CLOSURE OF THE SAVANNAH RIVER LABORATORY SEEPAGE BASINS AT THE SAVANNAH RIVER SITE, AIKEN SOUTH CAROLINA

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ABSTRACT

Closure of the SRL Seepage Basins, 4 earthen impoundments, is being driven by both CERCLA and a Civil Law Suit Consent Decree requiring a RCRA-like closure. Several issues related to the physical setting and extent of contamination at the site will have major impacts on the design of the clay cap system to be placed over the basins. The issues to be resolved are the stability of the northern wall of basin 4, radioactive uptake by vegetation growing within the basins, and the extent of contamination of the soil surrounding the process sewer line that discharged to the basins.

INTRODUCTION

The Savannah River Laboratory (SRL) Seepage Basins are 4 earthen basins which received low-level radioactive liquid waste from the Savannah River Laboratories from 1953 until 1982. In 1982, use of the basins was discontinued. Closure of the basins is being driven by a Consent Decree settled under Civil Act No. 1:85-2583. It is the intent of the SRS to comply with the requirements of both RCRA and CERCLA while working within the boundaries of the Consent Decree.

The closure of these basins has presented several challenges at one location. Identifying these challenges and the method used to respond to the challenges is the purpose of this paper. Three issues were identified. They were: 1) The stability of the slope of the northern wall of basin 4 and its impact on the design of the clay cap, 2) Radioactive uptake by the vegetation within the basins and the best method for disposal of the vegetation, and 3) Contaminant levels along the process sewer line and the best method of disposition of the process sewer line.

SITE DESCRIPTION

The SRL Seepage Basins consist of 4 unlined earthen basins plus the 286 m, 0.254 m diameter, vitrified clay process sewer line which emptied into basin 1, as shown in Fig. 1. The process sewer line was buried to a depth of 3 m. The four basins were connected by overflow channels. The basins encompass an area approximately 8500 m^2 in size. The total capacity of the basins is 24,860 m^3.

The process sewer line runs under one building and under a heavily traveled public access road.

The methods of release from the basins were evaporation, seepage into the subsurface, and overflow into the adjoining basin (for basins 1 through 3). Basin 4 had no overflow. However, basin 4 was never filled to capacity.

At present, no wastes are being disposed of in these basins or through the process sewer line. The only accumulation in the basins is from rainwater. Surface runoff from the areas adjacent to the site is minimal. The basins' berm is raised above the level of the surrounding land, thus reducing runoff into the basins.

ENVIRONMENTAL SETTING

The SRL Basins are located in the northwest section of the Savannah River Site (SRS) and are about 1,000 m southeast of the nearest plant boundary. The western boundary is SRP Road 1-A. The northern boundary is Tim's Branch and the southern and eastern boundaries are an unnamed tributary to Tim's Branch. The basins are enclosed by an 2.5-m high animal control fence, which is approximately 7.5 m from the edge of the basins. The basins are rectangular and were constructed by excavation and filling to the existing topography.

The original ground surface contours indicate that the site was relatively flat in the area of basins 1, 2, and 3, with an approximate average elevation of 105.5 m msl. To the east of these basins, the ground surface sloped downward at a grade of approximately 18% to the unnamed tributary. Northeast of these basins, the grade slopes downward approximately 15% to another unnamed tributary. To bring the berm of the 4th basin to grade, fill material was used to construct the north and east sides of the basin.

The basin interiors, and the exterior area up to about 3 m outside of the animal control fence, are currently grass covered. The basins are surrounded by trees and there are a significant number of trees growing inside the basins. Several of the trees within basin 4 have trunks with 0.36 m diameters.

Vegetation in the vicinity of the basin is primarily woods to the north, east and south. Wetlands are located on the north and east sides of the basins. The area to the west of Road 1-A, extending to the security fence enclosing the SRL complex, is sparsely covered with grasses and weeds.

WASTE CHARACTERISTICS

The SRL Seepage Basins were used to dispose of low-level radioactive liquid waste generated by the Savannah River Laboratory. The average activity for waste discharged to the basins was 50 d/m/mL for both alpha and beta-gamma.

During the 28-year loading history, approximately 130,000 m^3 of water was discharged to the basins. The total capacity of the basins is 24,860 m^3. The fissile content of the waste transferred to the basins during 1982 averaged 0.4 mCi per month. Uranium and plutonium in these analyses were divided as follows: ^{238}U (90%), ^{238}Pu (5%), and ^{239}Pu (5%). A summary of the total historical discharge of radionuclides to the SRL Seepage Basins is given in Table I. Tritium was the primary radionuclide discharged to the basins with NO_3, Na, Cl, Ca, and Ni being the primary chemical constituents discharged to the basins.

Using the discharge volume of water to the basin from the waste tanks and the concentrations of chemicals in the low-level waste stream as determined from the measurements in October 1982, the average annual and total 28-year loadings

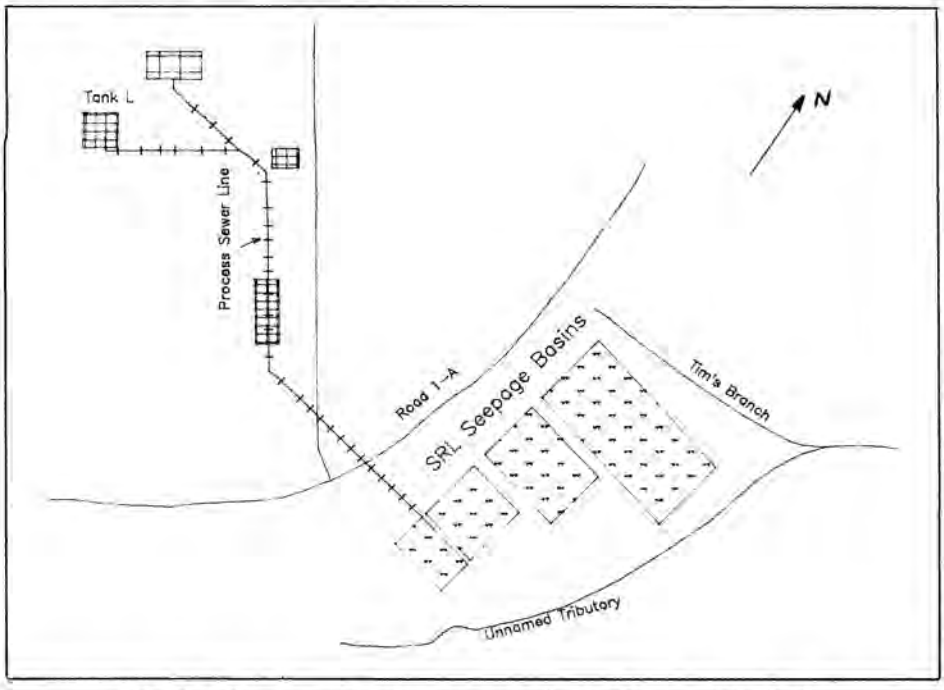

Fig. 1. SRL seepage basins area map (scale 1 inch = 250 feet).

TABLE I

Radioactive Releases to the SRL Seepage Basins from 1958 to 1980

Parameter	Activity (Ci)
^{3}H	105
$^{89,90}Sr$	0.4
^{137}Cs	4.7
Natural U	0.022
^{238}Pu	0.009
^{239}Pu	0.003
^{241}Am	0.001
$^{242,244}Cm$	0.001
$^{103,106}Ru$	1.4
^{60}Co	0.1
$^{141,144}Ce$	2.7
Alpha (unidentified)	4.2
Beta-gamma (unidentified)	10.6

of the major contaminants to the basins were calculated (Table II).

A volume reduction program was instituted in 1982, prior to the sampling and analyses shown in Table II. The volume reduction program consisted of rerouting noncontact cooling water which reduced dilution of the wastewater and resulted in a more concentrated waste stream being discharged to the basins. Actual concentrations entering the basins are expected to have been variable, but lower than those shown by at least a factor of five.

REGULATORY STATUS

The SRL Seepage Basins are addressed in a Resource Conservation and Recovery Act (RCRA) permit, a draft Federal *Facility Agreement, and in a* Consent Decree resulting from a lawsuit. The closure of the basins must be closed in a RCRA-like manner, per the Consent Decree, and must meet RCRA and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements.

A RCRA Facility Investigation (RFI) Workplan was submitted to the South Carolina Department of Health and Environmental Control (SCDHEC) and the EPA Region IV in January 1991. SRS is awaiting comments.

Per the requirements of the Consent Decree, a Groundwater Quality Assessment Report, a Technical Data Summary, and a Site Assessment Report were prepared. These documents include a Groundwater Quality Assessment Report, a Technical Data Summary, and a Site Assessment Report. SRS received comments on the Site Assessment Report from the SCDHEC and the Natural Resources Defense Council November 29, 1991.

Upon receipt of the comments to the Site Assessment Report, WSRC has 120 calendar days to submit a Closure Plan to SCDHEC. Thus, the submittal date to SCDHEC is March 28, 1992. In an effort to comply with CERCLA, the Closure Plan will be submitted to the Environmental Protection Agency (EPA) at the same time as it is submitted to the SCDHEC. Per EPA's request a section will be added to the Closure Plan to identify and evaluate options for the treatment of the basin soils. This will be in lieu of a formal Feasibility Study document. A baseline risk assessment will be submitted to both the SCDHEC and the EPA within 6 months of submittal of the Closure Plan.

RESOLUTION OF DESIGN ISSUES

Slope Stability of Basin 4 North Wall

The question of the stability of the northern wall of basin 4 needed to be resolved prior to beginning design of the cap system. It is know that this wall and a portion of the east wall of basin 4 are fill material. However, the extent of the fill is not known. No as built drawings were prepared on the construction of the SRL Seepage Basins.

TABLE II

Historical Loadings of Major Contaminants to the SRL Seepage Basins

Constituent	Concentration* (mg/L)	Annual Load (kg/yr)	28-Year Total (kg)
Ba	0.5	2.3	64
Cd	<0.01	<0.05	<1.3
Co	<0.01	<0.05	<1.3
Cr	9.5	44	1,220
Cu	0.4	1.8	52
Hg	0.2	1	26
Mg	6.3	29	810
Mn	3.4	16	438
Na	189	869	24,500
Ni	5.2	24	670
Pb	4	18	515
Sr	0.11	0.5	14
U	2.9	13	373
Zn	1.7	7.8	219

Note: Soil core analyses provide better estimate of loadings for those constituents that are relatively immobile in soil. Importantly, soil cores suggest that approximately 320 kg of Cr, 10 kg of Hg, and 230 kg of As have been released to the SRL Seepage Basins.

*Analyses performed 10/01/82.

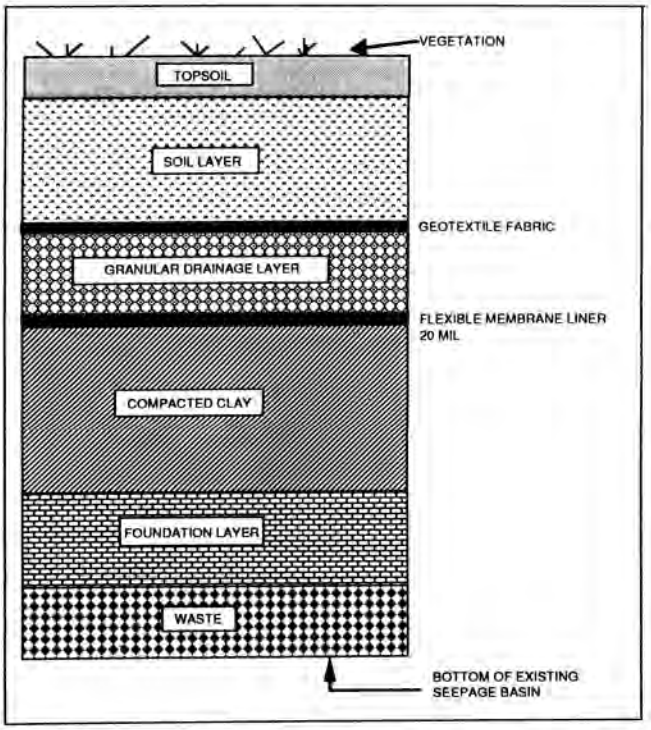

Fig. 2. Conceptual model of the Cap System at the SRL Seepage Basins.

The importance of knowing the *stability of the northern* wall of basin 4, is constructing the cap so that the placement and compaction of the clay and fill materials will not cause this wall to blow out. A conceptual drawing of the cap is shown in Fig. 2.

The stability question will be answered by performing electric cone penetration tests along the perimeter of the SRL Seepage Basins and correlating the results will data provided from 4-15 m geotechnical SPT borings. The results will provide information of the strength of the north wall soils.

The resulting decision as to how far down the north wall must be cut to prevent blow out of that wall will have an impact on the soil erosion plan, vegetation removal, and intrusion on wetlands.

Radioactive Uptake in Vegetation and Disposal

The four basins contain a significant amount of vegetation. The vegetation consists of grass, brush, and trees, up to 0.36 m in diameter, with the greatest amount of vegetation being in basin 4. Based on previous knowledge, the amount of vegetation present in the basins is too great to be placed in its entirety under the cap. It is believed that placement of the entire amount of vegetation under the cap could lead to subsidence problems in the future. The nature of the contaminants has led to the concern that burning the vegetation could lead to release of radionuclides into the atmosphere.

Using uptake parameters found in the literature and the contaminant concentrations found in the soil at the basins, calculations were made to determine the concentrations that would be released to the atmosphere by burning the vegetation. The inhalation dose calculations were made for burning all basins and for burning only basin 4, which contains the largest amount of vegetation. The resulting inhalation doses from burning the vegetation are presented in Table III. Radionuclide concentrations are based on inhalation doses of 1 mrem, the NCRP guide for negligible health effects, and 100 mrem, the DOE guide for annual exposure.

The results of the calculations indicate that burning the vegetation from all basins or from only basin 4 during the day could introduce a level of contaminants to the atmosphere that could cause an exposure greater than the 1 mrem recommended as negligible by the NCRP but lower than the DOE 100 mrem release guide. Because uptake may be affected by site specific conditions and literature uptake values will be conservative, samples of the vegetation at the SRL Seepage Basins were collected and will be analyzed to provide actual uptake values. Preliminary data indicate that the actual activities are close to or below the values used to estimate the doses presented in Table III, thus leading to the possibility that the 1 mrem inhalation dose as set by the NCRP guide may be met for burning the vegetation in basin 4.

Based on the information available at present, the path forward is to burn the vegetation in basin 4, with the remaining vegetation being chipped and placed under the cap.

Disposition of the Process Sewer Line

The process sewer line that connects the waste tanks to the basins is a 0.254 m diameter vitrified clay pipe of an approximate length of 286 m, buried to an approximate depth of 3 m. This line has been out of service since 1982. Review of engineering drawings indicated that the line is intercepted by a sanitary sewer line at one point. Knowledge of the condition

TABLE III

Inhalation Dose from Burning Vegetation (mrem)

	All Basins		Basin 4 Only	
	Day	Night	Day	Night
Americium-241	0.365	1.176	0.105	0.223
Cesium-137	0.031	0.099	0.009	0.018
Cobalt-60	0.000	0.001	0.000	0.000
Curium-243,244	4.746	15.287	0.919	1.938
Plutonium-238	0.023	0.073	0.001	0.003
Plutonium-239,240	0.087	0.281	0.001	0.002
Strontium-90	0.227	0.732	0.022	0.047
Uranium-238	0.004	0.013	0.001	0.002
Totals	5.483	17.662	1.059	2.233
Total Day and Night		23.145		3.292

of similar process sewer lines in other areas of the Savannah River Site led to the concern that this process sewer line would be crushed and broken.

To assess the extent of contamination due to this line, soil borings had been planned. Presentation of the plan to the EPA, led to a modification requiring diagonal coring to collect samples directly under the process sewer line in addition to the vertical coring adjacent to the line. To optimize the location of the core samples while keeping the number of samples to a minimum, a video survey of the process sewer line was conducted. This was accomplished by using a pipe crawler which has a video camera mounted on it. The results of this survey show the line is not broken or crushed except for the location where the sanitary sewer line cuts across it, as was indicated on the engineering drawings. Because of the condition of the process sewer line, it is believed that any soil contamination is minimal. Results of the coring will verify the correctness of this assumption.

Based on the assumption made, the planned course of action is to remove the section of pipe on each side of the area where the line has been severed and to grout the remaining length of the process sewer line. The section of line that will be removed will be crushed and placed beneath the clay cap.

CONCLUSION

The SRL Seepage Basins are 4 earthen basins which received low-level radioactive liquid waste from the Savannah River Laboratories from 1953 until 1982. The closure of these basins will consist of placement of a RCRA clay cap over the 4 basins. Several issues to be resolved prior to finalizing the design of the cap and completion of the closure plan have been identified. They are slope stability of the north wall of basin 4, disposal of the vegetation within the basins, and disposition of the process sewer line. Assumptions have been made based on present knowledge and paths forward have been identified. Additional investigative work is in progress to validate the assumptions made.

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