ARF # 15490

United States Department of Energy

Savannah River Site

Record of Decision for Remedial Alternative Selection for the C-Area Burning/Rubble Pit Operable Unit (131-C) and Old C-Area Burning/Rubble Pit (NBN) (U)

CERCLIS Number: 31

WSRC-RP-2007-4082

Revision 1

May 2008

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

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

DISCLAIMER

Printed in the United States of America

Prepared for
U.S. Department of Energy
and
Washington Savannah River Company LLC
Aiken, South Carolina

RECORD OF DECISION
REMEDIAL ALTERNATIVE SELECTION (U)

C-Area Burning/Rubble Pit (131-C) and
Old C-Area Burning/Rubble Pit (NBN) Operable Unit (U)

CERCLIS Number: 31

WSRC-RP-2007-4082
Revision 1

May 2008

Savannah River Site
Aiken, South Carolina

Prepared by:

Washington Savannah River Company LLC
for the
U. S. Department of Energy under Contract DE-AC09-96SR18500
Savannah River Operations Office
Aiken, South Carolina

This page was intentionally left blank.

DECLARATION FOR THE RECORD OF DECISION

Unit Name and Location

C-Area Burning/Rubble Pit (131-C) and Old C-Area Burning/Rubble Pit (NBN) (CBRP)

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) Identification Number: OU-31

Savannah River Site

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Identification Number: SC1 890 008 989

Aiken, South Carolina

United States Department of Energy

The C-Area Burning/Rubble Pit (131-C) and Old C-Area Burning/Rubble Pit (NBN) (CBRP OU) is listed as a Resource Conservation and Recovery Act (RCRA) 3004(u) Solid Waste Management Unit/CERCLA unit in Appendix C of the Federal Facility Agreement (FFA) for the Savannah River Site (SRS).

The FFA is a legally binding agreement between regulatory agencies (United States Environmental Protection Agency [USEPA] and South Carolina Department of Health and Environmental Control [SCDHEC]) and regulated entities (United States Department of Energy [USDOE]) that establishes the responsibilities and schedules for the comprehensive remediation of SRS. The media associated with CBRP OU are disposal pit surface soils, vadose zone soils beneath CBRP, groundwater, and surface water.

Statement of Basis and Purpose

This decision document presents the selected remedy for the CBRP OU in northwestern Barnwell County, South Carolina, which was chosen in accordance with CERCLA, as amended by the Superfund Amendments Reauthorization Act, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record File (ARF) for this site.

USEPA, SCDHEC, and USDOE concur with the selected remedy.

Assessment of the Site

There have been releases of trichloroethylene (TCE) (the predominant organic contaminant) and tetrachloroethylene (PCE) to the environment at CBRP, resulting in a groundwater plume with contaminant concentrations above maximum contaminant levels (MCLs) moving west toward Fourmile Branch. The response action selected in this Record of Decision (ROD) is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. There are no active sources of groundwater contamination in the CBRP OU. Historical sources in and adjacent to CBRP have been remediated and/or controlled by an interim action (IA) using a soil cover and soil vapor extraction (SVE) as discussed in further detail below.

Description of the Selected Remedy

The scope of the CBRP OU remedial action includes seven subunits:

- CBRP disposal pit (surface and subsurface soil),
- Vadose zone (soil beneath CBRP),
- Old CBRP (surface and subsurface soil),
- Mounded area north of CBRP (surface and subsurface soil),
- Concrete drainage ditch south of CBRP (adjacent surface soil),
- Groundwater plume, and
- Surface water.

The following insert lists the refined constituents of concern (RCOCs) by subunit:

Media	Subunit	HH RCOCs	CM RCOCs	ARAR (MCLs) RCOCs	Eco RCOCs
Soil	CBRP Disposal Pit	HpCDD, OCDD (future resident)	None	None	HpCDD
	Old CBRP	None	None	None	None
	Mounded area	None	None	None	None
	Concrete drainage ditch	None	None	None	None
	Vadose zone	None	TCE	None	None
Groundwater	Groundwater plume	TCE, cDCE, DCE, VC	None	PCE, TCE, cDCE, DCE, VC, DCM	None
Surface water	Twin Lakes	None	None	PCE, TCE, VC	None
	Fourmile Branch	None	None	VC	None

ARAR applicable or relevant and appropriate requirement
cDCE cis-1,2-dichloroethylene
DCE 1,1-dichloroethylene
DCM dichloromethane
Eco ecological
HH human health
HpCDD 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin
OCDD octachlorodibenzo-p-dioxin
VC vinyl chloride

The selected remedy is a combination of the preferred alternatives for each of the subunits that provide the greatest level of protection to human and ecological receptors in a comparable timeframe. The expected future use of C Area and the CBRP OU is industrial; land use controls (LUCs) will be part of the final remedy.

An IA initiated at the CBRP OU in 1999 included the placement of a 1.0E-06 cm/sec soil cover over the CBRP disposal pit (January 1999), the installation of an SVE system for the vadose zone west of CBRP (September 1999), and the installation of an air sparging (AS) network to strip volatile organic compounds (VOCs) from the groundwater in the upper zone of the water table aquifer at the west end of CBRP (June 2000). The soil cover was designed to prevent exposure of ecological receptors to contaminated surface soil in the CBRP and to reduce the infiltration rate through the CBRP waste interval. The SVE system, which removed over 2,100 lb of TCE from the vadose zone, was replaced with an active solar-powered MicroBlower™ system in December 2004. The system consists of four MicroBlower™ units, which recover a total of 50 lb of VOCs per year (WSRC 2005). The AS network contributed to reducing groundwater TCE concentrations below the CBRP disposal pit in the area of the IA before the water table dropped below the well screens due to drought conditions. Groundwater TCE concentrations remain above MCLs; however, TCE concentrations near the CBRP disposal pit have declined nearly three orders of magnitude since the IA was implemented.

The Core Team, comprising representatives of SCDHEC, USDOE, and USEPA, met in December 2006 and agreed on the components of the selected remedy for the CBRP OU. Constituents of concern (COCs) for future resident and future industrial worker exposure scenarios at Old CBRP, the mounded area, and the concrete drainage ditch were evaluated in the uncertainty section of the *RCRA Facility Investigation/Remedial Investigation with Baseline Risk Assessment for C-Area Burning/Rubble Pit (131-C) (U)* (RFI/RI/BRA) (WSRC 2002a). The RFI/RI/BRA did not identify any RCOCs for the Old CBRP, the mounded area, or the concrete drainage ditch. Thus there is no problem warranting action associated with these subunits and No Action is the selected remedy.

Based on the detailed evaluation of alternatives performed in the Focused Corrective Measures Study/Feasibility Study (FCMS/FS) (WSRC 2004a), the selected remedies for final remedial actions for the remaining CBRP OU subunits include the following:

Institutional Controls

Institutional controls (ICs) will be a component of the final remedies for the remaining subunits. ICs at CBRP OU will consist of groundwater and surface water use restrictions, restrictions on disturbing the soil cover, inspections and maintenance of the soil cover, and Site Use/Site Clearance restrictions. The SRS site boundary fencing and security personnel will prevent trespassers from gaining access to the surface of CBRP OU and the monitoring wells. In the long term, if the property is transferred to nonfederal ownership, the U.S. Government will take those actions mandated by Section 120(h) of CERCLA including deed notification to disclose former waste management and disposal activities as well as remedial actions taken on the site. Deed restrictions will preclude the use of local groundwater as a source of potable water, until the remedial action objectives (RAOs) for groundwater are achieved.

CBRP Disposal Pit (surface soils) and Vadose Zone beneath CBRP Subunits

Alternative S-2: maintain the existing soil cover and continue operation of the existing MicroBlower™ SVE system. This alternative was selected because the soil cover effectively eliminates the exposure pathway for ecological receptors and reduces infiltration through the waste interval. The MicroBlower™ SVE system will continue to remove remaining diffusion rate-limited VOCs in the vadose zone source beneath and adjacent to CBRP.

The purpose of ICs for the CBRP soils is to prevent potential exposure by preventing erosion of the CBRP soil cover and limiting excavation of contaminated soil. ICs include the installation of signs to warn on-unit workers of the presence of the closed CBRP. Land-use restrictions such as excavation permit restrictions and deed restrictions will be used to restrict the activities that can be performed at CBRP.

Groundwater Subunit

Alternative GW-2: monitored natural attenuation (MNA). TCE is the principal contaminant in a groundwater plume that originates in the vadose zone source under the west end of CBRP and is migrating west toward the Twin Lakes wetland and Fourmile Branch. Groundwater monitoring of selected monitoring wells will continue until remedial goals are attained.

The purpose of ICs for CBRP OU groundwater is to prevent potential exposure by limiting access to contaminated groundwater. ICs include groundwater use restrictions. Land-use controls such as deed restrictions will be used to protect against the use of CBRP OU groundwater for any purpose.

Surface Water Subunit

Alternative SW-2: implementation of the groundwater MNA remedy to reduce groundwater VOC concentrations, thereby reducing surface water concentrations. Emerging VOC-contaminated groundwater at the seepline along Twin Lakes and Fourmile Branch resulted in surface water with contamination levels above MCLs during the RCRA Facility Investigation/Remedial Investigation (RFI/RI). None of the surface water RCOCs exceeded its

MCL during 2007. Selected existing surface water sampling stations will be monitored to confirm that contaminant concentrations are not increasing during the groundwater MNA remedy.

The purpose of ICs for CBRP OU surface water is to prevent potential exposure by limiting access to contaminated surface water. ICs include restrictions on the use of surface water at SRS. Land-use controls such as deed restrictions will be used to protect against the use of CBRP OU surface water for any purpose.

The following LUC objectives are necessary to ensure protectiveness of the selected remedy:

- Restrict on-site worker access and prevent unauthorized contact, removal, or excavation of contaminated media (i.e., surface and vadose zone soils)
- Maintain the integrity of any current or future remediation or monitoring systems (i.e., soil cover, SVE systems, and groundwater monitoring wells)
- Prevent access to or use of groundwater and surface water until remedial goals are attained
- Prohibit the development and use of property for residential housing, elementary schools, childcare facilities, and playgrounds
- Prevent construction of inhabitable buildings without an evaluation of indoor air quality to address vapor intrusion

Due to the complexity of multiple contaminated areas, SRS has been divided into Integrator Operable Units (IOUs) for the purpose of managing a comprehensive cleanup strategy. IOU boundaries generally correspond to natural watersheds or drainage corridors and may include many OUs. OUs within an IOU are evaluated and remediated individually. The public has the opportunity to participate in the remedy selection process for each OU. The CBRP is an OU located within the Fourmile Branch IOU and any remedial action for the surface water in Fourmile Branch will be developed under the Fourmile Branch IOU ROD. This is the final ROD for the CBRP OU. Upon disposition of all OUs within the Fourmile Branch IOU, a comprehensive ROD for the IOU will be pursued with additional public involvement.

CERCLA ROD remedial action reviews will be conducted every five years to ensure that the selected remedy is still protective of human health and the environment. SCDHEC will revise the RCRA permit to reflect selection of the final remedy using the procedures under 40 Code of Federal Regulation (CFR) Part 270, and South Carolina Hazardous Waste Management Regulations (SCHWMR) R.61-79.264.101; 270.

Statutory Determinations

Based on the unit RFI/RI/BRA Report (WSRC 2002a) the CBRP OU poses a threat to human health and the environment. Therefore, Alternatives S-2, GW-2, and SW-2 with ICs have been selected as the remedy for the CBRP OU. CBRP OU does not contain principal threat source material. The future land use of the CBRP OU is assumed to be industrial.

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate (ARARs) to the remedial action (unless justified by a waiver), and is cost-effective. The remedy selected for the CBRP disposal pit soils and vadose zone satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduce the toxicity, mobility, or volume of materials comprising principal threats through treatment). VOCs removed by the MicroBlower™ system will be exposed to passive photolytic degradation. However, the groundwater remedy does not satisfy the statutory preference for treatment as a principal element of the remedy because no active treatment is implemented to address the VOC contamination. VOCs in the groundwater plume will be exposed to reductive dechlorination, mineralization, and other natural attenuation processes in the biomantle along the seeplines in the Twin Lakes wetland and along Fourmile Branch.

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 include a deed notification disclosing former waste management and disposal activities as well as remedial actions taken on the site. The contract for sale and the deed will contain the notification required by CERCLA Section 120(h). The deed notification shall notify any potential purchaser that the groundwater beneath the property is contaminated. These requirements are also consistent with the intent of the RCRA deed notification requirements at final closure of a RCRA facility if contamination will remain at the unit.

The deed shall also include deed restrictions precluding residential use of contaminated groundwater. 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.

The selected remedy for the CBRP OU leaves hazardous substances in place that pose a potential future risk and will require land use restrictions until groundwater is restored to MCLs. As agreed on March 30, 2000, among the USDOE, USEPA, and SCDHEC, SRS has implemented a Land Use Control and Assurance Plan (LUCAP) to ensure that the LUCs required by numerous remedial decisions at SRS are properly maintained and periodically verified. The unit-specific Land Use Control Implementation Plan (LUCIP) incorporated by reference into this ROD will provide details and specific measures required to implement and maintain the LUCs selected as part of this remedy. The USDOE is responsible for implementing, maintaining, monitoring, reporting upon, and enforcing the LUCs selected under this ROD. The LUCIP, developed as part of this action, will be submitted concurrently with the Corrective Measures Implementation/ Remedial Action Implementation Plan (CMI/RAIP), as required in the FFA for review and approval by USEPA and SCDHEC. Upon final approval, the LUCIP will be appended to the

LUCAP and is considered incorporated by reference into the ROD, establishing LUC implementation and maintenance requirements enforceable under CERCLA. The approved LUCIP will establish implementation, monitoring, maintenance, reporting, and enforcement requirements for the unit. The LUCIP will remain in effect unless and until modifications are approved by SCDHEC and USEPA as needed to be protective of human health and the environment. LUCIP modification will only occur through another CERCLA document.

Data Certification Checklist

This ROD provides the following information:

RCOCs and their respective concentrations (Section V)

- Baseline risk represented by the RCOCs (Section VII)
- Cleanup levels established for the RCOCs and the basis for the levels (Section VIII)
- Current and reasonably anticipated future land and groundwater use assumptions used in the ROD (Section XII)
- Potential land and groundwater use that will be available at the site as a result of the selected remedy (Section XI)
- Estimated capital, operation and maintenance, and total present worth cost; discount rate; and the number of years over which the remedy cost estimates are projected (Section XI)
- Key decision factor(s) that led to selecting the remedy (i.e., describe how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria) (Section XI)
- All historical source materials constituting principal threats in the CBRP OU have been remediated or depleted (Section II)

This page intentionally left blank.

6/5/08
Date

Jeffrey M. Allison
Manager
U. S. Department of Energy
Savannah River Operations Office

6/18/08
Date

Franklin E. Hill
Director
Superfund Division
U. S. Environmental Protection Agency - Region 4

6/25/08
Date

for Robert W. King, Jr.
Deputy Commissioner
Environmental Quality Control
South Carolina Department of Health and Environmental Control

DECISION SUMMARY
REMEDIAL ALTERNATIVE SELECTION (U)

C-Area Burning/Rubble Pit (131-C) and Old C-Area Burning/Rubble Pit (NBN) Operable Unit (U)

CERCLIS Number: 31

WSRC-RP-2007-4082
Revision 1

May 2008

Savannah River Site
Aiken, South Carolina

Prepared By:

Washington Savannah River Company LLC
for the
U. S. Department of Energy under Contract DE-AC09-96SR18500
Savannah River Operations Office
Aiken, South Carolina

This page was intentionally left blank

TABLE OF CONTENTS

Section **Page**

LIST OF FIGURES iii
LIST OF TABLES iv
LIST OF ACRONYMS AND ABBREVIATIONS v
I. SAVANNAH RIVER SITE AND OPERABLE UNIT NAME, LOCATION, AND DESCRIPTION 1
II. SITE AND OPERABLE UNIT COMPLIANCE HISTORY 5
III. HIGHLIGHTS OF COMMUNITY PARTICIPATION 13
IV. SCOPE AND ROLE OF THE OPERABLE UNIT 15
V. OPERABLE UNIT CHARACTERISTICS 17
VI. CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES 37
VII. SUMMARY OF OPERABLE UNIT RISKS 41
VIII. REMEDIAL ACTION OBJECTIVES AND REMEDIAL GOALS 47
IX. DESCRIPTION OF ALTERNATIVES 50
X. COMPARATIVE ANALYSIS OF ALTERNATIVES 59
XI. THE SELECTED REMEDY 87
XII. STATUTORY DETERMINATIONS 102
XIII. EXPLANATION OF SIGNIFICANT CHANGES 103
XIV. RESPONSIVENESS SUMMARY 103
XV. POST-ROD DOCUMENT SCHEDULE AND DESCRIPTION 103
XVI. REFERENCES 107

LIST OF FIGURES

Figure

Figure 1. Location of the CBRP OU within the Savannah River Site 3
Figure 2. Layout of the C-Area Burning/Rubble Pit Operable Unit 7
Figure 3. CBRP Volatile Organic Compound Plume and Surface Water and Sediment Sample Locations 19
Figure 4. Schematic Cross-section of CBRP OU, Plume Discharges to Fourmile Branch 23
Figure 5. Schematic Cross-section of CBRP OU, TCE Plume Discharges to Twin Lakes Wetland 25

LIST OF FIGURES *(Continued)*

Figure		Page
Figure 6.	Location of MNA Wells and RFI/RI Surface Water and Sediment Samples	27
Figure 7.	Conceptual Site Model for CBRP OU	31
Figure 8.	Land Use Map for CBRP OU	39
Figure 9.	Land Use Control Outline for CBRP OU	97
Figure 10.	Post-ROD Schedule	105

LIST OF TABLES

Table		
Table 1.	Summary of Analytical Results for Refined Constituents of Concern, Medium-specific Exposure Point Concentrations, and Status	42
Table 2.	Cancer Toxicity Data Summary for the Groundwater RCOCs	44
Table 3.	CBRP RCOCs by Medium and Subunit with Risk and Hazard Quotient and Remedial Goals Options	45
Table 4.	Summary of the Potential ARARs for the CBRP OU	48
Table 5.	Remedial Alternatives	51
Table 6.	Comparison of Soil Alternatives against the Threshold and Primary Balancing Criteria	67
Table 7.	Comparison of Groundwater Alternatives against the Threshold and Primary Balancing Criteria	76
Table 8.	Comparison of Surface Water Alternatives against the Threshold and Primary Balancing Criteria	83
Table 9.	Land Use Controls for CBRP OU	92

LIST OF APPENDICES

APPENDIX A - RESPONSIVENESS SUMMARY A-1

LIST OF ACRONYMS AND ABBREVIATIONS

4Q2000	fourth calendar quarter 2000
ACE	Army Corps of Engineers
ARAR	applicable or relevant and appropriate requirement
ARF	Administrative Record File
AS	air sparging
bgs	below ground surface
BRA	Baseline Risk Assessment
CBRP	C-Area Burning/Rubble Pit (131-C) and Old C-Area Burning/Rubble Pit (NBN)
cDCE	cis-1,2-dichloroethylene
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
CIP	(Savannah River Site Federal Facility Agreement) Community Involvement Plan (WSRC 2006a)
CM	contaminant migration COC/RCOC
cm/sec	centimeter per second
CMI/RAIP	corrective measures implementation/remedial action implementation plan
COC	constituent of concern
CPT	cone penetrometer technology
CSM	conceptual site model
DCE	1,1-dichloroethylene
DCM	dichloromethane
DQO	data quality objectives
Eco	ecological
ERH	electrical resistance heating
ESD	explanation of significant difference
FCMS/FS	focused corrective measures study/feasibility study
FFA	Federal Facility Agreement
ft	feet
GPR	ground penetrating radar
HH	human health
HpCDD	1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin
HQ	hazard quotient
IA	interim action
IC	institutional controls
IOU	integrator operable unit
IRA	interim remedial action
IRAO	interim remedial action objective
IRIS	Integrated Risk Information System
IROD	Interim Record of Decision
J	Result qualifier. The analyte was positively identified in the sample below the practical quantitation limit (PQL), the reported concentration was estimated.

LIST OF ACRONYMS AND ABBREVIATIONS *(Continued)*

lb	pound
LDR	Land Disposal Restrictions, 40CFR268
LLC	Limited Liability Company
LUC	land use controls
LUCAP	Land Use Controls Assurance Plan
LUCIP	Land Use Controls Implementation Plan
MCL	maximum contaminant level
μg/kg	microgram per kilogram
μg/L	micrograms/liter (parts per billion)
mg/L	milligrams per liter (parts per million)
MNA	monitored natural attenuation
MNA/IC	monitored natural attenuation/institutional controls
msl	mean sea level
NBN	no building number
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Protection Act
NPL	National Priorities List
OCDD	octachlorodibenzo-p-dioxin
O&M	operations and maintenance
OMB	Office of Management and Budget
OSHA	Occupational Safety and Health Administration
OU	operable unit
PCE	tetrachloroethylene
PQL	practical quantitation limit
PW	present worth
RAIP	remedial action implementation plan
RAO	remedial action objective
RCOC	refined constituent of concern
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facility investigation
RFI/RI	RCRA facility investigation/remedial investigation
RGO	remedial goal option
RI	remedial investigation
RME	reasonable maximum exposure
ROD	record of decision
SB/PP	statement of basis/proposed plan
SCDHEC	South Carolina Department of Health and Environmental Control
scfm	standard cubic feet per minute
SCHWMR	South Carolina Hazardous Waste Management Regulations
SRS	Savannah River Site
SVE	soil vapor extraction
TBC	to-be-considered

LIST OF ACRONYMS AND ABBREVIATIONS *(Continued)*

TCE	trichloroethylene
tDCE	trans-1,2-dichloroethylene
U	Result qualifier. The chemical was analyzed for, but was not detected at the reported PQL.
UCL	upper confidence level
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
UTRA	Upper Three Runs aquifer
VC	vinyl chloride
VOC	volatile organic compound
WSRC	Westinghouse Savannah River Company LLC prior to December 8, 2005; Washington Savannah River Company LLC after December 8, 2005
yr	year

This page was intentionally left blank

I. SAVANNAH RIVER SITE AND OPERABLE UNIT NAME, LOCATION, AND DESCRIPTION

C-Area Burning/Rubble Pit (131-C) and Old C-Area Burning/Rubble Pit (NBN) (CBRP)

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) Identification Number: OU-31

Savannah River Site

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Identification Number: SC1 890 008 989

Aiken, South Carolina

United States Department of Energy (USDOE)

Savannah River Site (SRS) occupies approximately 310 mi^2 of land adjacent to the Savannah River, principally in Aiken and Barnwell counties of South Carolina (Figure 1). SRS is located approximately 25 mi southeast of Augusta, Georgia, and 20 mi south of Aiken, South Carolina.

USDOE owns SRS, which historically produced tritium, plutonium, and other special nuclear materials for national defense and the space program. 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.

The Federal Facility Agreement (FFA) (FFA 1993) for SRS lists the CBRP Operable Unit (OU) as a Resource Conservation and Recovery Act (RCRA) Solid Waste Management Unit/CERCLA unit requiring further evaluation.

The CBRP OU was evaluated through an investigation process that integrates and combines the RCRA corrective action process with the CERCLA remedial process to determine the actual or potential impact to human health and the environment of releases of hazardous substances to the environment.

This page was intentionally left blank.

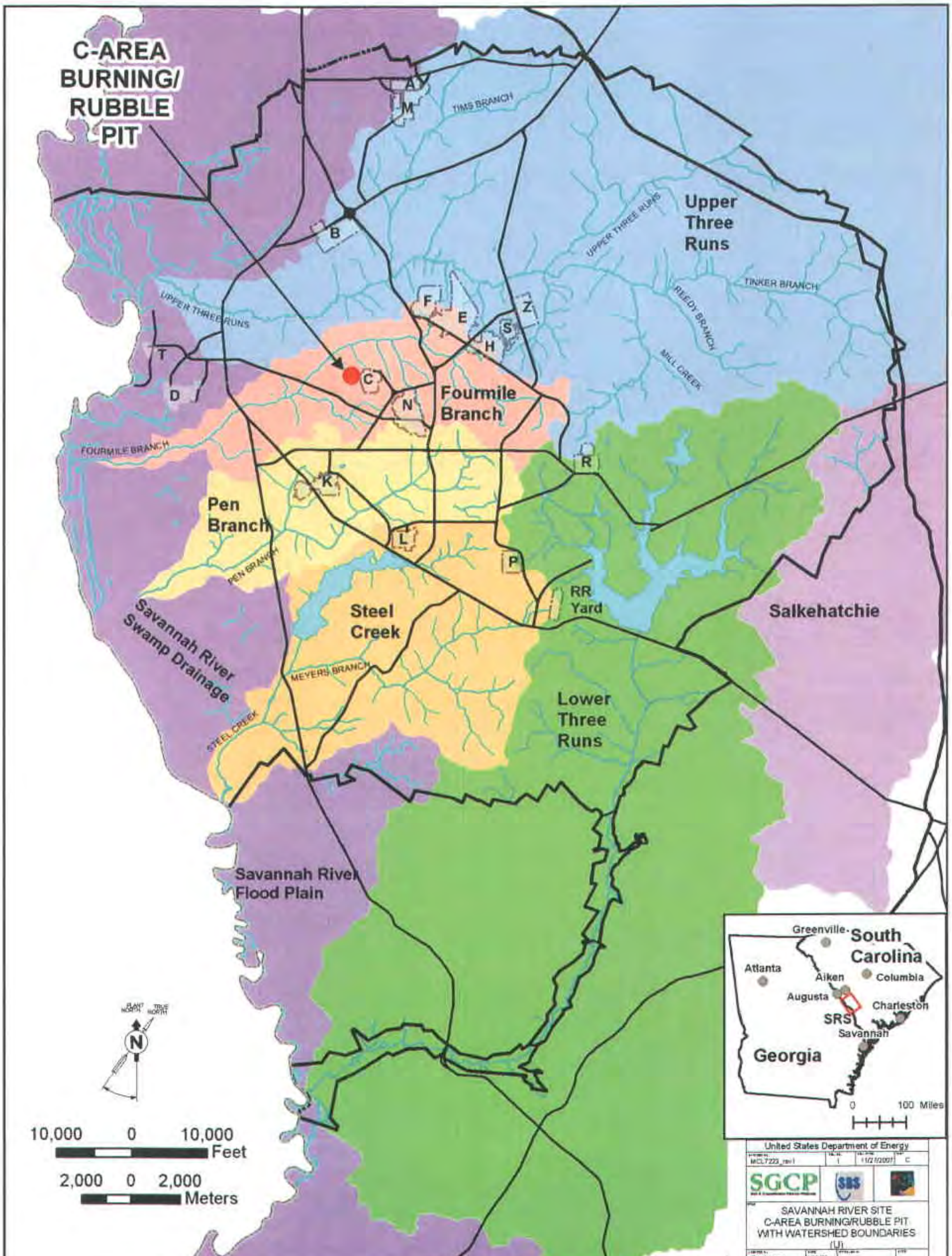


Figure 1. Location of the CBRP OU within the Savannah River Site

This page was intentionally left blank.

II. SITE AND OPERABLE UNIT COMPLIANCE HISTORY

SRS Operational and Compliance History

The primary mission of SRS has been to produce tritium, plutonium, and other special nuclear materials for our nation's defense programs. Production of nuclear materials for the defense program was discontinued in 1988. SRS has provided nuclear materials for the space program, as well as for medical, industrial, and research efforts up to the present. Chemical and radioactive wastes are byproducts of nuclear material production processes. These wastes have been treated, stored, and, in some cases, disposed of at SRS. Past disposal practices have resulted in soil and groundwater contamination.

Hazardous waste materials handled at SRS are managed under RCRA, a comprehensive law requiring responsible management of hazardous waste. Certain SRS activities require South Carolina Department of Health and Environmental Control (SCDHEC) operating or post-closure permits under RCRA. SRS received a RCRA hazardous waste permit from SCDHEC, which was most recently renewed on September 30, 2003. Module VIII 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 CERCLA requirements to provide for a focused environmental program. In accordance with Section 120 of CERCLA 42 United States Code Section 9620, USDOE has negotiated an FFA (FFA 1993) with United States Environmental Protection Agency (USEPA) and SCDHEC to coordinate remedial activities at SRS as one comprehensive strategy to fulfill these dual regulatory requirements. USDOE functions as the lead agency for remedial activities at SRS, with concurrence by USEPA-Region 4 and SCDHEC.

Operable Unit Operational and Compliance History

Operable Unit Operational History

C Area is located on a broad ridge between Fourmile Branch and Castor Creek, a tributary of Fourmile Branch about 3.5 mi northeast of the Ellenton town-site. Prior to the creation of SRS in early 1951, the area was privately owned woodlands and farmland. The principal pursuits were silviculture (turpentine, timber, and pulpwood production) and agriculture. Local farms produced cattle, hogs, and chickens. Corn and cotton were the main row crops. Farmers also produced a wide variety of vegetables for personal consumption.

Old CBRP and the mounded area (Figure 2) presumably operated when construction began on C Area in 1951 through the completion of construction on C-Reactor in early 1955. Old CBRP was used as a burning pit to dispose of combustible waste generated during construction. While no specific information on the operation of Old CBRP is available, it is assumed that the waste disposed of was typical of combustible construction waste in the early 1950s: waste oils, cloth, scrap wood, pallets, paper, cardboard, rubber, and other general trash (cans and bottles). Waste materials recovered from Old CBRP during the investigation included broken glass, copper wire, stainless steel turnings, nails, wood, and concrete rubble. When operations at Old CBRP ceased, it was backfilled to grade with native soil, obscuring all surface expression of Old CBRP. The mounded area received typical noncombustible rubble (concrete, bricks, tile, asphalt, and scrap metal) from early SRS construction. Operations at both of these facilities were probably curtailed when construction was completed because finishing and maintenance activities on a new facility would have generated a relatively small volume of waste for the first few years of operation.

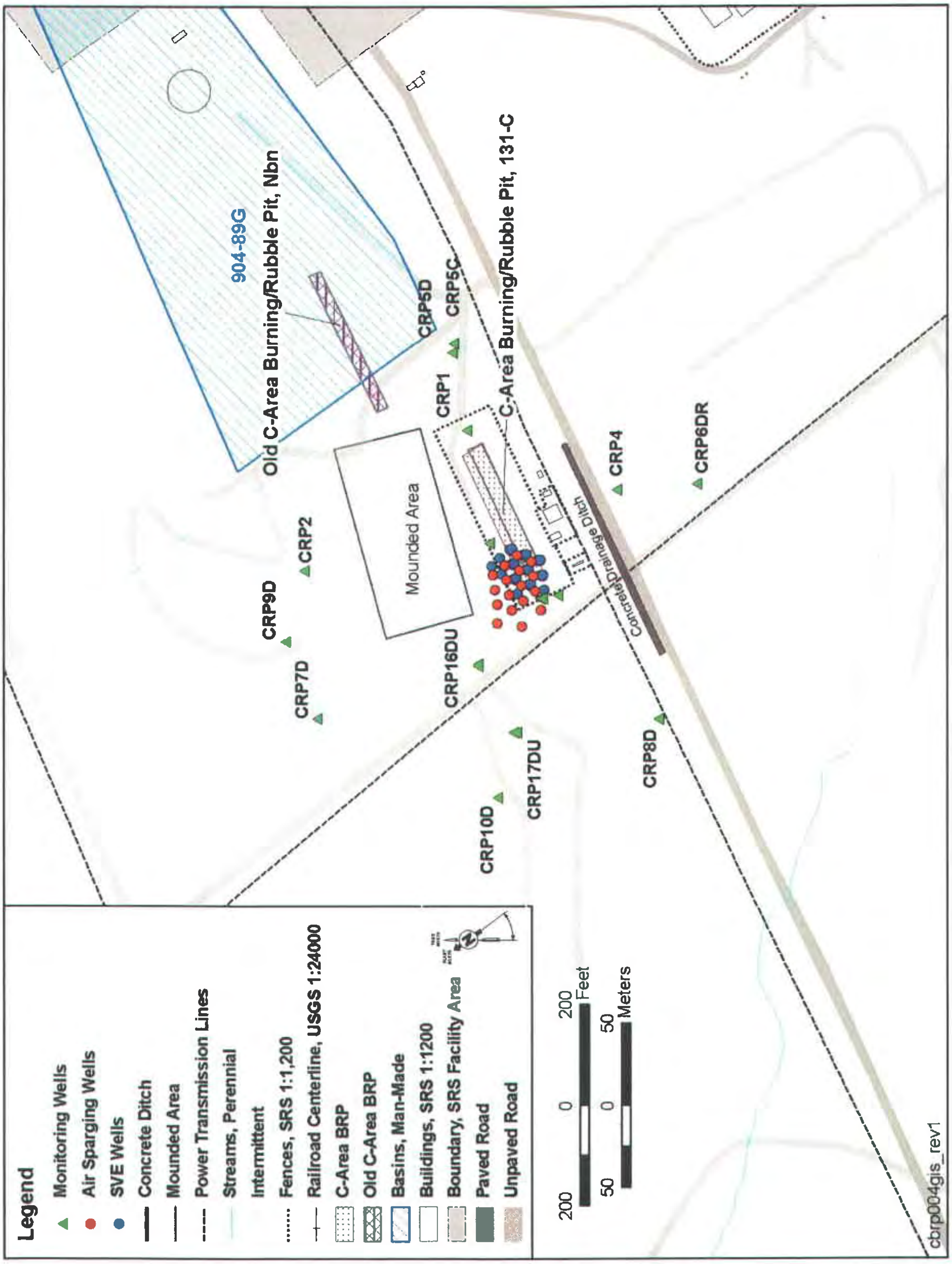


Figure 2. Layout of the C-Area Burning/Rubble Pit Operable Unit

This page was intentionally left blank.

Old CBRP was filled with burning residue and rubble and was replaced by CBRP in the early 1960s before construction of the C-Area Retention Basin 904-89G in 1963. The excavation of the retention basin removed about 70% of Old CBRP. Soil excavated from the retention basin was piled on a rubble disposal site north of CBRP, creating the mounded area. Soil samples collected from Old CBRP, the mounded area, and the concrete drainage ditch were analyzed for a complete suite of metals; volatile and semivolatile organic compounds (VOCs and semi-VOCs); pesticides, polychlorinated biphenyls, dioxins, and furans; and radionuclides. Constituents of concern (COCs) for future resident and future industrial worker exposure scenarios at Old CBRP, the mounded area, and the concrete drainage ditch were evaluated in the uncertainty section of the RCRA Facilities Investigation/Remedial Investigation with Baseline Risk Assessment (RFI/RI/BRA) (WSRC 2002a). The RFI/RI/BRA concluded that there were no refined constituents of concern (RCOCs) at any of these facilities. CBRP was constructed in the early to mid-1960s (after Old CBRP was filled) for use as a burning pit to dispose of combustible waste generated during the operation and maintenance of C-Area facilities. Disposal of known or suspected radioactive materials in SRS burning/rubble pits was specifically prohibited. These materials were disposed of at the Old Radioactive Waste Burial Ground. No records were kept of the total volume, specific use, and exact composition of waste disposed in the burning pit. Waste materials disposed of during the operation of the burning pit included organic liquids of unknown use and origin (solvents), waste oils, wood, paper, plastics, and rubber. The accumulated materials were burned periodically (generally monthly) to reduce the waste volume. SRS suspended the burning of waste in open pits in October 1973. After 1973, the residual material in the burning pit was covered with a thin layer of soil, and the pit was converted to a rubble pit to dispose of rubble believed to be chemically inert (including concrete, bricks, tile, asphalt, plastic, metal, empty drums, wood products, and rubber). Rubble pit operations were terminated prior to 1981 and SRS backfilled the CBRP to grade with approximately 2 ft of native soil.

The Twin Lakes wetland is the tributary of Fourmile Branch which drains most of the surface around the CBRP OU. Before SRS was created, local farmers built earthen dams to impound the flow, creating two small lakes known as the Twin Lakes. In the early 1980s, SRS breached the dams and drained the lakes. The exposed lakebeds are very flat and poorly drained. The lower portion of the Twin Lakes wetland is now a perennial stream fed by groundwater seeps in the area of the Twin Lakes.

Site-specific data for the CBRP are available from ground penetrating radar (GPR) surveys conducted in 1986 and 1993 and soil-gas surveys from 1985/1986 and 1991. The GPR surveys defined the pit boundaries and indicated the presence of buried metal objects at the CBRP. The 1985/1986 soil-gas survey results indicated the presence of chlorinated solvents in the soil at depths of 12 to 35 ft. Trichloroethylene (TCE) and tetrachloroethylene (PCE) were the major soil-gas constituents detected. The highest concentrations were detected inside the pit boundaries.

In 1983, three groundwater monitoring wells, CRP1, CRP2, and CRP3, were installed around the CBRP. CRP4 was installed in 1984. Well CRP1 is located approximately on the extension of the centerline of the trench at the east end and is upgradient of CBRP. Wells CRP2 and CRP4 are side gradient wells, and well CRP3 is downgradient (Figure 2). Well CRP3 was impacted by grout during installation and has been abandoned. Between 1978 and 2004, 110 conventional and multilevel groundwater monitoring wells and piezometers were installed to monitor groundwater conditions west and down gradient of C Area.

In the Twin Lakes wetland, the biomantle, which constitutes the upper part of the soil profile, is the most biologically active portion of the soil profile based on biodiversity (the number of species of micro-organisms and megafauna) and population density (the number of individual soil organisms). The biomantle contains the largest concentration of humates and other organic matter in a typical soil profile. The biomantle is also the most chemically active portion of the soil profile because of the level of microbial activity, the nutrient uptake and fixing activities of higher plants, the relative abundance of organic matter, the presence of carbonic acid in soil moisture, the low dissolved solids content of infiltrating precipitation, and almost unimpeded soil-gas exchange with the atmosphere. Thus, the wetland biomantle is the site of the most effective degradation of VOCs in emerging groundwater.

In September 2000 and March 2001, 26 monitored natural attenuation (MNA) wells were installed in the Twin Lakes and Fourmile Branch wetlands to study VOC degradation in the biomantle as the groundwater plume emerges to form the wetlands. The MNA study (WSRC 2002a, Appendix G) demonstrated that natural processes, primarily reductive dechlorination and mineralization, in the biomantle were 98.9% effective in degrading the VOCs in the plume. Figures 8 and 9 show the locations of the plume, Twin Lakes and Fourmile Branch wetlands, and Land Use Control Outline for CBRP OU; the MNA wells are also shown on Figure 9, individual MNA wells are identified on Figure 6.

An Interim Action (IA) initiated at the CBRP OU in 1999 included the placement of a 1.0E-06 cm/sec soil cover over the CBRP (January 1999), the installation of a soil vapor extraction (SVE) system for the vadose zone west of CBRP (operation began in September 1999), and the installation of an air sparging (AS) network to strip VOCs from the groundwater in the upper zone of the Upper Three Runs aquifer (UTRA) at the west end of CBRP (operation began in June 2000). The soil cover was designed to prevent exposure of ecological receptors to contaminated surface soil in the CBRP and to reduce the infiltration rate through the CBRP waste interval. The SVE system removed over 2,100 lb of TCE from the vadose zone in about five years. The AS network contributed to reducing groundwater TCE concentrations in the groundwater below the pit during the IA. Due to drought conditions since 1998, decline of the water table reduced the thickness of the saturated zone above the tan clay to the point that the AS wells were no longer sufficiently submerged to be effective. TCE concentrations remain above maximum contaminant levels (MCLs); however, concentrations near the pit have declined nearly three orders of magnitude since the IA was implemented, and the vadose zone source pathway has been broken by the SVE system and soil cover. The CBRP air sparge wells (AS 1 through AS 17) and all surface piping and blowers are still in place. If restart of the AS system is justified, the AS system could be operational within a few weeks.

Operable Unit Compliance History

RFI/RI field investigations were conducted from August 1995 to February 1996; during May 1996, January 1997, and July 1997; June 1998 (RFI/RI surface water/sediment samples); from May 2000 to August 2000 (data gap investigation); from September 2000 to March 2001 (MNA characterization); and from April 2001 to July 2001 (Old CBRP investigation). Detailed information on these investigations is available in the *RCRA Facility Investigation (RFI)/Remedial Investigation (RI) Report with Baseline Risk Assessment (BRA) for the C-Area Burning/Rubble Pit (131-C) (U)* (WSRC 2002a), which was approved in June 2002.

The IA, which included installation of the soil cover on CBRP and installation of SVE and AS systems, was conducted under the *Interim Record of Decision Remedial Alternative Selection for the C-Area Burning/Rubble Pit (131-C) (U)* (IROD) (WSRC 1998), which was approved in March 1999. The components of the IA were implemented as follows: installation of soil cover on CBRP in January 1999, installation of SVE system in the vadose zone at the west end of CBRP in September 1999, and installation of the AS system in the water table aquifer at the west end of CBRP in June 2000. The IROD also established the interim remedial action objective (IRAO) for the IA. The general groundwater IRAO was to treat the area in the vicinity of the pit, within the 25,000 µg/L isoconcentration contour, with an objective to reduce concentrations and control the migration of VOCs within the 25,000 µg/L VOC contour (WSRC 1998, Figure 9). SRS prepared and submitted five reports on the effectiveness of the CBRP interim remedial action for 2000 through 2004 (WSRC 2001a, WSRC 2002b, WSRC 2003b, WSRC 2004b, and WSRC 2005).

The *Focused Corrective Measures Study/Feasibility Study Report for the C-Area Burning/Rubble Pit (131-C) Operable Unit (U)* (FCMS/FS) (WSRC 2004a) was approved in July 2004.

The *Statement of Basis/Proposed Plan for the C-Area Burning/Rubble Pit Operable Unit (CBRP) (U)* (SB/PP) (WSRC 2007) was approved in September 2007. The 45-day public comment period began October 15, 2007 and extended through November 29, 2007.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

Both RCRA and CERCLA require that the public be given an opportunity to review and comment on the draft permit modification and proposed remedial alternative. Public participation requirements are listed in South Carolina Hazardous Waste Management Regulation (SCHWMR) R.61-79.124 and Sections 113 and 117 of CERCLA (42 United States Code Sections 9613 and 9617). These requirements include establishment of an Administrative Record File (ARF) that documents the investigation and selection of the remedial alternative for addressing CBRP OU groundwater. The ARF must be established at or near the facility at issue.

The *Savannah River Site Federal Facility Agreement Community Involvement Plan (U)* (CIP) (WSRC 2006b) is designed to facilitate public involvement in the decision-making process for permitting, closure, and the selection of remedial alternatives. The CIP addresses the requirements of RCRA, CERCLA, and the National Environmental Policy Act, 1969 (NEPA). 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. The *Statement of Basis/Proposed Plan for the C-Area Burning/Rubble Pit Operable Unit (131-C) (U)* (WSRC 2007), a part of the ARF, highlights key aspects of the investigation and identifies the preferred action for addressing the CBRP OU.

The FFA ARF, 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

The RCRA ARF 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
8911 Farrow Road
Columbia, South Carolina 29203
(803) 896-4000

The South Carolina Department of
Health and Environmental Control –
Region 5
Aiken Environmental Quality Control
Office
206 Beaufort Street, Northeast
Aiken, South Carolina 29801
(803) 641-7670

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

The SB/PP 45-day public comment period began on October 15, 2007, and ended on November 29, 2007. A Responsiveness Summary, prepared to address any comments received during the public comment period, is provided in Appendix A of this Record of Decision (ROD) and will also be available in the final RCRA permit.

IV. SCOPE AND ROLE OF THE OPERABLE UNIT

Due to the complexity of multiple contaminated areas, SRS has been divided into Integrator Operable Units (IOUs) for the purpose of managing a comprehensive cleanup strategy. Waste units within an IOU are evaluated and remediated individually; the public has the opportunity to be involved in the remedy selection process for each waste unit. The CBRP is an OU located within the Fourmile Branch IOU. This is the final ROD for CBRP OU. Upon disposition of all OUs within the Fourmile Branch IOU, a comprehensive ROD will be pursued with additional public involvement.

The scope of the CBRP OU remedial action includes seven subunits:

- CBRP disposal pit (surface and subsurface soil),
- Vadose zone (soil beneath CBRP),
- Old CBRP (surface and subsurface soil),
- Mounded area north of CBRP (surface and subsurface soil),
- Concrete drainage ditch south of CBRP (adjacent surface soil),
- Groundwater plume, and
- Surface water.

The selected remedy is a combination of the preferred alternatives for each of the subunits that provide the greatest level of protection to human and ecological receptors in a comparable time frame.

The IA initiated at the CBRP OU in 1999 included the placement of a soil cover over the CBRP to provide a barrier to human and ecological receptors and to reduce infiltration through the waste interval, the installation of an SVE system for the vadose zone, and the installation of an AS network to strip VOCs from the local groundwater. The IA reduced groundwater TCE concentrations below the pit by nearly three orders of magnitude between 1999 and 2004 when the SVE system was replaced with an active solar-powered MicroBlower™ SVE system. The MicroBlower™ system recovers approximately 50 lb of VOCs annually; 1.8 lb per year is the minimum extraction rate to control the TCE source (WSRC 2005).

The Core Team, comprising representatives of SCDHEC, USDOE, and USEPA, met in December 2006 and agreed on the components of the selected remedy for the CBRP OU. The RFI/RI/BRA for CBRP (WSRC 2002a) did not identify any RCOCs for Old CBRP, the mounded area, or the concrete drainage ditch. Thus, No Action is the selected remedy for these subunits.

Institutional controls (ICs) will be a component of the final remedies for the remaining four subunits. ICs at CBRP OU will consist of groundwater and surface water use restrictions, restrictions on disturbance of the soil cover, and Site Use/Site Clearance restrictions. The soil cover will be inspected periodically for erosion and other disturbance; maintenance will be performed as necessary. The SRS site boundary fencing and security personnel will prevent trespassers from gaining access to the surface of CBRP OU and the monitoring wells. In the long term, if the property is transferred to nonfederal ownership, the U.S. Government will take those actions mandated by Section 120(h) of CERCLA, including deed notification to disclose former waste management and disposal activities as well as remedial actions taken on the site. Deed restrictions will preclude the use of local groundwater as a source of potable water until the remedial action objectives (RAOs) for groundwater are achieved. Five-year remedy reviews will document the progress of the remediation effort.

There have been releases of VOCs (predominantly TCE and PCE) to the environment at CBRP, resulting in a groundwater plume with contaminant concentrations above MCLs. The response action selected in this ROD is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. The final remedial action for the CBRP OU disposal pit shallow and subsurface soils and vadose zone soils beneath CBRP was developed as Alternative S-2 in the FCMS/FS (WSRC 2004a): maintain the existing soil cover (providing a barrier to ecological receptors and reducing infiltration through the VOC source) and continue operation of the existing MicroBlower™ system, removing remaining diffusion rate-limited VOCs in the vadose zone source beneath and adjacent to CBRP.

The final remedial action for CBRP OU groundwater is GW-2: MNA, primarily reductive dechlorination and mineralization in the biomantle along the Twin Lakes and Fourmile Branch wetlands and stream channels.

The final remedial action for CBRP OU surface water is SW-2: implementation of the groundwater MNA remedy to reduce groundwater VOC concentrations, thereby reducing surface water concentrations. Surface water sampling stations have been established and monitored to establish a baseline. Selected surface water sampling stations will be monitored to confirm that contaminant concentrations are not increasing during the groundwater MNA remedy.

V. OPERABLE UNIT CHARACTERISTICS

No RCOCs were identified for Old CBRP, the mounded area, and the concrete drainage ditch; No Action is the appropriate remedial strategy for these subunits. These subunits will not be discussed further.

Disposal Pit Soil and Vadose Zone Subunits

CBRP was constructed in the early to mid-1960s to replace Old CBRP as a burning pit to dispose of combustible waste generated during the operation and maintenance of C-Area facilities. The dimensions of CBRP are approximately 350 ft long, 25 ft wide, and 8 to 12 ft deep with sloping sides. No records were kept of the total volume, specific use, and exact composition of waste disposed of in the burning pit. Waste materials disposed of during the operation of the burning pit included organic liquids of unknown use and origin (solvents), waste oils, wood, paper, plastics, and rubber. The accumulated materials were burned periodically (generally monthly) to reduce the waste volume. SRS suspended the burning of waste in open pits in October 1973. When burning ceased, the residual material in the burning pit was covered with a thin layer of soil, and the pit was converted to a rubble pit to dispose of rubble believed to be chemically inert (including concrete, bricks, tile, asphalt, plastic, metal, empty drums, wood products, and rubber). Rubble pit operations were terminated prior to 1981 and SRS backfilled the CBRP to grade with approximately 2 ft of native soil. CBRP was trenched during characterization; the bottom of the pit was covered with 12 to 18 inches of charred residue from the operation of the burning pit.

1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD) was found in the surface soils of the disposal pit. A TCE source was found in vadose zone soils between 25 and 30 ft below ground surface (bgs) at the west end of CBRP.

Groundwater Subunit

The groundwater plume (Figure 3) originates beneath the west end of CBRP and migrates west toward the Twin Lakes wetland and Fourmile Branch through the upper zone of the water table aquifer, the UTRA. The dimensions of the plume are approximately 4,000 ft long and 1,000 ft wide. The elevation of the water table at CBRP is about 200 ft relative to mean sea level (msl), or 65 ft bgs; the elevation of the tan clay, which divides the UTRA into upper and lower zones, is about 180 ft msl or 85 ft bgs. Contamination is confined to the upper portion of the UTRA near CBRP. Contamination breaks through the tan clay about 800 ft down gradient of CBRP, and contaminant levels in the lower UTRA west of this area exceed MCLs (see Figure 3).

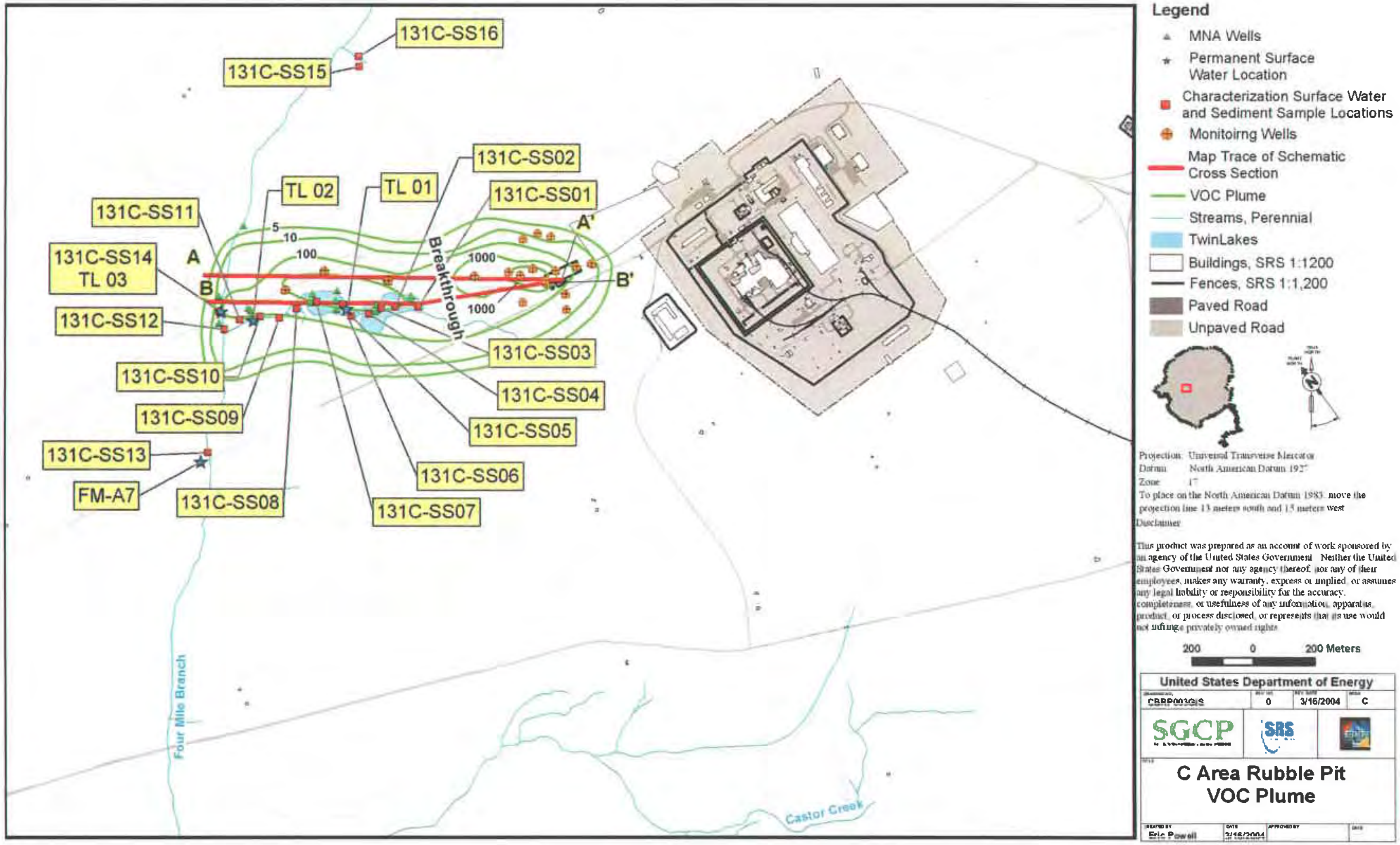


Figure 3. **CBRP Volatile Organic Compound Plume and Surface Water and Sediment Sample Locations**

This page was intentionally left blank.

Schematic cross-sections showing the relationship between the remaining subunits are shown on Figure 4 with the plume discharging to Fourmile Branch and on Figure 5 with the plume discharging to the Twin Lakes wetland (See Figure 3 for map trace of schematic cross-sections).

TCE is the principal VOC in the groundwater. PCE, dichloromethane (DCM), cis-1,2-dichloroethylene (cDCE), and vinyl chloride (VC) have also exceeded their MCLs. In 2004 after the IA, TCE concentrations in the groundwater near CBRP were less than 1000 µg/L (WSRC 2005), a significant reduction from the maximum of 130,000 µg/L before the IA.

The biomantle, the most effective site of VOC degradation in the TCE plume, was studied in 2000 through 2003. During the MNA characterization, a total of 26 wells were installed adjacent to and within Twin Lakes and Fourmile Branch wetlands (Figure 6).

This page was intentionally left blank.

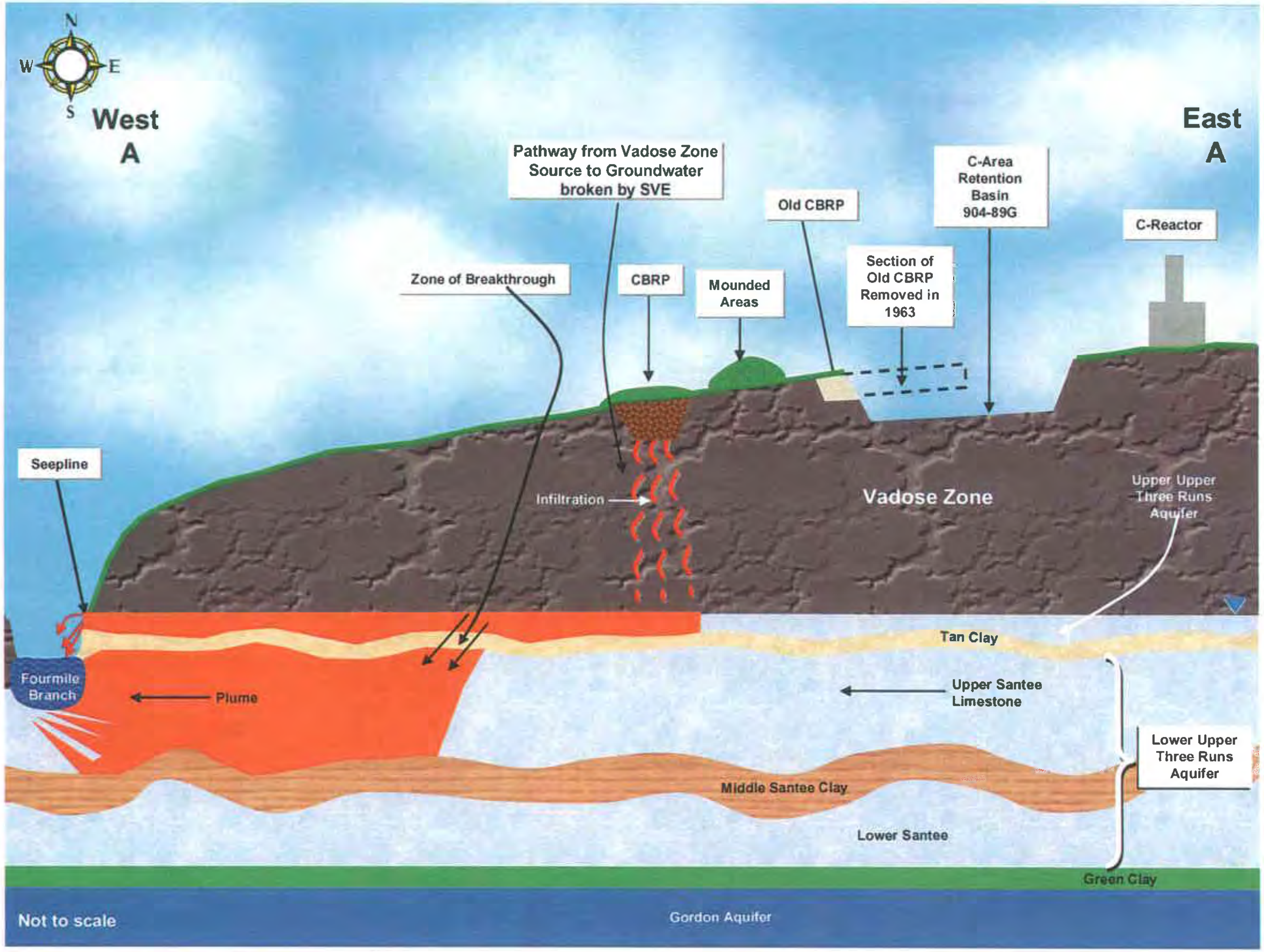


Figure 4. Schematic Cross-section of CBRP OU, Plume Discharges to Fourmile Branch

This page was intentionally left blank.

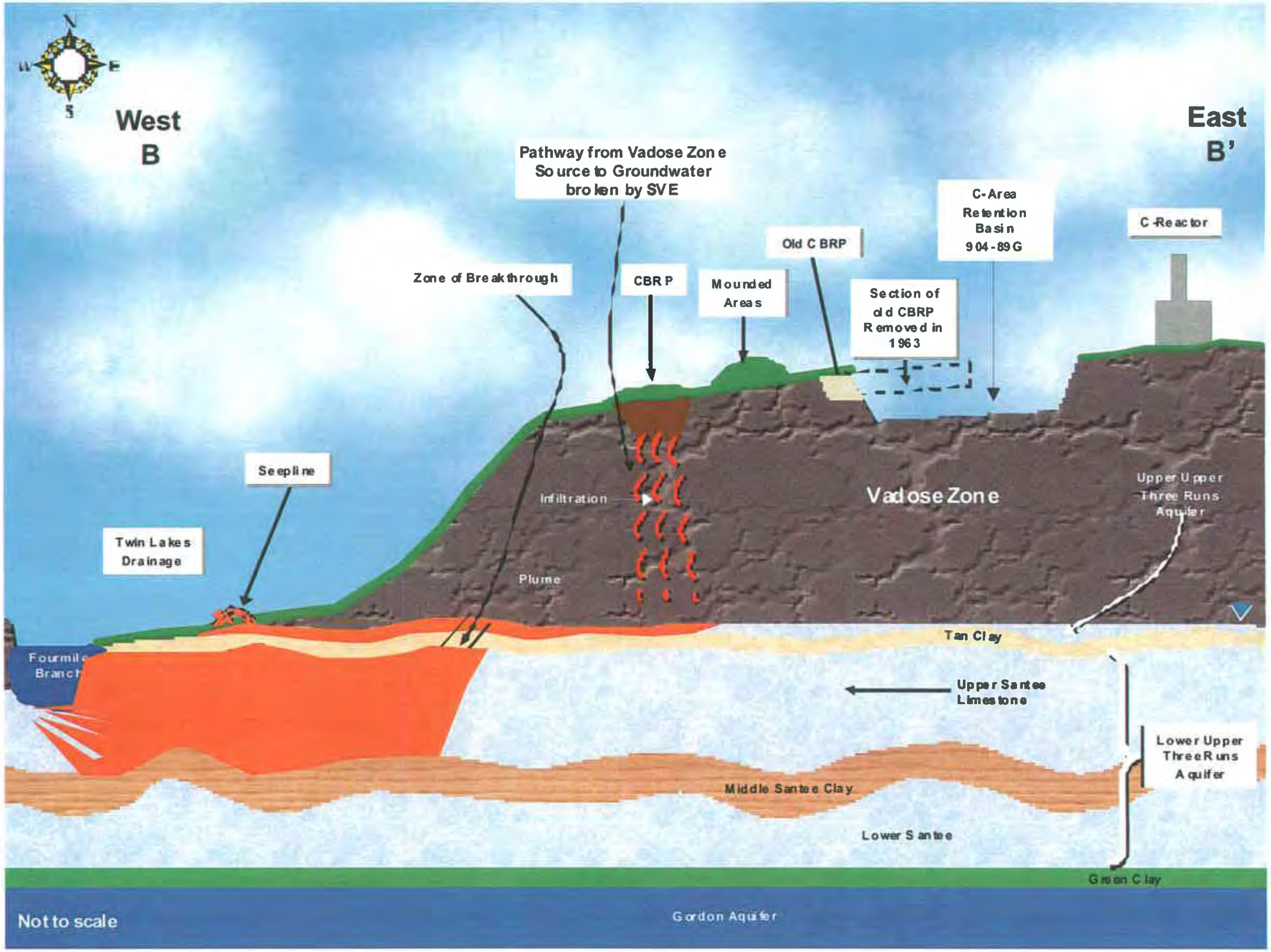


Figure 5. Schematic Cross-section of CBRP OU, TCE Plume Discharges to Twin Lakes Wetland

This page was intentionally left blank.

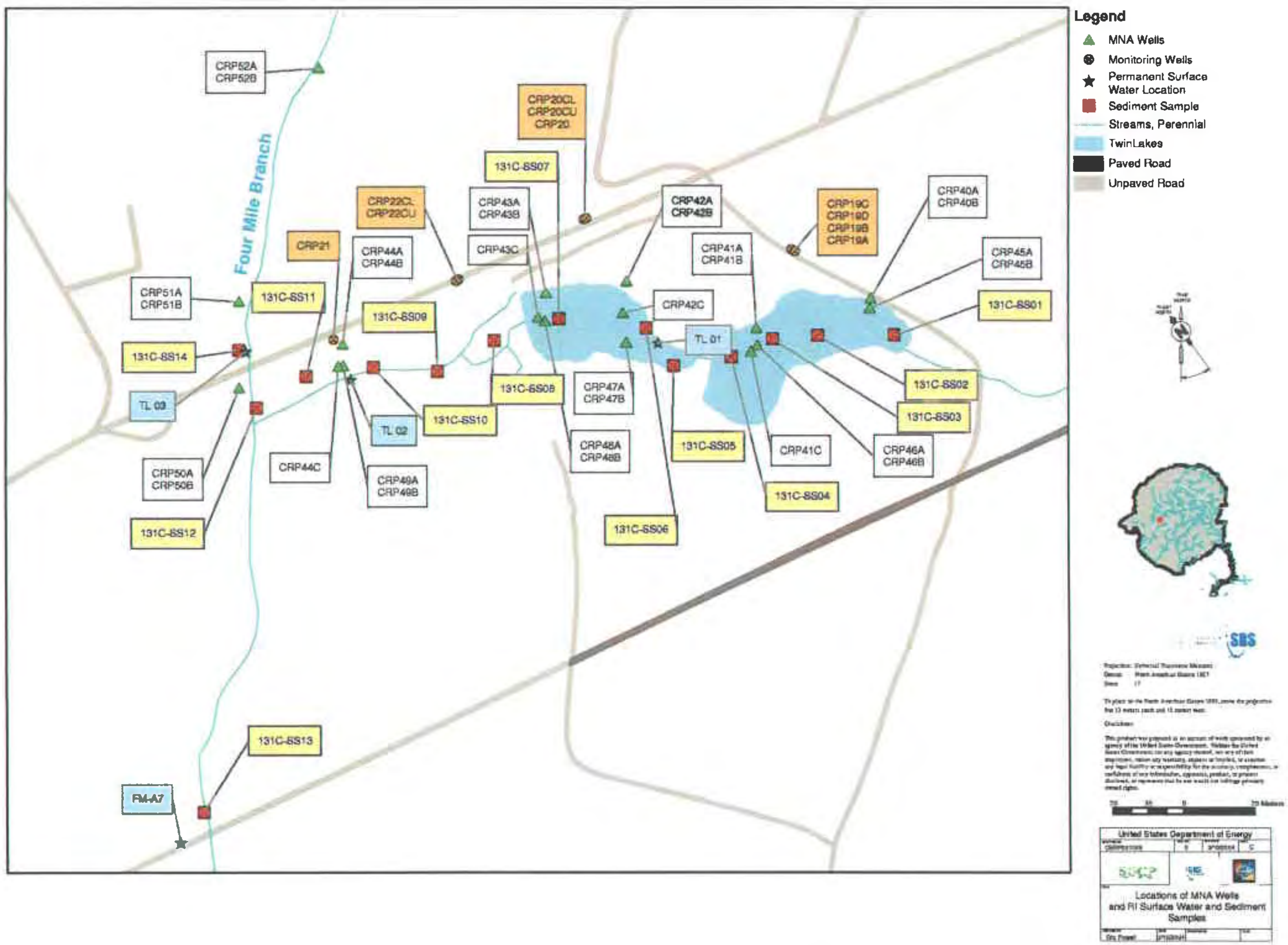


Figure 6. Location of MNA Wells and RFI/RI Surface Water and Sediment Samples

This page was intentionally left blank.

These wells were used to study areas where natural attenuation of the contaminants was occurring and to document the effectiveness of natural attenuation. Generally, the contaminant concentration reported for the shallow screen of each well pair is lower than that reported for the deep screen, indicating that considerable reductive dechlorination takes place in a vertical distance of about 2 ft.

Surface Water Subunit

The Twin Lakes wetland is the tributary of Fourmile Branch which drains most of the surface around the CBRP OU. SRS drained the Twin Lakes in the early 1980s; the upper portion of the Twin Lakes wetland (above the former lakes) is now an intermittent stream and the lower portion is now a perennial stream fed by groundwater seeps.

Contaminant levels in groundwater emerging along the Twin Lakes and Fourmile Branch seeplines exceeded MCLs during the RFI/RI. Surface water samples did not exceed MCLs during 2007. The seepline is located along the surface outcrop of aquitards such as the tan clay where the water above the aquitard emerges. Figure 3 shows the VOC groundwater plume and the location of RFI/RI surface water and sediment samples.

Conceptual Site Model for the CBRP OU

A conceptual site model (CSM) was developed to characterize the sources, potential exposure pathways, and exposure media relevant to the CBRP OU. The CSM shows that the primary contaminants are from past disposal of waste in CBRP. During the RFI/RI investigation, no RCOCs were identified for Old CBRP, the mounded area, or the concrete drainage ditch along the south side of CBRP. The primary release mechanisms are deposition of contaminants on the surface during waste disposal and infiltration/percolation of the waste constituents in CBRP to surface, subsurface, and deep soil.

Secondary release mechanisms for surface soil include fugitive dust generation, volatilization, biotic uptake, and leaching to groundwater. The exposure pathways include air, biota, surface water, and groundwater. Figure 7 illustrates the CSM used during characterization and the BRA.

The soil cover and SVE system have broken the pathway between the vadose zone source and groundwater.

Media Assessment

Disposal Pit Surface Soils and Vadose Zone Investigation

GPR surveys conducted in 1986 and 1993 defined the CBRP boundaries, and soil-gas surveys from 1985/1986 and 1991 indicated the presence of chlorinated solvents (predominantly TCE with subordinate PCE and degradation products) in vadose zone soils at depths of 12 to 35 ft.

During the RFI/RI investigations, CBRP was investigated by trenching (two trenches were cut across the disposal pit, perpendicular to its long axis) and collecting soil cores. In the bottom of the pit, trenching revealed 12 to 18 inches of charred residue which was covered with a thin layer of soil. The overlying rubble layer contained concrete, bricks, tile, asphalt, plastic, metal, empty drums, wood products, and rubber. Rubble pit operations were terminated before 1981 and SRS backfilled CBRP to grade with approximately 2 ft of native soil.

For the assessment of the nature and extent of contamination, three soil intervals were defined: surface soil (0 to 1.0 ft bgs), subsurface soil (0 to 4.0 ft bgs), and deep soil (4 ft bgs to the water table). Data from these intervals were assessed in three overlapping exposure groups: surface soils, subsurface soils, and all depths (the vadose zone).

ARF # 15490

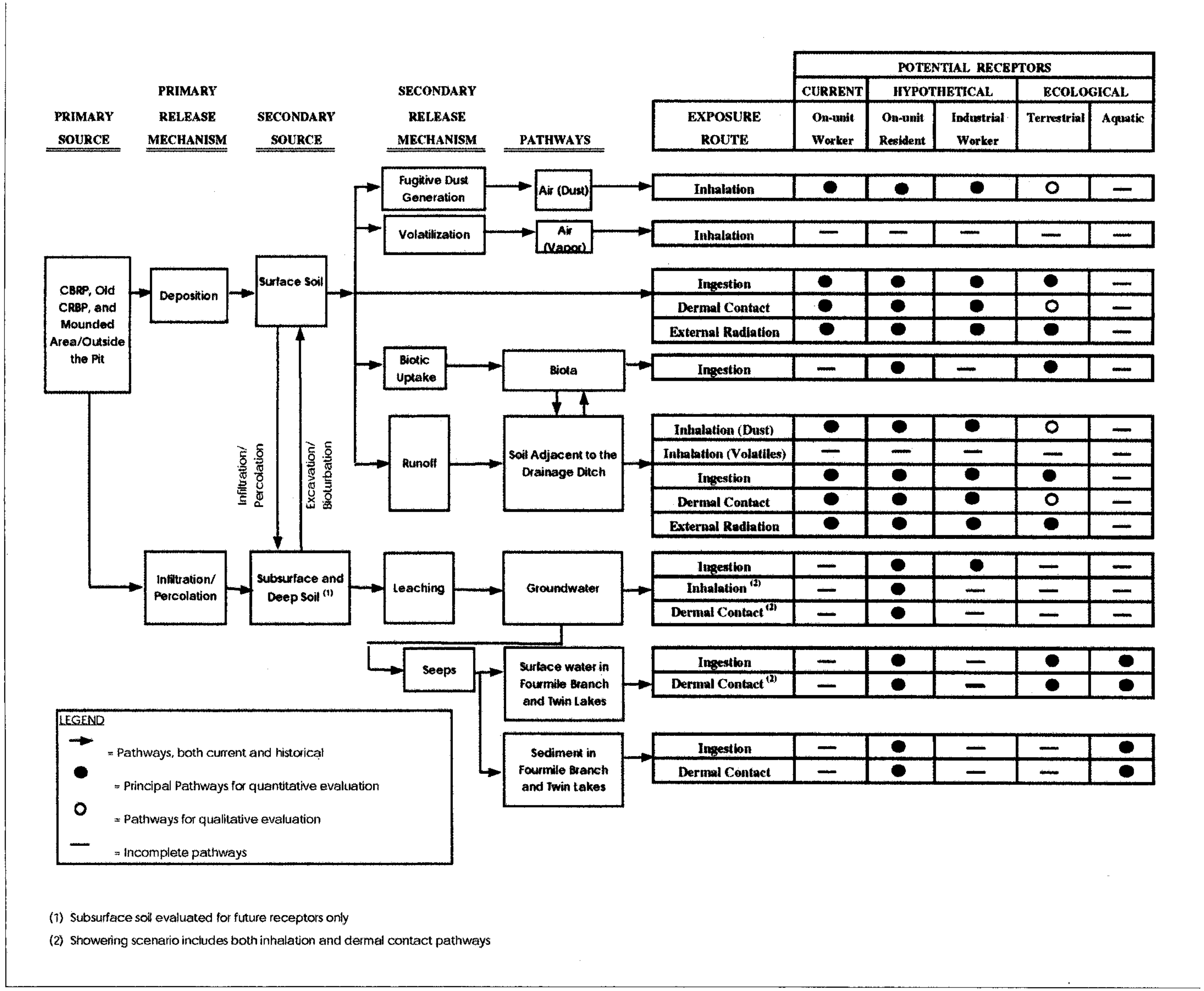


Figure 7. Conceptual Site Model for CBRP OU

HpCDD was found in the soil cores of surface soils within the disposal pit during the RFI/RI. Dioxins were never used in any of the processes at SRS, but dioxins and related chemicals are produced during incomplete combustion. Thus, the dioxins found in the pit may have been produced during the routine burning of waste in the pit.

TCE was the principal solvent in use at SRS from mid-1951 through 1970 and was later supplanted by PCE. A TCE source was found in vadose zone soils between 25 and 30 ft bgs at the west end of CBRP.

Groundwater Plume Investigation

Groundwater monitoring at CBRP began in 1983 when three groundwater monitoring wells, CRP1, CRP2, and CRP3, were installed. More than 110 wells and piezometers have been installed west and down gradient of C Area; these wells are summarized in the following insert:

Groundwater Monitoring Network	Installed	Active Wells	Inactive/ Abandoned Wells
CRP (C-Area Burning/Rubble Pit, conventional wells)	1983-2000	26	2
CRP (C-Area Burning/Rubble Pit, multilevel wells)	2002	14	0
CRP (C-Area Burning/Rubble Pit, MNA wells)	2000-2003	26	5
CRW (C-Area Reactor Groundwater, multilevel wells)	2002-2004	35	2
CSB (C Area Reactor Seepage Basin wells)	1978-1999	11	13
RGW (Regional Groundwater piezometers near C Area)	1998	4	0
Totals		**115**	**22**

The following constituents have been detected at concentrations above primary or secondary drinking water standards in the CRP-series wells: TCE, 1,1-dichloroethylene (DCE), cDCE, PCE, and VC. The following insert summarizes MCL exceedances in the CRP series wells (which define the plume) for the period 1/1/2003 through 2/20/2008.

RCOC	MCL	Maximum	Well	Date
Upgradient End of CBRP Plume		Conventional Wells and Multilevel Wells		
D-, DU-, and DL-screen Interval				
TCE	5 µg/L	2350 µg/L	CRP 3	6/10/2003
cDCE	70 µg/L	309 µg/L	CRP 27DU	6/11/2003
VC	2µg/L	8.77 µg/L	CRP 27DU	6/11/2003
DCM	5 µg/L	183.3 µg/L	CRP 3	9/23/2004
C-screen Interval				
PCE	5 µg/L	14.2 µg/L	CRP 5C	5/17/2007
Zone of Breakthrough		Conventional Wells		
D-screen Interval				
TCE	5 µg/L	434 µg/L	CRP 18D	12/7/2005
C-screen Interval				
TCE	5 µg/L	44.2 µg/L	CRP 18C	3/3/2004
Downgradient Portion of CBRP Plume		Conventional Wells		
D-screen Interval				
TCE	5 µg/L	118 µg/L	CRP 19D	11/29/2005
C-, CU-, and CL-screen Interval				
PCE	5 µg/L	127 µg/L	CRP 19C	8/27/2003
TCE	5 µg/L	8330 µg/L	CRP 20CL	12/7/2005
cDCE	70 µg/L	115 µg/L	CRP 20CL	6/19/2003
DCM	5 µg/L	18.73 µg/L	CRP19C	8/27/2003
Distal End of CBRP Plume		MNA Wells		
MNA A-screen (4 feet bgs)				
TCE	5 µg/L	2030 µg/L	CRP 41A	9/15/2003
DCE	7 µg/L	155.2 µg/L	CRP 42A	9/23/2004
cDCE	70 µg/L	193.2 µg/L	CRP 42A	9/23/2004
VC	2 µg/L	13.6 µg/L	CRP 50A	5/24/2006
DCM	5 µg/L	30.1 µg/L	CRP 40A	9/23/2004
MNA B-screen (6 ft bgs)				
TCE	5 µg/L	1980 µg/L	CRP 42B	12/5/2005
cDCE	70 µg/L	1890 µg/L	CRP 48B	9/19/2003
VC	2 µg/L	84.7 µg/L	CRP 48B	9/19/2003
DCM	5 µg/L	29.6 µg/L	CRP 40B	9/23/2004

There have been several overlapping cone penetrometer technology (CPT) investigations of groundwater quality and shallow stratigraphy around C Area. These investigations, summarized below, included more than 300 CPTs from which more than 1,400 groundwater samples were collected. Many of these CPTs were within or adjacent to the

CBRP TCE plume. Typically multiple vertically discrete groundwater samples were collected from each CPT.

CPT Series	Number of CPTs	Period	Number of Samples	Number of Detects
131C	72	07/09/1998 - 07/27/2000	75	27
CGW	102	08/18/2000 - 08/15/2001	607	93
CRG	21	09/25/2000 - 10/25/2000	57	29
CRSB	106	05/15/1998 - 04/08/1999	673	128
Totals	**301**		**1412**	**277**

Surface Water Investigation

RFI/RI/BRA Tables 4-24 and 4-27 summarize the surface water data for the Twin Lakes and Fourmile Branch wetlands and channels during the RFI/RI (mid 1990s).

From permanently established surface water monitoring stations along Fourmile Branch (FMA7) and the Twin Lakes wetland (TL01, TL02, and TL03) (Figure 6), it is known that VOC concentrations naturally attenuate before reaching Fourmile Branch. The analytical results for the latest samples from these stations are summarized in the following insert. trans-1,2-Dichloroethylene (tDCE) was not identified as an RCOC because it has not exceeded its MCL, but tDCE was included in this insert because it is a degradation product of the PCE-TCE reductive dechlorination chain.

VOC/MCL	TL01 11/13/07	TL02 11/13/07	TL03 11/13/07	FMA7 9/18/07
PCE/ 5.0 µg/L	U	U	U	U
TCE/ 5.0 µg/L	U	4.92	J0.22	U
cDCE/ 70.0 µg/L	U	6.31	U	U (9/14/2005)
tDCE/ 100.0µg/L	U	U	U	U (9/14/2005)
VC/ 2.0 µg/L	U	U	U	U (9/14/2005)

"J" The analyte was positively identified in the sample below the practical quantitation limit (PQL), the reported concentration was estimated.
"U" The chemical was analyzed for, but was not detected at the reported PQL.

Media Assessment Results

Disposal Pit Soils and the Vadose Zone

The only RCOCs identified for soils in CBRP were HpCDD (ecological RCOC) and TCE (contaminant migration [CM] RCOC) in the vadose zone. The IA was initiated in 1999 to prevent exposure of industrial workers and ecological receptors to contaminants in surface soils. The low permeability soil cover system, constructed during the IA, reduced infiltration through the waste interval and leaching of contaminants in the waste interval to groundwater. The SVE and AS systems have removed VOCs from the vadose zone and the upper part of the UTRA. The SVE system was replaced with the MicroBlower™ SVE system, which recovers about 50 lb of VOCs annually, more than enough to control the TCE source. The pathway from the TCE source in the vadose zone to the groundwater is broken.

Groundwater Plume

The RCOCs for groundwater at CBRP OU are TCE, PCE, DCM, DCE, cDCE, and VC. PCE and TCE were used as solvents at SRS between approximately 1951 and 1979. Contaminant concentrations near the remediated source unit and in the down gradient plume are declining, indicating that the source is depleted and controlled by the source-specific IA, discussed in Section II. Contaminant levels within the plume are still above MCLs.

Surface Water

TCE, PCE, and VC were identified as applicable or relevant and appropriate requirement (ARAR) RCOCs because they exceeded applicable MCLs during the RFI/RI investigation. None of these RCOCs exceeded its MCL in the 2007 water samples.

Site-Specific Factors

There are no active, continuing primary sources of groundwater contamination at the CBRP OU. The secondary TCE source in the vadose zone is controlled by the active MicroBlower™ SVE system, which removes approximately 50 lb of VOCs annually. The recovery rate required to control the secondary TCE source is 1.8 lb/yr (WSRC 2005). There is no practicable treatment technology for low concentrations of dioxin in soil, and there are no disposal sites licensed to receive dioxin waste; thus containment is the only practicable remedial action for low levels of dioxin in the soil. Natural attenuation processes (reductive dechlorination, mineralization, dispersion, and dilution) are occurring in the biomantle at the Twin Lakes and Fourmile Branch wetlands and are effective in reducing VOC contaminant concentrations in emerging groundwater below remedial goals options (RGOs). Contaminant levels in surface water along the seepline are below RGOs/MCLs, so groundwater discharge to surface water is not impacting human health or ecological receptors.

Contaminant Transport Modeling

Contaminant fate and transport models were performed to identify CM constituents of concern (COCs) on the basis of leaching by infiltrating water and subsequent transport to groundwater. These models were also used to predict the rate of CM and to project contaminant concentrations at receptor locations via various transport media. The overall objective of these models is to evaluate potential future impact to human health and the environment. The leachability modeling identified TCE as a CM RCOC for the vadose zone subunit.

VI. CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

Land Uses

The current on-site land use of C Area is industrial. Timber and pulpwood are harvested from the surrounding woodlands. Controlled deer hunts are conducted in the surrounding areas several times each year.

According to the *Savannah River Future Use Project Report* (USDOE 1996), residential uses of SRS land should be prohibited. The Savannah River Site *Long-Range Comprehensive Plan* (USDOE 2000) designates the CBRP OU as being within the site industrial area (Figure 8). Industrial land use is the most likely future land use scenario.

Groundwater Uses/Surface Water Uses

SRS does not use the water table aquifer (UTRA) or surface water for drinking water, hygiene, recreation, or process water and currently controls any well drilling in this area. Water from the UTRA is not currently used for any purpose at SRS. Groundwater and surface water are not used for agricultural purposes (i.e., irrigation) at SRS.

This page intentionally left blank.

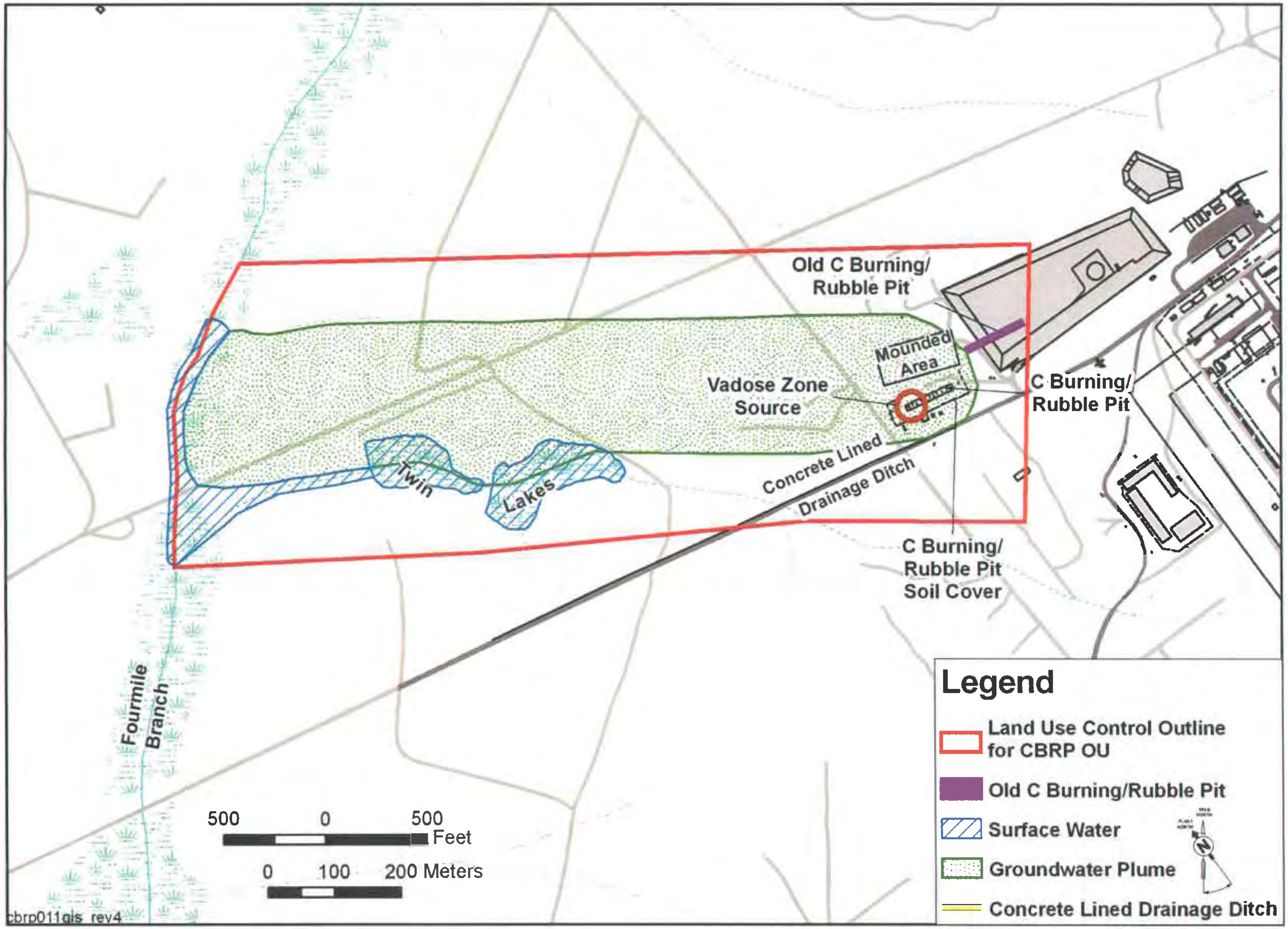


Figure 8. Land Use Map for CBRP OU

This page was intentionally left blank.

Surface water in the Twin Lakes wetland and Fourmile Branch is not used for any purpose where significant human exposure might occur (i.e., drinking water supply or hygiene, agricultural, process, or recreational purposes) at SRS. However, Fourmile Branch water does feed into the Savannah River, which may be used for recreational and agricultural purposes outside of SRS and as a source of drinking water for distant downstream communities. There were no exceedances of MCLs in surface water associated with the CBRP OU in the latest round of surface water sampling (May 2007).

VII. SUMMARY OF OPERABLE UNIT RISKS

Baseline Risk Assessment

An RFI/RI/BRA was performed to assess the risk to human health and the environment posed by the CBRP OU (WSRC 2002a). As a component of the RFI/RI process, a BRA was performed to evaluate risks associated with the CBRP OU. The BRA estimates the magnitude of human health and ecological risks and the threat posed by future leaching to groundwater if no action were taken. It provides the bases for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. The BRA includes human health and ecological risk assessments. This section summarizes the results of the risk assessment for the CBRP OU subunits.

Summary of Human Health Risk Assessment

Human health risks were assessed for current and future land use scenarios. The potentially exposed receptor under the current land use scenario is the known on-unit worker. The potentially exposed receptors under the future land use scenario are the hypothetical industrial worker and the hypothetical resident (adult and child). Existing land use controls (LUCs) will ensure protection against unrestricted (i.e., residential) use.

The human health risk assessment (WSRC 2002a) considered both current and future land uses and the individuals who are likely to be exposed currently and in the future. Current exposures based on surface soil data were evaluated for an industrial worker who may occasionally be in the area working under existing ICs. Future exposures were evaluated for a more frequently exposed industrial worker and for residents. The most likely future land use for the CBRP OU is industrial and the most likely human health exposure scenario is the future industrial worker. The probable exposure routes for the future industrial worker at the CBRP OU are ingestion of contaminated media and dermal exposure to contaminated media, and ingestion of contaminated groundwater.

Current Land Use

No human health RCOCs were identified for the current land use scenario (on-unit worker) for surface soil, the vadose zone soil, groundwater, or surface water.

Future Land Use

At the CBRP OU, no human health RCOCs were identified for the surface soil exposure group for the future industrial worker. One CM RCOC, TCE, was recognized for the vadose zone. HH RCOCs and/or ARAR RCOCs were identified in groundwater and surface water. Table 1 summarizes the analytical results for the RCOCs, medium-specific exposure point concentrations, and status of the RCOC. Table 2 summarizes the cancer toxicity data for the groundwater RCOCs. Table 3 summarizes cancer risk and hazard quotient (HQ) for the RCOCs by subunit and medium and the medium-specific RGOs. Table 1 Summary of Analytical Results for Refined Constituents of Concern, Medium-specific Exposure Point Concentrations, and Status.

Table 1. Summarizes the Analytical Results for the RCOCs, Medium-Specific Exposure Point Concentrations, and Status of the RCOC

Exposure Timeframe: Current/Future							
Exposure Scenario: Current On-unit Worker/Hypothetical Industrial Worker/Ecological Receptor (burrowing mammal)							
Medium	**RCOC**	**Frequency of Detection**	**Minimum Detection**	**Maximum Detection**	**Exposure Point Concentration**	**Statistical Measure**	**Status**
Soil 0-1 ft	HpCDD	1/4	1.2 µg/kg	1.2 µg/kg	1.01 µg/kg	95% UCL	Eco RCOC
Vadose	TCE	20/80	1.21 µg/kg	286 µg/kg	NA	NA	CM RCOC
Groundwater	PCE	34/102	0.61 µg/L	7.65 µg/L	1.66 µg/L	* RME	ARAR RCOC
	TCE	10/14	4.4 µg/L	1660 µg/L	1660 µg/L	Maximum	HH RCOC
	DCM	1/15	43.5 µg/L	43.5 µg/L	8.75 µg/L	95% UCL	ARAR RCOC
	DCE	3/120	1.18 µg/L	5.4 µg/L	0.482 µg/L	* RME	HH RCOC
	cDCE	19/33	12 µg/L	960 µg/L	168 µg/L	* RME	HH RCOC
	VC	6/120	3.59 µg/L	180 µg/L	6.04 µg/L	* RME	HH RCOC
Surface water	PCE	4/12	0.565 µg/L	7.06 µg/L	1.98 µg/L	95% UCL	ARAR RCOC
	TCE	6/12	0.62 µg/L	26.2 µg/L	6.48 µg/L	95% UCL	ARAR RCOC
	VC	4/12	0.984 µg/L	37.1 µg/L	9.03 µg/L	95% UCL	ARAR RCOC
* RME	data gap reasonable maximum exposure						
ARAR RCOC	applicable or relevant and appropriate requirement refined constituent of concern, exceeded MCL						
CM RCOC	contaminant migration RCOC						
Eco RCOC	ecological RCOC						
HH RCOC	human health RCOC						
UCL	Upper Confidence Limit						
Note: RFI/RI field investigations were conducted from August 1995 to February 1996; during May 1996, January 1997, and July 1997; June 1998 (RFI/RI surface water/sediment samples); from May 2000 to August 2000 (Data Gap investigation); from September 2000 to March 2001 (MNA characterization); and from April 2001 to July 2001 (Old CBRP investigation).							

Table 2. Cancer Toxicity Data Summary for the Groundwater RCOCs

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater
Pathway:	Ingestion
Exposure Point:	Water Table Well – Tap
Receptor:	Future Industrial Worker
Receptor Age:	Adult

RCOC	Oral Cancer Slope Factor*	USEPA Weight of Evidence Classification	Cancer Risk
PCE	5.20E-02 kg-day/mg	--	3.02E-07
TCE	1.10E-02 kg-day/mg	--	6.4E-05
DCM	7.50E-03 kg-day/mg	B2	2.10E-07
DCE	6.00E-01 kg-day/mg	--	1.01E-06
cDCE	--	--	--
VC	1.90E+00 kg-day/mg	--	4.01E-05
Total Medium Risk for Groundwater Ingestion			1.06E-04

* Source of Slope Factor: USEPA Integrated Risk Management System (IRIS) Database, March 1996. Slope Factor for TCE was a provisional value provided by the Superfund Technical Support Center

Table 3. CBRP RCOCs by Medium and Subunit with Risk and Hazard Quotient and Remedial Goals Options

Media	Subunits	RCOCs	Basis/Receptor	Risk/HQ	RGO
Soil	Disposal Pit	HpCDD	Ecological hazard to small burrowing animals (shrew)	14.3	0.07 µg/kg
	Vadose Zone	TCE	CM RCOC, exceeds MCL in <10 yrs	*	58 µg/kg
Groundwater	Groundwater Plume	PCE	ARAR RCOC, exceeds MCL	**	5 µg/L
		TCE	Risk/hazard to future industrial worker, exceeds MCL	6.4E-05/ 2.7	5 µg/L
		DCM	ARAR RCOC, exceeds MCL	**	5 µg/L
		DCE	Risk to future industrial worker	1.01E-06	7 µg/L
		cDCE	Hazard to future industrial worker	0.164	70 µg/L
		VC	Risk to future industrial worker	4.01E-05	2 µg/L
Surface Water	Twin Lakes	PCE	Exceeds surface water ARAR (MCL)	**	5 µg/L
		TCE	Exceeds surface water ARAR (MCL)	**	5 µg/L
		VC	Exceeds surface water ARAR (MCL)	**	2 µg/L
	Fourmile Branch	VC	Exceeds surface water ARAR (MCL)	**	2 µg/L

Risk and hazard for most likely future human health exposure scenario (future industrial worker)
* CM RCOC, determined based on MCL exceedance, not risk-based
** ARAR RCOC due to MCL exceedance, not risk-based

Disposal Pit Soils and Vadose Zone

HpCDD was found in the surface soils of the disposal pit. Risk for future industrial workers is less than 1.0E-06 for HpCDD. HpCDD is an ecological RCOC in surface soil; the HQ for small burrowing animals (shrews) is 14.3. Dioxins are products of incomplete combustion so the dioxins found in the pit may have been the result of waste burning during operation.

A TCE source was found in vadose zone soils between 25 and 30 ft bgs at the west end of CBRP (Figure 2). TCE exceeds its MCL in the groundwater and so TCE in the vadose zone source is defined as a CM RCOC. The minimum recovery rate to control the VOC source at CBRP is 1.8 lb/yr. The solar-powered, active MicroBlower™ system recovers an average of 50 lb/yr (WSRC 2005).

Groundwater Plume

Total media carcinogenic risk for groundwater is 1.06E-04 to the future industrial worker as shown in Table 2. The anticipated future land use scenario for C Area and the CBRP OU is industrial.

Surface Water

PCE, TCE, and VC have exceeded MCLs in surface water in the Twin Lakes and Fourmile Branch wetlands and are identified as ARAR RCOCs. None of the ARAR RCOCs exceeded their MCLs in 2007. No constituents with human health risks greater than 1.0E-06 were found in the Quaternary sediments in Fourmile Branch.

VIII. REMEDIAL ACTION OBJECTIVES AND REMEDIAL GOALS

RAOs are unit-specific goals that establish the extent of cleanup required to protect human health and the environment and to mitigate the effects of contamination. RAOs are based on an evaluation of ARARs and to-be-considered (TBC) requirements [CERCLA 121(d)(2)(A)].

These RAOs are intended to protect future industrial workers and ecological receptors from the RCOCs in the media of the CBRP OU subunits. The RGOs for CBRP OU are contaminant concentrations in subunit soils that will not leach to groundwater above the MCLs. The MCLs are the chemical-specific ARARs for groundwater and surface water. The RGOs are listed in Table 3. Potential ARARs for CBRP OU are summarized in Table 4.

Disposal Pit Surface Soil

The RAO for surface soil in CBRP is: Prevent exposure of ecological receptors to HpCDD in the pit surface soils.

The RGO for HpCDD as an ecological RCOC is 0.07 µg/kg (Table 3).

Vadose Zone beneath CBRP

The RAO for vadose zone beneath CBRP is: Prevent migration of TCE vapor from vadose zone soils to groundwater at levels that will exceed the MCL.

The RAO for TCE has been attained due to the IA soil cover, SVE system, and AS system. The RGO for TCE as a CM RCOC is 58 µg/kg.

Table 4. Summary of the Potential ARARs for the CBRP OU

Location-Specific ARARs				
Location	**Citation**	**Synopsis**	**Status**	**Remedial Alternative**
Wetlands	Section 404 of the Clean Water Act	For action involving construction of facilities or management of property in wetlands.	Applicable if remedial activities impact wetlands	GW-2, GW-3, GW-4, SW-3
Surface Water and Groundwater	SC.R.61-68 SC Water Classification and Standards	Establishes general rules for protection of classified and existing water use.	Relevant and appropriate classification of groundwater and surface water	GW-1, GW-2, GW-3, GW-4, SW-1, SW-2, SW-3
CBRP	SC.R.61-79.265	Establishes closure and post closure care for hazardous waste disposal facilities	Relevant and appropriate for the disposal pit and contaminated groundwater	All Alternatives
Chemical-Specific ARARs				
Chemical	**Citation**	**Synopsis**	**Status**	**Remedial Alternative**
PCE, TCE, cDCE, DCE, VC, DCM	SC.R.61-68 SC Water Classification and Standards	Establishes quantitative criteria for protection of human health	Relevant and appropriate MCLs	All
Hazardous waste	SC R.61-79	Defines criteria for determining RCRA hazardous waste and disposal requirements	Applicable for waste removed from the area of contamination	S-4, GW-2, GW-3, GW-4
Action-Specific ARARs				
Action	**Citation**	**Synopsis**	**Status**	**Remedial Alternative**
Air Quality Standards	40Code of Federal Regulation (CFR)50, 40CFR60, 40CFR61, 40CFR63 Subpart G SC R.61-62.5	Identifies allowable air concentrations and permit requirements for air emissions of toxic chemicals from new and existing sources.	Applicable for emissions of VOCs	S-2, S-3, GW-4
Underground Injection Permit	SC R.61-87	Provides authority for permits to ensure that all underground injection systems are designed and operated in a manner that is protective of groundwater quality.	Applicable for subsurface injection	S-3, GW-3, GW-4

Table 4. Summary of the Potential ARARs for the CBRP OU *(Continued)*

Action-Specific ARARs				
Action	**Citation / Title**	**Synopsis**	**Comments**	**Remedial Alternative**
Land Disturbance	SC R.72-300	Stormwater management and sediment control	Applicable for any land disturbance activity	S-4
Well installation	SC R.61-71 South Carolina Well Standards	Requirement for installation of monitoring wells	Applicable for groundwater monitoring	GW-2, GW-2, GW-4
Surface water impact	Section 401 of the Clean Water Act	Establishes requirements for discharges to surface water and wetlands	Applicable for discharges that may impact surface water quality	SW-3

Groundwater Plume

The RAOs for groundwater are:

- Treat and/or mitigate groundwater contaminated above MCLs.
- Prevent human exposure to groundwater contaminated with TCE and PCE above MCLs of 5.0 μg/L.
- Reduce the concentration of TCE and PCE in the groundwater to levels at or below MCLs and attenuate the groundwater plume to the extent practicable.
- Prevent discharge of contaminated groundwater to surface water resulting in concentrations exceeding their MCLs.

The RGOs for groundwater are the MCLs: 5.0 μg/L for PCE, 5.0 μg/L for TCE, 7.0 μg/L for DCE, 70.0 μg/L for cDCE, 2.0 μg/L for VC, and 5.0 μg/L for DCM.

Surface Water

The RAO for surface water is: Reduce the levels of TCE, DCE, and VC in surface water at or below the MCLs.

The RGOs for surface water are the MCLS: 5.0 μg/L for PCE, 5.0 μg/L for TCE, and 2.0 μg/L for VC.

IX. DESCRIPTION OF ALTERNATIVES

Remedy Components, Common Elements, and Distinguishing Features of Each Alternative

This section summarizes the remedial alternatives studied in the detailed analysis phase of the CBRP OU FCMS/FS (WSRC 2004a). In accordance with the National Oil and Hazardous Substances Contingency Plan (NCP), it is desirable, when practical, to offer a range of diverse alternatives to compare during the detailed analysis. The range of alternatives includes options that (1) immobilize chemicals, (2) reduce the contaminant volume, or (3) reduce the need for long-term, onsite management. Some alternatives have been developed that involve little or no treatment yet provide protection to human health and the environment by preventing or controlling exposure to or migration of the contaminants through engineered methods or ICs.

Remedial alternatives were developed to address contamination in surface soils, vadose zone soils, groundwater, and surface water (Table 5). Alternatives that remediate contaminants in soil can effectively reduce contaminants in groundwater. Likewise, alternatives that remediate contaminants in groundwater will reduce contaminants in surface water. All three media are intimately connected. A combination of soil, groundwater, and surface water alternatives is necessary to ensure remediation.

Table 5. Remedial Alternatives

Disposal Pit Surface Soil Subunit	Vadose Zone Subunit	Groundwater Plume Subunit	Surface Water Subunit
(S-1) No Action	**(S-1)** No Action	**(GW-1)** No Action	**(SW-1)** No Action
(S-2) Maintain Existing Soil Cover System constructed during the IA	**(S-2)** Continued Operation of SVE System with Maintenance of Soil Cover	**(GW-2)** ICs and Monitored Natural Attenuation	**(SW-2)** ICs and Monitored Natural Attenuation
	(S-3) Thermal Desorption to remove TCE Residual Source with electrical resistance heating (ERH)	**(GW-3)** Zero-valent Iron Reactive Barrier Wall near Fourmile Branch	**(SW-3)** Lakebed Zero-valent Iron Reactor in the Lower Twin Lakes wetland
	(S-4) Excavation and Removal of TCE Residual Source	**(GW-4)** Optimized Reactive Iron Recirculation Wells	

All the alternatives presented, with the exception of the no action alternatives, have a common set of ICs. These ICs include the installation of signs and fences, or the construction of other barriers to restrict access. Land use restrictions such as excavation permit and deed restrictions will be used to restrict activities that can be performed at CBRP OU. In compliance with South Carolina regulations, all monitoring wells are locked to prevent access to groundwater or tampering, and the integrity of the monitoring wells is maintained.

Alternatives for Disposal Pit Soils and Vadose Zone beneath CBRP

<u>Alternative S-1. No Action</u>

As required by the NCP, the No Action alternative (S-1) is provided as a baseline for comparison. No action is taken to restrict access, limit exposure, or reduce contaminant concentrations, volume, or mobility; ICs are not maintained, and monitoring and reporting are not conducted. No resources would be expended in reducing contamination, and contaminants would deteriorate naturally.

Parameter	S-1
Estimated capital cost	$0
Present worth operations and maintenance (O&M) cost	$0
Total estimated cost	$0
Time to implement	0 months
Approximate operating time	Not applicable

Alternative S-2: Continued Operation of SVE System with Maintenance of Soil Cover

The SVE system has been converted to an active, solar-powered MicroBlower™ system. A MicroBlower™ is an active, low power SVE unit, powered by a 24-volt solar panel-battery bank which allows the unit to operate 24 hours per day. MicroBlowers™ can either be used to remove or inject volatile nutrient compounds in the vadose zone. MicroBlowers™ are capable of generating a maximum vacuum of 10.2 inches of water and a maximum flow rate of 18 standard cubic feet per minute (scfm) per well. MicroBlowers™ may be applicable to polishing efforts after conventional SVE has removed the majority of contamination, when mass transfer limits effectiveness of conventional SVE systems, or for small, shallow targets. MicroBlower™ systems are characterized by low operation and maintenance costs. The first MicroBlower™ was installed at the SRS A-Area Ash Trench in April 2002.

The CBRP MicroBlower™ system has recovered about 50 lb of TCE annually since December 2004. This system will continue to remove organic vapor from the vadose zone soils by withdrawing contaminants in the vapor phase. The minimum extraction rate to maintain control of the TCE source is 1.8 lb/yr (WSRC 2005). Before the IA SVE was implemented in 1999, TCE concentrations in the groundwater ranged as high as 130,000 µg/L in the source area. By June 2003, TCE concentrations beneath the source area were less than 1,000 µg/L. The interim remedial action (IRA) has reduced TCE concentrations in the groundwater to less than 1% of the pre-IRA levels in about four years and has recovered a total of 2,100 lb of VOCs. The MicroBlower™ system was specifically designed to prevent vadose zone vapor-phase contaminants from migrating to groundwater.

The present worth (PW) costs for Alternative S-2 included operating the MicroBlower™ system and maintaining the soil cover.

Parameter	S-2
Estimated capital cost	Previously installed
Present worth O&M cost-Soil Cover Maintenance	$273,000
Present worth O&M cost-MicroBlower™ System	$430,000
Total estimated cost	$703,000
Time to implement	0 months
Approximate operating time	5 years-MicroBlower™ SVE

Alternative S-3: Thermal Desorption to remove Residual Source with Electrical Resistance Heating

Alternative S-3 is only effective for the secondary VOC source in the vadose zone soil. Electrical resistance heating (ERH) is a generic term for in situ thermal desorption by using the flow of electrical current through resistant soil materials to heat the contaminated soil and drive off VOC contaminants in the vapor phase. The vapor phase is recovered by SVE wells and brought to the surface for treatment. ERH is particularly effective in removing recalcitrant organic compounds from fine-grained, low permeability strata, which are actually more conductive and heat up more rapidly than clean, coarse-grained, high permeability lithologies. ERH has been implemented in more than 22 demonstrations and large-scale deployments for a variety of organic compounds; the average contaminant recovery efficiency has been greater than 98% in less than 120 days.

Parameter	S-3
Estimated capital cost	$2,817,000
Present worth O&M cost-ERH	$808,000
Present worth O&M cost- Soil Cover Maintenance	$274,000
Total estimated cost	$3,899,000
Time to implement	10 months
Approximate operating time	0.5 years

Alternative S-4: Excavation and Removal of Residual TCE Source

Alternative S-4 is only effective for the secondary VOC source in the vadose zone soil. Contaminated soil in the vadose zone would be excavated and removed for passive aeration and disposal at SRS (S-4a) or excavated and removed for off-site disposal (S-4b). Soil between 17 and 27 ft bgs would be excavated from an area approximately 30 by 60 ft.

The disposal pit soil is beneath the IRA soil cover. Surface soils at the disposal pit contained concentrations up to 2.6 μg/kg HpCDD, and contaminated soils would have to be segregated and returned to the pit for disposal since no waste disposition path could be identified to treat or dispose of dioxin-contaminated soils. The soil cover would be restored and maintained.

Parameter	S-4a	S-4b
Estimated capital cost	$969,000	$2,135,000
Present worth O&M cost-Excavation and Removal	$328,000	$328,000
Present worth O&M cost-Soil Cover Maintenance	$273,000	$273,000
Total estimated cost	$1,570,000	$2,736,000
Time to implement	6 months	6 months
Approximate operating time	6 months	6 months

Alternatives for Groundwater Plume

Alternative GW-1. No Action

As required by the NCP, the No Action alternative (GW-1) is provided as a baseline for comparison. Under this alternative, no remedial activities would be conducted to remove, treat, or otherwise lessen the toxicity, mobility, or affected volume of contaminated groundwater. Existing administrative controls associated with SRS would be discontinued under this No Action scenario, and groundwater monitoring would be discontinued. This alternative assumes that the unit would be released for unrestricted use. The No Action case assumes there is no source control of the original TCE source.

Parameter	GW-1
Estimated capital cost	$0
Present worth O&M cost	$0
Total estimated cost	$0
Time to implement	0 months
Approximate operating time	Not applicable

Alternative GW-2: Institutional Controls and Monitored Natural Attenuation

Under this alternative no additional active treatment technology would be used. This alternative assumes that source control is continued with a maintained soil cover and active MicroBlower™ SVE system (Alternative S-2). This alternative takes advantage of the high natural degradation of organic contaminants by biotic reductive dechlorination and mineralization occurring in the biomantle of the Twin Lakes and Fourmile Branch wetlands.

The degradation rate calculated from samples collected in Twin Lakes wetland monitoring wells in 2000 was approximately 4.5/yr (WSRC 2002a). These shallow well pairs have been sampled several times since 2000 and the degradation rate has remained constant. TCE is being consumed in the sediment at a rate of 98.9% as contaminated groundwater flows upward through approximately 5 ft of biologically active sediment in the wetlands and mixes with surface water. The absence of TCE and reduced concentrations of daughter products in some of the wetland monitoring wells indicate that TCE is being completely destroyed by naturally occurring processes.

A monitoring and reporting program for groundwater would be implemented and an effectiveness monitoring plan would be developed in the corrective measures implementation/remedial action implementation plan (CMI/RAIP). Monitoring would continue until contaminant concentrations reach acceptable levels as defined by the RGOs.

Costs associated with Alternative GW-2 include labor and materials to reassess the groundwater model periodically, conduct required groundwater monitoring, perform monitoring reporting, maintain monitoring wells, and maintain administrative controls. Costs are estimated for a 70-year O&M period to degrade contamination in the TCE groundwater plume down gradient of the controlled source. Based on groundwater modeling (WSRC 2001b, WSRC 2002b, and WSRC 2003a), 70 years is the timeframe required for the plume which originates beneath the disposal pit to be depleted below RGOs throughout its length and degraded below RGOs in the biomantle in the Twin Lakes drainage and along Fourmile Branch.

Parameter	GW-2
Estimated capital cost	$112,000
Present worth O&M cost	$493,000
Total estimated cost	$605,000
Time to implement	0 months
Approximate operating time	70 years

Alternative GW-3: Zero-valent Iron Reactive Barrier Wall near Fourmile Branch

GW-3 is an in situ zero-valent iron barrier wall at Fourmile Branch to remediate organic contaminants by passive in situ abiotic reductive dechlorination. A major concern for the long-term effectiveness of zero-valent iron reactive systems is loss of porosity and permeability due to mineral precipitation or biofouling. This alternative will be able to completely degrade TCE contamination to ethylene and ethane in about 70 years. However, the barrier wall will not treat TCE concentrations released to the Twin Lakes wetland. Depth limitations for a conventional trench and fill barrier wall preclude a location up gradient of the Twin Lakes wetland. High capital costs incurred during installation are offset by low O&M costs over the lifetime of the project.

Parameter	GW-3
Estimated capital cost	$7,636,000
Present worth O&M cost	$395,000
Total estimated cost	$8,031,000
Time to implement	9 months
Approximate operating time	70 yrs

Alternative GW-4: Optimized Reactive Iron Recirculation Wells

The GW-4 alternative is the reactive iron recirculation well, an innovative technology. A reactive iron cell is installed in an over-sized borehole, and combined with recirculation well technology, which returns treated water to the aquifer. Contaminated groundwater is drawn through the treatment cell surrounding the well bore (essentially an over-sized, zero-valent iron sand pack) by a submersible pump. The treated water is returned to the aquifer. Based on modeling predictions, this alternative can attain MCLs in 70 years.

Parameter	GW-4
Estimated capital cost	$1,922,000
Present worth O&M cost	$2,676,000
Total estimated cost	$4,598,000
Time to implement	6 months
Approximate operating time	70 yrs

Alternatives for Surface Water

Alternative SW-1. No Action

As required by the NCP, the No Action alternative (SW-1) is provided as a baseline for comparison. Under this alternative, no remedial activities will be conducted to remove, treat, or otherwise lessen the toxicity, mobility, or affected volume of contaminated groundwater emerging in the wetlands. Existing administrative controls associated with SRS would be discontinued under this No Action scenario. This alternative assumes that the unit would be released for unrestricted use and that there is no source control of the original TCE source.

Parameter	SW-1
Estimated capital cost	$0
Present worth O&M cost	$0
Total estimated cost	$0
Time to implement	0 months
Approximate operating time	Not applicable

Alternative SW-2: Institutional Controls and Monitored Natural Attenuation

Alternative SW-2 is very similar to Alternative GW-2; under this alternative no active treatment technology would be used. This alternative assumes that source control is continued with a maintained soil cover and active MicroBlower™ SVE system (Alternative S-2). This alternative takes advantage of the high natural degradation of organic contaminants in the emerging groundwater by biotic reductive dechlorination and mineralization occurring in the biomantle of the Twin Lakes and Fourmile Branch wetlands. The only difference is that the medium under the ICs is surface water. Monitoring would consist of surface water sampling at permanent surface water sampling stations and trend evaluation for parent (PCE and TCE) and daughter products (cDCE and VC).

The PW costs for monitoring and ICs are estimated for 70 years until the plume is depleted. Based on groundwater modeling (WSRC 2001b, WSRC 2002b, WSRC 2003a), 70 years is the time frame required for the plume beneath the disposal pit to migrate to Fourmile Branch. The southern portion of the CBRP TCE groundwater plume will have migrated to the Twin Lakes wetland over the next 10 years.

Parameter	SW-2
Estimated capital cost	\$112,000
Present worth O&M cost	\$493,000
Total estimated cost	\$605,000
Time to implement	0 months
Approximate operating time	70 years

Alternative SW-3: Lakebed Zero-valent Iron Reactor in the lower Twin Lake

Zero-valent iron technology would be used to convert the lower Twin Lakes wetland into a lakebed reactor. A funnel and gate type of soil and zero-valent iron berm would be installed on the surface across the lower Twin Lake at the former dam for the lower Twin

Lake. The compacted soil funnel would direct contaminated surface water through the reactive granulated iron gate, and VOC contaminants would be reductively dechlorinated.

Costs associated with Alternative SW-3 include labor and materials to install the berm and reactive iron gate. Alternative SW-3 will not treat any of the groundwater discharges to surface water from the plume into Fourmile Branch. Therefore, O&M costs, consisting primarily of surface water monitoring and inspections after major rainfall events, are also estimated for a 70-year period.

Parameter	SW-3
Estimated capital cost	$524,000
Present worth O&M cost	$150,000
Total estimated cost	$674,000
Time to implement	2 months
Approximate operating time	70 yrs

X. COMPARATIVE ANALYSIS OF ALTERNATIVES

A set of nine criteria established by the NCP is used to compare alternatives. The criteria were derived from the statutory requirements of CERCLA Section 121. The NCP [40 CFR § 300.430 (e) (9)] sets forth nine evaluation criteria that provide the basis for evaluating alternatives and selecting a remedy. The nine criteria are categorized into three groups: threshold criteria, primary balancing criteria, and modifying criteria. The threshold criteria must be satisfied for an alternative to be eligible for selection. The primary balancing criteria are used to weigh major tradeoffs among the alternatives. The modifying criteria consider public and regulatory acceptance. The criteria are listed below:

Threshold Criteria

1) overall protection of human health and the environment;
2) compliance with ARARs;

Primary 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; and

9) community acceptance.

Seven of the criteria (threshold and primary balancing criteria) are used to evaluate all the alternatives based on human health and environmental protection, cost, and feasibility issues. The preferred alternative is further evaluated under the final two criteria: state acceptance and community acceptance, based on comments during the public review period. Brief descriptions of all nine criteria are given below.

The alternatives for each subgroup/environmental medium are grouped together for comparison. In the interest of brevity, the general discussion of the criteria only appears in the comparative analysis for the first subunit/environmental medium (disposal pit surface soils and vadose zone).

The comparisons are also presented in tables by subunit/environmental medium. The summary table for each subunit/environmental medium follows the comparative analysis of that subunit/environmental medium in the text.

Comparison of Threshold and Primary Balancing Criteria for the Soil Alternatives: Disposal Pit Soils and the Vadose Zone beneath CBRP Subunits

See threshold and primary balancing criteria summary for the disposal pit surface soils and the vadose zone beneath CBRP subunits in Table 6.

1. Overall Protection of Human Health and the Environment – The remedial alternatives are assessed to determine the degree to which each alternative eliminates, reduces, or controls threats to human health and the environment through treatment, engineering methods, or ICs.

Alternative S2 provides the best overall protection for both of the soils subunits in that the soil cover and the active solar-powered MicroBlower™ SVE system have already been installed in the IA. The soil cover provides a barrier to prevent exposure of human and ecological receptors to the dioxin-contaminated soils in the disposal pit and the MicroBlower™ SVE system actively removes VOCs from the vadose zone. The MicroBlower™ system is recovering about 50 lb of VOCs/yr; an extraction rate of 1.8 lb/yr is required to control the vadose zone TCE source. Alternative S-3, thermal desorption with ERH, would provide a very good level of overall protection by heating the recalcitrant vadose zone source and driving the VOC contaminants into the vapor phase which can be removed by the SVE system. Installation of electrode wells presents the risk of exposure of on-site workers. Alternative S-4, removal and disposal, would provide a good level of protection as the vadose zone source material would be entirely removed. However, the dioxin-contaminated soil would have to be removed and stockpiled and then returned to the disposal pit when the vadose zone source is removed. On-site workers may be exposed to contaminated soils from both the shallow zone and the vadose zone. Alternatives S-2, S-3, and S-4 all use ICs to prevent human exposure. The existing ICs would be discontinued under S-1. Alternative S-1, No Action, does not provide any additional protection beyond that provided by the facilities installed in the IA from either of the bodies of contaminated soil. Since cap inspections and maintenance would be discontinued under S1, the soil cover could be breached, exposing on-site workers and ecological receptors to the dioxin-contaminated soil. The operation of the MicroBlower™ system would be suspended, and the TCE source would no longer be controlled but could migrate to groundwater.

2. Compliance with ARARs – ARARs are federal and state environmental regulations that establish standards that remedial actions must meet unless waived consistent with the

NCP. There are three types of ARARs: (1) chemical-specific, (2) location-specific, and (3) action-specific.

Chemical-specific ARARs are usually health- or risk-based levels or methodologies that, when applied to unit-specific conditions, result in the establishment of numerical values. Often these numerical values are promulgated in federal or state regulations. RGOs for the CBRP OU are based on chemical-specific ARARs (Tables 3 and 4).

Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in specific locations. Some examples of specific locations include floodplains, wetlands, historic places, and sensitive ecosystems or habitats.

Action-specific ARARs are usually technology- or remedial activity-based requirements or limitations on actions taken with respect to hazardous substances or unit-specific conditions. These requirements are triggered by the particular remedial activities selected to accomplish a remedy.

In addition to ARARs, compliance with other criteria, guidance, and proposed standards that are not legally binding but may provide useful information or recommended procedures should be reviewed as TBC when setting remedial objectives.

Chemical-Specific ARARs: There are no chemical-specific ARARs for dioxins or VOCs in soils. RAOs have been developed and are appropriate for the soils. Alternative S-2 has already achieved the RAO for the dioxin-contaminated soil with the soil cover and the RAO for the vadose zone by breaking the migration pathway of vapor phase VOCs to groundwater. S-3 would meet the RAO for the vadose zone contamination by thermal desorption and SVE. S-4 would also meet the RAO for the vadose zone contamination by removing the fine-grained source material and the VOC contamination. S-3 would cause less disturbance of the existing soil cover than S-4 and so would rate higher than S-4 for the shallow soil RAO. The No Action Alternative S-1 would not meet either RAO after soil cover inspections and maintenance are suspended and the MicroBlower™ system is shut down.

Location-Specific ARARs: Alternatives S-2, S-3, and S-4 are all consistent with the post-closure care ARAR; S-1 does not meet this ARAR.

Action-specific ARARs: Air quality standards would be applicable to both S-2 and S-3 since the MicroBlower™ SVE system operates with lower contaminant volumes over a longer period of time, about five years as compared to four months for ERH. S-2 will be easier to operate in compliance. S-4, Excavation and removal, will have to comply with land disturbance ARARs to control dust and soil erosion. If S-4 is selected with the off-site disposal option, it will be necessary to comply with Department of Transportation rules and regulations for transporting hazardous waste. There are no action-specific ARARs applicable to the No Action Alternative S-1.

3. Long-Term Effectiveness and Permanence – The remedial alternatives are assessed based on their ability to maintain reliable protection of human health and the environment after implementation.

Alternatives S-2, S-3, and S-4 are long-term, permanent remedies; all three include provisions for maintenance of the soil cover removal of vadose zone contamination. S-4 would involve removing part of the cap and shallow soils, removing the vadose zone source, and then returning the dioxin-contaminated soil to the CBRP and restoring the soil cover. The No Action Alternative S-1 provides no long-term effectiveness or permanence since no controls are established to prevent breaching of the soil cover, erosion of the soil cover, or termination of the operation of the MicroBlower™ system.

4. Reduction of Toxicity, Mobility, or Volume Through Treatment – The remedial alternatives are assessed based on the degree to which they employ treatment that reduces toxicity (the harmful nature of the contaminants), mobility (the ability of the contaminants to move through the environment), or volume of contaminants associated with the unit.

Alternatives S-2, S-3, and S-4 all involve reducing the volume of VOCs in the vadose zone; they also all include provisions for the soil cover to reduce the mobility of contaminated soil particles and to reduce infiltration and leaching in the waste interval and vadose zone. The No Action Alternative S-1 does not reduce the toxicity, mobility, or volume of contaminants.

5. Short-Term Effectiveness – The remedial alternatives are assessed considering factors relevant to implementation of the remedial action, including risks to the community during implementation, impacts on workers, potential environmental impacts (e.g., air emissions), and the time until protection is achieved. Remedial worker exposure is minimized and maintained below occupational-health criteria through the proper use of engineering controls, procedures, appropriate personal protective equipment, site monitoring, and adherence to a health and safety plan.

There is no risk to on-site workers for Alternative S-2 because all of the components for this remedy are already in place and S-2 has already met the RAOs. There will be some risk to on-site workers during installation of the ERH system for S-3 and during excavation for S-4. These risks include exposure to high voltage, exposure to carcinogenic VOCs, and heavy equipment. Implementation of the No Action Alternative S-1 presents no short-term risk to on-site workers, the community, or the environment. In the short term, No Action is not effective in reducing contaminant concentrations.

S-2 will operate at least another five years to remove the VOCs from the vadose zone, but S-2 has already met the RAO for the vadose zone by preventing migration of VOCs to groundwater. The approximate O&M time for Alternative S-3 is about one year including installation time, and S-4 will require approximately one year to excavate and dispose of the vadose zone source. Based on depletion of the vadose zone source to groundwater, S-1 will require about 70 years for the aquifer to purge itself due to flow rates in the saturated zone.

6. Implementability – The remedial alternatives are assessed by considering the difficulty of implementing the alternative, including technical feasibility, constructability,

reliability of technology, ease of undertaking additional remedial actions (if required), monitoring considerations, administrative feasibility (regulatory requirements), and availability of services and materials.

No construction is required for the No Action Alternative S-1 or the existing MicroBlower™ SVE system, S-2, so they could be implemented immediately. Implementation of Alternatives S-3 and S-4 is achieved through conventional construction equipment, materials, and methods that are readily available; these alternatives can be implemented in 3 to 6 months.

7. Cost – The evaluation of remedial alternatives must include capital and O&M costs. Present value costs are estimated within +50/-30% according to USEPA guidance, with a graduated discount factor for increasing O&M time (2.1% for 0 to 3 years, 2.8% for 4 to 5 years, 3.0% for 6 to 7 years, 3.1% for 8 to 10 years, and 3.9% for 11 years or longer). Discount rates are from Office of Management and Budget [OMB] Circular No. A-94, Appendix C, 2006 (OMB 2006). The 2006 annual review of ERTEC-2002-00011 versus OMB 2006 found that changes to discount rates for more recent years were not enough to warrant revising ERTEC-2002-00011 at this time. The cost estimates given with each alternative are prepared from the best information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final project schedule, and other variable factors. As a result, the final project costs may vary from the estimates presented herein.

The total PW costs of soil alternatives range from $0 (S-1) to $3.9 million (S-3). PW costs for all alternatives are shown in the following insert:

Alternative	Cost
Disposal Pit Surface Soils and Vadose Zone	
S-1: No Action (Surface Soil and Vadose Zone)	$0
S-2: Continued Operation of MicroBlower™ System (Vadose Zone) with Maintenance of Soil Cover (Surface Soil)	$703,000
S-3: Thermal Desorption with ERH (Vadose Zone)	$3,899,000
S-4a: Excavation and Removal, with on-site aeration and disposal (Vadose Zone)	$1,570,000
S-4b: Excavation and Removal, with off-site disposal (Vadose Zone)	$2,736,000

8. State Acceptance – SCDHEC approval of the proposed action in the SB/PP constitutes acceptance of the selected remedy.

9. Community Acceptance – The community acceptance of the preferred alternative is assessed by giving the public an opportunity to comment on the remedy selection process. A public comment period was held between October 15, 2007, and November 29, 2007; no comments were received. Had SRS received public comments concerning the proposed remedy, the comments and responses would have been incorporated in the *Responsiveness Summary* in Appendix A of this ROD.

Table 6. Comparison of Soil Alternatives against the Threshold and Primary Balancing Criteria

Criterion	S-1. No Action	S-2. Continued Operation of MicroBlower™ System with Maintenance of Soil Cover	S-3. Thermal Desorption with ERH	S-4. Excavation and Removal
1. Overall Protectiveness				
Human Health	Not protective of future resident	Protective. Organic contaminants are removed or covered, pathway for surface soils incomplete.	Protective. Organic contaminants are removed or covered.	Protective. Organic contaminants are removed.
Environment	Not protective of terrestrial plants or small mammals.	Protective. Subsurface contamination removed and pathway to receptors is incomplete.	Protective. Subsurface contamination removed.	Protective. Subsurface contamination removed.
Control of Source Zone	No control. Source material has potential of leaching to groundwater.	Currently controlled and migration pathway to groundwater is broken. Vadose zone contamination is removed. Leaching of deep soil source material to groundwater is currently controlled.	High control. Vadose zone contamination is removed. Leaching of deep soil source material to groundwater is sufficiently decreased.	High control. Vadose zone contamination is removed. Leaching of deep soil source material to groundwater is eliminated.
2. Compliance with ARARs				
Chemical-Specific, Including Attainment of Media Protection Standards (RCRA criterion)	No ARARs exist. RAOs are appropriate. Would not meet these goals.	No ARARs exist. RAOs are appropriate. RAOs have been achieved by treatment of vadose zone contaminants.	No ARARs exist. RAOs are appropriate. Would meet RAOs by treatment of vadose zone contaminants.	Hazardous waste and disposal requirements would be applicable for offsite disposal
Location-Specific	Does not meet the post closure care ARAR.	Consistent with the relevant and appropriate post closure care ARAR.	Consistent with the relevant and appropriate post closure care ARAR.	Consistent with the relevant and appropriate post closure care ARAR
Action-Specific, Including Attainment of Waste Management Standards (RCRA Criterion)	None.	Air Quality Standards would be applicable.	Air Quality Standards, Underground injection and well installation requirement would be applicable.	Land disturbance ARAR would be applicable.

Table 6. Comparison of Soil Alternatives against the Threshold and Primary Balancing Criteria (*Continued*)

Criterion	S-1. No Action	S-2. Continued Operation of MicroBlower™ System with Maintenance of Soil Cover	S-3. Thermal Desorption with ERH	S-4. Excavation and Removal
3. Long-Term Effectiveness and Permanence				
Magnitude of Residual Risks	Residual risk remains above 1.0E-05.	Residual risk is currently reduced to less than 1.0E-06.	Residual risk is significantly reduced to less than 1.0E-06.	Residual risk is significantly reduced to less than 1.0E-06.
Adequacy of Controls	Not adequately protective of human health; ineffective in protecting ecological receptors. Ineffective in preventing contaminant leaching to groundwater.	Adequately protective of human health and ecological receptors as long as soil cover maintenance and ICs are continued. Currently effective in preventing significant contaminant leaching to groundwater.	Adequately protective of human health and ecological receptors as long as soil cover maintenance and ICs are continued. Effective in preventing significant contaminant leaching to groundwater.	Adequately protective of human health and ecological receptors as long as soil cover is restored and maintenance and ICs are continued. Effective in preventing significant contaminant leaching to groundwater.
Permanence	Not permanent. Leaves contaminated surface and subsurface soil onsite. Potential for contaminant leaching to groundwater.	Permanent. Leaves disposal pit soils contaminated with HPCCD at levels (RME=1.01 µg/kg) which are greater than the ecological RGO of 0.07 µg/kg. The industrial worker risk is <1.0E-6. All disposal pit soils are under the soil cover. Residual TCE is trapped in fine-grained, low permeability soils and is not mobile except by vapor diffusion. The MicroBlower™ system is designed to intercept 100% of any downward migrating vapor from the source zone in the future.	Permanent. Leaves disposal pit soils contaminated with HpCDD at levels (RME=1.01µg/kg) which are greater than the ecological RGO of 0.07 µg/kg. The industrial worker risk is <1.0E-6. All disposal pit soils are under the soil cover. Residual TCE is trapped in fine-grained, low permeability soils and is not mobile except by vapor diffusion. The ERH system would leave 1 to 2% of the TCE after remediation.	Permanent. Leaves disposal pit soils contaminated with HpCDD at levels (RME=1.01µg/kg) that are greater than the ecological RGO of 0.07µg/kg. The industrial worker risk is <1.0E-6. All disposal pit soils are under the soil cover. Residual TCE is trapped in fine-grained, low permeability soils and is not mobile except by vapor diffusion. It is estimated the excavation would remove most but not all of the residual TCE.

Table 6. Comparison of Soil Alternatives against the Threshold and Primary Balancing Criteria (*Continued*)

Criterion	S-1. No Action	S-2. Continued Operation of MicroBlower™ System with Maintenance of Soil Cover	S-3. Thermal Desorption with ERH	S-4. Excavation and Removal
4. Reduction of Toxicity, Mobility, or Volume				
Treatment type	No active treatment.	Removes residual TCE source and vapor phase organics in deep soils.	Removes residual TCE source and vapor phase organics in deep soils.	Removes residual TCE source in deep soils.
Degree of Expected Reduction in Toxicity, Mobility, or Volume	No reduction.	Reduction of contaminant toxicity, mobility, and volume in deep soils. Mobility is currently arrested. Volume is currently significantly reduced.	Reduction of contaminant toxicity, mobility, and volume in deep soils.	Reduction of contaminant toxicity, mobility, and volume in deep soils.
Amount of Hazardous Materials Destroyed or Treated	None.	Would treat 43,630 yds^3 of soil and reduce VOC concentration in the vadose zone.	Would treat 43,630 yds^3 of soil and reduce VOC concentration in the vadose zone.	Would remove residual TCE source in vadose zone, 667 yds^3
Degree to Which Treatment is Irreversible	No treatment.	Organic contaminant removal is irreversible.	Organic contaminant removal is irreversible.	Organic contaminant removal is irreversible.
Types and Quantities of Residuals Remaining After Treatment	No treatment.	Residual TCE would remain in the source zone but removed by the MicroBlower™ system.	Minor amounts of TCE would remain in the source zone.	Minor amounts of TCE would remain in the source zone.
5. Short Term Effectiveness				
Risk to Workers	None.	None. Remedy is currently in place and functional.	Low; potential risk due to inhalation or direct contact during installation of wells and extraction of vapors; Occupational safety and Health Administration (OSHA) and applicable work safety regulations will be followed.	Moderate; potential risk due to inhalation or direct contact during excavation and removal; OSHA and applicable work safety regulations will be followed.
Risk to Community	None.	None; no public areas near unit.	None; no public areas near unit.	None; no public areas near unit.

Table 6. Comparison of Soil Alternatives against the Threshold and Primary Balancing Criteria (*Continued*)

Criterion	S-1. No Action	S-2. Continued Operation of MicroBlower™ System with Maintenance of Soil Cover	S-3. Thermal Desorption with ERH	S-4. Excavation and Removal
Risk to Environment	None.	Negligible.	Negligible; potential risk due to exposure to soil during electrode installation.	Negligible; potential risk due to exposure to soil during excavation and removal.
Potential Public Concerns	No action may prompt concern due to continued human health and environmental risks.	Enforceability of deed restrictions in the future may be limited; continued integrity of the cover.	Enforceability of deed restrictions in the future may be limited; continued integrity of the cover.	Enforceability of deed restrictions in the future may be limited; continued integrity of the cover.
Time to Achieve RAOs	Not applicable.	RAO is currently achieved because the SVE/MicroBlower™ System has met the RAO of preventing migration of TCE vapor from vadose zone soils to groundwater at levels that will exceed the MCL.	1 year. The existing MicroBlower™ system will need to be shut down and removed and the cover breached in order to install and operate the ERH system.	1 year. The existing MicroBlower™ system will need to be shut down and removed and the cover breached in order to excavate contaminated soils.
6. Implementability				
Availability of Materials, Equipment, Contractors	Not applicable.	Implemented in 1999 during the IA.	Readily available.	Readily available.
Ability to Construct and Operate the Technology	Not applicable.	Constructed in 1999.	Straight forward, commonly used technologies.	Straight forward, commonly used technologies.
Ability to Obtain Permits/Approvals from Other Agencies	Not applicable.	Implemented in 1999.	Implementable; air emissions permit required; 5-year remedy review required.	Implementable; 5-year remedy review required.
Ability to Monitor Effectiveness of Remedy	Not applicable.	Implemented in 1999.	Implementable; Groundwater monitoring of adjacent wells required.	Implementable; confirmatory soil samples will be collected at the bottom of the excavation.

Table 6. Comparison of Soil Alternatives against the Threshold and Primary Balancing Criteria (*End*)

Criterion	S-1. No Action	S-2. Continued Operation of MicroBlower™ System with Maintenance of Soil Cover	S-3. Thermal Desorption with ERH	S-4. Excavation and Removal	
Ease of Undertaking Additional Action (if Required)	Not incompatible.	Not incompatible, but not likely to be needed.	Not incompatible, but not likely to be needed.	Not incompatible; but not likely to be needed	
Time to Implement	0 months.	Implemented in 1999. 5-year O&M.	10 months construct. 1-year O&M.	6 months to implement. 1 year O&M.	
7. Cost					
Present Worth Capital Cost	$0	$0	$2,817,141	a) $969,000	b)$2,135,000
Present Worth O&M Cost (5-year)	$0	$703,000*	$1,082,000*	$601,000	$601,000
Total Present Worth Cost	$0	$703,000	$3,899,000	$1,570,000	$2,736,000

*Includes $273,407 for O&M cost of maintaining soil cover system.

This page intentionally left blank.

Comparison of Threshold and Primary Balancing Criteria for Groundwater Alternatives

See threshold and primary balancing criteria summary for the TCE groundwater plume subunit in Table 7.

1. Overall Protection of Human Health and the Environment – Groundwater modeling indicates contaminant concentrations eventually decrease to below MCLs in all alternatives. Alternatives GW-2, GW-3, and GW-4 will all use ICs to prevent human exposure. The No Action Alternative GW-1 will not be protective of human health and the environment because continued ICs on the use of groundwater cannot be ensured.

2. Compliance with ARARs – *Chemical-Specific ARARs*: Under the No Action Alternative GW-1, no controls are established to prevent human contact with contaminated groundwater, and no measures are taken to demonstrate that MCLs are being achieved. Alternatives GW-2, GW-3, and GW-4 use combinations of treatment and MNA to achieve MCLs and ICs to prevent human exposure. The zero-valent iron treatment component of Alternatives GW-3 and GW-4 is only effective for VOC contamination.

Location-Specific ARARs: Alternatives GW-2, GW-3, GW-4 will be implemented in a manner that complies with any location-specific ARARs that may be identified later. There are no location-specific ARARs applicable to the No Action Alternative GW-1.

Action-specific ARARs: Alternatives GW-2, GW-3, and GW-4 will be implemented to comply with ARARs for monitoring well construction and will be implemented to comply with action-specific ARARs to treat contaminated groundwater and limit worker exposure to treatment process chemicals. There are no action-specific ARARs applicable to the No Action Alternative GW-1.

3. Long-Term Effectiveness and Permanence – Alternatives GW-2, GW-3, and GW-4 permanently reduce TCE and PCE concentrations through biotic and abiotic reductive dechlorination. The No Action Alternative GW-1 provides no long-term effectiveness or

permanence since no controls are established to prevent contact with contaminated groundwater and no measures are taken to demonstrate that MCLs are being achieved.

4. Reduction of Toxicity, Mobility, or Volume Through Treatment – Alternatives GW-3 and GW-4 use zero-valent iron to treat VOC-contaminated groundwater to permanently reduce the toxicity and volume. Alternative GW-2 does not include a treatment component; therefore, the toxicity, mobility, or volume of contaminants is reduced through natural processes (biotic reductive dechlorination and mineralization) rather than treatment. The No Action Alternative GW-1 does not reduce the toxicity, mobility, or volume of contaminants.

5. Short-Term Effectiveness – Alternative GW-1 does not require any construction and hence presents no risk to on-site workers. GW-3 will require the excavation of a long, deep trench during the installation of the barrier wall and GW-4 will require the installation of several over-sized wells. Both Alternatives GW-3 and GW-4 will require the placement of finely granulated iron, which may cause respiratory problems for some workers. None of the groundwater alternatives present a risk to the community because there are no public access areas within 5 miles of CBRP OU and there are currently no exceedances of MCLs in either Fourmile Branch or Twin Lakes wetlands surface water.

Remedial worker exposure is minimized and maintained below occupational-health criteria through the proper use of engineering controls, procedures, appropriate personal protective equipment, site monitoring, and adherence to a health and safety plan. Potential contact with chemicals presents an additional hazard during implementation of zero-valent iron technologies such as Alternatives GW-3 and GW-4; the risk may be mitigated by establishing exclusion zones and using appropriate personal protective equipment for workers who handle the chemicals.

The approximate O&M time for Alternative GW-4 is approximately 70 years because the wells cut the plume into several segments, and these are treated simultaneously. O&M time for GW-2 and GW-3 is 70 years.

6. Implementability – No construction is required for the GW-1 so the No Action Alternative GW-1 could be implemented immediately. Implementation of the other alternatives is achieved using conventional construction equipment, materials, and methods that are readily available. Alternative GW-2 MNA-IC involves no additional monitoring well installation and can be implemented immediately. GW-3 and GW-4 will require about 9 months for implementation.

7. Cost – Present value costs for all groundwater alternatives are shown in the following insert:

Alternative	Cost
Groundwater Plume	
GW-1: No Action	$0
GW-2: Institutional Controls and Monitored Natural Attenuation	$605,000
GW-3: In Situ Zero-valent Iron Barrier Wall	$8,031,000
GW-4: Optimized Reactive Iron Recirculation Wells	$4,598,000

Table 7. Comparison of Groundwater Alternatives against the Threshold and Primary Balancing Criteria

Criterion	GW-1. No Action	GW-2. Institutional Controls and Monitored Natural Attenuation	GW-3. In situ Zero-valent Iron Barrier Wall	GW-4. Optimized Reactive Iron Recirculation Wells
1. Overall Protectiveness				
Human Health	Not protective of future groundwater users.	No current groundwater receptors. ICs will prohibit future groundwater use. ICs would be required for 70 years based on modeling predictions. Monitoring will ensure there are no unpredicted releases that exceed MCLs.	No current groundwater receptors. ICs would prohibit future groundwater use. ICs would be required for 70 years based on modeling predictions.	No current groundwater receptors. ICs will prohibit future groundwater use. ICs would be required in the treatment zone for 70 years based on modeling predictions. This alternative will not treat all the groundwater within the plume boundary.
Environment	As a result of the IA, protective of groundwater, source has been controlled, eliminating pathway to aquifer. Natural processes will destroy contaminants without human intervention.	Protective of groundwater; source has been controlled, eliminating pathway to aquifer. Natural processes will destroy contaminants without human intervention. Monitoring will ensure there are no unpredicted releases that exceed MCLs.	Protective of groundwater; source has been controlled, eliminating pathway to aquifer. Treatment will remove contaminants.	Protective of groundwater; source has been controlled eliminating pathway to aquifer. Treatment will remove contaminants.
2. Compliance with ARARs				
Chemical-Specific	No action but natural attenuation would meet MCLs.	Would meet MCLs.	Would meet MCLs in the treatment zone only.	Would meet MCLs in the treatment zone only.
Location-Specific	Not applicable.	None.	None.	None.

Table 7. Comparison of Groundwater Alternatives against the Threshold and Primary Balancing Criteria *(Continued)*

Criterion	GW-1. No Action	GW-2. Institutional Controls and Monitored Natural Attenuation	GW-3. In situ Zero-valent Iron Barrier Wall	GW-4. Optimized Reactive Iron Recirculation Wells
Action-Specific	None.	SC construction/ operating permit for well construction; OSHA regulations for remediation workers.	SC construction/ operating permit for well construction; RCRA groundwater protection standards for remediation of contaminated groundwater; RCRA regulations for hazardous waste (excavated soil); OSHA regulations for remediation workers.	SC construction/ operating permit for well construction; RCRA groundwater protection standards for remediation of contaminated groundwater; RCRA regulations for hazardous waste (excavated soil); OSHA regulations for remediation workers.
3. Long-Term Effectiveness and Performance				
Magnitude of Residual Risks	Residual risk to future groundwater users would exceed 1.0E-05.	ICs would prevent future use. Groundwater would achieve ARARs in 70 years.	ICs would prevent future use. Groundwater would achieve ARARs in 70 years.	ICs would prevent future use. Groundwater would achieve ARARs in 70 years
Adequacy of Controls	Not adequately protective of future groundwater users.	Adequate as long as ICs are in place; adequate in preventing future receptors from using groundwater.	Adequate in reducing contamination; adequate in preventing future receptors from using groundwater.	Adequate in reducing contamination; adequate in preventing future receptors from using groundwater.
Permanence	Not permanent.	Permanent as long as ICs are in place; leaves contaminated groundwater on site for 70 years.	Permanent as long as ICs are in place for 70 years.	Permanent as long as ICs are in place for 70 years.

Table 7. Comparison of Groundwater Alternatives against the Threshold and Primary Balancing Criteria *(Continued)*

Criterion	GW-1. No Action	GW-2. Institutional Controls and Monitored Natural Attenuation	GW-3. In situ Zero-valent Iron Barrier Wall	GW-4. Optimized Reactive Iron Recirculation Wells
4. Reduction of Toxicity, Mobility, or Volume				
Treatment Type	No treatment, but natural attenuation by reductive dechlorination and mineralization.	Source has been depleted. Gradual (natural) attenuation below MCLs over 70 years based on model predictions.	In situ reductive dechlorination by zero-valent iron technologies.	In situ reductive dechlorination by zero-valent iron technologies.
Degree of Expected Reduction in Toxicity, Mobility, or Volume	No treatment but gradual (natural) attenuation below MCLs over 70 years.	Gradual attenuation below MCLs over 70 years based on model predictions.	Treatment over 70 years until plume migrates through wall.	Treatment over 70 years until plume migrates to and can be pumped through wells
Amount of Hazardous Materials Destroyed or Treated	No treatment but 99% of contaminant destroyed in biomantle as groundwater emerges to surface water. Gradual attenuation over 70 year time frame below MCLs over entire plume.	99% of contaminant destroyed in biomantle as groundwater emerges to surface water. Gradual attenuation over 70 year time frame below MCLs over entire plume.	Abiotic reductive dechlorination would reduce TCE and degradation products below MCLs at Fourmile Branch plume boundary only.	Abiotic reductive dechlorination would reduce TCE and degradation products below MCLs along axis of plume.
Degree to Which Treatment is Irreversible	No treatment but reductive dechlorination and mineralization are irreversible.	Reductive dechlorination and mineralization are irreversible.	Reductive dechlorination is irreversible.	Reductive dechlorination is irreversible.
Types and Quantities of Residuals Remaining After Treatment	No treatment but ethylene, ethane, and chloride in groundwater.	Ethylene, ethane, and chloride in groundwater. Soil cuttings; purge water.	Ethylene, ethane, and chloride in groundwater. Soil cuttings; purge water from monitoring wells.	Ethylene, ethane, and chloride in groundwater. Soil cuttings; purge water from monitoring wells.

Table 7. Comparison of Groundwater Alternatives against the Threshold and Primary Balancing Criteria *(Continued)*

Criterion	GW-1. No Action	GW-2. Institutional Controls and Monitored Natural Attenuation	GW-3. In situ Zero-valent Iron Barrier Wall	GW-4. Optimized Reactive Iron Recirculation Wells
5. Short-Term Effectiveness				
Risks to Workers	None.	None.	Minor; potential risk during installation of wall (direct contact with soil and iron filings and inhalation of vapor) and groundwater sampling activities; OSHA and applicable work safety regulations will be followed.	Minor; potential risk during installation of wells (direct contact with soil and iron filings and inhalation of vapor) and groundwater sampling activities; OSHA and applicable work safety regulations will be followed.
Risk to Community	None.	None. No current groundwater receptor and no impact to Fourmile Branch surface water.	Negligible; no public areas near unit.	Negligible; no public areas near unit.
Risk to Environment	None.	None. No receptors. No impact to Fourmile Branch surface water.	Negligible; potential risk due to soil erosion during construction of wall.	Negligible; potential risk due to soil erosion during construction of wells.
Potential Public Concerns	Potential concern over continued groundwater contamination.	Potential concern excessive remedial costs when there is no viable receptor and natural attenuation is present.	Potential concern unfamiliar technology.	Potential concern unfamiliar technology.
Time to Achieve RAOs	Not applicable.	70 years, estimated.	70 years, estimated.	70 years for the entire plume.
6. Implementability				
Availability of Materials, Equipment, Contractors	Not applicable.	Readily available.	Readily available.	Readily available.
Ability to Construct and Operate the Technology	Not applicable.	None required, monitoring wells are already in place.	Straight forward; commonly used construction practices for installation of barrier wall.	Straight forward; commonly used construction practices for installation of iron recirculation wells.

Table 7. Comparison of Groundwater Alternatives against the Threshold and Primary Balancing Criteria *(End)*

Criterion	GW-1. No Action	GW-2. Institutional Controls and Monitored Natural Attenuation	GW-3. In situ Zero-valent Iron Barrier Wall	GW-4. Optimized Reactive Iron Recirculation Wells
Ability to Obtain Permits/Approvals from Other Agencies	Not applicable.	Ready implementable; 5-year remedy review required.	If an Army Corps of Engineers (ACE) 404 permit is required, this remedy could not be implemented.	Implementable; 5-year remedy reviews required; injection permit.
Ability to Monitor Effectiveness of Remedy	Not applicable.	Readily implementable; groundwater monitoring required.	Readily implementable; groundwater monitoring required.	Readily implementable; groundwater monitoring required.
Ease of Undertaking Final Action (if required)	Not incompatible.	Should be final action.	Not incompatible.	Not incompatible.
Time to Implement	0 months.	Immediate.	9 months construct. 70 years O&M	9 months construct. 70 years O&M
7. Cost				
Present Worth Capital Cost	$0	$112,000*	$7,636,000*	$1,922,000*
Present Worth O&M Cost	$0	$493,000†	$395,000*‡	$2,676,000*‡
Total Present Worth Cost	$0	$605,000	$8,031,000	$4,598,000

*Includes $112,000 capital cost for maintaining ICs.
†GW-2 O&M Costs reflect a surface water monitoring component that would not be included in GW-3 since GW-3 is strictly a groundwater remedy.
‡O&M Cost for GW-3 and GW-4 does not include costs to replenish the zero valent iron.

Comparison of Threshold and Primary Balancing Criteria for Surface Water Alternatives

See threshold and primary balancing criteria summary for the surface water subunit in Table 8.

1. Overall Protection of Human Health and the Environment – Alternatives SW-2 and SW-3 will use ICs to prevent human health and will be protective of the environment because current surface water discharges are below MCLs for all RCOCs. The No Action Alternative SW-1 will not be protective of human health and the environment because continued ICs on the use of surface water cannot be assured.

2. Compliance with ARARs – *Chemical-Specific ARARs*: SW-3 would meet ARARs in the Twin Lakes wetland immediately. SW-2 would meet ARARs within 70 years based on modeling. However, it currently appears that the modeling may have been overly conservative and overstated the timeframe to achieve ARARs since surface water sample results are currently below MCLs. SW-1 would probably also meet ARARs in about 70 years due to the natural attenuation processes. Under the No Action Alternative SW-1, no controls are established to prevent human contact with contaminated surface water and no measures are taken to demonstrate that MCLs are being achieved. The treatment component of Alternative SW-3 is only effective for VOC contamination in the Twin Lakes wetland, contaminated groundwater emerging along the Fourmile Branch seepline would still be remediated by natural attenuation.

Location-Specific ARARs: The No Action Alternative SW-1 would not meet ARARs for wetlands. All other alternatives will be implemented in a manner that complies with location-specific ARARs.

Action-specific ARARs: There are no action-specific ARARs applicable to the No Action Alternative SW-1. Alternatives SW-2 and SW-3 will be implemented to comply with wetland ARARs and OSHA regulations for remediation workers.

3. Long-Term Effectiveness and Permanence – The overall long-term effectiveness and permanence of all surface water alternatives is dependent on natural attenuation, which is monitored through continued O&M and ICs until RGOs are achieved.

4. Reduction of Toxicity, Mobility, or Volume Through Treatment – The MNA Alternative SW-2 uses the processes of natural attenuation to permanently reduce VOC concentrations by 99% in groundwater emerging along the Twin Lakes and Fourmile Branch wetlands. These processes include biotic reductive dechlorination, mineralization, dilution, and cross-media transfer. SW-3 uses zero-valent iron to permanently reduce VOCs in the Twin Lakes wetland. SW-3 has no influence on the groundwater emerging along the Fourmile Branch seepline. The No Action Alternative SW-1 does not reduce the toxicity, mobility, or volume of contaminants except by natural attenuation processes.

5. Short-Term Effectiveness – None of the surface water alternatives contributes to significant short-term risk to on-site workers, the community, or the environment. Modeling indicates that SW-3 will lower VOC concentrations in the Twin Lakes wetland below MCLs in about 10 years. The O&M time for SW-2 is about 70 years. SW-1 does not provide for ICs or monitoring to control access to contaminated surface water or documentation of the contaminant levels.

6. Implementability – No construction is required for Alternatives SW-1 and SW-2, so they could be implemented immediately. Implementation of Alternative SW-3 is achieved using conventional construction equipment, materials, and methods that are readily available.

7. Cost – Present value costs for all surface water alternatives are shown in the following insert:

Alternative	Cost
Surface Water	
SW-1: No Action	$0
SW-2: Institutional Controls and Monitored Natural Attenuation	$605,000
SW-3: Lakebed Zero-valent Iron Reactor in Lower Twin Lake	$674,000

Table 8. Comparison of Surface Water Alternatives against the Threshold and Primary Balancing Criteria

Criterion	SW-1. No Action	SW-2. Institutional Controls and Monitored Natural Attenuation	SW-3. Lakebed Zero-valent Iron Reactor in Lower Twin Lake
1. Overall Protectiveness			
Human Health	Not protective of future surface water users.	Current risk is <1.0E-06 for Fourmile Branch and the Twin Lakes Wetlands for the most conservative receptor (future adolescent resident). ICs will prevent access by current worker. There are currently no MCL exceedances in surface water.	Protective of surface water users.
Environment	Not protective of surface water.	No ecological impact. Current surface water discharges are not contributing to degradation of surface water in either Twin Lakes or Fourmile Branch.	No ecological impact. Current surface water discharges are not contributing to degradation of surface water in either Twin Lakes or Fourmile Branch.
2. Compliance with ARARs			
Chemical-specific	No action but natural attenuation would meet MCLs.	Would meet MCL ARAR for protection of human health within 70 years based on modeling.	Would meet MCLs in Twin Lakes immediately, would not address contamination in Fourmile Branch.
Location-specific	Would not meet ARARs.	Protective of classified use of surface water.	Wetland impacts ARARs.
Action-specific	None.	OSHA regulations for remediation workers	OSHA regulations for remediation workers
3. Long-term Effectiveness and Performance			
Magnitude of Residual Risks	Residual risk to future surface water users would exceed 1.0E-06.	There are currently no MCL exceedances in surface water.	There were no MCL exceedances in surface water in 2007.

Table 8. Comparison of Surface Water Alternatives against the Threshold and Primary Balancing Criteria *(Continued)*

Criterion	SW-1. No Action	SW-2. Institutional Controls and Monitored Natural Attenuation	SW-3. Lakebed Zero-valent Iron Reactor in Lower Twin Lake
Adequacy of Controls	Not adequately protective of future surface water users.	Adequate as long as ICs are in place; adequate in preventing surface water contamination from spreading beyond point of compliance.	Adequate in reducing contamination; adequate in preventing spread of surface water contamination.
Permanence	Not permanent.	ICs would need to be maintained for 70 years or until monitoring indicates surface water discharges are below MCLs.	Permanent as long as ICs are in place; leaves greatly reduced level of contaminated surface water.
4. Reduction of Toxicity, Mobility, or Volume			
Treatment Type	No treatment but natural attenuation by reductive dechlorination and mineralization.	No treatment but natural attenuation by reductive dechlorination and mineralization.	In situ reductive dechlorination by zero-valent iron technologies in Lower Twin Lakes.
Degree of Expected Reduction in Toxicity, Mobility, or Volume	No treatment but gradual (natural) attenuation by reductive dechlorination and mineralization.	No treatment but gradual (natural) attenuation by reductive dechlorination and mineralization. Surface waters in Twin Lakes are modeled to be below MCLs in 10 years.	Concentration of RCOCs would be reduced below MCLs in the Twin Lakes surface water.
Amount of Hazardous Materials Destroyed or Treated	No treatment but 99% of contaminant destroyed in biomantle as groundwater emerges to surface water. Gradual attenuation over 70 year time frame below MCLs over entire plume.	No treatment but 99% of contaminant destroyed in biomantle as groundwater emerges to surface water. Gradual attenuation over 70 year time frame below MCLs over entire plume.	Reductive dechlorination and mineralization would reduce VOCs below MCLs in Twin Lakes surface water.
Degree to Which Treatment is Irreversible	No treatment but reductive dechlorination and mineralization are irreversible.	No treatment but reductive dechlorination and mineralization are irreversible.	Reductive dechlorination would be irreversible in Lower Twin Lakes.

Table 8. Comparison of Surface Water Alternatives against the Threshold and Primary Balancing Criteria (*Continued*)

Criterion	SW-1. No Action	SW-2. Institutional Controls and Monitored Natural Attenuation	SW-3. Lakebed Zero-valent Iron Reactor in Lower Twin Lake
Types and Quantities of Residuals Remaining After Treatment	No treatment but ethylene, ethane, and chloride in surface water.	Ethylene, ethane, and chlorides in surface water.	Ethylene, ethane, and chlorides in surface water.
5. Short-term Effectiveness			
Risks to Workers	None.	Negligible; potential risk during environmental sampling activities; OSHA and applicable work safety regulations will be followed.	Minor; potential risk during installation of lakebed reactor and sampling activities; OSHA and applicable work safety regulations will be followed.
Risk to Community	None.	None.	Negligible; no public areas near unit.
Risk to Environment	None.	None.	Negligible; potential risk due to soil erosion during installation of lakebed reactor.
Potential Public Concerns	Potential concern over continued surface water contamination.	Potential concern over high remedial cost when there is no impact to surface and there are no receptors.	Potential concern unfamiliar technology.
Time to Achieve RAOs (in upgradient groundwater)	Not applicable.	70 years.	10 years at Twin Lakes, 70 years at Fourmile Branch.
6. Implementability			
Availability of Materials, Equipment, Contractors	Not applicable.	Readily available.	Readily available.
Ability to Construct and Operate the Technology	Not applicable.	Not applicable.	Straight forward; commonly used construction practices for installation of lakebed reactor
Ability to Obtain Permits/Approvals from Other Agencies	Not applicable.	Ready implementable; 5-year remedy review required.	If 404 permit is not obtainable due to wetland impacts, this remedy could not be implemented.

Table 8. Comparison of Surface Water Alternatives against the Threshold and Primary Balancing Criteria (*End*)

Criterion	SW-1. No Action	SW-2. Institutional Controls and Monitored Natural Attenuation	SW-3. Lakebed Zero-valent Iron Reactor in Lower Twin Lake
Ability to Monitor Effectiveness of Remedy	Not applicable.	Readily implementable; surface water monitoring required.	Readily implementable; surface water monitoring required.
Ease of Undertaking Final Action (if required)	Not incompatible.	Not incompatible.	Not incompatible.
Time to Implement	0 months.	Can be implemented immediately. Monitoring would determine duration, modeled 10 years at Twin Lakes, 70 years at Fourmile Branch.	2 months construct. 10 years O&M
7. Cost			
Present Worth Capital Cost	$0	$112,000*	$524,000*
Present Worth O&M Cost	$0	$493,000	$150,000
Total Present Worth Cost	$0	$605,000	$674,000

*Includes $112,000 capital cost for maintaining ICs.

XI. THE SELECTED REMEDY

Detailed Description of the Selected Remedy

The scope of the CBRP OU remedial action encompasses seven subunits and three environmental media. Only four of these subunits had RCOCs and hence a problem warranting action. The four subunits are:

- disposal pit surface soils,
- vadose zone beneath CBRP,
- the groundwater plume, and
- surface water.

The preferred alternatives that comprise the selected remedy are as follows:

- Alternative S-2: Continued operation of MicroBlower™ SVE system with maintenance of soil cover,
- Alternative GW-2: MNA-IC, and
- Alternative SW-2: MNA-IC for surface water.

The bases for selecting the soil cover, MicroBlower™ SVE system and MNA/IC for groundwater and surface water over the more robust technologies considered in the FCMS/FS (WSRC 2004a) are as follows:

- ICs at CBRP OU will consist of general site access controls, groundwater use restrictions, the SRS Site Use/Site Clearance program, and deed restrictions and notifications.
- The soil cover, SVE system, and AS system were installed in 1999 as the components of an IA to control the VOC source in the vadose zone and were successful.
- The soil cover provides an effective barrier to prevent the exposure of ecological receptors to dioxin-contaminated surface soil in the disposal pit.

- The 10E-06 cm/sec soil cover has also reduced infiltration and leaching of the waste interval and the vadose zone source.

- The SVE and AS systems recovered about 2,100 lb of TCE before they were shut down and replaced with the active solar-powered MicroBlower™ SVE system. The MicroBlower™ SVE system was designed to recover all of the VOCs that are desorbed from the fine-grained soils about 30 ft bgs at the west end of CBRP (Figure 2). Vadose zone source control requires that the system recover at least 1.8 lb TCE/yr. The MicroBlower™ SVE system has been operating since December 2004 and has been recovering about 50 lb of VOCs/yr. TCE concentrations beneath the west end of CBRP have declined from more than 130,000 µg/L in 1999 to less than 1,000 µg/L in 2003. The vadose zone source has been effectively remediated, and the migration pathway to groundwater has been broken by SVE and the soil cover.

- There are no active, continuing primary sources of groundwater contamination at the CBRP OU. The identified sources have been remediated by the IA.

- Natural attenuation processes (principally biotic reductive dechlorination and mineralization) are occurring at the CBRP OU in the biomantle along the Twin Lakes and Fourmile Branch wetlands and are effective in reducing VOC concentrations by 99%.

- MNA/IC provides the same level of protection as the more robust technologies at a much lower cost.

- MNA/IC will achieve the CBRP OU remedial objectives within a time frame (approximately 70 years) that is comparable to that offered by the more robust technologies and at significantly lower cost. It appears that surface water remedial objectives are currently being attained ahead of modeling predictions.

- Groundwater discharge to surface water is not impacting human health or ecological receptors.

- A monitoring plan will be designed in the CMI/RAIP to include representative wells, MNA wells in the Twin Lakes wetland, and surface water sample stations along the Twin Lake and Fourmile Branch wetlands.

Changes to the selected remedy described in the ROD will be documented in the Administrative Record utilizing a memo, an explanation of significant difference (ESD), or ROD amendment.

Remedy Component: Institutional Controls

ICs would be maintained to prevent unrestricted land use. ICs will be implemented through the following:

- Access controls to prevent exposure to on-site workers via the Site Use/Site Clearance Program, work control, worker training, and worker briefing of health and safety requirements.
- Access controls to prevent exposure to trespassers, as described in the 2000 RCRA Part B Permit Renewal Application, Volume I, Section F.1, which describes the security procedures and equipment, 24-hour surveillance system, artificial or natural barriers, control entry systems, and warning signs in place at the SRS boundary.

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 site. The contract for sale and the deed will contain the notification required by CERCLA Section 120(h). The deed notification shall notify any potential purchaser that the groundwater beneath the property is contaminated. These requirements are also consistent with the intent of the RCRA deed notification requirements at final closure of a RCRA facility if contamination will remain at the unit.

The deed shall also include deed restrictions precluding residential use of contaminated groundwater. The deed shall expressly prohibit activities inconsistent with the remedial goals and objectives in this ROD upon any and all transfers. 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.

The selected remedy for CBRP OU leaves hazardous substances in place that pose a potential future risk and will require land use restrictions for an indefinite period of time. As agreed on March 30, 2000, among the USDOE, USEPA, and SCDHEC, SRS is implementing a Land Use Control and Assurance Plan (LUCAP) to ensure that the LUCs required by numerous remedial decisions at SRS are properly maintained and periodically verified. The unit-specific Land Use Controls Implementation Plan (LUCIP) referenced in this ROD will provide details and specific measures required to implement and maintain the LUCs selected as part of this remedy (Table 9). The USDOE is responsible for implementing, maintaining, monitoring, reporting upon, and enforcing the LUCs selected under this ROD. The LUCIP, developed as part of this action, will be submitted concurrently with the CMI/RAIP as required in the FFA for review and approval by USEPA and SCDHEC. Upon final approval, the LUCIP will be appended to the LUCAP and is considered incorporated by reference into the ROD, establishing LUC implementation and maintenance requirements enforceable under CERCLA and the *SRS Federal Facility Agreement* (FFA 1993). The approved LUCIP will establish implementation, monitoring, maintenance, reporting, and enforcement requirements for the unit. The LUCIP will remain in effect unless and until modifications are approved as needed to be protective of human health and the environment. The deed shall expressly prohibit activities inconsistent with the remedial goals and objectives in this ROD upon any and all transfers. The LUCs, listed in Table 9, shall be maintained until the concentration of hazardous substances associated with the unit have been reduced to levels that allow for unlimited exposure and unrestricted use. Approval by USEPA and SCDHEC is required for any modification or termination of the ICs.

Future residential water usage will be prohibited until RAOs and RGOs are attained (approximately 70 years) to ensure long-term protectiveness. LUCs will prohibit residential use of local groundwater and will be maintained until groundwater is restored to MCLs.

Table 9. Land Use Controls for CBRP OU

Type of Control	Purpose of Control	Duration	Implementation	Affected Areas[a]
1. Property Record Notices[b]	Provide notice to anyone searching records about the existence and location of contaminated areas.	Until the concentrations of hazardous substances associated with the unit have been reduced to levels that allow for unlimited exposure and unrestricted use.	Notice recorded by USDOE in accordance with state laws at County Register of Deeds office if the property or any portion thereof is ever transferred to non-federal ownership.	Areas of groundwater contamination exceeding MCLs.
2. Property record restrictions[c]: Groundwater	Prohibit the use of groundwater in areas of known or suspected contamination.	Until the concentration of hazardous substances associated with the unit have been reduced to levels that allow for unlimited exposure and unrestricted use.	Drafted and implemented by USDOE upon transfer of affected areas. Recorded by USDOE in accordance with state law at County Register of Deeds office.	Areas of groundwater contamination exceeding MCLs.
3. Other Notices[d]	Provide notice to city and/or county about the existence and location of waste disposal and residual contamination areas for zoning/planning purposes.	Until the concentrations of hazardous substances associated with the unit have been reduced to levels that allow for unlimited exposure and unrestricted use.	Notice recorded by USDOE in accordance with state laws at County Register of Deeds office if the property or any portion thereof is ever transferred to non-federal ownership.	Areas of groundwater contamination exceeding MCLs.
4. Site Use Program[e]	Provide notice to worker/developer (i.e., permit requestor) on extent of contamination and limit penetration activities to those approved by SRS.	As long as property remains under USDOE control	Implemented by USDOE and site contractors Initiated by permit request	Remediation and monitoring systems and areas where groundwater contamination exceeds MCLs.
5. Physical Access Controls[f] (e.g., gates, portals)	Control and restrict general site access by workers and the public to prevent unauthorized entry.	Until the concentrations of hazardous substances associated with the unit have been reduced to levels that allow for unlimited exposure and unrestricted use.	Controls maintained by USDOE	At select locations throughout SRS.
6. Security Surveillance Measures	Control and monitor access by workers/public	Until the concentrations of hazardous substances associated with the unit have been reduced to levels that allow for unlimited exposure and unrestricted use.	Established and maintained by USDOE Necessity of patrols evaluated upon completion of remedial actions.	Patrol of selected areas throughout SRS, as necessary.

Table 9. Land Use Controls for CBRP OU *(Continued)*

[a]Affected areas – Specific locations identified in the SRS LUCIP or subsequent post-ROD documents.

[b]Property Record Notices – Refers to any non-enforceable, purely informational document recorded along with the original property acquisition records of USDOE and its predecessor agencies that alerts anyone searching property records to important information about residual contamination and waste disposal areas in the property.

[c]Property Record Restrictions – Includes conditions and/or covenants that restrict or prohibit certain uses of real property and are recorded along with original property acquisition records of USDOE and its predecessor agencies.

[d]Other Notices – Includes information on the location of waste disposal areas and residual contamination depicted on survey plat, which is provided to a zoning authority (i.e., city planning commission) for consideration in appropriate zoning decisions for non-USDOE property.

[e]Site Use Program – Refers to the internal USDOE/USDOE contractor administrative program(s) that requires the permit requestor to obtain authorization, usually in the form of a permit, before beginning any penetration activity (e.g., well drilling) for the purpose of ensuring that the proposed activity will not affect underground utilities/structures, or in the case of contaminated groundwater, will not disturb the affected areas without appropriate precautions and safeguards.

[f]Physical Access Controls – Physical barriers or restrictions to entry.

The following LUC objectives are necessary to ensure the protectiveness of the selected remedy:

preclude residential use of local contaminated groundwater;

maintain the integrity of any current or future remedial or monitoring system or component such as monitoring wells until remedial goals are achieved and restrictions are no longer warranted, and

prevent unauthorized access to contaminated groundwater in the area.

Groundwater contamination within the OU boundary was investigated during the RFI/RI and a TCE groundwater plume was mapped in the RFI/RI Report. The LUC boundary (Figure 9) includes all areas currently contaminated above the MCLs and adequate buffer zone to include any changes in plume geometry over time. LUC boundaries extend westward from CBRP along the plume boundaries to Fourmile Branch and along the Twin Lakes wetland on the south.

Remedy Component: Continued Operation of MicroBlower™ SVE System with Maintenance of Soil Cover (Alternative S-2)

In the 1999 IA, the soil cover, consisting of 4 ft of low permeability soil compacted to 10^{-6} cm/sec hydraulic conductivity or less, was paired with SVE-AS to provide protection from human health and ecological RCOCs and to reduce mobility and volume of VOC contamination in the vadose zone. The existing IA soil cover will be maintained as a containment barrier between human and ecological receptors and contaminated surface soils under the in situ treatment alternatives.

The IA demonstrated that SVE was effective in reducing VOC mass in the deep soil. However, it does not affect dioxins in surface soils. As a result, SVE is not effective as a stand-alone technology but may be combined with other technologies. In December 2004, the SVE system had recovered nearly 2,100 lb of TCE and had reached the point of diminishing returns. The conventional SVE system was replaced with an active solar-powered MicroBlower™ SVE system.

Operation of the MicroBlower™ SVE system will continue to remove organic contaminants from the vadose zone soils by withdrawing contaminants in the vapor phase. No further construction would be required to implement Alternative S-2. All necessary permits are already in place so there would be no delays for permitting.

Before the IA was implemented in 1999, TCE concentrations in the groundwater ranged as high as 130,000 μg/L in the source area. By June 2003, TCE concentrations beneath the source area were less than 1,000 μg/L. The IA has reduced TCE concentrations in the groundwater to less than 1% of the pre-IA levels in about 3 years. Because all three components of the IA (AS, SVE, and soil cover) were active during this period, it is not possible to quantify the contribution of an individual component to the reduction in TCE concentrations.

ICs would include deed restrictions precluding any activity that would disturb either the MicroBlower™ SVE system or the compacted soil cover and notifications disclosing the former waste management and disposal activities as well as remedial actions taken onsite. ICs would also ensure that any continuing groundwater monitoring and cover maintenance commitments would be met. The need for these controls would be re-evaluated over time if contamination no longer posed an unacceptable risk.

The IA has demonstrated that TCE concentrations in the vadose zone can be reduced by SVE and the soil cover; TCE concentrations in the groundwater can also be reduced via source reduction and breaking the migration pathway.

This page intentionally left blank.

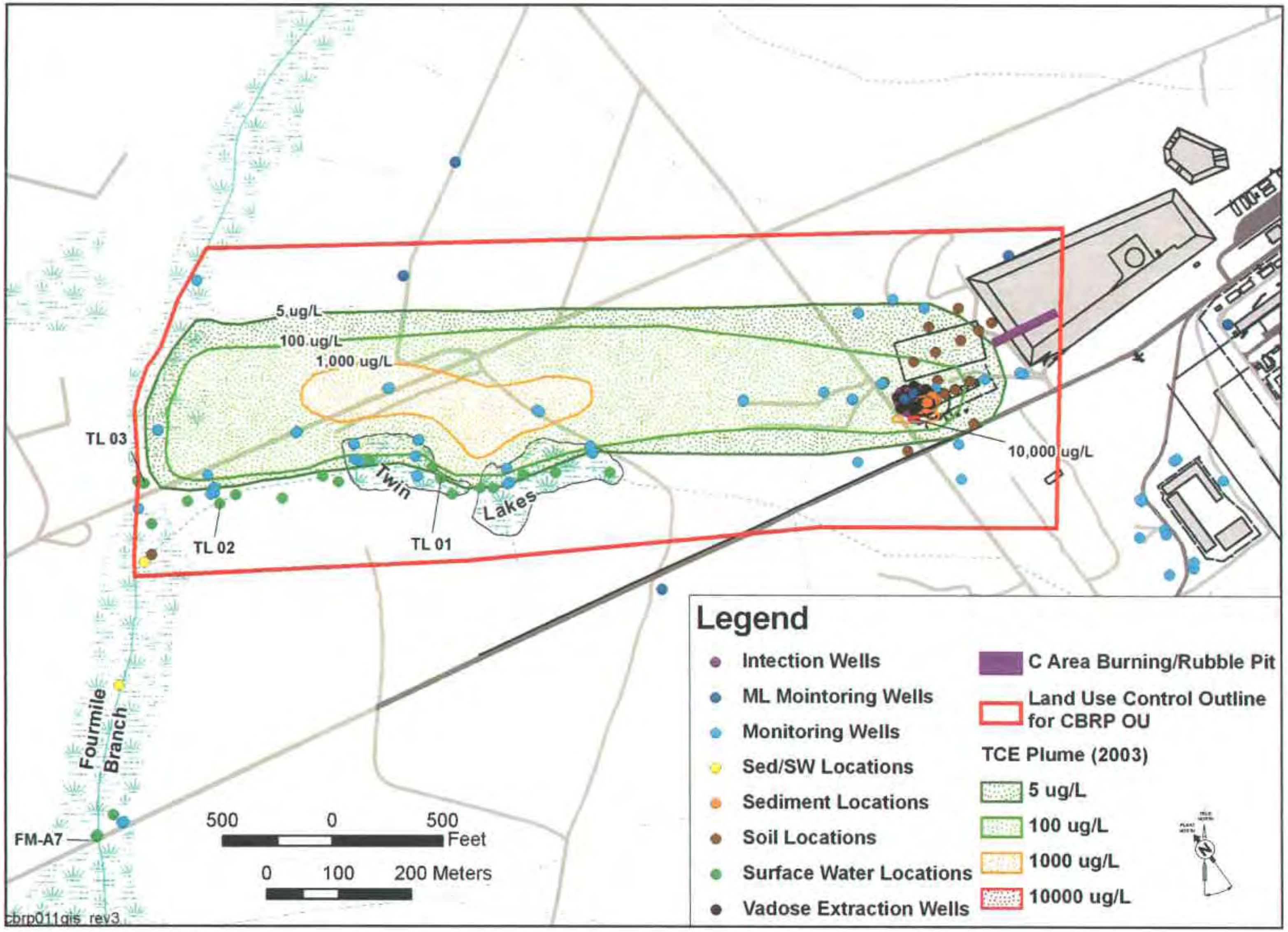


Figure 9. Land Use Control Outline for CBRP OU

This page intentionally left blank.

If the present trend in TCE concentrations in the groundwater continues, the MCL will be attained in less than five years. The PW costs for five-year remedy reviews for Alternative S-2 are included in the estimate for maintenance of the soil cover for 500 years.

Remedy Component: Natural Attenuation

Natural attenuation refers to natural processes such as biotic reductive dechlorination, mineralization, advection, diffusion, dilution, hydrodynamic dispersion, sorption, cross-media transfer, aerobic and anaerobic biodegradation, radioactive decay, and numerous other natural processes that can reduce the concentration of contaminants in groundwater without human intervention.

PCE and TCE concentrations can be reduced by most of the processes discussed in the preceding paragraph. PCE and TCE are subject to more rapid biodegradation under anaerobic than aerobic conditions; DCE and VC are degraded more rapidly under aerobic conditions. Aerobic conditions prevail throughout most of the plumes except in the Twin Lakes and Fourmile Branch wetlands, suggesting that very little biodegradation of PCE and TCE is to be expected in the aerobic upgradient portion of the VOC plume. Other processes such as dilution would obviously be effective in reducing PCE and TCE concentrations. PCE and TCE have not been detected in surface water samples from Fourmile Branch, indicating that natural attenuation is effective in reducing PCE and TCE concentrations below MCLs in this system.

Remedy Component: Groundwater Monitoring and Reporting

The long-term monitoring of groundwater conditions in the plume and surface water conditions in the Twin Lakes and Fourmile Branch wetlands will ensure that the expected natural attenuation processes (biotic reductive dechlorination and mineralization) are performing as modeled and contaminant concentrations are decreasing as predicted.

The following monitoring data quality objectives (DQOs) will be used for the CBRP OU monitoring program:

DQO #1: Perform monitoring to ensure that the plume movement horizontally is trending consistent with the conceptual flow path to Fourmile Branch as predicted by the model.

DQO #2: Perform monitoring to ensure that the plume(s) movement vertically is trending consistent with the conceptual flow path as predicted by the model.

DQO #3: Perform monitoring to ensure that the plume contaminants (VOCs) are trending to lower concentration as they approach Fourmile Branch in the groundwater.

DQO #4: Perform surface water monitoring to ensure that the plume contaminants (VOCs) are below regulatory thresholds and not trending to higher concentration in Fourmile Branch.

DQO #5: Perform groundwater monitoring to ensure that there are no releases of contaminants from unknown or existing sources and that existing remediated or depleted sources are under control.

The monitoring well network will include existing wells, MNA well pairs, and surface water sampling stations in the Twin Lakes wetland and Fourmile Branch in the VOC plume. The final version of the monitoring plan will be produced during the design phase of the project.

Monitoring activities and submittal of a Groundwater Monitoring Report will comply with the schedule that will be developed in the CMI/RAIP.

Cost Estimate for the Selected Remedy

Separate PW cost estimates were prepared for Alternatives S-2, Continued operation of MicroBlower™ SVE system with maintenance of soil cover; GW-2, MNA/ICs for the VOC Plume; and SW-2, MNA/ICs for surface water. These alternatives were combined in the selected remedy; the actual cost for the selected remedy will be less than the total of the separate estimates because duplicated activities such as report preparation and deed notification will be consolidated.

Alternative	Cost
Disposal Pit Surface and Vadose Zone	
S-2: Continued Operation of MicroBlower™ System (Vadose Zone) with Maintenance of Soil Cover (Surface Soil)	$703,000
TCE Groundwater Plume	
GW-2: Institutional Controls and Monitored Natural Attenuation	$605,000
Surface Water	
SW-2: Institutional Controls and Monitored Natural Attenuation	$605,000
Total Present Worth Cost	**$1,913,000**

The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the ARF, and ESD, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30% of the actual project cost.

Estimated Outcomes of Selected Remedy

After the MNA/IC O&M period (approximately 70 years), groundwater in the CBRP OU should have attained the RGOs listed in Table 3, contaminant levels at which the groundwater can be released for unrestricted use.

Waste Disposal and Transport

Contamination at CBRP OU is limited to the soil and groundwater and, based on available documentation, the origin of the VOC contaminants cannot be concluded. Therefore, it is assumed that the contamination found in the CBRP OU groundwater and vadose zone is not from a listed RCRA hazardous waste source. RCRA requirements do not apply provided the waste generated during the remedial action does not exhibit a hazardous waste characteristic. However, consistent with USEPA policy, environmental media designated for land application will be evaluated against Health-Based Levels to ensure protection of human health and the environment. Unless otherwise noted in this ROD or in post-ROD documents, waste will be managed consistent with the current, approved *Investigation-Derived Waste Management Plan* (WSRC 2006a).

XII. STATUTORY DETERMINATIONS

Based on the unit RFI/RI/BRA report, the CBRP OU poses a threat to human health and the environment. Therefore, MNA/IC (Alternatives GW-2 and SW-2) has been selected as the remedy for the CBRP OU. CBRP OU does not contain principal threat source material. The future land use of the CBRP OU is assumed to be industrial land use.

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment. The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally ARARs to the remedial action (unless justified by a waiver), and is cost-effective. PCE and TCE will be degraded by natural processes such as reductive dechlorination and mineralization. The selected remedy includes ICs and monitoring of groundwater and surface water to ensure protection of human health and the environment and compliance with ARARs.

The selected remedy utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. The IA reduced TCE concentrations in groundwater from 130,000 µg/L before the IA was implemented in 1999 to less than 700 µg/L in May 2007, attaining the IRAO and satisfying the preference for treatment. Use of MicroBlowers™ will continue the physical treatment in the vadose zone until groundwater RAOs are achieved.

XIII. EXPLANATION OF SIGNIFICANT CHANGES

The remedy/remedies selected in this ROD do not contain any significant changes from the preferred alternative(s) presented in the SB/PP. No comments were received during the public comment period.

XIV. RESPONSIVENESS SUMMARY

The Responsiveness Summary serves the dual purposes of (1) presenting stakeholder concerns about the site and preferences regarding the remedial alternatives, and (2) explaining how those concerns were addressed and how the preferences were factored into the remedy selection process.

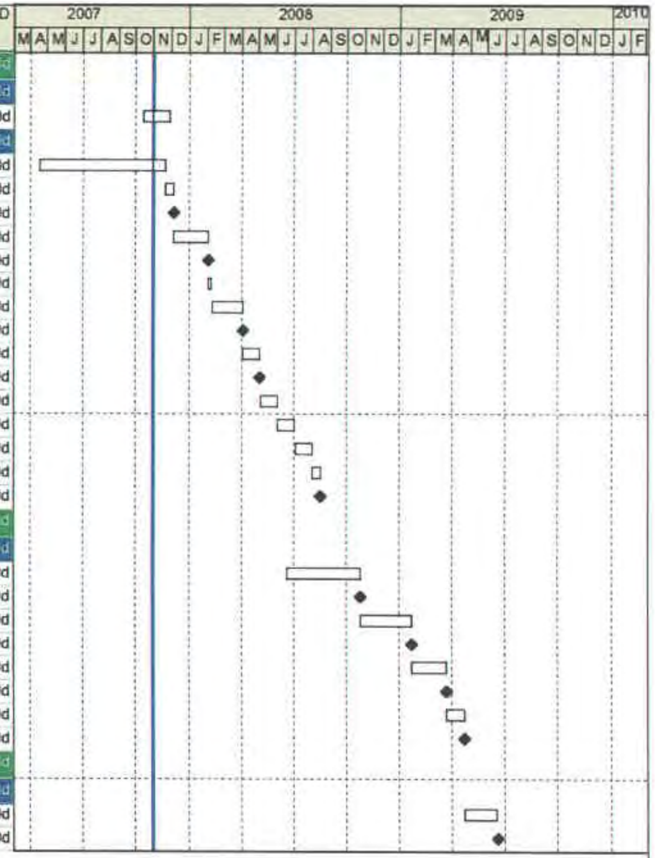
The Responsiveness Summary is included as Appendix A of this document.

XV. POST-ROD DOCUMENT SCHEDULE AND DESCRIPTION

The post-ROD schedule is presented in Figure 10.

This page intentionally left blank.

Activity Name	Start	Finish	OD
Regulatory Requirements	18-Apr-07 A	15-Aug-08	265.0d
Proposed Plan (PP)	15-Oct-07 A	29-Nov-07	25.0d
PUBLIC COMMENT PERIOD (PP)	15-Oct-07 A	29-Nov-07	45.0d
Record of Decision (ROD)	18-Apr-07 A	15-Aug-08	265.0d
DEVELOP REV.0 ROD	18-Apr-07 A	21-Nov-07	79.0d
RESPONSIVENESS SUMMARY & APPROVALS (ROD)	22-Nov-07	05-Dec-07	14.0d
SUBMIT Rev. 0 ROD		05-Dec-07	0.0d
EPA/SCDHEC REVIEW REV.0 ROD	06-Dec-07	03-Feb-08	60.0d
EPA/SCDHEC RETURNS REV.0 COMMENTS FOR ROD		03-Feb-08	0.0d
SRS INCORPORATE EPA/SCDHEC COMMENTS IN ROD	04-Feb-08	09-Feb-08	6.0d
SRS INCORPORATE EPA/SCDHEC COMMENTS IN ROD	10-Feb-08	03-Apr-08	54.0d
SRS SUBMITTAL OF REV.1 ROD		03-Apr-08	0.0d
EPA/SCDHEC FINAL REVIEW & APPROVAL (ROD)	04-Apr-08	03-May-08	30.0d
RECEIPT of ROD APPROVAL		03-May-08	0.0d
DOE obtain signature on ROD	04-May-08	02-Jun-08	30.0d
EPA obtain signature on ROD	03-Jun-08	02-Jul-08	30.0d
SCDHEC obtain signature on ROD	03-Jul-08	01-Aug-08	30.0d
Prepare for Public Notice	02-Aug-08	15-Aug-08	14.0d
ISSUE ROD		15-Aug-08	0.0d
Detailed Engineering and Pre-Construction	20-Jun-08	21-Apr-09	164.0d
Detailed Engineering and Pre-Construction	20-Jun-08	21-Apr-09	164.0d
Develop Rev.0 CMI/RAIP (Post ROD Docs)	20-Jun-08	23-Oct-08	88.0d
SRS SUBMITTAL OF REV.0 CMI/RAIP		23-Oct-08	0.0d
EPA/SCDHEC REVIEW (CMI/RAIP)	24-Oct-08	21-Jan-09	90.0d
EPA/SCDHEC RETURNS REV.0 COMMENTS		21-Jan-09	0.0d
SRS INCORPORATES EPA/SCDHEC COMMENTS (CMI/RA	22-Jan-09	22-Mar-09	60.0d
SRS SUBMITTAL OF REV.1 CMI/RAIP		22-Mar-09	0.0d
EPA/SCDHEC FINAL REVIEW & APPROVAL CMI/RAIP	23-Mar-09	21-Apr-09	30.0d
EPA/SCDHEC APPROVAL (CMI/RAIP)		21-Apr-09	0.0d
Construction	23-Apr-09	18-Jun-09	31.0d
Construction	23-Apr-09	18-Jun-09	31.0d
MOBILIZATION	23-Apr-09	17-Jun-09	39.0d
REMEDIAL ACTION (RA) START DATE	18-Jun-09		0.0d



Actual Work
Remaining Work
Critical Remaining Work
◆ Mil...

S&G
SOIL AND GROUNDWATER CLOSURE PROJECTS

Page 1 of 1

FOUR MILE BRANCH GENERAL

RCRA/CERCLA Implementation Schedule

Date	Revision	Che...	Approved

Figure 10. Post-ROD Schedule

This page intentionally left blank.

XVI. REFERENCES

Federal Facility Agreement (FFA), 1993. *Federal Facility Agreement for the Savannah River Site,* Administrative Docket Number 89-05-FF, Effective Date: August 16, 1993, WSRC-OS-94-42

Office of Management and Budget (OMB) 2006. "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs" (10/29/1992) OMB Circular A-94, http://www.whitehouse.gov/omb/circulars/a094/a094.pdf

Appendix C updated January 2006.

http://www.whitehouse.gov/omb/memoranda/fy2006/m06-05.pdf

Table of Past Years Discount Rates from Appendix C of OMB Circular No. A-94

http://www.whitehouse.gov/omb/circulars/a094/dischist-2006.pdf

USDOE, 1996. *Savannah River Site Future Use Project Report Project, Stakeholder Recommendations for SRS Land and Facilities*, January 1996

USDOE, 2000. *Long-Range Comprehensive Plan*, United States Department of Energy, Savannah River Operations Office, Aiken, SC (December) http://planning.srs.gov/SitePlans/comprehensiveplan.pdf

USEPA, 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA.* EPA/540/G-89/004, OSWER Directive 9355.3-01 (October), Office of Emergency and Remedial Response, USEPA, Washington, DC

USEPA, 1996. *Integrated Risk Information System (IRIS).* (March), USEPA On-Line Database of Toxicity Values, Office of Research and Development, Environmental Criteria and Assessment Office, Cincinnati, OH

WSRC, 1998. *Interim Record of Decision Remedial Alternative Selection for the C-Area Burning/Rubble Pit (131-C) (U)*, WSRC-RP-98-4039, Revision 1 (September), Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2001a. *Report on the Effectiveness of the C-Area Burning/Rubble Pit (CBRP) (U)*, WSRC-RP-2001-4086, Revision 0 (April), Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2001b. *Groundwater Modeling for the C-Area Burning/Rubble Pit (U)*, WSRC-TR-2001-00298, Revision 0 (October), Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2002a. *RCRA Facility Investigation (RFI)/Remedial Investigation (RI) Report with Baseline Risk Assessment (BRA) for the C-Area Burning/Rubble Pit (131-C) (U)*, WSRC-RP-96-170, Revision 1.4 (May), Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2002b. *Report on the Effectiveness of the C-Area Burning/Rubble Pit (CBRP) Interim Remedial Action for 2001 (U)*, WSRC-RP-2002-4080, Revision 1 (November), Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2003a. *Groundwater Flow and TCE Transport Modeling for the C-Area Burning/Rubble Pit (U)*, WSRC-TR-2003-4066, Revision 0 (April) (Included results of the unissued report *Additional Groundwater Remediation Alternatives Modeling for the C-Area Burning/Rubble Pit (U)* prepared by GeoTrans, Inc. in January 2003) Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2003b. *Report on the Effectiveness of the C-Area Burning/Rubble Pit (CBRP) Interim Remedial Action for 2002 (U)*, WSRC-RP-2003-4103 (June), Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2004a. *Focused Corrective Measures Study/Feasibility Study Report for the C-Area Burning/Rubble Pit (131-C) Operable Unit (U)*, WSRC-RP-2002-4164, Revision 1.2 (June), Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2004b. *Report on the Effectiveness of the C-Area Burning/Rubble Pit (CBRP) Interim Remedial Action for 2003 (U)*, WSRC-RP-2004-4066 (June 18), Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2005. *Report on the Effectiveness of the C-Area Burning/Rubble Pit (CBRP) Interim Remedial Action for 2004 (U)*, WSRC-RP-2005-4043 (June 20), Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2006a. *Investigation-Derived Waste Management Plan,* WSRC-RP-94-1227, Revision 8 (June), Washington Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2006b. *Savannah River Site Federal Facility Agreement Community Involvement Plan (U),* WSRC-RP-96-120, Revision 5 (July), Washington Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2007. *Statement of Basis/Proposed Plan for the C-Area Burning/Rubble Pit Operable Unit (CBRP) (U),* WSRC-RP-2007-4004, Revision 1 (September), Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

This page was intentionally left blank.

ARF # 15490

APPENDIX A

RESPONSIVENESS SUMMARY

This page intentionally left blank.

Responsiveness Summary

The SB/PP 45-day public comment period began on October 15, 2007 and ended on November 29, 2007.

Public Comments

No public comments were received.