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United States Department of Energy

Savannah River Site

Record of Decision
Remedial Alternative Selection for the General Separations Area Consolidation Unit (U)

WSRC-RP-2002-4002

Revision 0

August 2002

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

SRS

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

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

RECORD OF DECISION
REMEDIAL ALTERNATIVE SELECTION (U)

General Separations Area Consolidation Unit

WSRC-RP-2002-4002
Revision 0

August 2002

Savannah River Site
Aiken, South Carolina

Prepared by:

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

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DECLARATION FOR THE RECORD OF DECISION

Unit Name and Location

The General Separations Area Consolidation Unit includes the following waste units:

- H-Area Retention Basin (281-3H) and Spill on 05/01/1956 of Unknown Amount of Retention Basin Pipe Leak (NBN)

- Warner's Pond (685-23G) and Spill on 03/08/1978 of Unknown Seepage Basin Pipe Leak in H-Area Seepage Basin (NBN) and Spill on 02/08/1978 of H-Area Process Sewer Line Cave-In (NBN)

- HP-52 Ponds

- Old Radioactive Waste Burial Ground (Including Solvent Tanks) (643-E)

Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) Identification Numbers: OU-22, OU-48, OU-49, and OU-32

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

Savannah River Site
Aiken, South Carolina
United States Department of Energy

The General Separations Area Consolidation Unit (GSACU) consists of four primary waste units: H-Area Retention Basin (281-3H) (HRB), Warner's Pond (685-23G), HP-52 Ponds, and the Old Radioactive Waste Burial Ground (643-E) (ORWBG) including its 22 underground storage tanks known as the Old Solvent Tanks (650-01E through 650-22E) (OSTs). The Warner's Pond unit also includes a portion of the H-Area Inactive Process Sewer Line (HIPSL). Collectively, these waste units are identified as a single operable unit (OU) because of their proximity to each other and similar health and environmental threats. The unit 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 media associated with the GSACU are soil, sediment, and debris.

Statement of Basis and Purpose

This decision document presents the selected remedy for the GSACU, located at the SRS near Aiken, South Carolina. The remedy was chosen in accordance with CERCLA, as amended by the Superfund Amendments Reauthorization Act (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record File for this site.

The South Carolina Department of Health and Environmental Control (SCDHEC) and the United States Environmental Protection Agency (USEPA) concur with the selected remedy.

Assessment of the Site

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, pollutants or contaminants into the environment.

Description of the Selected Remedy

The selected remedy for HRB, Warner's Pond, and HP-52 Ponds is Alternative 7 (Consolidation at the ORWBG) and the selected remedy for the ORWBG is Alternative ORWBG VI (Institutional Controls with Low Permeability Cap). Individual intruder barriers will be installed over the long-lived persistent radioactive hot spots in the ORWBG (HS-500-1 through HS-500-8) before institutional controls are terminated at the ORWBG. The options of *in situ* stabilization of HS-Hg-1 and removal of the radioactive hot spots in the ORWBG will not be implemented.

Principal threat source material (PTSM) is present at HRB, Warner's Pond, HP-52 Ponds, and ORWBG. At HRB, Warner's Pond, and HP-52 Ponds, PTSM (and soil containing contaminant migration constituents of concern [CMCOCs]) will be removed to the extent practicable. At the ORWBG, treatment or removal of the PTSM is not practicable; consequently, engineering controls, including containment, will be used to manage the PTSM.

The selected remedy includes the following activities:

1. Excavate materials constituting industrial PTSM and soil containing CMCOCs above remedial goals (RGs) at HRB, Warner's Pond, and HP-52 Ponds to the extent practicable. The excavation will not breach the integrity of the hardpan. Soil RGs for CMCOCs are established to prevent leaching of constituents to groundwater at concentrations above maximum contaminant levels (MCLs) within 1,000 years. Table 5b provides additional explanation regarding the generation of soil RGs for CMCOCs.

2. Manage standing surface water (in HRB) and water that accumulates during excavation by solidification and consolidation with the excavated soil and/or by another means such as treatment at the Effluent Treatment Facility (ETF).

3. Consolidate the excavated soil and material by transferring it to the areas of the ORWBG that have not yet been covered by the native soil cover (e.g., over the OSTs). In the unlikely event that there is insufficient available space at the ORWBG, ship the excess waste to an off-SRS facility approved to receive CERCLA remediation waste.

4. When inactive pipelines are encountered during removal of soil, excavate those sections of the pipelines with the soil. At Warner's Pond, this will include the inactive CERCLA pipelines within the berms, the diversion box, and the RCRA-regulated HIPSL. Characterization data show that soil around the HIPSL is non-hazardous. Sections of the HIPSL and any contents will be sampled and analyzed during the characterization of Warner's Pond to determine if they are hazardous in accordance with South Carolina Hazardous Waste Management Regulation R.61-79.261. If the HIPSL pipeline or its contents are hazardous, these materials will not be consolidated into the ORWBG. A RCRA

Closure Plan will be developed to document the disposition of the RCRA pipeline. The RCRA closure plan will be approved by SCDHEC prior to remedial action on the HIPSL (indicated in yellow on Figure 4).

For remaining intact portions of inactive pipelines, including portions that are not in contact with PTSM or cannot be readily removed (such as the section of the HIPSL under the railroad track), plug the ends of the pipelines and grout in place. If a pipeline is not intact, cannot be reliably grouted in place, and is non-hazardous, remove it and consolidate it with the soil transferred to the ORWBG. Risks posed by remnant contamination in soil after excavation will be determined prior to backfilling.

5. Consolidate any vegetation in contact with PTSM by removing it and transferring it to the ORWBG. Vegetation will be shredded, chipped, or spatially distributed and incorporated into the excavated soil. Placement of this material at ORWBG will be engineered in a manner that minimizes subsidence.

6. Evaluate the risk of remnant material after excavation at HRB, Warner's Pond, and HP-52 Ponds. Contaminant migration risk from the potential source to the Upper Three Runs Aquifer (UTRA) beneath each unit will be evaluated.

7. Mitigate residual risk at HRB, Warner's Pond, and HP-52 Ponds by backfilling and placing clean soil over open excavations that contain residual contamination exceeding RGs. A soil cover will be used to minimize infiltration so that (1) no unit-related contaminants will cause MCL exceedances in the UTRA beneath each unit, and (2) the accumulation of perched water atop the hardpan is minimized.

8. Restore surface water drainage at Warner's Pond to a natural state by removing the berms that cause ponding of water.

9. Prepare a post-construction report for HRB, Warner's Pond, and HP-52 Ponds to summarize the remediation activities and summarize how residual risks are addressed.

10. Implement institutional controls at HRB, Warner's Pond, and HP-52 Ponds. Institutional controls will consist of site maintenance (site inspections, mowing, general housekeeping, repair of erosion damage, and other routine maintenance as needed) and access controls (warning signs and land use restrictions). Institutional controls will include continued use of SRS's Site Use and Site Clearance Programs to restrict disturbance of the cover system and waste at each unit and to prevent drinking water use of contaminated groundwater under each unit.

11. Construct a low-permeability geosynthetic cover system (with a soil hydraulic conductivity of $\leq 1 \times 10^{-7}$ cm/sec) over the ORWBG; including the areas where consolidated materials from HRB, Warner's Pond, and HP-52 Ponds were placed; but excluding the areas between interim covers B and D. A hydraulic conductivity of $\leq 1 \times 10^{-7}$ cm/sec is selected because it provides infiltration control that sufficiently manages uncertainties related to residual contamination without further investigation, and it is consistent with low permeability caps placed over similar facilities at SRS. Contiguous facilities associated with SRS's active Solid Waste Management Program (such as 643-7E/643-8E and associated paved parking areas) will not be covered by the cap. These facilities will continue to actively support SRS solid waste activities at least until all transuranic waste stored at SRS has been shipped to the Waste Isolation Pilot Plant (WIPP).

12. Implement institutional controls at the ORWBG. Institutional controls will consist of site maintenance (site inspections, mowing, general housekeeping, repair of erosion damage, other routine maintenance as needed, and periodic maintenance of the infiltration control system) and access controls (security fences, warning signs, and land use restrictions). Institutional controls will include continued use of SRS's Site Use and Site Clearance Programs to restrict disturbance of the cover system and waste at the unit and to prevent drinking water use of contaminated groundwater under the unit.

13. Before institutional controls are terminated at the ORWBG, install intruder barriers over the long-lived persistent radioactive hot spots (hot spots HS-500-1 through HS-500-8) to deter inadvertent human intrusion. The likely configuration of the intruder barrier is heavy rip-rap.

The barrier will be installed above the low permeability cap but beneath a soil cover. Covering the rip rap will minimize development of an undesirable habitat (e.g., a habitat among rip-rap favorable for deep-rooting plants and burrowing animals that could degrade the low permeability cap). Placement of the barrier will not interfere with the long-term integrity of the cap. A reasonable estimated timeframe for installing the intruder barrier is 100 years. The barrier will not be installed until institutional controls are terminated; the United States Department of Energy (USDOE) expects to maintain institutional controls at the Burial Ground Complex for at least 100 years.

For HRB, the scope of the response action is to remediate the basin bottom/sidewalls, the berm around the basin, the soil pile, the 75-ft section of process sewer line from the operational diversion box to the basin, the 100-ft long discharge sewer line, and the discharge area including a concrete spillway to the effluent stream. The area inside the boundary of HRB formerly identified as a Site Evaluation Area (SEA) (Spill on 05/01/1956 of Unknown Amount of Retention Basin Pipe Leak) is part of HRB and is included in the response action. The diversion box is still operational and is not included in the scope of the remediation. The existing effluent stream south of the unit to which the basin discharged has been characterized in the vicinity of HRB. However, this stream is not included in the scope of this remedial action because it is primarily contaminated by upgradient sources in H Area unrelated to HRB. The effluent stream is being addressed separately as part of the RCRA/CERCLA characterization of the upgradient facilities and the integrator operable unit (IOU) program. Although contaminated with radionuclides and inorganics, groundwater in the aquifer under the unit (the UTRA) is not included in the scope of this response action because no unit-related groundwater contaminants have been identified. Groundwater is not part of this unit; it is being addressed separately under the H-Area Groundwater Operable Unit (HAGOU).

For Warner's Pond, the scope of the response action is to remediate the former pond area (including the asphalt area and the berms), an 850-ft segment of the HIPSL (including manholes and the diversion box), and other inactive pipelines in the asphalt area and berms. The areas within the boundary of the Warner's Pond area formerly identified as SEAs (Spill on 03/08/1978 of Unknown Seepage Basin Pipe Leak in H-Area Seepage Basin [NBN] and Spill on 02/08/1978 of H-Area Process Sewer Line Cave-In [NBN]) are part of the Warner's Pond unit and are included with the response action. The effluent stream that has been diverted around the former pond area is not included in the scope of this remedial action because the stream is primarily contaminated by upgradient sources. The effluent stream is being addressed separately as part of the RCRA/CERCLA characterization of the upgradient facilities and the IOU program. The groundwater at Warner's Pond is contaminated with radionuclides and inorganics, although these contaminants cannot be attributed with certainty to the waste unit. Groundwater in the UTRA is not included in the scope of this response action. Groundwater is not part of this unit; it is being addressed separately under the HAGOU.

For HP-52 Ponds, the scope of the response action is to remediate the two former pond areas, the old effluent ditch, several soil piles at the unit that resulted from re-positioning and covering of contaminated soils in the area, and contamination in the historic drainage channel near the former beaver pond. The active regulated effluent stream that has been diverted around the former pond area is not included in the scope of this remedial action because the stream is fed by on-going H-Area facility operations with a potential for contamination. This active effluent stream is being addressed separately as part of the RCRA/CERCLA characterization of the upgradient facilities and the IOU program. Although contaminated with radionuclides and inorganics, groundwater in the UTRA is not included in the scope of this response action because the groundwater does not appear to have been affected by this unit. Groundwater is not part of this unit; it is being addressed separately under the HAGOU.

For ORWBG, the scope of the response action is to address the waste buried at depth in the unit and to implement a final action for the OSTs. The scope of the action excludes the areas between interim covers B and D because these areas are actively supporting SRS's solid waste management operations including the "ship-to-WIPP" program. There is no contaminated surface water at the ORWBG. Groundwater in the vicinity of the ORWBG has been contaminated by releases from the various facilities in the Burial Ground Complex, including the ORWBG. The contaminated groundwater is not included in the scope of this response action because it is being addressed by the corrective action program in the SRS RCRA Part B permit for the Mixed Waste Management Facility (MWMF) in accordance with Settlement Agreement 87-52-SW.

A separate remedial action will be necessary for miscellaneous areas of the Burial Ground Complex which are not included in the remedy for the GSACU. This separate action will address the area of the operational Solid Waste Management Division buildings, including underlying trenches, in the ORWBG and the non-hazardous waste portion of the Low Level Radioactive Waste Disposal Facility (643-7E) (including Combined Spills from ORWBG as reported in WSRC-RP-97-419).

IOUs are defined as surface water bodies (e.g., SRS streams, Savannah River) and associated wetlands, including the water, sediment, and related biota. These surface water bodies are referred to as "integrator" OUs because they represent the integration of potential contamination discharged to surface water or migrating through groundwater from source OUs, SEAs, National Pollutant Discharge Elimination System outfalls, and operational facilities to points of potential receptor exposure. The GSACU is within the Fourmile Branch and Upper Three Runs watersheds. Several source control and groundwater OUs within these watersheds will be evaluated to determine effects, if any, to associated streams and wetlands. SRS will manage all OUs to mitigate impact to the IOUs. SRS's actions to address contamination at HRB, Warner's Pond, and HP-52 Ponds serve to mitigate potential impacts to nearby streams. Upon disposition of all OUs, a final comprehensive ROD for each IOU will be pursued with additional public involvement.

SCDHEC has modified the SRS RCRA permit to incorporate the *Institutional Controls with Low Permeability Cap* remedy for the ORWBG.

Statutory Determinations

Based on the RCRA Facility Investigation/Remedial Investigation (RFI/RI) reports and Baseline Risk Assessments (BRAs), the GSACU poses a threat to human health and the environment. Therefore, Alternative 7 for HRB, Warner's Pond, and HP-52 Ponds (Consolidation at the

ORWBG) and Alternative ORWBG VI for the ORWBG (Institutional Controls with Low Permeability Cap) have been selected as the remedies for the GSACU.

Section 300.430(f)(2) of the NCP requires that a five-year remedy review of the ROD be performed if hazardous substances, pollutants, or contaminants above levels that allow for unlimited use and unrestricted exposure remain in the OU. The three parties - SCDHEC, USEPA, and USDOE - have determined that a five-year review of the ROD for the GSACU will be performed to ensure that the remedy continues to provide adequate protection 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 to the remedial action (unless justified by a waiver), is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. There is a statutory preference for treatment as a principal element of a remedy to the extent practicable. Although treatment is not part of the remedy for the GSACU, PTSM will be removed from HRB, Warner's Pond, and HP-52 Ponds. For the ORWBG treatment of the principal threats including the radioactive hot spots and HS-Hg-1 is not practicable. However, use of engineering controls (such as containment through capping) combined with institutional controls is protective of human health and the environment and is consistent with expectations in the NCP.

Because this remedy will result in hazardous substances remaining onsite above levels that allow for unlimited use and unrestricted exposure, a review will be conducted within five years after initiation of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

The selected remedy leaves hazardous substances in place that pose a potential future risk and will require land use restrictions for an indefinite period of time. As negotiated with USEPA, and in accordance with USEPA-Region IV policy (Johnston 1998), SRS has developed a Land Use Control Assurance Plan (LUCAP) (WSRC 1999) to ensure that land use restrictions are maintained and periodically verified. A unit-specific Land Use Control Implementation Plan (LUCIP) will provide detail and specific measures required for the land use controls selected as part of this remedy. USDOE-Savannah River Operations Office is responsible for implementing, maintaining, monitoring, reporting upon, and enforcing the land use controls under this ROD. The LUCIP selected 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 Land Use Controls (LUC) implementation and maintenance requirements enforceable under CERCLA. The approved LUCIP will establish implementation, monitoring, and maintenance, reporting, and enforcement requirements for the unit. The LUCIP will remain in effect until modified as needed to be protective of human health and the environment. LUCIP modification will only occur through another CERCLA document.

USDOE expects to retain control of the GSACU for the foreseeable future, and the future land use is anticipated to be the same as the current land use (industrial). However, in the unlikely case the property is transferred to nonfederal ownership, the US 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, in perpetuity, notify any potential purchaser that the property has been used for the management and disposal of waste. These requirements are also consistent with the intent of the RCRA deed notification requirements at final closure of a RCRA facility if contamination will remain at the unit.

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

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

Data Certification Checklist

This ROD provides the following information:

- Constituents of concern (COCs) and their respective concentrations
- Baseline risk represented by the COCs
- Cleanup levels established for the COCs and the basis for the levels
- Current and future land and groundwater use assumptions used in the risk assessments and ROD
- Land and groundwater use that will be available at the site as a result of the selected remedy
- 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
- Decision factor(s) that led to selecting the remedy (i.e., describes how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria)
- How source materials constituting principal threats are addressed

8/23/02
Date

Jeffrey M. Allison
Acting Manager
U. S. Department of Energy, Owner and Co-operator,
Savannah River Operations Office

9/26/02
Date

Richard D. Green
Division Director
Waste Management Division
U. S. Environmental Protection Agency – Region IV

9/17/02
Date

R. Lewis Shaw
Deputy Commissioner
Environmental Quality Control
South Carolina Department of Health and Environmental Control

DECISION SUMMARY
REMEDIAL ALTERNATIVE SELECTION (U)

General Separations Area Consolidation Unit

WSRC-RP-2002-4002
Rev. 0

August 2002

Savannah River Site
Aiken, South Carolina

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TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

AEA	Atomic Energy Act
ARAR	applicable or relevant and appropriate requirement
bls	below land surface
BRA	Baseline Risk Assessment
CAB	Citizens' Advisory Board
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CFR	Code of Federal Regulations
Ci	curies
cm/sec	centimeters per second
CMCOC	contaminant migration constituent of concern
CMI/RAIP	corrective measures implementation/ remedial action implementation plan
CMS/FS	corrective measures study/feasibility study
COBRA	computerized burial record analysis
COC	constituent of concern
COI	constituent of interest
COPC	constituent of potential concern
CSM	conceptual site model
cy	cubic yards
EIA	Environmental Impact Assessment
ESD	Explanation of Significant Difference
ETF	Effluent Treatment Facility
FFA	Federal Facility Agreement
ft	feet
GSACU	General Separations Area Consolidation Unit
HAGOU	H-Area Groundwater Operable Unit
HIPSL	H-Area Inactive Process Sewer Line
HQ	hazard quotient
HRB	H-Area Retention Basin (281-3H)
HS-Hg-1	mercury hot spot within ORWBG
HSWA	Hazardous and Solid Waste Amendments
IOU	integrator operable unit
IROD	interim record of decision
LLC	Limited Liability Company
LLRWDF	Low Level Radioactive Waste Disposal Facility
LUC	Land Use Controls
LUCAP	Land Use Controls Assurance Plan
LUCIP	Land Use Controls Implementation Plan
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
MWMF	Mixed Waste Management Facility

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

NBN	no building number
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	not detected
NEPA	National Environmental Policy Act
NPL	National Priorities List
O&M	operations and maintenance
ORWBG	Old Radioactive Waste Burial Ground (643-E)
OSTs	Old Solvent Tanks (650-01E through 22E)
OU	operable unit
pCi/g	picoCuries per gram
pCi/L	picoCuries per liter
PTSM	principal threat source material
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RG	remedial goal
RGO	remedial goal option
RI	Remedial Investigation
ROD	Record of Decision
SARA	Superfund Amendments Reauthorization Act
SB/PP	Statement of Basis/Proposed Plan
SCDHEC	South Carolina Department of Health and Environmental Control
SCHWMR	South Carolina Hazardous Waste Management Regulations
SEA	site evaluation area
SRS	Savannah River Site
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
UTRA	Upper Three Runs Aquifer
VOC	volatile organic compound
WAC	waste acceptance criteria
WIPP	Waste Isolation Pilot Plant
WSRC	Westinghouse Savannah River Company

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

Unit Name, Location, and Brief Description

The General Separations Area Consolidation Unit (GSACU) includes the following waste units:

- H-Area Retention Basin (281-3H) and Spill on 05/01/1956 of Unknown Amount of Retention Basin Pipe Leak (NBN)
- Warner's Pond (685-23G) and Spill on 03/08/1978 of Unknown Seepage Basin Pipe Leak in H-Area Seepage Basin (NBN) and Spill on 02/08/1978 of H-Area Process Sewer Line Cave-In (NBN)
- HP-52 Ponds
- Old Radioactive Waste Burial Ground (ORWBG) (Including Solvent Tanks) (643-E)

Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) Identification Numbers: OU-22, OU-48, OU-49, and OU-32

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

Savannah River Site
Aiken, South Carolina
United States Department of Energy

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

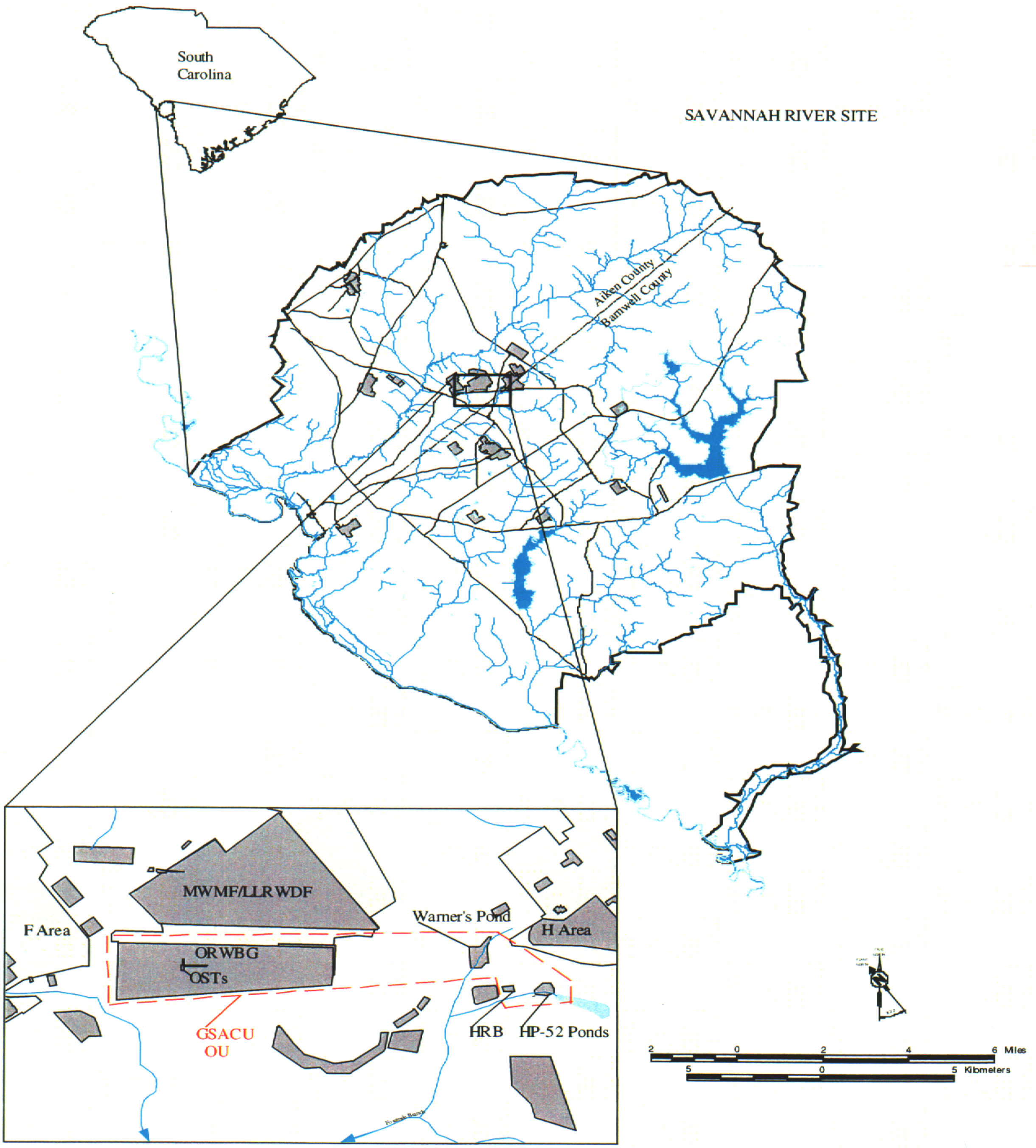


Figure 1. Location of the GSACU at SRS

The United States Department of Energy (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 by-products 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 GSACU as a Resource Conservation and Recovery Act (RCRA) Solid Waste Management Unit/CERCLA unit requiring further evaluation. The GSACU required further evaluation through an investigation process that integrates and combines the RCRA Facility Investigation (RFI) process with the CERCLA Remedial Investigation (RI) process to determine the actual or potential impact to human health and the environment of releases of hazardous substances, pollutants or contaminants to the environment.

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 United States 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 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 from SCDHEC a RCRA hazardous waste permit, which was most recently renewed on September 5, 1995.

Module IV of the Hazardous and Solid Waste Amendments (HSWA) 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 RFI program with CERCLA requirements to provide for a focused environmental program. In accordance with Section 120 of CERCLA, 42 U.S.C.A. § 9620, USDOE has negotiated a FFA (FFA 1993) with the United States Environmental Protection Agency (USEPA) and SCDHEC to coordinate remedial activities at SRS into one comprehensive strategy that fulfills these dual regulatory requirements. USDOE functions as the lead agency for remedial activities at SRS, with concurrence by the USEPA - Region IV and the SCDHEC.

Operable Unit Operational and Compliance History

The GSACU consists of four primary waste units: H-Area Retention Basin (HRB), Warner's Pond, HP-52 Ponds, and the ORWBG including its 22 underground storage tanks known as the OSTs. The Warner's Pond unit also includes a portion of the HIPSL. Collectively, these waste units are identified as a single operable unit (OU) (Figure 1) because of their proximity to each other and similar health and environmental threats.

The GSACU has been assessed through characterization and a series of documents written by USDOE and approved by the regulatory agencies (SCDHEC and USEPA). These documents are listed on Table 1, and reference citation information is provided in Section XVI, References.

Initially, the four waste units were being evaluated separately. The RCRA/CERCLA documents for HRB and the ORWBG were completed through the Corrective Measures Study/Feasibility Study (CMS/FS) stage, and it was determined that there was a

Table 1. Key RCRA/CERCLA Documents for the GSACU

	Work Plan	RFI/RI & BRA	CMS/FS	IROD	SB/PP
HRB	WSRC 1997a	WSRC 1998	WSRC 2000a	N/A	WSRC 2002
Warner's Pond	WSRC 2001a	--	--	N/A	
HP-52 Ponds		--	--	N/A	
ORWBG (including OSTs)	WSRC 1997b WSRC 2000b	WSRC 1997c WSRC 1997d WSRC 1997e	WSRC 2001b	WSRC 1996 WSRC 2000c	

Reference citation information is provided in Section XVI, References.

-- Document not prepared. Units combined into single OU due to similarity of health and environmental threats, contaminants of concern, and proximity.

N/A = not applicable

preference to remove principal threat source material (PTSM) from HRB and place it at the ORWBG. At this point, principal threat source material (PTSM) was also identified at Warner's Pond and HP-52 Ponds during precharacterization work. Given the similar health and environmental threats, similar geologic setting, and proximity of the units; USDOE, SCDHEC, and USEPA agreed to consolidate HRB, Warner's Pond, HP-52 Ponds, and the ORWBG into a single OU to expedite remedial action. As a result, an RFI/RI/BRA and CMS/FS were not needed for Warner's Pond or HP-52 Ponds (Table 1).

HRB

HRB (281-3H) is a single open inactive retention basin surrounded by a berm (Figures 2 and 3). HRB is 200 ft long by 120 ft wide by 7 ft deep. From 1955 to 1972, it received non-hazardous radioactively-contaminated wastewater from chemical separations facilities and from the H-Area Tank Farm. Wastewater flowed from these facilities through an underground process sewer line to a diversion box that directed the waste stream to either HRB (281-3H) or a former retention basin (281-7H) located several hundred yards to the west at the location of the current operational retention basin (281-8H). The diversion box is still operational and is currently used to route wastewater to the operational retention basin 281-8H. The process sewer line from the diversion box to HRB is no longer in service and is part of the HRB unit. This segment is a 3-ft diameter concrete pipe 75 ft long. Drainage from HRB was via a 100-ft long, 3-ft diameter concrete pipe on the south side of the basin. The pipe discharged to a concrete spillway along an existing active effluent stream that flows from H Area to Fourmile Branch (Figure 3). The exact volumes of wastewater received at the basin and discharged from the basin are not known. In May 1956, an undetermined volume of material leaked from the discharge gate on the south side of HRB. SRS constructed a temporary holding pond (approximately 45 x 45 ft) to contain the material. This area was identified as a site evaluation area (SEA) called Spill on 05/01/1956 of Unknown Amount of Retention Basin Pipe Leak (NBN) (no building number) and subsequently has been included in the HRB unit.

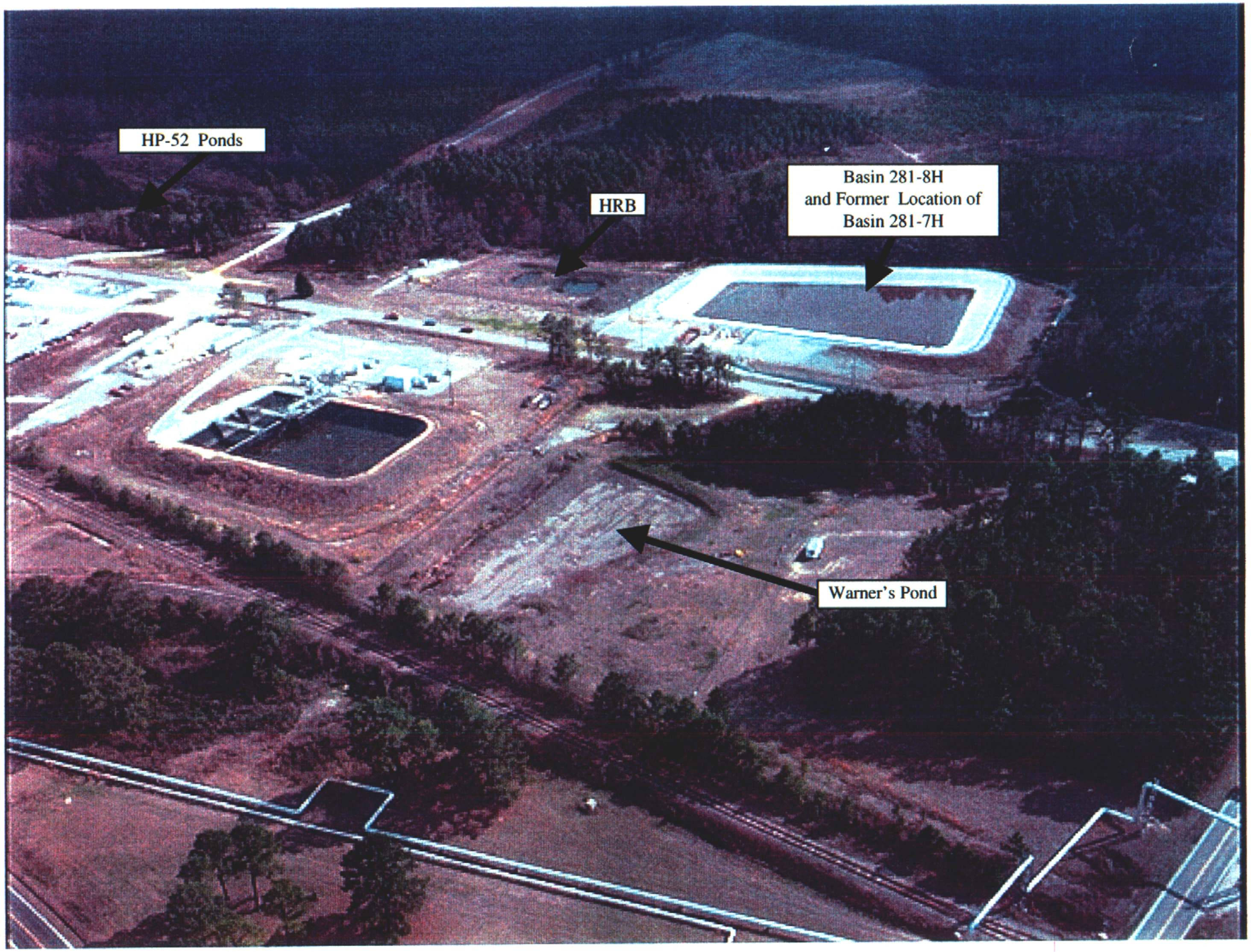


Figure 2. Oblique Aerial Photograph of HRB, Warner's Pond, and HP-52 Ponds

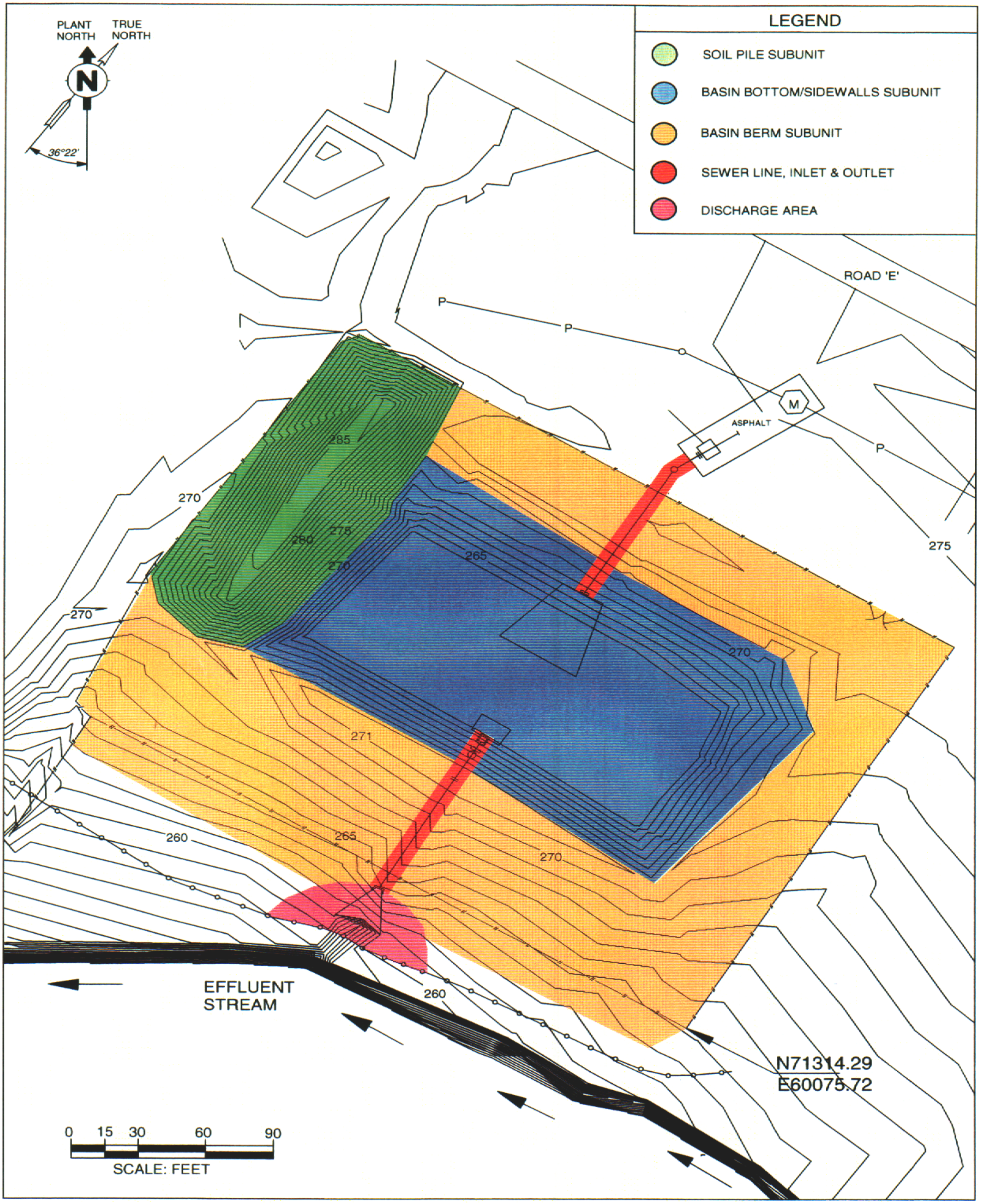


Figure 3. Map of HRB

There is a soil pile on the western side of the basin. The soil pile is 160 ft long by 60 ft wide by 15 ft high. The soil is the excavated remains of a former basin (281-7H) (the location of the operational 281-8H basin) which was adjacent to HRB. When the basin 281-8H was constructed in 1972, contaminated soil from 281-7H was removed, placed on asphalt next to HRB, and covered by asphalt.

Trees and other vegetation were removed from HRB in 1996. HRB is now primarily covered with grasses and scattered small shrubs. Standing rainwater is normally present in HRB. The amount varies seasonally, depending on the amount of rainfall and the evaporation rate.

Warner's Pond

Warner's Pond (Figures 2 and 4) is a 4-acre site centered on an area that was formerly occupied by a 1-acre pond ("Former Pond" on Figure 4). The pond was constructed in 1956 as an emergency holding pond to receive contaminated cooling water from the 221-H (H Canyon) building that flowed into an effluent stream. Contaminated cooling water was discharged to Warner's Pond on three occasions: 1956 (cooling coil leak), 1960 (source not determined), and 1965 (cooling coil leak which released approximately 300 curies [Ci] of activity). Contaminated water from all three events entered the pond via the effluent stream leading from H Area and was diverted or pumped to HRB or to the H-Area Seepage Basins. In 1966, Warner's Pond was drained, backfilled with two feet of clean soil, and paved with asphalt.

There are several inactive pipelines that run through the Warner's Pond area and are part of the unit. One is a RCRA-regulated pipeline known as the H-Area Inactive Process Sewer Line (HIPSL) ("RCRA Inactive Process Sewer Line" on Figure 4). The HIPSL is an 18-inch-diameter vitrified clay pipe through which liquid waste was transported from the Separations Facilities to the H-Area Seepage Basins. The HIPSL is approximately 2 to 6 ft below land surface (bls) in the former pond area and 4 to 10 ft bls on the north side of the railroad tracks. Facility records indicate the sewer line operated from 1955 to

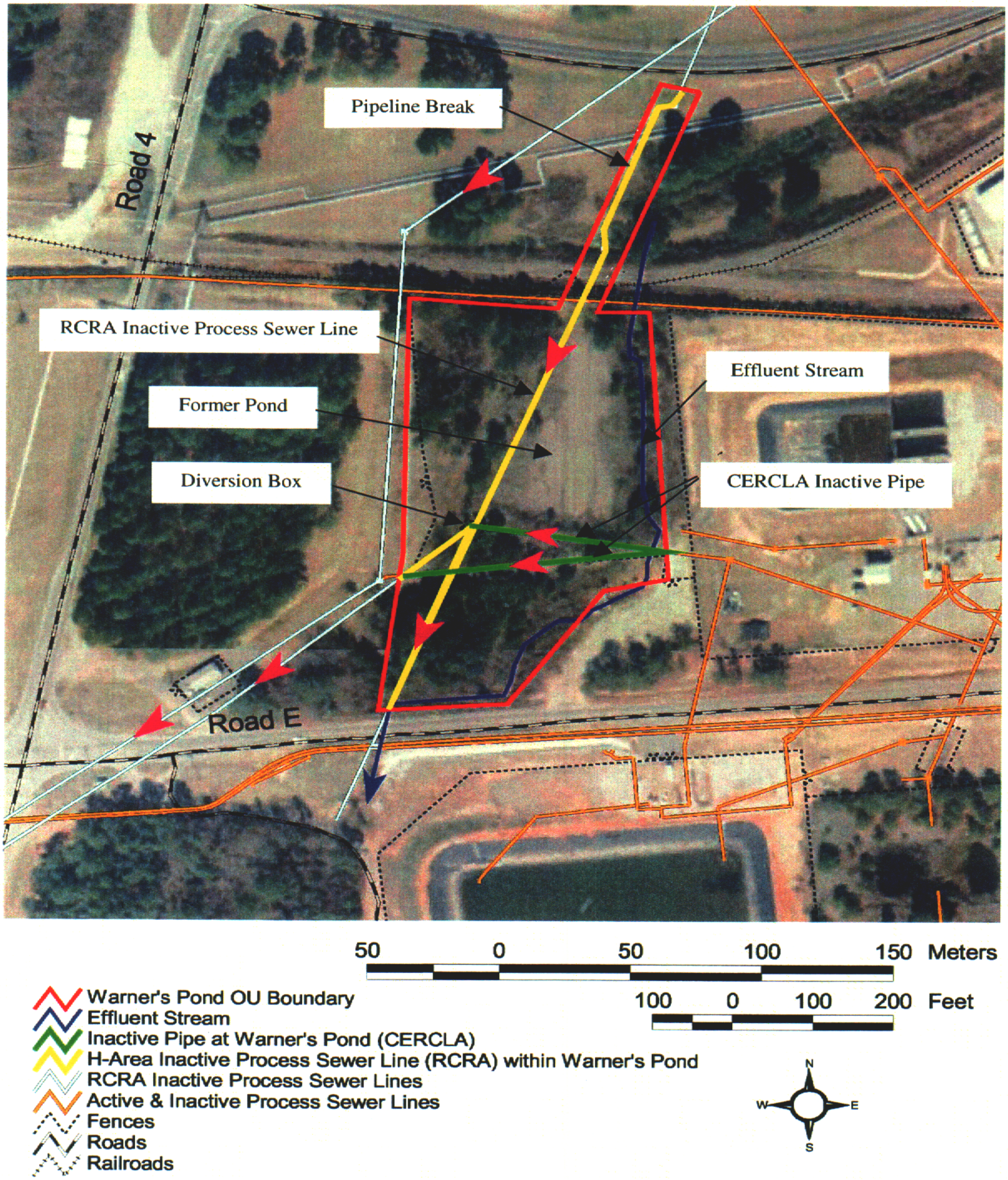


Figure 4. Map of Warner's Pond

Pink arrows indicate flow direction in pipelines when the pipelines were active.

1982. This effluent was characteristically hazardous due to mercury and chromium concentrations and low pH. No listed wastes were managed at the HIPSL. There are approximately 1,250 ft of RCRA HIPSL, several manholes, and a diversion box inside the Warner's Pond OU boundary.

Within the Warner's Pond waste unit, the HIPSL splits into two pipelines at the diversion box: the main pipeline (the western branch) which discharged to the H-Area Seepage Basins, and an overflow pipeline (the eastern branch) which discharged to an unnamed tributary of Fourmile Branch. The eastern branch of the pipeline is identified as a part of the HIPSL because it is downgradient of the other part of the HIPSL and potentially may have received RCRA discharge.

The other two inactive pipelines in the Warner's Pond waste unit ("CERCLA Inactive Pipe" on Figure 4) are within the berms and are regulated for remedial action in accordance with the SRS FFA (CERCLA) as opposed to corrective action under the SRS RCRA Permit. One section is approximately 350 ft of reinforced concrete pipe and the other section is approximately 230 ft of polyethylene pipe. These pipelines were gravity-fed to the HIPSL and are near grade within the berms. These pipelines adjoin the HIPSL from a network of sewer lines (now inactive) that carried effluent to several non-RCRA regulated units (HRB [281-3H] and the former retention basin 281-7H). This configuration provided the option to manage potentially radiologically-contaminated effluent (non-RCRA contaminated cooling water from the chemical separations process and occasional contaminated storm sewer drainage from the H-Area Separations Tank Farm) that was sent to two basins (281-3H and 281-7H) or diverted to the pipelines.

In 1978, two spills (overflows) from a diversion box along the then-active vitrified clay process sewer line contaminated soils in the vicinity of the diversion box over an area at least 25 by 250 ft. This area was identified as a SEA called Spill on 03/08/1978 of Unknown Seepage Basin Pipe Leak in H-Area Seepage Basin (NBN) and subsequently has been included in the Warner's Pond unit.

There are also reports that 40 ft of the HIPSL collapsed in 1978 just north of the railroad line at the northern part Warner's Pond ("Pipeline Break" on Figure 4). This area was identified as a SEA called Spill on 02/08/1978 of H-Area Process Sewer Line Cave-In (NBN) and subsequently has been included in the Warner's Pond unit.

In 1978, radiological survey data and sampling data identified elevated beta-gamma activity at Warner's Pond that warranted corrective measures. Soils exceeding 2,000 counts per minute (approximately 1,000 cubic yards [cy]) were removed from the former pond area and sent to the Burial Ground Complex for disposal. The area was then treated with herbicide, graded with fresh soil, topped with a clay overburden, and re-paved with asphalt. The effluent stream that fed the former pond has been re-directed around the contaminated area.

Trees and other vegetation were removed from Warner's Pond in 1996. Warner's Pond is primarily covered with asphalt that is in generally good condition with few cracks.

HP-52 Ponds

The HP-52 Ponds unit (Figures 2 and 5) is a 1.1-acre site centered on an area that was formerly occupied by two small holding ponds ("Former Pond Area" in Figure 5). In 1967 during a transfer of high level waste, some material spilled onto the ground and flowed into a nearby storm sewer and reached the HP-52 outfall. Two small holding ponds referred to as the "HP-52 Cesium Ponds" or "HP-52 Ponds" were constructed to contain the contaminated water. Contaminated soil from the spill containing approximately 1,200 Ci of radioactivity was removed and shipped to the ORWBG. The stream banks below the HP-52 outfall were paved with asphalt to minimize contaminant migration from the soil to the stream.

A smaller spill occurred in 1969 when a waste transfer line ruptured and released high level waste to the storm sewer and outfall. After the 1969 spill, soil containing 0.5 Ci of radioactivity was disposed in the ORWBG. Following this event, the pond areas were filled

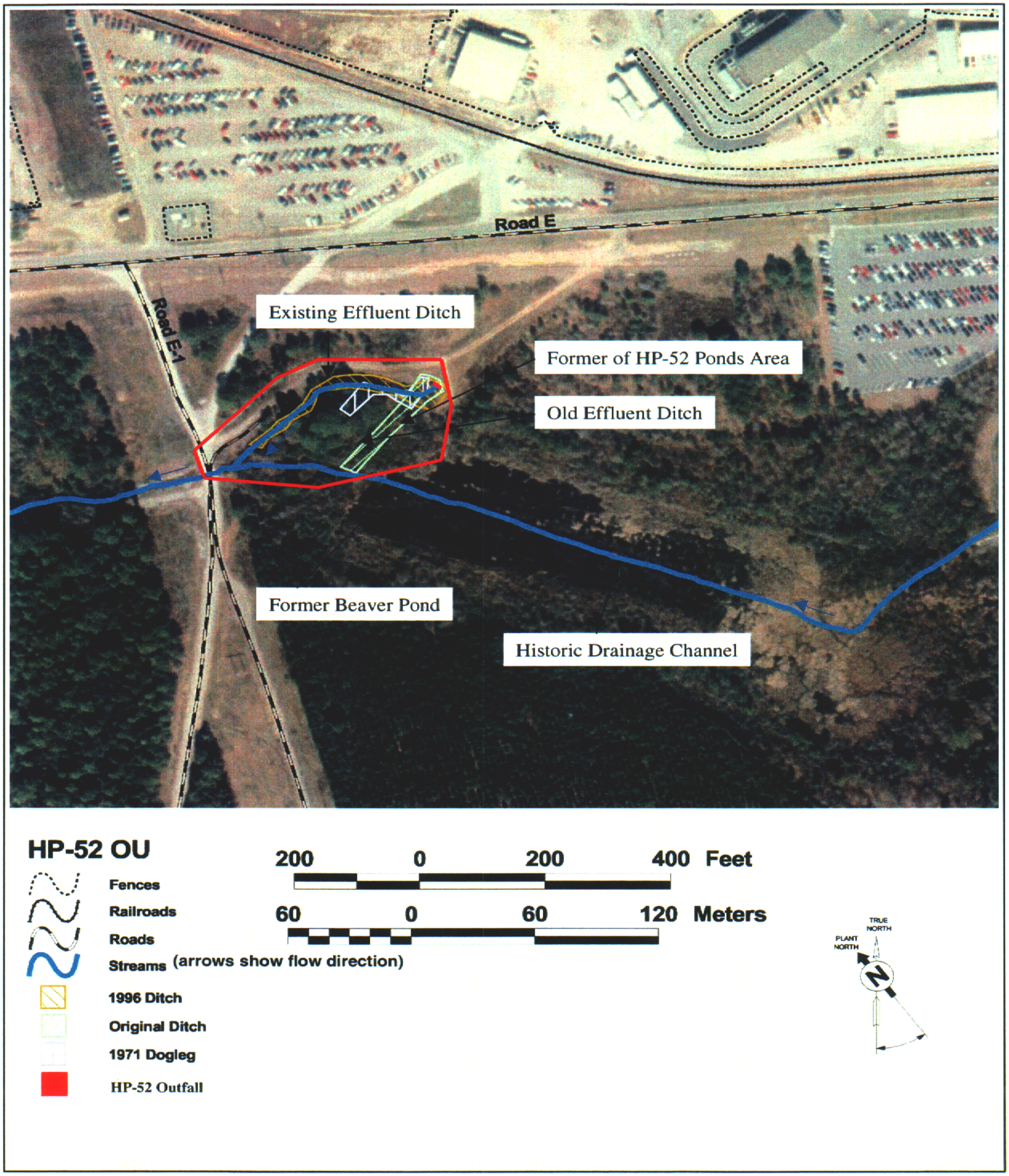


Figure 5. Map of HP-52 Ponds

with contaminated soil excavated from the stream banks, and covered with clean backfill. Stream flow was diverted from the original effluent ditch ("Old Effluent Ditch" in Figure 5) and re-directed around the former ponds area and the original effluent ditch was backfilled.

There is no historical evidence to document the exact locations of the former ponds at HP-52 Ponds. The former ponds area noted on Figure 5 was inferred from the field locations of, and information associated with, two concrete waste site markers.

Several soil piles are present at HP-52 Ponds. The piles are the result of movement of soil at the unit to fill the pond areas, to backfill ditches, and to redirect the active regulated effluent ditch.

A pre-SRS historic drainage channel fed by stormwater runoff is present south of the former ponds area ("Historic Drainage Channel" on Figure 5). Beaver dams created a pond ("Former Beaver Pond" on Figure 5) along the historic drainage channel. During pre-characterization sampling, sediments beneath the former beaver pond (Figure 5) were determined to be radiologically contaminated due to the HP-52 spills. The beaver dams were removed and the pond drained; as a result, the exposed materials are evaluated as soil.

Trees and other vegetation were removed from HP-52 Ponds in 1996. The HP-52 Ponds unit is now primarily covered with grasses and scattered small shrubs.

ORWBG

The ORWBG (Figures 6, 7, and 8) is part of the central disposal area for solid radioactive waste at SRS known as the Burial Ground Complex. Waste was disposed at the ORWBG from 1952 until 1974, when the site was essentially filled and the majority of waste disposal operations shifted to other facilities in the Burial Ground Complex.

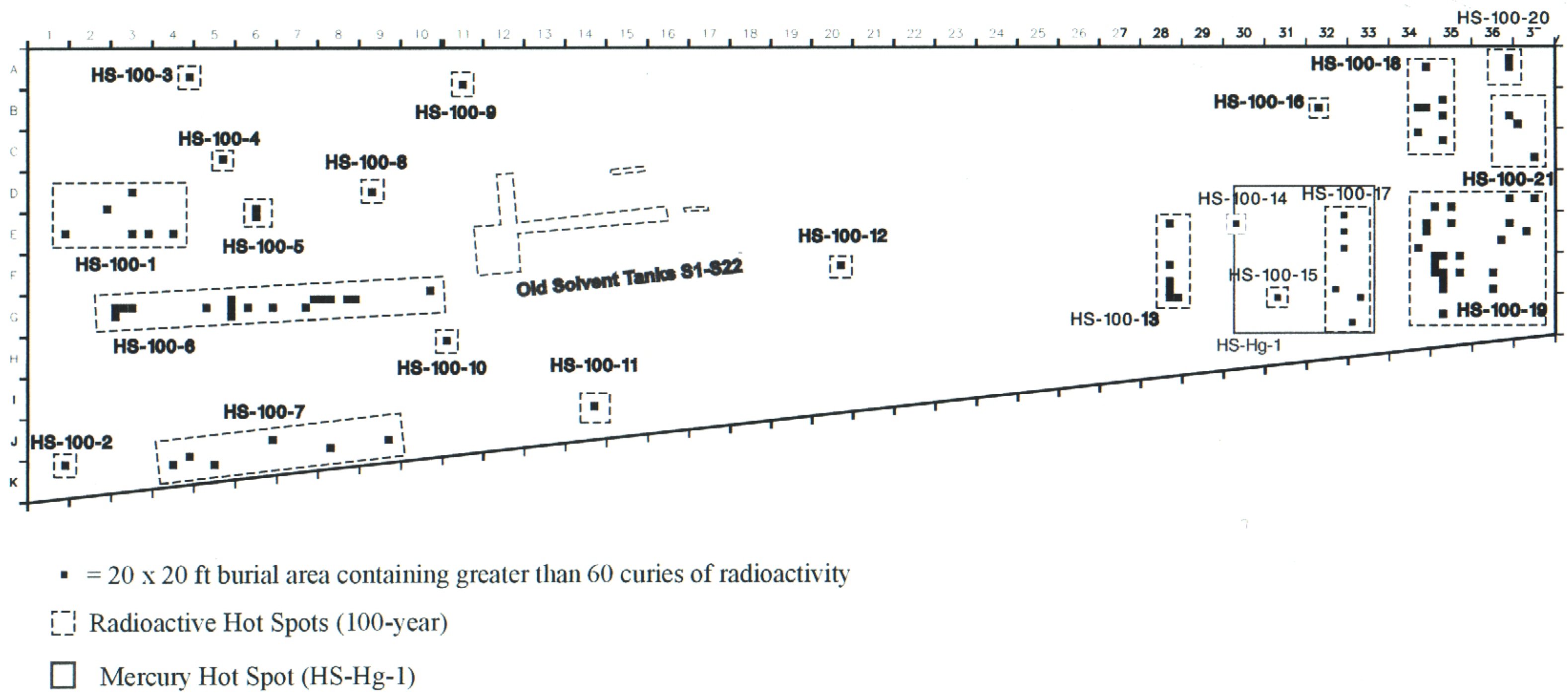
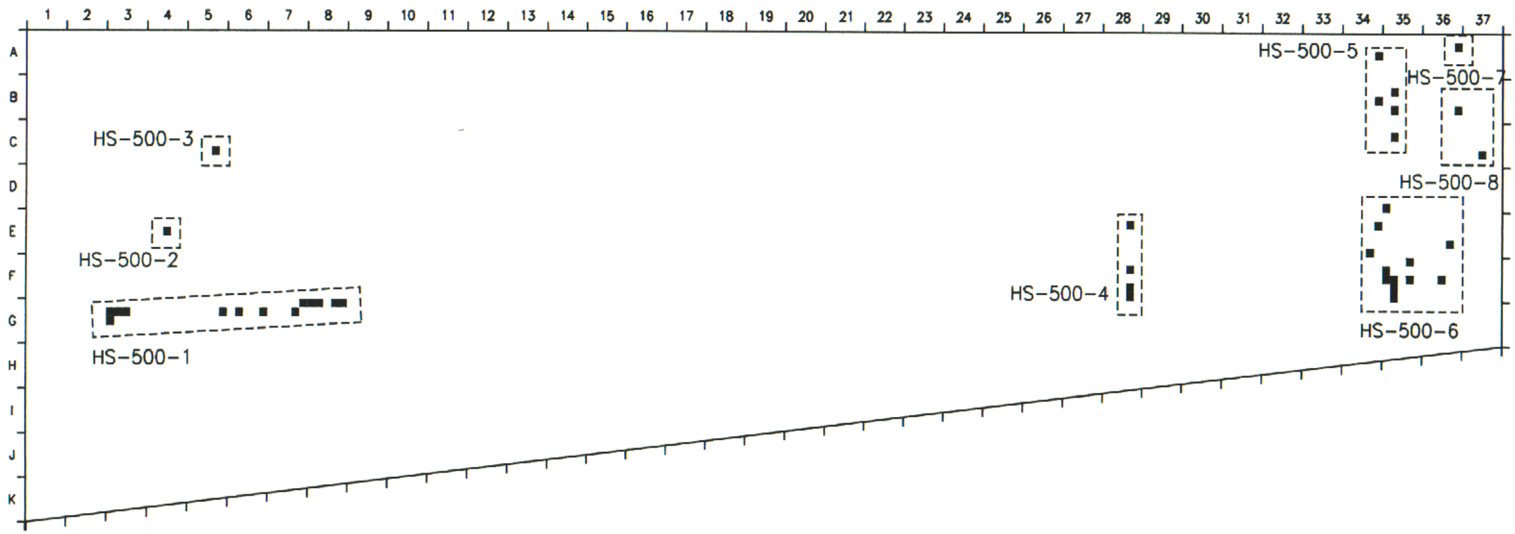


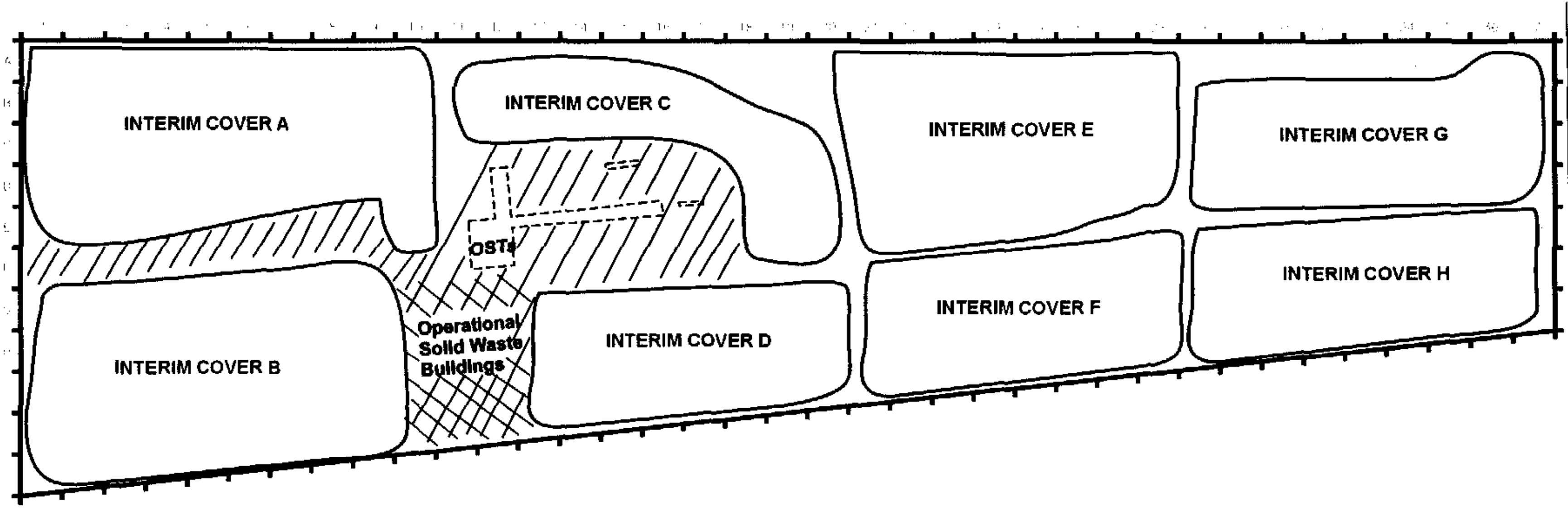
Figure 6. Map of OSTs, Mercury Hot Spot, and 100-Year Radioactive Hot Spots in the ORWBG



▪ = 20 x 20 ft burial area containing greater than 60 curies of radioactivity

⁝⁝ Radioactive Hot Spots (500-year)

Figure 7. Map of 500-Year Radioactive Hot Spots in the ORWBG



Areas of burial trenches not yet covered by the native soil cover

Areas not included in the scope of this remedial action (operational area – will not be capped under this ROD)

Figure 8. Map of the Existing Native Soil Cover at the ORWBG

The ORWBG is a 76-acre disposal area for solid radioactive waste produced at SRS as well as shipments from other USDOE and Department of Defense facilities. It accommodated disposal of various levels and types of radioactive waste materials, including radioactively-contaminated hazardous substances. These materials included low-level waste, intermediate-level waste, and waste containing transuranic isotopes. Volumetrically, the majority of waste disposed at the ORWBG was low-level incidental waste from laboratory and production operations, including small equipment, spent air filters, clothes, analytical waste, decontamination residues, plastic sheeting, gloves, soil, and construction debris.

During its operational history, approximately 7,125,000 ft^3 of radioactive wastes including radioactively-contaminated hazardous substances were buried at depth within the ORWBG. Most wastes disposed in the ORWBG were placed in drums, cans, cardboard boxes, plastic bags, and metal containers and buried in earthen trenches approximately 20 ft deep. Lesser amounts of waste were buried in concrete culverts, casks, and stainless steel vessels. After approximately 16 ft of waste had been placed in the trenches, the trenches were returned to grade by backfilling with approximately 4 ft of cover soil. Most waste was disposed at the ORWBG from 1952 until 1972. In addition, small quantities of radioactive waste (contaminated primarily with transuranic isotopes) were disposed in 1973 and 1974. The ORWBG was also used to dispose of contaminated equipment, to incinerate used solvent and bury the residue, and for sandblasting to decontaminate equipment.

At the time of burial, approximately 5.1 million Ci of radioactivity was placed in the ORWBG. Much of the short-lived radioactivity has decayed, but a large inventory of radioactive and hazardous substances remain buried at depth in the ORWBG.

In 1996, USDOE issued an Interim Record of Decision (IROD) (WSRC 1996) to place a soil cover on the ORWBG. The interim action installed a mounded 2- to 8-foot-thick low permeability native soil layer with vegetative cover and an associated drainage network over most of the ORWBG to minimize infiltration and leaching of the buried waste (Figure 8). However, the native soil cover was not placed over the OSTs (which were empty at the time except for residual contamination) because it could have hindered characterization or the final remedial action and because the weight of the soil cover and the equipment used during its placement could have damaged the tanks. Also, the native soil cover was not placed in the area where Solid Waste Management Division has operating administrative buildings (between interim covers B and D) nor in an area in the western part of the ORWBG between interim covers A and B (Figure 8).

A second interim action was started in 2001 to stabilize the OSTs (WSRC 2000c). The OSTs, including the residual materials in the tanks, are being grouted in place. The interim action is scheduled to be completed in June 2003.

The ORWBG is covered by a vegetative cover of grass, which was established as part of the 1996 interim action.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

Both RCRA and CERCLA require the public to 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 Regulations (SCHWMR) R.61-79.124 and Sections 113 and 117 of CERCLA, 42 U.S.C.A. §§ 9613 and 9617. These requirements include establishment of an Administrative Record File that documents the investigation and selection of the remedial alternative for addressing the GSACU. The Administrative Record File must be established at or near the facility at issue. The SRS Public Involvement Plan (USDOE 1994) is designed to facilitate public involvement in the decision-making process for permitting, closure, and the selection of remedial alternatives. The SRS Public Involvement Plan addresses the requirements of RCRA, CERCLA, and the National Environmental Policy Act (NEPA) of 1969. 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 General Separations Area Consolidation Unit* (WSRC 2002), a part of the Administrative Record File, highlights key aspects of the investigation and identifies the preferred action for addressing the GSACU.

USDOE Order 451.1B (NEPA Compliance Program) directs that NEPA values (i.e., cumulative, offsite, ecological, and socioeconomic impacts) should be integrated into USDOE CERCLA documents to the extent practicable. An Environmental Impact Assessment (EIA) (USDOE 2002) for remediation of the GSACU was prepared for remediation of the GSACU in accordance with SRS NEPA/CERCLA Integration Guidance (WSRC 1997f). The EIA was a part of the CERCLA review of alternatives and is a reference in the CERCLA documentation for this project.

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

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

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

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

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

The Statement of Basis/Proposed Plan (SB/PP) 45-day public comment period began on June 6, 2002, and ended on July 20, 2002. A Responsiveness Summary, prepared to address comments received during the public comment period, is provided in Appendix A of this Record of Decision (ROD). It is also available with the final RCRA permit modification.

IV. SCOPE AND ROLE OF THE OPERABLE UNIT WITHIN THE SITE STRATEGY

RCRA/CERCLA Programs at SRS

RCRA/CERCLA units (including the GSACU) at SRS are subject to a multi-stage RI process that integrates the requirements of RCRA and CERCLA as outlined in the FFA (FFA 1993). The RCRA/CERCLA processes are summarized below:

- investigation and characterization of potentially impacted environmental media (such as soil, groundwater, and surface water) comprising the waste site and surrounding areas
- evaluation of risk to human health and the local ecological community
- screening of possible remedial actions to identify the selected technology which will protect human health and the environment
- implementation of the selected alternative
- documentation that the remediation has been performed competently
- evaluation of the effectiveness of the technology

The steps of this process are iterative in nature and include decision points that require concurrence between USDOE as owner/manager, USEPA and SCDHEC as regulatory oversight agencies, and the public (see Figure 9).

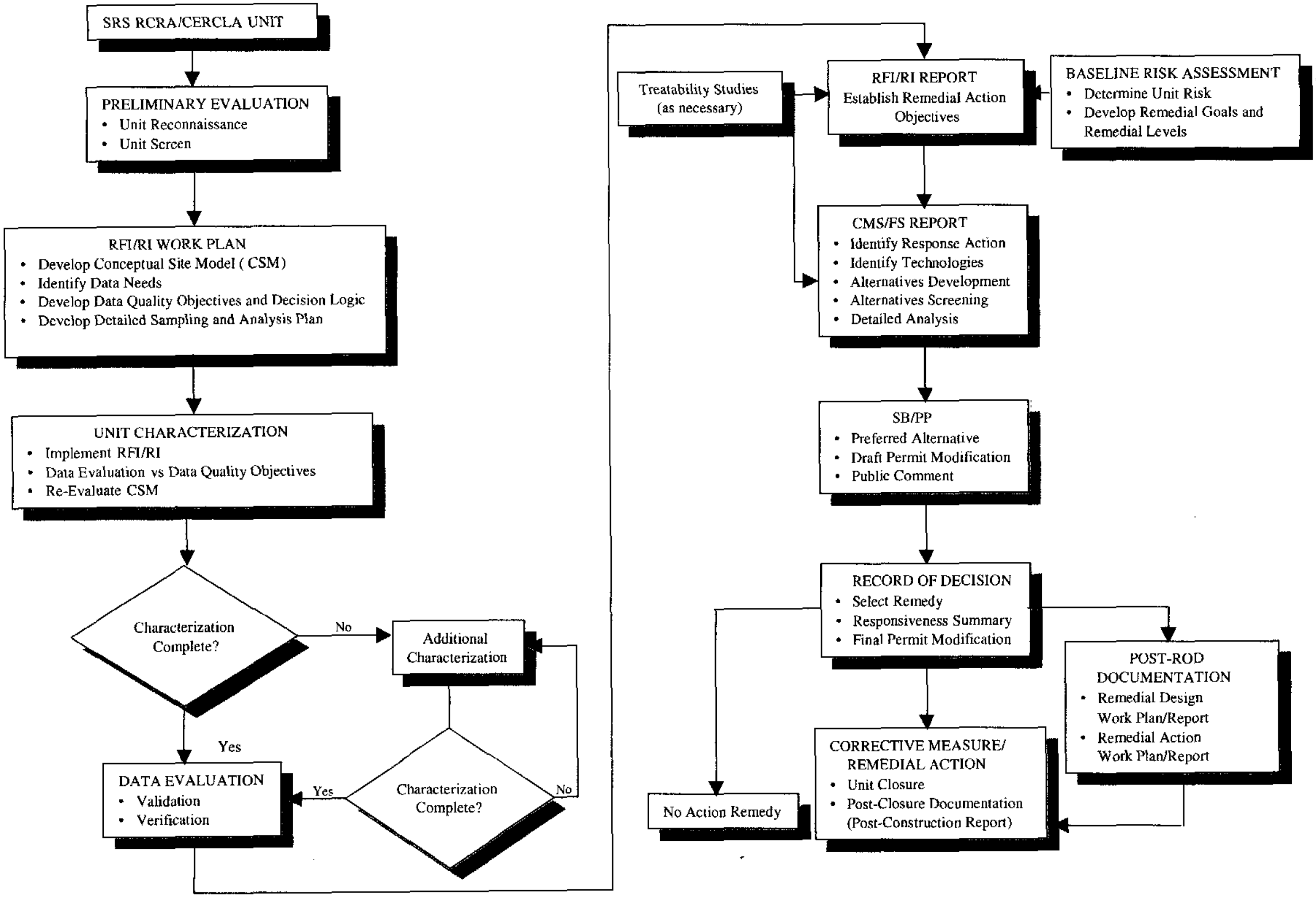


Figure 9. RCRA/CERCLA Logic and Documentation

Operable Unit Remedial Strategy

The overall strategy for addressing the GSACU was to (1) investigate the ORWBG (including the OSTs) to understand the nature and extent of the buried waste, (2) characterize HRB, Warner's Pond, and HP-52 Ponds by delineating the nature and extent of contamination and identifying the media of concern; (3) evaluate media of concern and exposure pathways at HRB, Warner's Pond, and HP-52 Ponds and characterize potential risks and identify constituents warranting remediation; and (4) identify and perform a final action to remediate, as needed, the identified constituents of concern (COCs).

This ROD presents the final action for the GSACU, which is made up of HRB, Warner's Pond, portions of the HIPSL in Warner's Pond, HP-52 Ponds, and the ORWBG (which includes the OSTs). For HRB, the scope of the remedial action is to remediate the basin bottom/sidewalls, the berm around the basin, the soil pile, the 75-ft section of process sewer line from the operational diversion box to the basin, the 100-ft long discharge sewer line, and the discharge area including a concrete spillway to the effluent stream. The area inside the boundary of HRB formerly identified as a SEA (Spill on 05/01/1956 of Unknown Amount of Retention Basin Pipe Leak) is part of HRB and is included in the remedial action. The diversion box is still operational and is not included in the scope of the remediation. The existing effluent stream south of the unit to which the basin discharged has been characterized in the vicinity of HRB. However, this stream is not included in the scope of this remedial action because it is primarily contaminated by upgradient sources in H Area unrelated to HRB. The effluent stream is being addressed separately as part of the RCRA/CERCLA characterization of the upgradient facilities and the IOU program. Although contaminated with radionuclides and inorganics, groundwater in the aquifer under the unit (the UTRA) is not included in the scope of this remedial action because no unit-related groundwater contaminants have been identified. Groundwater is not part of this unit; it is being addressed separately under the H-Area Groundwater Operable Unit (HAGOU).

For Warner's Pond, the scope of the remedial action is to remediate the former pond area (including the asphalt area and the berms), an 850-ft segment of the HIPSL including manholes and the diversion box, and other inactive pipelines in the asphalt area and berms. The areas within the boundary of the Warner's Pond area formerly identified as SEAs (Spill on 03/08/1978 of Unknown Seepage Basin Pipe Leak in H-Area Seepage Basin [NBN] and Spill on 02/08/1978 of H-Area Process Sewer Line Cave-In [NBN]) are part of the Warner's Pond unit and are included with the remedial action. The effluent stream that has been diverted around the former pond area is not included in the scope of this remedial action because the stream is primarily contaminated by upgradient sources. The effluent stream is being addressed separately as part of the RCRA/CERCLA characterization of the upgradient facilities and the IOU program. The groundwater at Warner's Pond is contaminated with radionuclides and inorganics, although these contaminants cannot be attributed with certainty to the waste unit. Groundwater in the UTRA is not included in the scope of this remedial action. Groundwater is not part of this unit; it is being addressed separately under the HAGOU.

For HP-52 Ponds, the scope of the remedial action is to remediate the two former pond areas, the old effluent ditch, several soil piles at the unit that resulted from re-positioning and covering of contaminated soils in the area, and contamination in the historic drainage channel near the former beaver pond. The active regulated effluent stream that has been diverted around the former pond area is not included in the scope of this remedial action because the stream is fed by on-going H-Area facility operations with a potential for contamination. This active effluent stream is being addressed separately as part of the RCRA/CERCLA characterization of the upgradient facilities and the IOU program. Although contaminated with radionuclides and inorganics, groundwater in the UTRA is not included in the scope of this remedial action because the groundwater does not appear to have been affected by this unit. Groundwater is not part of this unit; it is being addressed separately under the HAGOU.

For ORWBG, the scope of the remedial action is to address the waste buried at depth in the unit and to implement a final action for the OSTs. The scope of the action excludes the areas between interim covers B and D because these areas are actively supporting SRS's solid waste management operations including the "ship-to-WIPP" (Waste Isolation Pilot Plant) program. There is no contaminated surface water at the ORWBG. Groundwater in the vicinity of the ORWBG has been contaminated by releases from the various facilities in the Burial Ground Complex, including the ORWBG (WSRC 1995, WSRC 1997d). The contaminated groundwater is not included in the scope of this remedial action because it is being addressed by the corrective action program in the SRS RCRA Part B permit for the Mixed Waste Management Facility (MWMF) (WSRC 1995) in accordance with Settlement Agreement 87-52-SW.

A separate remedial action will be necessary for miscellaneous areas of the Burial Ground Complex which are not included in the remedy for the GSACU. That separate action will address the remaining areas of the Burial Ground Complex, specifically the operational Solid Waste Management Division buildings (including underlying trenches) in the ORWBG (Figure 8) and the non-hazardous waste portion of the Low Level Radioactive Waste Disposal Facility (LLRWDF) (643-7E) (Figure 1) (including Combined Spills from ORWBG as reported in WSRC-RP-97-419). That separate action, previous RCRA closures, and this GSACU ROD represent a complete remedial strategy for the source units of the Burial Ground Complex.

The remedial action identified in this ROD for the GSACU will not affect the remedial actions of other OUs at SRS.

IOUs are defined as surface water bodies (e.g., SRS streams, Savannah River) and associated wetlands, including the water, sediment, and related biota. These surface water bodies are referred to as "integrator" OUs because they represent the integration of potential contamination discharged to surface water or migrating through groundwater from source OUs, SEAs, National Pollutant Discharge Elimination System outfalls, and operational facilities to points of potential receptor exposure. The GSACU is within the Fourmile Branch and Upper Three Runs watersheds. Several source control and groundwater OUs within these watersheds will be evaluated to determine effects, if any, to associated streams and wetlands. SRS will manage all OUs to mitigate impact to the IOU. SRS's actions to address contamination at HRB, Warner's Pond, and HP-52 Ponds serve to mitigate potential impacts to nearby streams. Upon disposition of all OUs, a final comprehensive ROD for each IOU will be pursued with additional public involvement.

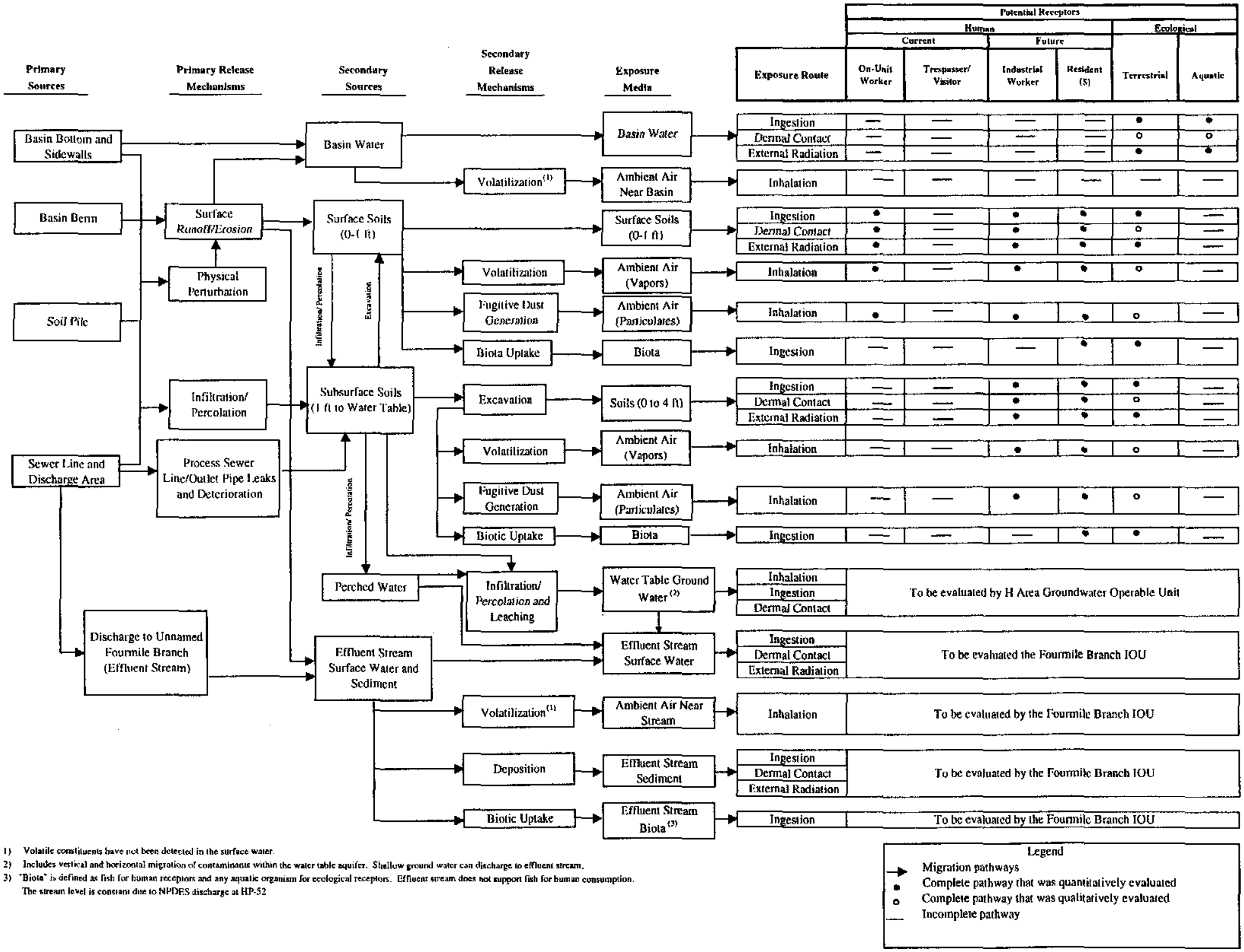
V. OPERABLE UNIT CHARACTERISTICS

Conceptual Site Model

To better understand the risks posed to current and future receptors, a conceptual site model (CSM) for each unit was developed. The CSMs illustrate the sources of contamination, potential exposure pathways, and exposure media relevant to the unit. The CSMs are provided as Figures 10, 11, 12, and 13. Detailed discussions of the CSMs are available in the RFI/RI/BRA for HRB (WSRC 1998), the RFI/RI Work Plan for Warner's Pond and HP-52 Ponds (WSRC 2001a), and the CMS/FS for the ORWBG (WSRC 2001b).

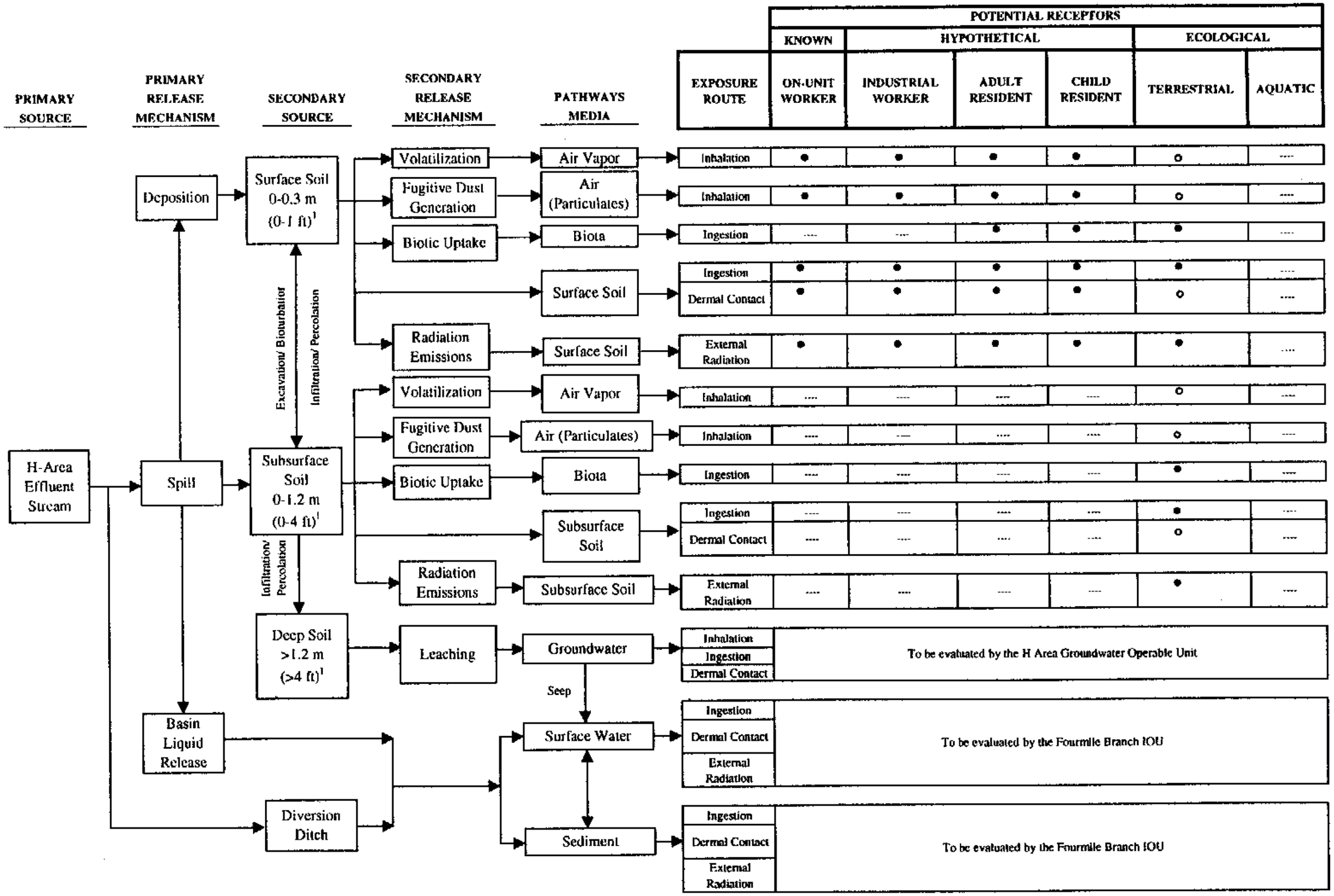
Media Assessment

The media assessment pertinent to this ROD includes the source units (e.g., contamination in soil). Groundwater in the aquifer under HRB, Warner's Pond, HP-52 Ponds, and the ORWBG is not included in the scope of this ROD. Groundwater in the aquifer under HRB, Warner's Pond, and HP-52 Ponds is being addressed separately under the HAGOU. Groundwater in the aquifer under the ORWBG is being addressed by the corrective action program in the SRS RCRA Part B permit for the MWMF. The following paragraphs summarize the characterization of the HRB, Warner's Pond, HP-52 Ponds, and ORWBG source units.



1) Volatile constituents have not been detected in the surface water.
2) Includes vertical and horizontal migration of contaminants within the water table aquifer. Shallow ground water can discharge to effluent stream.
3) "Biota" is defined as fish for human receptors and any aquatic organism for ecological receptors. Effluent stream does not support fish for human consumption. The stream level is constant due to NPDES discharge at HP-52

Figure 10. Conceptual Site Model for HRB



LEGEND

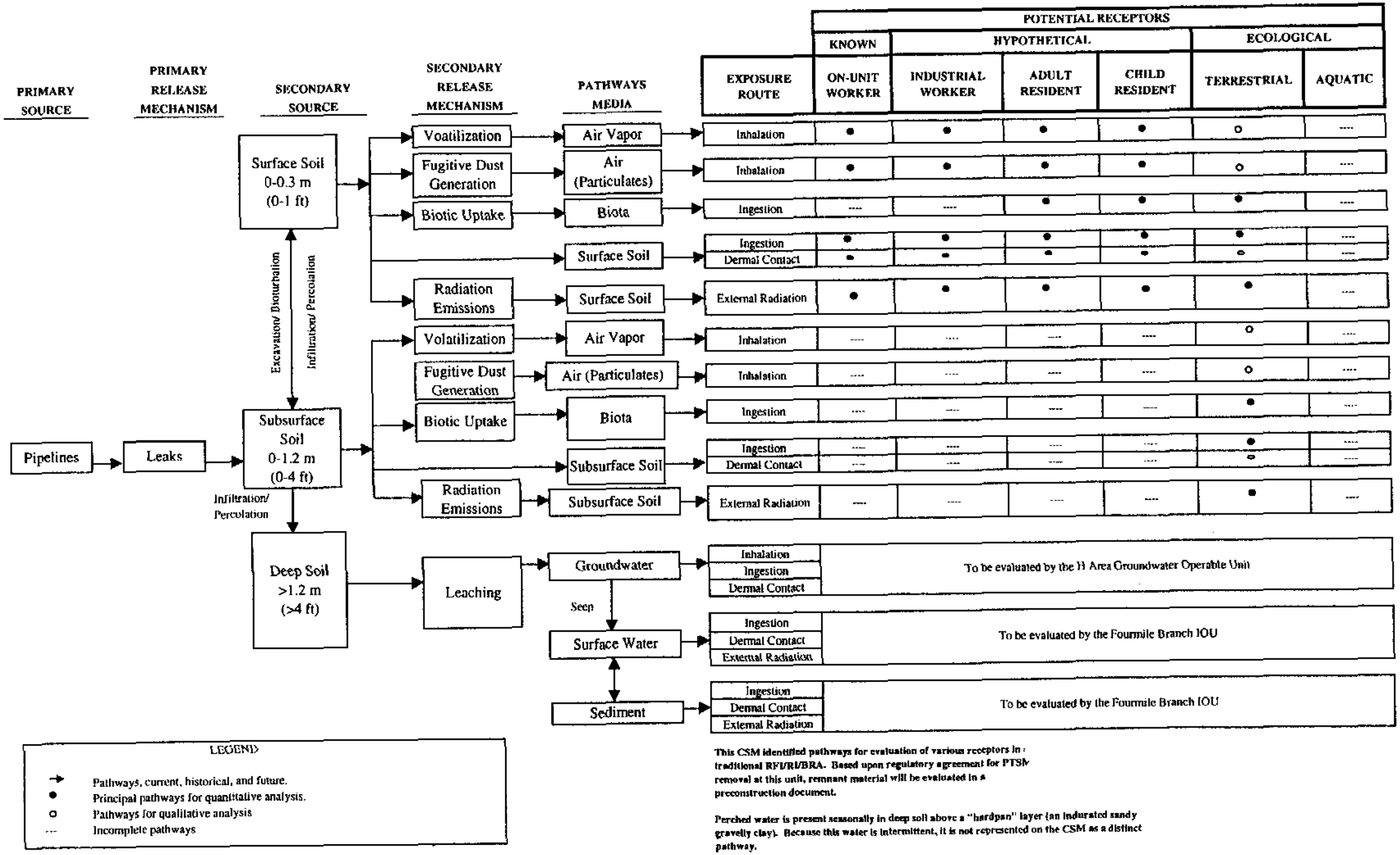
- Pathways, current, historical, and future.
- ● Principal pathways for quantitative analysis.
- o Pathways for qualitative analysis
- --- Incomplete pathways

1) Soils in the basin of the Warner's Pond

This CSM identified pathways for evaluation of various receptors in a traditional RFI/RI/BRA. Based upon regulatory agreement for PTSM removal at this unit, remnant material will be evaluated in a preconstruction document.

Perched water is present seasonally in deep soil above a "hardpan" layer (an indurated sandy gravelly clay). Because this water is intermittent, it is not represented on the CSM as a distinct pathway.

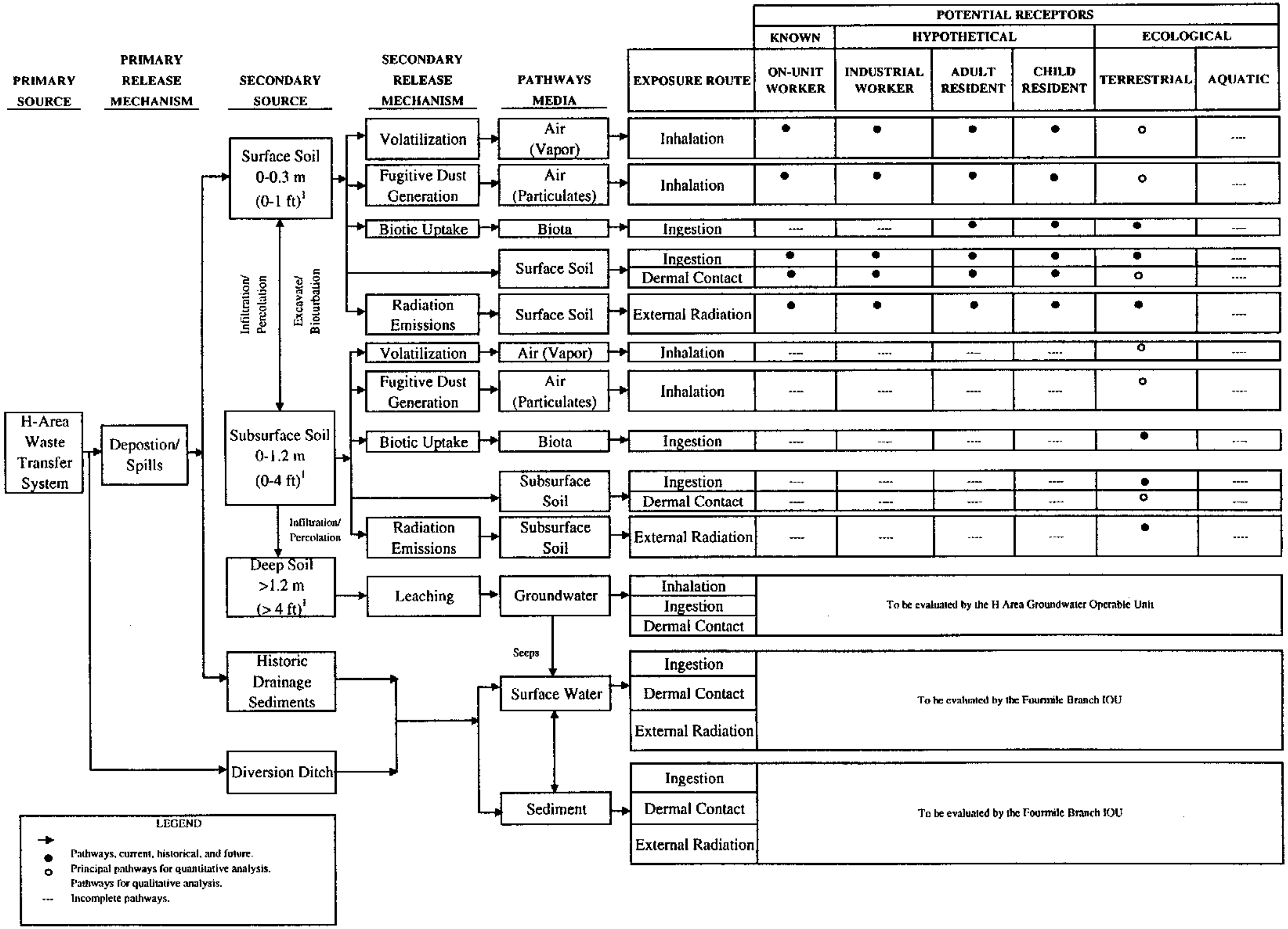
Figure 11. Conceptual Site Model for Warner's Pond



This CSM identified pathways for evaluation of various receptors in traditional RFI/RI/BRA. Based upon regulatory agreement for PTSM removal at this unit, remnant material will be evaluated in a preconstruction document.

Perched water is present seasonally in deep soil above a "hardpan" layer (an indurated sandy gravelly clay). Because this water is intermittent, it is not represented on the CSM as a distinct pathway.

Figure 11. Conceptual Site Model for Warner's Pond (Continued)



1) Soils in the basins of the HP-52 ponds.

Figure 12. Conceptual Site Model for HP-52 Ponds

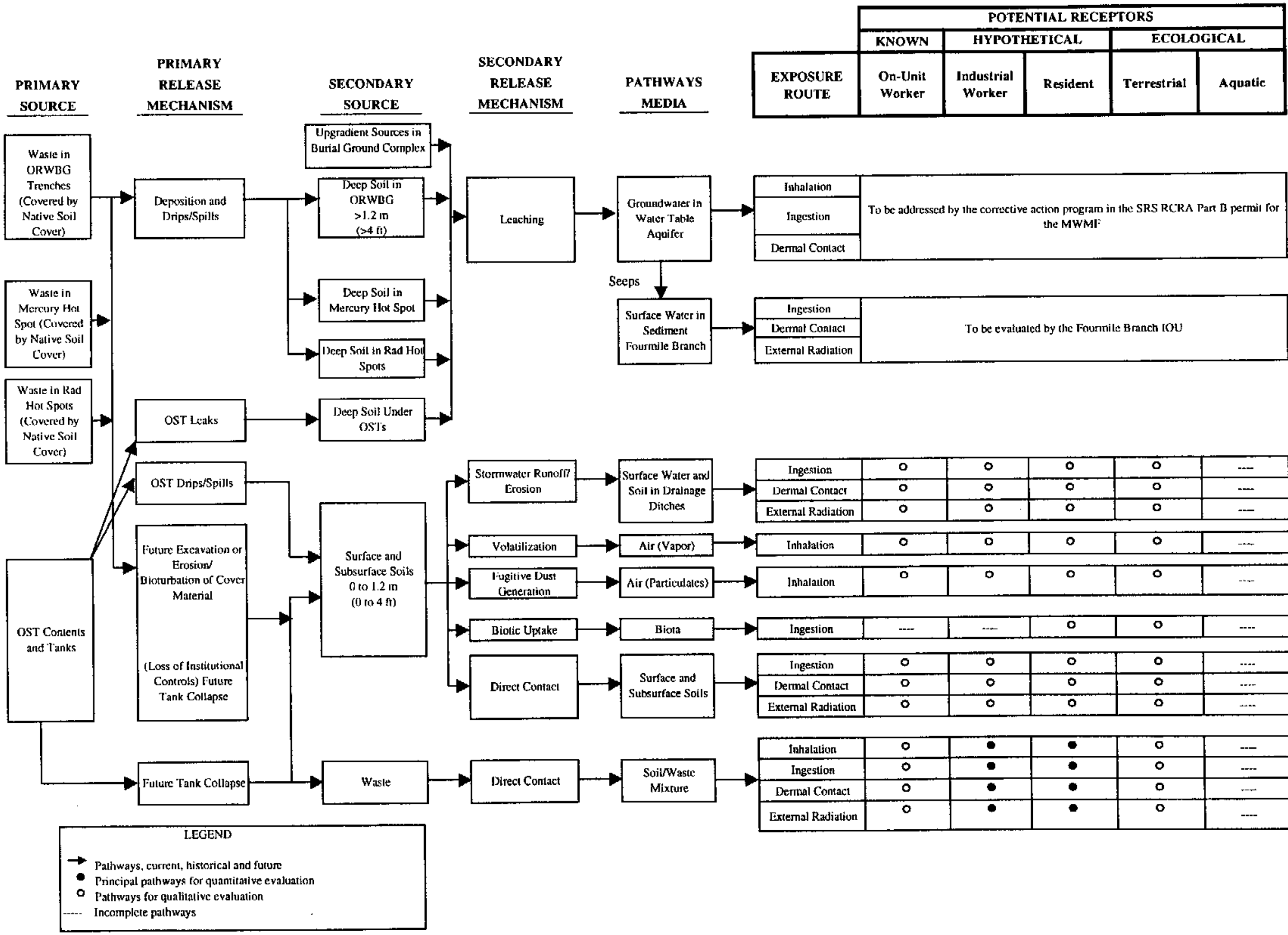


Figure 13. Conceptual Site Model for the ORWBG

HRB

Various environmental investigations have been conducted at HRB since the early 1970s. The RFI/RI field investigation was conducted in 1998 (WSRC 1997a, WSRC 1998). One-hundred thirty-five soil samples and two surface water samples were collected. Samples were obtained from the basin, the berm surrounding the basin, the process sewer line/discharge area, the soil pile, and the effluent stream south of the basin.

Warner's Pond

Precharacterization environmental investigations were performed in 1997 and 1998 (WSRC 2001a). Samples were collected from the former pond area (9 soil samples from 3 locations, and 2 paired surface water and sediment samples) and from the soil surrounding the HIPSL (15 locations, 56 soil samples).

HP-52 Ponds

Precharacterization environmental investigations were performed in 1997 and 2000 (WSRC 2001a). Samples were collected from the former ponds area (3 locations, 9 soil samples), the existing effluent ditch (2 paired sediment and surface water samples), and from the historic drainage channel (5 paired surface water and sediment samples).

ORWBG

Traditional characterization (i.e., intrusive sampling) was not performed at the ORWBG for the reasons listed below:

- There is an extensive amount of data available from past studies and historical burial records.
- Intrusive sampling in the ORWBG would have posed unnecessary risks to the health and safety of the workers because of direct contact with contaminated material.

- Intrusive sampling in the ORWBG would have disturbed the buried material and potentially caused spreading of contaminated material.

- Because of the heterogeneous nature of the waste, sampling would not have accurately characterized the nature and extent of contamination.

Characterization was accomplished through a detailed literature review; evaluation of aerial photographs, construction drawings, health physics burial maps, and the computerized burial record analysis (COBRA) database (a historical catalog of individual disposals); evaluation of past studies; review of process history; and interviews with SRS staff. This investigation is documented in *Source Term for the Old Radioactive Waste Burial Ground (ORWBG), Savannah River Site* (WSRC 1997c). Historical information was augmented by non-intrusive investigations such as groundwater monitoring (WSRC 1997d), soil gas surveys, ambient air monitoring of volatiles, monitoring of tritiated atmospheric vapor and standing surface water, and ground penetrating radar surveys. A summary of the investigation techniques and results is provided in *Corrective Measures Study/Feasibility Study for the Old Radioactive Waste Burial Ground 643-E* (WSRC 2001b). The data provided sufficient information to understand the hazards associated with the ORWBG and to select a remedial alternative.

Media Assessment Results

Table 2 presents a summary of COCs for HRB, Warner's Pond, HP-52 Ponds, and the ORWBG. Table 3 presents the total inventory of radionuclides and the volume of contaminated soil at each unit.

HRB

The unit investigation determined that soils in the basin bottom/sidewalls, in the basin berm, in the soil pile, and in the sewer line and discharge area are contaminated with radionuclides and arsenic (Table 2). The highest levels of contamination at HRB are in the basin bottom/sidewalls. Most of the contamination in the basin bottom is in the upper

Table 2. Summary of COCs at the GSACU

COC	Type of COC				Units	Maximum Concentration	Maximum Background
ORWBG [1]							
Cadmium	COI				N/A		
Lead	COI				N/A		
Mercury	COI				N/A		
VOCs	COI				N/A		
Tritium	COI				N/A		
Cesium-137	COI				N/A		
Plutonium-238	COI				N/A		
Plutonium-239	COI				N/A		
Strontium-90	COI				N/A		
Uranium-235	COI				N/A		
Uranium-238	COI				N/A		
Carbon-14	COI				N/A		
Cobalt-60	COI				N/A		
Technetium-99	COI				N/A		
Iodine-129	COI				N/A		
Neptunium-237	COI				N/A		
HRB							
Arsenic				HH	mg/kg	13.2	5.2
Americium-241				HH	pCi/g	129	2.04
Cesium-137	PTSM (toxicity)		Eco	HH	pCi/g	38,000	0.55
Cobalt-60				HH	pCi/g	0.771	ND
Curium-243/244	PTSM (toxicity)			HH	pCi/g	810	0.57
Europium-154	PTSM (toxicity)			HH	pCi/g	48.1	ND
Plutonium-238			Eco	HH	pCi/g	1700	ND
Plutonium-239/240		CMCOC		HH	pCi/g	94.6	ND
Strontium-90	PTSM (mobility)	CMCOC		HH	pCi/g	9,000	ND
Thorium-228				HH	pCi/g	9.33	1.98
Uranium-238				HH	pCi/g	40.4	1.18
Warner's Pond [2,3]							
Mercury		CMCOC			mg/kg	1.52	0.061
Americium-241		CMCOC			pCi/g	75.8	2.04
Cesium-137	PTSM (toxicity)			HH	pCi/g	422	0.55
Curium-243/244				HH	pCi/g	42.4	0.57
Europium-154				HH	pCi/g	6.45	ND
Iodine-129		CMCOC			pCi/g	1.33	ND
Potassium-40		CMCOC		HH	pCi/g	5.98	4.07
Radium-226				HH	pCi/g	2.87	1.83
Radium-228				HH	pCi/g	17.3	53.5
Strontium-90		CMCOC			pCi/g	131	ND
HP-52 Ponds [3]							
Cesium-137	PTSM (toxicity)			HH	pCi/g	415	0.55
Potassium-40				HH	pCi/g	1.92	4.07
Radium-226				HH	pCi/g	1.14	1.83

1 Constituents of interest (COIs) were defined on the basis of previous sampling, review of the burial records, process history, and previous regulatory and historical documentation, rather than on the basis of quantitative risk assessments.

2 Constituents listed as contaminant migration constituents of concern (CMCOCs) for Warner's Pond are actually constituents of potential concern (COPCs) which are based on conservative fate and transport calculations. They have not been subjected to detailed computer modeling or an uncertainty analysis, and consequently, some of these constituents may not pose an actual leachability threat.

3 Constituents listed as human health COCs for Warner's Pond and HP-52 Ponds are actually COPCs which are based on preliminary human health screening. They have not been subjected to detailed risk calculations or an uncertainty analysis, and consequently, some of these constituents may not pose an actual exposure threat.

Eco = ecological COC
HH = human health COC
ND = not detected
N/A = not applicable

Table 3. Quantities of Contaminated Media at the GSACU

	HRB	Warner's Pond	HP-52 Ponds	ORWBG
Total Estimated Inventory of Radionuclides (Ci)[1]	55	2	1	571,000
Size of Unit (acres)	1.5	4	1.1	76
Estimated Volume of Contaminated Soil Requiring Remediation (cy)	12,000	11,000	10,000	Volume of Waste = 264,000

1 The total estimated inventory of radionuclides is the current inventory. The inventories for HRB, Warner's Pond, and HP-52 Ponds were calculated based on the results of recent characterization sampling. The inventory for the ORWBG was calculated by determining the amount of radioactivity originally disposed in the unit, and then accounting for radioactive decay of each isotope that has occurred since disposal to the present. For details of the methodology, please refer to *Source Term for the Old Radioactive Waste Burial Ground (ORWBG), Savannah River Site* (WSRC 1997c). For information about when the waste was disposed and at what levels of radioactivity, please refer to Section II.

1 ft of soil. In the basin sidewalls, the contamination is primarily in the uppermost 2 ft of soil. In the basin berm, the contamination is primarily in the upper 1 ft of soil. Along the process sewer line, the contamination is at and below the pipe elevation. The discharge area has the deepest detected contamination. At the soil pile, the contamination is limited to the soil pile itself and does not extend below the asphalt layer beneath the soil pile. Available data suggest that the hardpan provides a natural limit to the downward migration of contaminants at HRB, although this is not a certainty.

Warner's Pond

The investigations determined that soils in the former pond area, in the berms, along the HIPSL, and at the diversion box are contaminated with radionuclides (Table 2). Additionally, some soils in the former pond area are contaminated with mercury. The extent of contamination, including any remnant left after excavation, will be refined during post-ROD field activities.

HP-52 Ponds

The investigations determined that soils and sediments in the former ponds area, the old effluent ditch, the soil piles, and the historic drainage channel near the former beaver pond are contaminated with radionuclides (Table 2). The extent of contamination, including any remnant left after excavation, will be refined during post-ROD field activities.

ORWBG

Areas of particular interest or "hot spots" within the ORWBG were identified in *Delineation of Potential "Hot Spots" for the Old Radioactive Waste Burial Ground (ORWBG)* (WSRC 1997e). These "hot spots" were identified based on the following criteria: high concentrations and/or high levels of radioactivity, persistence of high radioactivity levels through time, burial type, waste form, and mobility. Three general types of hot spots (discussed below) are identified: the mercury hot spot, radioactive hot spots, and the OSTs (Figures 6 and 7).

Mercury Hot Spot (HS-Hg-1): HS-Hg-1 is an area containing approximately 20% of the total mercury in the ORWBG (total inventory in the ORWBG is 28.6 cubic feet). HS-Hg-1 is located in the southeastern part of the ORWBG (Figure 6). Each burial consisted of two or three one-liter polyethylene bottles filled with elemental mercury, double-bagged and containerized in 5-gallon cans.

Radioactive Hot Spots: The radioactive hot spots are multiple and distinct areas containing relatively high concentrations of radionuclides (i.e., greater than 60 Ci per 20 x 20 ft grid cell). Generally these consist of tritium, transuranic isotopes, carbon-14, and fission products such as cesium-137 and strontium-90. Because of natural radioactive decay, the radioactive composition (and therefore the associated risk) decreases over time. Some areas of the ORWBG now categorized as radioactive hot spots will not be as radioactive in the future. For example, hot spots with tritium, which has a half-life of 12.3 years, will undergo decay such that in 100 years they no longer fit the criteria as radioactive hot spots; essentially all tritium in the hot spots disappears. Thus, the radioactive hot spots are subdivided according to their radioactivity at varying time intervals in the future. Radioactive hot spots having greater than 60 Ci per grid cell in 100 years since disposal activities essentially ceased (1974 + 100 years = 2074) are categorized as 100-year hot spots (HS-100-1 through HS-100-21) (Figure 6). Radioactive hot spots having greater than 60 Ci per grid cell in 300 and 500 years are categorized as 300-year and 500-year hot spots, respectively. The geometries of the 300- and 500-year hot spots are the same (HS-300/500-1 through HS-300/500-8) (Figure 7).

Old Solvent Tanks (OSTs): The ORWBG contains 22 underground storage tanks known as the OSTs. From 1953 to 1977, the OSTs were used to store hundreds of thousands of gallons of degraded solvent byproducts from the plutonium-uranium extraction (PUREX) process and smaller amounts of tritiated pump oil. In 1977, the liquid was pumped out and transferred to another facility, but residual material that could not be pumped out (approximately 5,635 gallons of liquids and 36.38 ft^3 of solids) remained in the tanks.

Site-Specific Factors

There are no site-specific factors that may affect the remedial action at the GSACU. There are no unique, special, or sensitive habitats. There are no areas of archaeological or historical importance in the vicinity of the OU. The land in the area of the GSACU has been, and continues to be, used extensively for SRS industrial activities.

Contaminant Transport Analysis

At HRB, Warner's Pond, and HP-52 Ponds, a 10 to 15 ft thick indurated sandy gravelly clay is present approximately 10 to 15 ft below the land surface. This layer, commonly referred to as the "hardpan," is a natural barrier to downward vertical flow through the vadose zone. Rainwater that infiltrates the soil collects on top of the hardpan, attesting to the low hydraulic conductivity of the layer.

Contaminant fate and transport analyses were performed to determine if any constituents in soil will leach through the vadose zone and result in groundwater concentrations above maximum contaminant levels (MCLs) within 1,000 years. For HRB, the analyses included a comparison of soil concentrations to soil screening levels and included computer modeling (SESOIL for metals and RESRAD for radionuclides) (WSRC 1998). For Warner's Pond and HP-52 Ponds, the analyses included a comparison of soil concentrations to soil screening levels using the VZCOMML model (WSRC 2001a).

For the ORWBG, contaminant transport was computed using a program named LVSTRAN (Leaching Vadose Saturated Transport) to evaluate baseline conditions and to assess the effect of different types of low permeability caps on reducing the leachability threat to groundwater (WSRC 2001b).

The results of the analysis are provided in Section VII, Summary of OU Risks.

VI. CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

Land Uses

The GSACU is located in the interior of the SRS, approximately 6 miles from the nearest SRS boundary (Figure 1). SRS is a secured government facility with no residents. General public access to SRS is prohibited by perimeter fences, guards, and security patrols. Access by SRS workers to areas within the GSACU is controlled by physical and administrative controls. Physical controls include fences and chain barriers. Administrative controls include SRS's Site Use and Site Clearance Programs which restrict disturbance of the units and prevent drinking water use of contaminated groundwater under the units.

The GSACU is within the industrially developed General Separations Area within the buffer zone of an area designated for future heavy industrial and nuclear use. The large inventory of unrecoverable radioactive wastes buried in the ORWBG, as well as the proximity of the GSACU to nuclear materials processing facilities such as the H-Area Separations facilities and H-Area Tank Farm, makes the GSACU unsuitable for residential use.

As outlined in the *Savannah River Site Future Use Project Report* (USDOE 1996), the USDOE has taken steps to prohibit residential use of SRS, including land in the vicinity of the GSACU, through its plan for current and future use of the SRS. Therefore, future residential use of the area is not anticipated.

The USDOE, USEPA, and SCDHEC agree that industrial land use restrictions are appropriate for the GSACU. Industrial land use restrictions will include land use controls to ensure protection against unrestricted (residential) uses. The future land use of the GSACU is anticipated to be the same as the current land use (industrial use and control by the federal government).

Groundwater Uses/Surface Water Uses

Groundwater at the GSACU is not currently being used for human consumption or any other purpose. It is unlikely that drinking water wells will be installed in the future in the potentially affected area (from the GSACU to the discharge areas along Fourmile Branch and Upper Three Runs) because (1) residential use of the area is unlikely due to the proximity of the GSACU to the heavy industrial zones of F and H Areas; and (2) water table wells in this area produceinsufficient water to be used as a source of drinking water.

Fourmile Branch and Upper Three Runs are the only sources of significant surface water near the GSACU. Surface water in Fourmile Branch or Upper Three Runs is not used for irrigation, consumption, or other uses.

USDOE controls drilling and surface water use through SRS's Site Use and Site Clearance Programs; therefore, as long as USDOE maintains control of SRS, neither surface water nor groundwater at the GSACU will be used as a potential drinking water source.

Future residential use of groundwater or surface water at the GSACU is not anticipated.

VII. SUMMARY OF OPERABLE UNIT RISKS

The risks to human health and the environment are normally determined in a Baseline Risk Assessment (BRA) which identifies the COCs. A BRA was completed for HRB (see Section II) and COCs were identified. Given the similar health and environmental threats, similar geologic setting, and proximity of the units; USDOE, SCDHEC, and USEPA agreed that BRAs were not needed for Warner's Pond or HP-52 Ponds. Constituents identified as human health COCs for Warner's Pond and HP-52 Ponds are actually COPCs which are based on preliminary human health screening of information from precharacterization environmental investigations. These constituents have not been subjected to detailed risk calculations or an uncertainty analysis, and consequently, some of these constituents may not pose an actual exposure threat.

Constituents listed as COCs for the ORWBG are actually constituents of interest (COIs). COIs were defined on the basis of previous sampling, review of the burial records, process history, and previous regulatory and historical documentation, rather than on the basis of quantitative risk assessments. Table 2 presents a summary of COCs for HRB, Warner's Pond, HP-52 Ponds, and the ORWBG.

Risks at HRB

Human Health Risks at HRB

HRB poses unacceptable risks to current industrial workers, future industrial workers, and hypothetical on-unit residents. Human health COCs include americium-241, arsenic, cesium-137, cobalt-60, curium-243/244, europium-154, plutonium-238, plutonium-239/240, strontium-90, thorium-228, and uranium-238. The total media risk for a future industrial worker exceeds the acceptable target risk (less than 1×10^{-6} [one excess cancer in a million]) for the basin bottom/sidewalls (4×10^{-1}), basin berm (3×10^{-4}), soil pile (1×10^{-2}), and sewer line/discharge area (2×10^{-4}). PTSM based on toxicity (risk greater than 1×10^{-3}) is present in the basin bottom/sidewalls (due to elevated levels of cesium-137, curium-243/244, and europium-154) and in the soil pile (due to elevated levels of cesium-137).

Ecological Risks at HRB

Ecological COCs are identified for the basin bottom/sidewalls. Cesium-137 and plutonium-238 pose ecological risks to terrestrial insectivorous mammals (represented by short-tailed shrews). Hazard quotients (HQs) up to 15 for cesium-137 and 1.5 for plutonium-238 exceed the target HQ of 1. For ecological receptors, an HQ greater than 1 is used to indicate constituent concentrations exceeding acceptable risk levels.

Contaminant Migration Risks at HRB

Contaminant fate and transport analyses indicate that strontium-90 and plutonium-239/240 in the basin are CMCOCs (constituents predicted to leach to the UTRA and exceed groundwater standards within 1,000 years). Strontium-90 is predicted to exceed its MCL after 10 years, and increase to 20,235 times its MCL at 75 years. Plutonium-239/240 is predicted to exceed its MCL after 400 years, and increase to 700 times its MCL at 1,000 years. In addition, strontium-90 is a PTSM COC based on mobility (predicted to exceed MCLs within 10 years) in the sewer line/discharge area. It is predicted to leach to the UTRA and exceed its groundwater standard at 10 years, and increase to 948 times its MCL at 30 years.

Contamination in the basin is in contact with seasonal water that becomes trapped above the hardpan layer. Although the hardpan provides a natural barrier to downward migration, the contact between contaminated soil and water in the subsurface presents a leachability concern.

The inactive discharge pipeline and the associated trench in which the pipeline rests are potential conduits for contaminant migration from the basin to the former discharge area. This presents a contaminant migration risk for movement of contaminants out of the basin and into the effluent stream on the south side of HRB.

If the asphalt cover over the soil pile were to deteriorate, future erosion of the soil pile would present a contaminant migration risk, as contaminants may wash into HRB (basin 281-3H) and potentially into the adjacent active retention basin (basin 281-8H).

Risks at Warner's Pond

Human Health Risks at Warner's Pond

Warner's Pond poses unacceptable risks to current industrial workers, future industrial workers, and hypothetical on-unit residents. Human health COCs for a future industrial worker include cesium-137, curium-243/244, europium-154, potassium-40, radium-226, and radium-228. PTSM based on toxicity is present in the former pond area due to elevated levels of cesium-137. Soils along the HIPSL and at the diversion box, although determined non-hazardous, are contaminated with radionuclides. In addition, vegetation may be drawing up radionuclides from the subsurface and presenting an exposure risk. Surface water and sediment in the effluent stream are contaminated with radionuclides from upgradient sources unrelated to the GSACU.

Ecological Risks at Warner's Pond

No ecological COCs are present at Warner's Pond.

Contaminant Migration Risks at Warner's Pond

Americium-241, iodine-129, potassium-40, strontium-90, and mercury are identified as CMCOCs for the former pond area. They are predicted to leach through the vadose zone and affect groundwater above MCLs within 1,000 years.

Contamination in the former pond area is in contact with seasonal water that becomes trapped above the hardpan layer. The seasonal water is a result of impounded water behind berms that were installed at the south end of the ponded area perpendicular to the original drainage path. Although the hardpan provides a natural barrier to downward migration, the impounded water is contaminated and presents a leachability concern.

Risks at HP-52 Ponds

Human Health Risks at HP-52 Ponds

HP-52 Ponds poses unacceptable risks to current industrial workers, future industrial workers, and hypothetical on-unit residents. Human health COCs for a future industrial worker include cesium-137, potassium-40, and radium-226. PTSM based on toxicity is present in the former ponds area and in the old effluent ditch due to elevated levels of cesium-137. In addition, vegetation may be drawing up radionuclides from the subsurface and presenting an exposure risk.

Ecological Risks at HP-52 Ponds

No ecological COCs are present at HP-52 Ponds.

Contaminant Migration Risks at HP-52 Ponds

No contaminant migration COCs are present at HP-52 Ponds. However, contamination in the former ponds area is in contact with seasonal water that becomes trapped above the hardpan layer. Although the hardpan provides a natural barrier to downward migration, the contact with water in the subsurface presents a leachability concern.

Risks at ORWBG

Human Health and Ecological Risks for ORWBG

Typically, human health and ecological risk assessments for a source unit are performed on surface soil (0 to 1 ft bls) and subsurface soil (0 to 4 ft bls). Deeper soils are generally not assessed in the risk assessments because most excavation/construction activities and bioturbation do not go deeper than 4 ft. Contamination below 4 ft bls is generally sufficiently isolated from receptors.

At the ORWBG, surface and subsurface soils consist of backfill and the native soil cover (uncontaminated soils from an SRS borrow pit). Under conventional risk assessment guidelines, the level of risk posed by these soils is equivalent to the negligible ambient background risk posed by natural soils. Furthermore, the original backfill material and the native soil cover shield radiation that is being emitted from the waste at depth. Radiological surveys document that radiation levels at the ground surface of the ORWBG are near background levels.

Although unit soils do not pose a risk to human health or the environment under conventional risk assessment approaches, the presence of a large inventory of metals and long-lived radionuclides at depth is a potential long-term threat. These wastes meet the definition of PTSM based on toxicity.

COIs are constituents that the USDOE, USEPA, and SCDHEC have agreed are the primary constituents of concern for the ORWBG and are the primary drivers in the remedy selection process. COIs are mobile, hazardous, have a large inventory in the ORWBG, and/or have a long half-life. COIs were defined on the basis of previous sampling, review of the COBRA database, process history, and previous regulatory and historical documentation. COIs for the ORWBG and OSTs include cadmium, lead, mercury, volatile organic compounds (VOCs), tritium, cesium-137, plutonium-238, plutonium-239, strontium-90, uranium-235, uranium-238, carbon-14, cobalt-60, technetium-99, iodine-129, and neptunium-237. The constituents warranting remedial action at the ORWBG are termed COIs instead of COCs because the term COCs implies that quantitative risk assessments have been done. At the ORWBG, characterization and risk assessment were accomplished through detailed investigation of burial records rather than through collection and analysis of samples. Because COCs were not identified based on quantitative risk assessments in a conventional BRA, the constituents warranting remedial action were given a different name (COIs).

The active institutional controls currently in place at the ORWBG (security fences, warning signs, site inspections and maintenance, and land use restrictions) currently prevent exposure. The unit will not pose an unacceptable exposure risk as long as institutional controls are maintained because pathways to receptors at the surface are incomplete. The source unit would only pose an unacceptable risk if institutional controls were lost in the future. If institutional controls were lost, unauthorized use of the unit and degradation of the cover could occur, resulting in exposure to waste by inadvertent intrusion by humans, bioturbation and redistribution, or long-term erosion.

Contaminant Migration Risks at the ORWBG

Contaminant fate and transport calculations (WSRC 2001b) indicate that leaching which occurred prior to emplacement of the native soil cover in 1997 has resulted in downward migration of some of the more mobile constituents. Tritium, VOCs, iodine-129, technetium-99, and uncontainerized carbon-14 are the most susceptible to leaching. These constituents are not entirely mitigated by decay and may pose a current or short-term threat to groundwater. Tritium and VOCs are currently present in the groundwater system directly beneath the unit at concentrations above MCLs. Technetium-99 and iodine-129 are fission products, and some of their inventory in the ORWBG would have been disposed of as uncontainerized job control wastes susceptible to depletion by leaching. Other constituents having lower mobility (e.g., containerized carbon-14, cadmium, mercury, uranium-235, and uranium-238) may pose a potential future threat to groundwater. Mercury has been detected in groundwater above the MCL in one well, but the leachability threat of inorganics is expected to be low due to the chemically-reducing environment of the trenches. The leachability threat posed by plutonium-238, plutonium-239, cesium-137, strontium-90, cobalt-60, neptunium-237, and lead is mitigated by low mobility and/or half-lives that are short relative to the time required for their leaching and migration to groundwater. Lead has been sporadically detected in wells above the MCL, but the detections are attributed to lead-containing parts in the pumps.

Conclusion of GSACU Risks

The risks at HRB, Warner's Pond, and HP-52 Ponds are similar in that (1) all three units contain PTSM that presents an unacceptable human health risk to future industrial workers, and (2) cesium-137 is the primary contaminant, both in terms of the principal risk driver and the extent of contamination. Contamination at HRB, Warner's Pond, and HP-52 Ponds poses a threat to current and future industrial workers who may come into contact with it, and HRB and Warner's Pond represent continuing sources of potential groundwater contamination.

The ORWBG contains a very large inventory of short- and long-lived radioactive wastes and other hazardous substances. These buried wastes are considered PTSM and would pose an acute risk to human health and the environment if exposure were to occur. In addition, future leaching of contaminants may further affect groundwater quality under the ORWBG.

Actual or threatened releases of hazardous substances, pollutants, or contaminants from the GSACU, if not addressed by the selected remedy or one of the other active measures considered, would present a current or potential threat to public health, welfare, or the environment.

VIII. REMEDIAL ACTION OBJECTIVES AND REMEDIAL GOALS

Remedial goal options (RGOs) are concentration goals for individual chemicals for specific medium and land use combinations. They are designed to provide conservative, long-term targets for the selection and analysis of remedial alternatives. RGOs are selected to be protective of both human health and the environment, as well as to comply with federal and state applicable or relevant and appropriate requirements (ARARs). Table 4 presents ARARs. Human health RGOs were based on the industrial worker scenario and ecological RGOs on a unit foraging factor of 1 (Table 5c).

RGOs for each COC at HRB were calculated in the RFI/RI/BRA. Given the similarity in the nature and scope of the problem at HRB, Warner's Pond, and HP-52 Ponds; the RGOs calculated for HRB are also applicable for Warner's Pond and HP-52 Ponds.

Two constituents, cesium-137 and strontium-90, from the list of COCs can be used as indicator contaminants for HRB, Warner's Pond, and HP-52 Ponds (i.e., contaminants that can be used to guide the remediation and to assess when cleanup goals are met). Cesium-137 is the primary risk driver in the human health and ecological risk assessments and is the contaminant responsible for the designation of soils as PTSM based on toxicity. Strontium-90 is the primary contaminant migration concern and is the contaminant responsible for the designation of soils as PTSM based on mobility.

Table 4. Potential ARARs for the GSACU

Media Affected	Regulation or Citation	Synopsis of Regulation or Citation	Status	Pertinent Alternatives	
				HRB, Warner's Pond, HP-52	ORWBG
All Media	NEPA 10 CFR 1021	Environmental impact for federal projects	Action-specific	1, 2, 3, 4, 7	I, II, III, VI, VII
Air Quality	Ambient Air Quality 40 CFR 50.6 SC R.61-62.5	Standard for ambient concentrations of 10 micron and smaller particulates in air	Action-specific	2, 3, 4, 7	II, III, VI, VII
	Fugitive Dust SC R.61-62.6	Standard for ambient concentrations of fugitive particulates in air	Action-specific	2, 3, 4, 7	II, III, VI, VII
	NESHAP 40 CFR 61.92	Standards for radiological (100 mrem/yr) and other hazardous pollutants in ambient air	Action-specific and Chemical-specific	2, 3, 4, 7	II, III, VI, VII
Drinking Water Quality	Safe Drinking Water Act SC R.61-58	Standard establishes drinking water MCLs and MCLGs	Chemical-specific	1, 2, 3, 4, 7	I, II, III, VI, VII
Ground and Surface Water Quality	SC R.72-300 through 316 and SC R.72-405 through 445	Stormwater Management and Sediment Reduction	Action-specific	2, 3, 4, 7	II, III, VI, VII
	Clean Water Act/NPDES SC R.61-9	Stormwater and other effluent discharge permitting requirement	Action-specific	2, 3, 4, 7	II, III, VI, VII
Radioactive Materials and Waste	10 CFR 61.40 and SC R.61-63	Disposal requirements for radioactive wastes and associated dose limits	Action-specific and Chemical-specific	4, 7	N/A
	10 CFR 835 and SC R.61-63	Occupational radiation dose limits and monitoring requirements	Chemical-specific	1, 2, 3, 4, 7	I, II, III, VI, VII
	DOE Order 435.1	Ensures that all USDOE radioactive waste is managed in a manner that is protective of worker and public health and safety, and the environment.	TBC	1, 2, 3, 4, 7	I, II, III, VI, VII
	DOE Order 5400.5	Standards for exposure to the public of radiation from DOE activities	TBC	1, 2, 3, 4, 7	I, II, III, VI, VII
	Atomic Energy Act / 42 USC 201 Sections 2011-2259	Governs DOE use and control of Special Nuclear Materials and their byproducts	Chemical-specific	1, 2, 3, 4, 7	I, II, III, VI, VII

Table 4. Potential ARARs for the GSACU (Continued)

Media Affected	Regulation or Citation	Synopsis of Regulation or Citation	Status	Pertinent Alternatives	
				HRB, Warner's Pond, HP-52	ORWBG
Hazardous Waste	RCRA, 40 CFR 262 and SC R.61-79.262	Standards applicable to generators of hazardous wastes.	Chemical-specific	4, 7	N/A
	RCRA, 40 CFR 268 and SC R.61-79.268	Land Disposal Restrictions (LDRs) for hazardous wastes	Chemical-specific	4, 7*	N/A
	RCRA, 40 CFR 264 Subpart N (Landfills), including 264.310	Basis for cap and standards for closure and post-closure care	Chemical-specific	N/A	I, II, III, VI, VII
	RCRA, 40 CFR 264.115	Requirement for independent registered professional engineer certification of RCRA closures	Action-specific	2, 3, 4, 7 (HIPSL only)	N/A
Solid Waste	SC R.61-107	Standards for management and disposal of nonhazardous wastes	Chemical-specific	4, 7	N/A
Worker Safety	OSHA / 29 CFR 1910	Safety standards for general industry	Action-specific and Chemical-specific	2, 3, 4, 7	II, III, VI, VII
	OSHA / 29 CFR 1926	Safety standards for construction	Action-specific	2, 3, 4, 7	II, III, VI, VII
	DOE Order 5484	Safety standards for remediation workers	TBC	2, 3, 4, 7	II, III, VI, VII
Transportation	49 CFR 107	Transport regulations for hazardous wastes	Action-specific	4	N/A
	DOE Order 5480.3	Requirements for shipping hazardous waste	TBC	4	N/A
	DOE Order 460.1A	Requirements for shipping hazardous substances	TBC	4	N/A
Floodplains	40 CFR 6, Appendix A	Standards for protection of floodplains	Location-specific	2, 3, 4, 7	N/A
	10 CFR 1022	Standards for protection of floodplains	Location-specific	2, 3, 4, 7	N/A

* LDRs apply only to Warner's Pond HIPSL materials that are determined to be hazardous.

N/A = Not Applicable
TBC = to-be-considered

Table 5a. RGs for PTSM COCs (Based on Toxicity)

PTSM COC	Maximum Concentration (pCi/g)	PTSM RGO (pCi/g)	Maximum Background (pCi/g)	PTSM RG [1] (pCi/g)
HRB				
Cs-137	38,000	104	0.55	104
Warner's Pond				
Cs-137	422	104	0.55	104
HP-52 Ponds				
Cs-137	415	104	0.55	104

[1] To manage PTSM, contamination above these levels will be excavated to the extent practicable.

Table 5b. RGs for CMCOCs and PTSM COCs (Based on Mobility)

CM COC	Maximum Concentration (pCi/g)	Soil RGO (pCi/g)	Maximum Background (pCi/g)	Remedial Goal [1]	
				Soil RG (pCi/g)	Groundwater RG (pCi/L)
HRB					
Sr-90 (basin bottom/basin sidewalls)	9,000	1.5	ND	1.5	8 MCL
Sr-90 (sewer line/discharge area)	1,800	0.65	ND	0.65	8 MCL
Warner's Pond					
Sr-90	131	1.12	ND	1.12	8 MCL

[1] Soil RGs for CMCOCs are established to prevent leaching of constituents to groundwater at concentrations above MCLs within 1,000 years. Contamination above Soil RGs will be excavated to extent practicable. If Soil RGs are attained, an infiltration control system will not be needed to protect groundwater. If Soil RGs are not attained, an infiltration control system will be installed to meet the Groundwater RG.

ND = Not Detected

Soil RGOs are influenced by the proximity of the contamination to the groundwater. The nearer a contaminant is to groundwater, the lower the soil RGO will be. For the same contaminant concentration, the soil RGO increases as distance from the groundwater increases. The table reflects the soil RGOs for varying distances the contaminants are from the groundwater.

Table 5c. RGs for Human Health/Ecological COCs

COC	Maximum Concentration (pCi/g)	Ecological RGO [1] (pCi/g)	Human Health RGO [2] (pCi/g)	Maximum Background (pCi/g)	Remedial Goal[3] (pCi/g)
HRB					
Cs-137	38,000	13,000	0.104	0.55	0.55*
Sr-90	9,000	--	57.2	ND	57.2
Warner's Pond					
Cs-137	422	--	0.104	0.55	0.55 *
HP-52 Ponds					
Cs-137	415	--	0.104	0.55	0.55 *

[1] Ecological RGOs are based on a unit-foraging factor of 1.
[2] Human Health RGOs are based on $1x10^{-6}$ industrial worker exposure.
[3] After removal of PTSM and CMCOCs, excavated areas with residual contamination above these levels will be covered with clean soil to mitigate ecological and human health risks.

* Because the calculated risk-based RGO is less than ambient background levels, the RG defaults to background levels (maximum background) in order to be technically practical to achieve.

ND = Not detected
-- = Not a COC for this evaluation

Collectively, these two constituents represent the majority of the contaminant inventory and risk. Selection of these two constituents as the indicator constituents is further supported by the fact that the extent of these two constituents encompasses the extent of the other COCs: remediation of these two COCs will result in the remediation of the other COCs. RGOs for cesium-137 and strontium-90 are identified on Table 5 (parts a, b, and c).

Remedial goals (RGs), the actual cleanup goals, are selected from the range of calculated RGOs. For this unit, RGs are shown on Tables 5a, 5b, and 5c to correlate with the selected remedy at HRB, Warner's Pond, and HP-52 Ponds. There is a preference to remove all PTSM and any leachability (contaminant migration) threat. Table 5a presents the concentrations that would need to be removed to eliminate PTSM based on toxicity. Table 5b presents the concentrations that would need to be removed to eliminate the leachability threat (or, if removal to these levels is not practicable, remediated by an infiltration control system to protect groundwater quality). If any residual contamination remains that presents a human health or ecological exposure threat, Table 5c presents the concentrations that would need to be covered to prevent exposure above risk-based levels.

Because of the conservative nature of the calculations in an RFI/RI/BRA, it is possible for a calculated risk-based RGO to be less than ambient background levels. Since it is technically impractical to remediate to less than background levels, the RGOs are compared to background levels: if the calculated RGO is less than background levels, the RG defaults to the maximum observed concentration in background samples. For cesium-137, the human health/ecological RG defaulted to background.

There are no quantitative constituent-specific RGOs for the ORWBG. This is because the ORWBG contains a large inventory of unrecoverable buried wastes (which are not feasible to remove) and the surface of the unit does not pose an exposure risk. The cleanup goal for the ORWBG is to meet the Remedial Action Objectives (RAOs) presented below.

RAOs describe what the cleanup will accomplish. RAOs provide the basis for evaluating the remedial alternatives and identify how the unit risks will be addressed by the remedial action.

The following RAOs apply to HRB, Warner's Pond, and HP-52 Ponds:

- Treat and/or remove PTSM (based on toxicity) by treating and/or removing cesium-137 at HRB, Warner's Pond, and HP-52 Ponds at levels above 104 pCi/g, to the extent practicable.

- Treat and/or remove PTSM (based on mobility) by treating and/or removing strontium-90 at the HRB sewer line/discharge area at levels above 0.65 pCi/g, to the extent practicable.

- Control migration and leaching of strontium-90 that could result in groundwater contamination in excess of MCLs beneath each unit by (1) removing soil above 1.5 pCi/g at the HRB basin bottom/sidewalls, above 0.65 pCi/g the HRB sewer line/discharge area, and above 1.12 pCi/g at Warner's Pond, to the extent practicable; and (2) reducing infiltration through any residual contamination above RGs.

- Protect human and ecological receptors from surface materials containing cesium-137 above 0.55 pCi/g and strontium-90 above 57.2 pCi/g.

The RAOs for the ORWBG (applicable to the hot spots and the ORWBG as a whole) include the following:

- Minimize the exposure risk to workers (current and future).

- Prevent or mitigate inadvertent human intrusion.

- Minimize ecological intrusion into the buried waste and redistribution/mobilization (erosion) of contaminants from the waste unit to the surrounding areas.

- Mitigate future leaching of contaminants to groundwater.

IX. DESCRIPTION OF ALTERNATIVES

Alternatives for HRB, Warner's Pond, and HP-52 Ponds

Seven remedial alternatives for HRB (Alternatives 1 through 7) were identified and evaluated in a CMS/FS (WSRC 2000a). Alternatives 5 and 6 were similar to Alternatives 3 and 4, except they included a provision for off-unit disposal of some wastes in the event that the volume of contaminated media at the unit was too large to manage on-unit. A subsequent design study determined that this provision was not necessary, and Alternatives 5 and 6 were dropped from further consideration. Alternatives 1, 2, 3, 4, and 7 were retained for further consideration.

Given the similarity in the scope of the problem at HRB, Warner's Pond, and HP-52 Ponds, the remedial alternatives developed for HRB are also applicable for Warner's Pond and HP-52 Ponds. The following alternatives for HRB, Warner's Pond, and HP-52 Ponds were retained for further consideration:

Alternative 1 – No Action

Total Present Worth Cost: HRB = \$0.1 million, Warner's Pond = \$0.1 million, HP-52 Ponds = \$0.1 million, Total = \$0.3 million

Construction Time to Complete: 0 years

The No Action Alternative is required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) in order to provide a baseline for comparison with other remedial alternatives. It involves no activity to monitor, remove, treat, or otherwise mitigate the contamination. The key ARARs for this alternative are the Atomic Energy Act (AEA) and USDOE Order 5400.5. If this alternative were selected, the expected outcome would be the same as current conditions: there would be unacceptable risks if exposure were to occur. The land would not be available for industrial or residential land use.

Alternative 2 – Engineered Cap with Barrier Wall, and Institutional Controls

Total Present Worth Cost: HRB = $11.2 million, Warner's Pond = $10.1 million, HP-52 Ponds = $9.6 million, Total = $30.9 million

Construction Time to Complete: 2-3 years

This alternative is a containment option. PTSM and soils containing CMCOCs would be excavated to the extent practicable and re-positioned within the unit as needed (e.g., at HRB, PTSM in the soil pile would be placed into the basin cavity). A low permeability engineered cap would be installed over the waste, and a vertical grout barrier wall would be installed around the perimeter of the waste unit to eliminate the lateral inflow of perched water and avoid contact of contaminated media with groundwater. Institutional controls consisting of site maintenance (site inspections, mowing, general housekeeping, repair of erosion damage, and other routine maintenance as needed) and access controls (warning signs and land use restrictions) would be implemented to prevent exposure to contamination left in place. The key ARARs for this alternative are the AEA and USDOE Order 5400.5. If this alternative were selected, the expected outcome would be that all PTSM would be contained, the units will not pose a leachability threat to groundwater, and contamination in soil will be covered with clean soil so it would not pose an exposure threat to receptors. The units would be available for future industrial land use with land use restrictions to prevent excavation.

Alternative 3 – In Situ Solidification/Stabilization with Barrier Wall and Soil Cover, and Institutional Controls

Total Present Worth Cost: HRB = $18.1 million, Warner's Pond = $16.4 million, HP-52 Ponds = $15.6 million, Total = $50.1 million

Construction Time to Complete: 3-4 years

This alternative is a treatment option. PTSM and soils containing CMCOCs would be excavated to the extent practicable and re-positioned within the unit as needed (e.g., at HRB, PTSM in the soil pile would be placed into the basin cavity). The waste would then be grouted in place. A soil cover would be installed over the waste unit for additional shielding. A vertical grout barrier wall would be installed around the perimeter of the waste unit to eliminate the lateral in-flow of perched water and contact of contaminated media with groundwater. Institutional controls consisting of site maintenance (site inspections, mowing, general housekeeping, repair of erosion damage, and other routine maintenance as needed) and access controls (warning signs and land use restrictions) would be implemented to prevent exposure to contamination left in place. The key ARARs for this alternative are the AEA and USDOE Order 5400.5. If this alternative were selected, the expected outcome would be that all PTSM would be treated, the units will not pose a leachability threat to groundwater, and contamination in soil will be covered with clean soil so it would not pose an exposure threat to receptors. The units would be available for future industrial land use with land use restrictions to prevent excavation.

Alternative 4 – Excavation of Contaminated Soil for Off-SRS Disposal, and Institutional Controls

Total Present Worth Cost: HRB = \$19.1 million, Warner's Pond = \$17.4 million, HP-52 Ponds = \$16.5 million, Total = \$53.0 million

Construction Time to Complete: 3-4 years

This alternative is a removal option. PTSM and soils containing CMCOCs would be excavated to the extent practicable, packaged, and shipped to an off-SRS disposal facility. After removal, the excavation would be restored by backfilling to grade. A soil cover would be used to minimize infiltration so that (1) no unit-related contaminants will cause MCL exceedances in the UTRA beneath a unit, and (2) the accumulation of perched water atop the hardpan is minimized. Institutional controls consisting of site maintenance (site inspections, mowing, general housekeeping, repair of erosion damage, and other routine maintenance as needed) and access controls (warning signs and land use restrictions) would be implemented to prevent exposure to contamination left in place. The key ARARs for this alternative are the AEA and USDOE Order 5400.5. If this alternative were selected, the expected outcome would be that no PTSM will remain, the units will not pose a leachability threat to groundwater, and any residual contamination in soil that exceeds human health or ecological RGOs will be covered with clean soil so it doesn't pose an exposure threat to receptors. The units would be available for future industrial land use with land use restrictions to prevent excavation.

Alternative 7 – Waste Consolidation at the ORWBG, and Institutional Controls

Total Present Worth Cost: HRB = \$10.6 million, Warner's Pond = \$9.6 million, HP-52 Ponds = \$9.1 million, Total = \$29.3 million

Construction Time to Complete: 3-4 years

This alternative is a removal option. PTSM and soils containing CMCOCs at HRB, Warner's Pond, and HP-52 Ponds would be excavated to the extent practicable and disposed at the ORWBG. After removal, the excavation would be restored by backfilling to grade. A soil cover would be used to minimize infiltration so that (1) no unit-related contaminants will cause MCL exceedances in the UTRA beneath a unit, and (2) the accumulation of perched water atop the hardpan is minimized. Institutional controls consisting of site maintenance (site inspections, mowing, general housekeeping, repair of erosion damage, and other routine maintenance as needed) and access controls (warning signs and land use restrictions) would be implemented to prevent exposure to contamination left in place. The key ARARs for this alternative are the AEA and USDOE Order 5400.5. If this alternative were selected, the expected outcome would be that no PTSM will remain at HRB, Warner's Pond or HP-52 Ponds; the units will not pose a leachability threat to groundwater; and any residual contamination in soil that exceeds human health or ecological RGOs will be covered with clean soil so it doesn't pose an exposure threat to receptors. The units would be available for future industrial land use with land use restrictions to prevent excavation.

Alternatives for ORWBG

Nine remedial alternatives for ORWBG (Alternatives ORWBG I through IX) were identified and evaluated in a CMS/FS (WSRC 2001b). Alternatives ORWBG IV and V were similar to ORWBG III, differing only in the options for the barrier (light rip-rap, heavy rip-rap, and reinforced concrete slabs), and these options were subsequently incorporated into ORWBG III. Alternatives ORWBG VIII and IX were similar to ORWBG VII in the same respect, and these options were incorporated into ORWBG VII. Alternatives ORWBG IV, V, VIII, and IX were unnecessary and were dropped from further consideration. Alternatives ORWGB I, II, III, VI, and VII were retained for further consideration.

Each alternative consists of an action to the ORWBG as a whole, plus additional actions to hot spots. Any action for the ORWBG as a whole would also be applied to HS-Hg-1, the radioactive hot spots, and the OSTs.

The radioactive hot spots within the ORWBG were evaluated on a case-by-case basis. The three actions under consideration specifically for the radioactive hot spots (No Further Action, Intruder Barrier, and Removal) represent end members that could be combined to develop a specific remedy. For example, a selected remedy could include no further action for some hot spots, removal for others, and placement of an intruder barrier over the remaining hot spots.

Institutional controls are a component of all alternatives (except a No Further Action base case alternative) due to the large inventory of unretrievable waste in the ORWBG. Institutional controls would include site maintenance (site inspections, mowing, general housekeeping, repair of erosion damage, other routine maintenance as needed, and periodic maintenance of the infiltration control system) and access controls (security fences, warning signs, and land use restrictions). Unauthorized access and excavation would be prohibited, and the unit would remain undisturbed. Institutional controls for the ORWBG, OSTs, and surrounding areas are anticipated to be maintained in perpetuity.

Many of the remedial alternatives developed in the CMS/FS may logically be implemented over an extended period of time. For example, the need for an intruder barrier may arise only in the absence of institutional controls. Therefore, for all the alternatives, it is implicit that installation of some long-term features is not necessary in the short-term to meet RAOs and could potentially be deferred or implemented in phases.

The alternatives for ORWBG include the following:

ORWBG I - No Further Action

Total Present Worth Cost: $<0.1 million

Construction Time to Complete: 0 years

The No Further Action alternative is required by the NCP to serve as a baseline for comparison with other remedial alternatives. Under this alternative, no additional remedial activities at any area of the ORWBG would be performed. Current maintenance measures would be terminated. The existing low permeability native soil cover would be allowed to degrade. Institutional controls would not be implemented. The key ARARs for this alternative are the AEA and USDOE Order 5400.5. If this alternative were selected, the expected outcome would be the same as current conditions: exposure to waste and unacceptable exposure could occur if erosion and intrusion are not mitigated. Continued leaching of some constituents would increase as degradation of the cover occurs. The land would not be available for industrial or residential land use.

ORWBG II - Institutional Controls with Completion of the Native Soil Cover

Total Present Worth Cost: $2.0 million

Construction Time to Complete: 1 year

This alternative would involve institutional controls and completion of the low permeability native soil cover over the ORWBG. The low permeability native soil cover that was placed during the 1997 interim action would be expanded to cover inactive parts of the ORWBG that have not yet been covered (i.e., over the OSTs and between interim covers A and B). Institutional controls, including maintenance of the native soil cover and land use controls, would be implemented. This alternative includes an option to stabilize HS-Hg-1 using grout or chemical fixation agents to reduce the mobility of mercury. The remedy for a particular radioactive hot spot could be the same as that for the ORWBG as a whole, placement of an intruder barrier, or removal/disposal. The key ARARs for this alternative are the standards for closure and post-closure care specified in RCRA. If this alternative were selected, the expected outcome would be that the ORWBG would not pose a surface exposure risk to industrial workers or ecological receptors, and the leachability threat posed by waste at depth in the ORWBG would be mitigated by the native soil cover (although there is uncertainty whether a soil cover would provide adequate protection against future leaching to groundwater). The unit would be available for industrial land use with restrictions to prevent excavation.

ORWBG III - Institutional Controls with Completion of the Native Soil Cover and Addition of a Light Rip-Rap Barrier

Total Present Worth Cost: $12.4 million

Construction Time to Complete: 1-2 years

This alternative would involve institutional controls and a low permeability native soil cover with near-term placement of a light rip-rap barrier over the ORWBG. The low permeability native soil cover that was placed during the 1997 interim action would be expanded to cover inactive parts of the ORWBG that have not yet been covered (i.e., over the OSTs and between interim covers A and B). A light rip-rap barrier would be installed over the ORWBG to slow degradation of the cover and to provide some degree of deterrence against inadvertent intrusion in the event land use restrictions were to become ineffective. This alternative includes an option to stabilize HS-Hg-1 using grout or chemical fixation agents to reduce the mobility of mercury. The remedy for a particular radioactive hot spot could be the same as that for the ORWBG as a whole, placement of an intruder barrier, or removal/disposal. Institutional controls, including maintenance of the native soil cover and land use controls, would be implemented. The key ARARs for this alternative are the standards for closure and post-closure care specified in RCRA. If this alternative were selected, the expected outcome would be that the ORWBG would not pose a surface exposure risk to industrial workers or ecological receptors and the leachability threat posed by waste at depth in the ORWBG would be mitigated by the native soil cover (although there is uncertainty whether a soil cover would provide adequate protection against future leaching to groundwater). The unit would be available for industrial land use with restrictions to prevent excavation.

ORWBG VI - Institutional Controls with Low Permeability Cap

Total Present Worth Cost: $12.0 million

Construction Time to Complete: 2-3 years

This alternative would involve institutional controls with the addition of a low permeability cap. The low permeability native soil cover that was placed during the 1997 interim action would be expanded to cover inactive parts of the ORWBG that have not yet been covered (i.e., over the OSTs and between interim covers A and B). The low permeability native soil cover would then become the foundation for a low permeability cap that would be placed over the ORWBG. The cap would be a geosynthetic cover system meeting a performance standard for hydraulic conductivity of $\leq 1 \times 10^{-7}$ cm/sec. This alternative includes an option to stabilize HS-Hg-1 using grout or chemical fixation agents to reduce the mobility of mercury. The remedy for a particular radioactive hot spot could be the same as that for the ORWBG as a whole, placement of an intruder barrier, or removal/disposal. Institutional controls, including maintenance of the cap and land use controls, would be implemented. The key ARARs for this alternative are the standards for closure and post-closure care specified in RCRA. If this alternative were selected, the expected outcome would be that the ORWBG would not pose a surface exposure risk to industrial workers or ecological receptors, and the leachability threat posed by waste at depth in the ORWBG will be mitigated by the low permeability cap. The unit would be available for industrial land use with restrictions to prevent excavation.

ORWBG VII - Institutional Controls with a Low Permeability Cap and a Light Rip-Rap Barrier

Total Present Worth Cost: $22.5 million

Construction Time to Complete: 3-4 years

This alternative involves institutional controls and a low permeability native soil cover with a low permeability cap and near-term placement of a light rip-rap barrier over the ORWBG. The low permeability native soil cover that was placed during the 1997 interim action would be expanded to cover inactive parts of the ORWBG that have not yet been covered (i.e., over the OSTs and between interim covers A and B). The low permeability native soil cover would then become the foundation for a low permeability cap. The cap would be a geosynthetic cover system meeting a performance standard for hydraulic conductivity of $\leq 1 \times 10^{-7}$ cm/sec. A light rip-rap barrier would be installed over the ORWBG as a layer of the cap to slow degradation of the cap and to provide some degree of deterrence against inadvertent intrusion in the event land use restrictions were to become ineffective. This alternative includes an option to stabilize HS-Hg-1 using grout or chemical fixation agents to reduce the mobility of mercury. The remedy for a particular radioactive hot spot could be the same as that for the ORWBG as a whole, placement of an intruder barrier, or removal/disposal. Institutional controls, including maintenance of the cap and land use controls, would be implemented. The key ARARs for this alternative are the standards for closure and post-closure care specified in RCRA. If this alternative were selected, the expected outcome would be that the ORWBG would not pose a surface exposure risk to industrial workers or ecological receptors, and the leachability threat posed by waste at depth in the ORWBG will be mitigated by the low permeability cap. The unit would be available for industrial land use with restrictions to prevent excavation.

X. COMPARATIVE ANALYSIS OF ALTERNATIVES

Description of the Nine Evaluation Criteria

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

Threshold criteria:

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

Balancing criteria:

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

Modifying criteria:

8. State acceptance
9. Community acceptance

Comparative Analysis for HRB, Warner's Pond, and HP-52 Ponds

Table 6 presents a summary of the evaluation of the alternatives against the comparative analysis criteria. The evaluation is also briefly summarized below.

Table 6. Comparative Analysis of Alternatives – HRB, Warner's Pond, and HP-52 Ponds

EVALUATION CRITERIA	Alternative 1 No Action	Alternative 2 Engineered Cap with Barrier Wall	Alternative 3 *In Situ* Solidification/ Stabilization with Barrier Wall and Soil Cover	Alternative 4 Excavation of Contaminated Soil for Off-SRS Disposal	Alternative 7 Waste Consolidation at the ORWBG
Overall Protection of Human Health and the Environment					
Human Health	Not Protective	Protective	Protective	Protective	Protective
Environment	Not Protective	Moderately protective	Moderately protective	Protective	Protective
Compliance with ARARs					
Chemical-, Location-, and Action-Specific	Does not comply with AEA or DOE Order 5400.5	Complies	Complies	Complies	Complies
Long-Term Effectiveness and Permanence					
Magnitude of Residual Risks	High, particularly in the absence of institutional controls.	Moderate. Contamination would be isolated from exposure by backfill/soil cover. Some long-term concerns associated with leaving contamination in place near streams.	Moderate. Contamination would be locked up in grout. Some long-term concerns associated with leaving contamination in place near streams.	Low. PTSM and CMCOCs removed to extent practicable and relocated to a facility designed to accept radioactive waste. Residual contamination would be isolated from exposure by backfill/soil cover.	Low. PTSM and CMCOCs removed to extent practicable and relocated to a facility designed to accept radioactive waste. Residual contamination would be isolated from exposure by backfill/soil cover.
Permanence	Not Applicable. There are no remedy components.	Moderate. Cap and barrier wall will provide exposure barrier only as long as integrity is maintained. Existing and additional institutional controls needed for permanence.	Moderate. Cover and grout with barrier wall will provide exposure barriers. Existing and additional institutional controls needed for permanence.	High. Minimal institutional controls required. All contaminant pathways would be permanently eliminated.	High. Minimal institutional controls required. All contaminant pathways would be permanently eliminated.
Reduction of Toxicity, Mobility, or Volume through Treatment					
Degree of Expected Reduction in Toxicity	No reduction other than natural radioactive decay.	No reduction other than natural radioactive decay.	No reduction other than natural radioactive decay, but bioavailability reduced.	Toxicity transferred to receiving facility.	Toxicity transferred to receiving facility.
Degree of Expected Reduction in Mobility	None	No treatment, but capping would reduce contaminant mobility through containment.	Solidification would permanently reduce contaminant mobility by limiting leaching through the waste.	Mobility transferred to receiving facility.	Mobility transferred to receiving facility.

Table 6. Comparative Analysis of Alternatives – HRB, Warner's Pond, and HP-52 Ponds (Continued)

EVALUATION CRITERIA	Alternative 1 No Action	Alternative 2 Engineered Cap with Barrier Wall	Alternative 3 *In Situ* Solidification/ Stabilization with Barrier Wall and Soil Cover	Alternative 4 Excavation of Contaminated Soil for Off-SRS Disposal	Alternative 7 Waste Consolidation at the ORWBG
Degree of Expected Reduction in Volume	None	Negligible change.	Negligible increase. Volume of contaminated media would increase as grout becomes contaminated.	Volume reduced by transfer to receiving facility. Overall volume of waste would increase as materials and equipment become contaminated during removal, handling, and disposal.	Volume reduced by transfer to receiving facility. Overall volume of waste would increase as materials and equipment become contaminated during removal, handling, and disposal.
Short-Term Effectiveness					
Risk to Remedial Workers	None	Minimal	Medium; minimal handling of contaminated soils. However, longer hours are required for grouting.	Medium. Risks are associated with excavation and transportation.	Medium. Risks are associated with excavation and transportation.
Risk to Community	None	None	None	Medium to high. Transport off-SRS on public rights-of-way.	None
Time Until Protection is Achieved	N/A	2-3 years after remedial action (RA) start	3-4 years after RA start	3-4 years after RA start	3-4 years after RA start
Implementability					
Technical Feasibility	Readily implementable	Readily implementable but would require more effort than No Action.	Readily implementable but would require more effort than capping. Future remedial actions, if warranted, would be difficult.	Implementable. Must meet DOT shipping and disposal facility WAC. Potential future need for treatment at disposal site.	Implementable. Must meet DOT shipping and disposal Burial Ground WAC.
Administrative Feasibility	No administrative constraints	No administrative constraints	No administrative constraints	Possible public concern with off-SRS transportation.	No administrative constraints
Availability of Materials, Equipment, Contractors	None required	Readily available.	Readily available.	Readily available.	Readily available.

Table 6. Comparative Analysis of Alternatives – HRB, Warner's Pond, and HP-52 Ponds (Continued)

EVALUATION CRITERIA		Alternative 1 No Action	Alternative 2 Engineered Cap with Barrier Wall	Alternative 3 *In Situ* Solidification/ Stabilization with Barrier Wall and Soil Cover	Alternative 4 Excavation of Contaminated Soil for Off-SRS Disposal	Alternative 7 Waste Consolidation at the ORWBG
Cost (present value, in millions)						
HRB	Capital Cost	$0.0	$6.2	$13.1	$18.1	$9.6
	O&M Cost	$0.1	$5.0	$5.0	$1.0	$1.0
	Total Cost	$0.1	$11.2	$18.1	$19.1	$10.6
Warner's Pond	Capital Cost	$0.0	$5.6	$11.9	$16.5	$8.7
	O&M Cost	$0.1	$4.5	$4.5	$0.9	$0.9
	Total Cost	$0.1	$10.1	$16.4	$17.4	$9.6
HP-52	Capital Cost	$0.0	$5.3	$11.3	$15.7	$8.3
	O&M Cost	$0.1	$4.3	$4.3	$0.8	$0.8
	Total Cost	$0.1	$9.6	$15.6	$16.5	$9.1
Total	**Capital Cost**	**$0.0**	**$17.1**	**$36.3**	**$50.3**	**$26.6**
	O&M Cost	**$0.3**	**$13.8**	**$13.8**	**$2.7**	**$2.7**
	Total Cost	**$0.3**	**$30.9**	**$50.1**	**$53.0**	**$29.3**

Overall Protection of Human Health and the Environment

Alternatives 2, 3, 4, and 7 would be protective of human health and the environment. PTSM and soils containing CMCOCs would either be contained (capping), treated (grouting), or removed to the extent practicable. Each alternative includes mechanisms to (1) provide shielding to reduce radiation exposure to within acceptable limits, (2) protect groundwater quality, and (3) prevent human access to contaminated media. Alternatives 4 and 7 provide a greater level of overall protection because the contamination would be removed from the waste units (to the extent practicable) rather than managed in place.

Alternative 1 (No Action) would not be protective of human health and the environment. The resulting conditions would be the same as current conditions, which pose unacceptable risks to current and future industrial workers.

Compliance with ARARs

All alternatives (except the No Action alternative) would comply with the ARARs identified in Table 4. No Action would not comply with the AEA or USDOE Order 5400.5 because radioactive contamination would be left unprotected and unmonitored. The AEA states that "source, byproduct, and special nuclear materials must be regulated…to protect the health and safety of the public." The AEA precludes USDOE from transferring property containing radioactive substances to non-federal ownership.

Long-Term Effectiveness and Permanence

All alternatives except the No Action alternative effectively eliminate exposure pathways so that there would be no unacceptable risk to a future industrial worker.

Alternative 2, 3, 4, and 7 will result in generally similar levels of residual risk in that no exposure pathways will remain. Alternatives 4 and 7 would eliminate most risk through transfer to another facility, and clean backfill would prevent exposure to residual risk at depth. Alternative 3 would lock up contamination and make it unavailable for exposure. Alternative 2 would isolate contamination under the engineered cap. The presence of streams near HRB, Warner's Pond, and HP-52 Ponds presents some residual risk concerns in the long-term because the streams could be potential mechanisms for erosion and redistribution of contaminants and may be a future point of exposure. Alternatives 4 and 7 reduce this long-term residual risk better than Alternatives 2 and 3 because contaminants would be removed from the units rather than managed in place.

Although the residual risk for each alternative is generally similar, the alternatives have different degrees of permanence. Alternatives 4 and 7 remove (to the extent practicable) PTSM and soil containing CMCOCs from the unit, thereby providing a greater level of permanence than the other alternatives. Alternative 3 is more permanent than Alternative 2 because an engineered cap (Alternative 2) is subject to erosion and would require more long-term maintenance. Alternative 1 is the least effective alternative.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives 4 and 7 achieve reduction of toxicity and mobility through transfer to another facility. However, the overall volume of waste would increase as materials and equipment become contaminated during excavation, handling, and disposal. Alternative 3 provides treatment to immobilize contaminants for all soils exceeding industrial PTSM and CMCOC standards. However, the grouting operations used to stabilize/immobilize the contaminants would also increase the final volume of the contaminated media.

No form of treatment is involved with Alternative 2 (capping) to reduce toxicity, mobility, or volume; however, Alternative 2 would reduce mobility through containment.

No form of treatment is involved with Alternative 1 to reduce toxicity, mobility, or volume; however, the radioactivity at HRB, Warner's Pond, and HP-52 Ponds will slowly decrease through radioactive decay. If no remedial action is taken, radioactivity at HRB (which exhibits the highest levels) will decay to background levels through natural radioactive decay in approximately 500 years.

Short-Term Effectiveness

Risk to Remedial Workers

The short-term risks to remedial workers increase with the volume of contaminated media directly handled or processed and with project duration. Handling and/or processing contaminated media increases the risk of remedial worker exposure to radiation effects. In addition, remedial workers are exposed to potential construction-related risks, which increase with project duration and depth of excavation. Using established health and safety procedures, potential short-term risks to remedial workers should be manageable for all alternatives under consideration.

Alternative 1 would offer the least risk to workers since the soils are not disturbed. Alternative 2 would offer a slightly greater risk by moving some contaminated soils and placing the barrier wall and engineered cap. Alternative 3 would offer a slightly greater risk by moving the same soils, mixing/grouting the soils, and placing the soil cover. Alternatives 4 and 7 would provide higher risk because they involve excavating the largest volumes of soil, and then the soils must be packaged, sampled, and shipped/transported, which results in greater handling and exposure time.

Risk to Community

Alternatives 1, 2, 3, and 7 present no risk to the community because the contaminated soils would remain within SRS boundaries. There would be no exposure concerns to the public because the GSACU is located several miles from the nearest SRS boundary. Any increase in off-SRS traffic would be negligible. Alternative 4 would present the greatest risk to the public because contaminated soils would be transferred over public railways and/or roadways to an off-SRS disposal facility.

Time Until Protection is Achieved

The amount of time needed to achieve protectiveness after remedial action start is not significantly different between the alternatives: Alternative 2 is 2 to 3 years and Alternatives 3, 4, and 7 are 3 to 4 years. Given that SRS has controls in place to prevent unacceptable exposure to current workers, the time to construct the remedy is not identified as a key consideration in the remedy selection process.

Implementability

The applied technologies (capping, *in situ* solidification/stabilization, and disposal) are common for the disposition of hazardous waste units. Alternative 1 (No Action) would be the easiest alternative to implement because it involves no construction. Alternative 2 (capping) involves relatively straightforward, conventional construction activities and adequate material, equipment, and contractor capabilities are available. Alternative 3 is implementable with standard construction techniques, but any future remedial actions at HRB, Warner's Pond, or HP-52 Ponds would be difficult because the contaminated soil would be solidified with grout. Alternative 7 would be implementable with standard construction and SRS transportation procedures. Alternative 4 is also implementable, but may cause public concern regarding the off-SRS transportation of radioactive waste.

Cost

Cost estimates for each alternative for HRB, Warner's Pond, and HP-52 Ponds are provided in Table 6. Total estimated present-worth costs range from $0.3 million for Alternative 1 to $53.0 million for Alternative 4.

Comparative Analysis for ORWBG

Table 7 presents a summary of the evaluation of the alternatives against the comparative analysis criteria. The evaluation is also briefly summarized below.

Table 7. Comparative Analysis of Alternatives – ORWBG

EVALUATION CRITERIA	ORWBG I No Further Action	ORWBG II Soil Cover	ORWBG III Soil Cover with Light Rip-Rap Barrier (over Entire ORWBG)	ORWBG VI Low Permeability Cap	ORWBG VII Low Perm. Cap with Light Rip-Rap Barrier (over Entire ORWBG)
		Alternatives ORWBG II, III, VI, and VII include options for (1) grouting all trenches within HS-Hg-1, (2) placing heavy rip-rap intruder barriers over selected radioactive hot spots, and (3) removing selected radioactive hot spots.			
Overall Protection of Human Health and the Environment					
Human Health	Not protective. Exposure to waste could occur if erosion and intrusion are not mitigated.	Protective as long as institutional controls are maintained. Institutional controls would prevent exposure by controlling erosion of the cover/cap (through site maintenance) and by preventing inadvertent intrusion (through access controls). If institutional controls were relinquished, some areas would pose a high risk to an intruder (mitigated by option to place intruder barriers prior to relinquishing institutional controls).	Protective as long as institutional controls are maintained. Institutional controls would prevent exposure by controlling erosion of the cover/cap (through site maintenance) and by preventing inadvertent intrusion (through access controls). If institutional controls were relinquished, some areas would pose a high risk to an intruder. Barrier would prevent intrusion and erosion if institutional controls are relinquished.	Protective as long as institutional controls are maintained. Institutional controls would prevent exposure by controlling erosion of the cover/cap (through site maintenance) and by preventing inadvertent intrusion (through access controls). If institutional controls were relinquished, some areas would pose a high risk to an intruder (mitigated by option to place intruder barriers prior to relinquishing institutional controls).	Protective as long as institutional controls are maintained. Institutional controls would prevent exposure by controlling erosion of the cover/cap (through site maintenance) and by preventing inadvertent intrusion (through access controls). If institutional controls were relinquished, some areas would pose a high risk to an intruder. Barrier would prevent intrusion and erosion if institutional controls are relinquished.
Environment Control of source release focuses on *future* contaminant migration to groundwater	Not protective. Degradation of the cover would occur, with eventual exhumation of the waste by erosion. Continued leaching of some constituents would increase as degradation of the cover occurs. Leaching poses a short-term and long-term threat to groundwater.	Protective as long as institutional controls are maintained, although there is some uncertainty with whether a soil cover would provide adequate protection against future leaching to groundwater. Effectiveness of soil cover would decrease if maintenance is terminated.	Protective as long as institutional controls are maintained, although there is some uncertainty with whether a soil cover would provide adequate protection against future leaching to groundwater. Effectiveness of the soil cover would decrease if maintenance is terminated. However, a barrier, if emplaced prior to the end of institutional controls, would extend the effective lifespan of the cap.	Protective as long as institutional controls are maintained. Effectiveness of low permeability cap would decrease if maintenance is terminated.	Protective as long as institutional controls are maintained. Effectiveness of low permeability cap would decrease if maintenance is terminated. However, a barrier, if emplaced prior to the end of institutional controls, would extend the effective lifespan of the cap.

Table 7. Comparative Analysis of Alternatives – ORWBG – Continued

EVALUATION CRITERIA	ORWBG I No Further Action	ORWBG II Soil Cover	ORWBG III Soil Cover with Light Rip-Rap Barrier (over Entire ORWBG)	ORWBG VI Low Permeability Cap	ORWBG VII Low Perm. Cap with Light Rip-Rap Barrier (over Entire ORWBG)
		Alternatives ORWBG II, III, VI, and VII include options for (1) grouting all trenches within HS-Hg-1, (2) placing heavy rip-rap intruder barriers over selected radioactive hot spots, and (3) removing selected radioactive hot spots.			
Compliance with ARARs					
Chemical-, Location-, and Action-Specific	Does not comply with AEA, DOE Order 5400.5, or infiltration control requirements of RCRA.	Infiltration control requirements of RCRA can not be verified.	Infiltration control requirements of RCRA can not be verified.	Complies. The cap will meet a performance standard for hydraulic conductivity of $\leq 1 \times 10^{-7}$ cm/sec.	Complies. The cap will meet a performance standard for hydraulic conductivity of $\leq 1 \times 10^{-7}$ cm/sec.
Long-Term Effectiveness and Permanence					
Magnitude of Residual Risks	Low. The existing native soil cover already isolated contamination at depth. Risk would generally decrease with radioactive decay, but if inadvertent intrusion were to occur, some hot spots would pose a long-term (>500 years) acute and/or chronic exposure threat.	Low. The existing native soil cover already isolated contamination at depth. Access controls would prevent unauthorized entry and site maintenance would prevent exposure by preventing erosion of the cover. In the absence of access controls, there would be no protection against inadvertent intrusion or long-term erosion/exhumation of the waste. Residual risk would be high. If any wastes are removed from the hot spots, the remaining wastes in the hot spot would pose a similar risk to those parts of the ORWBG not identified as hot spots.	Low. The existing native soil cover already isolated contamination at depth. If institutional controls are terminated, the light rip-rap barrier would provide some reduction of residual risk because it would provide some protection against inadvertent intrusion and long-term erosion/exhumation of the waste. If institutional controls are maintained, a barrier is a redundant remedy component. If any wastes are removed from the hot spots, the remaining wastes in the hot spot would pose a similar risk to those parts of the ORWBG not identified as hot spots.	Same as ORWBG II.	Same as ORWBG III.

Table 7. Comparative Analysis of Alternatives – ORWBG – Continued

EVALUATION CRITERIA	ORWBG I No Further Action	ORWBG II Soil Cover	ORWBG III Soil Cover with Light Rip-Rap Barrier (over Entire ORWBG)	ORWBG VI Low Permeability Cap	ORWBG VII Low Perm. Cap with Light Rip-Rap Barrier (over Entire ORWBG)
		Alternatives ORWBG II, III, VI, and VII include options for (1) grouting all trenches within HS-Hg-1, (2) placing heavy rip-rap intruder barriers over selected radioactive hot spots, and (3) removing selected radioactive hot spots.			
Permanence	Not permanent. The native soil cover would erode and there would be the possibility of future exhumation of waste by erosion and intrusion.	A soil cover is subject to erosion and deterioration, but permanence can be achieved through inspection and maintenance associated with institutional controls. *In situ* stabilization of HS-Hg-1 would provide some permanence but this action would be redundant as long as institutional controls are in place. Intruder barriers over radioactive hot spots would be designed for long-term effectiveness and durability.	Same as ORWBG II except: A light rip-rap barrier would provide greater permanence of the soil cover but would be redundant as long as institutional controls are in place.	Same as ORWBG II.	Same as ORWBG II except: A light rip-rap barrier would provide greater permanence of the cap but would be redundant as long as institutional controls are in place.
Reduction in Toxicity, Mobility, or Volume Through Treatment					
Degree of Expected Reduction in Toxicity	No reduction other than natural radioactive decay.	No reduction other than natural radioactive decay.	No reduction other than natural radioactive decay.	No reduction other than natural radioactive decay.	No reduction other than natural radioactive decay.

Table 7. Comparative Analysis of Alternatives – ORWBG – Continued

EVALUATION CRITERIA	ORWBG I No Further Action	ORWBG II Soil Cover	ORWBG III Soil Cover with Light Rip-Rap Barrier (over Entire ORWBG)	ORWBG VI Low Permeability Cap	ORWBG VII Low Perm. Cap with Light Rip-Rap Barrier (over Entire ORWBG)
		Alternatives ORWBG II, III, VI, and VII include options for (1) grouting all trenches within HS-Hg-1, (2) placing heavy rip-rap intruder barriers over selected radioactive hot spots, and (3) removing selected radioactive hot spots.			
Degree of Expected Reduction in Mobility	No reduction of mobility.	Reduction through containment (soil cover). Because the leachability threat of mercury is low and the cover is expected to be maintained in the long-term, stabilizing HS-Hg-1 would provide negligible reduction in contaminant migration and would be a redundant response to the infiltration control system. Further, *in situ* activities could rupture any intact containers, releasing additional mercury.	Reduction through containment (soil cover). Because the leachability threat of mercury is low and the cover is expected to be maintained in the long-term, stabilizing HS-Hg-1 would provide negligible reduction in contaminant migration and would be a redundant response to the infiltration control system. Further, *in situ* activities could rupture any intact containers, releasing additional mercury.	Reduction through containment (low permeability cap meeting performance standard for hydraulic conductivity of $\leq 1 \times 10^{-7}$ cm/sec). Because the leachability threat of mercury is low and the cover is expected to be maintained in the long-term, stabilizing HS-Hg-1 would provide negligible reduction in contaminant migration and would be a redundant response to the infiltration control system. Further, *in situ* activities could rupture any intact containers, releasing additional mercury.	Reduction through containment (low permeability cap meeting performance standard for hydraulic conductivity of $\leq 1 \times 10^{-7}$ cm/sec). Because the leachability threat of mercury is low and the cover is expected to be maintained in the long-term, stabilizing HS-Hg-1 would provide negligible reduction in contaminant migration and would be a redundant response to the infiltration control system. Further, *in situ* activities could rupture any intact containers, releasing additional mercury.
Degree of Expected Reduction in Volume	No reduction in volume.	If grout is injected into HS-Hg-1, volume of contaminated media would increase. If wastes in the radioactive hot spots are removed, the overall volume of waste would increase as materials and equipment become contaminated during removal, handling, staging, transportation, storage, and disposal.	Same as ORWBG II.	Same as ORWBG II.	Same as ORWBG II.

Table 7. Comparative Analysis of Alternatives – ORWBG – Continued

EVALUATION CRITERIA	ORWBG I No Further Action	ORWBG II Soil Cover	ORWBG III Soil Cover with Light Rip-Rap Barrier (over Entire ORWBG)	ORWBG VI Low Permeability Cap	ORWBG VII Low Perm. Cap with Light Rip-Rap Barrier (over Entire ORWBG)
		Alternatives ORWBG II, III, VI, and VII include options for (1) grouting all trenches within HS-Hg-1, (2) placing heavy rip-rap intruder barriers over selected radioactive hot spots, and (3) removing selected radioactive hot spots.			
Short-Term Effectiveness					
Risk to Remedial Workers	None. No onsite work.	Negligible risk associated with heavy equipment use to place soil cover. Stabilization of HS-Hg-1 would pose high to unacceptable risk from the possibility of direct exposure. Risk would be proportional to the extent of stabilization and the method used. Removal of wastes from radioactive hot spots would present high to unacceptable risk associated with intrusive activities.	Same as ORWBG II except more extensive heavy equipment use to place barrier.	Same as ORWBG II except more extensive heavy equipment use to place low permeability cap.	Same as ORWBG II except more extensive heavy equipment use to place low permeability cap and barrier.
Risk to Community	None. No additional activities.	On-unit activities (cover/cap construction, stabilization of HS-Hg-1) pose no exposure concerns; unit is located several miles from the nearest SRS boundary. Removal of radioactive hot spots would present some risk to community as wastes would ultimately transported on public rights-of-way to an off-SRS disposal facility.	Same as ORWBG II.	Same as ORWBG II.	Same as ORWBG II.
Time Until Protection is Achieved	N/A	1 year	1-2 years	2-3 years	3-4 years

Table 7. Comparative Analysis of Alternatives – ORWBG – Continued

EVALUATION CRITERIA	ORWBG I No Further Action	ORWBG II Soil Cover	ORWBG III Soil Cover with Light Rip-Rap Barrier (over Entire ORWBG)	ORWBG VI Low Permeability Cap	ORWBG VII Low Perm. Cap with Light Rip-Rap Barrier (over Entire ORWBG)
		Alternatives ORWBG II, III, VI, and VII include options for (1) grouting all trenches within HS-Hg-1, (2) placing heavy rip-rap intruder barriers over selected radioactive hot spots, and (3) removing selected radioactive hot spots.			
Implementability					
Technical Feasibility	Readily implementable.	Installation of the soil cover is implementable. However, portions of the remedy present major implementability concerns. The heterogeneous nature of the waste, the absence of reliable verification methods, and radiological health and safety present significant challenges to the feasibility of *in situ* stabilization of HS-Hg-1 and removal of wastes from the radioactive hot spots.	Same as ORWBG II.	Same as ORWBG II.	Same as ORWBG II.
Administrative Feasibility	No administrative constraints to implementation.	No administrative constraints to implementation. Institutional controls readily implementable.	Same as ORWBG II.	Same as ORWBG II.	Same as ORWBG II.
Availability of Materials, Equipment, Contractors	No materials, equipment, or contractors required.	Removal of radioactive hot spots would present some difficulty finding qualified contractors.	Removal of radioactive hot spots would present some difficulty finding qualified contractors.	Removal of radioactive hot spots would present some difficulty finding qualified contractors.	Removal of radioactive hot spots would present some difficulty finding qualified contractors.
Cost (present value, in millions)					
Capital Cost	$0.0	$0.8	$11.2	$10.8	$21.3
O&M Cost	$<0.1	$1.2	$1.2	$1.2	$1.2
Total Cost	$<0.1	$2.0	$12.4	$12.0	$22.5

Costs are rounded to the nearest $0.1 million. The present value cost of No Further Action is less than $0.1 million: capital costs are $0, O&M costs (five-year ROD reviews) are $47,435.

Optional Costs (not included in total costs shown in table):

In-situ grouting of all trenches in HS-Hg-1 = $8.0 million

Heavy rip-rip intruder barrier over persistent hot spots = $325,000/acre ($1.4 million for HS-500-1 through –8) (Present value = $31,000, based on 3.9% discount rate and implementation in 100 years). This is the capital cost to furnish and install the rip-rap only. The O&M cost of cap reconstruction after placement of the barrier is included in the long-term O&M costs for the ORWBG cap, which also includes periodic refurbishment of the cap.

Removal of hot spots containing potentially removable wastes = $100 million

Overall Protection of Human Health and the Environment

For the ORWBG, all alternatives except No Further Action would be protective of human health and the environment as long as institutional controls are in place. Institutional controls are a component of all alternatives except No Further Action. Of all the potential remedial actions (such as caps, intruder barriers, and *in situ* stabilization), institutional controls provide the greatest level of protection of human health and the environment. For as long as they are maintained, institutional controls would (1) prevent exposure by controlling erosion of the cover (through site maintenance), (2) prevent inadvertent intrusion through land use restrictions, and (3) limit infiltration and leaching through cover/cap maintenance. As long as institutional controls are maintained, all of the alternatives (except No Further Action) provide a comparable level of overall protection of human health and the environment, although there is some uncertainty whether a soil cover would provide sufficient protection against future leaching to groundwater.

No Further Action would not provide overall protection of human health and the environment. If erosion and intrusion are not mitigated, exposure could occur if the waste were to be eventually exhumed. Also, if the existing soil cover is not maintained, the cover would slowly deteriorate by erosion and leaching would increase.

Compliance with ARARs

Alternatives with a low permeability cap (ORWBG VI and VII) would comply with all ARARs. The low permeability cap would ensure compliance with the infiltration control requirements in RCRA. For alternatives having the native soil cover as the only infiltration control system (ORWBG I, II, and III), compliance with RCRA regulations for infiltration control could not be verified without additional characterization. ORWBG I (No Further Action) would not comply with the AEA or USDOE Order 5400.5 because the unit could be released from USDOE control. The AEA states that "source, byproduct, and special nuclear materials must be regulated...to protect the health and safety of the public." The ORWBG contains by-product material (radioactive material yielded radioactive by exposure to radiation incident to the production or utilization of special nuclear materials). The AEA precludes USDOE from transferring property containing radioactive waste to non-federal ownership. Table 4 identifies potential ARARs.

Long-Term Effectiveness and Permanence

All ORWBG alternatives will result in similar levels of residual risk to human receptors because there will be no current exposure pathways upon completion of the remedial action. The existing native soil cover already isolates the contamination under clean soil, and institutional controls (a component of all alternatives except No Further Action) would prevent invasive activities.

With respect to permanence, a native soil cover and low permeability cap are both subject to erosion and deterioration, but permanence can be achieved through inspection and maintenance associated with institutional controls. Maintenance and repair associated with institutional controls is the most effective and reliable method to achieve permanence. Institutional controls for the ORWBG are anticipated to be maintained in perpetuity. Periodic inspections and routine maintenance associated with institutional controls, such as repair of erosion and subsidence of the cover, would be required in the long-term. No Further Action offers no permanence because institutional controls (including maintenance of the native soil cover) would not be implemented. The native soil cover would deteriorate by erosion and there would be the possibility of future exhumation of waste by erosion and intrusion.

A light rip-rap barrier over the entire ORWBG would provide some additional permanence. A barrier is durable and can extend the effective life of a cover by reducing the amount of deterioration from bioturbation, but even barriers have some minimal maintenance requirements. As long as institutional controls (maintenance and access controls) are in place, a barrier would be a redundant technology. The benefit of a barrier would only be realized if institutional controls are relinquished, as institutional controls provide greater protection of the cover and better protection against intrusion. Any decisions on selection of a barrier system must include an assessment of undesirable habitat creation for plants and animals.

For HS-Hg-1, *in situ* stabilization of HS-Hg-1 would provide some long-term isolation of waste, but as long as institutional controls (maintenance requirements and access controls) are in place, *in situ* stabilization of HS-Hg-1 would be a redundant technology.

For the radioactive hot spots, any one of the three options (No Further Action, Intruder Barrier, Removal) provides some permanence. Reliability of remedy components is not applicable for the No Further Action alternative; there are no remedy components. An intruder barrier provides some permanence because it is designed for long-term durability with minimal maintenance requirements. The long-term reliability (to 1,000 years) of intruder barriers has not been demonstrated, but the barriers would be constructed of a resistant material such as rip-rap. Rip-rap may have greater permanence than reinforced concrete. Removal is permanent because the source term would be removed from the unit and relocated to another facility. Removal of wastes from radioactive hot spots would result in an overall increase of long-term monitoring requirements as the monitoring requirements would be transferred to the receiving facility.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Degree of Expected Reduction in Toxicity

None of the alternatives are intended to reduce contaminant toxicity. Natural radioactive decay will slowly reduce the inventory of short-lived radionuclides, but long-lived radionuclides and non-radioactive contaminants will persist.

Degree of Expected Reduction in Mobility

All alternatives (except No Further Action) would reduce infiltration and associated leaching through containment. A low permeability cap would provide some additional reduction in infiltration compared to a native soil cover.

In situ stabilization of HS-Hg-1 is the only remedial activity that reduces contaminant mobility through treatment. Because the leachability threat of mercury is low and the cover is expected to be maintained in the long-term, stabilizing HS-Hg-1 would provide negligible additional reduction in contaminant migration and would be a redundant response to the infiltration control system. Further, *in situ* activities could rupture any intact containers, releasing additional mercury.

Degree of Expected Reduction in Volume

None of the alternatives for the ORWBG as a whole and HS-Hg-1 reduce volume through treatment.

For removal options for the radioactive hot spots, the source volume would be reduced by transfer out of the ORWBG and into another facility. However, the net volume of waste would increase as materials and equipment associated with excavation repackaging and disposal operations are contaminated. Likewise, some equipment supporting *in situ* stabilization of HS-Hg-1 may be contaminated and will need to be packaged and disposed off-unit. *In situ* stabilization would result in some increase in waste volume as the grout/reagent injected into the subsurface would contact the waste and become contaminated.

Short-Term Effectiveness

Risk to Remedial Workers

For the ORWBG as a whole, the risks associated with the non-intrusive activities are minimal and are proportional to the extent of heavy equipment use. There would be more heavy equipment use required to construct a low permeability cap than to expand the native soil cover; however this risk is readily managed using standard safety procedures.

For HS-Hg-1, alternatives that involve *in situ* stabilization present high to unacceptable risk to remedial workers because *in situ* stabilization involves intrusive activities. There is a high risk of direct exposure during *in situ* stabilization (e.g., from rupture of a buried container). The risk is proportional to the extent of grouting (proportional to the number of injection holes) and depends on the method used. There is also some uncertainty with the safety of grouting in this application. Large and rigid buried objects can obstruct grouting equipment which may result in direct contact or unnecessary exposure associated with field repairs and troubleshooting. Grouting trenches poses high to unacceptable risk to remedial workers.

For the radioactive hot spots, there is no risk to workers associated with No Further Action because no additional activities would be performed. Emplacing a barrier is a non-intrusive activity that presents minimal risk associated with heavy equipment use. Removal and disposal of the radioactive hot spots presents high to unacceptable risk to workers – primarily due to uncertainties with (1) unacceptable risk to workers for removal of some wastes, including containerized and uncontainerized fission product wastes; (2) wastes not being removable because the original burials were not containerized, such as carbon-14 deionizer resins; and (3) unsegregated wastes.

Risk to Community

None of the alternatives for the ORWBG as a whole or HS-Hg-1 pose a risk to the community. The ORWBG is located in the interior of the SRS several miles from the nearest SRS boundary. There are no exposure concerns because the general public is prohibited from entering the SRS. There would be a negligible increase in off-SRS vehicular traffic associated with each alternative.

For the radioactive hot spots, removal presents the greatest risk to the community because exhumed transuranic waste would ultimately be shipped over public roadways or railways to an offsite disposal facility such as WIPP.

Time Until Protection is Achieved

The amount of time needed to achieve protectiveness after start of remediation ranges from 1 year for ORWBG II to 3 to 4 years for ORWBG VII. Construction of a low permeability cap would take somewhat longer than expansion of the native soil cover. For the radioactive hot spots, removal would take longer than emplacing a barrier.

Because the buried waste does not pose a current exposure threat, and because the existing native soil cover provides infiltration control, there are no imminent risks and the time until remediation is complete is not identified as a key consideration in the remedy selection process.

Implementability

Technical Feasibility

For the ORWBG, the non-intrusive activities such as expansion of a native soil cover, construction of a cap, or placement of a barrier are standard construction activities and pose no implementability restrictions.

In situ stabilization of HS-Hg-1 does present significant implementability challenges. For this alternative where no exhumation is involved, the presence of a large amount of debris in the subsurface would obstruct the injection of treatment materials such as grout or chemical fixation compounds. This would result in difficulty in achieving the desired remedial objective, difficulty in verifying performance criteria, and radiological health and safety concerns. *In situ* stabilization is still an emerging technology and would require advancement before it could meet the desired remedial objective at this hot spot.

The technical feasibility of removing wastes in the radioactive hot spots does present significant implementability concerns. The technical feasibility is specific to each hot spot. It is not technically feasible to remove wastes such as uncontainerized fission product wastes and deionizer resins because removal would result in unacceptable risk to workers. For other wastes, the technical feasibility is dependent on the timing of removal; some wastes may not be removable until co-located short-lived radionuclides, such as cobalt-60, have decayed to lesser activities.

Administrative Feasibility

There are no administrative constraints to implementation. Institutional controls are readily implementable in the near-term as well as in the long-term provided the area remains under USDOE or federal government control.

Availability of Materials, Equipment, and Contractors

None of the non-intrusive activities would pose an implementability concern related to availability of materials, equipment, or contractors. Removal of radioactive hot spots would present some difficulty finding qualified contractors.

Cost

Cost estimates for the potential remedial actions for the ORWBG are presented on Table 7.

XI. THE SELECTED REMEDY

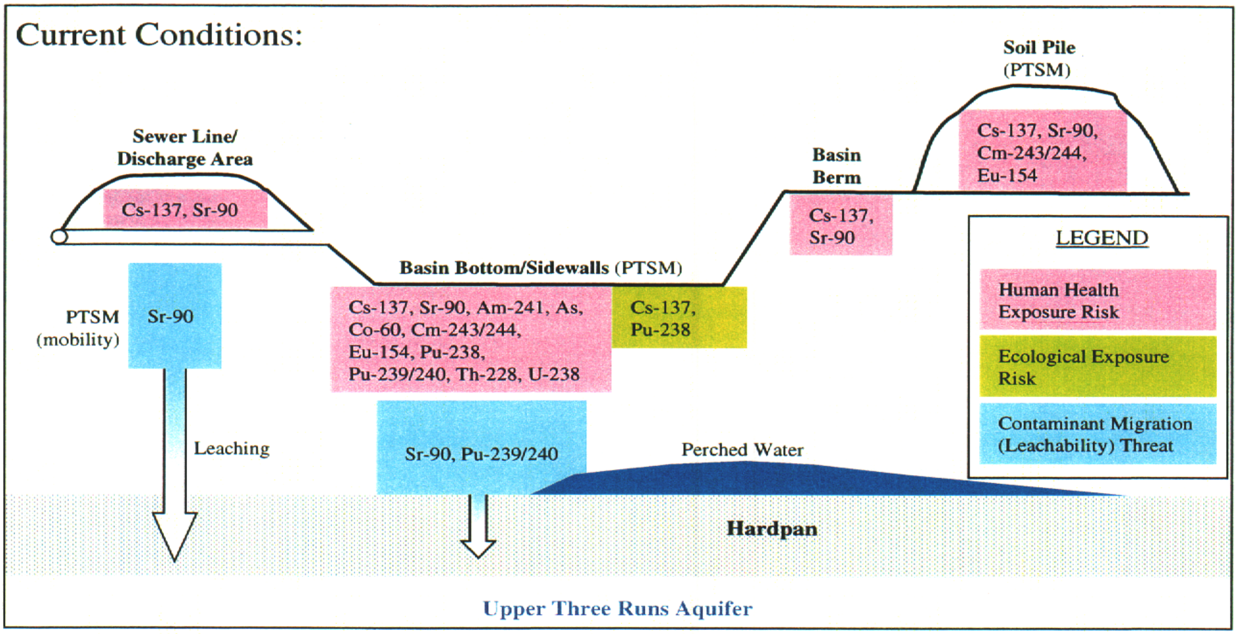
Based upon the evaluation of alternatives, the selected remedy for HRB, Warner's Pond, and HP-52 Ponds is Alternative 7 (Consolidation at the ORWBG) and the selected remedy for the ORWBG is Alternative ORWBG VI (Institutional Controls with Low Permeability Cap). Individual intruder barriers will be installed over the long-lived persistent radioactive hot spots (HS-500-1 through HS-500-8) before institutional controls are terminated at the ORWBG. The options of *in situ* stabilization of HS-Hg-1 and removal of the radioactive hot spots will not be implemented.

Figures 14 through 17 are schematic illustrations of the selected remedy at each unit.

Rationale for Selecting this Remedy

The rationale for selecting this remedy over the other alternatives includes the following:

- The remedy satisfies the preference to remove PTSM and CMCOCs at HRB, Warner's Pond, and HP-52 Ponds to the extent practicable.
- Consolidation of material at the ORWBG is less expensive than disposal at an off-SRS facility and does not involve transportation of radioactive wastes on off-SRS public rights-of-way.
- A low permeability cap over the ORWBG is selected instead of a native soil cover because (1) other similar facilities at SRS were closed using a low permeability cap, (2) it is a common standard of infiltration control for low permeability caps, and (3) it manages uncertainty with the leachabilty risk posed by the ORWBG.
- A light rip-rap barrier over the entire ORWBG is not selected because its utility at preventing intrusion and erosion is a redundant action to institutional controls, which will prevent inadvertent intrusion. Furthermore, a barrier may create habitat for deep-rooting plants and burrowing animals which could negatively affect the low permeability cap.
- Stabilization of HS-Hg-1 is not selected because (1) HS-Hg-1 does not pose a risk that is significantly different than the ORWBG as a whole, (2) invasive activities may rupture any intact containers of mercury that may exist, (3) there is uncertainty



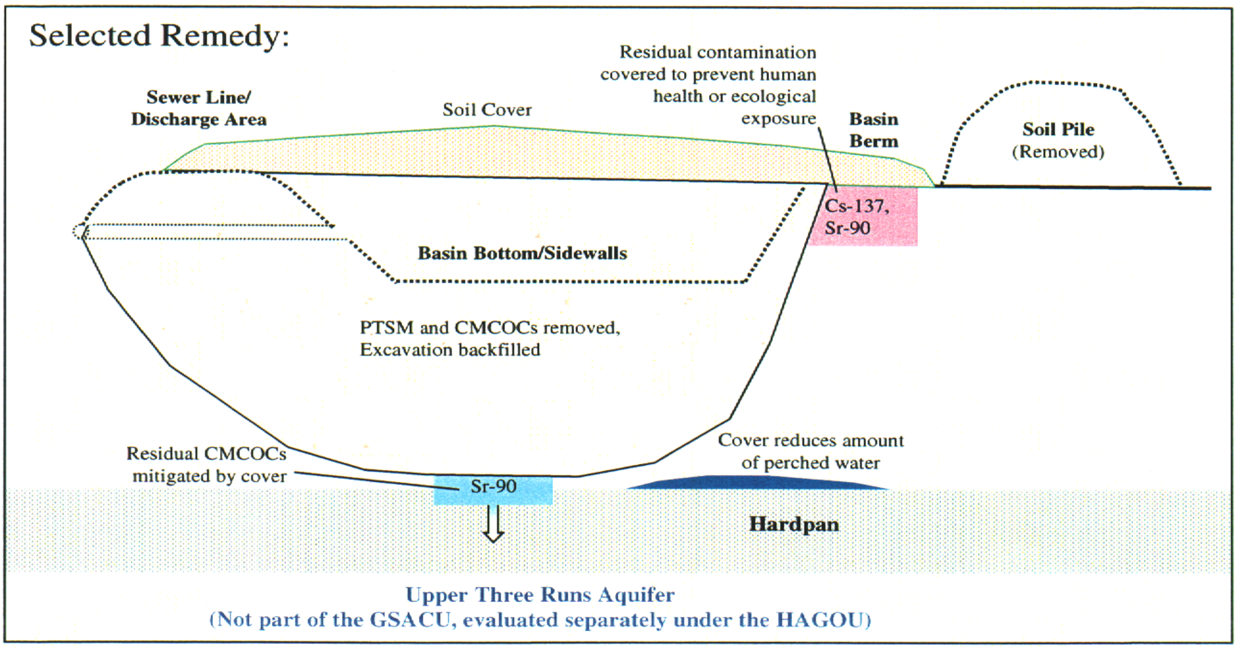
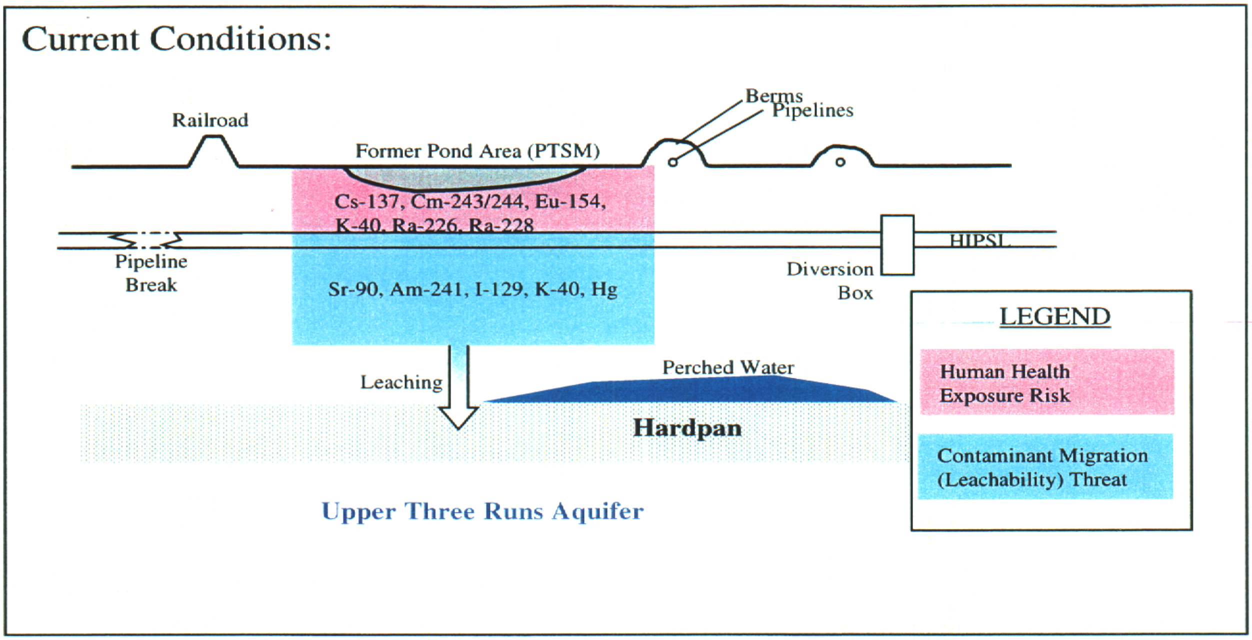


Figure 14. Schematic Illustration of Selected Remedy at HRB

(figure not to scale)



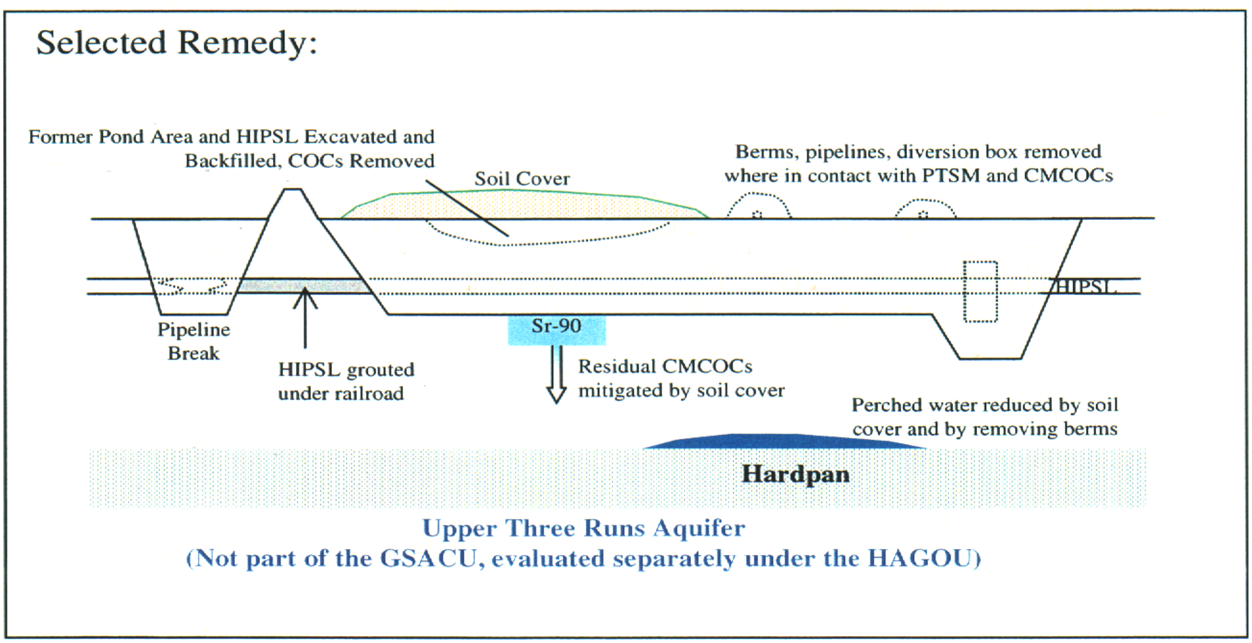


Figure 15. Schematic Illustration of Selected Remedy at Warner's Pond

(figure not to scale)

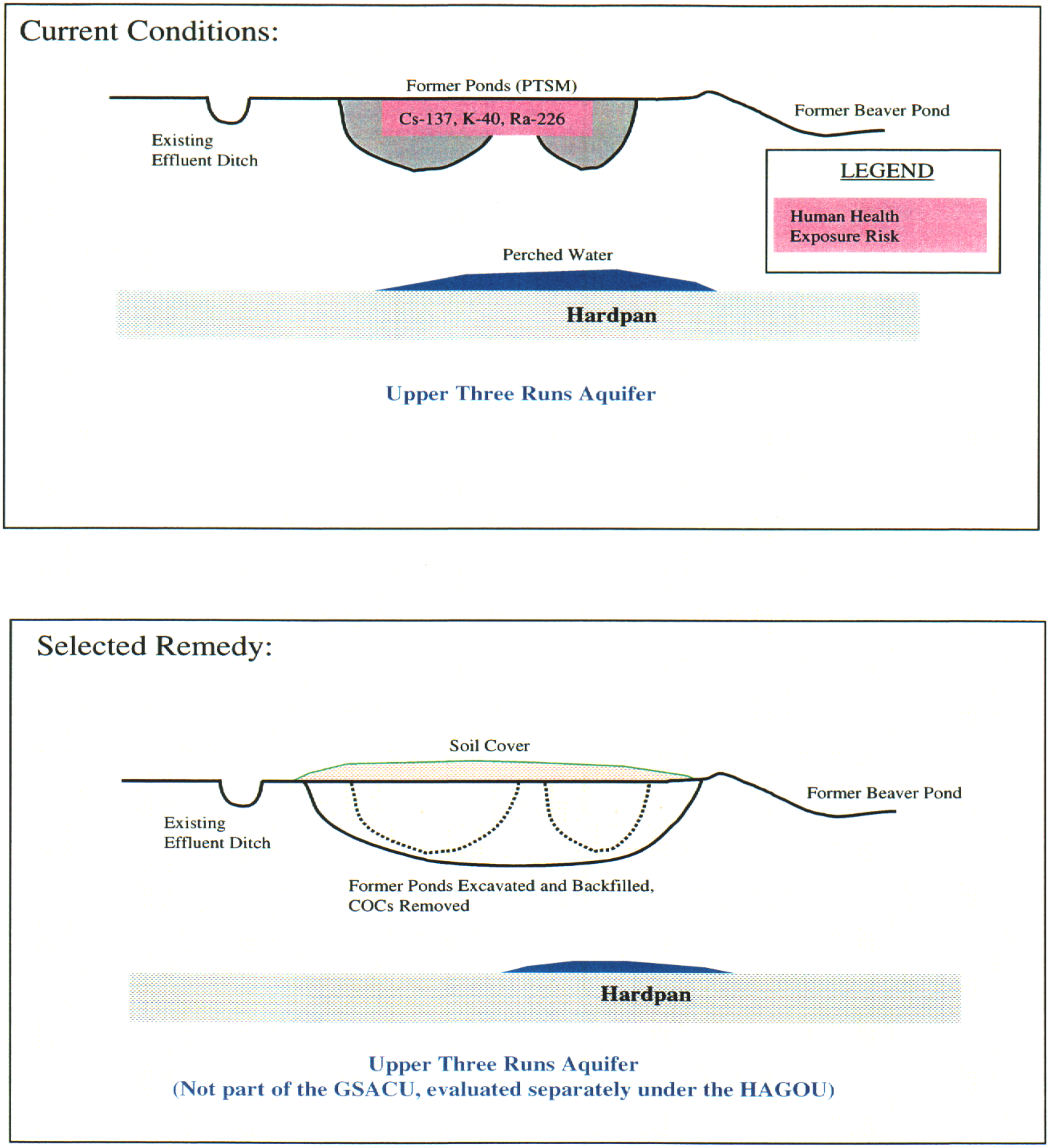


Figure 16. Schematic Illustration of Selected Remedy at HP-52 Ponds

(figure not to scale)

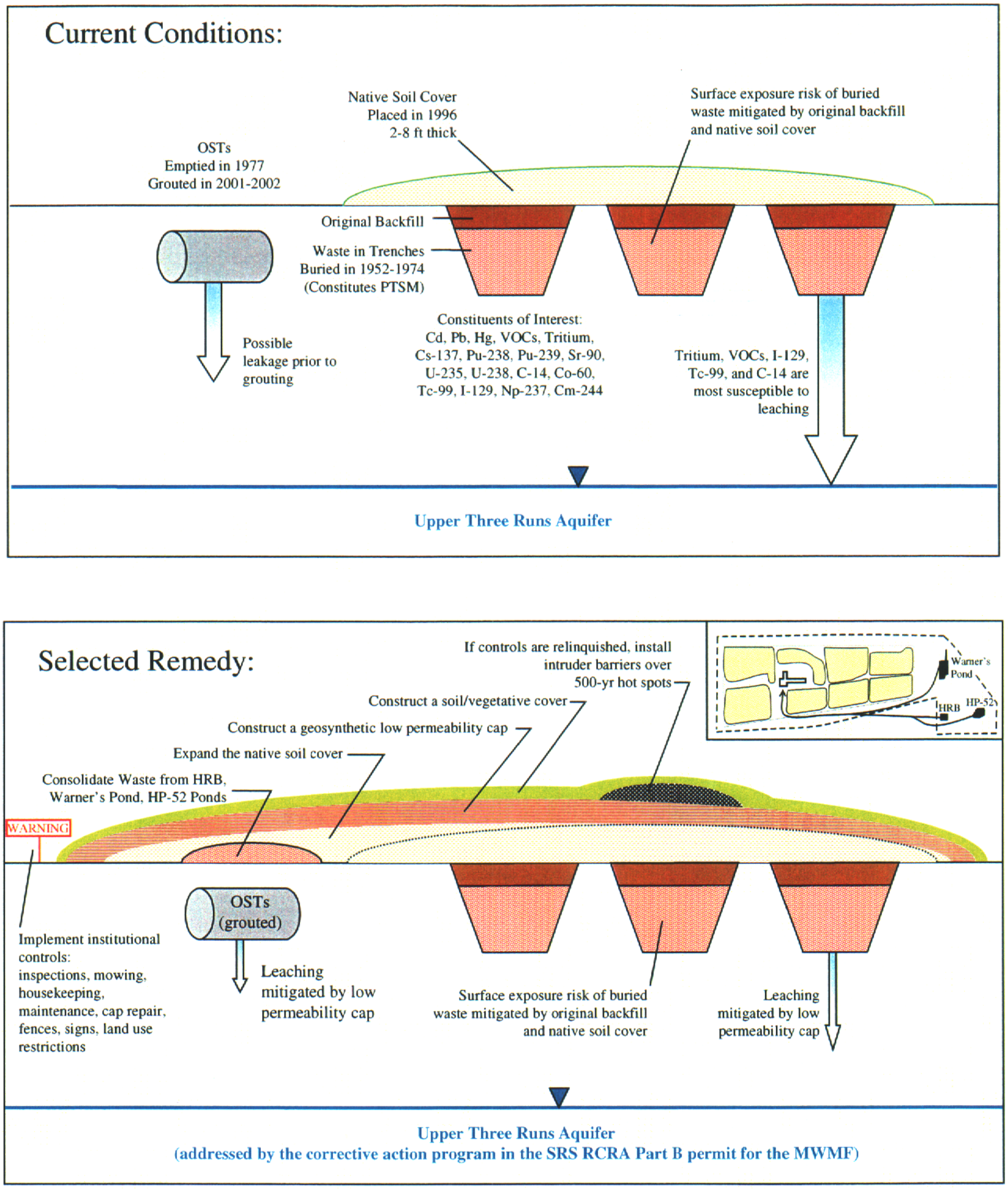


Figure 17. Schematic Illustration of Selected Remedy at ORWBG

(figure not to scale)

with the technical feasibility of grouting among debris as buried objects can obstruct grouting equipment and there may not be a reliable verification method in this application, (4) invasive activities would create unnecessary risks to the workers involved, and (5) the low permeability cap and institutional controls in place for the ORWBG as a whole will provide sufficient protection of HS-Hg-1.

- Removal of the radioactive hot spots in the ORWBG is not selected because invasive work would create unnecessary risks to the workers involved.

How the Selected Remedy Will Meet the RAOs

The selected remedy will meet the RAOs for HRB, Warner's Pond, and HP-52 Ponds as follows:

- <u>Treat and/or remove PTSM (based on toxicity) by treating and/or removing cesium-137 at HRB, Warner's Pond, and HP-52 Ponds at levels above 104 pCi/g, to the extent practicable</u>: PTSM will be removed to the extent practicable.

- <u>Treat and/or remove PTSM (based on mobility) by treating and/or removing strontium-90 at the HRB sewer line/discharge area at levels above 0.65 pCi/g, to the extent practicable</u>: PTSM will be removed to the extent practicable.

- <u>Control migration and leaching of strontium-90 that could result in groundwater contamination in excess of MCLs in the UTRA beneath a unit by (1) removing soil above 1.5 pCi/g at the HRB basin bottom/sidewalls, above 0.65 pCi/g the HRB sewer line/discharge area, and above 1.12 pCi/g at Warner's Pond, to the extent practicable; and (2) reducing infiltration through any residual contamination above RGs</u>: Soil containing CMCOCs above RGs will be removed to the extent practicable. Also, a soil cover will be placed over any residual contaminants to minimize infiltration so that no unit-related contaminants will cause MCL exceedances in the UTRA beneath a unit and so that the accumulation of perched water atop the hardpan is minimized.

- Protect human and ecological receptors from surface materials containing cesium-137 above 0.55 pCi/g and strontium-90 above 57.2 pCi/g: After PTSM and CMCOCs are removed, the excavations will be backfilled and covered with clean soil that poses no more risk than ambient background levels.

The selected remedy will meet the RAOs for the ORWBG as follows:

- Minimize the exposure risk to workers (current and future): The selected remedy for the ORWBG will not involve invasive activities (i.e., treatment or removal of HS-Hg-1 or the radioactive hot spots), so remedial workers will not be exposed to unnecessary risks associated with invasive activities. Maintenance of the low permeability cap will isolate contamination under clean soil, therefore future workers will not be exposed to surface contamination.

- Prevent or mitigate inadvertent human intrusion: Institutional controls will prevent inadvertent human intrusion into the ORWBG through physical controls (fences and warning signs) and administrative controls (SRS Site Use and Site Clearance Programs). The selected remedy mandates that physical intruder barriers be placed over the 500-year hot spots prior to termination of institutional controls.

- Minimize ecological intrusion into the buried waste and redistribution/mobilization (erosion) of contaminants from the waste unit to the surrounding areas: The low permeability cap will be maintained as needed to isolate contamination under clean soil, prevent trees from growing on the cap (thus preventing deterioration by tree roots), and prevent erosion from exhuming contaminants where they could be redistributed at the surface by wind and water.

- Mitigate future leaching of contaminants to groundwater: The low permeability cap will be placed over the ORWBG to mitigate future leaching.

Detailed Description of the Selected Remedy

The selected remedy includes the following activities:

1. Excavate materials constituting industrial PTSM and soil containing CMCOCs above RGs at HRB, Warner's Pond, and HP-52 Ponds to the extent practicable. The excavation will not breach the integrity of the hardpan. Soil RGs for CMCOCs are established to prevent leaching of constituents to groundwater at concentrations above MCLs within 1,000 years. Table 5b provides additional explanation regarding the generation of soil RGs for CMCOCs.

2. Manage standing surface water (in HRB) and water which accumulates during excavation by solidification and consolidation with the excavated soil and/or by another means such as treatment at the Effluent Treatment Facility (ETF).

3. Consolidate the excavated soil and material by transferring it to the areas of the ORWBG that have not yet been covered by the native soil cover (e.g., over the OSTs). In the unlikely event that there is insufficient available space at the ORWBG, ship the excess waste to an off-SRS facility approved to receive CERCLA remediation waste.

4. When inactive pipelines are encountered during removal of soil, excavate those sections of the pipelines with the soil. At Warner's Pond, this will include the inactive CERCLA pipelines within the berms, the diversion box, and the RCRA-regulated HIPSL. Characterization data show that soil around the HIPSL is non-hazardous. Sections of the HIPSL and any contents will be sampled and analyzed during the characterization of Warner's Pond to determine if they are hazardous in accordance with South Carolina Hazardous Waste Management Regulation R.61-79.261. If the HIPSL pipeline or its contents are hazardous, these materials will not be consolidated into the ORWBG. A RCRA Closure Plan will be developed to document the disposition of the RCRA pipeline. The RCRA closure

plan will be approved by SCDHEC prior to remedial action on the HIPSL (indicated in yellow on Figure 4).

For remaining intact portions of inactive pipelines, including portions that are not in contact with PTSM or cannot be readily removed (such as the section of the HIPSL under the railroad track), plug the ends of the pipelines and grout in place. If a pipeline is not intact, cannot be reliably grouted in place, and is non-hazardous, remove it and consolidate it with the soil transferred to the ORWBG. Risks posed by remnant contamination in soil after excavation will be determined prior to backfilling.

5. Consolidate any vegetation in contact with PTSM by removing it and transferring it to the ORWBG. Vegetation will be shredded, chipped, or spatially distributed and incorporated into the excavated soil. Placement of this material at ORWBG will be engineered in a manner that minimizes subsidence.

6. Evaluate the risk of remnant material after excavation at HRB, Warner's Pond, and HP-52 Ponds. Contaminant migration risk from the potential source to the UTRA beneath each unit will be evaluated.

7. Mitigate residual risk at HRB, Warner's Pond, and HP-52 Ponds by backfilling and placing clean soil over open excavations that contain residual contamination exceeding RGs. A soil cover will be used to minimize infiltration so that (1) no unit-related contaminants will cause MCL exceedances in the UTRA beneath each unit, and (2) the accumulation of perched water atop the hardpan is minimized.

8. Restore surface water drainage at Warner's Pond to a natural state by removing the berms that cause ponding of water.

9. Prepare a post-construction report for HRB, Warner's Pond, and HP-52 Ponds to summarize the remediation activities and summarize how residual risks are addressed.

10. Implement institutional controls at HRB, Warner's Pond, and HP-52 Ponds. Institutional controls will consist of site maintenance (site inspections, mowing, general housekeeping, repair of erosion damage, and other routine maintenance as needed) and access controls (warning signs and land use restrictions). Institutional controls will include continued use of SRS's Site Use and Site Clearance Programs to restrict disturbance of the cover system and waste at each unit and to prevent drinking water use of contaminated groundwater under each unit.

11. Construct a low-permeability geosynthetic cover system (with a soil hydraulic conductivity of $\leq 1 \times 10^{-7}$ cm/sec) over the ORWBG; including the areas where consolidated materials from HRB, Warner's Pond, and HP-52 Ponds were placed; but excluding the areas between interim covers B and D. A hydraulic conductivity of $\leq 1 \times 10^{-7}$ cm/sec is selected because it provides infiltration control that sufficiently manages uncertainties related to residual contamination without further investigation, and it is consistent with low permeability caps placed over similar facilities at SRS. Contiguous facilities associated with SRS's active Solid Waste Management Program (such as 643-7E/643-8E and associated paved parking areas) will not be covered by the cap. These facilities will continue to actively support SRS solid waste activities at least until all transuranic waste stored at SRS has been shipped to WIPP.

12. Implement institutional controls at the ORWBG. Institutional controls will consist of site maintenance (site inspections, mowing, general housekeeping, repair of erosion damage, other routine maintenance as needed, and periodic maintenance of the infiltration control system) and access controls (security fences, warning signs, and land use restrictions). Institutional controls will include continued use of SRS's Site Use and Site Clearance Programs to restrict disturbance of the cover system and waste at the unit and to prevent drinking water use of contaminated groundwater under the unit.

13. Before institutional controls are terminated at the ORWBG, install intruder barriers over the long-lived persistent radioactive hot spots (hot spots HS-500-1 through HS-500-8) to deter inadvertent human intrusion. The likely configuration of the intruder barrier is heavy rip-rap. The barrier will be installed above the low permeability cap but beneath a soil cover. Covering the rip rap will minimize development of an undesirable habitat (e.g., a habitat among rip-rap favorable for deep-rooting plants and burrowing animals that could degrade the low permeability cap). Placement of the barrier will not interfere with the long-term integrity of the cap. A reasonable estimated timeframe for installing the intruder barrier is 100 years. The barrier will not be installed until institutional controls are terminated; the USDOE expects to maintain institutional controls at the Burial Ground Complex for at least 100 years.

The selected remedy leaves hazardous substances in place that pose a potential future risk and will require land use restrictions for an indefinite period of time. As negotiated with USEPA, and in accordance with USEPA-Region IV policy (Johnston 1998), SRS has developed a Land Use Control Assurance Plan (LUCAP) (WSRC 1999) to ensure that land use restrictions are maintained and periodically verified. A unit-specific Land Use Control Implementation Plan (LUCIP) will provide detail and specific measures required for the land use controls selected as part of this remedy. USDOE-Savannah River Operations Office is responsible for implementing, maintaining, monitoring, reporting upon, and enforcing the land use controls under this ROD. The LUCIP selected 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, and maintenance, reporting, and enforcement requirements for the unit. The LUCIP will remain in effect until modified as needed to be protective of human health and the environment. LUCIP modification will only occur through another CERCLA document.

USDOE expects to retain control of the GSACU for the foreseeable future. However, in the unlikely case the property is 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 individual subunits of the GSACU. The contract for sale and the deed will contain the notification required by CERCLA Section 120(h). The deed notification shall, in perpetuity, notify any potential purchaser that the property has been used for the management and disposal of waste. These requirements are also consistent with the intent of the RCRA deed notification requirements at final closure of a RCRA facility if contamination remains at the OU.

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

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

The five-year review requirement, a CERCLA ROD review, will be conducted every five years to determine whether the remedy is meeting RAOs.

The remedy may change as a result of the remedial design or construction processes. Changes to the remedy described in the ROD will be documented in the Administrative Record File utilizing a memo, an Explanation of Significant Difference (ESD), or a ROD Amendment.

Cost Estimate for the Selected Remedy

The present worth costs for this remedy are as follows:

Capital Cost: $37.4 million

Operations and Maintenance (O&M) Cost: $3.9 million

Total Present Worth Cost: $41.3 million

For HRB, Warner's Pond, and HP-52 Ponds, these costs include removing PTSM and CMCOCs, backfilling and restoring the excavations, installing a soil cover, and implementing institutional controls ($29.3 million, see Alternative 7 on Table 6). For the ORWBG, these costs include constructing a low permeability cover, implementing institutional controls, and performing five-year ROD reviews ($12.0 million, see Alternative ORWBG VI on Table 7). In addition, the cost includes placing intruder barriers over the 500-year radioactive hot spots before institutional controls are relinquished ($31,000). Cost estimates were generated using a 3.9% interest (discount) rate. The net present value cost for intruder barriers is based on an assumption that the barriers will be placed 100 years in the future. For five-year CERCLA ROD reviews, institutional controls, and cap maintenance/repair, a 500-year time period was used for cost estimating purposes; however, there is no time limit on these activities. The ROD will be reviewed every five years to assess whether the remedy is still meeting RAOs. Although there is no time limit on the five-year review requirement or institutional controls, the net present value for this long-term cost is negligible. Appendix B provides tables of cost estimates for the selected remedy.

The GSACU is owned by USDOE, which is responsible for the contamination, has performed the site investigation, and will be the source of the cleanup monies.

Estimated Outcomes of Selected Remedy

The expected condition after the selected remedy is implemented is that neither HRB, Warner's Pond, HP-52 Ponds, nor the ORWBG will pose a surface exposure risk to industrial workers or ecological receptors. No contaminants at HRB, Warner's Pond, or HP-52 Ponds will pose a leachability risk that would result in groundwater contamination above MCLs in the UTRA beneath the units. The leachability threat posed by waste at depth in the ORWBG will be mitigated by the low permeability cap. The GSACU will be available for future industrial land use with land use restrictions.

The selected remedy is considered a reasonable remedy to mitigate the GSACU risks; however, there are always uncertainties. The primary uncertainties associated with the selected remedy include the following:

- There is uncertainty with the practicality of removing all soil containing CMCOCs to levels at or below RGs. The fate and transport calculations performed for HRB, Warner's Pond, and HP-52 Ponds were intentionally conservative. They do not, for example, account for any dispersion or mixing in the aquifer. Consequently, the calculated RGs are low and there is some uncertainty with how much the actual contaminant migration threat is overstated. This uncertainty can be managed by performing a more detailed contaminant migration assessment of any residual contamination that remains after excavation. If modeling indicates that residual materials pose a continued leachability threat, then an infiltration control system will be installed to protect groundwater quality. Groundwater contamination is being handled under the HAGOU.

- There is some uncertainty about the extent and continuity of the hardpan under HRB, Warner's Pond, and HP-52 Ponds. The absence of unit-related groundwater contamination at these units is evidence that the hardpan has served to limit the downward migration of contamination. The remedy includes excavation of soil having contaminants above RGs to the extent practical, but without compromising the integrity of the hardpan. Contaminated soils in contact with perched water atop the hardpan will be excavated as they are encountered. A soil cover is included as part of the remedy if residual contamination poses a leachability risk. If the hardpan is found not to be present or continuous, the remedy will remain unchanged. The soil cover will be designed to meet the performance standard for permeability necessary to protect groundwater from contaminant migration at levels that would exceed MCLs. This remedial goal is independent of the natural limit to the downward migration of contaminants provided by the hardpan.

- There are uncertainties with the groundwater modeling study which assessed the leachability risk posed by the ORWBG. These uncertainties are a result of the absence of analytical data from samples, limited information on the hydrogeologic conditions and lithology under the unit, uncertainty with source term estimates, limited information on some burial locations, and uncertainties inherent in any modeling effort. Any attempt to further reduce these uncertainties would require intrusive sampling and investigation at the ORWBG, which would pose unnecessary exposure risks to the workers involved and is not likely to resolve uncertainty due to the heterogeneous nature of the waste. Uncertainty with the model is managed by selecting an infiltration control system (geosynthetic cap) that will provide a high degree of infiltration control. Any remaining uncertainty associated with the effect that past and future leaching through the ORWBG will have on groundwater quality under the ORWBG is being managed by the corrective action for groundwater.

- Because the large inventory of long-lived radionuclides in the ORWBG will require controls in perpetuity, there is some uncertainty with the ability to maintain institutional controls in the very long-term. This uncertainty is managed by the five-year review requirement of the ROD. The ROD will be reviewed at least every five years to determine whether the remedy still provides adequate protection of human health and the environment. As another means of managing the uncertainty of very long-term institutional controls, intruder barriers will be installed over the long-lived persistent radioactive hot spots (hot spots HS-500-1 through HS-500-8) before institutional controls are terminated at the ORWBG to deter inadvertent human intrusion.

- There is some uncertainty with the volume of contaminated soil that will need to be removed to meet RAOs, and consequently there is some uncertainty whether there is sufficient available space at the ORWBG to accommodate all the material. Based on available data, the amount of soil from HRB, Warner's Pond, and HP-52 Ponds to be placed at the ORWBG is estimated at 33,000 cy (excavation volume increased by 25% due to handling). Based on three-dimensional modeling, the amount of available space at the ORWBG to place waste under a cap is estimated at 60,000 cy, reflecting a reduction of the available space by 30% to accommodate placement of clean soil berms and covers around contaminated materials during construction. Because the estimated volume of waste generated is only about half of the available volume at the ORWBG, there is little uncertainty that there is enough space at the ORWBG. Any remaining uncertainty is managed by the selected remedy, which includes a provision to send the excess volume to an off-SRS disposal facility in the event that there is insufficient space at the ORWBG.

Waste Management

Waste generated during remediation will consist of approximately 33,000 cy of soil mixed with some debris, including pipelines and vegetation. In addition, job control wastes such as decontamination fluids and personal protective equipment will be generated. These will be managed on-unit and consolidated at the ORWBG. Vegetation will be shredded, chipped, or spatially distributed and incorporated into the excavated soil. Placement of this material at ORWBG will be engineered in a manner that minimizes subsidence. Free liquids will not be consolidated at the ORWBG. Waste liquids, including standing surface water in the HRB basin, will be mixed with solids prior to consolidation at the ORWBG. All wastes generated will be dispositioned in accordance with a site-specific waste management plan.

XII. STATUTORY DETERMINATIONS

Based on the unit RFI/RI data, the GSACU poses a threat to human health and the environment. Therefore, Alternative 7 (Consolidation at the ORWBG) has been selected as the remedy for HRB, Warner's Pond, and HP-52 Ponds and Alternative ORWBG VI (Institutional Controls with Low Permeability Cap) has been selected as the remedy for the ORWBG. Individual intruder barriers will be installed over the long-lived persistent radioactive hot spots in the ORWBG (HS-500-1 through HS-500-8) before institutional controls are terminated at the ORWBG. The options of *in situ* stabilization of HS-Hg-1 and removal of the radioactive hot spots in the ORWBG will not be implemented.

PTSM is present at HRB, Warner's Pond, HP-52 Ponds, and ORWBG. At HRB, Warner's Pond, and HP-52 Ponds, PTSM (and soil containing CMCOCs) will be removed to the extent practicable. At the ORWBG, treatment or removal of the PTSM is not practicable; consequently, engineering controls, such as containment through capping, will be used to manage the PTSM.

Based on information currently available, USDOE, USEPA, and SCDHEC believe the selected remedy provides the best balance of tradeoffs among the other alternatives with respect to the evaluation criteria. The three parties expect the selected remedy to satisfy the statutory requirements in CERCLA Section 121(b) to (1) be protective of human health and the environment, (2) comply with ARARs, (3) be cost-effective, (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable, and (5) satisfy the preference for treatment (through removal) as a principal element at HRB, Warner's Pond, and HP-52 Ponds. For the ORWBG, treatment of the principal threats including the radioactive hot spots and HS-Hg-1 is not practicable. However, use of engineering controls (such as containment through capping) combined with institutional controls is protective of human health and the environment and is consistent with expectations in the NCP.

Section 300.430(f)(2) of the NCP requires that a 5-year remedy review of the ROD be performed if hazardous substances, pollutants, or contaminants above levels that allow for unlimited use and unrestricted exposure remain in the OU. The three parties, SCDHEC, USEPA, and USDOE, have determined that a 5-year review of the ROD for the GSACU will be performed to ensure that the remedy continues to provide adequate protection of human health and the environment.

XIII. EXPLANATION OF SIGNIFICANT CHANGES

There were no significant changes made to the ROD based on the comments received during the public comment period for the SB/PP. Comments that were received during the public comment period are addressed in the Responsiveness Summary included in Appendix A of this document.

XIV. RESPONSIVENESS SUMMARY

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

XV. POST-ROD DOCUMENT SCHEDULE AND DESCRIPTION

Table 8 is an implementation schedule for the GSACU showing the post-ROD document submittals and the remedial action start date. Major milestones are as follows:

- SRS will submit a CMI/RAIP to SCDHEC and USEPA in accordance with FFA requirements.

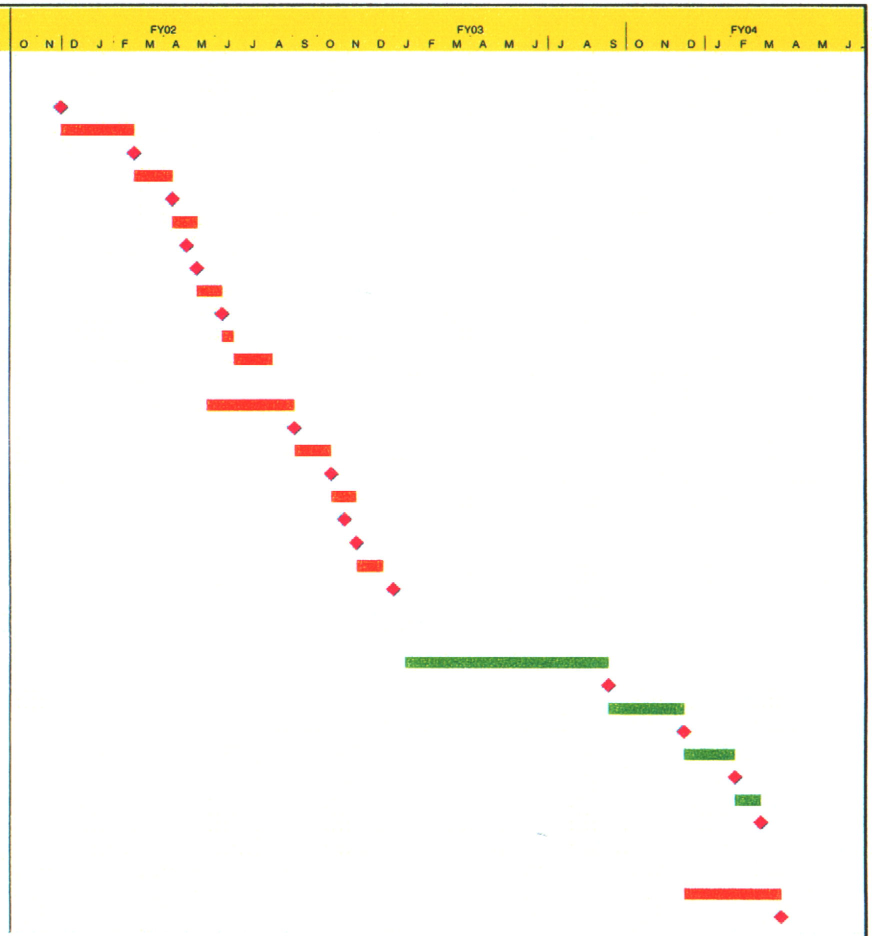
- The remedial action start date is anticipated to be March 2004.

- Construction is anticipated to be completed approximately 3-4 years after the remedial action start date.

- SRS will submit a post-construction report 90 days after construction is complete (i.e., after completion of a post-construction walkdown and acceptance by the core team [USDOE, USEPA, and SCDHEC]).

Table 8. Implementation Schedule

Activity Description	Orig Dur	Early Start	Early Finish
LCS 14 - STATEMENT OF BASIS/PROPOSED PLAN & ROD			
Proposed Plan			
PP scoping meeting & CMS/FS comment resolution	0		28NOV01*
Develop Proposed Plan	59	29NOV01	25FEB02
Submit Rev. 0 Proposed Plan	0		25FEB02
EPA/SCDHEC review of Rev.0 Proposed Plan	45	26FEB02	11APR02
EPA/SCDHEC returns Rev.0 comments on PP	0		11APR02
SRS incorporates EPA/SCDHEC comments PP	30	12APR02	11MAY02
Proposed Plan comment resolution meeting	0	29APR02	
SRS submittal of Rev.1 Proposed Plan	0		11MAY02
EPA/SCDHEC final review and approval PP	30	12MAY02	10JUN02
Receipt of EPA/SCDHEC approval	0		10JUN02
Notification of public comment	14	11JUN02	24JUN02
Public comment period	45	25JUN02	08AUG02
Record of Decision			
Develop ROD	70	24MAY02	03SEP02
Submit Rev. 0 ROD	0		03SEP02
EPA/SCDHEC review of Rev. 0 ROD	45	04SEP02	18OCT02
EPA/SCDHEC returns Rev. 0 comments for ROD	0		18OCT02
SRS incorporates EPA/SCDHEC comments ROD	30	19OCT02	17NOV02
ROD comment resolution meeting	0	04NOV02	
SRS submittal of Rev.1 ROD	0		17NOV02
EPA/SCDHEC final review and approval of ROD	30	18NOV02	17DEC02
Submit signed ROD to EPA/SCDHEC	0		31DEC02
LCS 15 - DETAILED ENG & PRECONST ACTIVITIES			
Develop Rev. 0 CMI/RAIP (Post-Rod Document)	164	15JAN03	08SEP03
SRS submittal of Rev. 0 CMI/RAIP	0		08SEP03
EPA/SCDHEC review of Rev. 0 CMI/RAIP	90	09SEP03	07DEC03
EPA/SCDHEC returns Rev. 0 comments for CMI/RAIP	0		07DEC03
SRS incorporates EPA/SCDHEC comments CMI/RAIP	60	08DEC03	05FEB04
SRS submittal of Rev.1 CMI/RAIP	0		05FEB04
EPA/SCDHEC final review and approval of CMI/RAIP	30	06FEB04	06MAR04
Submit signed CMI/RAIP to EPA/SCDHEC	0		06MAR04
LCS 16 - CONSTRUCTION			
Mobilization	77	08DEC03	29MAR04
RA Start	0	30MAR04	



Start Date	01OCT92	Early Bar	BCON
Finish Date	29MAR04	Progress Bar	Sheet 1 of 1
Data Date	01OCT99	Critical Activity	GSA CONSOLIDATION UNIT
Run Date	13FEB02 14:14		Date / Revision / Checked / Approved

XVI. REFERENCES

FFA, 1993. *Federal Facility Agreement for the Savannah River Site,* Administrative Docket No. 89-05-FF, WSRC-OS-94-42, Effective Date: August 16, 1993.USDOE, 1994. *Public Involvement, A Plan for Savannah River Site*, United States Department of Energy, Savannah River Operations Office, Aiken, South Carolina.

Johnston, J.D. (USEPA-Region IV), 1998. *EPA Region IV Policy, Assuring Land Use Controls at Federal Facilities*, Letter to T. Heenan (USDOE-Savannah River) (April 21).

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

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

USDOE, 2002. *Environmental Impact Assessment, Remediation of the General Separations Area Consolidation Unit at the Savannah River Site, DOE/EIA-0001*, United States Department of Energy, Aiken, South Carolina.

WSRC, 1995. *RCRA Part B Permit Renewal Application for the Mixed Waste Management Facility*, WSRC-IM-91-53, vol. 7, Mixed Waste Management Facility Postclosure, Westinghouse Savannah River Company, Aiken, South Carolina.

WSRC, 1996. *Interim Record of Decision Remedial Alternative Selection Old Radioactive Waste Burial Ground (643-E) Savannah River Site*, WSRC-RP-96-102, Westinghouse Savannah River Company, Aiken, South Carolina.

WSRC, 1997a. *RFI/RI Work Plan Addendum for the H-Area Retention Basin Operable Unit (281-3H),* WSRC-RP-97-146, Rev. 1.5, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina.

WSRC, 1997b. *Workplan/RCRA Facility Investigation/Remedial Investigation Report for the Old Radioactive Waste Burial Ground 643-E, S01-S22,* Savannah River Site, Vol. I, WSRC-RP-97-00127, Westinghouse Savannah River Company, Aiken, South Carolina.

WSRC, 1997c. *Source Term for the Old Radioactive Waste Burial Ground (ORWBG), Savannah River Site,* WSRC-RP-97-0119, Westinghouse Savannah River Company, Aiken, South Carolina.

WSRC, 1997d. *Summary of Water Table Monitoring for the Old Radioactive Waste Burial Ground (ORWBG),* WSRC-RP-97-00330, Westinghouse Savannah River Company, Aiken, South Carolina.

WSRC, 1997e. *Delineation of Potential "Hot Spots" for the Old Radioactive Waste Burial Ground (ORWBG),* WSRC-TR-97-00329, Rev. 0, Westinghouse Savannah River Company, Aiken, South Carolina.

WSRC, 1997f. *Savannah River Site NEPA/CERCLA Integration Guidance,* WSRC-RP-97-232, Westinghouse Savannah River Company, Aiken, South Carolina.

WSRC, 1998. *RCRA Facility Investigation/ Remedial Investigation Report with Baseline Risk Assessment for the H-Area Retention Basin (281-3H),* WSRC-RP-98-4136, Rev. 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina.

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

WSRC, 2000a. *Focused Corrective Measures Study/Feasibility Study for the H-Area Retention Basin (281-3H),* WSRC-RP-2000-4110, Rev. 0, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina.

WSRC, 2000b. *Addendum to the Workplan/RCRA Facility Investigation/ Remedial Investigation Report for the Old Radioactive Waste Burial Ground, 643-E, S01-S22*, WSRC-RP-99-4023, Westinghouse Savannah River Company, Aiken, South Carolina.

WSRC, 2000c. *Interim Record of Decision for the Old Solvent Tanks at the Old Radioactive Waste Burial Ground*, WSRC-RP-2000-4193, Rev. 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina.

WSRC, 2001a. *RCRA Facility Investigation/ Remedial Investigation Work Plan for Warner's Pond and HP-52 Ponds Operable Units,* WSRC-RP-2001-4048, Rev. 0, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina.

WSRC, 2001b. *Corrective Measures Study/Feasibility Study for the Old Radioactive Waste Burial Ground, 643-E*, WSRC-RP-98-4012, Rev. 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina.

WSRC, 2002. *Statement of Basis/Proposed Plan for the General Separations Area Consolidation Unit*, WSRC-RP-2001-4267, Rev. 1, Westinghouse Savannah River Company, Aiken, South Carolina.

APPENDIX A -

RESPONSIVENESS SUMMARY

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RESPONSIVENESS SUMMARY

The 45-day public comment period for the SB/PP for the GSACU began on June 6, 2002, and ended on July 20, 2002. Comments and responses are provided below.

Public Comments

COMMENT #1: SRS received one oral comment from a member of the public who inquired about how the expected soil excavation volumes were calculated.

RESPONSE: The expected soil excavation volumes were calculated by multiplying the lateral extent of contamination by the expected depth of contamination. Where data were incomplete or estimated, or where the extent or depth of contamination were unknown, appropriate contingencies were included.

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APPENDIX B –

COST ESTIMATES FOR THE SELECTED REMEDY

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Appendix B-1. Cost Estimate for Selected Remedy for HRB, Warner's Pond, and HP-52 Ponds - Capital Cost Summary

Alternative: 7
Name: Waste Consolidation at the ORWBG
Base Year: 2000
Date: November 1, 2000

	Description	Unit	Quantity	Unit Cost	Item Total	Activity Total
REMEDIAL DESIGN PHASE - HRB						$533,343
	Preliminary Engineering				$30,467	
	Detailed Engineering and Pre-Construction				$353,726	
	Project Support				$149,150	
	Subtotal Remedial Design Phase					$533,343
REMEDIAL ACTION PHASE - HRB						
1	**Pre-Construction Maintenance**					$36,880
	Grass/Brush Cutting	AC	16	$530.64	$8,490	
	Apply Herbicide and Insecticide	AC	16	$254.90	$4,078	
	SRS Oversight	HR	480	$50.65	$24,312	
2	**Subcontract Technical Requirements**				$579,915	$579,915
3	**Subcontractor Mobilization**					$67,060
	Flatbed Truck	EA	3	$594.82	$1,784	
	Pickup	EA	2	$594.83	$1,190	
	Dump Truck	EA	16	$594.83	$9,517	
	Truck w/ Water Tank	EA	1	$594.83	$595	
	Tool Van	EA	2	$594.83	$1,190	
	Dozer	EA	4	$1,189.65	$4,759	
	Front End Loader	EA	2	$1,189.65	$2,379	
	Motor Grader	EA	2	$1,189.65	$2,379	
	Hyd Excavator/Backhoe	EA	4	$1,189.65	$4,759	
	Tractor	EA	2	$1,189.65	$2,379	
	Hydromulcher	EA	1	$1,189.65	$1,190	
	Trencher	EA	1	$1,189.65	$1,190	
	Crane	EA	2	$1,189.65	$2,379	
	Sheepsfoot Roller	EA	2	$1,189.65	$2,379	
	Vibratory Drum Roller	EA	2	$1,189.65	$2,379	
	Miscellaneous Small Equipment	LS	1	$2,379.00	$2,379	
	Assembly of Equipment	DAY	8	$2,623.97	$20,992	
	Set-up 3 Construction Trailers	HR	120	$27.01	$3,241	
4	**Temporary Security Fence**	LF	1,400	$12.55	$17,570	$17,570
5	**Temporary Utilities**	LS	1	$8,149.00	$8,149	$8,149

Appendix B-1. Cost Estimate for Selected Remedy for HRB, Warner's Pond, and HP-52 Ponds - Capital Cost Summary (Continued)

	Description	Unit	Quantity	Unit Cost	Item Total	Activity Total
6	**General Site Work**					$2,762
	Grass/Brush Cutting	AC	1.5	$908.79	$1,363	
	Apply Pesticide	AC	1.5	$404.83	$607	
	Disc Material	SY	7,300	$0.11	$792	
7	**Erosion Control**					$13,402
	Install and Remove Silt Fence	LF	300	$1.13	$340	
	Install and Remove Hay Bales	LF	300	$10.67	$3,202	
	Insp./Maint./Rep./Clean Erosion Cntrl Fac.	HR	210	$46.95	$9,860	
8	**Prepare Borrow Area**					$16,853
	Clearing w/ Dozer	AC	1.1	$1,542.90	$1,697	
	Grub and Remove Stumps	AC	1.1	$1,369.80	$1,507	
	Excavating, bulk w/ Dozer	CY	1,800	$1.54	$2,765	
	Load for Hauling	CY	2,200	$1.20	$2,641	
	Haul to Stockpile	CY	2,200	$3.75	$8,243	
9	**Geophysical/Geotechnical Investigation**					$13,015
	Skilled Samplers	HR	58	$26.45	$1,534	
	Soil Particle Size Analysis	EA	29	$118.96	$3,450	
	Moisture Content	EA	29	$10.71	$310	
	Liquid Limit, Plastic Limit, Plasticity Index	EA	29	$63.06	$1,829	
	Lab Compaction ASTM D698	EA	29	$157.04	$4,554	
	Transportation to Lab	Trip	3	$446.12	$1,338	
10	**Excavation at Basin**					$1,519,303
	Excavate Place in Lift Liners	CY	10,165	$14.54	$147,758	
	Pipe Removal	LF	160	$17.58	$2,813	
	Load Lift Liners on Flatbed Truck	EA	1,470	$98.17	$144,310	
	Haul Lift Liners to Burial Ground	EA	1,470	$54.60	$80,261	
	Unload Liners at Burial Ground	EA	1,470	$61.36	$90,193	
	Dump Liners at Burial Ground	EA	1,470	$251.72	$370,034	
	Purchase Lift Liner	EA	1,470	$450.00	$661,500	
	Purchase Lifting Frame	EA	2	$6,605.39	$13,211	
	Purchase Loading Frame	EA	2	$4,611.31	$9,223	
11	**Backfill Excavated Areas/Berm**					$274,193
	Load Backfill at Borrow Pit	CY	10,800	$2.63	$28,357	
	Haul Material from Borrow Pit	CY	13,000	$13.80	$179,460	
	Spread Material for Compaction	CY	10,800	$2.46	$26,540	
	Compaction	CY	10,800	$1.32	$14,243	
	Rough Grade and Scarify	MSF	500	$30.86	$15,429	
	Cut and Regrade	CY	1,880	$5.41	$10,164	
12	**Site Surveys**					$29,311
	Topography Pre-Construction	AC	3	$1,691.34	$5,074	
	Topography Basin Pre-Construction	AC	1.5	$2,673.00	$4,010	
	Topography Basin Low Perm Soil	AC	1.5	$1,691.00	$2,537	
	Topography As Built	AC	3	$1,691.34	$5,074	
	Survey Monuments	EA	4	$104.74	$419	

Appendix B-1. Cost Estimate for Selected Remedy for HRB, Warner's Pond, and HP-52 Ponds - Capital Cost Summary (Continued)

	Description	Unit	Quantity	Unit Cost	Item Total	Activity Total
	SC Surveyor	HR	70	$66.18	$4,633	
	As Built Drawings	HR	120	$56.18	$6,742	
	Closed Basin Marker	EA	4	$205.45	$822	
13	**Dust Suppression**	HR	420	$49.82	$20,924	$20,924
14	**Wind Barrier**	LF	200	$31.19	$6,238	$6,238
15	**Construction Water and Facilities**				$24,351	$24,351
16	**Geophysical/Geotechnical Investigation**					$82,478
	Nuclear Density/Sand-Cone Density	HR	200	$76.14	$15,228	
	Nuclear Density	HR	660	$76.14	$50,250	
	25% Retesting	LS	1	$17,000.00	$17,000	
17	**Sampling and Analysis**				$203,415	$203,415
18	**Site Restoration Fine Grading**	SY	14,500	$0.58	$8,464	$8,464
19	**Soil/Vegetative Cover**					$279,545
	Load Fill Material at Borrow Pit	CY	10,200	$3.03	$30,901	
	Haul Material from Borrow Pit	CY	12,200	$13.80	$168,416	
	Spread Common Fill	CY	10,200	$1.54	$15,665	
	Compaction	CY	10,200	$0.45	$4,570	
	Rough Grade and Scarify	MSF	441	$19.29	$8,505	
	Obtain Top Soil Off-Site	CY	1,300	$35.69	$46,397	
	Spread Top Soil	CY	1,300	$1.52	$1,973	
	Scarify Top Soil	SY	7,000	$0.20	$1,426	
	Water Top Soil Mix	DAY	1	$889.00	$889	
	Proof Roll Top Soil Mix	CY	1,300	$0.62	$803	
20	**Site Seeding**					$12,200
	Spread Lime with Tractor	MSF	131	$9.84	$1,290	
	Seeding Hydro/Air Seeding w/ Mulch/Fert.	MSF	131	$54.19	$7,098	
	Follow-up Fertilizer w/ Tractor	MSF	131	$4.36	$571	
	Water Seeded Area	DAY	2	$889.24	$1,778	
	Maintenance Seeding	MSF	27	$54.19	$1,463	
21	***Permanent Fencing***	LF	1,060	$30.00	$31,800	$31,800
22	**Demobilization Construction Equipment**					$61,812
	Flat Bed Truck	EA	3	$594.82	$1,784	
	Pickup	EA	2	$594.83	$1,190	
	Dump Truck	EA	16	$594.83	$9,517	
	Truck w/ Water Tank	EA	1	$595.00	$595	
	Tool Van	EA	2	$594.83	$1,190	
	Dozer	EA	4	$1,189.65	$4,759	
	Front End Loader	EA	2	$1,189.65	$2,379	
	Motor Grader	EA	2	$1,189.65	$2,379	
	Hyd Excavator/Backhoe	EA	4	$1,189.65	$4,759	
	Tractor	EA	2	$1,189.65	$2,379	
	Hydromulcher	EA	1	$1,189.65	$1,190	
	Trencher	EA	1	$1,189.65	$1,190	
	Crane	EA	2	$1,189.65	$2,379	

Appendix B-1. Cost Estimate for Selected Remedy for HRB, Warner's Pond, and HP-52 Ponds - Capital Cost Summary (Continued)

	Description	Unit	Quantity	Unit Cost	Item Total	Activity Total
	Sheepsfoot Roller	EA	2	$1,189.65	$2,379	
	Vibratory Drum Roller	EA	2	$1,189.65	$2,379	
	Miscellaneous Small Equipment	LS	1	$2,379.00	$2,379	
	Disassembly of Equipment	DAY	6	$2,623.97	$15,744	
	Removal Three Construction Trailers	HR	120	$27.01	$3,241	
23	**Remove Temporary Security Fence**	LF	1,400	$2.91	$4,073	$4,073
24	**Remove Temporary Utilities**					$2,142
	Remove Temporary Water and Sewer	LS	1	$714.00	$714	
	Remove Temporary Service	LS	1	$714.00	$714	
	Remove Temporary Power	LS	1	$714.00	$714	
25	**Equipment Decontamination**					$92,297
	Construct Decon Pad	SF	864	$13.06	$11,281	
	Decon Equipment	HR	500	$33.24	$16,619	
	Remove Decon Pad	SF	864	$5.69	$4,914	
	Construction Equipment	LS	1	$59,483.00	$59,483	
26	**Final Acceptance**	LS	1	$6,000.00	$6,000	$6,000
27	**Rad Screens**					$31,263
	Transport to Lab	EA	70	$188.42	$13,189	
	Rad Screen	EA	70	$258.20	$18,074	
28	**Construction Management and Engineering**				$119,501	$119,501
29	**Project Support for Construction**				$101,436	$101,436
30	**Remediation Derived Waste**					$53
	Solid (Lift Liner) Containerization	LS	1	$53.00	$53	
31	**Solid (Lift Liner) Characterization**					$8,703
	Waste Stream Sampling	EA	1	$1,200.00	$1,200	
	Waste Stream Sample Analysis	EA	1	$2,460.00	$2,460	
	Rad Field Screen	EA	1	$366.00	$366	
	Waste Program Support	EA	1	$317.00	$317	
	RCO Support	EA	1	$304.00	$304	
	ERE Exempt Support	EA	1	$263.00	$263	
	Waste Program Support	EA	1	$528.00	$528	
	ERE Exempt Support (Documentation)	EA	1	$2,632.00	$2,632	
	Waste Program Support (Manifest)	EA	1	$633.00	$633	
32	**Lift Liner Transporting**					$533,537
	Container Loading	EA	1,470	$211.00	$310,170	
	RCO Support	LS	1,470	$151.95	$223,367	
33	**Post Construction**					$40,966
	Final Safety Inspection	HR	80	$65.79	$5,263	
	Post Construction Report	HR	150	$65.79	$9,869	
	Final Remediation Report	HR	200	$65.79	$13,158	
	Geotech Labor	HR	200	$63.38	$12,676	
34	**Project Support for Post Construction**				$13,147	$13,147
35	**Project Support During Remedial Action Phase**				$117,984	$117,984

Appendix B-1. Cost Estimate for Selected Remedy for HRB, Warner's Pond, and HP-52 Ponds - Capital Cost Summary (Continued)

Description	Unit	Quantity	Unit Cost	Item Total	Activity Total
Subtotal Remedial Action Phase - HRB					$4,380,742
Subtotal Remedial Design & Action Phase - HRB					$4,914,085
Surcharge	3.50%		$2,663,506	$93,223	$93,223
Subtotal					$5,007,308
ESS	14.45%				$723,556
G&A	17.16%				$983,416
Contingency	20.00%				$1,342,856
TOTAL CAPITAL COST - HRB					**$8,057,136**

The capital cost estimate was initially developed in the HRB CMS/FS based on a contaminated soil volume of 10,165 cy. The volume estimate was subsequently revised to 12,150 cy. The capital cost estimate was scaled using the ratio of the revised volume to the initial volume; i.e., increased by a factor of 1.195 (12,150/10,165).

ADJUSTED TOTAL CAPITAL COST - HRB **$9,630,517**

Cost estimates for Warner's Pond and HP-52 Ponds were determined by scaling the HRB cost estimate using the ratio of the volume of contaminated soil at HRB to the volume of contaminated soil at Warner's Pond and HP-52 Ponds. Results are presented in Table 6 of the ROD.

Appendix B-2. Cost Estimate for Selected Remedy for HRB, Warner's Pond, and HP-52 Ponds - Summary of Present Value Analysis

Alternative: 7
Name: Waste Consolidation at the ORWBG
Base Year: 2000
Date: November 1, 2000
Interest Rate: 3.9%

Years	5
Annuity Factor	4.46

ANNUAL COSTS - HRB	Unit Quantity	Dollars/ Unit	Annual Dollars	Cost
Post-Closure				
Collection of Samples (13 wells twice/yr)	26	$100	$2,600	$11,607
Collection of Trip Blanks (25%)	6.5	$100	$650	$2,902
Collection of Splits (1/20)	1.3	$100	$130	$580
Collection of Duplicates (1/20)	1.3	$100	$130	$580
Analysis Trip Blanks	6.5	$100	$650	$2,902
Analysis Samples, Splits, Duplicates	28.6	$900	$25,740	$114,913
EMS-EXR Data Management (Mobilization, V&V, Data Summary Report, Data Management)			$11,876	$53,016
ER-FPC Field Char. Report			$5,000	$22,322
Annual Report			$4,056	$18,109
Monitoring Well Maintenance			$14,937	$66,683
Project Support for Well Monitoring and Institutional Control			$3,037	$13,558
Preventative and Corrective Maintenance	1.45	$5,000	$7,250	$32,367
Project Support (maintenance)			$6,341	$28,307
Project Support (O&M)			$8,874	$39,616
Project Support (PCS/LTM Phase)			$8,959	$39,996
Subtotal Annual Dollars			$100,229	$447,458
ESS	14.45%		$14,483	$64,658
G&A	17.16%		$19,685	$87,879
Contingency	20.00%		$26,879	$119,999
Total NPV Annual Costs				**$719,994**

PERIODIC COSTS - HRB		Cost
Land Survey		$3,810
Well Aband.		$25,102
D&R Monitoring Well Equipment		$43,978
Grout Monitoring Wells		$26,670
Subtotal - Non-discounted		$99,560
Year	5	
Subtotal - present value		$82,226
ROD Reviews - present value		$4,306
Total NPV Periodic Costs - HRB		**$86,532**
TOTAL O&M COSTS - (Annual + Periodic) - HRB		**$806,526**

The O&M cost estimate was initially developed in the HRB CMS/FS based on a contaminated soil volume of 10,165 cy. The volume estimate was subsequently revised to 12,150 cy. The O&M cost estimate was scaled using the ratio of the revised volume to the initial volume; i.e., increased by a factor of 1.195 (12,150/10,165).

ADJUSTED TOTAL O&M COST - HRB **$964,023**

Cost estimates for Warner's Pond and HP-52 Ponds were determined by scaling the HRB cost estimate using the ratio of the volume of contaminated soil at HRB to the volume of contaminated soil at Warner's Pond and HP-52 Ponds. Results are presented in Table 6 of the ROD.

Appendix B-3. Cost Estimate for Selected Remedy for the ORWBG - Capital Cost Summary

Alternative: ORWBG VI
Name: Geosynthetic Low Permeability Cap
Base Year: 2000
Date: November 1, 2000

	Description	Quantity	Unit	Unit Cost	Item Total	Activity Total
1	**Mobilization**	1	LS	$25,000	$25,000	$25,000
2	**Documentation**	1	LS	$60,000	$60,000	$60,000
3	**Soil Testing/Sampling** (3 per IA hill)	24	EA	$50.00	$1,200	$1,200
4	**Erosion Control**					$48,502
	Silt Fences	11,027	LF	$1.29	$14,275	
	Hay Bales	11,027	LF	$1.29	$14,275	
	Rip Rap for Erosion Control	556	CY	$35.89	$19,952	
5	**Site Preparation**					$824,353
	Excavate Trench for Key Erosion Mat	477	CY	$14.99	$7,149	
	Remove & Stockpile Topsoil (76 ac, 1.5' thick)	183,920	CY	$4.16	$765,886	
	Rolling (Minor Compaction)	367,840	SY	$0.14	$51,318	
6	**Sediment Basin**					$214,549
	Excavate Sediment Basin	18,489	CY	$11.27	$208,314	
	Install Rip Rap @ Sediment Basin Spillway	167	CY	$37.35	$6,235	
7	**Cap Construction**					$5,559,235
	Excavate Trench for Key Geosynthetic Clay Layer	1,192	CY	$11.27	$13,432	
	Furnish Soil Reinforcement (76 ac)	367,840	SY	$1.85	$680,504	
	Place Soil Reinforcement	367,840	SY	$0.37	$134,434	
	F & I Geosynthetic Clay Layer	367,840	SY	$4.90	$1,801,404	
	Flexible Membrane Liner (40 mil HDPE smooth)	242,284	SY	$3.55	$859,443	
	Flexible Membrane Liner (textured)	78,222	SY	$4.45	$347,874	
	80 mil HDPE Geomembrane (in ditches)	47,333	SY	$7.00	$331,333	
	F & I Synthetic Erosion Mat	7,528	SY	$1.24	$9,322	
	F & I Erosion Blanket	9,059	SY	$3.38	$30,651	
	Drainage Layer, filter on 1 side (76 ac)	367,840	SY	$3.12	$1,146,756	
	Replace Topsoil (76 ac, 2' thick)	245,227	CY	$0.83	$204,082	

Appendix B-3. Cost Estimate for Selected Remedy for the ORWBG - Capital Cost Summary (Continued)

	Description	Quantity	Unit	Unit Cost	Total	Total
8	**Site Restoration**					$342,516
	Fill Sediment Basin & Berms	18,489	CY	$2.05	$37,846	
	Compact Sediment Basin	18,489	CY	$0.71	$13,122	
	Remove Rip Rap @ Sediment Basin Spillway	167	CY	$21.27	$3,553	
	Load Borrow for Fill for Gravel Road and Drainage	1,937	CY	$0.43	$831	
	Haul Fill for Gravel Road and Drainage	1,937	CY	$0.52	$1,014	
	Place Fill for Gravel Road and Drainage	1,937	CY	$1.06	$2,053	
	Grade Road and Shoulder	31,294	SY	$1.97	$61,743	
	Compact Road	31,294	SY	$2.12	$66,406	
	Furnish Gravel for Road	4,024	CY	$15.00	$60,353	
	Place and Compact Gravel	23,843	SY	$0.42	$10,119	
	Furnish Gravel for Ramps	194	CY	$15.00	$2,910	
	Put&Comp Gravel/Ramps	1,192	SY	$0.42	$506	
	F & I 24" CMP Culvert	238	LF	$25.41	$6,060	
	Vegetative Cover - seeding	76	AC	$1,000	$76,000	
10	**Site Surveys**					$35,250
	Survey	1		$30,000	$30,000	
	Survey Monuments	30		$175	$5,250	
11	**Miscellaneous Control Items**					$2,700
	Furnish and Install Signs	30	EA	$90	$2,700	
12	**Demobilization**	1	LS	$25,000	$25,000	$25,000
	Subtotal					$7,138,305
	ESS	14.45%				$1,031,485
	G&A	17.16%				$1,224,933
	Contingency	20.00%				$1,427,661
TOTAL CAPITAL COST - ORWBG						**$10,822,384**

Appendix B-4. Cost Estimate for Selected Remedy for the ORWBG - Summary of Present Value Analysis

Alternative: ORWBG VI
Name: Geosynthetic Low Permeability Cap
Base Year: 2000
Date: November 1, 2000
Interest Rate: 3.9%

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (3.9%)	Present Worth
0	$10,822,384		$10,822,384	1.000	$10,822,384
1		$17,570	$17,570	0.962	$16,910
2		$17,570	$17,570	0.926	$16,276
3		$17,570	$17,570	0.892	$15,665
4		$17,570	$17,570	0.858	$15,077
5		$27,570	$27,570	0.826	$22,770
6		$17,570	$17,570	0.795	$13,966
7		$17,570	$17,570	0.765	$13,442
8		$17,570	$17,570	0.736	$12,937
9		$17,570	$17,570	0.709	$12,452
10		$70,033	$70,033	0.682	$47,769
11		$17,570	$17,570	0.656	$11,535
12		$17,570	$17,570	0.632	$11,102
13		$17,570	$17,570	0.608	$10,685
14		$17,570	$17,570	0.585	$10,284
15		$27,570	$27,570	0.563	$15,531
16		$17,570	$17,570	0.542	$9,526
17		$17,570	$17,570	0.522	$9,169
18		$17,570	$17,570	0.502	$8,825
19		$17,570	$17,570	0.483	$8,493
20		$70,033	$70,033	0.465	$32,583
21		$17,570	$17,570	0.448	$7,868
22		$17,570	$17,570	0.431	$7,572
23		$17,570	$17,570	0.415	$7,288
24		$17,570	$17,570	0.399	$7,015
25		$1,111,434	$1,111,434	0.384	$427,066
26		$17,570	$17,570	0.370	$6,498
27		$17,570	$17,570	0.356	$6,254
28		$17,570	$17,570	0.343	$6,019
29		$17,570	$17,570	0.330	$5,793
30		$70,033	$70,033	0.317	$22,225
31		$17,570	$17,570	0.305	$5,366
32		$17,570	$17,570	0.294	$5,165
33		$17,570	$17,570	0.283	$4,971
34		$17,570	$17,570	0.272	$4,785
35		$27,570	$27,570	0.262	$7,226
36		$17,570	$17,570	0.252	$4,432
37		$17,570	$17,570	0.243	$4,266
38		$17,570	$17,570	0.234	$4,106
39		$17,570	$17,570	0.225	$3,952
40		$70,033	$70,033	0.216	$15,159
41		$17,570	$17,570	0.208	$3,660
42		$17,570	$17,570	0.201	$3,523
43		$17,570	$17,570	0.193	$3,391
44		$17,570	$17,570	0.186	$3,264
45		$27,570	$27,570	0.179	$4,929

Appendix B-4. Cost Estimate for Selected Remedy for the ORWBG - Summary of Present Value Analysis (Continued)

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (3.9%)	Present Worth
46		$17,570	$17,570	0.172	$3,023
47		$17,570	$17,570	0.166	$2,910
48		$17,570	$17,570	0.159	$2,800
49		$17,570	$17,570	0.153	$2,695
50		$1,153,898	$1,153,898	0.148	$170,369
51		$17,570	$17,570	0.142	$2,497
52		$17,570	$17,570	0.137	$2,403
53		$17,570	$17,570	0.132	$2,313
54		$17,570	$17,570	0.127	$2,226
55		$27,570	$27,570	0.122	$3,362
56		$17,570	$17,570	0.117	$2,062
57		$17,570	$17,570	0.113	$1,985
58		$17,570	$17,570	0.109	$1,910
59		$17,570	$17,570	0.105	$1,838
60		$70,033	$70,033	0.101	$7,053
61		$17,570	$17,570	0.097	$1,703
62		$17,570	$17,570	0.093	$1,639
63		$17,570	$17,570	0.090	$1,578
64		$17,570	$17,570	0.086	$1,518
65		$27,570	$27,570	0.083	$2,293
66		$17,570	$17,570	0.080	$1,407
67		$17,570	$17,570	0.077	$1,354
68		$17,570	$17,570	0.074	$1,303
69		$17,570	$17,570	0.071	$1,254
70		$70,033	$70,033	0.069	$4,811
71		$17,570	$17,570	0.066	$1,162
72		$17,570	$17,570	0.064	$1,118
73		$17,570	$17,570	0.061	$1,076
74		$17,570	$17,570	0.059	$1,036
75		$1,111,434	$1,111,434	0.057	$63,055
76		$17,570	$17,570	0.055	$959
77		$17,570	$17,570	0.053	$923
78		$17,570	$17,570	0.051	$889
79		$17,570	$17,570	0.049	$855
80		$70,033	$70,033	0.047	$3,281
81		$17,570	$17,570	0.045	$792
82		$17,570	$17,570	0.043	$763
83		$17,570	$17,570	0.042	$734
84		$17,570	$17,570	0.040	$706
85		$27,570	$27,570	0.039	$1,067
86		$17,570	$17,570	0.037	$654
87		$17,570	$17,570	0.036	$630
88		$17,570	$17,570	0.035	$606
89		$17,570	$17,570	0.033	$583
90		$70,033	$70,033	0.032	$2,238
91		$17,570	$17,570	0.031	$540
92		$17,570	$17,570	0.030	$520
93		$17,570	$17,570	0.028	$501
94		$17,570	$17,570	0.027	$482
95		$27,570	$27,570	0.026	$728
96		$17,570	$17,570	0.025	$446
97		$17,570	$17,570	0.024	$430
98		$17,570	$17,570	0.024	$413
99		$17,570	$17,570	0.023	$398
100		$1,153,898	$1,153,898	0.022	$25,154

Appendix B-4. Cost Estimate for Selected Remedy for the ORWBG - Summary of Present Value Analysis (Continued)

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (3.9%)	Present Worth
101		$17,570	$17,570	0.021	$369
102		$17,570	$17,570	0.020	$355
103		$17,570	$17,570	0.019	$341
104		$17,570	$17,570	0.019	$329
105		$27,570	$27,570	0.018	$496
106		$17,570	$17,570	0.017	$304
107		$17,570	$17,570	0.017	$293
108		$17,570	$17,570	0.016	$282
109		$17,570	$17,570	0.015	$271
110		$27,570	$27,570	0.015	$410
111		$17,570	$17,570	0.014	$251
112		$17,570	$17,570	0.014	$242
113		$17,570	$17,570	0.013	$233
114		$17,570	$17,570	0.013	$224
115		$27,570	$27,570	0.012	$339
116		$17,570	$17,570	0.012	$208
117		$17,570	$17,570	0.011	$200
118		$17,570	$17,570	0.011	$192
119		$17,570	$17,570	0.011	$185
120		$70,033	$70,033	0.010	$710
121		$17,570	$17,570	0.010	$172
122		$17,570	$17,570	0.009	$165
123		$17,570	$17,570	0.009	$159
124		$17,570	$17,570	0.009	$153
125		$27,570	$27,570	0.008	$231
126		$17,570	$17,570	0.008	$142
127		$17,570	$17,570	0.008	$136
128		$17,570	$17,570	0.007	$131
129		$17,570	$17,570	0.007	$126
130		$27,570	$27,570	0.007	$191
131		$17,570	$17,570	0.007	$117
132		$17,570	$17,570	0.006	$113
133		$17,570	$17,570	0.006	$108
134		$17,570	$17,570	0.006	$104
135		$27,570	$27,570	0.006	$158
136		$17,570	$17,570	0.005	$97
137		$17,570	$17,570	0.005	$93
138		$17,570	$17,570	0.005	$90
139		$17,570	$17,570	0.005	$86
140		$70,033	$70,033	0.005	$330
141		$17,570	$17,570	0.005	$80
142		$17,570	$17,570	0.004	$77
143		$17,570	$17,570	0.004	$74
144		$17,570	$17,570	0.004	$71
145		$27,570	$27,570	0.004	$107
146		$17,570	$17,570	0.004	$66
147		$17,570	$17,570	0.004	$63
148		$17,570	$17,570	0.003	$61
149		$17,570	$17,570	0.003	$59
150		$27,570	$27,570	0.003	$89
151		$17,570	$17,570	0.003	$54
152		$17,570	$17,570	0.003	$52
153		$17,570	$17,570	0.003	$50
154		$17,570	$17,570	0.003	$49
155		$27,570	$27,570	0.003	$73

Appendix B-4. Cost Estimate for Selected Remedy for the ORWBG - Summary of Present Value Analysis (Continued)

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (3.9%)	Present Worth
156		$17,570	$17,570	0.003	$45
157		$17,570	$17,570	0.002	$43
158		$17,570	$17,570	0.002	$42
159		$17,570	$17,570	0.002	$40
160		$70,033	$70,033	0.002	$154
161		$17,570	$17,570	0.002	$37
162		$17,570	$17,570	0.002	$36
163		$17,570	$17,570	0.002	$34
164		$17,570	$17,570	0.002	$33
165		$27,570	$27,570	0.002	$50
166		$17,570	$17,570	0.002	$31
167		$17,570	$17,570	0.002	$30
168		$17,570	$17,570	0.002	$28
169		$17,570	$17,570	0.002	$27
170		$27,570	$27,570	0.001	$41
171		$17,570	$17,570	0.001	$25
172		$17,570	$17,570	0.001	$24
173		$17,570	$17,570	0.001	$23
174		$17,570	$17,570	0.001	$23
175		$27,570	$27,570	0.001	$34
176		$17,570	$17,570	0.001	$21
177		$17,570	$17,570	0.001	$20
178		$17,570	$17,570	0.001	$19
179		$17,570	$17,570	0.001	$19
180		$70,033	$70,033	0.001	$72
181		$17,570	$17,570	0.001	$17
182		$17,570	$17,570	0.001	$17
183		$17,570	$17,570	0.001	$16
184		$17,570	$17,570	0.001	$15
185		$27,570	$27,570	0.001	$23
186		$17,570	$17,570	0.001	$14
187		$17,570	$17,570	0.001	$14
188		$17,570	$17,570	0.001	$13
189		$17,570	$17,570	0.001	$13
190		$27,570	$27,570	0.001	$19
191		$17,570	$17,570	0.001	$12
192		$17,570	$17,570	0.001	$11
193		$17,570	$17,570	0.001	$11
194		$17,570	$17,570	0.001	$11
195		$27,570	$27,570	0.001	$16
196		$17,570	$17,570	0.001	$10
197		$17,570	$17,570	0.001	$9
198		$17,570	$17,570	0.001	$9
199		$17,570	$17,570	0.000	$9
200		$70,033	$70,033	0.000	$33
201		$17,570	$17,570	0.000	$8
202		$17,570	$17,570	0.000	$8
203		$17,570	$17,570	0.000	$7
204		$17,570	$17,570	0.000	$7
205		$27,570	$27,570	0.000	$11
206		$17,570	$17,570	0.000	$7
207		$17,570	$17,570	0.000	$6
208		$17,570	$17,570	0.000	$6
209		$17,570	$17,570	0.000	$6
210		$27,570	$27,570	0.000	$9

Appendix B-4. Cost Estimate for Selected Remedy for the ORWBG - Summary of Present Value Analysis (Continued)

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (3.9%)	Present Worth
211		$17,570	$17,570	0.000	$5
212		$17,570	$17,570	0.000	$5
213		$17,570	$17,570	0.000	$5
214		$17,570	$17,570	0.000	$5
215		$27,570	$27,570	0.000	$7
216		$17,570	$17,570	0.000	$5
217		$17,570	$17,570	0.000	$4
218		$17,570	$17,570	0.000	$4
219		$17,570	$17,570	0.000	$4
220		$70,033	$70,033	0.000	$15
221		$17,570	$17,570	0.000	$4
222		$17,570	$17,570	0.000	$4
223		$17,570	$17,570	0.000	$3
224		$17,570	$17,570	0.000	$3
225		$27,570	$27,570	0.000	$5
226		$17,570	$17,570	0.000	$3
227		$17,570	$17,570	0.000	$3
228		$17,570	$17,570	0.000	$3
229		$17,570	$17,570	0.000	$3
230		$27,570	$27,570	0.000	$4
231		$17,570	$17,570	0.000	$3
232		$17,570	$17,570	0.000	$2
233		$17,570	$17,570	0.000	$2
234		$17,570	$17,570	0.000	$2
235		$27,570	$27,570	0.000	$3
236		$17,570	$17,570	0.000	$2
237		$17,570	$17,570	0.000	$2
238		$17,570	$17,570	0.000	$2
239		$17,570	$17,570	0.000	$2
240		$70,033	$70,033	0.000	$7
241		$17,570	$17,570	0.000	$2
242		$17,570	$17,570	0.000	$2
243		$17,570	$17,570	0.000	$2
244		$17,570	$17,570	0.000	$2
245		$27,570	$27,570	0.000	$2
246		$17,570	$17,570	0.000	$1
247		$17,570	$17,570	0.000	$1
248		$17,570	$17,570	0.000	$1
249		$17,570	$17,570	0.000	$1
250		$27,570	$27,570	0.000	$2
251		$17,570	$17,570	0.000	$1
252		$17,570	$17,570	0.000	$1
253		$17,570	$17,570	0.000	$1
254		$17,570	$17,570	0.000	$1
255		$27,570	$27,570	0.000	$2
256		$17,570	$17,570	0.000	$1
257		$17,570	$17,570	0.000	$1
258		$17,570	$17,570	0.000	$1
259		$17,570	$17,570	0.000	$1
260		$70,033	$70,033	0.000	$3
261		$17,570	$17,570	0.000	$1
262		$17,570	$17,570	0.000	$1
263		$17,570	$17,570	0.000	$1
264		$17,570	$17,570	0.000	$1
265		$27,570	$27,570	0.000	$1

Appendix B-4. Cost Estimate for Selected Remedy for the ORWBG - Summary of Present Value Analysis (Continued)

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (3.9%)	Present Worth
266		$17,570	$17,570	0.000	$1
267		$17,570	$17,570	0.000	$1
268		$17,570	$17,570	0.000	$1
269		$17,570	$17,570	0.000	$1
270		$27,570	$27,570	0.000	$1
271		$17,570	$17,570	0.000	$1
272		$17,570	$17,570	0.000	$1
273		$17,570	$17,570	0.000	$1
274		$17,570	$17,570	0.000	$0
275		$27,570	$27,570	0.000	$1
276		$17,570	$17,570	0.000	$0
277		$17,570	$17,570	0.000	$0
278		$17,570	$17,570	0.000	$0
279		$17,570	$17,570	0.000	$0
280		$70,033	$70,033	0.000	$2
281		$17,570	$17,570	0.000	$0
282		$17,570	$17,570	0.000	$0
283		$17,570	$17,570	0.000	$0
284		$17,570	$17,570	0.000	$0
285		$27,570	$27,570	0.000	$1
286		$17,570	$17,570	0.000	$0
287		$17,570	$17,570	0.000	$0
288		$17,570	$17,570	0.000	$0
289		$17,570	$17,570	0.000	$0
290		$27,570	$27,570	0.000	$0
291		$17,570	$17,570	0.000	$0
292		$17,570	$17,570	0.000	$0
293		$17,570	$17,570	0.000	$0
294		$17,570	$17,570	0.000	$0
295		$27,570	$27,570	0.000	$0
296		$17,570	$17,570	0.000	$0
297		$17,570	$17,570	0.000	$0
298		$17,570	$17,570	0.000	$0
299		$17,570	$17,570	0.000	$0
300		$70,033	$70,033	0.000	$1
301		$5,570	$5,570	0.000	$0
302		$5,570	$5,570	0.000	$0
303		$5,570	$5,570	0.000	$0
304		$5,570	$5,570	0.000	$0
305		$21,270	$21,270	0.000	$0
306		$5,570	$5,570	0.000	$0
307		$5,570	$5,570	0.000	$0
308		$5,570	$5,570	0.000	$0
309		$5,570	$5,570	0.000	$0
310		$21,270	$21,270	0.000	$0
311		$5,570	$5,570	0.000	$0
312		$5,570	$5,570	0.000	$0
313		$5,570	$5,570	0.000	$0
314		$5,570	$5,570	0.000	$0
315		$21,270	$21,270	0.000	$0
316		$5,570	$5,570	0.000	$0
317		$5,570	$5,570	0.000	$0
318		$5,570	$5,570	0.000	$0
319		$5,570	$5,570	0.000	$0
320		$21,270	$21,270	0.000	$0

Appendix B-4. Cost Estimate for Selected Remedy for the ORWBG - Summary of Present Value Analysis (Continued)

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (3.9%)	Present Worth
321		$5,570	$5,570	0.000	$0
322		$5,570	$5,570	0.000	$0
323		$5,570	$5,570	0.000	$0
324		$5,570	$5,570	0.000	$0
325		$21,270	$21,270	0.000	$0
326		$5,570	$5,570	0.000	$0
327		$5,570	$5,570	0.000	$0
328		$5,570	$5,570	0.000	$0
329		$5,570	$5,570	0.000	$0
330		$21,270	$21,270	0.000	$0
331		$5,570	$5,570	0.000	$0
332		$5,570	$5,570	0.000	$0
333		$5,570	$5,570	0.000	$0
334		$5,570	$5,570	0.000	$0
335		$21,270	$21,270	0.000	$0
336		$5,570	$5,570	0.000	$0
337		$5,570	$5,570	0.000	$0
338		$5,570	$5,570	0.000	$0
339		$5,570	$5,570	0.000	$0
340		$21,270	$21,270	0.000	$0
341		$5,570	$5,570	0.000	$0
342		$5,570	$5,570	0.000	$0
343		$5,570	$5,570	0.000	$0
344		$5,570	$5,570	0.000	$0
345		$21,270	$21,270	0.000	$0
346		$5,570	$5,570	0.000	$0
347		$5,570	$5,570	0.000	$0
348		$5,570	$5,570	0.000	$0
349		$5,570	$5,570	0.000	$0
350		$21,270	$21,270	0.000	$0
351		$5,570	$5,570	0.000	$0
352		$5,570	$5,570	0.000	$0
353		$5,570	$5,570	0.000	$0
354		$5,570	$5,570	0.000	$0
355		$21,270	$21,270	0.000	$0
356		$5,570	$5,570	0.000	$0
357		$5,570	$5,570	0.000	$0
358		$5,570	$5,570	0.000	$0
359		$5,570	$5,570	0.000	$0
360		$21,270	$21,270	0.000	$0
361		$5,570	$5,570	0.000	$0
362		$5,570	$5,570	0.000	$0
363		$5,570	$5,570	0.000	$0
364		$5,570	$5,570	0.000	$0
365		$21,270	$21,270	0.000	$0
366		$5,570	$5,570	0.000	$0
367		$5,570	$5,570	0.000	$0
368		$5,570	$5,570	0.000	$0
369		$5,570	$5,570	0.000	$0
370		$21,270	$21,270	0.000	$0
371		$5,570	$5,570	0.000	$0
372		$5,570	$5,570	0.000	$0
373		$5,570	$5,570	0.000	$0
374		$5,570	$5,570	0.000	$0
375		$21,270	$21,270	0.000	$0

Appendix B-4. Cost Estimate for Selected Remedy for the ORWBG - Summary of Present Value Analysis (Continued)

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (3.9%)	Present Worth
376		$5,570	$5,570	0.000	$0
377		$5,570	$5,570	0.000	$0
378		$5,570	$5,570	0.000	$0
379		$5,570	$5,570	0.000	$0
380		$21,270	$21,270	0.000	$0
381		$5,570	$5,570	0.000	$0
382		$5,570	$5,570	0.000	$0
383		$5,570	$5,570	0.000	$0
384		$5,570	$5,570	0.000	$0
385		$21,270	$21,270	0.000	$0
386		$5,570	$5,570	0.000	$0
387		$5,570	$5,570	0.000	$0
388		$5,570	$5,570	0.000	$0
389		$5,570	$5,570	0.000	$0
390		$21,270	$21,270	0.000	$0
391		$5,570	$5,570	0.000	$0
392		$5,570	$5,570	0.000	$0
393		$5,570	$5,570	0.000	$0
394		$5,570	$5,570	0.000	$0
395		$21,270	$21,270	0.000	$0
396		$5,570	$5,570	0.000	$0
397		$5,570	$5,570	0.000	$0
398		$5,570	$5,570	0.000	$0
399		$5,570	$5,570	0.000	$0
400		$21,270	$21,270	0.000	$0
401		$5,570	$5,570	0.000	$0
402		$5,570	$5,570	0.000	$0
403		$5,570	$5,570	0.000	$0
404		$5,570	$5,570	0.000	$0
405		$21,270	$21,270	0.000	$0
406		$5,570	$5,570	0.000	$0
407		$5,570	$5,570	0.000	$0
408		$5,570	$5,570	0.000	$0
409		$5,570	$5,570	0.000	$0
410		$21,270	$21,270	0.000	$0
411		$5,570	$5,570	0.000	$0
412		$5,570	$5,570	0.000	$0
413		$5,570	$5,570	0.000	$0
414		$5,570	$5,570	0.000	$0
415		$21,270	$21,270	0.000	$0
416		$5,570	$5,570	0.000	$0
417		$5,570	$5,570	0.000	$0
418		$5,570	$5,570	0.000	$0
419		$5,570	$5,570	0.000	$0
420		$21,270	$21,270	0.000	$0
421		$5,570	$5,570	0.000	$0
422		$5,570	$5,570	0.000	$0
423		$5,570	$5,570	0.000	$0
424		$5,570	$5,570	0.000	$0
425		$21,270	$21,270	0.000	$0
426		$5,570	$5,570	0.000	$0
427		$5,570	$5,570	0.000	$0
428		$5,570	$5,570	0.000	$0
429		$5,570	$5,570	0.000	$0
430		$21,270	$21,270	0.000	$0

Appendix B-4. Cost Estimate for Selected Remedy for the ORWBG - Summary of Present Value Analysis (Continued)

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (3.9%)	Present Worth
431		$5,570	$5,570	0.000	$0
432		$5,570	$5,570	0.000	$0
433		$5,570	$5,570	0.000	$0
434		$5,570	$5,570	0.000	$0
435		$21,270	$21,270	0.000	$0
436		$5,570	$5,570	0.000	$0
437		$5,570	$5,570	0.000	$0
438		$5,570	$5,570	0.000	$0
439		$5,570	$5,570	0.000	$0
440		$21,270	$21,270	0.000	$0
441		$5,570	$5,570	0.000	$0
442		$5,570	$5,570	0.000	$0
443		$5,570	$5,570	0.000	$0
444		$5,570	$5,570	0.000	$0
445		$21,270	$21,270	0.000	$0
446		$5,570	$5,570	0.000	$0
447		$5,570	$5,570	0.000	$0
448		$5,570	$5,570	0.000	$0
449		$5,570	$5,570	0.000	$0
450		$21,270	$21,270	0.000	$0
451		$5,570	$5,570	0.000	$0
452		$5,570	$5,570	0.000	$0
453		$5,570	$5,570	0.000	$0
454		$5,570	$5,570	0.000	$0
455		$21,270	$21,270	0.000	$0
456		$5,570	$5,570	0.000	$0
457		$5,570	$5,570	0.000	$0
458		$5,570	$5,570	0.000	$0
459		$5,570	$5,570	0.000	$0
460		$21,270	$21,270	0.000	$0
461		$5,570	$5,570	0.000	$0
462		$5,570	$5,570	0.000	$0
463		$5,570	$5,570	0.000	$0
464		$5,570	$5,570	0.000	$0
465		$21,270	$21,270	0.000	$0
466		$5,570	$5,570	0.000	$0
467		$5,570	$5,570	0.000	$0
468		$5,570	$5,570	0.000	$0
469		$5,570	$5,570	0.000	$0
470		$21,270	$21,270	0.000	$0
471		$5,570	$5,570	0.000	$0
472		$5,570	$5,570	0.000	$0
473		$5,570	$5,570	0.000	$0
474		$5,570	$5,570	0.000	$0
475		$21,270	$21,270	0.000	$0
476		$5,570	$5,570	0.000	$0
477		$5,570	$5,570	0.000	$0
478		$5,570	$5,570	0.000	$0
479		$5,570	$5,570	0.000	$0

Appendix B-4. Cost Estimate for Selected Remedy for the ORWBG - Summary of Present Value Analysis (Continued)

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (3.9%)	Present Worth
480		$21,270	$21,270	0.000	$0
481		$5,570	$5,570	0.000	$0
482		$5,570	$5,570	0.000	$0
483		$5,570	$5,570	0.000	$0
484		$5,570	$5,570	0.000	$0
485		$21,270	$21,270	0.000	$0
486		$5,570	$5,570	0.000	$0
487		$5,570	$5,570	0.000	$0
488		$5,570	$5,570	0.000	$0
489		$5,570	$5,570	0.000	$0
490		$21,270	$21,270	0.000	$0
491		$5,570	$5,570	0.000	$0
492		$5,570	$5,570	0.000	$0
493		$5,570	$5,570	0.000	$0
494		$5,570	$5,570	0.000	$0
495		$21,270	$21,270	0.000	$0
496		$5,570	$5,570	0.000	$0
497		$5,570	$5,570	0.000	$0
498		$5,570	$5,570	0.000	$0
499		$5,570	$5,570	0.000	$0
500		$21,270	$21,270	0.000	$0
Totals	**$10,822,384**	**$12,797,723**	**$23,620,107**		**$12,071,866**

Total Present Value of O&M Costs - ORWBG **$1,249,482**

O&M Costs:

0-100 years:
Annual inspections, general repairs & site maintenance ($5,570/yr).
Biannual mowing, minor soil additions/repairs ($12,000/yr).
Replace 10% of veg cover every 10 years ($42,463 each).
Replace 10% of cap every 25 years ($1,083,864 each).
ROD Reviews every 5 years ($10,000 each).

101-300 years:
Annual inspections, general repairs & site maintenance ($5,570/yr).
Biannual mowing, minor soil additions/repairs ($12,000/yr).
Replace 10% of veg cover every 20 years ($42,463 each).
ROD Reviews every 5 years ($10,000 each).

301-500 years:
Annual inspections, general repairs & site maintenance ($5,570/yr).
Brush removal every 5 years ($5,700).
ROD Reviews every 5 years ($10,000 each).

Intruder Barrier Over 500-Year Radioactive Hot Spots:

Heavy rip-rap barrier: $325,000/acre ($1.4 million for HS-500-1 through HS-500-8).
Present value = $31,000, based on 3.9% discount rate and implementation in 100 years.
This cost is the capital cost to furnish and install the rip-rap only. The O&M cost of cap reconstruction after placement of the barrier is included in the long-term O&M costs for the ORWBG cap, which also includes periodic refurbishment of the cap.