sampled in the ditch. One sample of surface soil and one sample of surface water were collected at each location. The samples were analyzed for TAL inorganics, TCL SVOCs, TCL VOCs, TCL pesticides/PCBs, and radionuclides.

Evaluation of the nature and extent of contamination at the ditch indicated that neither soil nor surface water in the ditch has been impacted by the PBRP OU. The observed concentrations of constituents in the ditch are consistent with natural ambient background conditions.

Seepline

The seepline was characterized during Phase II activities in 1998 to determine if leaching of PBRP impacted the seepline (Figure 2). Sediment and surface water samples were obtained from four locations along the seepline. The samples were analyzed for TAL inorganics, TCL SVOCs, TCL VOCs, TCL pesticides/PCBs, and radionuclides.

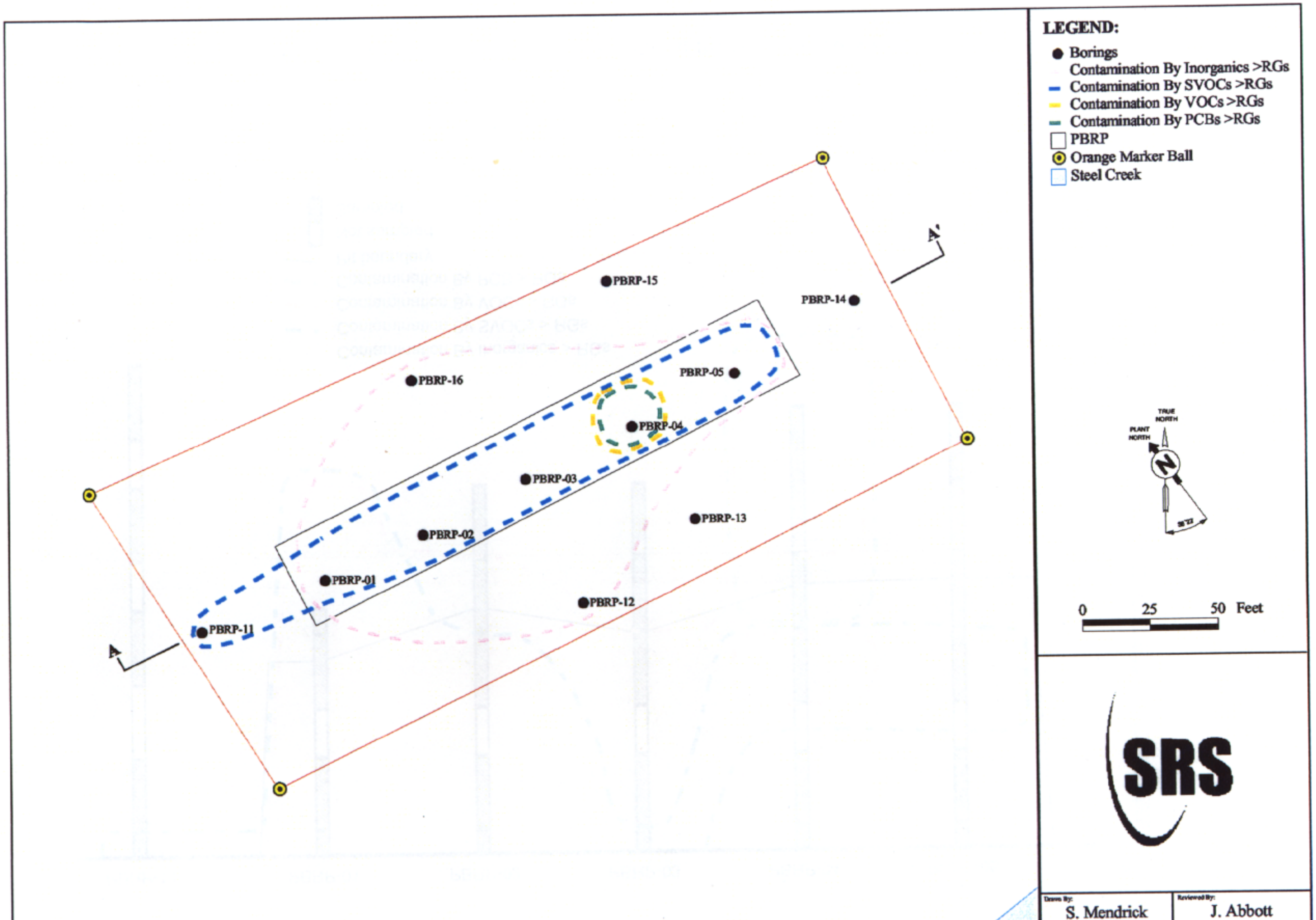

Figure 4. Soil Contamination at PBRP - Plan View

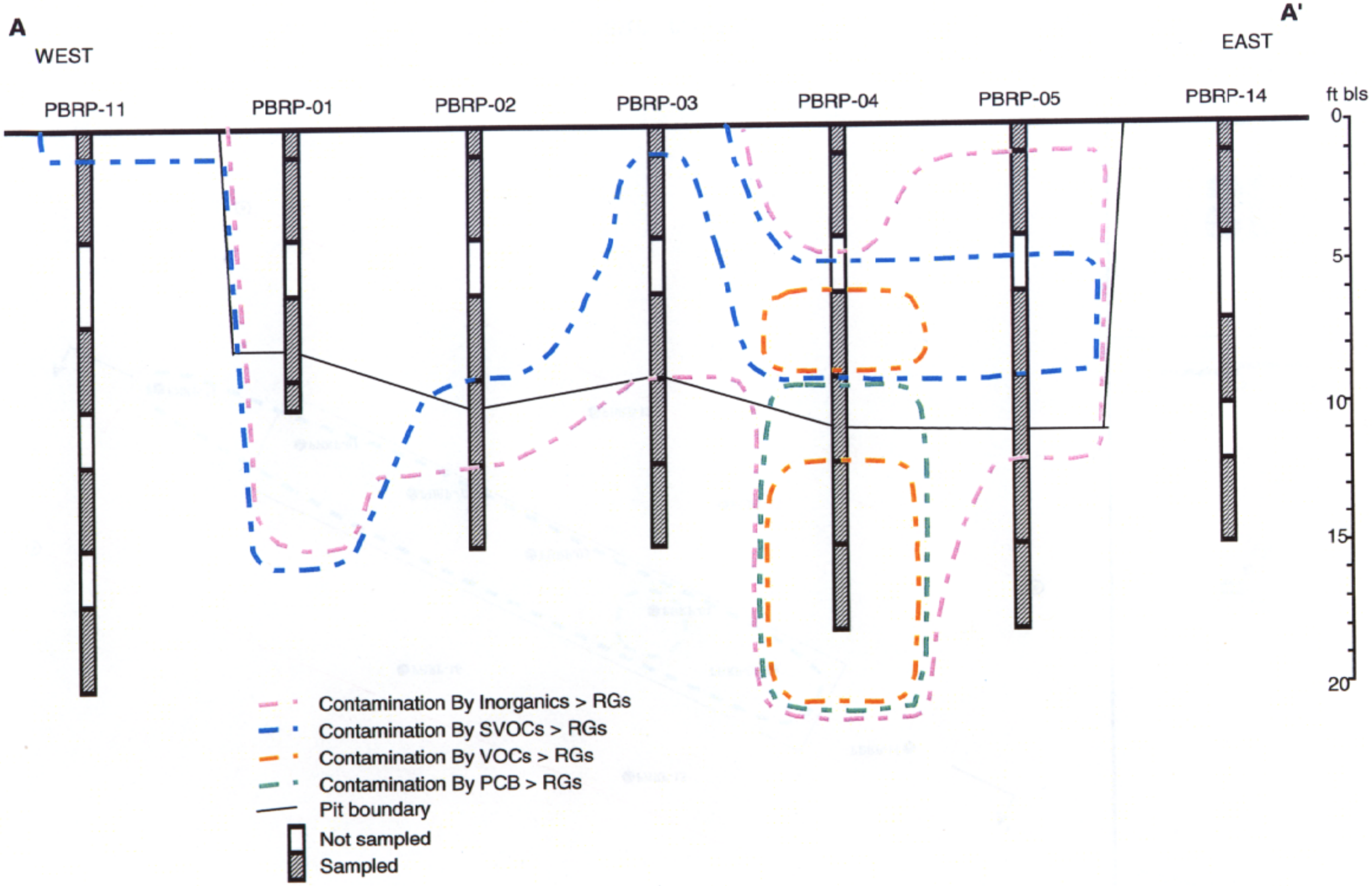

Figure 5. Soil Contamination at PBRP - Cross-Section

The seepline is not a significant source of surface water. At most areas of the seepline, surface water is not present for at least part of the year, and sometimes the seepline dries up completely.

Field data indicate the seepline is attributable to an ephemeral water layer above a localized clay lens. It is not an outcrop of the water table aquifer.

Based on the analytical results from the samples, and given the small size of the seepline and the ephemeral nature of the surface water, no RCOCs were identified for the seepline.

Steel Creek

Steel Creek was characterized during Phase II activities in 1998 to determine if leaching of PBRP impacted Steel Creek. Sediment and surface water samples were collected from eight locations along Steel Creek. The samples were analyzed for TAL inorganics, TCL SVOCs, TCL VOCs, TCL pesticides/PCBs, and radionuclides.

The nature and extent of the constituents detected in Steel Creek indicate that they did not originate from the PBRP OU but rather from an unrelated upgradient source. The contribution of contamination to Steel Creek from PBRP, if any, is indistinguishable from the contribution from the upgradient source. No RCOCs were identified for Steel Creek.

Groundwater

Characterization of groundwater was performed through a series of sampling events. Generally, the sampling locations of each successive event were selected based on review of data previously collected with the intent of targeting the areas exhibiting the highest levels of contamination.

The groundwater investigation began in 1983 with installation and monitoring of four wells around the pit (PRP-1A, PRP-2, PRP-3, and PRP-4). In 1998, the pumps were replaced and the wells were refurbished. A fifth well was installed under Phase II activities in May 1998 (PRP-5).

In 1998, three temporary piezometers were installed around the OU to establish groundwater flow direction, and twenty-seven cone penetrometer technology (CPT) pushes were advanced around the OU to aid in interpretation of the nature and extent of contamination.

In October and November 1999, SRS installed two new wells: one well (PRP-6) was installed approximately 15 ft upgradient (east) of well PRP-3, and the other well (PRP-7) was installed approximately 80 ft downgradient (west) of well PRP-3. These data demonstrated that the results from PRP-3 had not been representative of actual groundwater conditions. Well PRP-3 was abandoned in Fall 2000.

There is no discernable contaminant plume in the groundwater and detections above maximum contaminant levels (MCLs) are sporadic. Excluding results obtained from well PRP-3 before it was abandoned, only 1,1-dichloroethene and trichloroethene exceed MCLs. 1,1-Dichloroethene was detected above its MCL of 7 micrograms per liter (μg/L) in well PRP-6 in one of four sampling events

(9.29 μg/L in January 2001) and in well PRP-7 in one of four sampling events (7.13 μg/L in November 1999). Trichloroethene was detected above its MCL of 5 μg/L in well PRP-7 in one of four sampling events (15.9 μg/L in November 1999). Figures 6 and 7 show the locations of wells and CPT samples at PBRP and present analytical results for 1,1-dichloroethene and trichloroethene.

The water table aquifer discharges to Steel Creek, 250 ft south of PBRP.

Operable Unit Characteristics

The following sections address geographical, geological, and ecological characteristics of the PBRP OU as well as threatened or affected resources and principal threat source material (PTSM) and low-level threat source materials.

Geographical Characteristics and Land Use

The OU is located in the west-central portion of SRS (Figure 1). PBRP is located to the northwest of P-Reactor Area (Figure 1), approximately 394 ft south of Road F. The area is delineated by orange balls. Figures 2 and 3 are photographs of the OU.

PBRP is close to, but outside of, the perimeter fence and industrial buffer zone of P Area, one of several inactive nuclear reactor areas at SRS. In the *Savannah River Site Future Use Project Report* (USDOE 1996a), SRS stakeholders recommended that P Area be designated for future industrial (nuclear) use. The proximity to the P-Area Heavy Industrial (nuclear) zone with buffer, the proximity to Steel Creek which has received radioactive discharges in the past from P Area, and the presence of buried debris at the unit make the PBRP OU unsuitable for residential use. Although the PBRP OU is located outside of the defined industrial use zone, USDOE, USEPA, and SCDHEC agree that industrial land use restrictions are appropriate for the PBRP OU area.

Future industrial land use is anticipated. Industrial land use will include land use controls to ensure protection against unrestricted (residential) uses. Unrestricted (residential) use of this area is not anticipated.

Groundwater at the OU is not currently being used for human consumption or any other purpose. Surface water is not used for irrigation, consumption, or other uses. Future residential use of groundwater or surface water at the OU is not anticipated.

Geological Characteristics

The backfill material in PBRP and all soils within a 200 ft radius of the pit are classified as Udorthents per the Unified Soil Classification System. Udorthents are well-drained soils formed in heterogeneous materials derived as spoil or refuse from excavations and major construction operations.

The near-surface geology comprises interbedded layers of sand, silt, and clay of the Upland Unit, Tobacco Road Sand, and Dry Branch Formation. These lithologic units compose a multilayered hydraulic complex in which retarding beds are interspersed with more permeable beds.

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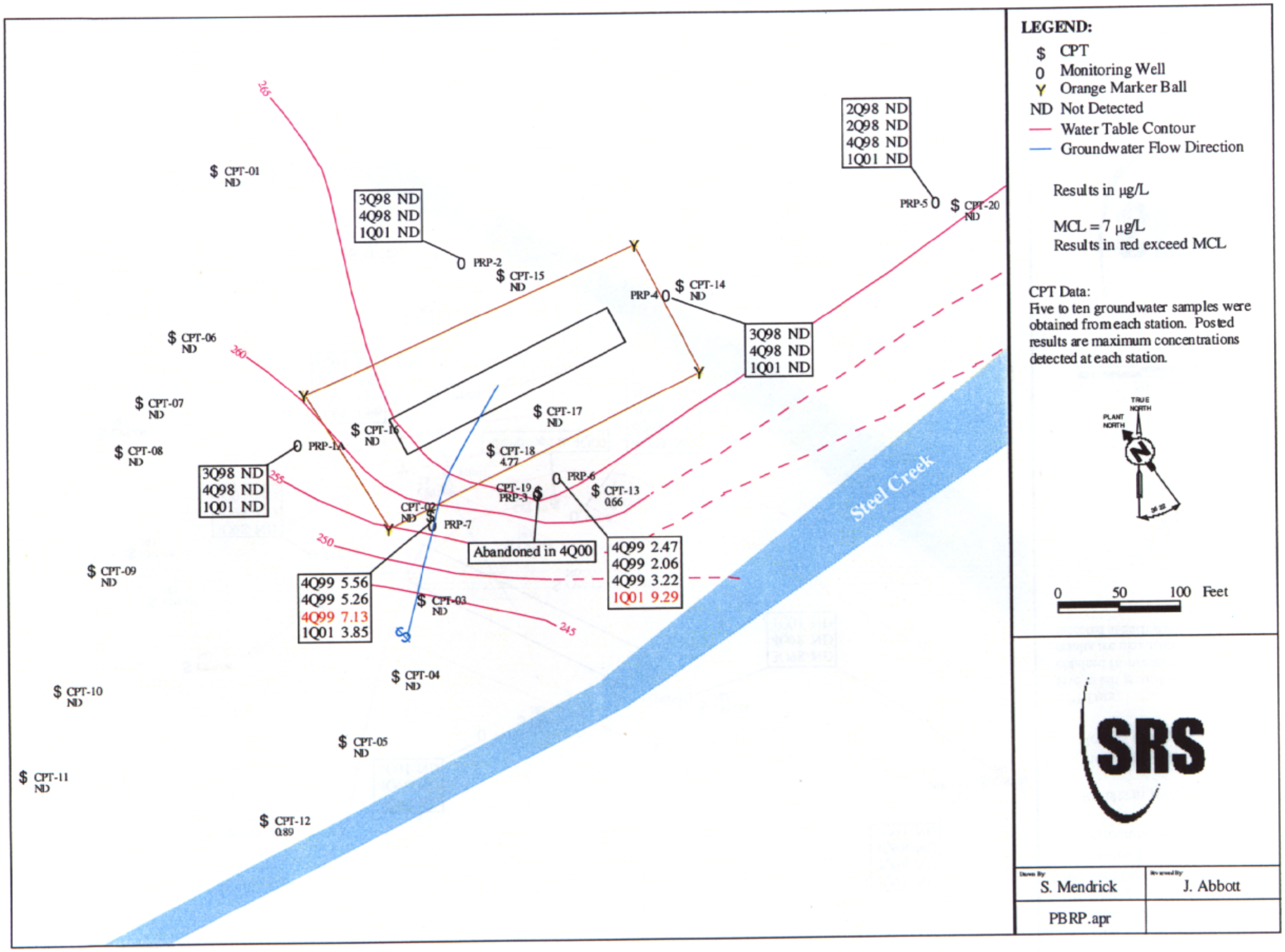


Figure 6. Groundwater Contamination – 1,1-Dichloroethene

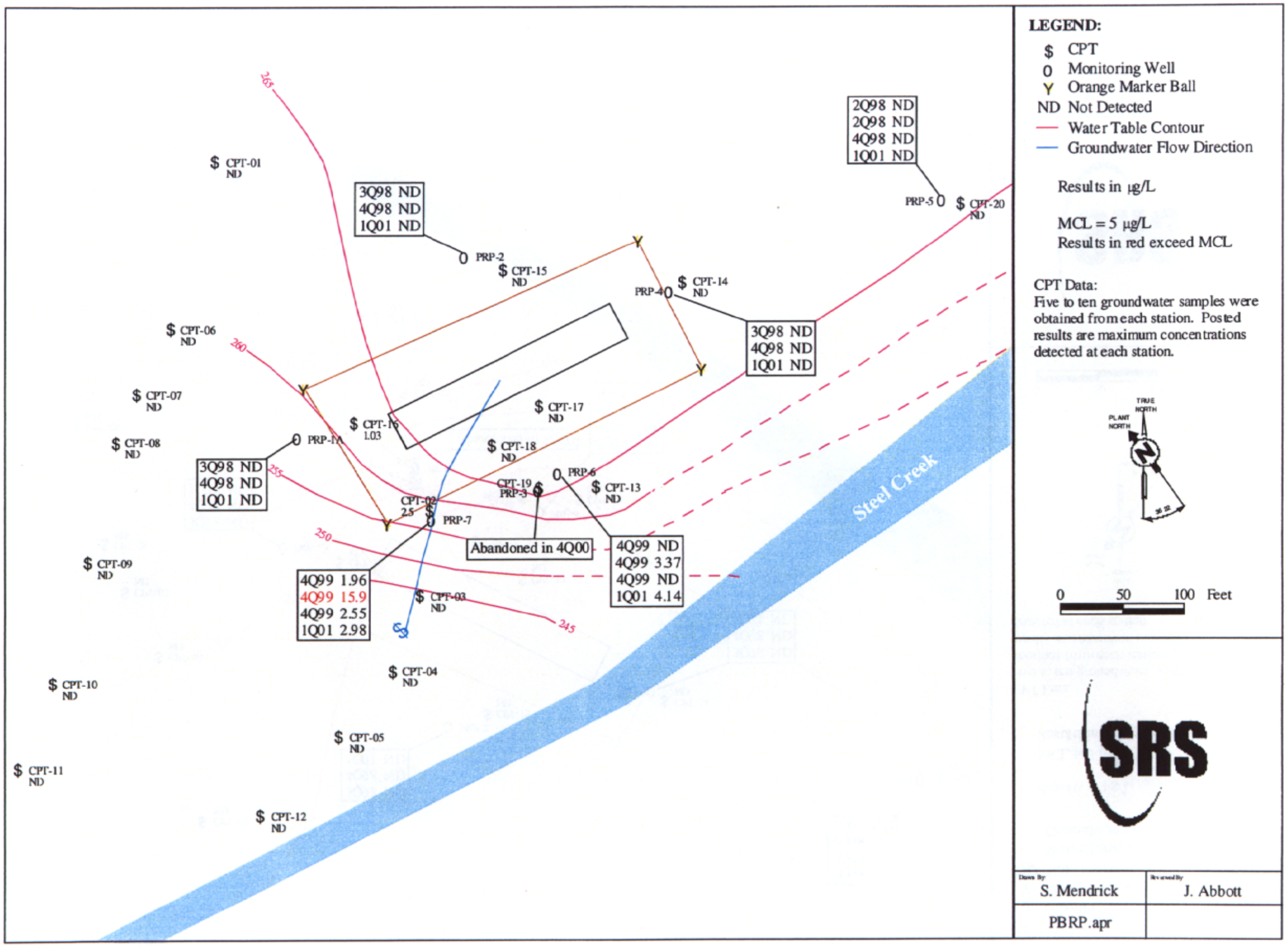


Figure 7. Groundwater Contamination - Trichloroethene

The vadose zone is approximately 23 ft thick at PBRP. The water table aquifer represents the "upper" aquifer zone of the Upper Three Runs aquifer and is composed of silt and clay. The upper aquifer zone is approximately 57 ft thick; it extends from the water table to a locally continuous clay layer (the "tan clay") at a depth of approximately 80 ft bls. The general groundwater flow direction is to the west.

During most of the year, the elevation of the water table is approximately the same as the elevation of the Steel Creek streambed. Consequently, Steel Creek is a discharge point for the water table aquifer. Water is present in Steel Creek throughout the year.

Ecological Characteristics

The land surface at PBRP is covered by grassy vegetation and several pine trees. The area around the orange marker balls is wooded. There are no unique, special, or sensitive habitats in the vicinity of the OU. No threatened, endangered, or sensitive species have been identified at the OU, and the habitats at the OU generally do not meet the needs of most threatened, endangered, or sensitive species. Information about the ecology in the vicinity is documented in a Threatened, Endangered, and Sensitive Species Listing (Bumpus and Garner, 1994).

Threatened or Affected Resources

Threatened or affected resources at the OU include soil at PBRP, surface water and sediment in Steel Creek, and groundwater in the water table aquifer. The potential adverse impacts to the natural resources of the unit are minimal due to the small affected area, the limited potential for migration and/or receptor contact, the generally low contaminant concentrations, and the potential remedial actions. Groundwater in the Upper Three Runs aquifer is not used as a source of drinking water. If future land use were unrestricted, Steel Creek would be a potential drinking water source.

Principal and Low-Level Threat Source Materials

Based on industrial exposure assumptions, no highly mobile or highly toxic source materials constituting PTSM (see Glossary) are present at the PBRP OU. At PBRP, the contamination consists of low-mobility and low-toxicity material isolated by backfill with its exposure limited by land use restrictions. In groundwater, the concentrations only slightly and sporadically exceed MCLs. There is no discernible groundwater plume. There is no free product (non-aqueous phase liquids).

IV. SCOPE AND ROLE OF OPERABLE UNIT RESPONSE ACTION

The overall strategy for addressing the OU was to (1) characterize the waste unit, delineating the nature and extent of contamination and identifying the media of concern (perform the RFI/RI); (2) perform a BRA to evaluate media of concern and exposure pathways and to characterize potential risks and identify RCOCs; and (3) identify and perform a final action to remediate, as needed, the identified media of concern.

The RFI/RI/BRA identified contamination warranting remediation in PBRP and in groundwater (see Section V). This SB/PP identifies the final action for these subunits. Figure 8 is a conceptual model of the unit, which shows potentially exposed populations in current and future risk scenarios and identifies

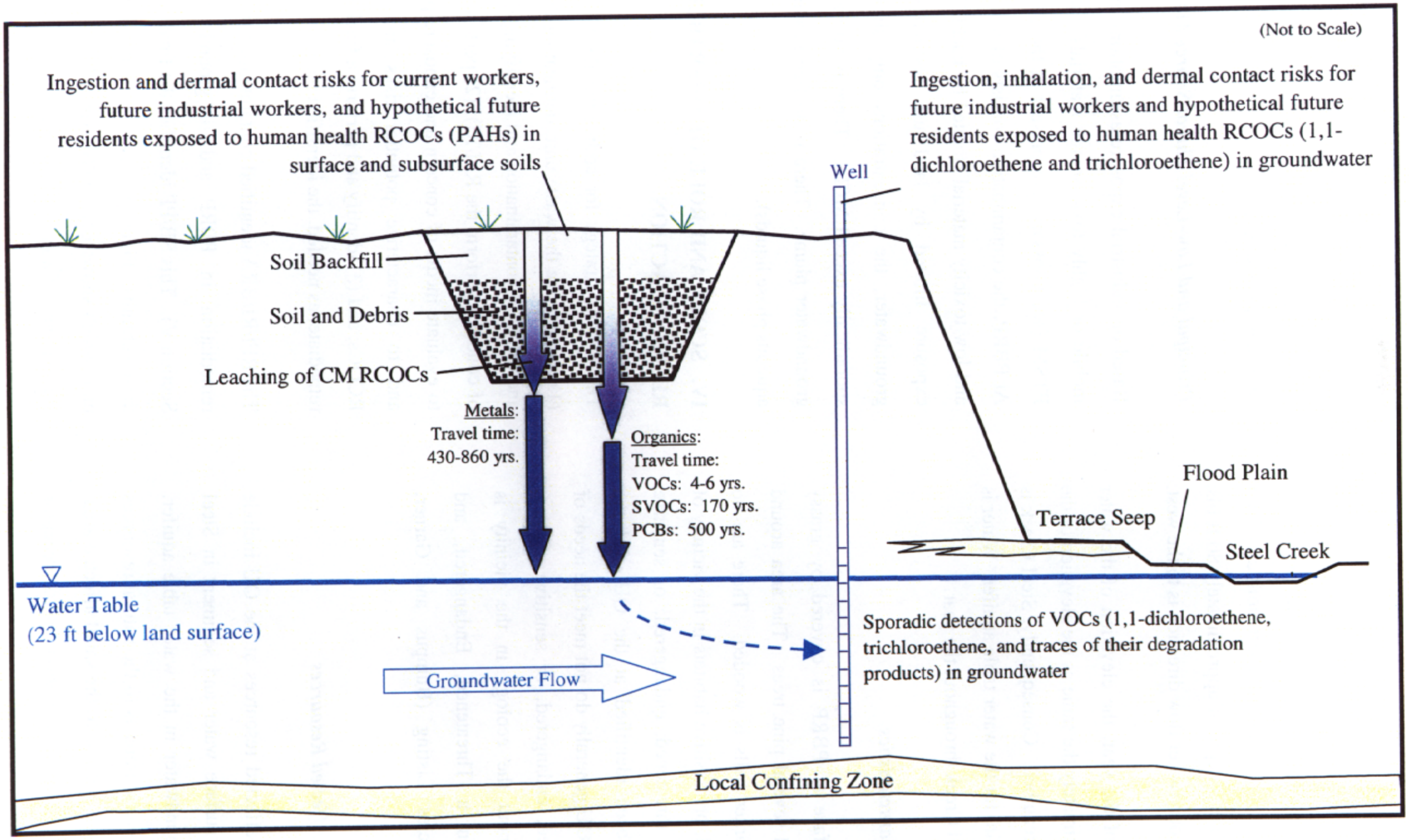


Figure 8. Conceptual Model of Baseline Conditions

exposure pathways (routes of exposure). The RFI/RI/BRA determined that there is no problem warranting action for the ditch or seepline; therefore no action is proposed for these subunits. Steel Creek will be evaluated with the Steel Creek IOU.

The response action proposed in this SB/PP for the PBRP OU will not impact the response actions of other OUs at SRS.

The PBRP OU is within the Steel Creek watershed. Several source control and groundwater OUs within this watershed will be evaluated to determine impacts, if any, to associated streams and wetlands. SRS will manage all OUs to mitigate impact to the watershed. Upon disposition of all OUs, a final comprehensive ROD for the watershed comprising the Steel Creek IOU will be pursued with additional public involvement. Surface water and sediment data from Steel Creek generated during the PBRP OU RFI/RI will be provided to the IOU program for use in evaluation of the Steel Creek IOU.

Based on industrial exposure assumptions, no PTSM is present at the PBRP OU.

V. SUMMARY OF OU RISKS

An RFI/RI/BRA was performed to assess the risks posed by the OU to human health and the environment (WSRC 2001). The assessment included quantitative calculation of human health risks, ecological risks, and the threat posed by future leaching to groundwater. A summary of risks and hazards is presented in Table 1. Figure 8 is a conceptual model of baseline conditions.

PBRP is undeveloped and there are no drinking water wells currently located in the surrounding area. SRS workers occasionally visit the site to perform routine activities such as inspections, periodic maintenance, and environmental sampling. Based on this land use, the risk assessments in the BRA evaluated a current exposure scenario of an on-unit worker exposed to soil at the pit.

PBRP is located in an area that has been recommended for future industrial (nuclear) use by the SRS Citizens' Advisory Board and USDOE (USDOE 1996a). For future land use, two receptors were evaluated, the hypothetical industrial worker and the hypothetical resident. Given that the future land use is expected to be similar to current conditions, the resident scenario is a conservative exposure scenario. Exposure to groundwater was included as part of the risk assessment for both future land-use scenarios.

RCOCs are identified for PBRP and groundwater. At the ditch and seepline, no RCOCs were identified that necessitate remediation. Contaminants in Steel Creek are not identified as RCOCs for this OU because the contamination did not originate from PBRP. Based on industrial exposure assumptions, no PTSM is present at the OU.

PBRP

At PBRP, miscellaneous inert debris remains in place at depth in the unit.

Human health risk calculations indicate benzo(a)pyrene would pose an unacceptable risk to a current on-unit worker (carcinogenic risks of up to 1×10^{-6} for a current on-unit worker equal the benchmark level of 1×10^{-6}). Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)-

Table 1. Summary of Risks and Hazards

RCOC	Type of RCOC	Summary of Risks
PBRP Soil		
Antimony	CM	Predicted to exceed MCL in 612 years. Max groundwater concentration (10X MCL) in 800 years
Chromium	CM	Predicted to exceed MCL in 422 years. Max groundwater concentration (30X MCL) in 830 years
Copper	CM	Predicted to exceed RBC in 489 years. Max groundwater concentration (5X MCL) in 860 years
Nickel	CM	Predicted to exceed MCL in 232 years. Max groundwater concentration (3X MCL) in 430 years
Zinc	CM	Predicted to exceed RBC in 232 years. Max groundwater concentration (4X RBC) in 450 years
Benzo(a)anthracene	$HH_{ind,\ res}$	Future Industrial Worker Risk = up to 5×10^{-5} Hypothetical Resident Risk = up to 2×10^{-4}
Benzo(a)pyrene	$HH_{cur,\ ind,\ res}$	Current Worker Risk = up to 1×10^{-6} Future Industrial Worker Risk = up to 5×10^{-4} Hypothetical Resident Risk = up to 2×10^{-3}
Benzo(b)fluoranthene	$HH_{ind,\ res}$	Future Industrial Worker Risk = up to 5×10^{-5} Hypothetical Resident Risk = up to 2×10^{-4}
Benzo(k)fluoranthene	$HH_{ind,\ res}$	Future Industrial Worker Risk = up to 4×10^{-6} Hypothetical Resident Risk = up to 2×10^{-5}
Chrysene	HH_{res}	Hypothetical Resident Risk = up to 2×10^{-6}
Dibenzo(a,h)anthracene	$HH_{ind,\ res}$	Future Industrial Worker Risk = up to 7×10^{-5} Hypothetical Resident Risk = up to 3×10^{-4}
Dibenzofuran	CM	Predicted to exceed RBC in 94 years. Max groundwater concentration (19X RBC) in 170 years
Fluoranthene	HH_{res}	Hypothetical Resident Hazard = up to 0.14
Indeno(1,2,3-c,d)pyrene	$HH_{ind,\ res}$	Future Industrial Worker Risk = up to 2×10^{-5} Hypothetical Resident Risk = up to 1×10^{-4}
Phenanthrene	HH_{res}	Hypothetical Resident Hazard = up to 0.16
Pyrene	HH_{res}	Hypothetical Resident Hazard = up to 0.16
Tetrachloroethene	CM	Predicted to exceed MCL in 5 years. Max groundwater concentration (15X MCL) in 6 years
Trichloroethene	CM	Predicted to exceed MCL in 4 years. Max groundwater concentration (10X MCL) in 4 years
PCB-1242	CM	Predicted to exceed MCL in 428 years. Max groundwater concentration (9X MCL) in 500 years
Groundwater		
1,1-Dichloroethene	ARAR $HH_{res,\ ind}$	Max concentration is at MCL
Trichloroethene	ARAR HH_{res}	Exceeds MCL by 3X

ARAR = ARAR RCOC
CM = Contaminant Migration RCOC
HH_{cur} = Human health RCOC for the current on-unit worker
HH_{ind} = Human health RCOC for the future industrial worker
HH_{res} = Human health RCOC for the future on-unit resident

fluoranthene, dibenzo(a,h)anthracene, and indeno-(1,2,3-c,d)pyrene would pose an unacceptable risk to a future industrial worker (carcinogenic risks of up to 5×10^{-4} for a future industrial worker exceed the benchmark level of 1×10^{-6}). If future land use is unrestricted, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-c,d)pyrene, phenanthrene, and pyrene would pose an unacceptable risk to a future on-unit resident (carcinogenic risks of up to 2×10^{-3} and noncarcinogenic hazard quotients [HQs] of up to 0.16 for a future on-unit resident exceed the benchmark levels of 1×10^{-6} and 0.1, respectively). Collectively, all of PBRPs RCOCs are hereafter referred to as polycyclic aromatic hydrocarbons (PAHs).

No ecological RCOCs are identified.

Contaminant fate and transport analyses indicate that nine constituents at PBRP present a contaminant migration (leachability) threat to groundwater. These contaminant migration refined constituents of concern (CM RCOCs) include antimony, chromium, copper, nickel, zinc, dibenzofuran, tetrachloroethene, trichloroethene, and PCB-1242. These constituents are predicted to exceed MCLs or risk-based concentrations (RBCs) within 1,000 years (Table 1).

Groundwater

Groundwater has been locally impacted by the pit. RCOCs for groundwater include 1,1-dichloroethene and trichloroethene. Detections are low and sporadic, and there is no defined plume.

Only trichloroethene and 1,1-dichloroethene exceed MCLs in groundwater. 1,1-Dichloroethene was detected above its MCL of 7 µg/L in well PRP-6 in one of four sampling events (9.29 µg/L in January 2001) and in well PRP-7 in one of four sampling events (7.13 µg/L in November 1999). Trichloroethene was detected above its MCL of 5 µg/L in well PRP-7 in one of four sampling events (15.9 µg/L in November 1999). Figures 6 and 7 present analytical results for 1,1-dichloroethene and trichloroethene.

Conclusion

The assessments conclude that no PTSM is present at the OU based on industrial exposure assumptions. However, PBRP soil and groundwater pose risks to human health. Hence, actual or threatened releases of hazardous substances, pollutants or contaminants from PBRP and groundwater, if not addressed by the Preferred Alternative or another active measure, will present a current or potential threat to public health, welfare, or the environment.

VI. REMEDIATION OBJECTIVES

The RFI/RI/BRA concluded that only the PBRP and groundwater subunits have RCOCs and need remedial action. Therefore, remedial action objectives (RAOs) are only developed for these subunits.

The RAOs for the contaminated soil and debris at PBRP are as follows:

- Protect current workers at PBRP from exposure to benzo(a)pyrene in surface soil at concentrations that exceed target risk levels.

- Protect hypothetical future industrial workers at PBRP from exposure to PAHs in surface and subsurface soils at concentrations that exceed target risk levels.

The RAOs for groundwater are as follows:

- Protect hypothetical future industrial workers at PBRP from exposure to 1,1-dichloroethene and trichloroethene in groundwater at concentrations that exceed target risk levels.
- Protect groundwater resources from contaminant migration of antimony, chromium, copper, nickel, zinc, dibenzofuran, tetrachloroethene, trichloroethene, and PCB-1242 in PBRP soil that would impact the groundwater above MCLs or RBCs.

In the RFI/RI/BRA, remedial goal options (RGOs) were calculated for each RCOC. RGOs are concentration goals for individual chemicals for specific medium and land use combinations. They are designed to provide conservative, long-term targets for the selection and analysis of remedial alternatives. Final remedial goals (RGs) are selected from the RGOs to be protective of both human health and the environment, as well as to comply with federal and state applicable or relevant and appropriate requirements (ARARs).

Human health RGOs were calculated for various land use/receptor scenarios including current and future industrial workers and hypothetical on-unit residents. A range of RGOs is provided, corresponding to target HQs of 0.1, 1, and 3 as well as target cancer risks of 1×10^{-6}, 1×10^{-5}, and 1×10^{-4}. In situations where both noncarcinogenic and carcinogenic toxicity values are available, human health RGOs were calculated using both values.

Ecological RGOs were not calculated because no ecological RCOCs were identified.

CM RGOs were calculated for each CM RCOC. The CM RGO is the highest concentration that can be left in soil without posing a leachability threat to groundwater at levels that will exceed MCLs or RBCs (under baseline conditions).

To be protective of both human health and the environment, the RG is selected as the lower of the (1) most restrictive human health RGO for the expected future land use (future industrial), and (2) the CM RGO. If available, additional information such as chemical-specific ARARs and other guidance (e.g., Toxic Substances Control Act clean-up levels, USEPA - Office of Solid Waste and Emergency Response [OSWER] guidance, and MCLs) may also be considered in selecting RGs (Table 2). Table 3 presents ARARs.

Because of the generally conservative assumptions used in the RGO calculations, it is possible for a risk-based RGO to be less than what occurs naturally in unimpacted ambient background conditions. This RG would not be technically possible to achieve. To avoid this, the RGs are compared to background benchmarks. Table 2 presents three benchmarks: the maximum result in the unit-specific background soil, the unit-specific 2X average background concentration, and the 95th percentile for unimpacted background soils at SRS (USDOE 1996b).

Table 2. Remedial Goals

RCOC	Type of RCOC	RGOs			Background Benchmarks			RG
		ARAR RGO	CM RGO	HH RGO	Unit-Specific Maximum	Unit-Specific 2X Average	SRS 95th Percentile	
PBRP Soil (mg/kg)								
Antimony	CM	--	0.259	--	0.374	0.374	4.588	4.588*
Chromium	CM	--	2.80	--	26.80	20.60	35.22	35.22*
Copper	CM	--	40.8	--	7.90	5.56	NA	40.8
Nickel	CM	--	2.05	--	4.80	2.88	11.432	11.432*
Zinc	CM	--	1110	--	6.90	6.32	20.475	1110
Benzo(a)anthracene	$HH_{res, ind}$	--	--	2.56	ND	ND	NA	2.56
Benzo(a)pyrene	$HH_{res, ind, cur}$	--	--	0.256	ND	ND	NA	0.256
Benzo(b)fluoranthene	$HH_{res, ind}$	--	--	2.56	ND	ND	NA	2.56
Benzo(k)fluoranthene	$HH_{res, ind}$	--	--	25.6	ND	ND	NA	25.6
Chrysene	HH_{res}	--	--	256	ND	ND	NA	256
Dibenzo(a,h)anthracene	$HH_{res, ind}$	--	--	0.256	ND	ND	NA	0.256
Dibenzofuran	CM	--	0.195	--	ND	ND	NA	0.195
Fluoranthene	HH_{res}	--	--	2670	ND	ND	NA	2670
Indeno(1,2,3-c,d)pyrene	$HH_{res, ind}$	--	--	2.56	ND	ND	NA	2.56
Phenanthrene	HH_{res}	--	--	3270	ND	ND	NA	3270
Pyrene	HH_{res}	--	--	2000	ND	ND	NA	2000
Tetrachloroethene	CM	--	0.00338	--	ND	ND	NA	0.00338
Trichloroethene	CM	--	0.00153	--	ND	ND	NA	0.00153
PCB-1242	CM	--	0.00843	--	ND	ND	NA	0.00843
Groundwater (µg/L)								
1,1-Dichloroethene	ARAR, $HH_{res, ind}$	7.0	--	0.477	ND	ND	NA	7.0
Trichloroethene	ARAR, HH_{res}	5.0	--	26.0	ND	ND	NA	5.0

Type of COC: ARAR = ARAR COC

CM = Contaminant Migration COC

$HH_{res, ind, cur}$ = Human health COC for the resident, industrial worker, current worker

"--" = not applicable. This chemical is not an RCOC for this assessment category.

ND = not detected

NA = not available

SRS 95th percentile from USDOE 1996.

HH RGO is based on future industrial worker exposure scenario.

Table 3. Potential ARARs and TBC Criteria

Citation(s)	Status	Requirement Summary	Reason for Inclusion	Alternative
Chemical				
40 CFR 141 – MCLs and MCLGs	Relevant and Appropriate	MCLs and MCLGs for groundwater that may be a source of drinking water	MCLs should generally be met for cleanup of groundwater under the CERCLA program	GW1, GW2, PBRP1, PBRP2
SC R.61-58.5 – MCLs and MCLGs	Relevant and Appropriate	MCLs and MCLGs for groundwater that may be a source of drinking water	State regulations implementing MCLs.	GW1, GW2, PBRP1, PBRP2
SC R.61-68 Water Classification	Relevant and Appropriate	States official classified water uses for all surface and groundwater in South Carolina	Mandates meeting MCLs for groundwater.	GW1, GW2, PBRP1, PBRP2
40 CFR 143.3 Secondary Drinking Water Standards	Relevant and Appropriate	Establishes levels for contaminants that affect the aesthetic qualities of drinking water.	Secondary Drinking Water Standards relevant for setting remediation levels.	GW1, GW2, PBRP1, PBRP2
40 CFR 260-268 and SC R.61-79.260-268 Federal and State Hazardous Waste Regulations	Applicable	Defines criteria for determining whether a waste is RCRA hazardous waste and provides treatment, storage and disposal requirements.	Would apply if specific chemicals are found to be present.	PBRP1, PBRP2
SC R.61-62.5 Air Quality Standard	Applicable	Establishes air quality standards for emissions.	Would apply to air emissions of Standard 2 Toxic Air Pollutants and Standard 8 Ambient Air Quality Standards.	PBRP2
SC R.61-107.16 Solid Waste Management: Industrial Solid Waste Landfills	Relevant and Appropriate	Establishes design standards for non-hazardous industrial solid waste landfills.	Would apply if contamination is left in place.	PBRP1, PBRP2
Action				
40 CFR 50.6 National Primary and Secondary Ambient Air Quality Standards	Applicable	The concentration of particulate matter (PM_{10}) in ambient air shall not exceed 50 $\mu g/m^3$ (annual arithmetic mean) or 150 $\mu g/m^3$ (24-hour average concentration).	Dust suppression will likely be required to minimize dust emissions during construction/remedial action.	PBRP2
SC R.61-62.1 Air Permit Requirements	Applicable	Requires construction and operating permits for sources of air pollution.	If remedial action creates point source of air pollutants, permits may be required.	PBRP2

Table 3. Potential ARARs and TBC Criteria (Continued)

Citation(s)	Status	Requirement Summary	Reason for Inclusion	Alternative
Action				
SC R.61-62.6 Fugitive Dust	Applicable	Fugitive particulate material shall be controlled.	Construction/remedial action may be required for dust suppression.	PBRP2
SC R.61-9 NPDES Permits	Applicable	Requirements for control of storm water discharges.	Any storm water discharges must meet these standards.	PBRP1, PBRP2
SC R.61-71 Well Construction Standards	Applicable	Prescribes minimum standards for the construction of wells.	Standards for installation and abandonment of wells.	PBRP2, GW2
SC R.72-300 Standards for Stormwater Management and Sediment Reduction	Applicable	Stormwater management and sediment control plan for land disturbances.	Construction/remedial action may require an erosion control plan.	PBRP2

CFR = Code of Federal Regulations

SCR = South Carolina Regulations

MCLG = Maximum Contaminant Level Goal

There are no location-specific ARARs for the PBRP OU.

Comparison of the risk-based RGOs to these background benchmarks indicates that all RGOs except antimony, chromium, and nickel are above background levels and can be attained. The RGs for antimony, chromium, and nickel default to background levels (Table 2).

For groundwater, two RGOs are available: an ARAR RGO (the MCL) and a risk-based human health RGO (calculated using unit-specific exposure assumptions for the future industrial worker). For groundwater, the RG is set to the MCL because MCLs are substantive for environmental protection requirements promulgated under federal and state law. Table 2 presents the RGs.

VII. SUMMARY OF ALTERNATIVES

Generally, before an SB/PP is written, a CMS/FS is prepared to identify and screen a wide range of potential remedial technologies and identify a short list of candidate alternatives to be assessed in the SB/PP. For this OU, however, USDOE, USEPA, and SCDHEC agreed that the problem warranting action and the scope of the problem at each subunit was well-defined and that the list of likely response actions was short enough to proceed directly from the RFI/RI/BRA to the SB/PP without the need for a full CMS/FS.

Throughout the RFI/RI process, USDOE, USEPA, and SCDHEC have evaluated a range of possible response actions for the subunits that require remediation (PBRP and groundwater). The information regarding the development and evaluation of remedial alternatives and their cost estimates, which is generally presented in a CMS/FS report, is presented in Appendices A and B attached to this SB/PP.

Remedial alternatives are developed for those subunits requiring remediation (PBRP and groundwater). Remedial alternatives have not been developed for the ditch or seepline because there are no RCOCs for those subunits. Steel Creek is being addressed separately under the IOU program.

Because USDOE, USEPA, and SCDHEC agreed the problem warranting action and scope of the problem were well-defined, and because they agreed there is a limited range of appropriate response actions, the number of alternatives is small. Two alternatives are identified for PBRP (No Action, and Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls), and two alternatives are identified for groundwater (No Action, and Continued Monitoring and Reporting). These alternatives are assessed to determine the most appropriate alternative for each subunit. The alternatives evaluated are briefly summarized in the following paragraphs. For additional information on the development and evaluation of alternatives, refer to Appendix A of this SB/PP.

PBRP

PBRP1: No Action. No Action would consist of no remedial activities at PBRP. Institutional controls would not be implemented. The No Action alternative is required by the National Oil and Hazardous Substances Contingency Plan (NCP) to serve as a baseline for comparison with other remedial alternatives. The No Action alternative would not be protective of human health and the environment. There would be no reduction of risk, and potential exposure pathways would remain. The Five-Year Review Requirement, a CERCLA ROD review, would be conducted every five years to determine whether the remedy is meeting RAOs. The costs for this alternative are as follows:

Total Capital Cost:	$0
Total O&M Cost:	$32,000
Total Present Value Cost:	$32,000

For consistency in the comparative analysis, this cost includes the cost for the Five-Year Review Requirement, which is also presented with the groundwater subunit alternative cost. However, this cost is an OU-wide cost that is not duplicated for each subunit (PBRP and groundwater). For a detailed cost estimate, refer to Appendix B, Table B-1.

PBRP2: Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls. Under this alternative, an engineered cover (hydraulic conductivity of approximately 10^{-5} cm/sec) would be emplaced over the pit to reduce infiltration and associated leaching. The cover would also provide a barrier between human receptors and the buried human health RCOCs.

Contaminant fate and transport calculations indicate that an engineered soil cover would provide sufficient infiltration control to prevent inorganics and PCBs from leaching to groundwater above MCLs/RBCs within 1,000 years. As long as biodegradation and volatilization are occurring, they along with the cover's infiltration reduction would also prevent VOCs and SVOCs from migrating to groundwater above MCLs/RBCs. There is evidence of biodegradation at the unit because sampling during the RFI/RI confirmed the presence of organic biodegradation products at the unit. Volatilization of organics to the atmosphere (via soil gas) is occurring through natural processes under current baseline conditions. However, if a low permeability cover were to be placed, volatilization would be reduced by the cover. A soil vapor extraction system such as BaroBalls™ would need to be constructed to offset reduced volatilization due to the low permeability cover. The BaroBalls™ system is a simple valve that opens and closes based on differences between atmospheric and soil-gas pressures, allowing gas to flow from a well to the atmosphere. The BaroBalls™ system increases the effectiveness of barometric pumping by preventing the inflow of air into a venting well when atmospheric pressure reverses, a condition that can reduce contaminant removal by diluting and dispersing the pollutant.

Institutional controls would be implemented. Institutional controls would consist of site maintenance (repair of erosion damage, cover maintenance, and warning signs) and site controls (SRS Site Use and Site Clearance Programs, which restrict invasive and permanent installation activities at the waste unit). Institutional controls will maintain the integrity of the engineered soil cover, which in turn will maintain the effectiveness of the cover to mitigate leaching. The Five-Year Review Requirement, a CERCLA ROD review, would be conducted every five years to determine whether the remedy is meeting RAOs. The expected outcome of this alternative is that human health RCOCs would be isolated from exposure below the cover and that the cover system would provide sufficient infiltration control to prevent future leaching of CM RCOCs to groundwater above MCLs/RBCs. The costs for this alternative are as follows:

Total Capital Cost: $377,000

Total O&M Cost: $149,000

Total Present Value Cost: $526,000

The cost for implementation of an engineered soil cover is $308,000. The additional cost for the installation of the BaroBalls™ system is $72,000. The cost for institutional controls is $114,000. For consistency in the comparative analysis, total costs include the cost for the Five-Year Review Requirement ($32,000), which is also presented with the groundwater subunit costs. However, this cost is an OU-wide cost that is not duplicated for each subunit (PBRP and groundwater). For detailed cost estimates, refer to Appendix B, Tables B-1, B-2, B-3, and B-4.

Groundwater

GW1: No Action. No Action would consist of no remedial activities to groundwater. The No Action alternative is required by the NCP to serve as a baseline for comparison with other remedial alternatives. The No Action alternative would not be protective of human health and the environment. There would be no reduction of risk, and potential exposure pathways would remain. The Five-Year Review Requirement, a CERCLA ROD review, would be conducted every five years, as needed, to determine whether the remedy is meeting RAOs. The costs for this alternative are as follows:

Total Capital Cost: $0

Total O&M Cost: $32,000

Total Present Value Cost: $32,000

For consistency in the comparative analysis, this cost includes the cost for the Five-Year Review Requirement, which is also presented with the PBRP subunit alternative costs. However, this cost is an OU-wide cost that is not duplicated for each subunit (PBRP and groundwater). For a detailed cost estimate, refer to Appendix B, Table B-1.

GW2: Continued Monitoring and Reporting. 1,1-Dichloroethene and trichloroethene have been detected sporadically above MCLs in the groundwater and it is anticipated that groundwater concentrations will decrease with time through natural processes. This alternative relies on natural processes to attenuate contaminants. Natural processes may reduce contaminant mass (through destructive processes such as biodegradation and chemical transformations), reduce contaminant concentrations (through simple dilution or dispersion), or bind contaminants to soil particles so the contamination does not spread or migrate very far (absorption). Under this alternative, institutional controls would be implemented to restrict groundwater use and monitor groundwater to verify that a discernable plume above MCLs does not develop. Monitoring would consist of continued sampling of selected wells (PRP-5, PRP-6, and PRP-7) and comparison of the analytical results to MCLs. The Five-Year Review Requirement, a CERCLA ROD review, would be conducted every five years, as needed, to determine whether the remedy is meeting RAOs. The costs for this alternative are as follows:

Total Capital Cost: $0

Total O&M Cost: $71,000

Total Present Value Cost: $71,000

The cost for monitoring and reporting is $39,000. For consistency in the comparative analysis, the total costs include the cost for the Five-Year Review Requirement ($32,000), which is also presented with the PBRP subunit alternative costs. However, this cost is an OU-wide cost that is not duplicated for each subunit (PBRP and groundwater). For detailed cost estimates, refer to Appendix B, Tables B-1 and B-5.

VIII. EVALUATION OF ALTERNATIVES

Description of the Nine Evaluation Criteria

Each of the remedial alternatives is evaluated against the nine criteria established by the NCP 40 Code of Federal Regulations (CFR) 300. The criteria are derived from the statutory requirements of CERCLA Section 121. The criteria provide the basis for evaluating the alternatives and selecting a remedy. The nine criteria are as follows:

Threshold criteria:

1. Overall protection of human health and the environment
2. Compliance with ARARs

Balancing criteria:

3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume through treatment
5. Short-term effectiveness
6. Implementability
7. Cost

Modifying criteria:

8. State acceptance
9. Community acceptance

For a detailed description of the nine criteria and evaluation of the alternatives against them, refer to Appendix A.

Table 4 presents a summary of this evaluation. The evaluation is also briefly summarized below. For more detailed evaluation, please refer to Appendix A.

PBRP

Overall Protection of Human Health and the Environment: Alternative PBRP2 would be protective because human health RCOCs would be covered to prevent exposure; infiltration and leaching of CM RCOCs would be reduced enough to prevent groundwater from being impacted above MCLs/RBCs in the future; and the cover over the contaminated soils would mitigate erosion and redistribution of pit soils. Alternative PBRP1 is not protective because human health RCOCs (PAHs) would remain at the unit in surface and subsurface soils and would pose an unacceptable risk to current workers, future industrial workers, and hypothetical residents. Also, CM RCOCs would remain at the unit under current conditions and would pose a leachability threat to groundwater. Further, erosion of pit soils could spread contamination.

Compliance with ARARs: Alternative PBRP2 would comply with ARARs (Table 3). The engineered cover system would comply with 40 CFR 141 and SC R.61-58.5 by preventing leaching of contaminants to the groundwater in excess of MCLs. Alternative PBRP1 would not comply with these regulations because leaching of contaminants to the groundwater would not be prevented.

Long-term Effectiveness and Permanence: PBRP2 offers greater long-term effectiveness compared to PBRP1. Whereas the residual risk associated with PBRP1 would be the same as current conditions, the residual risk associated with PBRP2 would be less than the target risk range. The risk from RCOCs would be mitigated by isolation of contaminated soils

Table 4. Alternatives Evaluation Summary

Alternative	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction in Toxicity, Mobility, or Volume Through Treatment	Short-Term Effectiveness	Implementability	Cost (Total Present Worth)
PBRP							
PBRP1 **No Action**	Not Protective	Does not comply	Not Effective Assessment of permanence is not applicable because No Action does not meet RAOs	None	Not Effective	Implementable	ROD Review: $32,000
PBRP2 **Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls**	Protective	Complies	Effective Permanent as long as the cover is maintained	None through treatment, but reduction in mobility and toxicity through containment. Also, reduction in mobility through removal of VOCs.	Effective	Implementable	ROD Review: $32,000 Institutional Controls: $114,000 Soil Cover: $308,000 BaroBalls™: $72,000
Groundwater							
GW1 **No Action**	Not Protective	Does not comply	Effective, but degree of actual effectiveness would be uncertain Assessment of permanence is not applicable because it would be unknown if protection is achieved	None through treatment but reduction in toxicity and volume through natural processes	Effective, but degree of actual effectiveness would be uncertain	Implementable	ROD Review: $32,000
GW2 **Continued Monitoring and Reporting**	Protective	Complies	Effective, and Permanent	None through treatment but reduction in toxicity and volume through natural processes	Effective	Implementable	ROD Review: $32,000 Monitoring: $39,000

Approval of the SB/PP by SCDHEC and USEPA is considered as State acceptance of the preferred alternative. Community acceptance of the preferred alternative is assessed by giving the public an opportunity to comment on the SB/PP. Public comments are documented in the Responsiveness Summary of the ROD.

For consistency in the comparative analysis, the costs for the groundwater alternatives include the cost for the Five-Year Review Requirement, which is also presented with the PBRP subunit alternative costs. This cost is an OU-wide cost that is not duplicated for each subunit (PBRP and groundwater). For detailed cost estimates, refer to Appendix B.

under the cover, and the leachability risk would be mitigated by infiltration control. An assessment of permanence for PBRP1 is not applicable because RAOs are not met and there are no remedy components. PBRP2 is permanent as long as the cover system is maintained. If the cover system were not maintained and the cover were to erode, the remedy would gradually become less effective.

Reduction of Toxicity, Mobility, or Volume Through Treatment: Neither alternative offers reduction in toxicity, mobility, or volume *through treatment.* However, PBRP2 reduces toxicity in surface and subsurface soils through isolation under the cover and reduces mobility in the vadose zone through containment. Also, removal of VOCs to the atmosphere reduces the mobility of VOCs to groundwater.

Short-term Effectiveness: PBRP2 offers greater short-term effectiveness compared to PBRP1 because PBRP2 is the only alternative that achieves protection. PBRP1 does not achieve RAOs and is therefore not effective. PBRP2 presents negligible risks to remedial workers or to the community. Release of VOCs through the BaroBalls^{TM} to the atmosphere presents negligible risk to workers or the community because the concentrations are low and will be readily dispersed to concentrations below detection limits. Once in the atmosphere, VOCs are rapidly broken down into harmless components by natural processes.

Implementability: Both alternatives are implementable. PBRP1 does not involve any action; therefore, it is readily implementable. PBRP2 would require some engineering design for the cover system and periodic repairs, but there are no implementability restrictions.

Cost: PBRP1 is less expensive than PBRP2.

State Acceptance: The approval of this SB/PP by SCDHEC and USEPA constitutes acceptance of the preferred alternative by the regulatory agencies.

Community Acceptance: This SB/PP provides for community involvement through a document review process and a public comment period. Public input will be documented in the Responsiveness Summary section of the ROD.

Groundwater

Overall Protection of Human Health and the Environment: Alternative GW2 is protective because monitoring would track the attenuation of contaminants and would identify a plume in the unlikely event that a discernable plume develops. Alternative GW1 is not protective because groundwater contamination above MCLs would be left unmonitored.

Compliance with ARARs: GW2 should eventually comply with ARARs; monitoring would evaluate RCOC concentrations for compliance with 40 CFR 141 and SC R.61-58.5. GW1 would not comply with the Safe Drinking Water Act because groundwater contamination above MCLs would be left unmonitored.

Long-term Effectiveness and Permanence: GW2 offers greater long-term effectiveness because monitoring will reduce uncertainty with the magnitude of residual risks. An assessment of permanence for GW1 is not applicable because it would be uncertain if protection is achieved and there are no remedy components. GW2 is permanent in that once RGs are met, the concentrations are expected to remain below MCLs; an increase in concentrations above MCLs is not anticipated.

Reduction of Toxicity, Mobility, or Volume Through Treatment: Neither alternative offers reduction in toxicity, mobility, or volume *through treatment.* However, reduction is expected as a result of natural processes, including biodegradation.

Short-term Effectiveness: GW2 offers greater short-term effectiveness compared to GW1. Although GW2 presents some minor exposure risks to remedial workers, this is offset by the fact that the time until GW1 achieves protection is unknown. Therefore, the short-term effectiveness of GW1 is unknown. Risks to remedial workers performing GW2 (groundwater sample crews) can be managed using standard health and safety measures. There are no exposure concerns for the community.

Implementability: Both alternatives are implementable. GW1 does not involve any action; therefore, it is readily implementable. GW2 is also readily implementable, as monitoring uses standard equipment and techniques.

Cost: GW1 is less expensive than GW2.

State Acceptance: The approval of this SB/PP by SCDHEC and USEPA constitutes acceptance of the preferred alternative by the regulatory agencies.

Community Acceptance: This SB/PP provides for community involvement through a document review process and a public comment period. Public input will be documented in the Responsiveness Summary section of the ROD.

IX. PREFERRED ALTERNATIVE

Based upon the characterization data and risk assessments in the RFI/RI/BRA (WSRC 2001), the RAOs, and the evaluation of alternatives, the preferred alternative for PBRP is Alternative PBRP2 (Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls) and the preferred alternative for groundwater is Alternative GW2 (Continued Monitoring and Reporting). Figure 9 is a schematic illustration of the proposed remedy.

An engineered cover system (hydraulic conductivity of approximately 10^{-5} cm/sec) will be emplaced over the pit to reduce infiltration and associated leaching. The cover will also provide a barrier between human receptors and the buried human health RCOCs. Contaminant fate and transport calculations indicate that an engineered soil cover would provide sufficient infiltration control to prevent inorganics and PCBs from leaching to groundwater above MCLs/RBCs within 1,000 years. As long as biodegradation and volatilization are occurring, it would also prevent VOCs and SVOCs from migrating to groundwater above MCLs/RBCs. There is evidence for biodegradation at the unit because sampling during the RFI/RI confirmed the presence of organic biodegradation products at the unit. Volatilization of organics to the atmosphere (via soil gas) is occurring

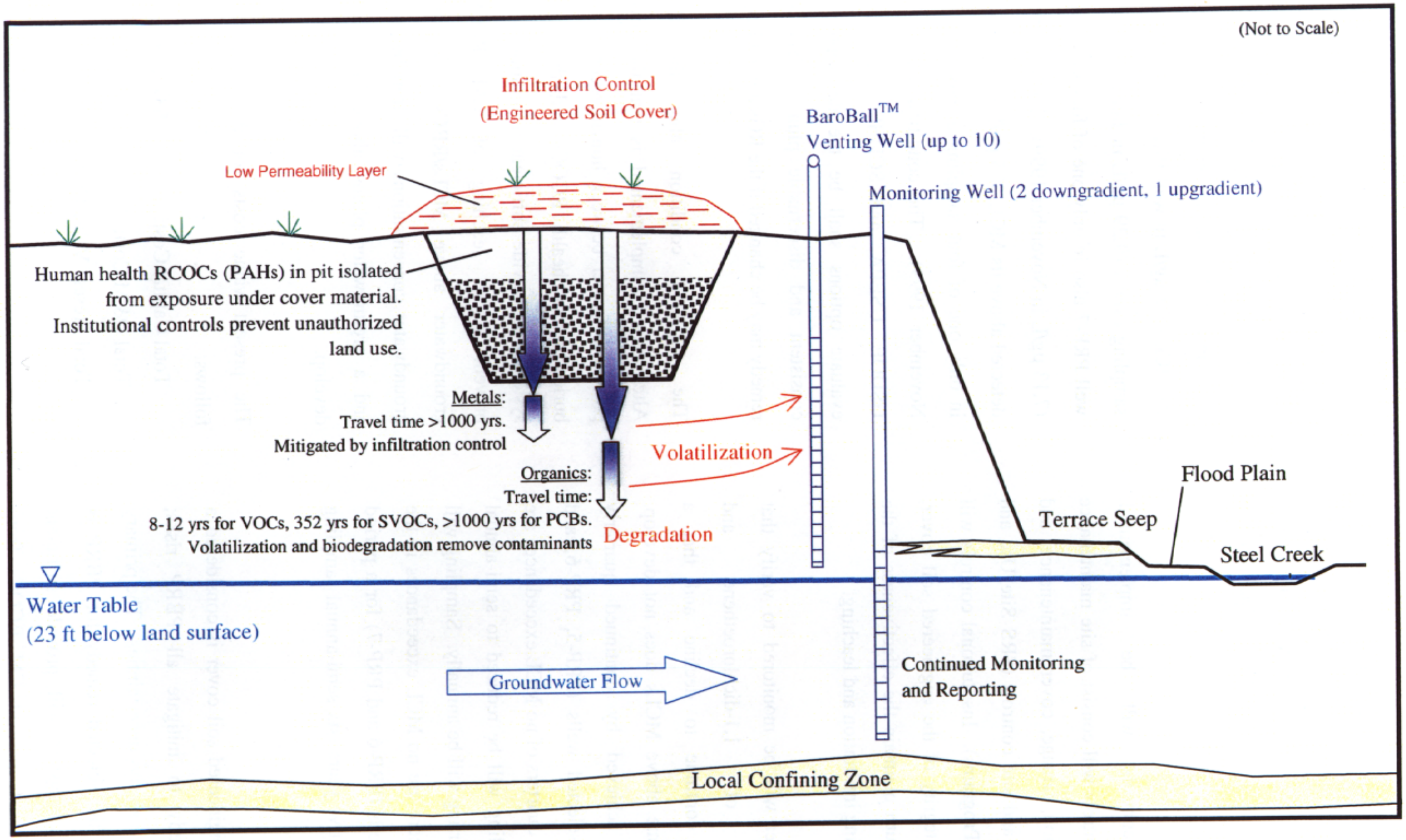


Figure 9. Schematic Illustration of the Proposed Remedy

through natural processes under current baseline conditions. However, when the low permeability cover is placed, volatilization will be reduced by the cover. A passive soil vapor extraction system such as BaroBalls™ will be constructed in order to offset reduced volatilization due to the low permeability cover.

Institutional controls will be implemented. Institutional controls will consist of site maintenance (repair of erosion damage, cover maintenance, and warning signs) and site controls (SRS Site Use and Site Clearance Programs). Institutional controls will maintain the integrity of the engineered soil cover, which will in turn maintain the effectiveness of the cover at mitigating infiltration and leaching.

The groundwater will be monitored to verify that concentrations of 1,1-dichloroethene and trichloroethene continue to decline and that a discernable plume above MCLs does not develop. This will be achieved by continued quarterly monitoring of selected wells (PRP-5, PRP-6, and PRP-7). If four quarters of no MCL exceedances are observed, sampling will be reduced to semi-annual sampling. Reporting will be annually. Sampling will continue until there are no MCL exceedances in the downgradient wells (PRP-6 and PRP-7) for a period of three consecutive years (six semi-annual sampling events).

The proposed engineered soil cover is considered a reasonable remedy to mitigate all PBRP risks; however, there are always uncertainties. The primary uncertainty with the selected remedy for PBRP is whether the cover system will provide sufficient infiltration control to prevent CM RCOCs from leaching to groundwater above MCLs/RBCs. This uncertainty is managed by the preferred remedy for groundwater, which includes groundwater monitoring. As depicted on Figures 6 and 7, there is no history of a discernable plume. MCL exceedances have been sporadic and limited to PRP-6 and PRP-7 only. In fact, 1,1-dichloroethene was detected above its MCL of 7 μg/L in well PRP-6 in only one of four sampling events (9.29 μg/L in January 2001) and in well PRP-7 also in only one of four sampling events (7.13 μg/L in November 1999). Trichloroethene was detected above its MCL of 5 μg/L in well PRP-7 also in only one of four sampling events (15.9 μg/L in November 1999). The condition that will trigger USDOE, USEPA, and SCDHEC to convene to evaluate options shall be the development of a consistent and discernable plume. The selected remedy may be changed if the RGs are not being met.

The expected condition after the Preferred Alternative is implemented is that the cover will provide a barrier between human receptors and the buried human health RCOCs and that the cover system will provide sufficient infiltration control to prevent future leaching of CM RCOCs to groundwater above MCLs/RBCs. In addition, groundwater concentrations will drop below MCLs and a groundwater plume above MCLs will not develop.

The present value costs for this remedy are as follows:

Total Capital Cost:	$377,000
Total O&M Cost:	$188,000
Total Present Value Cost:	$565,000

These costs include the cost of placing an engineered cover ($308,000), installation of BaroBalls™ ($72,000), groundwater monitoring ($39,000), implementation of institutional controls ($114,000), and the Five-Year Review Requirement ($32,000). For detailed cost estimates, refer to Appendix B.

Waste generated during remediation will likely be limited to well-cutting materials, decontamination fluids, development water, purge water, and cleared local vegetation. These wastes should be non-toxic and non-hazardous in nature. Wastes generated will be managed and dispositioned in accordance with the Investigation-Derived Waste Management Plan (WSRC 1994). Prior to installation of the soil cover, the area will be cleared. The area outside of the soil cover will be grubbed. Merchantable trees will be harvested and sold. The remaining trees will be dispositioned off unit. The trees and vegetation are not contaminated and are not waste material. Therefore, sampling will not be performed on trees that will be removed from the OU. The tree stumps will be ground to prevent damage to the soil cover.

Per the USEPA – Region IV Land Use Controls (LUCs) Policy, a LUC Assurance Plan (LUCAP) for SRS has been developed and approved by the regulators (WSRC 1999). In addition, a LUC Implementation Plan (LUCIP) for the PBRP OU will be developed and submitted to the regulators for their approval with the post-ROD documentation. The LUCIP will detail how SRS will implement, maintain, and monitor the land use control elements of the OU preferred alternative to ensure that the remedy remains protective of human health and the environment. The institutional controls prescribed by the preferred alternative will be implemented in accordance with Section 3.2 of the LUCAP. This includes compliance with SRS's Site Use and Site Clearance Programs, which restrict invasive and permanent installation activities at the waste unit.

In the long term, if the property is ever transferred to nonfederal ownership, the U.S. Government will take those actions necessary pursuant to Section 120(h) of CERCLA. Those actions will include a deed notification disclosing former waste management and disposal activities as well as remedial actions taken on the OU. The deed notification shall, in perpetuity, notify any potential purchaser that the property has been used for the management and disposal of waste. These requirements are also consistent with the intent of the RCRA deed notification requirements at final closure of a RCRA facility if contamination remains at the OU.

The deed shall also include deed restrictions precluding residential use of the property. However, the need for these deed restrictions may be reevaluated at the time of transfer in the event that exposure assumptions differ and/or the residual contamination no longer poses an unacceptable risk under residential use. Any reevaluation of the need for the deed restrictions will be done through an amended ROD with USEPA and SCDHEC review and approval.

In addition, if the site is ever transferred to nonfederal ownership, a survey plat of the OU will be prepared, certified by a professional land surveyor, and recorded with the appropriate county recording agency.

Based on information currently available, USDOE, USEPA, and SCDHEC believe the preferred alternative provides the best balance of tradeoffs among the other alternatives with respect to the evaluation criteria. The three parties expect the preferred alternative to satisfy the statutory requirements in CERCLA Section 121(b) to (1) be protective of human health and the environment, (2) comply with ARARs, (3) be cost-effective, (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable, and (5) satisfy the preference for treatment as a principal element.

This SB/PP provides for involvement with the community through a document review process and a public comment period. As previously discussed, public input will be documented in the Responsiveness Summary. The preferred alternative can change in response to public comment or new information. To submit written or oral comments, please refer to Section II.

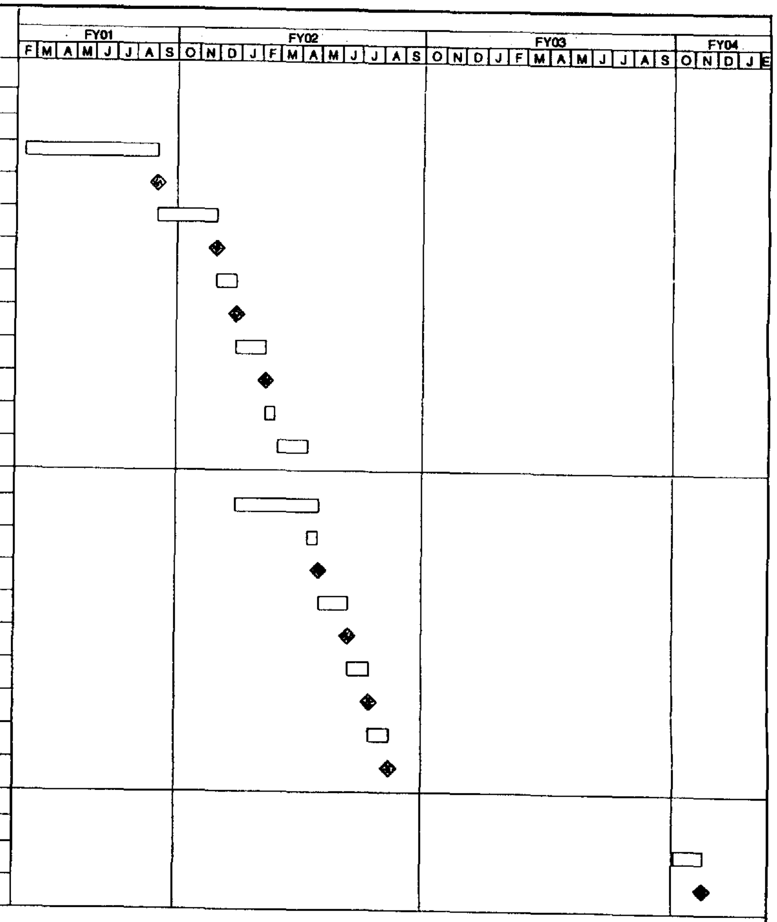
IX. POST-ROD SCHEDULE

Table 5 is an implementation schedule for the OU showing the ROD date, post-ROD document submittals, and the remedial action start date. The ROD will be drafted after receipt of, and response to, public and regulatory comments on this SB/PP. The Revision 0 ROD is scheduled for submittal to USEPA and SCDHEC for review in April 2002. The final ROD, which responds to regulatory agency comments, is scheduled for approval and issuance in August 2002.

After the ROD is signed, SRS will submit a Corrective Measures Implementation/ Remedial Action Implementation Plan (CMI/RAIP) to USEPA and SCDHEC. The remedial action start is anticipated to be November 2003. SRS will submit a post-construction report 90 days after construction is complete.

Table 5. Implementation Schedule

Activity ID	Activity Description	Orig Dur	Early Start	Early Finish
CA 1221 P-AREA B/R/P (131-P)				
LCS 14 - STATEMENT OF BASIS/PROPOSED PLAN & ROD				
STATEMENT OF BASIC/PROPOSED PLAN				
BJP0500881	DEVELOP SB/PP	138	15FEB01	31AUG01
BJP0500907	SUBMIT REV. 0 SB/PP	0		31AUG01
BJP0500882	EPA/SCDHEC REVIEW OF REV.0 SB/PP	87	01SEP01	26NOV01
BJP0500883	EPA/SCDHEC RETURNS REV.0 COMMENTS	0		26NOV01
BJP0500880	SRS INCORPORATE EPA/SCDHEC COMMENTS ON SB/PP	30	27NOV01	26DEC01
BJP0500900	SRS SUBMITTAL OF REV.1 SB/PP	0		26DEC01
BJP0500920	EPA/SCDHEC FINAL REVIEW AND APPROVAL	44	27DEC01	08FEB02
BJP0500940	RECEIPT OF EPA/SCDHEC OF REV.1 SB/PP APPROVAL	0		08FEB02
BJP0500960	NOTIFICATION OF PUBLIC COMMENT	14	09FEB02	22FEB02
BJP0500962	PUBLIC COMMENT PERIOD	45	28FEB02	13APR02
RECORD OF DECISION				
BJP0500909	DEVELOP REV.0 ROD	86	26DEC01*	29APR02
BJP0500963	RESPONSIVENESS SUMMARY	14	14APR02	27APR02
BJP0501050	SUBMIT REV. 0 ROD	0		29APR02
BJP0501055	EPA/SCDHEC REVIEW OF REV.0 ROD	45	30APR02	13JUN02
BJP0501056	EPA/SCDHEC RETURNS REV.0 COMMENTS FOR ROD	0		13JUN02
BJP0501135	SRS INCORPORATES EPA/SCDHEC COMMENTS ROD	30	14JUN02	13JUL02
BJP0501060	SRS SUBMITTAL OF REV.1 ROD	0		13JUL02
BJP0501040	EPA/SCDHEC FINAL REVIEW AND APPROVAL OF ROD	30	14JUL02	12AUG02
BJP0501020	SUBMIT SIGNED ROD TO EPA/SCDHEC	0		12AUG02
LCS 16 - REMEDIAL ACTION IMPLEMENTATION				
BJP0501355	MOBILIZATION	30	03OCT03	13NOV03
BJP0501360	REMEDIAL ACTION (RA) START DATE	0	14NOV03	



Start Date	01OCT92
Finish Date	12APR10
Data Date	01SEP99
Run Date	21FEB02 14:52

Early Bar
Progress Bar
Critical Activity

IMPL - BJPC Sheet 1 of 1

Environmental Restoration
CA 1221 P-AREA IHMU (131-P)
RCRA/CERCLA Implementation Schedule

Date	Revision	Checked	Approved
17DEC01	Extend Rev. 0 ROD, Sign ROD, and RA Start Milestone for PBRP.		
11FEB02	Extend EPA/SCDHEC Final Review and Approval	[signature]	[signature]

REFERENCES

FFA, 1993. *Federal Facility Agreement for the Savannah River Site*, Administrative Docket No. 89-05-FF, WSRC-OS-94-42, Effective Date: August 16, 1993.

Bumpus, D. and Garner, J., 1994. *Threatened, Endangered and Sensitive Species Listing 1994, Savannah River Forest Station Site 6, P-Area Bingham Pump Outage Pit (Waste Site #36)*, United States Department of Agriculture, Savannah River Forest Station, Savannah River Site, Aiken, South Carolina.

USDOE, 1994. *Public Involvement, A Plan for Savannah River Site*. United States Department of Energy, Savannah River Operations Office, Aiken, South Carolina.

USDOE, 1996a. *Savannah River Site: Future Use Project Report*, Stakeholder Recommendations for SRS Land and Facilities. January 1996. Cover letter: Fiori, Mario P., "SRS Future Use Project Report (Reference: Transmittal of Final Draft "Forging the Missing Link: A Resource Document for Identifying Future Use Options," Grumbly/Pearlman letter, 1-12-94)", United States Department of Energy Letter EB-96-015, Savannah River Site, Aiken, South Carolina 29808 (January 29).

USDOE, 1996b. *Preliminary Background Soils Study Report*, Revision 0, United States Department of Energy, Savannah River Operations Office, Environmental Restoration Division (November).

WSRC, 1994. *Investigation-Derived Waste Management Plan*, WSRC-RP-94-1227, Rev. 2, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina.

WSRC, 1999. *Land Use Control Assurance Plan for the Savannah River Site*, WSRC-RP-98-4125, Rev. 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina (August).

WSRC, 2001. *RFI/RI/BRA for the P-Area Burning/Rubble Pit (131-P)*, WSRC-RP-98-4174, Rev. 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina (April).

GLOSSARY

Administrative Record File: A file that is maintained, and contains all information used to make a decision on the selection of a response action under the Comprehensive Environmental Response, Compensation and Liability Act. This file is to be available for public review, and a copy is to be established at or near the site, usually at one of the information repositories. Also, a duplicate file is held in a central location, such as a regional or state office.

ARARs: Applicable or Relevant and Appropriate Requirements. Refers to the federal and state requirements that a selected remedy will attain. These requirements may vary from site to site.

Baseline Risk Assessment: Analysis of the potential adverse health effects (current or future) caused by hazardous substance release from a site in the absence of any actions to control or mitigate these releases.

Characterization: The gathering, identification, and compilation of data about the waste units to determine the rate and extent of contaminant migration resulting from the waste site, and the concentration of any contaminants that may be present.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 1980: A federal law passed in 1980 and modified in 1986 by the Superfund Amendments and Reauthorization Act. The Acts created a special tax that goes into the Trust Fund, commonly known as Superfund, to investigate and clean up abandoned or uncontrolled hazardous waste sites.

Corrective Action: A USEPA requirement to conduct remedial procedures under RCRA 3998(h) at a facility when there has been a release of hazardous waste or constituents into the environment. Corrective action may be required beyond the facility boundary and can be required regardless of when the waste was placed at the facility.

Exposure: Contact of an organism with a chemical or physical agent. Exposure is quantified as the amount of the agent available at the exchange boundaries of the organism (e.g., skin. lungs, digestive tract, etc.) and available for absorption.

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

Hazardous Waste: A subset of solid wastes that pose substantial or potential threats to public health or the environment and meet any of the following criteria identified in 40 CFR 260 and 261: (1) is specifically listed as a hazardous waste by USEPA, (2) exhibits one or more of the characteristics of hazardous waste (ignitability, corrosivity, reactivity, and/or toxicity), or (3) is generated by the treatment of hazardous waste, or is contained in a hazardous waste.

Hazard Quotient/Hazard Index: The hazard quotient (HQ) is used to express the risk of adverse non-carcinogenic effects from constituent exposure. The HQ is the ratio of the estimated chronic daily intake of a constituent to the reference dose (RfD). RfDs are reported as chemical intakes (mg/kg-day) and are the toxicity values used most often in evaluating noncarcinogenic effects on human health. The RfDs are developed by the USEPA and are defined as estimates of a daily exposure level for the human population, including sensitive subpopulations, that are likely to be without an appreciable risk of deleterious effects during a lifetime. The constituent-specific HQs are summed for each environmental medium and exposure pathway to obtain the Hazard Index (HI). After individual pathway risks are calculated, HIs may be combined across pathways to estimate total unit risk for each receptor. An HI greater than 1.0 has been defined by the USEPA as the level of potential concern for adverse noncarcinogenic health effects.

Integrator Operable Unit (IOU): IOUs are defined as surface water bodies (e.g., SRS streams, Savannah River) and associated wetlands, including the water, sediment, and related biota. These surface water bodies are referred to as IOUs because they represent the integration of potential contamination discharged to surface water or migrating through groundwater from source OUs, Site Evaluation Areas, National Pollutant Discharge Elimination System outfalls, and operational facilities to points of potential receptor exposure.

Media: A pathway through which contaminants are transferred. Five media by which contaminants may be transferred are groundwater, soil, surface water, sediments, and air.

National Priorities List (NPL): USEPA's formal list of the nation's most serious uncontrolled or abandoned waste sites, identified for possible long-term remedial response, as established by CERCLA.

Operable Unit (OU): A discrete action taken as one part of an overall site cleanup. The term is also used in USEPA guidance documents to refer to distinct geographic areas or media-specific units within a site. A number of OUs can be used in the course of a cleanup.

Operation and Maintenance (O&M): Activities conducted at a site after a response action occurs to ensure that the cleanup and/or systems are functioning properly.

Overall Protection of Human Health and the Environment: The assessment against this criterion describes how the alternative, as a whole, achieves and maintains protection of human health and the environment.

Principal Threat Source Material (PTSM): PTSM are those materials that have a high toxicity or mobility and cannot be reliably contained or present significant risk to human health or the environment. They include liquids (e.g., drummed wastes, waste in lagoons or tanks, or free product floating on or under groundwater) and other highly mobile materials (e.g., materials that are released from surface soil due to volatilization, leaching, or surface runoff), or materials having high concentrations of toxic compounds. A threshold concentration level for defining principal threat has not been established. However, general guidance is to consider treatment alternatives for source materials where the combined toxicity and mobility pose a potential risk of 10^{-3} or greater.

In this study, PTSM toxicity threshold criteria were determined by adjusting industrial RBCs/RBAs to risk levels of 1×10^{-3} (or HQs of 100 for noncarcinogens). The industrial soil RBCs/RBAs were selected because the anticipated future land use scenario for the PBRP is limited use with restrictions similar to an industrial zone. Because RBCs/RBAs are based on a risk level of 1×10^{-6} (for carcinogens and radionuclides) or a hazard quotient (HQ) of 1 (for noncarcinogens), the toxicity threshold criteria were adjusted for risk levels of 1×10^{-3} or HQs of 100 by multiplying the RBC for carcinogens by 1,000, the RBC for noncarcinogens by 100, and the RBA for radionuclides by 1,000. For lead, the toxicity threshold concentration is established as ten times the US EPA action level of 400 mg/kg. For PCBs, the toxicity threshold concentration is the TSCA threshold for regulating PCB waste (50 mg/kg). None of the detected constituents at PBRP are present in concentrations that exceed these PTSM threshold criteria, so there is no PTSM at this unit.

Proposed Plan: A legal document that provides a brief analysis of remedial alternatives under consideration for the site and proposes the preferred alternative. It actively solicits public review and comment on all alternatives under consideration.

Record of Decision (ROD): A legal document that explains to the public which remedial cleanup alternative will be used at a site. The Record of Decision is based on information and technical analysis generated during the Remedial Investigation /Baseline Risk Assessment/ Feasibility Study and consideration of public comments and community concerns.

Refined Constituent of Concern (RCOC): A constituent that poses an exposure risk that requires a risk management decision. Human health RCOCs have a cancer risk of at least 1×10^{-6} or a noncancer hazard of greater than or equal to 0.1. Ecological RCOCs have a hazard quotient greater than 1. Contaminant migration RCOCs are predicted to leach to groundwater above MCLs within 1,000 years.

Resource Conservation and Recovery Act (RCRA), 1976: A federal law that established a regulatory system to track hazardous substances from their generation to disposal. The law requires safe and secure procedures to be used in treating, transporting, storing, and disposing of hazardous substances. RCRA is designed to prevent the creation of new, uncontrolled hazardous waste sites.

Responsiveness Summary: A summary of oral and/or written comments received during the proposed plan comment period and includes responses to those comments. The Responsiveness Summary is a key part of the ROD, highlighting community concerns.

Solid Waste: As defined under RCRA, any solid, semi-solid, liquid, or contained gaseous material discarded from industrial, commercial, mining, or agricultural operations, or from community activities. Solid waste includes garbage, construction debris, commercial refuse, sludge from water supply or waste treatment plants, and other discarded materials.

Statement of Basis: A report describing the corrective measures/remedial actions being conducted pursuant to South Carolina Hazardous Waste Management Regulations, as amended.

Subsurface Soil: Soil that is 1 to 4 ft below land surface.

Superfund: The common name used for CERCLA; also referred to as the Trust Fund. The Superfund program was established to help fund cleanup of hazardous waste sites. It also allows for legal action to force the responsible parties for the sites to clean them up.

Surface Soil: Soil that is 0 to 1 ft below land surface.

Target Risk Range: USEPA guidance for carcinogenic risk due to exposure to a known or suspected carcinogen between one excess cancer in an exposed population of ten thousand (1×10^{-4}) and one excess cancer in an exposed population of one million (1×10^{-6}). Risks within this range require risk management evaluation of remedial action alternatives to determine if risks can be reduced below one excess cancer in a million (1×10^{-6}). Risks greater than 1×10^{-4} indicate that remedial action is generally warranted.

TSCA Waste: TSCA wastes are individual chemical wastes (either liquid or solid), such as polychlorinated biphenyls (PCBs), which are regulated by the Toxic Substance Control Act (TSCA).

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APPENDIX A

DEVELOPMENT AND EVALUATION OF ALTERNATIVES

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A.1 RFI/RI/BRA Findings

An RFI/RI was performed to determine the nature and extent of contamination and the media of concern associated with the PBRP OU (which consists of the PBRP, a small drainage ditch proximal to the pit, a seepline along an embankment of Steel Creek, a segment of Steel Creek, and groundwater subunits). The results of the field investigations and sampling analyses concluded that constituents warranting remediation, or RCOCs, are present in two of the five subunits of the OU: PBRP and groundwater. The RFI/RI/BRA determined that there is no problem warranting action for the ditch or seepline. Steel Creek is contaminated, but by an upgradient source unrelated to the PBRP OU; Steel Creek is being evaluated separately under the Steel Creek IOU.

At PBRP, health risk calculations indicate benzo(a)pyrene would pose an unacceptable risk to a current on-unit worker (carcinogenic risks of up to 1×10^{-6} for a current on-unit worker equal the benchmark level of 1×10^{-6}). Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-c,d)pyrene would pose an unacceptable risk to a future industrial worker (carcinogenic risks of up to 5×10^{-4} for a future industrial worker exceed the benchmark level of 1×10^{-6}). If future land use is unrestricted, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-c,d)pyrene, phenanthrene, and pyrene would pose an unacceptable risk to a future on-unit resident (carcinogenic risks of up to 2×10^{-3} and noncarcinogenic hazard quotients of up to 0.16 for a future on-unit resident exceed the benchmark levels of 1×10^{-6} and 0.1, respectively). Ecological risk calculations indicate that no constituents at PBRP pose an unacceptable risk to ecological receptors. Contaminant fate and transport analyses indicate that antimony, chromium, copper, nickel, zinc, dibenzofuran, tetrachloroethene, trichloroethene, and PCB-1242 present a contaminant migration (leachability) threat to groundwater. These constituents are predicted to exceed MCLs or RBCs within 1,000 years.

In groundwater, detections are low and sporadic, and there is no defined plume. 1,1-Dichloroethene and trichloroethene have been detected sporadically above MCLs in the groundwater.

A.2 Remedial Action Objectives (RAOs)

Based on the RFI/RI/BRA report (WSRC 2000a), RAOs are identified for the subunits that require remedial action (PBRP and groundwater). The RAOs for the contaminated soil and debris at PBRP are:

- Protect current workers at PBRP from exposure to benzo(a)pyrene in surface soil at concentrations that exceed target risk levels.
- Protect hypothetical future industrial workers at PBRP from exposure to PAHs in surface and subsurface soils at concentrations that exceed target risk levels.

The RAOs for groundwater are:

- Protect hypothetical future industrial workers at PBRP from exposure to 1,1-dichloroethene and trichloroethene in groundwater at concentrations that exceed target risk levels.

- Protect groundwater resources from contaminant migration of antimony, chromium, copper, nickel, zinc, dibenzofuran, tetrachloroethene, trichloroethene, and PCB-1242 in PBRP soil that would impact the groundwater above MCLs or RBCs.

A.3 General Response Actions (GRAs)/Technologies

GRAs are those media-specific actions that will satisfy the RAOs. With the exception of No Action, each GRA identified attains at least one RAO. GRAs are identified based on review of the RAOs and remedies that have been used in the past for waste sites similar to this OU. Separate GRAs are identified for PBRP and groundwater, as the impacted media (soil and water) are different for the two subunits.

A.3.1 PBRP

GRAs/technologies identified for PBRP include No Action, Institutional Controls, Containment, In-situ Treatment, and Removal/Disposal (Excavation of soil/debris, and Extraction of VOCs).

No Action. This GRA is required by 40 CFR 300.430(e)(6) to serve as a baseline for comparison with other remedial actions. No Action does not include any effort to monitor, remove, treat, or otherwise mitigate the potential spread of contamination. Contaminant reduction is achieved through natural attenuation. This response action takes no measures to reduce the potential for exposure to contaminants. The only cost associated with this response is the Five-Year Review Requirement, a ROD review every five years, to determine if RAOs are being met. The No Action response action can be readily implemented and represents the least expensive alternative possible.

Institutional Controls. Institutional controls are administrative measures taken to minimize the potential for human exposure. Such controls currently limit public access to the unit (e.g., controlled site access) and warn site workers (e.g., RCRA/CERCLA unit postings).

Containment. Containment involves construction of an engineered barrier to isolate wastes. When properly constructed and maintained, containment technologies can provide a reliable and effective method for controlling direct exposure to waste and minimizing contaminant transport through leaching, erosion, and/or bio-uptake. Examples of technologies in this GRA include low permeability covers and containment cells.

In-situ Treatment. In-situ treatment technologies treat contaminated media in place. In-situ treatment technologies generally involve physical, chemical, and/or biological treatment processes that immobilize contaminants or reduce contaminant concentrations in soil. Relative to comparable ex-situ treatment technologies, in-situ remedial technologies have the advantages of minimal handling of contaminated media, lower capital cost, and lower remedial worker exposure. Examples of technologies in this GRA include in-situ stabilization (grouting or chemical fixation) and in-situ biological treatment.

Removal/Disposal: *Excavation*. This GRA involves the removal of contaminated material (soil/debris) by excavation for either treatment or disposal, or both. Material is excavated using conventional earth-moving equipment (e.g., a backhoe). The extent of excavation of contaminated soil is based on the RG. Dust suppression is required to minimize fugitive dust and ensure compliance with air discharge regulations. Following removal, the waste is treated (e.g., by soil washing, chemical oxidation/reduction, or chemical extraction) and/or disposed, and the excavation is backfilled and restored.

Removal: *Extraction of VOCs*. This GRA involves the removal of VOCs in soil by passive soil vapor extraction. A BaroBalls™ is a simple valve that opens and closes based on differences between atmospheric and soil gas pressures, allowing gas to flow from a well to the atmosphere. A BaroBalls™ increases the effectiveness of barometric pumping by preventing the inflow of air into a venting well when atmospheric pressure reverses, a condition that can reduce contaminant removal by diluting and dispersing the pollutant.

A.3.2 Groundwater

GRAs/technologies identified for PBRP include No Action, Monitoring and Reporting, In-situ Treatment, and Removal/Ex-Situ Treatment.

No Action. This GRA is required by 40 CFR 300.430(e)(6) to serve as a baseline for comparison with other remedial actions. No Action does not include any effort to monitor, remove, treat, or otherwise mitigate the potential spread of contamination. Contaminant reduction is achieved through natural attenuation. This response action takes no measures to reduce the potential for exposure to contaminants. The only cost associated with this action is for the Five-Year Review Requirement. The No Action response action can be readily implemented and represents the least expensive alternative possible.

Monitoring and Reporting. Monitoring and reporting consists of periodic sampling of monitoring wells. Sampling reduces uncertainty with the evolution of groundwater quality over time. This GRA relies on natural processes to attenuate contaminants. Natural processes may reduce contaminant mass (through destructive processes such as biodegradation and chemical transformations); reduce contaminant concentrations (through simple dilution or dispersion); or bind contaminants to soil particles so the contamination does not spread or migrate very far (adsorption). There is no discernable contaminant plume at the PBRP OU nor is one anticipated to develop. Because contaminant concentrations in groundwater are low, monitoring and reporting can verify that the concentrations remain low and can track contamination as it attenuates through natural processes. Natural processes may achieve unit-specific remedial objectives within a time frame that is reasonable compared to that offered by other more expensive remediation approaches. Monitoring and reporting can be used to confirm that contaminants are attenuating at rates consistent with meeting cleanup goals. If contaminant concentrations increase, monitoring and reporting can be used to trigger a more aggressive response action.

In-Situ Treatment. In-situ treatment allows groundwater to be treated without being brought to the surface, resulting in significant cost savings compared to removal/ex-situ treatment technologies. In-situ treatment, however, generally requires longer time periods, and there is less certainty about the uniformity of treatment because of the variability in aquifer characteristics and because the efficacy of the process is more difficult to verify. Examples of in-situ treatment technologies that are potentially viable for the types of contaminants at this OU include in-situ biological treatment technologies such as enhanced biodegradation and phytoremediation, and in-situ physical/chemical treatment technologies such as air sparging and passive treatment walls.

Removal/Ex-Situ Treatment. Removal/ex-situ treatment technologies, or "pump and treat" technologies, generally require shorter time periods than in-situ treatment technologies, and there is more certainty about the uniformity of treatment because of the ability to monitor and continuously mix the groundwater. However, ex-situ treatment requires pumping of groundwater, leading to increased costs and engineering for equipment, possible permitting, and material handling. Examples of removal/ex-situ treatment technologies that are potentially viable for the types of contaminants at this OU include ex-situ biological treatment technologies such as bioreactors and ex-situ physical/chemical treatment technologies such as air stripping.

A.4 Identification and Screening of Treatment Processes

The identified GRAs/technologies were screened using the criteria provided in the NCP. These criteria include effectiveness, implementability, and cost.

Effectiveness: For a technology to be effective it must achieve specified RAOs, be compatible with the contaminant characteristic and waste unit conditions, and be protective of public health and the environment. To accomplish this, the technology must effectively reduce or eliminate any short-term and long-term risk to human health or the environment directly associated with the waste unit, and must not adversely impact the environment, public health, or public welfare. Technologies for which unit contaminants or conditions clearly limit effectiveness or which do not provide adequate protection of the environment, public health, and public welfare are rejected and are not considered for detailed analysis. Additionally, technologies that have not demonstrated effectiveness at similar units are eliminated from further consideration.

Implementability: Irnplementability addresses both the technical and institutional feasibility of applying a technology. Under this criterion, technologies are evaluated based on technical feasibility, availability of resources and equipment, and administrative feasibility of implementation. The nature of the technology should be such that it can be implemented in a cost-effective and timely manner in the physical setting at the OU. In addition, implementation of the technology should not elicit substantial public concern. Site accessibility, available area, and potential future use of the property also affect the implementation of certain technologies. Mobilization and permitting requirements, where applicable, must be workable and must have been demonstrated previously at equivalent projects. Preliminary consideration is also given to regulatory constraints such as handling, disposal, and treatment requirements that affect the implementation of certain remedial technologies. These considerations are evaluated further during detailed analysis for retained technologies when action-specific ARARs are developed. Technologies that are not technically or administratively feasible are removed from further consideration.

Cost: A qualitative cost evaluation is provided so that cost comparisons can be made among technologies. Technology costs are described as being high, medium, or low, relative to technologies of similar type (e.g., process options within a GRA). Qualitative evaluations, which consider capital costs and operation and maintenance costs, are based upon prior estimates, previous experience, and engineering judgement. Technologies that provide comparable levels of applicability, effectiveness, and implementability at significantly greater cost are eliminated. Similarly, technologies that are comparable in cost but are clearly less effective than other retained technologies are also rejected.

Table A-1 summarizes the results of the identification and screening of the GRAs/treatment technologies.

A.5 Development of Alternatives

After screening, the retained GRAs/technologies are combined to develop the remediation alternatives. Because USDOE, USEPA, and SCDHEC agreed the problem warranting action and scope of the problem was well-defined, and because they agreed there are a limited range of appropriate response actions, the number of alternatives is small. Two alternatives are identified for PBRP, and two alternatives are identified for groundwater. The alternatives are briefly described below.

A.5.1 PBRP

Alternative PBRP1: No Action. The No Action alternative is required by NCP as a baseline for comparison with other remediation alternatives. No Action would consist of no remedial activities at PBRP. Institutional controls would not be implemented. The Five-Year Review Requirement, a CERCLA ROD review, would be conducted every five years to determine whether the remedy is meeting RAOs.

Alternative PBRP2: Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls. Under this alternative, an engineered cover (hydraulic conductivity of approximately 10^{-5} cm/sec) would be emplaced over the pit to reduce infiltration and associated leaching. The cover would also provide a barrier between human receptors and the buried human health RCOCs. Contaminant fate and transport calculations indicate that an engineered soil cover would provide sufficient infiltration control to prevent inorganics and PCBs from leaching to groundwater above MCLs/RBCs within 1,000 years. As long as biodegradation and volatilization are occurring, it would also prevent VOCs and SVOCs from migrating to groundwater above MCLs/RBCs. There is evidence for biodegradation at the unit because sampling during the RFI/RI confirmed the presence of organic biodegradation products at the unit. Volatilization of organics to the atmosphere (via soil gas) is occurring through natural processes under current baseline conditions. However, if a low permeability cover were to be placed, volatilization would be reduced by the cover. A soil vapor extraction system such as the BaroBalls™ system would need to be constructed in order to offset reduced volatilization due to the low permeability cover.

Institutional Controls would be implemented. Institutional controls would consist of site maintenance (repair of erosion damage, cover maintenance, and warning signs) and site controls (SRS Site Use and Site Clearance Programs). Site maintenance would consist of maintenance of drainage features to minimize the formation of large gullies and minor earthwork to repair any erosion damage that may occur. Site maintenance would also include maintaining signs around PBRP. Access controls would include site security measures such as warning signs. Signs would be posted around the facility with a legend warning of the hazard. They would be posted at each entrance to the restricted portion of the subunit and at other appropriate locations in sufficient numbers to be seen from any approach. Administrative controls (land use restrictions) would also be implemented to restrict human exposure to contaminants remaining at the unit. Administrative controls would prohibit residential use of the subunit. Institutional controls will maintain the integrity of the engineered soil cover, which will in turn maintain the effectiveness of the cover to mitigate waste leaching by limiting infiltration.

The Five-Year Review Requirement, a CERCLA ROD review, would be conducted every five years to determine whether the remedy is meeting RAOs.

A.5.2 Groundwater

Alternative GW1: No Action. No Action would consist of no remedial activities to groundwater. The No Action alternative is required by the NCP to serve as a baseline for comparison with other remedial alternatives. Contaminant attenuation would only occur through natural ongoing processes. The Five-Year Review Requirement, a CERCLA ROD review, would be conducted every five years to determine whether the remedy is meeting RAOs.

Alternative GW2: Continued Monitoring and Reporting. 1,1-Dichloroethene and trichloroethene have been detected sporadically above MCLs in the groundwater. Under this alternative, the groundwater would be monitored to verify that concentrations of 1,1-dichloroethene and trichloroethene remain consistently below MCLs and that a discernable plume does not develop. Monitoring would consist of continued sampling of selected wells and comparison of the analytical results to MCLs.

The Five-Year Review Requirement, a CERCLA ROD review, would be conducted every five years, as needed, to determine whether the remedy is meeting RAOs.

A.6 Detailed Analysis of Alternatives

A.6.1 Description of the Nine Evaluation Criteria

CERCLA specifies nine criteria that are used to evaluate remedial alternatives. These criteria are identified in 40 CFR 300.430(e)(9)(A-I). The nine criteria are divided into three categories: threshold, primary balancing, and primary modifying criteria.

Threshold Criteria

Threshold criteria are requirements that each alternative must achieve to be eligible for selection as a permanent remedy. The threshold criteria are:

1. Overall Protection of Human Health and the Environment: Each alternative is evaluated based on how it uses engineering or institutional controls to reduce the risk of exposure to contaminants from potential exposure pathways. Each alternative is evaluated as to whether or not it provides overall protection of human health and the environment, in the short-term and long-term.

2. Compliance with ARARs: Remedial actions under CERCLA are required to attain all ARARs. Applicable requirements are defined as "those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site". Relevant and appropriate requirements are defined as "those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not applicable, address problems or situations sufficiently similar to those encountered at a CERCLA site". A third category of requirements is known as TBCs. TBCs are defined as "non-promulgated advisories or guidance issued by federal or state government that are not legally binding". They may also include draft or proposed federal or state regulations.

   There are three categories of ARARs: chemical-, action-, and location-specific. Chemical-specific ARARs are usually health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes. Location-specific ARARs are restrictions placed on the concentration of hazardous substances for the conduct of activities solely because they occur in special locations. Table A-2 provides the chemical-, action-, and location-specific requirements and identify whether the requirement is applicable, relevant and appropriate, or TBC. The last column of each ARAR table indicates the alternative(s) to which the ARAR or TBC pertains.

Primary Balancing Criteria

Primary balancing criteria are factors that identify key trade-offs among alternatives. The primary balancing criteria are:

3. Long-Term Effectiveness and Permanence: Each alternative is evaluated based on the magnitude of residual risk and the adequacy and reliability of controls used to manage remaining waste after remedial objectives have been achieved. Alternatives that offer long-term effectiveness and permanence in halting or otherwise mitigating exposure or off-unit contaminant transport, and thereby minimize the need for future engineering controls, are comparatively considered as more suitable.

4. Reduction of Toxicity, Mobility, or Volume Through Treatment: The statutory preference is to select a remedial action that employs treatment to reduce the toxicity, mobility, or volume of hazardous substances. The degree to which alternatives employ recycling or treatment is assessed, including how treatment is used to address the principal threats posed by the unit.

5. Short-Term Effectiveness: This factor takes into account protection of remedial workers, members of the community, and the environment during implementation of the remedial action, and evaluates the time required to achieve clean-up goals. This factor also considers any adverse short-term impacts that may be posed to human health and the environment during implementation of the remedy.

6. Implementability: Each alternative is evaluated with respect to the technical and administrative feasibility of implementing the alternative, as well as the availability of necessary equipment and services. This criterion includes such items as the ability to obtain services, capabilities, equipment, and specialists necessary to construct components of the alternatives; the ability to operate the technologies and monitor their performance and effectiveness; and the ability to obtain necessary approvals from other agencies.

7. Cost: The present value costs of direct and indirect capital costs, as well as the operating and maintenance costs, are calculated for each alternative. The cost of any long-term liability associated with implementing the remedial alternative is also considered (where applicable). Accuracy of present worth cost estimates is +50/-30%.

Modifying Criteria

Modifying criteria are also considered during remedy selection. These criteria are assessed formally after the public review and comment period. The modifying criteria are:

8. State Acceptance: The preferred alternative should be acceptable to state and support agencies. Although SRS has worked closely with SCDHEC and USEPA during this remedial process, this criterion cannot be fully considered until the agency review has been conducted and the regulatory agencies have approved the SB/PP.

9. Community Acceptance: Community concerns are considered when selecting alternatives. This criterion cannot be fully considered until formal public comments on the SB/PP have been received during the public comment period and addressed in a Responsiveness Summary (which is included in the ROD).

A.6.2 Individual Analysis of Alternatives

Tables A-3 and A-4 present an assessment of the alternatives for the PBRP and groundwater subunits, respectively, against the nine CERCLA criteria. This assessment is discussed below.

A.6.2.1 PBRP

Alternative PBRP1 - No Action

Overall Protection of Human Health and the Environment: No Action is not protective of human health and the environment. Exposure to human health RCOCs remaining at the unit would not be restricted, which would pose unacceptable risks to current workers, future industrial workers, and hypothetical future residents. Also, CM RCOCs would remain at the unit under current conditions and would pose an unacceptable threat to groundwater. Further, erosion of pit soils could spread contamination.

Compliance with ARARs: No Action would not comply with ARARs including 40 CFR 141 and SC R.61-58.5. Contaminant migration modeling indicates that contaminants may leach to groundwater above MCLs.

Long-Term Effectiveness and Permanence: No Action does not offer long-term effectiveness because the magnitude of residual risks would be unacceptable: there would be no change in the residual risks compared to current conditions. Assessment of permanence is not applicable because No Action would not meet the RAOs and there are no remedy components to fail.

Reduction in Toxicity, Mobility, or Volume through Treatment: No Action offers no reduction in the toxicity, mobility, or volume of contamination. There would be no change from existing conditions.

Short-Term Effectiveness: No Action does not provide short-term effectiveness because RAOs are not achieved. Because there are no remedy components, actual implementation would not pose a risk to remedial workers or the community.

Implementability: No Action is readily implementable because there are no remedy components to implement. The Five-Year Review Requirement (review of the ROD) is a standard administrative procedure.

Cost: The cost for No Action is $32,000. This is the present worth cost to perform the Five-Year Review Requirement for 30 years.

Alternative PBRP2 – Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls

Overall Protection of Human Health and the Environment: Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls is protective of human health and the environment. The cover system would provide a barrier between human receptors and the buried human health RCOCs and would reduce infiltration and associated leaching of CM RCOCs. Contaminant fate and transport calculations indicate that an engineered soil cover would provide sufficient infiltration control to prevent inorganics and PCBs from leaching to groundwater above MCLs/RBCs within 1,000 years. As long as biodegradation and volatilization are occurring, it would also prevent VOCs and SVOCs from migrating to groundwater above MCLs/RBCs. There is evidence for biodegradation at the unit because sampling during the RFI/RI confirmed the presence of organic biodegradation products at the unit. Volatilization of organics to the atmosphere (via soil gas) is occurring through natural processes under current baseline conditions. However, if a low permeability cover were to be placed, volatilization would be reduced by the cover. A soil vapor extraction system such as BaroBalls™ would need to be constructed in order to offset reduced volatilization due to the low permeability cover. A BaroBalls™ is a simple valve that opens and closes based on differences between atmospheric and soil gas pressures, allowing gas to flow from a well to the atmosphere. A BaroBalls™ increases the effectiveness of barometric pumping by preventing the inflow of air into a venting well when atmospheric pressure reverses, a condition that can reduce contaminant removal by diluting and dispersing the pollutant. Covering the contaminated soils and site maintenance would mitigate threat of redistribution of pit soils by erosion. Institutional controls would protect against unrestricted land use (e.g., unauthorized excavation).

Compliance with ARARs: Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls would comply with ARARs. There are no constituents above standards. Action-specific ARARs would be met using standard construction practices (e.g., dust suppression and erosion control). The cover system would prevent leaching of contaminants to the groundwater above MCLs.

Long-Term Effectiveness and Permanence: Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls offers long-term effectiveness and permanence. The residual risk associated with this alternative would be less than the target risk range. The cover would isolate PAHs from exposure. The cover would also reduce leaching of metals, SVOCs, and PCBs so that they would not exceed MCLs/RBCs in groundwater. BaroBalls™ would allow VOCs to be released to the atmosphere instead of migrating to groundwater. Institutional Controls would prevent unauthorized land use. It is a permanent remedy in that the remedy components will not fail to perform as designed as long as the cover is maintained. VOCs would be permanently removed from the unit. Land use controls are generally considered permanent, but there is some uncertainty with the ability to maintain them in the very long-term (>100 years).

Reduction in Toxicity, Mobility, or Volume through Treatment: Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls would not offer reduction in toxicity, mobility, or volume through treatment. However, an engineered cover system with BaroBalls™ reduces mobility of CM RCOCs in the vadose zone through containment, and toxicity is reduced through isolation under the cover. Also, removal of VOCs to the atmosphere reduces the mobility of VOCs to groundwater.

Short-Term Effectiveness: Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls is effective in the short-term. Although an engineered cover system with BaroBalls™ presents some minor risks associated with heavy equipment use, the exposure risks to workers performing the remedial activities can be managed using standard health and safety procedures for work in contaminated areas. There are no exposure concerns for the general public, as the OU is located in the interior of SRS, a secured government facility. Release of VOCs through the BaroBalls™ wells to the atmosphere presents negligible risk to workers or the community because the concentrations are low and will be readily dispersed to concentrations below detection limits. Once in the atmosphere, VOCs are rapidly broken down into harmless components by natural processes.

Implementability: Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls is implementable. An Engineered Cover System with BaroBalls™ will require periodic inspections and routine maintenance associated with institutional controls, such as repair of erosion and subsidence of the cover, but there are no implementability restrictions. The Five-Year Review Requirement (review of the ROD) is a standard administrative procedure.

Cost: The present worth cost for Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls is $526,000. This is the cost to implement an engineered cover system ($308,000), install BaroBalls™ ($72,000), maintain institutional controls for 30 years ($114,000), and perform the Five-Year Review Requirement for 30 years ($32,000).

A.6.2.2 Groundwater

Alternative GW1 - No Action

Overall Protection of Human Health and the Environment: No Action is not protective of human health and the environment. Groundwater contamination above MCLs would be left unmonitored and it would be unknown if the groundwater contamination attenuated.

Compliance with ARARs: No Action would not comply with ARARs. No Action would not comply with the SDWA.

Long-Term Effectiveness and Permanence: The long-term effectiveness of No Action is uncertain, because the magnitude of residual risks in the long-term would be unknown if monitoring was not performed. Assessment of permanence is not applicable because No Action would not achieve RAOs.

Reduction in Toxicity, Mobility, or Volume through Treatment: No Action offers no reduction through treatment. However, toxicity and volume would decrease with time through natural processes, including biodegradation.

Short-Term Effectiveness: The short-term effectiveness is unknown because without monitoring it would be unknown when protection is achieved. Because there are no remedy components, implementation would not pose a risk to remedial workers or the community.

Implementability: No Action is readily implementable because there are no remedy components to implement. The Five-Year Review Requirement (review of the ROD) is a standard administrative procedure.

Cost: The present worth cost for No Action is $32,000. This is the cost to perform the Five-Year Review Requirement (review of the ROD) for 30 years. Note, however, that for completeness in the comparative analysis, this cost is also included in the cost estimates for the PBRP source unit, even though this is an OU-wide cost that would not be duplicated for both the PBRP and groundwater subunits.

Alternative GW2 – Continued Monitoring and Reporting

Overall Protection of Human Health and the Environment: Continued Monitoring and Reporting is protective of human health and the environment. Monitoring would track the groundwater quality.

Compliance with ARARs: Continued Monitoring and Reporting should eventually comply with ARARs; monitoring would evaluate RCOC concentrations for compliance with the SDWA.

Long-Term Effectiveness and Permanence: Continued Monitoring and Reporting offers long-term effectiveness and permanence. After natural processes have attenuated the contamination, residual risks would be indistinguishable from background risks, and there would be no remedy components to fail. Monitoring would confirm that residual risks remain low. Continued Monitoring and Reporting is permanent in that once RGs are met, the concentrations are expected to remain below MCLs; an increase in concentrations above MCLs is not anticipated.

Reduction in Toxicity, Mobility, or Volume through Treatment: There would be no reduction through treatment, but toxicity and volume would decrease with time through natural processes, including biodegradation.

Short-Term Effectiveness: Continued Monitoring and Reporting is effective in the short-term. There is negligible exposure risk to workers performing the remedial activities (installation and sampling of CPTs/monitoring wells). There are no exposure concerns for the general public, as the OU is located in the interior of SRS, a secured government facility.

Implementability: Continued Monitoring and Reporting is implementable. The techniques for monitoring and reporting are well understood. Monitoring would be required until concentrations are consistently below standards. The Five-Year Review Requirement (review of the ROD) is a standard administrative procedure.

Cost: The total present worth cost for Continued Monitoring and Reporting is $49,000. The cost to perform monitoring and reporting is $17,000. The cost to perform the Five-Year Review Requirement is $32,000. Note, however, that for completeness in the comparative analysis, the cost for the Five-Year Review Requirement is also included in the cost estimates for the PBRP source unit, even though this is an OU-wide cost that would not be duplicated for both the PBRP and groundwater subunits.

A.6.3 Comparative Analysis of Alternatives

In this section, the alternatives are evaluated against each other in context of the nine CERCLA criteria.

A.6.3.1 PBRP

Overall Protection of Human Health and the Environment: Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls would be protective because human health RCOCs would be covered to prevent exposure, infiltration and leaching of CM RCOCs would be reduced enough to prevent groundwater from being impacted above MCLs/RBCs in the future, and covering of contaminated soils would mitigate erosion and redistribution of pit soils. No Action is not protective because human health RCOCs (PAHs) would remain at the unit in surface and subsurface soils and would pose an unacceptable risk to current workers, future industrial workers, and hypothetical residents. Also, CM RCOCs would remain at the unit under current conditions and would pose a leachability threat to groundwater. Further, erosion of pit soils could spread contamination.

Compliance with ARARs: Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls would comply with ARARs. The cover system would comply with 40 CFR 141 and SC R.61-58.5 by preventing leaching to the groundwater above MCLs. No Action would not comply with these regulations because leaching may impact groundwater above MCLs.

Long-Term Effectiveness and Permanence: Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls offers greater long-term effectiveness compared to No Action. Whereas the residual risk associated with No Action would be the same as current conditions, the residual risk associated with Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls would be less than the target risk range. The risk from RCOCs would be mitigated by isolation of contaminated soils under the cover, and the leachability risk would be mitigated by infiltration control. An assessment of permanence for No Action is not applicable because RAOs are not met. Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls is permanent as long as the cover system is maintained. If the cover system was not maintained and erosion of the cover were to occur, the remedy would gradually become less effective.

Reduction of Toxicity, Mobility, or Volume: Neither alternative offers reduction in toxicity, mobility, or volume *through treatment*. However, Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls reduces toxicity in surface and subsurface soils and mobility in the vadose zone through containment.

Short-Term Effectiveness: Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls offers greater short-term effectiveness compared to No Action because Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls is the only alternative that achieves protection. No Action does not achieve RAOs and is therefore not effective. Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls presents negligible risks to remedial workers or the community. Release of VOCs through the BaroBalls™ wells to the atmosphere presents negligible risk to workers or the community because the concentrations are low and will be readily dispersed to concentrations below detection limits. Once in the atmosphere, VOCs are rapidly broken down into harmless components by natural processes.

Implementability: Both alternatives are implementable. No Action does not involve any action; therefore, it is readily implementable. Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls would require some engineering design for the cover system and periodic repairs, but there are no implementability restrictions.

Cost: No Action is less expensive than Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls.

State Acceptance: The approval of this SB/PP by SCDHEC and USEPA constitutes acceptance of the preferred alternative by the regulatory agencies.

Community Acceptance: This SB/PP provides for community involvement through a document review process and a public comment period. Public input will be documented in the Responsiveness Summary section of the ROD.

A.6.3.2 Groundwater

Overall Protection of Human Health and the Environment: Continued Monitoring and Reporting is protective because monitoring would track the attenuation of contaminants and would identify a plume in the unlikely event that a discernable plume develops. No Action is not protective because groundwater contamination above MCLs would be left unmonitored.

Compliance with ARARs: Continued Monitoring and Reporting should eventually comply with ARARs; monitoring would evaluate RCOC concentrations for compliance with 40 CFR 141 and SC R.61-58.5. No Action would not comply with the SDWA because groundwater contamination above MCLs would be left unmonitored.

Long-Term Effectiveness and Permanence: Continued Monitoring and Reporting offers greater long-term effectiveness because monitoring will reduce uncertainty with the magnitude of residual risks. An assessment of permanence for No Action is not applicable because RAOs are not met and there are no remedy components. Continued Monitoring and Reporting is permanent in that once RGs are met, the concentrations are expected to remain below MCLs; an increase in concentrations above MCLs is not anticipated.

Reduction of Toxicity, Mobility, or Volume: Neither alternative offers reduction in toxicity, mobility, or volume *through treatment*. However, reduction is expected as a result of natural processes, including biodegradation.

Short-Term Effectiveness: Continued Monitoring and Reporting offers greater short-term effectiveness compared to No Action. Although Continued Monitoring and Reporting presents some minor exposure risks to remedial workers, this is offset by the fact that the time until No Action achieves protection is unknown. Therefore, the short-term effectiveness of No Action is unknown. Risks to remedial workers performing Continued Monitoring and Reporting (groundwater sample crews) can be managed using standard health and safety measures. There are no exposure concerns for the community.

Implementability: Both alternatives are implementable. No Action does not involve any action; therefore, it is readily implementable. Continued Monitoring and Reporting is also readily implementable, as monitoring uses standard equipment and techniques.

Cost: No Action is less expensive than Continued Monitoring and Reporting.

State Acceptance: The approval of this SB/PP by SCDHEC and USEPA constitutes acceptance of the preferred alternative by the regulatory agencies.

Community Acceptance: This SB/PP provides for community involvement through a document review process and a public comment period. Public input will be documented in the Responsiveness Summary section of the ROD.

Table A-1. Screening of GRAs/Technologies Using NCP Criteria

GRA/Technology		Effectiveness	Implementability	Cost	Status	Rationale
PBRP						
No Action		Does not meet RAOs	High	Low	Retained	Required as a baseline by the NCP
Institutional Controls		Mitigates exposure by humans, but does not reduce leaching.	High	Low	Retained	Can be used in conjunction with other technologies to meet all RAOs
Containment		Effective in reducing receptor contact and leaching	High	Moderate	Retained	Effective at meeting RAOs
In-situ Treatment		Effective in reducing receptor contact and leaching	Low	High	Eliminated	Implementability restricted by debris. High cost but still would require long-term care of the waste
Removal/ Disposal	Excavation of soil/debris	Effective through removal of contaminants from unit	Moderate	High	Eliminated	Presents high costs and unnecessary risks to remedial workers
	Extraction of VOCs	Effective through removal of contaminants from unit	High	Low	Retained	Passive soil vapor extraction (BaroBalls™) is a low-cost and implementable remedy for effective removal of VOCs
Groundwater						
No Action		Effectiveness at reducing groundwater concentrations uncertain	High	Low	Retained	Required as a baseline by the NCP
Monitoring and Reporting		Effectiveness attained through attenuation	High	Low	Retained	Manages uncertainty with contaminant levels
In-Situ Treatment		Effective at reducing groundwater concentrations	Moderate	High	Eliminated	No discernable plume
Removal/ Ex-Situ Treatment		Effective at reducing groundwater concentrations	Moderate	High	Eliminated	No discernable plume

Table A-2. Potential ARARs and TBC Criteria

Citation(s)	Status	Requirement Summary	Reason for Inclusion	Alternative
Chemical				
40 CFR 141 – MCLs and MCLGs	Relevant and Appropriate	MCLs and MCLGs for groundwater that may be a source of drinking water	MCLs should generally be met for cleanup of groundwater under the CERCLA program	GW1, GW2, PBRP1, PBRP2
SC R.61-58.5 – MCLs and MCLGs	Relevant and Appropriate	MCLs and MCLGs for groundwater that may be a source of drinking water	State regulations implementing MCLs.	GW1, GW2, PBRP1, PBRP2
SC R.61-68 Water Classification	Relevant and Appropriate	States official classified water uses for all surface and groundwater in South Carolina	Mandates meeting MCLs for groundwater.	GW1, GW2, PBRP1, PBRP2
40 CFR 143.3 Secondary Drinking Water Standards	Relevant and Appropriate	Establishes levels for contaminants that affect the aesthetic qualities of drinking water.	Secondary Drinking Water Standards relevant for setting remediation levels.	GW1, GW2, PBRP1, PBRP2
40 CFR 260-268 and SC R.61-79.260-268 Federal and State Hazardous Waste Regulations	Applicable	Defines criteria for determining whether a waste is RCRA hazardous waste and provides treatment, storage and disposal requirements.	Would apply if specific chemicals are found to be present.	PBRP1, PBRP2
SC R.61-62.5 Air Quality Standard	Applicable	Establishes air quality standards for emissions.	Would apply to air emissions of Standard 2 Toxic Air Pollutants and Standard 8 Ambient Air Quality Standards.	PBRP2
SC R.61-107.16 Solid Waste Management: Industrial Solid Waste Landfills	Relevant and Appropriate	Establishes design standards for non-hazardous industrial solid waste landfills.	Would apply if contamination is left in place.	PBRP1, PBRP2
Action				
40 CFR 50.6 National Primary and Secondary Ambient Air Quality Standards	Applicable	The concentration of particulate matter (PM_{10}) in ambient air shall not exceed 50 $\mu g/m^3$ (annual arithmetic mean) or 150 $\mu g/m^3$ (24-hour average concentration).	Dust suppression will likely be required to minimize dust emissions during construction/remedial action.	PBRP2
SC R.61-62.1 Air Permit Requirements	Applicable	Requires construction and operating permits for sources of air pollution.	If remedial action creates point source of air pollutants, permits may be required.	PBRP2

Table A-2. Potential ARARs and TBC Criteria (Continued)

Citation(s)	Status	Requirement Summary	Reason for Inclusion	Alternative
Action				
SC R.61-62.6 Fugitive Dust	Applicable	Fugitive particulate material shall be controlled.	Construction/remedial action may be required for dust suppression.	PBRP2
SC R.61-9 NPDES Permits	Applicable	Requirements for control of storm water discharges.	Any storm water discharges must meet these standards.	PBRP1, PBRP2
SC R.61-71 Well Construction Standards	Applicable	Prescribes minimum standards for the construction of wells.	Standards for installation and abandonment of wells.	PBRP2, GW2
SC R.72-300 Standards for Stormwater Management and Sediment Reduction	Applicable	Stormwater management and sediment control plan for land disturbances.	Construction/remedial action may require an erosion control plan.	PBRP2

CFR = Code of Federal Regulations

SCR = South Carolina Regulations

MCLG = Maximum Contaminant Level Goal

There are no location-specific ARARs for the PBRP OU.

Table A-3. Comparative Analysis of Alternatives – PBRP

EVALUATION CRITERIA	Alternative PBRP1 No Action	Alternative PBRP2 Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls
Overall Protection of Human Health and the Environment		
Human Health	Not Protective. Human health RCOCs remaining at unit would pose an unacceptable risk to current workers, future industrial workers, and hypothetical future residents.	Protective. The cover system would provide a barrier between human receptors and the buried human health RCOCs. Institutional controls would protect against unrestricted land use (e.g., unauthorized excavation).
Environment	Not Protective. CM RCOCs remaining at unit would pose an unacceptable leachability risk to groundwater. Future leaching could impact groundwater above MCLs/RBCs. Also, erosion of pit soils could spread contamination.	Protective. The cover system would reduce infiltration and associated leaching of CM RCOCs. Although a cover can trap VOCs in the soil, BaroBalls™ would allow the VOCs to be released to the atmosphere instead of migrating downward to groundwater. Covering the contaminated soils and site maintenance would mitigate threat of redistribution of pit soils by erosion.
Compliance with ARARs		
Chemical-Specific	Does not comply with SDWA because leaching may impact groundwater above MCLs.	Complies. There are no constituents above standards (lead, PCBs, etc). The cover system would prevent leaching to groundwater above SDWA MCLs.
Location-Specific	None.	None.
Action-Specific	None.	Complies with all ARARs if standard construction practices are followed during remediation.
Long-Term Effectiveness and Permanence		
Magnitude of Residual Risks	High. PAHs would pose an unacceptable risk to current workers, future industrial workers, and future residents. Also, metals, SVOCs, VOCs, and PCBs are predicted to leach to groundwater at concentrations above MCLs/RBCs.	Low. The cover would isolate PAHs from exposure. The cover would reduce leaching of metals, SVOCs, and PCBs so that they would not exceed MCLs/RBCs in groundwater. The cover would allow more time for biodegradation to occur. BaroBalls™ would allow VOCs to be released to the atmosphere instead of migrating to groundwater. Institutional controls would prevent unauthorized land use.
Permanence	Not Applicable. Does not meet RAOs, and there are no remedy components.	Permanent as long as the cover is maintained. VOCs would be permanently removed from the unit. Land use controls are generally considered permanent, but there is some uncertainty with the ability to maintain them in the very long-term (>100 years).

Table A-3. Comparative Analysis of Alternatives – PBRP (Continued)

EVALUATION CRITERIA	Alternative PBRP1 No Action	Alternative PBRP2 Engineered Cover System with BaroBalls™, Natural Biodegradation, and Institutional Controls
Reduction in Toxicity, Mobility, or Volume Through Treatment		
Degree of Expected Reduction in Toxicity	None.	High. Toxicity reduced through isolation of contaminants. Toxicity of the cover material would be ambient background levels.
Degree of Expected Reduction in Mobility	None.	High. Mobility reduced through infiltration control and removal of VOCs.
Degree of Expected Reduction in Volume	None.	None.
Short-Term Effectiveness		
Risk to Workers	None. No onsite activity.	Negligible risk associated with heavy equipment use.
Risk to Community	None. No onsite activity.	No exposure concerns; unit is located several miles from the nearest SRS boundary. Negligible increase in off-SRS vehicular traffic.
Time until Protection is Achieved	Protection not achieved.	12-24 months after ROD is approved (time required to design and construct cover system).
Implementability		
Availability of Materials, Equipment, Contractors	No materials, equipment, or contractors required.	Construction materials and equipment are standard. Qualified contractors are available.
Administrative Feasibility/ Regulatory Requirements	None.	Some engineering work will be needed to design the cover system, but this does not pose an administrative constraint to implementation.
Technical Feasibility	Implementable. There are no remedy components to implement.	Implementable. The techniques used for capping and installation of BaroBalls™ are well understood.
Monitoring Considerations	None.	The cover system will require periodic monitoring and repair/refurbishment.
Cost		
Total Present Value Cost	Five-Year Review Requirement: $32,000	Engineered Cover System: $308,000 BaroBalls™: $72,000 Institutional Controls: $114,000 Five-Year Review Requirement: $32,000

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Table A-4. Comparative Analysis of Alternatives – Groundwater

EVALUATION CRITERIA	GW1 No Action	GW2 Continued Monitoring and Reporting
Overall Protection of Human Health and the Environment		
Human Health	Not Protective. Groundwater contamination above MCLs would be left unmonitored.	Protective. Monitoring would track the groundwater quality.
Environment	Not Protective. It would be unknown if the groundwater contamination attenuated.	Protective. Monitoring would track the groundwater quality.
Compliance with ARARs		
Chemical-Specific	Does not comply with SDWA.	Complies. Monitoring would verify compliance with the SDWA.
Location-Specific	None.	None.
Action-Specific	None.	Complies if standard practices are followed.
Long-Term Effectiveness and Permanence		
Magnitude of Residual Risks	Moderate. Although concentrations are low, there would be some uncertainty with the magnitude of residual risk if monitoring was not performed.	Low. Monitoring would confirm that residual risks remain low.
Permanence	Not Applicable. Does not meet RAOs.	Permanent in that once RGs are met, the concentrations are expected to remain below MCLs.
Reduction in Toxicity, Mobility, or Volume Through Treatment		
Degree of Expected Reduction in Toxicity	High. Toxicity would decrease with time through natural processes, including biodegradation.	High. Toxicity would decrease with time through natural processes, including biodegradation.
Degree of Expected Reduction in Mobility	None.	None.
Degree of Expected Reduction in Volume	High. The volume of groundwater contaminated above standards is expected to decrease to zero.	High. The volume of groundwater contaminated above standards is expected to decrease to zero.

Table A-4. Comparative Analysis of Alternatives – Groundwater (Continued)

EVALUATION CRITERIA	GW1 No Action	GW2 Continued Monitoring and Reporting
Short-Term Effectiveness		
Risk to Workers	None. No onsite activity.	Negligible. Negligible exposure risk during sampling managed through standard health and safety procedures.
Risk to Community	None. No onsite activity.	None. No exposure concerns; unit is located several miles from the nearest SRS boundary.
Time until Protection is Achieved	It would be unknown when protection is actually achieved.	Monitoring would establish when protection is actually achieved.
Implementability		
Availability of Materials, Equipment, Contractors	No materials, equipment, or contractors required.	Materials and equipment are standard. Qualified contractors for monitoring and reporting are available.
Administrative Feasibility/ Regulatory Requirements	None.	None.
Technical Feasibility	Implementable. There are no remedy components to implement.	Implementable. The techniques for monitoring and reporting are well understood.
Monitoring Considerations	None.	Monitoring will be required until concentrations are consistently below standards.
Cost		
Total Present Value Cost	Five-Year Review Requirement: $32,000*	Monitoring and Reporting: $39,000 Five-Year Review Requirement: $32,000*

*For consistency in the comparative analysis, the cost for the Five-Year Review Requirement is also shown with the costs for the PBRP source unit. However, this cost is an OU-wide cost that is not duplicated for each subunit.

APPENDIX B

COST ESTIMATES

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Table B-1. Cost Estimate for Five-Year Review Requirement (CERCLA ROD Reviews)

DESCRIPTION		QUANTITY	UNITS	UNIT COST	TOTAL COST
Direct Capital Costs					$0
Total Direct Capital Costs					$0
Indirect Capital Costs					
Engineering and design					$0
Project/construction management					$0
Health and safety					$0
Overhead & markups					$0
Contingency					$0
Total Indirect Capital Costs					$0
TOTAL ESTIMATED CAPITAL COSTS					$0
O&M Costs					
ROD Reviews (every five years for 30 years)		6	ea	$15,000	
Interest Rate (i)	0.07				
O&M Present Worth					$32,367
TOTAL ESTIMATED O&M COSTS					$32,367
TOTAL ESTIMATED COST					$32,367

O&M Present Worth = Sum [1/(1+i)^n_a] x periodic cost] where n_a are the years at which the periodic cost is incurred (5, 10, 15, 20, 25, & 30 yrs)

Table B-2. Cost Estimate for Institutional Controls

DESCRIPTION		QUANTITY	UNITS	UNIT COST	TOTAL COST
Direct Capital Costs					
Miscellaneous Control Items					
Documentation		1	ea	$10,000	$10,000
Final Survey		1	ea	$25,000	$25,000
Access Restrictions					
Furnish and Install Signs		15	ea	$90	$1,350
Site Controls					
Site Controls		1	ea	$5,000	$5,000
Total Direct Capital Costs					$41,350
Indirect Capital Costs					
Engineering and design					$0
Project/construction management (25% of total direct capital cost)					$10,338
Health and safety					$0
Overhead & markups (30% of total direct capital cost)					$12,405
Contingency (15% of total direct capital cost)					$6,203
Total Indirect Capital Costs					$28,945
TOTAL ESTIMATED CAPITAL COSTS					$70,295
O&M Costs					
Inspection		1	/yr	$1,000	$1,000
Maintain Signs		1	ls/yr	$500	$500
Mowing		2	/yr	$250	$500
Repairs (erosion control, reseeding, etc.)		1	ac/yr	$1,500	$1,500
Subtotal Annual O&M Costs					$3,500
Interest Rate (i)	0.07				
Number of Years (n)	30				
Present Worth Factor = {[(1+i)^n]-1} / {i[(1+i)^n]}	12.409				
O&M Present Worth (Annual O&M x PWF)					$43,432
TOTAL ESTIMATED O&M COSTS					$43,432
TOTAL ESTIMATED COST					$113,727

Table B-3. Cost Estimate for Engineered Soil Cover

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
Direct Capital Costs				
Construction of Soil Cover				
Mobilization/Demobilization	1	ls	$8,000	$8,000
Site Preparation (tree/brush removal)	34,800	sq. ft	$0.12	$4,176
Clay Layer (borrow and delivery)	3,000	cu. yd	$8.00	$24,000
Topsoil (purchase and delivery) (1.5 over extra AOC)	1,600	cu. yd	$10.00	$16,000
Cap Construction	34,800	sq. ft	$1.50	$52,200
Vegetation (seeding)	34,800	sq. ft	$0.10	$3,480
Total Direct Capital Costs				$107,856
Indirect Capital Costs				
Engineering and design (55% of total direct capital cost)				$59,321
Project/construction management (20% of total direct capital cost)				$21,571
Health and safety (10% of total direct capital cost)				$10,786
Overhead & markups (30% of total direct capital cost)				$32,357
Contingency (20% of total direct capital cost)				$21,571
Total Indirect Capital Costs				$145,606
TOTAL CAPITAL COSTS				$253,462
O&M Costs				
Soil Cover repairs (10% of initial cost every 5 yrs for 30 yrs)	6	ea	$25,346	
Interest Rate (i) 0.07				
O&M Present Worth				$54,692
TOTAL ESTIMATED O&M COSTS				$54,692
TOTAL ESTIMATED COST				$308,154

O&M Present Worth = Sum [1/(1+i)^n_a] x periodic cost] where n_a are the years at which the periodic cost is incurred (5, 10, 15, 20, 25, & 30 yrs)

Table B-4. Cost Estimate for BaroBall™ Wells

DESCRIPTION		QUANTITY	UNITS	UNIT COST	TOTAL COST
Direct Capital Costs					
Installation of wells and BaroBalls™		9	ea	\$2,500	\$22,500
Total Direct Capital Costs					\$22,500
Indirect Capital Costs					
Engineering and design (55% of total direct capital cost)					\$12,375
Project/construction management (20% of total direct capital cost)					\$4,500
Health and safety (10% of total direct capital cost)					\$2,250
Overhead & markups (30% of total direct capital cost)					\$6,750
Contingency (20% of total direct capital cost)					\$4,500
Total Indirect Capital Costs					\$30,375
TOTAL ESTIMATED CAPITAL COSTS					\$52,875
O&M Costs					
Maintenance and repair		1	/yr	\$1,000	\$1,000
Monitoring		18	/yr	\$200	\$3,600
Subtotal Estimated O&M Costs					\$4,600
Interest Rate (i)	0.07				
Number of Years (n)	5				
Present Worth Factor = {[(1+i)^n]-1} / {i[(1+i)^n]}	4.100				
O&M Present Worth (Annual O&M x PWF)					\$18,861
TOTAL ESTIMATED O&M COSTS					\$18,861
TOTAL ESTIMATED COST					\$71,736

Table B-5. Cost Estimate for Groundwater Monitoring and Reporting

DESCRIPTION		QUANTITY	UNITS	UNIT COST	TOTAL COST
Direct Capital Costs					
Installation of wells		0	ea	$0	$0
Total Direct Capital Costs					$0
Indirect Capital Costs					
Engineering and design					$0
Project/construction management					$0
Health and safety					$0
Overhead & markups					$0
Contingency					$0
Total Indirect Capital Costs					$0
TOTAL ESTIMATED CAPITAL COSTS					$0
O&M Costs					
Sampling (3 wells)		6	/yr	$550	$3,300
Analysis		6	/yr	$700	$4,200
Reporting		1	/yr	$2,000	$2,000
Subtotal Estimated O&M Costs					$9,500
Interest Rate (i)	0.07				
Number of Years (n)	5				
Present Worth Factor = {[(1+i)^n]-1} / {i[(1+i)^n]}	4.100				
O&M Present Worth (Annual O&M x PWF)					$38,952
TOTAL ESTIMATED O&M COSTS					$38,952
TOTAL ESTIMATED COST					$38,952

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